

**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL SOUTHERN ZONE BENCH  
AT CHENNAI**

**OA No 141 OF 2023**

**IN THE MATTER OF:**

**GANISETTI SATYANARAYANA & ANR.**

**..... Applicant**

**Vs**

**UNION OF INDIA AND OTHERS**

**..... Respondents**

**REPORT FILED BY THE COLLECTOR 5<sup>th</sup> RESPONDENT**

**DATE- 11.04.2025**



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ADVOCATE**

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**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL SOUTHERN ZONE  
BENCH AT CHENNAI  
Original Application No. 141 of 2023**

**IN THE MATTER OF:  
Ganiseti Satyanarayana &Anr.**

**.....APPLCANT**

**VERSUS**

**Union of India and others**

**...RESPONDENTS**

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It is certified that all the documents contained in the above annexure are true copies.

Date:09.04.2025

  
**Collector & District Magistrate,  
Anakapalli District**

  
Supt

**Report on Original Application No.141 of 2023(SZ) before the National Green Tribunal Southern Bench, Chennai by filed by Sri. Ganisetti Satyanarayana &Anr, R/o Venkatapuram Village, Munagapaka Mandal Anakapalli District, Andhra Pradesh against M/s. Visakha Pharmacy Limited (Formerly M/s. RamkyPharmacy (India) Pvt. Ltd.), JNPC, Parawada, Anakapalli District**

It is to submit that Sri. Ganisetti Satyanarayana &Anr, R/o Venkatapuram Village, Munagapaka Mandal Anakapalli District has filed a case before the National Green Tribunal Southern Bench, Chennai in O.A.No. 141 of 2023(SZ) and the facts and circumstances, petitioner prayed that this Hon'ble Tribunal may be pleased to:

- (i) Declare the action of the Respondents as contrary to the law and the mandatory Specific Conditions No. iii, vi, vii, viii, x, xvi, xviii of Environment Clearance dated 10.3.2005 imposed by the Union of India and quash the Environment Clearance accordingly.
- (ii) Direct the Respondents to stop the illegal construction of pond in 50 acres for storing the chemical water near the Thanam village adjoining to the M/s. RamkyPharmacy Ltd.
- (iii) Direct the Respondents to restore the irrigation tanks, water bodies and ground water by taking the corrective measures.
- (iv) Impose penalty on the responsible persons, entities for causing damage to the aquatic life in Bay of Bengal, livelihood, health of people, animals and endangering their lives at Thanam, Parawada etc villages of Anakapalli District in Andhra Pradesh.
- (v) Rehabilitate the affected population near the RamkyPharmacy on the basis of assessing the impact of chemical odour nuisance on the people due the release of gases by the Pharma companies.

Copy of the NGT Order dated 04.10.2023 is herewith with enclosed as **Annexure-I**.

**The Hon'ble NGT Order dated 10.02.2025 in its order**

- “1. The applicants have not yet filed their objections to the report of the APPCB.*
- 2. As a final chance, post the matter on 15.04.2025.”*

Copy of the NGT Order dated 10.02.2025 is herewith with enclosed as **Annexure-II**.

In this regard, the status of M/s. Visakha Pharmacy Ltd., (Formerly M/s. RamkyPharmacy (India) Pvt. Ltd.), JNPC, Parawada, Anakapalli District is submitted as follows:

## **1. Introduction:**

The J.N. Pharmacy was established in the year 2005, to setup a Pharma Park involving common infrastructure facilities viz., Power Plant – 100 MW, Multi Fuel – Gas/Coal/Oil, Power distribution (Substations /Transformers), Hazardous Waste Management (TSDF) – 2,00,000 TPA, Water Treatment Plant, Storage System, Water Distribution System Effluent / Sewerage network, CETP – 50 MLD, Storm Water Drainage, Common Boiler – 230 TPH, Common DG Set – 15 MW, incinerator – 1.5 TPH etc.

The APIIC allocated an area of 2143.0 Acres to establish pharma city in Parawada village, Anakapalli District. Out of 2143.0 Acres, 1429.31 acres have been allotted for development of industrial plots and the remaining 713.69 Acres is allotted for the common infrastructure facilities like Roads, Common utilities and green buffer area etc. So far, 104 industries are established and 94 Bulk drug & intermediates, Pharmaceuticals and Chemical units are in operation. The Source of water for pharmacy is Yeleru canal, supplied by Andhra Pradesh Industrial Infrastructure Corporation (APIIC).

The facility is having the following common facilities for treatment of the effluent generated by the member industries.

- A. Common Effluent Treatment Plan (CETP)
- B. Treatment, Storage and Disposal Facility (TSDF)
- C. Incinerator
- D. Alternative Fuel & Raw material pre-processing facility (AFRF)

**A. Common Effluent Treatment Plant (CETP):**

- a) The CETP is designed to treat High and Low TDS effluents separately received from member units in the Pharmacy. The APCCB vide CFO order dated 07.04.2025 issued CFO to the CETP to treat the HTDS effluents of 3000 KLD & LTDS effluents of 7053 KLD with validity upto 31.05.2026.
- b) The CETP installed 6 no. of MEEs of each capacity 500 KL/day to treat the HTDS effluent and ETP of 7053 KLD capacity to treat the Low TDS effluents.
- c) The facility has provided PLC SCADA system to carry out the automatic operations of the MEEs through control room.
- d) Presently, 95 member units are sending their effluents to CETP for further treatment and disposal.
- e) The facility installed online continuous effluent quality monitoring system for the parameters viz., pH, TSS, COD & BOD in the marine outfall pipeline to verify the standards of the treated effluent before discharging into Sea and the same is connected to the CPCB/APCCB web sites.

- f) The facility is storing the treated effluents in the guard ponds before discharging into the sea. The Capacities of Guard Ponds & marine pipeline details are tabulated as below:

No. of Guard ponds	On Shore (on land)	Off Shore (in sea)	Each Capacity
Total 10 G.P's	Length: 16 Km Diameter: 13.9 " Depth – 4.0 m	Length: 1.75 Km Diameter: 12.4 " Depth – 18.00 m	GP-1, GP-2 & GP-4 = 5400 KL, GP-3 = 5300 KL, GP-5 = 5200 KL, GP-6 = 5000 KL, GP-7 = 4500 KL, GP-8 = 6000 KL, GP- 9 = 5000 KL & GP-10 = 5000 KL

#### B. Treatment, Storage and Disposal Facility (TSDF):

Landfill is a secured containment system of hazardous waste with an objective to handle the hazardous waste generated in the industries in a scientific manner to prevent soil & ground water contamination.

The facility is having common treatment, storage and disposal facility (TSDF) for treatment and disposal of hazardous wastes.

The hazardous waste having CV less than 2500 K.Cal/Kg & not suitable for Utilizable, Incinerable & Recyclable, the waste is being filled in secured landfill facility duly following the waste stabilization methods to make the hazardous waste suitable for landfilling. The hazardous waste which don't required stabilization is directly filled in secured land fill.

The TSDF carries out stabilization process to make hazardous waste into less leachable, non-reactive before disposal into the landfill.

The waste having Calorific Value > 2500 Kcal/kg & Biodegradable organics > 5% and Non-biodegradable Organics > 20% is being incinerated in the incinerator in the Pharmacy.

The facility is treating and disposing the hazardous waste in accordance with the Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016.

336 industries in Visakhapatnam Zone registered with TSDF, Visakhapatnam for sending their hazardous waste for scientific disposal. Out of which 160 industries are regularly sending the hazardous waste to TSDF. Total area of TSDF, Visakhapatnam is 18.07 acres.

The primary leachate generated from the landfill is being sent as HTDS to the CETP of Pharmacy through closed conduits.

The APPCB issued CTEs to the TSDF in a phased manner from time to time. The first CTE was issued on 16.07.2010. In all the phases including expansions, the Board issued CTEs to this project covering total extent of 18.07 acres and to handle 18,03,200 MT of hazardous waste.

Similarly, CTOs were issued in a phased manner. The first CTO was issued on 02.09.2011. The previous CTO was issued on 20.02.2024 for a period upto 30.04.2026 to handle 40,000 MT of hazardous waste. In all phases the total quantity of hazardous waste permitted for disposal in CTOs is 16,23,200 MT, in which facility has already disposed 16,23,134.69 MT.

### **C. Incinerator**

#### **Process of incinerable waste treatment:**

The facility receives incinerable waste from the member units of JN Pharmacy, Parawada and from the districts i.e., Srikakulam, Vizianagaram, Visakhapatnam, East Godavari & West Godavari. The waste in the form of solid, semi-solid or non-aqueous liquid are stabilized / solidified and then fed to the incinerator for disposal. The facility has installed incinerator of capacity 1.5 TPH to incinerate the incinerable waste.

In the incinerator, solid waste is fed to the rotary kiln and burnt at a temperature of about 850<sup>0</sup>C. The gases from the rotary kiln are burnt in the secondary combustion chamber at a temperature of about 1100<sup>0</sup>C to 1200<sup>0</sup>C. After completion of incineration, waste is generated in the form of incinerated ash, spray drier salts and bag filter dust. These wastes are disposed in the landfill.

The facility is not regularly operating the incinerator due to shortage of incinerable waste as the industries are sending the waste to use as alternate fuel in the cement industries.

### **D. Alternative Fuel & Raw material pre-processing facility (AFRF)**

The facility is operating Alternative Fuel & Raw material pre-processing facility of capacity 100 TPD in Pharmacy in the name of M/s. Coastal Waste Management Project, Parawada, Anakapalli District. The facility obtained CTO of the Board for a period up to 31.12.2026.

After receiving Semi solid material from industries as utilizable waste, the material is blending with rice husk, saw dust etc. and converting into solid form to ensure CV is >2500 Kcal/kg and after pre-processing the waste is being sent to cement industries for Co-processing / As Alternative Fuel Raw Material.

## 2. Air pollution and control measures taken up by M/s. Visakha Pharmacy Limited

The main source of air pollution is boilers & fugitive emissions. The facility is having 3 x 10 TPH coal fired boilers (one boiler is standby.) All boilers stacks are provided with mechanical dust collectors followed by bag filters to control dust emissions. The facility provided online stack analyzers for continuously monitoring PM (Particulate Matter) parameter and connected to APPCB/CPCB website. While storing, handling and treating of effluents, the facility provided the following to control fugitive odor causing emissions:

- a. All the effluent receiving storage tanks are covered with HDPE hoods followed by double stage scrubber.
- b. As per the directions of APPCB, air stripper of MEE is replaced with Steam stripper.
- c. Wet scrubbers are provided for the stacks attached to spray drier of MEE system and incinerator.

Most of the industries have installed and operating mechanical dust collectors followed by bag filters as air pollution control equipment to control flue gas emissions from the boilers. Process emissions are controlled by installing scrubbers and fugitive emissions controlled by pumping transfer of solvents through pipelines, centrifuge vents connected to the scrubbers and by installing vent condensers to bulk solvent storage tanks.

The facility is having 3 online Continuous Ambient Air Quality Monitoring (CAAQM) stations for continuous monitoring the parameters VOC, NH<sub>3</sub> & SO<sub>2</sub> (odour causing compounds) located at Tadi(V), Thanam(V) & SEZ Parawada. The online monitoring systems were connected to the web site of APPCB. If there are any exceedances recorded, the auto alerts will be generated and communicated to the facility for rectification. As per reports, the AAQ parameters viz., PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub> are within the NAAQ standards. Copy of the CAAQ Analysis Reports for the last one year is enclosed as **Annexure-III**.

APPCB installed One manual ambient air quality station at CETP at a distance of about 500 m from Tanam village and monitoring the air quality for the parameters viz., PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub>. As per the analysis reports, the monitored values are meeting the NAAQ standards. Copy of the manual AAQ Reports for the last one year is enclosed as **Annexure-IV**.

## 3. Marine outfall Monitoring by APPCB:

The member industries located in Pharmacy are sending their effluents (High TDS & Low TDS effluents) to CETP through closed conveyance pipelines with digital flow

meters to the CETP to treat the effluents in CETP. After treatment, the treated wastewater is stored in guard ponds and after confirming to the marine discharge standards, the treated wastewater is discharged into sea through marine outfall in presence of APPCB officials with lock & key system.

The consolidated Analysis Report of marine disposals into sea for the last two years is enclosed as **Annexure-V**. Out of 283 samples, 15 samples were rejected from Jan-2024 to Dec-2024, the rejection percentage is 5.3% only. In case of the treated wastewater standards are not meeting the marine discharge standards, it will not be allowed for discharge into sea and sent back to CETP for re-treatment till comply with the marine discharge standards.

**NIO Studies on marine outfall:**

APPCB conducted studies through National Institute of Oceanography (NIO), Visakhapatnam to assess the marine outfalls of different industries established in the areas between Pydibheemavaram and Nakkapalli of North Andhra Coast in the year 2011. The NIO submitted report in the year 2014 and it is reported that “it is concluded from the present results that the coastal waters studied are not affected by the discharge of industrial effluents through marine outfalls and the small changes noticed may be due to the seasonal variations of chemical constituents caused through run off and other local activities”.

APPCB again conducted the study through NIO to carry out an assessment of the marine environment at and around the marine outfall points (MOP) of industries between Pydibhimavaram (Srikakulam district) and Kesavaram (Visakhapatam district) of north Andhra coast to ascertain cumulative effects, if any, on the ecology, water and sediment quality due to the discharge of treated effluents in to the coastal waters. Accordingly, CSIR-NIO has carried out field campaigns during pre-monsoon (February -March, 2018) and post monsoon (December, 2018) seasons in the coastal waters of north Andhra coast between Pydibhimavaram and Kesavaram for in-situ observations. The NIO submitted report to APPCB in 2020. Copy of the NIO report is herewith enclosed as **Annexure-VI**.

Based on the recommendations of the NIO report, APPCB has issued instructions to the industry on 27.05.2022 to conduct monthly eco-toxicology tests on treated effluent, trace metals and major organic compounds present in the treated effluent by CSIR-National Institute of Oceanography (NIO), Visakhapatnam.

The facility approached NIO to conduct monthly reports and NIO conducted analysis of marine outfall disposal samples and Sea water samples at marine outfall in Sea. Reports are awaited.

**4. Ground water quality monitoring in Tanam and Tadi Villages:**

APPCB is monitoring ground water quality in Tanam & Tadi Villages. As per the analysis results for the period Jan-2024 to Dec-2024, all the parameters are within the permissible limits for drinking water specifications except Total Alkalinity, Magnesium, Calcium and Fluoride concentrations in some samples occasionally. Copy of the reports are herewith enclosed as **Annexure- VII**.

The Andhra University conducted study on impact of ground water quality due to operations of CETP during the period from November 2020 to April, 2021 within 10 km radius from the CETP. As per the study, it was concluded that "Water quality of groundwater is within the permissible limits of drinking water standards. At few places along the coast groundwater quality influenced by salt water intrusion." Copy of the AU report on Hydrology (Ground Water Assessment Studies) - 2021 is herewith enclosed as **Annexure-VIII**.

#### 5. Accidents:

The Industries and Commerce Department, Govt. of A.P has issued G.O. RT.No. 156 Dated: 04.08.2020 with the following members to conduct a special drive of inspections for ensuring compliance of all the safety protocols and environmental norms by all the industrial units in the state of Andhra Pradesh:

- i. Joint Collector (A&W) in charge for Industries & Commerce - Chairman
- ii. Deputy Chief Inspector of Factories, Factories Dept. - Member
- iii. Inspector of Boilers, Boilers Dept. - Member
- iv. Regional Officer, APPCB. - Member
- v. Deputy Electrical Inspector - Member
- vi. District Fire Officer, APSDRFSD - Member
- vii. General Manager, District Industries Centre - Member Convenor

Subsequently, the EFST, Govt. of A.P vide G.O. RT.No. 79 Dated: 03.08.2022 constituted District Level Committee with the following members to verify and ensure complete compliance in respect of safety and environmental requirements in the industrial units and submit reports to the State level Committee. The State level committee shall take necessary remedial measures, in co-ordination with the concerned departments, to avoid occurrence of any accidents in future.

- 1) District Collector – Chairperson.
- 2) General Manager, District Industries Centre – Member
- 3) Deputy Chief Inspector of Factories – Member
- 4) Deputy Commissioner of Labour – Member – Convenor
- 5) Regional Officer, APPCB – Member

About 182 industries were identified and inspected in the Anakapalli District by the above committee and issued improvement notices to the industries by the respective departments to avoid and control accidents.

Accidents	Action taken by APPCB
<p>Incident took place due to flash fire at Visakha Solvents on 14.07.2020 at about 10:30 PM while taking the reflex sample during the spent solvent distillation process of Dimethyl Sulfoxide(DMSO). One employee was died and two were injured.</p>	<p>APPCB issued stop production order to M/s. Visakha Solvents Ltd at Plot No.84 A, JN.Pharmacy, Parawada, Visakhapatnam on 14.07.2020 by withdrew of CFO &amp; Hazardous waste authorization orders.</p> <p>The CPCB vide letter dt: 05.03.2021 has directed to M/s. Visakha Solvents to deposit the Environmental Compensation of Rs.30,01,092/-.</p> <p>The management of M/s. Visakha Solvents Limited has paid Rs.30,01,092/- towards Environmental damages to CPCB in connection with the OA No. 134/2020 in compliance of Hon'ble NGT Order dated 23.07.2020.</p> <p>At present, the management has dismantled the unit and closed the activities.</p>
<p>An incident occurred 28.11.2021 in the premises of M/s.RamkyPharmacy (India) Ltd., (CETP &amp; Incinerator) at HTDSeffluent collection tank in intermediate transfer pump house at Pharmacy internal road No-13 during checking of the effluent levels in collection tanks, resulting in the death of twopersons.</p>	<p>The Board has constituted a committee consisting the following members to investigate incident occurred in Pharma City on 28.11.2021 resulting death of two employees and also to suggest appropriate measures to avoid reoccurring of similar incidents in future</p> <ol style="list-style-type: none"> <li>a) Dr. R. R .Tiwari Director NIREH Bhopal.</li> <li>b) Dr. Subrahmanyam. Ch Professor, IIT Hyderabad.</li> <li>c) Dr. U. Vijaya Sarathi Sr Principal Scientist IICT Hyderabad.</li> <li>d) Dr. S. Gananadhamu Assistant Professor NIPER Hyderabad.</li> </ol> <p>The committee visited the accident site and also associated pharma industries on 02.12.2021 and 03.12.2021 and made</p>

	<p>certain suggestions.</p> <p>The Board has reviewed the facility and issued directions on 21.12.2021 which includes committee recommendations to avoid such kind of accidents. The compliance status of the direction dated 21.12.2021 is herewith enclosed as <b>Annexure-IX.</b></p>
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#### 6. Green belt:

The total area of the project is 2143.0 Acres. The facility has developed green belt in an extent of 471 acres with different species which is about 21.97% of total area. The Andhra University has carried out the study to assess the green belt developed by the pharmacy and reported that the pharmacy developed green belt in an area of 471 acres. Copy of Andhra University study report on greenbelt is enclosed as **Annexure-X.**

#### 7. Construction of pond in the Pharmacy:

The petitioner in the application alleged that the Project Proponent illegally digging large scale pond near Thanam village which will have adverse impact on the agriculture, ground water in the surrounding areas of the village.

In this regard, it is to submit that M/s. Visakha Pharmacy Limited has constructed pond in an area of 2.0 acres in 55 acres land which is not located in the buffer zone area or in the area earmarked for greenbelt development for JN Pharmacy. The issue was reviewed by the Board and issued directions to the facility on 20.07.2022.

The compliance status of the external advisory committee (Task Force) directions dated 20/07/2022 is submitted below:

S.no.	Directions	Compliance
1.	The proposed lined ponds shall not be located in the buffer zone area or in the area earmarked for greenbelt development.	<p>M/s. Visakha Pharmacy Ltd., has purchased 55 acres in Sy.No.165, 166, 167, 168 &amp; 169 and 157(part) in South-West directions adjacent to the JN Pharmacy in addition to the existing area of 2143.0 Acres allotted by the APIIC to M/s.VisakhaPharmacyLimited.</p> <p>M/s.VisakhaPharmacy</p>

		Limitedhas constructed pond in an area of 2.0 acres in 55 acres land which is not located in the buffer zone area or in the area ear marked for greenbelt development for JN Pharmacy.
2.	Online water quality monitoring systems shall be provided at storm water outlets with data connectivity to APPCB website.	Due to objections raised by the villagers of Thanam, the facility has stopped construction of pond for collection of rain water runoff from storm drains of Pharmacy.
3.	The contaminated storm water collected shall be pumped to CETP for further treatment and disposal along with LTDS effluents.	At present, rain water is existing in the pond.

#### 8. Re-habitations of Villages in Parawada Mandal:

The Special Deputy Collector (LA), APIIC, Visakhapatnam has reported that, as per the instructions of the Project Administrator, Visakhapatnam, the enumeration of household details in **Tadi, Chinna Tadi and Tadi BC Colony rehabilitations** of Parawada Mandal was completed. The following are the details:

a) No. of Households	:	1276
b) Major sons	:	483
c) Major Un-married daughters	:	156
<b>Total</b>	<b>:</b>	<b>1915</b>
d) No.of households residing in the village	:	599
e) No.of households not residing in the village	:	677
<b>Total</b>	<b>:</b>	<b>1276</b>
f) No.of persons to be rehabilitated from the Permanent households	:	879

The Special Deputy Collector,(LA), APIIC, Visakhapatnam has also reported that, the Collector, Visakhapatnam has submitted proposals to Govt.in Industries & Commerce Department, for sanction of Rs.57.63 Crs to meet the R&R provisions and accordingly the Govt.in G.O.Ms.No.29 Industries & Commerce (Infra) Department, Dt.06.02.2019 issued orders sanctioning the amount and that due to non provision of suitable Head of

Account (HoA), the said amount was not utilized and therefore again the Collector, Anakapalli has requested the Govt. to revise the G.O. and to map to the Special Deputy Collector (LA), APIIC, Visakhapatnam. The Special Deputy Collector (LA), APIIC, Visakhapatnam has finally informed that, the Govt. asked the Commissioner, Industries to examine and to furnish the details of budget availability to meet the R&R provisions.

#### 9. Action Taken by APPCB:

1. The Board is regularly monitoring the common facilities and member industries in the pharmacy once in 6 months by higher officials of APPCB to verify the compliance status of the APPCB consent conditions / directions issued to the facility and the industries. Any violations found during the inspection, APPCB is reviewing the facility and industries before external advisory (Task Force) Committee Meeting and issuing directions to the industries time to time for strict compliance with Board conditions.
2. Five industries in pharmacy dumped the hazardous waste on the bund of vooracheruvu of Tanam village in September, 2016. As part of action, the APPCB has issued stop production orders to the five industries and forfeited the Bank Guarantee of Rs. 50 Lakhs submitted by Visakha Pharmacy for permitting the waste to outside the pharma city.
3. An incident of fish death took place in PeddaCheruvu, Parawada, Visakhapatnam on 30.10.2020. The same was covered in the newspapers on 31.10.2020. The Board has constituted a three-member expert committee of Andhra University and the committee submitted report to the Board on 18.11.2020.
  - a) *“The committee opines that the mass mortality of the fish is due to sudden depletion of DO (Dissolved Oxygen) induced by the highly eutrophicated state of the tank.*
  - b) *The committee further opines that the Peddacheruvvu is a very important wetland of the area, which is left neglected and requires good management for its restoration. The committee recommends that the local bodies should immediately address the problem, in the absence of which, the area is vulnerable for public health problems, more particularly from the vector borne diseases.”*

*The collector & District Magistrate instructed the Joint Collector (Asara & Welfare) to verify the petition along with the following officials:*

1. Joint Director, Fisheries Department.
2. Joint Chief Inspector of Factories, Factories Department.
3. Environmental Engineer, A.P. Pollution Control Board.

As per the instructions of the Collector & District Magistrate, Visakhapatnam, the undersigned along with Joint Director, Fisheries Department, Joint Chief Inspector of

Factories, Factories Department and Environmental Engineer (FAC), A.P. Pollution Control Board verified the Complaint and submitted report on 18.11.2020 along with the following recommendations:

- i. Since there is a suspicion of the villagers & farmers that the channel which is emptying into Oora Cheruvu is discharging untreated wastewater and storm water. It is recommended to divert the wastewater from the channel into the CETP for treatment and discharge into sea through marine pipeline.
  - ii. M/s. RamkyPharmacy (I) Pvt Ltd which is operating CETP is directed to prevent the discharge of water through this channel into Oora Cheruvu.
  - iii. M/s. RamkyPharmacy (I) Pvt Ltd has to take all precautionary measures not to discharge any type of wastewater through this channel into Oora Cheruvu.
4. The Board issued directions to all the industries in the Pharmacy vide circular memo dated 26.08.2020 to avoid contaminated storm water discharges into the drains leading to contamination of nearby water bodies. Copy of the directions dated 26.08.2020 is herewith enclosed as **Annexure-XI**.
  5. The Board has issued work order to NEERI, Hyderabad for carrying out study on “Assessment of Contamination and preparation of Remediation plan for Tanam Cheruvu” located at Tanam Village, Visakhapatnam to M/s. CSIR-National Environmental Engineering Research Institute (NEERI), Hyderabad. Final report is awaited.

**Action taken by the District Administrations:**

Frequent complaints were received from the surrounding villagers against the industries located in M/s. Visakha Pharmacy Limited JNPC, Parawada, Anakapalli on discharging of untreated wastewater in to storm water drains.

The Collector & District Magistrate, Anakapalli District has directed the Zonal Manager, APIIC, the Superintendent Engineer, Irrigation Department, Anakapalli District and the Deputy Director, Ground Water Department, Anakapalli District to submit the status report of the irrigation & others drains existing in the downstream of M/s. Visakha Pharma City Limited 18.10.2024 on the following:

1. Direct the Respondent to stop the illegal construction of pond in 50 Acres for storing the chemical water near the Thanam Village adjoining to the M/s. Ramky Pharma city Ltd.,
2. Direct the respondents to restore the irrigation tanks, water bodies and ground water by taking the corrective measures.
3. Impose penalty on the responsible persons, entities for causing damage to the aquatic life in Bay of Bengal, Livelihood, health of people, animals and endangering their lives at Thanam, Parawada etc Villages of Anakapalli District.

Copy of the Collector & District Magistrate, Anakapalli District letter dated 18.10.2024 is herewith enclosed as **Annexure-XII**.

The Superintending Engineer, Irrigation Circle, Visakhapatnam has submitted a report vide letter dated 12.12.2024 reported that the Vora tank, Sanyasayya Banda, and Pedda tank serve a total of 121 acres, 29 acres, and 87 acres, respectively, in Parawada Village, Parawada Mandal. While the flow of effluents into the Vora tank is prevented as long as the left bank of the drain remains intact, the other two tanks are inevitably affected. Consequently, the surrounding ayacut (irrigated land) and the aquatic life, as well as livestock, have been suffering due to the pollution.

The Collector & District Magistrate, Anakapalli District vide letter dated 05.02.2025 has directed the Superintendent Engineer, Irrigation Department, Anakapalli District to inquire into the contents of the affidavit and to identify the source of the contamination, provide details of the analysis conducted to support the conclusion that the downstream waterbodies and the ayukattu region have been impacted by the discharge of effluents from Ramky Pharma City and suggest remedial measures to restore the affected waterbodies located downstream of M/s. Visakha Pharmacity Limited. Additionally, any related complaints should be submitted so that the matter can be presented to the Hon'ble National Green Tribunal. Copy of the Collector & District Magistrate, Anakapalli District letter dated 05.02.2025 is herewith enclosed as **Annexure-XIII**.

The Superintendent Engineer, Irrigation Circle, Visakhapatnam has submitted report vide letter dated 07.02.2025 stating the following:

1. It is submitted that, the Voora tank of Parawada along with its surplus channel (Mallodugedda), Sanyasayyabanda tank of Parawada along with its surplus channel of Sanyasayyabanda, Pedda tank of Parawada and its surplus channel are being impacted by the discharge of Effluents from RamkyPhrama city, was arrived based on the physical observation and flow pattern of the existing chain of tank system only. The flow of effluents of Pharma city i.e., Green colour liquid in the drain within the tank bed area along the periphery of one side of foreshore of the Voora tank can be physically observed. Merging of drain into the surplus channel of the Voora tank also this, can be observed physically on field. As this surplus channel of Voora tank, which is also known as Mallodugedda, crosses Bharankam-Paravada road, the effect of Effluents on Gedda water can be observed through Its colour and odour at this Road bridge point also.

2. As these Voora tank, Sanyasayyabanda and Pedda tank are Cascade (Chain) of tanks, flow of this Mallodugedda (Surplus channel of Voora tank) automatically enters into Sanyasayyabanda and after reaching its surplus level, surplus flow of Sanyasayyabanda also enters Pedda tank. Other than the above mentioned physical observation and flow pattern of tank system, no additional analysis or water quality tests were conducted to arrive the Conclusion. Hence, our conclusion is limited to whether the effluents enter into these water bodies or not, but not on degree of Contamination and severity of its impact.
3. The Superintending Engineer, Visakhapatnam requested the Collector & District magistrate to addressed the A.P. Pollution Control Board, Visakhapatnam for conducting necessary Quality tests on the effluents as well as water in the above mentioned water bodies to conclude on degree of Contamination as well as on remedial methods to restore the affected water bodies.

Copy of the report submitted by the Superintendent Engineer, Irrigation Circle, Visakhapatnam is herewith enclosed as **Annexure-XIV**.

APPCB is carrying out regular sampling in the Vooracheruvu and its surroundings and as per analysis report of the months March-2025, there is no significant contamination in water quality of the Vooracheruvu

To overcome the above issue, it is necessary to construct storm water collection tank within M/s. Visakha Pharmacy area in the downstream by M/s. Visakha Pharmacy Limited duly obtaining all the requisite permissions.

Further, the APPCB has reviewed M/s. Visakha Pharmacy Limited before the Consent to Operate Committee meeting held on 17.03.2025 and issued the CTO Order vide dated 07.04.2025 for treatment of industrial and domestic effluents from member industries of 1053 KLD (High TDS effluents: 3000 KLD + Low TDS effluents: 7053 KLD) with the following conditions to comply with:

1. The industry shall construct at least 2 to 3 storm water catchment sumps at different places and shall pump the collected water to CETP for further treatment & disposal along with LTDS effluents.
2. The facility shall provide 2 Steam Strippers for the two new MEEs (No.7 & 8) by the end of April,2025 in addition to the existing 3 Strippers.
3. The facility shall install online analyzer for PM (CEMS) for 3 no of Spray Drier stacks.
4. The facility shall submit safety audit report.
5. The facility shall carryout health studies in & around 5 Kms radius through reputed organizations / institutions.

6. The facility shall ensure that contaminated water shall not join the downstream water bodies under any circumstances.
7. The facility shall provide online water quality monitoring system at outlets of catchment sumps for data connectivity to APPCB website.
8. The CETP shall comply with all norms notified by the MoEF&CC, GoI, New Delhi from time to time.
9. This order is subject to orders of the Hon'ble National Green Tribunal (NGT), Southern Zone in Original Application No 141/2023 and 130/2024.

Copy of the CTO Order vide dated 07.04.2025 is herewith enclosed as **Annexure-XV**.

APPCB is continuous monitoring the downstream tanks and collecting the samples regularly. As per analysis reports there is no significant concentration in the samples in the downstream tanks of Vooracheruvu and Peddacheruvu. APPCB is also continuously monitoring M/s. Visakha Pharmacity Limited and issuing directions time to time for rectification.

  
Sudh

  
**Collector & District Magistrate**  
**Anakapalli District**

**Item No. 01:****BEFORE THE NATIONAL GREEN TRIBUNAL  
SOUTHERN ZONE, CHENNAI****Original Application No.141 of 2023 (SZ)**  
(Through Video Conference)**IN THE MATTER OF**

Ganiseti Satyanarayana, Andhra Pradesh

... Applicant(s)

**Versus**

Union of India &amp; Ors.

...Respondent(s)

**Date of hearing: 04.10.2023.****CORAM:****HON'BLE SMT. JUSTICE PUSHPA SATHYANARAYANA, JUDICIAL MEMBER  
HON'BLE DR. SATYAGOPAL KORLAPATI, EXPERT MEMBER**

For Applicant(s): Mr. K. Sravan Kumar

For Respondent(s): Dr. Kuna Suryanarayana for MoEF&CC.  
Ms. Madhuri Donti Reddy for R2, R3 & R5.**ORDER**

1. Issue Notice to the respondents through Tribunal as well as privately.
2. Dr. Kuna Suryanarayana accepts notice on behalf of the MoEF&CC and  
Ms. Madhuri Donti Reddy accepts notice on behalf of the respondent nos.  
2, 3 and 5.

3. Post the matter on 06.11.2023.

.....J.M.  
**(Smt. Justice Pushpa Sathyanarayana)**

.....E.M.  
**(Dr. Satyagopal Korlapati)**

O.A.No.141/2023 (SZ)  
04<sup>th</sup> October, 2023. AM.



Item No.05:-

Annexure-II

**BEFORE THE NATIONAL GREEN TRIBUNAL  
SOUTHERN ZONE, CHENNAI**

[Through Physical Hearing (Hybrid Option)]

**Original Application No. 141 of 2023 (SZ)**

**IN THE MATTER OF:**

Ganiseti Satyanarayana,  
Andhra Pradesh and Anr.

...Applicant(s)

*Versus*

Union of India,  
Rep. by its Secretary,  
MOEF & CC, New Delhi and ors.

...Respondent(s)

Date of hearing: 10.02.2025.



**CORAM:**

**HON'BLE Smt. JUSTICE PUSHPA SATHYANARAYANA, JUDICIAL MEMBER**

**HON'BLE Dr. SATYAGOPAL KORLAPATI, EXPERT MEMBER**

For Applicant(s): Mr. Abhiram Bannur represented  
Mr. Sravan Kumar.

For Respondent(s): Dr. Kuna. Suryanarayana for R1.  
Mrs. Madhuri Donti Reddy for R2, R3 & R5.  
Mrs. Revathi Manivanan for R4.  
Mr. Arun Karthick Mohan for R6.

**ORDER**

1. The applicants have not yet filed their objections to the report of the APPCB.

2. As a final chance, post the matter on **15.04.2025**.

Sd/-

Smt. Justice Pushpa Sathyanarayana, JM

Sd/-

Dr. Satyagopal Korlapati, EM

O. A. No.141/2023 (SZ)  
10<sup>th</sup> February, 2025. Mn.





# Real Time Data Acquisition And Monitoring

Site Name: Visakha Pharmacity Limited (Earlier Known As .Ramky Pharmacity (India) Ltd., (CETP))

Report: Custom Report

From Date: 2024/01/01 00:00:00 To Date : 2024/12/31 23:59:41

Description	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
Prescribed Standards	0 - 80	0 - 80	0 - 400	0 - 100	0 - 60	0 -
Maximum Data	62.0	34.0	6.32	96.0	53.0	0.56
Minimum Data	5.69	3.13	0.49	4.71	2.69	0.44
Geometric Mean	11.66	14.83	0.58	30.52	16.31	0.5
Median	11.51	15.0	0.55	31.35	16.88	0.5
Standard Deviation	3.18	1.94	0.37	19.18	9.9	0.01
Maximum Value At Time	2024-01-10	2024-01-10	2024-01-10	2024-01-10	2024-01-10	2024-01-07
Minimum Value At Time	2024-01-07	2024-01-07	2024-04-09	2024-10-17	2024-10-17	2024-01-09
Valid Data Points	308	308	308	311	311	308
Total Data Points	366	366	366	366	366	366
Data Availability %	84.15%	84.15%	84.15%	84.97%	84.97%	84.15%

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
1	2024-01-01	8.18	4.49	0.83	85.07	48.54	0.50
2	2024-01-02	8.91	4.89	0.91	91.89	51.87	0.48
3	2024-01-03	11.70	6.42	1.20	95.46	52.99	0.49
4	2024-01-04	8.75	4.80	0.89	89.34	50.82	0.53
5	2024-01-05	6.09	3.34	0.62	64.56	37.14	0.52
6	2024-01-06	7.26	3.92	0.74	75.72	43.08	0.54
7	2024-01-07	5.69	3.13	0.58	60.92	35.07	0.56
8	2024-01-08	NA	NA	NA	NA	NA	NA

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
9	2024-01-09	32.86	18.02	3.25	94.02	52.62	0.44
10	2024-01-10	62.00	34.00	6.32	96.00	53.00	0.49
11	2024-01-11	NA	NA	NA	NA	NA	NA
12	2024-01-12	NA	NA	NA	NA	NA	NA
13	2024-01-13	NA	NA	NA	NA	NA	NA
14	2024-01-14	NA	NA	NA	NA	NA	NA
15	2024-01-15	NA	NA	NA	NA	NA	NA
16	2024-01-16	NA	NA	NA	NA	NA	NA
17	2024-01-17	NA	NA	NA	NA	NA	NA
18	2024-01-18	NA	NA	NA	NA	NA	NA
19	2024-01-19	NA	NA	NA	NA	NA	NA
20	2024-01-20	NA	NA	NA	NA	NA	NA
21	2024-01-21	NA	NA	NA	NA	NA	NA
22	2024-01-22	NA	NA	NA	NA	NA	NA
23	2024-01-23	NA	NA	NA	NA	NA	NA
24	2024-01-24	NA	NA	NA	NA	NA	NA
25	2024-01-25	NA	NA	NA	NA	NA	NA
26	2024-01-26	NA	NA	NA	NA	NA	NA
27	2024-01-27	NA	NA	NA	NA	NA	NA
28	2024-01-28	NA	NA	NA	NA	NA	NA
29	2024-01-29	NA	NA	NA	NA	NA	NA
30	2024-01-30	NA	NA	NA	NA	NA	NA
31	2024-01-31	NA	NA	NA	NA	NA	NA
32	2024-02-01	NA	NA	NA	NA	NA	NA
33	2024-02-02	NA	NA	NA	NA	NA	NA

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
34	2024-02-03	NA	NA	NA	NA	NA	NA
35	2024-02-04	NA	NA	NA	NA	NA	NA
36	2024-02-05	NA	NA	NA	NA	NA	NA
37	2024-02-06	NA	NA	NA	NA	NA	NA
38	2024-02-07	NA	NA	NA	NA	NA	NA
39	2024-02-08	NA	NA	NA	NA	NA	NA
40	2024-02-09	NA	NA	NA	NA	NA	NA
41	2024-02-10	NA	NA	NA	NA	NA	NA
42	2024-02-11	NA	NA	NA	NA	NA	NA
43	2024-02-12	NA	NA	NA	NA	NA	NA
44	2024-02-13	NA	NA	NA	NA	NA	NA
45	2024-02-14	NA	NA	NA	NA	NA	NA
46	2024-02-15	11.76	15.04	0.58	52.79	25.68	0.44
47	2024-02-16	11.71	15.05	0.55	52.40	26.77	0.49
48	2024-02-17	11.63	15.22	0.54	52.68	26.24	0.51
49	2024-02-18	11.54	15.05	0.56	52.30	26.58	0.50
50	2024-02-19	11.52	15.08	0.54	52.66	26.75	0.49
51	2024-02-20	11.46	14.91	0.54	52.37	26.52	0.50
52	2024-02-21	11.50	15.03	0.55	52.50	26.45	0.49
53	2024-02-22	11.42	15.10	0.56	52.52	26.24	0.52
54	2024-02-23	11.56	14.89	0.56	52.49	26.31	0.51
55	2024-02-24	11.57	15.05	0.55	52.59	26.69	0.50
56	2024-02-25	11.42	15.00	0.55	52.22	26.37	0.49
57	2024-02-26	11.50	15.00	0.54	52.74	26.43	0.50
58	2024-02-27	11.59	14.79	0.55	52.34	26.29	0.49
59	2024-02-28	11.57	15.06	0.56	52.27	26.56	0.49

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
60	2024-02-29	11.54	14.86	0.56	52.69	26.44	0.50
61	2024-03-01	11.48	14.93	0.54	52.26	26.52	0.50
62	2024-03-02	11.49	14.97	0.55	52.68	26.76	0.51
63	2024-03-03	11.36	15.06	0.54	52.32	26.49	0.50
64	2024-03-04	11.59	14.95	0.54	52.65	26.45	0.50
65	2024-03-05	11.43	15.09	0.54	52.63	26.24	0.49
66	2024-03-06	11.49	15.00	0.54	52.40	26.84	0.49
67	2024-03-07	11.54	14.95	0.55	52.48	26.32	0.49
68	2024-03-08	11.47	14.96	0.53	52.40	26.29	0.50
69	2024-03-09	11.56	15.12	0.55	52.59	26.18	0.49
70	2024-03-10	11.65	14.96	0.55	52.54	26.27	0.50
71	2024-03-11	11.57	15.16	0.54	52.55	26.70	0.51
72	2024-03-12	11.60	15.25	0.54	52.90	26.37	0.49
73	2024-03-13	11.21	14.94	0.53	52.29	25.84	0.50
74	2024-03-14	11.57	15.05	0.55	52.70	26.28	0.51
75	2024-03-15	11.62	15.08	0.55	52.48	26.36	0.50
76	2024-03-16	11.57	15.00	0.55	52.66	26.90	0.50
77	2024-03-17	11.66	15.09	0.55	52.44	26.01	0.48
78	2024-03-18	11.51	15.01	0.55	52.50	26.73	0.51
79	2024-03-19	11.63	14.85	0.55	52.59	26.60	0.53
80	2024-03-20	11.47	15.08	0.55	52.41	26.41	0.49
81	2024-03-21	11.66	14.91	0.55	52.65	26.20	0.50
82	2024-03-22	11.60	15.02	0.56	52.34	26.44	0.51
83	2024-03-23	11.50	15.05	0.55	52.56	26.77	0.49
84	2024-03-24	11.46	14.97	0.56	52.27	26.47	0.50

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
85	2024-03-25	11.55	15.03	0.55	52.65	26.66	0.50
86	2024-03-26	11.59	15.03	0.55	52.66	26.37	0.51
87	2024-03-27	11.57	15.12	0.55	52.71	26.78	0.49
88	2024-03-28	11.59	14.94	0.54	52.69	26.40	0.51
89	2024-03-29	11.40	15.02	0.54	52.66	26.01	0.51
90	2024-03-30	11.61	15.04	0.54	52.58	26.50	0.50
91	2024-03-31	11.45	14.99	0.54	52.48	26.32	0.49
92	2024-04-01	11.33	14.96	0.55	52.62	26.41	0.50
93	2024-04-02	11.49	14.94	0.56	52.57	26.49	0.50
94	2024-04-03	11.68	15.00	0.56	52.52	26.81	0.50
95	2024-04-04	11.56	14.95	0.55	52.52	26.47	0.49
96	2024-04-05	11.45	14.98	0.55	52.57	26.28	0.50
97	2024-04-06	11.46	14.90	0.55	52.66	26.48	0.49
98	2024-04-07	11.55	15.01	0.55	52.53	26.78	0.50
99	2024-04-08	11.61	14.88	0.55	52.36	26.16	0.50
100	2024-04-09	12.22	14.77	0.49	54.32	26.15	0.46
101	2024-04-10	11.96	15.90	0.69	52.01	28.19	0.54
102	2024-04-11	NA	NA	NA	NA	NA	NA
103	2024-04-12	11.44	15.02	0.55	52.96	26.31	0.49
104	2024-04-13	11.42	15.00	0.55	52.49	26.23	0.49
105	2024-04-14	11.45	15.06	0.56	52.40	26.46	0.50
106	2024-04-15	11.49	15.10	0.54	52.72	26.50	0.51
107	2024-04-16	11.40	15.07	0.54	52.78	26.47	0.50
108	2024-04-17	11.59	14.98	0.55	52.47	26.64	0.49
109	2024-04-18	11.73	15.06	0.55	52.52	26.38	0.49

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
110	2024-04-19	11.45	14.99	0.56	52.51	26.26	0.48
111	2024-04-20	11.56	14.63	0.50	52.27	26.50	0.54
112	2024-04-21	NA	NA	NA	NA	NA	NA
113	2024-04-22	11.85	14.92	0.55	52.66	26.62	0.51
114	2024-04-23	11.50	14.94	0.55	52.64	26.66	0.51
115	2024-04-24	11.56	14.98	0.56	52.21	26.42	0.51
116	2024-04-25	11.57	15.02	0.54	52.62	26.76	0.49
117	2024-04-26	11.36	14.99	0.56	52.26	26.12	0.50
118	2024-04-27	11.50	14.88	0.56	52.20	26.35	0.50
119	2024-04-28	11.57	15.10	0.53	52.97	26.26	0.49
120	2024-04-29	11.83	14.76	0.58	52.37	26.03	0.50
121	2024-04-30	11.20	14.60	0.54	51.78	26.05	0.48
122	2024-05-01	NA	NA	NA	NA	NA	NA
123	2024-05-02	11.55	15.03	0.55	52.60	26.44	0.51
124	2024-05-03	11.55	14.81	0.55	35.62	18.46	0.49
125	2024-05-04	11.47	14.95	0.54	12.22	6.98	0.50
126	2024-05-05	11.56	15.00	0.55	13.33	7.62	0.50
127	2024-05-06	11.44	15.05	0.55	13.38	7.65	0.51
128	2024-05-07	11.53	14.99	0.55	10.44	5.96	0.50
129	2024-05-08	11.51	15.11	0.55	15.48	8.84	0.50
130	2024-05-09	11.47	15.14	0.55	9.12	5.21	0.50
131	2024-05-10	11.48	15.09	0.54	11.54	6.59	0.50
132	2024-05-11	11.61	14.95	0.53	11.85	6.77	0.49
133	2024-05-12	NA	NA	NA	NA	NA	NA
134	2024-05-13	NA	NA	NA	NA	NA	NA
135	2024-05-14	11.48	14.95	0.55	17.67	10.10	0.51

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
136	2024-05-15	11.61	14.99	0.55	16.96	9.69	0.51
137	2024-05-16	11.49	14.95	0.55	10.07	5.75	0.49
138	2024-05-17	NA	NA	NA	9.48	5.42	NA
139	2024-05-18	11.46	14.63	0.56	10.18	5.81	0.53
140	2024-05-19	11.28	15.29	0.56	6.15	3.51	0.51
141	2024-05-20	11.57	14.94	0.56	8.20	4.68	0.50
142	2024-05-21	11.57	14.96	0.54	9.81	5.60	0.50
143	2024-05-22	11.39	15.02	0.56	10.48	5.99	0.50
144	2024-05-23	11.55	14.95	0.56	9.12	5.21	0.50
145	2024-05-24	11.43	14.97	0.55	11.71	6.69	0.50
146	2024-05-25	11.45	14.92	0.54	20.70	11.83	0.49
147	2024-05-26	11.51	14.99	0.55	24.00	13.71	0.51
148	2024-05-27	11.55	15.06	0.56	26.09	14.91	0.50
149	2024-05-28	11.42	14.95	0.55	28.89	16.51	0.50
150	2024-05-29	11.65	15.04	0.56	26.77	15.30	0.50
151	2024-05-30	11.55	14.90	0.56	25.42	14.52	0.50
152	2024-05-31	11.45	15.14	0.52	25.94	14.82	0.50
153	2024-06-01	11.49	15.22	0.52	14.56	8.32	0.50
154	2024-06-02	NA	NA	NA	NA	NA	NA
155	2024-06-03	11.41	14.95	0.55	29.86	16.79	0.49
156	2024-06-04	11.56	14.91	0.55	24.36	13.92	0.49
157	2024-06-05	11.44	15.00	0.54	26.62	15.21	0.49
158	2024-06-06	11.50	15.09	0.54	17.11	9.77	0.52
159	2024-06-07	11.52	15.01	0.55	18.56	10.46	0.50
160	2024-06-08	11.36	15.07	0.56	12.67	7.24	0.51
161	2024-06-09	11.48	15.17	0.56	11.81	6.74	0.49

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
162	2024-06-10	11.64	14.92	0.54	13.23	7.56	0.50
163	2024-06-11	11.55	15.11	0.56	14.38	8.23	0.47
164	2024-06-12	11.58	15.01	0.56	33.07	18.73	0.52
165	2024-06-13	11.45	14.94	0.55	24.09	13.77	0.50
166	2024-06-14	11.61	15.01	0.55	23.67	13.52	0.52
167	2024-06-15	11.58	14.91	0.54	19.83	11.33	0.49
168	2024-06-16	11.56	14.90	0.55	24.42	13.95	0.50
169	2024-06-17	11.53	15.06	0.54	24.77	14.15	0.52
170	2024-06-18	11.58	15.07	0.55	22.88	13.07	0.51
171	2024-06-19	11.60	14.87	0.54	13.55	7.73	0.50
172	2024-06-20	11.41	14.98	0.55	12.62	7.21	0.51
173	2024-06-21	11.62	14.97	0.55	62.98	34.95	0.51
174	2024-06-22	11.44	14.98	0.54	58.14	32.31	0.52
175	2024-06-23	11.57	15.03	0.54	14.90	8.51	0.50
176	2024-06-24	11.57	15.01	0.56	17.00	9.71	0.52
177	2024-06-25	11.29	14.97	0.54	12.44	7.11	0.50
178	2024-06-26	11.51	15.05	0.55	12.54	7.16	0.50
179	2024-06-27	11.37	15.04	0.56	8.41	4.81	0.50
180	2024-06-28	11.46	15.21	0.55	14.68	8.39	0.51
181	2024-06-29	11.41	15.13	0.55	16.37	9.35	0.50
182	2024-06-30	11.35	15.15	0.54	11.32	6.47	0.49
183	2024-07-01	11.44	14.89	0.53	13.53	7.73	0.50
184	2024-07-02	11.44	14.98	0.55	18.66	10.66	0.50
185	2024-07-03	11.46	14.80	0.55	11.90	6.80	0.50
186	2024-07-04	11.33	15.00	0.56	20.17	11.52	0.50

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
187	2024-07-05	11.57	14.86	0.55	18.46	10.55	0.51
188	2024-07-06	11.89	14.86	0.54	46.97	26.13	0.47
189	2024-07-07	NA	NA	NA	NA	NA	NA
190	2024-07-08	11.82	15.54	0.54	28.23	16.13	0.47
191	2024-07-09	11.33	14.95	0.54	15.40	8.80	0.50
192	2024-07-10	11.52	15.12	0.56	14.81	8.46	0.50
193	2024-07-11	11.47	15.00	0.55	16.85	9.63	0.50
194	2024-07-12	11.40	14.96	0.54	16.55	9.45	0.50
195	2024-07-13	11.42	15.05	0.55	9.05	5.17	0.50
196	2024-07-14	11.36	14.98	0.56	9.16	5.23	0.50
197	2024-07-15	11.45	15.04	0.55	12.06	6.89	0.51
198	2024-07-16	11.37	14.98	0.55	18.60	10.55	0.50
199	2024-07-17	11.69	14.96	0.55	6.88	3.93	0.49
200	2024-07-18	11.42	15.02	0.55	10.88	6.22	0.51
201	2024-07-19	11.68	14.93	0.54	4.83	2.76	0.50
202	2024-07-20	11.46	15.01	0.55	7.07	4.04	0.49
203	2024-07-21	11.58	14.94	0.55	8.75	5.00	0.50
204	2024-07-22	11.66	15.06	0.54	10.43	5.96	0.50
205	2024-07-23	11.57	15.14	0.55	11.68	6.67	0.50
206	2024-07-24	11.47	14.97	0.54	8.98	5.13	0.48
207	2024-07-25	11.54	14.92	0.55	8.93	5.10	0.52
208	2024-07-26	11.57	15.06	0.55	7.27	4.15	0.49
209	2024-07-27	11.43	15.03	0.56	7.82	4.46	0.50
210	2024-07-28	11.58	14.98	0.54	14.97	8.56	0.51
211	2024-07-29	11.43	14.99	0.55	16.76	9.57	0.50
212	2024-07-30	11.50	14.96	0.56	14.07	8.03	0.51

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
213	2024-07-31	11.38	15.08	0.55	12.96	7.41	0.49
214	2024-08-01	11.48	15.06	0.56	12.39	7.08	0.49
215	2024-08-02	11.55	14.94	0.55	12.73	7.27	0.51
216	2024-08-03	11.44	14.93	0.54	13.56	7.75	0.52
217	2024-08-04	NA	NA	NA	NA	NA	NA
218	2024-08-05	NA	NA	NA	NA	NA	NA
219	2024-08-06	11.80	15.09	0.55	11.28	6.44	0.49
220	2024-08-07	11.60	14.86	0.54	10.88	6.21	0.51
221	2024-08-08	11.50	15.02	0.55	11.79	6.73	0.50
222	2024-08-09	11.55	15.06	0.54	17.87	10.21	0.51
223	2024-08-10	11.53	14.86	0.56	20.41	11.66	0.50
224	2024-08-11	10.61	14.45	0.53	14.18	8.10	0.52
225	2024-08-12	11.47	14.95	0.54	22.06	12.60	0.49
226	2024-08-13	11.57	14.99	0.55	19.64	11.22	0.50
227	2024-08-14	11.50	15.08	0.56	14.61	8.34	0.50
228	2024-08-15	11.51	15.09	0.54	11.38	6.50	0.49
229	2024-08-16	11.48	15.06	0.56	11.19	6.39	0.48
230	2024-08-17	11.65	15.02	0.56	12.13	6.93	0.48
231	2024-08-18	11.37	14.79	0.56	10.20	5.83	0.50
232	2024-08-19	11.27	15.09	0.56	20.84	11.70	0.46
233	2024-08-20	NA	NA	NA	NA	NA	NA
234	2024-08-21	11.56	15.14	0.56	23.23	13.11	0.50
235	2024-08-22	11.46	15.03	0.55	7.68	4.39	0.50
236	2024-08-23	11.48	15.03	0.55	10.25	5.86	0.49
237	2024-08-24	11.54	14.98	0.55	13.72	7.84	0.51

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
238	2024-08-25	11.63	15.02	0.55	13.45	7.68	0.50
239	2024-08-26	11.67	14.89	0.56	14.05	8.02	0.49
240	2024-08-27	11.55	15.07	0.55	14.30	8.17	0.49
241	2024-08-28	11.54	15.03	0.56	12.16	6.94	0.49
242	2024-08-29	11.56	14.98	0.55	13.77	7.87	0.49
243	2024-08-30	11.51	14.98	0.55	10.61	6.06	0.50
244	2024-08-31	11.65	14.94	0.55	5.72	3.27	0.50
245	2024-09-01	11.58	15.00	0.55	12.68	7.24	0.51
246	2024-09-02	11.53	14.89	0.55	14.53	8.30	0.51
247	2024-09-03	11.54	15.02	0.56	15.19	8.68	0.50
248	2024-09-04	11.57	14.90	0.56	16.67	9.53	0.51
249	2024-09-05	11.62	14.94	0.55	8.46	4.84	0.51
250	2024-09-06	11.53	15.07	0.56	11.66	6.66	0.52
251	2024-09-07	11.76	14.92	0.60	7.05	4.03	0.54
252	2024-09-08	NA	NA	NA	NA	NA	NA
253	2024-09-09	NA	NA	NA	NA	NA	NA
254	2024-09-10	11.23	14.99	0.55	12.98	7.42	0.51
255	2024-09-11	11.33	14.99	0.55	15.79	9.02	0.50
256	2024-09-12	11.60	15.06	0.56	15.31	8.75	0.50
257	2024-09-13	11.39	14.91	0.55	12.97	7.41	0.50
258	2024-09-14	11.49	15.03	0.55	15.48	8.84	0.50
259	2024-09-15	11.39	15.15	0.54	17.72	10.13	0.51
260	2024-09-16	11.52	15.10	0.54	16.74	9.56	0.49
261	2024-09-17	11.32	14.98	0.56	17.45	9.97	0.48
262	2024-09-18	11.45	14.97	0.56	93.14	51.44	0.50

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
263	2024-09-19	11.55	15.02	0.55	63.91	35.43	0.51
264	2024-09-20	9.80	15.02	0.54	17.53	10.01	0.46
265	2024-09-21	NA	NA	NA	12.20	6.97	NA
266	2024-09-22	NA	NA	NA	13.67	7.81	NA
267	2024-09-23	11.42	15.03	0.54	10.91	6.23	0.50
268	2024-09-24	11.43	14.97	0.55	16.15	9.23	0.50
269	2024-09-25	11.23	15.02	0.54	10.86	6.20	0.53
270	2024-09-26	11.66	14.85	0.54	7.99	4.57	0.49
271	2024-09-27	NA	NA	NA	NA	NA	NA
272	2024-09-28	11.10	14.95	0.56	52.71	29.14	0.50
273	2024-09-29	NA	NA	NA	NA	NA	NA
274	2024-09-30	11.55	15.07	0.55	18.30	10.33	0.50
275	2024-10-01	11.62	14.94	0.55	11.09	6.34	0.49
276	2024-10-02	11.45	14.91	0.55	11.67	6.67	0.50
277	2024-10-03	11.65	14.98	0.55	27.34	15.62	0.48
278	2024-10-04	11.50	14.94	0.55	21.36	12.21	0.51
279	2024-10-05	11.66	15.08	0.55	23.47	13.41	0.51
280	2024-10-06	11.52	15.04	0.55	21.47	12.27	0.49
281	2024-10-07	11.53	15.14	0.53	20.35	11.64	0.51
282	2024-10-08	11.50	14.94	0.56	18.73	10.70	0.49
283	2024-10-09	11.53	14.96	0.55	11.77	6.72	0.49
284	2024-10-10	11.75	15.13	0.55	7.54	4.31	0.50
285	2024-10-11	11.37	15.13	0.56	17.03	9.55	0.50
286	2024-10-12	11.57	14.89	0.55	10.38	5.93	0.51
287	2024-10-13	NA	NA	NA	NA	NA	NA
288	2024-10-14	NA	NA	NA	NA	NA	NA

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
289	2024-10-15	NA	NA	NA	NA	NA	NA
290	2024-10-16	11.41	15.20	0.57	7.65	4.37	0.49
291	2024-10-17	11.52	14.75	0.53	4.71	2.69	0.50
292	2024-10-18	11.45	15.05	0.54	5.51	3.15	0.50
293	2024-10-19	11.40	14.92	0.54	8.13	4.64	0.50
294	2024-10-20	11.63	14.94	0.55	6.10	3.49	0.50
295	2024-10-21	11.49	15.07	0.55	10.67	6.10	0.50
296	2024-10-22	11.66	14.99	0.56	31.24	17.02	0.49
297	2024-10-23	11.39	15.01	0.54	31.58	17.02	0.50
298	2024-10-24	11.55	15.07	0.54	31.31	17.05	0.49
299	2024-10-25	11.35	14.87	0.54	31.31	16.98	0.50
300	2024-10-26	11.42	14.99	0.56	31.44	16.92	0.49
301	2024-10-27	11.65	15.12	0.56	31.46	17.06	0.51
302	2024-10-28	11.44	14.99	0.55	31.45	16.79	0.50
303	2024-10-29	11.48	15.09	0.53	31.63	16.97	0.52
304	2024-10-30	11.42	15.13	0.57	31.89	17.24	0.50
305	2024-10-31	11.53	15.01	0.54	31.44	16.92	0.50
306	2024-11-01	11.59	15.05	0.55	31.48	17.05	0.50
307	2024-11-02	11.48	14.87	0.54	31.54	17.17	0.51
308	2024-11-03	11.48	15.03	0.55	31.55	16.92	0.50
309	2024-11-04	11.59	15.00	0.56	31.39	17.15	0.50
310	2024-11-05	11.52	15.04	0.56	31.60	17.02	0.50
311	2024-11-06	11.52	14.94	0.55	31.37	16.99	0.51
312	2024-11-07	11.58	15.00	0.55	31.42	16.99	0.51
313	2024-11-08	11.60	15.06	0.57	31.62	17.09	0.50
314	2024-11-09	11.43	14.99	0.56	31.43	16.93	0.48

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
315	2024-11-10	11.54	15.00	0.55	31.50	17.14	0.49
316	2024-11-11	11.57	15.07	0.54	31.52	16.88	0.51
317	2024-11-12	11.50	14.99	0.55	31.50	17.03	0.48
318	2024-11-13	11.31	14.98	0.55	31.47	17.05	0.50
319	2024-11-14	11.48	15.12	0.56	31.49	16.91	0.50
320	2024-11-15	11.43	14.78	0.54	31.82	16.96	0.49
321	2024-11-16	11.56	15.35	0.57	31.62	17.07	0.50
322	2024-11-17	11.41	14.94	0.55	31.59	17.07	0.49
323	2024-11-18	11.45	15.07	0.55	31.44	16.99	0.51
324	2024-11-19	11.48	14.99	0.56	31.74	17.00	0.49
325	2024-11-20	11.58	15.13	0.56	31.57	16.95	0.49
326	2024-11-21	11.71	14.90	0.56	31.35	17.04	0.49
327	2024-11-22	11.70	15.01	0.55	31.49	16.93	0.50
328	2024-11-23	11.46	14.92	0.56	31.47	16.98	0.51
329	2024-11-24	11.61	15.11	0.54	31.55	16.90	0.52
330	2024-11-25	11.38	15.02	0.54	31.60	16.85	0.49
331	2024-11-26	11.44	14.98	0.55	31.53	16.96	0.50
332	2024-11-27	11.29	15.04	0.57	31.49	17.00	0.51
333	2024-11-28	11.41	15.02	0.55	31.70	16.88	0.50
334	2024-11-29	11.45	14.99	0.56	31.37	16.97	0.49
335	2024-11-30	11.36	14.89	0.55	31.43	16.99	0.51
336	2024-12-01	11.67	14.99	0.54	31.68	17.11	0.50
337	2024-12-02	11.55	14.99	0.55	31.49	17.01	0.50
338	2024-12-03	11.53	15.05	0.54	31.41	17.04	0.48
339	2024-12-04	11.65	15.09	0.54	31.52	17.12	0.51
340	2024-12-05	11.41	15.07	0.55	31.41	16.90	0.51

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
341	2024-12-06	11.63	15.01	0.53	31.53	17.04	0.50
342	2024-12-07	11.67	15.10	0.56	31.35	16.99	0.50
343	2024-12-08	11.48	15.00	0.55	31.54	17.04	0.51
344	2024-12-09	11.41	15.13	0.55	31.37	17.08	0.49
345	2024-12-10	11.76	14.97	0.54	31.35	16.94	0.49
346	2024-12-11	11.62	15.14	0.56	31.45	16.93	0.50
347	2024-12-12	11.37	15.21	0.56	31.36	16.83	0.51
348	2024-12-13	11.57	15.03	0.54	31.47	16.97	0.51
349	2024-12-14	11.22	14.86	0.56	31.70	17.11	0.48
350	2024-12-15	NA	NA	NA	NA	NA	NA
351	2024-12-16	11.36	14.94	0.55	31.64	17.15	0.51
352	2024-12-17	11.57	15.03	0.54	31.37	16.95	0.50
353	2024-12-18	11.50	15.02	0.56	31.56	17.02	0.49
354	2024-12-19	NA	NA	NA	NA	NA	NA
355	2024-12-20	11.53	14.89	0.54	31.49	16.84	0.51
356	2024-12-21	11.51	14.98	0.56	31.68	17.10	0.50
357	2024-12-22	11.43	14.65	0.58	31.74	17.08	0.49
358	2024-12-23	11.57	14.93	0.56	31.59	17.07	0.48
359	2024-12-24	11.61	15.08	0.54	31.39	17.00	0.50
360	2024-12-25	11.30	15.04	0.55	31.65	17.11	0.50
361	2024-12-26	11.41	15.11	0.54	31.45	17.01	0.50
362	2024-12-27	11.41	15.00	0.54	31.44	16.87	0.51
363	2024-12-28	11.34	14.89	0.54	31.56	17.02	0.50
364	2024-12-29	11.37	14.94	0.55	31.60	17.05	0.50
365	2024-12-30	11.50	15.10	0.55	31.76	17.13	0.51

SI No	Time	Station_2_Thadi-SO2 - (ug/m3) Raw	Station_2_Thadi-NOx - (ug/m3) Raw	Station_2_Thadi-NH3 - (ug/m3) Raw	Station_2_Thadi-PM10 - (ug/m3) Raw	Station_2_Thadi-PM2.5 - (ug/m3) Raw	Station_2_Thadi-VOC - (ug/m3) Raw
366	2024-12-31	11.65	14.95	0.55	31.66	17.23	0.48

**Report Details:** RO\_Visakhapatnam | 2025-01-25 12:18:03 | Custom Report



# Real Time Data Acquisition And Monitoring

Site Name: Visakha Pharmacity Limited (Earlier Known As .Ramky Pharmacity (India) Ltd.,(CETP))

Report: Custom Report

From Date: 2024/01/01 00:00:00 To Date : 2024/12/31 23:59:49

Description	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
Prescribed Standards	0 - 80	0 - 80	0 - 400	0 - 100	0 - 60	0 -
Maximum Data	16.64	15.66	13.34	61.03	34.44	1.2
Minimum Data	0.11	0.12	0.09	3.06	1.73	0.06
Geometric Mean	9.73	9.75	8.1	38.83	20.16	0.49
Median	14.9	14.93	12.4	47.37	23.97	0.5
Standard Deviation	6.88	6.84	5.74	13.63	6.61	0.15
Maximum Value At Time	2024-09-07	2024-09-07	2024-09-07	2024-01-13	2024-01-13	2024-01-03
Minimum Value At Time	2024-05-17	2024-05-17	2024-05-17	2024-05-17	2024-05-17	2024-05-17
Valid Data Points	355	355	355	355	355	355
Total Data Points	366	366	366	366	366	366
Data Availability %	96.99%	96.99%	96.99%	96.99%	96.99%	96.99%

Sl No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
1	2024-01-01	1.78	1.95	1.46	50.27	28.38	0.97
2	2024-01-02	1.90	2.07	1.55	53.51	30.21	1.04
3	2024-01-03	2.16	2.36	1.77	60.86	34.37	1.20
4	2024-01-04	2.02	2.21	1.66	57.01	32.21	1.10
5	2024-01-05	1.09	1.19	0.90	30.73	17.37	0.60
6	2024-01-06	1.36	1.48	1.11	38.33	21.64	0.74
7	2024-01-07	1.44	1.57	1.17	40.44	22.82	0.78
8	2024-01-08	1.72	1.87	1.40	48.34	27.29	0.93
9	2024-01-09	2.12	2.31	1.73	59.70	33.67	1.15
10	2024-01-10	1.49	1.63	1.22	42.02	23.71	0.82
11	2024-01-11	1.99	2.17	1.63	56.05	31.66	1.08
12	2024-01-12	1.93	2.10	1.58	54.31	30.66	1.06

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
13	2024-01-13	2.16	2.36	1.77	61.03	34.44	1.18
14	2024-01-14	NA	NA	NA	NA	NA	NA
15	2024-01-15	NA	NA	NA	NA	NA	NA
16	2024-01-16	0.84	0.92	0.69	23.74	13.42	0.46
17	2024-01-17	0.77	0.84	0.63	21.77	12.28	0.42
18	2024-01-18	NA	NA	NA	NA	NA	NA
19	2024-01-19	0.89	0.97	0.73	25.06	14.20	0.49
20	2024-01-20	0.99	1.07	0.81	27.74	15.63	0.54
21	2024-01-21	1.02	1.11	0.83	28.66	16.18	0.55
22	2024-01-22	0.90	0.98	0.74	25.30	14.27	0.49
23	2024-01-23	1.56	1.70	1.28	43.93	24.81	0.85
24	2024-01-24	1.16	1.27	0.95	32.71	18.40	0.63
25	2024-01-25	0.68	0.74	0.56	19.12	10.79	0.37
26	2024-01-26	1.11	1.21	0.91	31.07	17.57	0.60
27	2024-01-27	1.41	1.54	1.15	39.74	22.43	0.77
28	2024-01-28	1.41	1.53	1.15	39.61	22.36	0.77
29	2024-01-29	1.69	1.84	1.38	47.56	26.83	0.92
30	2024-01-30	1.72	1.88	1.40	48.46	27.38	0.93
31	2024-01-31	0.92	1.00	0.75	25.93	14.67	0.50
32	2024-02-01	1.10	1.19	0.90	30.73	17.28	0.60
33	2024-02-02	0.67	0.73	0.55	18.91	10.68	0.36
34	2024-02-03	0.83	0.90	0.68	23.43	13.21	0.45
35	2024-02-04	0.88	0.97	0.73	24.91	14.10	0.48
36	2024-02-05	0.89	0.97	0.73	25.06	14.16	0.49
37	2024-02-06	0.74	0.81	0.60	20.91	11.82	0.41
38	2024-02-07	1.00	1.09	0.82	28.22	15.93	0.55
39	2024-02-08	1.17	1.27	0.96	33.01	18.59	0.64
40	2024-02-09	1.38	1.51	1.13	38.91	21.97	0.75
41	2024-02-10	1.25	1.37	1.03	35.27	19.94	0.68

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
42	2024-02-11	1.30	1.41	1.06	36.54	20.63	0.71
43	2024-02-12	1.22	1.33	1.00	34.39	19.42	0.66
44	2024-02-13	1.25	1.36	1.02	35.19	19.91	0.68
45	2024-02-14	1.16	1.26	0.95	32.55	18.41	0.63
46	2024-02-15	1.57	1.72	1.29	44.30	25.03	0.86
47	2024-02-16	1.28	1.39	1.05	36.04	20.34	0.70
48	2024-02-17	1.02	1.11	0.84	28.69	16.23	0.56
49	2024-02-18	0.76	0.83	0.62	21.28	12.01	0.41
50	2024-02-19	0.70	0.76	0.57	19.70	11.12	0.38
51	2024-02-20	0.60	0.65	0.49	16.89	9.54	0.33
52	2024-02-21	0.85	0.93	0.69	23.96	13.59	0.46
53	2024-02-22	0.65	0.71	0.53	18.34	10.36	0.36
54	2024-02-23	0.51	0.55	0.41	14.27	8.05	0.28
55	2024-02-24	0.53	0.58	0.43	14.89	8.40	0.29
56	2024-02-25	0.70	0.76	0.57	19.65	11.14	0.38
57	2024-02-26	0.86	0.93	0.70	24.14	13.63	0.47
58	2024-02-27	1.01	1.11	0.83	28.52	16.10	0.55
59	2024-02-28	1.07	1.17	0.88	30.34	17.16	0.58
60	2024-02-29	0.94	1.02	0.77	26.51	14.93	0.51
61	2024-03-01	0.97	1.06	0.79	27.31	15.43	0.53
62	2024-03-02	0.92	1.00	0.75	25.89	14.60	0.50
63	2024-03-03	0.80	0.87	0.65	22.51	12.71	0.44
64	2024-03-04	0.76	0.83	0.62	21.42	12.09	0.41
65	2024-03-05	0.85	0.93	0.69	23.89	13.50	0.46
66	2024-03-06	0.79	0.86	0.65	22.32	12.62	0.43
67	2024-03-07	0.63	0.68	0.51	17.71	10.01	0.34
68	2024-03-08	0.55	0.60	0.45	15.63	8.81	0.30
69	2024-03-09	0.74	0.80	0.60	20.79	11.72	0.40
70	2024-03-10	0.72	0.78	0.59	20.19	11.40	0.39

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
71	2024-03-11	0.76	0.83	0.62	21.28	12.07	0.41
72	2024-03-12	0.68	0.74	0.55	19.03	10.75	0.37
73	2024-03-13	0.65	0.71	0.53	18.18	10.26	0.35
74	2024-03-14	0.73	0.79	0.60	20.50	11.57	0.40
75	2024-03-15	0.61	0.66	0.50	17.12	9.66	0.33
76	2024-03-16	0.39	0.43	0.32	11.02	6.22	0.21
77	2024-03-17	0.64	0.70	0.52	17.94	10.12	0.35
78	2024-03-18	0.64	0.70	0.52	18.05	10.19	0.35
79	2024-03-19	0.62	0.68	0.51	17.52	9.88	0.34
80	2024-03-20	0.75	0.82	0.61	21.07	11.89	0.41
81	2024-03-21	1.00	1.10	0.82	28.26	15.96	0.55
82	2024-03-22	0.65	0.70	0.53	18.14	10.24	0.34
83	2024-03-23	0.47	0.51	0.38	13.20	7.45	0.26
84	2024-03-24	0.87	0.96	0.72	24.83	14.05	0.48
85	2024-03-25	1.05	1.15	0.88	29.66	16.63	0.59
86	2024-03-26	0.66	0.72	0.54	18.61	10.52	0.36
87	2024-03-27	0.41	0.44	0.33	11.43	6.45	0.22
88	2024-03-28	0.35	0.38	0.28	9.73	5.53	0.19
89	2024-03-29	0.42	0.45	0.34	11.73	6.62	0.23
90	2024-03-30	0.41	0.45	0.34	11.59	6.53	0.22
91	2024-03-31	0.34	0.37	0.28	9.60	5.41	0.18
92	2024-04-01	0.41	0.45	0.34	11.65	6.59	0.23
93	2024-04-02	0.33	0.35	0.27	9.21	5.20	0.18
94	2024-04-03	0.36	0.39	0.30	10.21	5.77	0.20
95	2024-04-04	0.31	0.33	0.25	8.61	4.87	0.17
96	2024-04-05	0.45	0.49	0.37	12.56	7.08	0.24
97	2024-04-06	0.43	0.47	0.35	12.07	6.79	0.23
98	2024-04-07	0.54	0.59	0.44	15.17	8.57	0.29
99	2024-04-08	0.84	0.91	0.69	23.55	13.36	0.46

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
100	2024-04-09	1.00	1.09	0.82	28.35	16.01	0.54
101	2024-04-10	0.95	1.04	0.79	26.73	15.07	0.52
102	2024-04-11	1.38	1.50	1.11	38.74	21.85	0.75
103	2024-04-12	1.03	1.12	0.84	28.90	16.32	0.56
104	2024-04-13	0.83	0.91	0.69	23.46	12.91	0.45
105	2024-04-14	1.19	1.29	0.97	33.44	18.91	0.65
106	2024-04-15	0.67	0.73	0.55	18.86	10.65	0.37
107	2024-04-16	0.65	0.71	0.53	18.44	10.40	0.36
108	2024-04-17	0.60	0.65	0.49	16.86	9.50	0.33
109	2024-04-18	0.50	0.55	0.41	14.14	7.98	0.27
110	2024-04-19	0.41	0.45	0.34	11.55	6.51	0.22
111	2024-04-20	0.44	0.48	0.36	12.39	7.02	0.24
112	2024-04-21	0.42	0.46	0.34	11.86	6.69	0.23
113	2024-04-22	0.57	0.62	0.47	15.93	8.98	0.31
114	2024-04-23	0.74	0.80	0.60	20.82	11.74	0.40
115	2024-04-24	0.81	0.89	0.67	23.00	12.96	0.44
116	2024-04-25	0.63	0.68	0.51	17.59	9.94	0.34
117	2024-04-26	0.45	0.49	0.37	12.60	7.12	0.25
118	2024-04-27	0.54	0.59	0.44	15.19	8.63	0.29
119	2024-04-28	0.55	0.60	0.45	15.65	8.78	0.30
120	2024-04-29	0.38	0.41	0.30	11.25	6.04	0.18
121	2024-04-30	0.49	0.54	0.41	13.37	7.77	0.28
122	2024-05-01	0.42	0.46	0.34	11.88	6.71	0.23
123	2024-05-02	0.46	0.50	0.38	13.02	7.35	0.25
124	2024-05-03	0.43	0.47	0.35	12.10	6.84	0.24
125	2024-05-04	0.29	0.32	0.24	8.16	4.65	0.16
126	2024-05-05	0.61	0.66	0.49	17.09	9.65	0.33
127	2024-05-06	0.60	0.65	0.49	16.89	9.53	0.33
128	2024-05-07	0.47	0.51	0.38	13.20	7.47	0.26

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
129	2024-05-08	0.60	0.66	0.50	16.97	9.61	0.33
130	2024-05-09	0.35	0.38	0.29	9.94	5.61	0.19
131	2024-05-10	0.56	0.61	0.46	15.84	8.93	0.31
132	2024-05-11	0.36	0.39	0.29	10.07	5.67	0.19
133	2024-05-12	NA	NA	NA	NA	NA	NA
134	2024-05-13	NA	NA	NA	NA	NA	NA
135	2024-05-14	0.59	0.64	0.48	16.57	9.33	0.32
136	2024-05-15	0.64	0.70	0.52	18.02	10.17	0.35
137	2024-05-16	0.40	0.44	0.33	11.39	6.44	0.22
138	2024-05-17	0.11	0.12	0.09	3.06	1.73	0.06
139	2024-05-18	NA	NA	NA	NA	NA	NA
140	2024-05-19	NA	NA	NA	NA	NA	NA
141	2024-05-20	NA	NA	NA	NA	NA	NA
142	2024-05-21	14.88	14.80	12.30	47.73	23.92	0.51
143	2024-05-22	15.09	15.03	12.61	47.41	24.09	0.51
144	2024-05-23	15.28	15.01	12.54	47.39	24.04	0.51
145	2024-05-24	15.13	15.21	12.53	47.46	24.05	0.50
146	2024-05-25	15.17	14.92	12.52	46.68	24.11	0.49
147	2024-05-26	14.90	15.02	12.46	47.47	23.98	0.50
148	2024-05-27	15.07	15.18	12.56	47.43	23.98	0.52
149	2024-05-28	15.10	15.00	12.47	47.76	23.98	0.51
150	2024-05-29	14.96	14.90	12.37	47.41	23.92	0.50
151	2024-05-30	14.80	15.04	12.45	47.62	23.96	0.50
152	2024-05-31	14.91	15.14	12.76	47.71	24.06	0.51
153	2024-06-01	14.73	15.11	12.53	47.66	24.08	0.51
154	2024-06-02	15.21	15.00	12.71	47.67	24.08	0.53
155	2024-06-03	14.86	15.10	12.50	47.35	23.95	0.51
156	2024-06-04	15.14	15.06	12.68	47.57	23.97	0.49
157	2024-06-05	15.42	15.09	12.69	47.55	23.99	0.51

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
158	2024-06-06	15.13	15.25	12.76	47.80	24.03	0.49
159	2024-06-07	14.93	14.92	12.56	46.80	24.05	0.51
160	2024-06-08	15.04	14.94	12.24	47.80	23.92	0.50
161	2024-06-09	14.94	15.04	12.42	48.03	23.99	0.50
162	2024-06-10	15.06	14.92	12.58	47.56	24.02	0.51
163	2024-06-11	15.12	15.01	12.45	47.11	23.96	0.52
164	2024-06-12	15.02	14.97	12.48	48.32	24.08	0.49
165	2024-06-13	15.24	15.14	12.17	47.98	23.99	0.50
166	2024-06-14	14.80	14.98	12.47	47.44	23.94	0.50
167	2024-06-15	14.93	15.07	12.24	47.32	24.03	0.50
168	2024-06-16	15.32	15.00	12.33	46.89	23.83	0.50
169	2024-06-17	15.10	15.18	12.42	47.24	24.02	0.49
170	2024-06-18	14.83	14.84	12.40	46.77	24.11	0.49
171	2024-06-19	15.18	14.93	12.55	47.56	24.06	0.51
172	2024-06-20	14.85	14.97	12.48	47.19	24.00	0.51
173	2024-06-21	15.03	14.88	12.58	47.42	24.09	0.51
174	2024-06-22	14.78	15.17	12.41	46.83	23.97	0.49
175	2024-06-23	14.86	15.06	12.43	47.39	24.09	0.50
176	2024-06-24	15.29	15.21	12.63	47.40	24.06	0.50
177	2024-06-25	14.91	14.98	12.53	47.61	23.91	0.51
178	2024-06-26	15.27	15.13	12.76	47.57	24.02	0.50
179	2024-06-27	15.15	15.06	12.45	47.70	24.05	0.50
180	2024-06-28	14.74	15.01	12.29	47.44	24.00	0.51
181	2024-06-29	14.90	14.79	12.58	47.44	23.98	0.49
182	2024-06-30	15.13	14.94	12.52	47.77	23.97	0.49
183	2024-07-01	15.04	14.84	12.43	47.54	24.03	0.50
184	2024-07-02	14.85	14.97	12.39	47.42	24.08	0.50
185	2024-07-03	15.22	15.00	12.52	47.54	23.96	0.50
186	2024-07-04	14.78	15.01	12.35	47.30	23.97	0.49

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
187	2024-07-05	15.00	15.06	12.76	47.23	24.03	0.52
188	2024-07-06	15.12	14.99	12.32	47.40	23.93	0.49
189	2024-07-07	14.97	14.93	12.60	47.89	24.09	0.50
190	2024-07-08	14.79	14.98	12.46	47.11	24.07	0.50
191	2024-07-09	15.03	14.93	12.36	47.54	24.04	0.50
192	2024-07-10	14.93	14.97	12.32	47.65	23.94	0.50
193	2024-07-11	14.90	15.19	12.43	47.13	24.03	0.49
194	2024-07-12	14.99	14.91	12.63	47.65	24.08	0.50
195	2024-07-13	15.00	14.85	12.59	47.45	23.95	0.51
196	2024-07-14	14.95	15.05	12.53	47.69	24.10	0.51
197	2024-07-15	15.16	15.17	12.55	47.22	24.10	0.53
198	2024-07-16	15.46	15.28	12.69	47.77	23.97	0.51
199	2024-07-17	14.71	14.92	12.75	47.50	23.99	0.51
200	2024-07-18	14.78	14.98	12.48	47.87	23.98	0.50
201	2024-07-19	15.16	15.05	12.62	47.23	23.93	0.51
202	2024-07-20	14.98	14.94	12.53	47.81	24.02	0.49
203	2024-07-21	15.14	14.98	12.47	47.94	24.08	0.51
204	2024-07-22	15.03	15.12	12.40	47.36	23.91	0.51
205	2024-07-23	15.04	14.93	12.51	48.04	24.01	0.51
206	2024-07-24	14.84	14.92	12.40	47.67	23.94	0.51
207	2024-07-25	15.09	14.94	12.53	47.21	24.07	0.49
208	2024-07-26	15.02	14.98	12.67	47.77	24.03	0.50
209	2024-07-27	14.84	15.00	12.60	47.67	24.12	0.51
210	2024-07-28	15.38	15.40	12.63	48.01	23.98	0.50
211	2024-07-29	15.09	15.03	12.18	47.46	23.92	0.50
212	2024-07-30	14.90	15.32	12.39	47.55	23.98	0.50
213	2024-07-31	15.29	15.05	12.60	47.48	24.05	0.50
214	2024-08-01	15.14	14.98	12.64	47.58	24.05	0.49
215	2024-08-02	14.88	14.82	12.73	47.31	23.89	0.50

Sl No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
216	2024-08-03	14.95	15.20	12.73	47.50	23.97	0.51
217	2024-08-04	14.74	15.05	12.47	47.40	23.98	0.51
218	2024-08-05	14.92	14.88	12.47	47.40	23.99	0.50
219	2024-08-06	15.06	15.04	12.59	47.78	24.04	0.50
220	2024-08-07	15.27	15.09	12.46	47.67	24.03	0.50
221	2024-08-08	15.35	15.24	12.81	47.62	24.16	0.53
222	2024-08-09	15.04	15.10	12.37	47.61	24.07	0.51
223	2024-08-10	15.41	15.09	12.36	47.76	24.10	0.49
224	2024-08-11	15.05	15.14	12.75	47.37	23.80	0.50
225	2024-08-12	14.71	15.00	12.77	47.45	23.86	0.48
226	2024-08-13	14.78	15.15	12.58	47.32	23.96	0.50
227	2024-08-14	14.81	14.60	12.27	47.38	24.02	0.50
228	2024-08-15	14.95	14.81	12.41	47.35	24.08	0.51
229	2024-08-16	15.10	14.78	12.72	47.65	24.03	0.50
230	2024-08-17	15.03	15.17	12.39	47.41	24.10	0.50
231	2024-08-18	15.01	15.04	12.55	47.40	24.10	0.49
232	2024-08-19	15.05	14.95	12.69	47.72	24.05	0.51
233	2024-08-20	14.90	14.81	12.44	47.31	24.04	0.52
234	2024-08-21	15.06	14.78	12.57	48.02	24.08	0.49
235	2024-08-22	14.71	14.86	12.52	47.71	24.10	0.52
236	2024-08-23	14.88	15.14	12.50	47.46	24.14	0.50
237	2024-08-24	14.90	14.98	12.41	47.57	23.87	0.50
238	2024-08-25	15.30	15.08	12.60	47.28	24.05	0.51
239	2024-08-26	15.09	15.08	12.61	47.57	24.03	0.50
240	2024-08-27	15.24	14.97	12.59	47.53	24.01	0.50
241	2024-08-28	14.97	14.80	12.38	47.77	24.07	0.49
242	2024-08-29	14.95	14.89	12.93	47.63	23.92	0.49
243	2024-08-30	14.99	14.97	12.60	47.43	23.82	0.49
244	2024-08-31	15.05	15.07	12.39	47.58	24.05	0.50

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
245	2024-09-01	15.11	14.92	12.39	47.37	24.12	0.49
246	2024-09-02	15.01	14.97	12.71	47.32	23.99	0.49
247	2024-09-03	15.04	15.09	12.57	47.91	23.97	0.49
248	2024-09-04	15.18	15.10	12.53	47.58	24.01	0.51
249	2024-09-05	15.10	15.04	12.42	47.58	24.04	0.50
250	2024-09-06	15.08	15.03	12.46	47.26	24.06	0.50
251	2024-09-07	16.64	15.66	13.34	49.17	24.12	0.56
252	2024-09-08	NA	NA	NA	NA	NA	NA
253	2024-09-09	14.93	15.01	12.72	47.98	24.06	0.55
254	2024-09-10	15.29	15.16	12.62	47.21	24.06	0.51
255	2024-09-11	15.74	15.22	12.53	47.47	23.99	0.51
256	2024-09-12	15.43	15.33	13.11	47.79	24.01	0.54
257	2024-09-13	15.52	15.39	12.89	47.51	24.08	0.52
258	2024-09-14	15.30	15.04	12.87	47.98	24.07	0.52
259	2024-09-15	15.44	14.97	12.74	47.63	23.94	0.50
260	2024-09-16	15.31	15.34	12.90	47.63	23.97	0.53
261	2024-09-17	14.93	15.07	12.47	47.53	24.10	0.51
262	2024-09-18	15.26	14.81	12.24	47.55	23.96	0.48
263	2024-09-19	14.99	15.14	12.52	47.44	23.97	0.51
264	2024-09-20	14.95	14.94	12.98	47.22	23.97	0.51
265	2024-09-21	NA	NA	NA	NA	NA	NA
266	2024-09-22	NA	NA	NA	NA	NA	NA
267	2024-09-23	15.07	15.15	12.74	46.86	24.13	0.51
268	2024-09-24	15.00	15.10	12.29	47.76	24.06	0.49
269	2024-09-25	15.40	15.03	12.33	47.56	24.14	0.51
270	2024-09-26	15.10	15.12	12.38	47.55	23.98	0.50
271	2024-09-27	14.96	14.86	12.50	47.47	24.04	0.50
272	2024-09-28	14.69	15.03	12.36	47.65	24.02	0.49
273	2024-09-29	15.07	15.11	12.34	47.38	24.02	0.51

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
274	2024-09-30	15.03	14.97	12.64	47.01	23.98	0.51
275	2024-10-01	15.12	15.04	12.43	47.09	24.10	0.50
276	2024-10-02	14.97	14.89	12.50	47.55	23.97	0.49
277	2024-10-03	15.11	15.12	12.38	48.54	24.00	0.50
278	2024-10-04	15.14	15.04	12.53	47.36	24.06	0.49
279	2024-10-05	15.35	14.84	12.21	47.42	24.01	0.50
280	2024-10-06	15.07	15.17	12.30	47.80	24.06	0.51
281	2024-10-07	15.06	14.84	12.37	48.05	23.97	0.51
282	2024-10-08	14.94	14.96	12.51	47.62	24.03	0.51
283	2024-10-09	15.47	15.11	12.76	47.32	23.91	0.53
284	2024-10-10	15.21	14.88	12.51	47.24	24.20	0.50
285	2024-10-11	15.51	14.94	12.46	47.25	23.97	0.51
286	2024-10-12	15.13	14.79	12.61	47.76	24.11	0.50
287	2024-10-13	15.07	15.22	12.45	47.53	24.02	0.50
288	2024-10-14	14.92	15.00	12.53	47.18	24.12	0.50
289	2024-10-15	14.92	14.94	12.37	47.33	24.04	0.50
290	2024-10-16	14.94	14.96	12.41	47.63	23.95	0.50
291	2024-10-17	15.07	15.03	12.47	47.41	24.02	0.49
292	2024-10-18	14.80	15.02	12.64	47.53	24.02	0.50
293	2024-10-19	14.96	14.91	12.33	47.29	23.97	0.49
294	2024-10-20	14.91	14.97	12.31	47.54	24.01	0.49
295	2024-10-21	14.97	15.03	12.65	47.68	23.99	0.50
296	2024-10-22	15.12	15.07	12.38	47.77	23.80	0.49
297	2024-10-23	14.82	15.07	12.38	47.60	23.99	0.51
298	2024-10-24	14.92	14.83	12.54	47.43	24.06	0.49
299	2024-10-25	15.18	15.00	12.60	47.81	23.95	0.50
300	2024-10-26	15.08	15.10	12.29	47.48	23.98	0.52
301	2024-10-27	15.06	15.16	12.58	47.64	24.05	0.51
302	2024-10-28	15.17	15.21	12.79	47.47	23.88	0.51

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
303	2024-10-29	15.05	15.34	12.68	48.42	24.15	0.51
304	2024-10-30	14.93	14.99	12.87	47.37	24.04	0.52
305	2024-10-31	14.71	15.03	13.07	47.56	24.20	0.51
306	2024-11-01	14.90	15.16	12.50	47.72	24.03	0.51
307	2024-11-02	15.03	15.18	12.64	47.06	24.02	0.51
308	2024-11-03	14.75	15.18	12.65	48.03	24.10	0.52
309	2024-11-04	15.22	15.12	12.72	47.99	24.07	0.51
310	2024-11-05	14.97	15.13	12.42	47.17	23.98	0.49
311	2024-11-06	14.93	14.93	12.44	47.43	23.97	0.49
312	2024-11-07	15.02	14.94	12.50	47.36	24.08	0.50
313	2024-11-08	15.07	14.99	12.72	47.76	23.93	0.50
314	2024-11-09	15.01	15.20	12.48	47.60	24.03	0.50
315	2024-11-10	14.95	15.10	12.62	47.55	24.13	0.51
316	2024-11-11	15.23	15.01	12.49	47.10	24.11	0.49
317	2024-11-12	15.12	15.01	12.39	47.72	23.95	0.49
318	2024-11-13	14.97	15.11	12.59	47.68	24.06	0.51
319	2024-11-14	14.94	15.07	12.87	47.22	23.99	0.52
320	2024-11-15	15.30	15.57	12.77	47.73	24.18	0.51
321	2024-11-16	14.79	14.89	12.09	47.88	23.97	0.51
322	2024-11-17	15.12	14.98	12.45	47.33	23.96	0.49
323	2024-11-18	15.10	15.01	12.53	47.60	24.05	0.49
324	2024-11-19	14.98	14.94	12.77	47.51	23.98	0.49
325	2024-11-20	14.91	14.95	12.73	47.66	23.91	0.50
326	2024-11-21	14.79	15.17	12.47	47.64	24.11	0.50
327	2024-11-22	14.98	14.93	12.70	47.46	23.96	0.49
328	2024-11-23	15.13	15.03	12.56	47.11	24.02	0.51
329	2024-11-24	15.12	15.12	12.49	47.43	24.08	0.51
330	2024-11-25	14.82	15.04	12.46	47.69	24.00	0.51
331	2024-11-26	14.92	15.03	12.73	47.52	24.03	0.51

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
332	2024-11-27	15.21	14.88	12.69	47.83	24.13	0.49
333	2024-11-28	14.84	15.03	12.50	47.55	23.97	0.48
334	2024-11-29	14.92	15.17	12.50	47.55	24.08	0.50
335	2024-11-30	15.17	15.11	12.48	47.92	24.01	0.51
336	2024-12-01	14.96	15.02	12.66	47.21	23.95	0.50
337	2024-12-02	15.06	14.98	12.64	47.02	23.86	0.50
338	2024-12-03	14.88	14.90	12.63	47.76	23.99	0.48
339	2024-12-04	15.05	15.05	12.38	47.44	24.06	0.50
340	2024-12-05	15.05	14.97	12.61	47.63	23.97	0.49
341	2024-12-06	15.12	15.04	12.42	47.63	23.97	0.49
342	2024-12-07	14.95	15.11	12.60	47.86	24.03	0.51
343	2024-12-08	15.19	15.07	12.67	47.54	24.03	0.50
344	2024-12-09	14.86	15.04	12.48	47.25	24.03	0.51
345	2024-12-10	14.81	15.01	12.41	48.30	23.93	0.50
346	2024-12-11	14.86	14.84	12.31	47.01	23.98	0.52
347	2024-12-12	14.98	15.04	12.51	47.50	24.12	0.51
348	2024-12-13	14.80	14.86	12.56	48.34	24.01	0.51
349	2024-12-14	14.72	14.95	12.56	47.35	23.92	0.50
350	2024-12-15	15.07	15.00	12.55	47.17	23.98	0.50
351	2024-12-16	14.93	15.12	12.47	47.75	24.05	0.50
352	2024-12-17	14.79	14.92	12.38	47.68	23.97	0.50
353	2024-12-18	15.30	15.07	12.48	47.34	24.03	0.50
354	2024-12-19	15.00	15.10	12.54	47.86	23.97	0.49
355	2024-12-20	15.10	15.19	12.46	47.69	24.02	0.48
356	2024-12-21	15.12	15.01	12.58	47.68	23.96	0.51
357	2024-12-22	14.79	14.93	12.49	47.13	24.02	0.49
358	2024-12-23	15.13	14.85	12.54	47.85	24.09	0.49
359	2024-12-24	15.24	14.53	12.48	47.41	23.97	0.51
360	2024-12-25	15.34	15.08	12.62	47.66	24.02	0.49

SI No	Time	Station_1_Thanam-SO2 - (ug/m3) Raw	Station_1_Thanam-NOx - (ug/m3) Raw	Station_1_Thanam-NH3 - (ug/m3) Raw	Station_1_Thanam-PM10 - (ug/m3) Raw	Station_1_Thanam-PM2.5 - (ug/m3) Raw	Station_1_Thanam-VOC - (ug/m3) Raw
361	2024-12-26	14.96	15.14	12.43	47.19	24.00	0.50
362	2024-12-27	14.94	15.12	12.41	46.56	23.90	0.51
363	2024-12-28	14.99	14.82	12.39	47.43	23.94	0.50
364	2024-12-29	14.94	14.94	12.61	47.47	23.98	0.50
365	2024-12-30	14.69	15.23	12.68	47.45	24.05	0.49
366	2024-12-31	15.17	14.85	12.62	47.64	23.89	0.51

Report Details: RO\_Visakhapatnam | 2025-01-25 18:20:14 | Custom Report

## Annexure-IV

Consolidated statement of Analysis Results(Jan-2024 to Dec-2024)NAMP Location: M/s Visakha Pharmacy, JNPC, Parawada, Anakapalli District.

Parameters	Monthly average $\mu\text{g}/\text{m}^3$ (Jan-2024 to Dec-2024)												Average	Standard
	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	July-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24		
<b>PM<sub>10</sub></b>	138.0	104.0	81.0	66.0	67.0	87.4	65.0	71.0	84.0	96.0	112.0	110.0	90.1	60.0
<b>PM<sub>2.5</sub></b>	50.0	37.0	33.0	27.0	25.0	29.1	24.0	26.0	35.0	41.0	48.0	46.0	35.1	40.0
<b>SO<sub>2</sub></b>	12.0	11.0	10.0	9.0	9.0	8.7	8.8	8.2	9.1	10.8	10.0	9.0	9.6	50.0
<b>NO<sub>2</sub></b>	25.0	23.0	22.0	22.0	21.0	20.6	19.9	17.9	21.1	23.4	24.3	22.4	21.9	40.0
<b>NH<sub>3</sub></b>	31.0	28.0	26	26.0	24.0	24.2	25.0	24.5	25.0	26.0	26.4	26.2	26.0	100.0

NAMP: National Ambient Air Quality Monitoring Programme.

  
 SENIOR ENVIRONMENTAL SCIENTIST

## Annexure-V

**A.P. POLLUTION CONTROL BOARD,  
ZONAL LABOARATORY: VISAKHAPATNAM**

Consolidated report of marine outfall discharges by M/s Visakha Pharma city Limited (Formerly M/s Ramky Pharma city (I), JNPC, Parawada, Anakapalli District for the period from January 2024 to December 2024

S.No	January 2024 to December 2024		Parameters exceeded
	Guard Pond samples collected	Guard Pond samples Rejected	
1	283	15	TSS, COD &NH <sub>3</sub> -N

Note:

1. Out of 283 samples, 15 samples were rejected from January 2024 to December 2024 the rejection percentage is 5.30% only for the last year.
2. In case of the treated wastewater is not meeting the marine discharge standards, it will not be allowed for discharge into sea and sent back to CETP for re-treatment till comply with the marine discharge standards.

  
 SENIOR ENVIRONMENTAL SCIENTIST

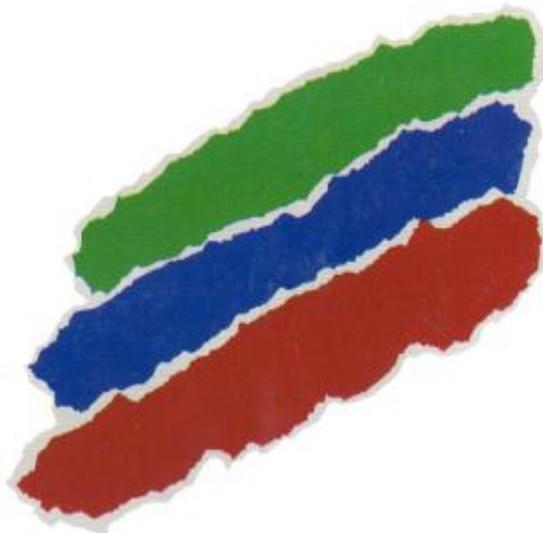
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October, 2020



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Regional Centre, Visakhapatnam – 530 017

October, 2020



## *Chapter 7*

### **Off Tikkavanipalem (Zone 5)**

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Coastal waters off Tikkavanipalem (Zone 5) contain marine outfall points (MOP) of pharmaceutical industry, i.e., M/s. JN Pharama City Ltd. and National Thermal Power Corporation (NTPC) Ltd. (Fig. 2.5). Tikkavanipalem is a coastal village situated towards south of Visakhapatnam. National Institute of Oceanography has carried out Rapid Marine Environmental Assessment studies to identify the marine out fall points for discharge of treated effluents from JN Pharma City Ltd. The NTPC project involves intake pipeline for drawl of seawater for cooling purpose and outfall pipeline for discharge of seawater into the sea. There is an existing corridor for intake of seawater for cooling purpose and discharge of water into the sea through a jetty at land fall point. The estimated discharge through Central Monitoring Basin (CMB) is 5870 cum/hr for Stage – I. The treated wastewater of Stage - I is being discharged into the sea at 400 m from the High Tide Line at a depth of 4 m. The discharge point selected by NTPC was not as suggested by NIO, but as recommended by some other Organization.

The location of the M/s. JN Pharma City is at about 30 km west of Visakhapatnam city. As the Pharma City comprises of several bulk drugs, pharmaceuticals and chemical sectors, the waste discharges are associated with high organic pollutant load. This industry is considered as one of the major 17 groups of industries for priority action for the control of pollution by Central Pollution Control Board. In order to maintain cleaner environment and achieve sustainability of the concerned industrial sector, the Pharma City decided to discharge the treated effluents into the sea through a pipeline as per the new guidelines of Ministry of Environment and Forests (MoEF) and Andhra Pradesh Pollution Control Board (APPCB). The discharge point suggested

by NIO for JN Pharma City is at a depth of 18 m and at a distance of 1.44 km from the coast. Results of studies conducted in the coastal waters off Tikkavanipalem during pre- and post-monsoon seasons were discussed in this chapter

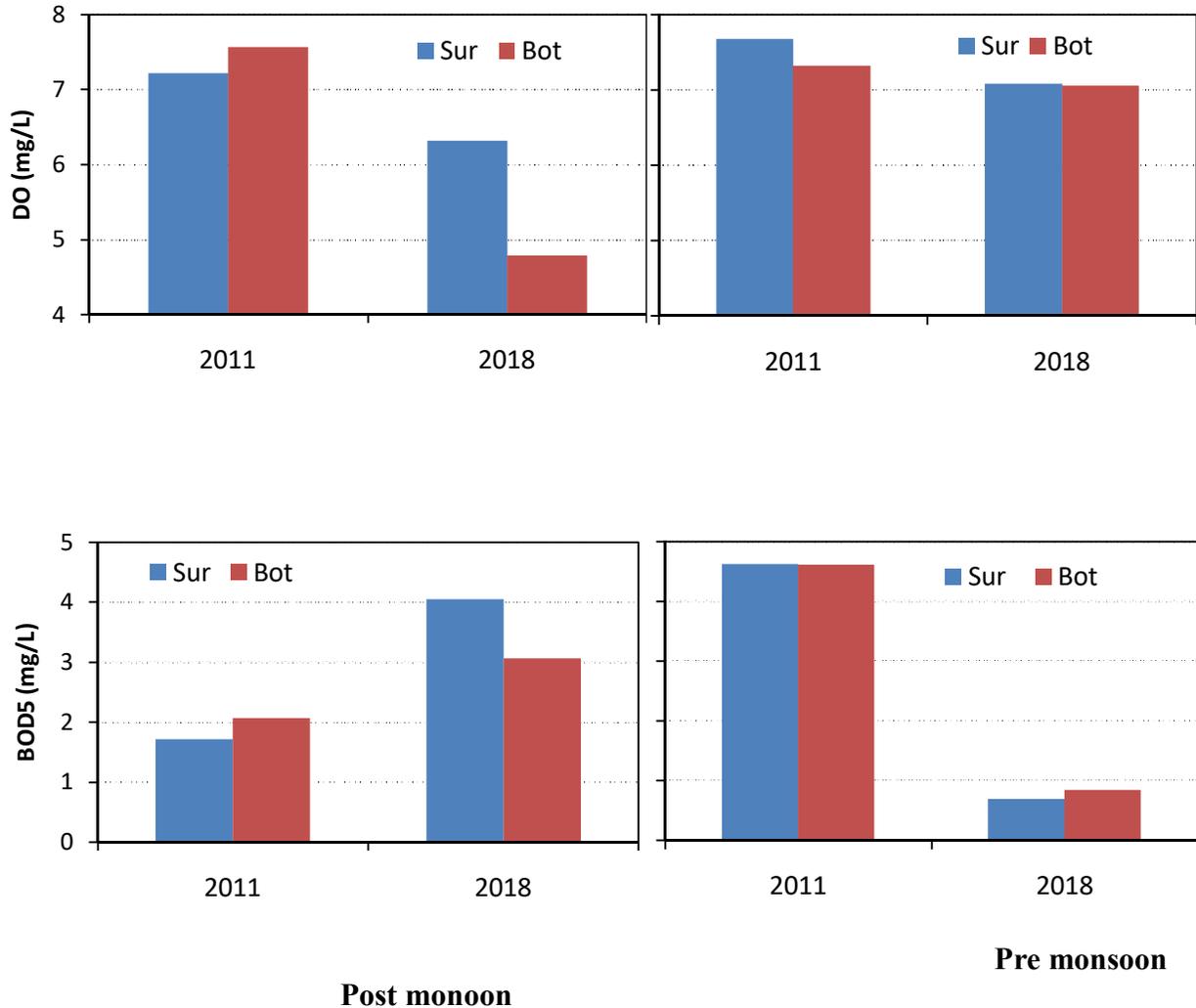
### 7.1 Physico-chemical parameters

Results of physico-chemical parameters studied in the coastal waters off Tikkavanipalem (zone 5) during pre monsoon and post monsoon seasons were given Tables 7.1a to 7.1c and 7.2a to 7.2c, respectively. Water column temperature of this zone varied from 26.6 to 27.3°C in the surface and 25.8 to 27.1°C in the bottom, with mean temperature of 27.0°C and 26.4°C, respectively, during pre monsoon (Table 7.1a). Relatively lower ranges of mean temperature were observed during post monsoon in both surface (mean: 24.2°C; range: 23.2 to 24.4°C) and bottom waters (mean: 24.4°C; range: 23.7 to 25.3°C) (Table 7.2a). Salinity ranged from 33.3 to 33.7 PSU, with a mean salinity of 33.5 PSU in the surface, and from 33.5 to 34.0 PSU (mean: 33.7 PSU) in bottom waters of this region during pre monsoon season (Table 7.1a). Compared to the pre monsoon, relatively lower salinities were found during post monsoon, with mean salinities of 29.2 PSU in the surface (range: 28.9 to 29.6 PSU) and 29.5 PSU in the bottom (range: 29.0 to 30.4 PSU) waters of this region (Table 7.2a). Total suspended matter (TSM) varied from 14.5 to 33.8 mg/L (mean: 18.6 mg/L) in the surface and from 15.8 to 23.0 mg/L (mean (18.7 mg/L) in the bottom waters during pre monsoon (Table 7.1a). Slightly lower range of TSM concentrations were found during the post monsoon season both in the surface (range: 8.0 to 21.7 mg/L; mean: 11.9 mg/L) and bottom waters as well (9.1 to 16.2 mg/L and 11.5 mg/L, respectively (Table 7.2a). TSM concentrations found in this study are very close to those reported in the previous study conducted in this region during 2011 (Table 7.3). pH values of surface and bottom waters in the region varied from 7.3 to 8.1 (mean: 7.6) and from 7.4 to 7.9

(mean: 7.6), respectively, during pre monsoon season (Table 7.1a). During post monsoon season, the ranges of pH values in the surface and bottom waters are relatively higher where it ranged from 8.3 to 9.0 in the surface and from 8.1 to 8.6 in the bottom waters.

Dissolved oxygen (DO) concentrations ranged from 6.1 to 6.7 mg/L (mean 6.3 mg/L) in the surface and from 3.9 to 6.4 mg/L (mean 4.8 mg/L) in the bottom waters during pre monsoon season (Table 7.1b). These DO concentrations are relatively lower when compared to those obtained during pre monsoon season of the year 2011 in this region (6.5 to 8.3 mg/L) (Fig. 7.1) (Table 7.3). Relatively higher DO concentrations were found during post monsoon season in both surface (range: 6.4 to 7.8 mg/L; mean: 7.1 mg/L) and bottom waters (6.6 to 7.7 mg/L and 7.1 mg/L, respectively (Table 7.2b) compared to the pre monsoon season (Table 7.1b). DO concentrations found during the post monsoon season are consistent with those obtained in this region during 2011 study (6.2 to 8.9 mg/L) (Fig. 7.1) (Table 7.3). Relatively lower dissolved oxygen concentrations during pre monsoon season may be due to the increased input of organic matter contamination through the release of treated effluents from JN Pharma City Ltd. and/or from NTPC Ltd. and Hindhuja Ltd. Biochemical oxygen demand for five days (BOD<sub>5</sub>) values varied from 3.9 to 4.4 and from 2.5 to 4.1 mg/L, with mean BOD<sub>5</sub> values of 4.0 mg/L and 3.1 mg/L in the surface and bottom waters, respectively, during pre monsoon season (Table 7.1b). Relatively lower ranges of BOD<sub>5</sub> values were found during post monsoon season in both surface (range: 0.2 to 1.4 mg/L; mean: 0.7 mg/L) and bottom (range: 0.3 to 1.7 mg/L; mean: 0.84 mg/L) waters (Table 7.2b). BOD<sub>5</sub> values found in this study are relatively lower during post monsoon season and higher during pre monsoon season when compared to those found in previous monitoring study conducted in this region in 2011 (Table 7.3). Ammonium concentrations ranged from 0.3 to 3.1  $\mu$ M (mean: 1.2  $\mu$ M) in the surface and from 0.1 to 3.1  $\mu$ M (mean: 1.4

$\mu\text{M}$ ) in the bottom waters during pre monsoon (Table 7.1b). Relatively lower concentrations of



**Fig. 7.1: Comparison of mean dissolved oxygen (DO; mg/L) and biochemical oxygen demand (BOD; mg/L) concentrations in coastal waters off Tikkavanipalem during pre monsoon and post monsoon seasons of the present study with that of the study conducted in 2011 in this region**

ammonium were found in this region during post monsoon season, with similar mean values of  $0.3 \mu\text{M}$  (range:  $0.1$  to  $0.5 \mu\text{M}$ ) in the surface and  $0.4 \mu\text{M}$  (range:  $0.3$  to  $0.6 \mu\text{M}$ ) in the bottom

waters (Table 7.2b). Relatively higher ammonium concentrations were found at the MOP of JN Pharma City Ltd. in both surface and bottom waters. Phosphate concentrations ranged from 0.4  $\mu\text{M}$  to 2.2  $\mu\text{M}$  (mean: 1.3  $\mu\text{M}$ ) in the surface and from 0.7  $\mu\text{M}$  to 2.6  $\mu\text{M}$  (mean: 1.6  $\mu\text{M}$ ) in the bottom waters during pre monsoon season (Table 7.1b). Considerably lower concentrations of phosphate were found in the surface (mean: 0.4  $\mu\text{M}$ ; range: 0.1 to 0.9  $\mu\text{M}$ ) and bottom (0.6  $\mu\text{M}$ ; range: 0.1 to 1.5  $\mu\text{M}$ ) waters during post monsoon season (Table 7.2c). Dissolved inorganic silicate concentrations ranged from as low as 0.6  $\mu\text{M}$  to as high as 6.4  $\mu\text{M}$  (mean: 4.4  $\mu\text{M}$ ) in the surface and from 3.9 to 26.9  $\mu\text{M}$  (mean: 7.6  $\mu\text{M}$ ) in the bottom waters during pre monsoon (Table 7.1c). Relatively higher silicate concentrations were found during post monsoon season, with mean silicate concentrations of 6.4  $\mu\text{M}$  (range: 0.3 to 16.3  $\mu\text{M}$ ) in the surface and 9.6  $\mu\text{M}$  (range: 4.3 to 20.9  $\mu\text{M}$ ) in the bottom waters (Table 7.2c). Higher silicate concentrations during the post monsoon season are mainly due to the influence of freshwater input to the study region through river discharge during the monsoon and equator ward flow of freshwaters from the northern Bay of Bengal by the southward flowing EICC during post monsoon season. Nitrite concentrations ranged from 0.1 to 0.3  $\mu\text{M}$  (mean: 0.2  $\mu\text{M}$ ) in the surface and 0.1 to 0.5  $\mu\text{M}$  (mean: 0.2  $\mu\text{M}$ ) in the bottom waters during the pre monsoon season (Table 7.1c). Relatively higher concentrations of nitrite were found during post monsoon in the surface (0.1 to 2.7  $\mu\text{M}$ ) and bottom (0.1 to 3.4  $\mu\text{M}$ ) waters, with mean nitrite concentrations of 0.5  $\mu\text{M}$  and 1.0  $\mu\text{M}$  in the surface and bottom waters, respectively. Dissolved inorganic nitrate concentrations varied from 0.6 to 1.9  $\mu\text{M}$  (mean: 1.0  $\mu\text{M}$ ) and from 0.8 to 2.3  $\mu\text{M}$  (mean: 1.3  $\mu\text{M}$ ) in the surface and bottom waters, respectively, during pre monsoon (Table 7.1c). Similar range of nitrate concentrations were found during post monsoon, with mean nitrate concentrations of 0.8  $\mu\text{M}$  (range: 0.1 to 3.6  $\mu\text{M}$ ) in the surface and 0.8  $\mu\text{M}$  (range: 0.1 to 2.3  $\mu\text{M}$ ) in the bottom waters (Table 7.2c). Mean

total phosphorus (TP) concentrations were found to be 0.9  $\mu\text{M}$  (range: 0.2 to 2.2  $\mu\text{M}$ ) in the surface and 1.7  $\mu\text{M}$  (range: 0.7 to 3.0  $\mu\text{M}$ ) in the bottom waters of this region during post monsoon season (Table 7.2b). Total petroleum hydrocarbon (TPHC) concentrations varied from as low as 1.5 to as high as 54.0  $\mu\text{g/L}$  (mean: 13.6  $\mu\text{g/L}$ ) in the surface and from 2.4 to 38.8  $\mu\text{g/L}$  (mean: 12.8  $\mu\text{g/L}$ ) in the bottom waters of this region during post monsoon. These PHC concentrations are higher compared to those obtained during 2011 study in this region (1.0 to 34.1  $\mu\text{g/L}$ ), indicating that increased input of PHC to this region in recent years.

Results of physico-chemical parameters studied in the coastal waters off Tikkavanipalem (zone 5) showed no significant deviation from ambient concentrations of the physico-chemical parameters in the coastal waters of east coast of India, except for dissolved oxygen. Mean dissolved oxygen concentrations in bottom waters of this zone during pre monsoon (mean: 4.8  $\text{mg/L}$ ) are slightly depleted than the threshold limit of dissolved oxygen for healthy coastal waters (5.0  $\text{mg/L}$ ), indicating that the coastal waters of this region are at the initial stage of deterioration in water quality. It could be due to the increased input of organic matter contamination through treated effluent release from JN Pharma City Ltd. and/or NTPC Ltd. and Hindhuja Ltd. However, coastal waters of this region are well oxygenated during post monsoon season. Comparison of physico-chemical data obtained in this study with that of the study conducted in this region during pre and post monsoon seasons of 2011 was given in Table 7.3. Seasonal variability between pre and post monsoon season were attributed to input of freshwater discharge from rivers during the southwest monsoon (June-September) and southward flow of freshwaters from the northern Bay of Bengal to the present study region by the equator ward flowing east Indian coastal current (EICC) during October-December. Although, PHC concentrations in this study were found to be higher compared to reported values from this

region in 2011, however, they are within the threshold limit, indicating no significant pollution of TPHC in this region.

**Table 7.1a: Spatial variability in temperature (°C), Salinity (PSU), total suspended matter (mg/L) and pH in surface and bottom waters off Tikkavanipalem coast during the pre monsoon season**

Station	Temperature (°C)		Salinity (PSU)		TSM (mg/l)		pH	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
TVM-1	26.8	26.8	33.7	33.5	17.6	18.0	7.3	7.6
TVM-2	26.9	26.7	33.6	33.5	17.0	20.2	7.6	-
TVM-3	26.9	26.8	33.5	33.6	15.0	16.5	7.7	7.8
TVM-4	-	-	-	-	-	-	7.9	7.6
TVM-5	26.8	26.7	33.5	33.6	33.8	22.1	7.3	7.7
TVM-6	27.2	26.6	33.5	33.9	-	17.3	7.6	7.4
TVM-7	27.1	27.1	33.5	33.5	16.3	17.9	7.3	7.4
TVM-8	27.2	26.0	33.4	33.8	23.0	21.9	7.7	7.7
TVM-9	27.3	26.0	33.3	33.8	-	15.8	-	7.7
TVM-10	27.3	26.5	33.4	33.7	15.9	19.9	7.5	7.5
TVM-11	27.0	25.9	33.3	33.9	14.5	23.0	7.3	7.5
TVM-12	27.1	25.9	33.4	33.9	18.7	18.5	7.4	7.5
TVM-13	27.0	25.8	33.3	34.0	20.4	17.8	8.1	7.6
TVM-14	27.2	26.0	33.4	33.8	17.2	19.0	7.4	7.7
TVM-15	27.0	26.2	33.4	33.8	14.6	18.2	7.8	7.8
TVM-16	27.1	26.1	33.4	33.9	17.6	19.8	7.8	7.9
NTP-MOP	26.8	26.9	33.7	33.7	19.6	15.8	7.6	7.5
JNP-MOP	26.6	26.0	33.6	33.8	18.0	15.8	-	-

**Table 7.1b: Spatial variability in dissolved oxygen (mg/L), biochemical oxygen demand (BOD<sub>5</sub>; mg/L), ammonium (µM) and phosphate (µM) concentrations in surface and bottom waters off Tikkavanipalem coast during pre monsoon season**

Station	DO (mg/l)		BOD <sub>5</sub> (mg/l)		Ammonium (µM)		Phosphate (µM)	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
TVM-1	-	6.1	4.2	4.0	0.6	0.6	0.5	0.7
TVM-2	6.7	5.9	4.4	3.9	0.3	-	1.3	1.3
TVM-3	6.1	6.2	4.1	4.1	0.6	1.3	1.3	1.2
TVM-4	6.2	3.9	4.0	2.5	1.3	0.3	1.6	1.7
TVM-5	6.1	6.4	4.1	4.0	1.3	0.1	1.8	1.9
TVM-6	6.4	6.1	4.1	3.6	0.7	0.6	1.7	1.7
TVM-7	6.5	6.4	4.3	4.1	0.4	2.0	2.0	2.6
TVM-8	6.4	4.4	3.9	2.8	0.7	0.6	1.8	2.0
TVM-9	6.4	4.2	4.0	2.9	1.1	0.6	0.9	0.9
TVM-10	6.4	4.0	3.9	2.6	0.4	1.3	1.3	1.7
TVM-11	6.7	3.9	3.9	2.5	0.4	2.0	1.8	2.3
TVM-12	6.4	4.1	3.9	2.5	1.8	2.7	0.9	1.4
TVM-13	6.2	3.9	4.2	2.5	2.1	1.4	0.8	1.7
TVM-14	6.2	4.0	3.9	2.6	2.6	2.8	0.9	1.9
TVM-15	6.1	3.9	4.0	2.6	1.3	1.7	0.4	0.7
TVM-16	6.2	3.9	4.3	2.6	1.6	1.4	0.5	2.2
NTP-MOP	6.2	4.1	4.1	2.6	0.9	0.9	1.7	0.8
JNP-MOP	-	-	-	-	3.1	3.1	2.2	1.7

**Table 7.1c: Spatial variability in silicate ( $\mu\text{M}$ ) nitrite ( $\mu\text{M}$ ) and nitrate ( $\mu\text{M}$ ) concentrations in surface and bottom waters off Tikkavanipalem coast during pre monsoon season**

Station	Silicate ( $\mu\text{M}$ )		Nitrite ( $\mu\text{M}$ )		Nitrate ( $\mu\text{M}$ )	
	Surface	Bottom	Surface	Bottom	Surface	Bottom
TVM-1	5.1	26.9	0.1	0.2	1.0	1.2
TVM-2	-	-	0.2	0.2	0.9	1.0
TVM-3	5.4	4.8	0.1	0.2	0.9	1.6
TVM-4	6.4	4.5	0.1	0.2	1.2	0.8
TVM-5	5.9	9.0	0.1	0.2	0.9	0.8
TVM-6	5.7	7.5	0.2	0.1	0.9	1.2
TVM-7	4.6	5.2	0.2	0.1	1.2	1.4
TVM-8	3.1	8.1	0.2	0.2	1.0	1.4
TVM-9	3.1	7.3	0.3	0.1	1.1	1.0
TVM-10	0.9	5.9	0.2	0.2	0.8	1.3
TVM-11	3.9	7.3	0.2	0.3	0.8	0.9
TVM-12	4.1	7.4	0.3	0.4	0.9	1.2
TVM-13	3.9	5.4	0.2	0.5	1.2	1.2
TVM-14	4.5	5.0	0.2	0.3	0.6	1.0
TVM-15	3.2	9.0	0.1	0.2	0.9	1.9
TVM-16	3.9	7.8	0.1	0.2	1.9	2.3
NTP-MOP	5.4	4.1	0.1	0.1	0.7	1.1
JNP-MOP	0.6	3.9	0.1	0.2	1.2	1.0

**Table 7.2a: Spatial variability in temperature (°C), Salinity (PSU), total suspended matter (mg/L) and pH in surface and bottom waters off Tikkavanipalem coast during the post monsoon season**

Station	Temperature (°C)		Salinity (PSU)		pH		TSM (mg/l)	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
TVM-1	24.1	24.0	29.3	29.3	8.4	8.5	8.9	-
TVM-2	24.3	24.3	29.3	29.2	8.6	8.6	11.1	10.7
TVM-3	24.3	24.4	29.3	29.0	8.6	8.4	10.1	9.8
TVM-4	24.3	24.5	29.2	29.7	8.3	8.4	9.8	14.2
TVM-5	24.3	24.3	29.0	29.4	8.4	8.4	9.5	14.4
TVM-6	24.4	24.2	29.2	29.3	8.4	8.6	17.9	12.2
TVM-7	24.3	23.9	29.2	29.3	8.5	8.5	10.7	10.4
TVM-8	24.2	24.3	29.3	29.3	9.0	8.5	21.7	16.2
TVM-9	24.1	24.4	29.3	29.5	8.6	8.6	9.9	10.6
TVM-10	24.0	24.7	29.4	29.3	8.6	8.1	10.7	9.1
TVM-11	24.2	25.3	29.3	30.3	8.5	8.5	16.7	10.1
TVM-12	24.2	24.3	29.3	30.2	8.5	8.4	8.0	9.3
TVM-13	24.1	25.2	29.4	30.4	8.6	8.5	10.5	15.5
TVM-14	23.2	24.9	29.6	29.9	8.5	8.5	15.0	11.7
TVM-15	24.0	24.5	29.3	29.3	8.4	8.4	10.9	10.6
TVM-16	24.3	24.2	28.9	29.3	8.5	8.4	10.5	10.5
JNP-MOP	24.3	24.4	29.2	29.3	8.4	8.3	10.5	9.7
NTPC-MOP	24.2	23.7	29.0	29.2	8.6	8.4	11.5	10.4

**Table 7.2b: Spatial variability in dissolved oxygen (mg/L), biochemical oxygen demand (BOD<sub>5</sub>; mg/L), total phosphorous (µM) and ammonium (µM) concentrations in surface and bottom waters off Tikkavanipalem coast during post monsoon season**

Station	DO (mg/l)		BOD <sub>5</sub> (mg/l)		TP (µM)		Ammonium (µM)	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
TVM-1	6.7	6.7	1.0	1.2	0.5	0.8	0.3	0.4
TVM-2	7.2	7.1	1.4	1.7	0.8	0.7	0.5	0.6
TVM-3	7.0	6.9	1.0	1.4	0.7	1.1	0.5	0.6
TVM-4	7.6	7.3	0.6	0.9	1.3	2.3	0.4	0.4
TVM-5	7.3	7.4	0.2	0.8	0.2	1.4	-	0.3
TVM-6	6.7	6.8	0.8	1.0	2.2	2.8	0.4	0.5
TVM-7	6.4	6.6	1.2	1.5	1.0	2.5	0.1	0.3
TVM-8	6.8	6.8	0.3	0.7	1.0	2.9	0.3	0.4
TVM-9	7.8	7.7	0.4	0.6	1.0	1.4	0.3	0.4
TVM-10	7.1	7.1	0.2	0.5	0.7	1.1	-	-
TVM-11	7.5	7.4	0.6	0.4	0.6	1.7	0.3	0.4
TVM-12	6.6	6.8	0.7	0.6	0.8	3.0	0.5	0.5
TVM-13	7.0	7.0	0.5	0.3	0.4	0.9	0.3	0.5
TVM-14	7.5	7.3	0.3	0.5	1.2	1.9	0.1	0.3
TVM-15	6.6	6.6	1.3	1.1	0.7	1.2	0.4	0.5
TVM-16	7.6	7.5	1.0	0.8	0.8	1.0	0.1	0.3
JNP-MOP	7.2	7.2	0.3	0.5	1.7	1.2	0.5	0.5
NTPC-MOP	6.6	6.7	0.7	0.6	1.1	2.0	-	0.4

**Table 7.2c: Spatial variability in nitrite ( $\mu\text{M}$ ), nitrate ( $\mu\text{M}$ ), phosphate ( $\mu\text{M}$ ) and silicate ( $\mu\text{M}$ ) concentrations in surface and bottom waters off Tikkavanipalem coast during post monsoon season**

Station	Nitrite ( $\mu\text{M}$ )		Nitrate ( $\mu\text{M}$ )		Phosphate ( $\mu\text{M}$ )		Silicate ( $\mu\text{M}$ )	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
TVM-1	0.6	0.2	0.5	0.1	0.4	0.7	0.7	11.2
TVM-2	1.1	0.7	0.6	0.6	0.2	0.2	4.6	7.3
TVM-3	0.3	0.2	0.4	0.6	0.5	0.1	6.9	8.4
TVM-4	2.7	3.4	1.9	2.3	0.2	0.9	6.4	7.6
TVM-5	0.2	0.2	0.6	1.0	-	0.3	7.9	8.7
TVM-6	0.2	2.7	0.4	1.9	0.2	1.5	8.8	4.3
TVM-7	0.2	0.4	0.9	0.4	0.8	0.7	0.3	6.8
TVM-8	0.2	0.1	0.5	0.4	0.1	0.7	7.9	11.6
TVM-9	0.2	2.5	0.1	2.2	0.7	0.7	8.3	11.2
TVM-10	0.2	1.0	0.6	0.2	0.2	0.2	8.7	17.5
TVM-11	0.1	0.2	0.4	0.4	0.5	0.7	5.8	4.8
TVM-12	0.3	0.5	0.3	0.6	0.5	0.7	6.0	7.3
TVM-13	0.2	7.7	1.5	0.1	0.2	0.2	2.1	7.0
TVM-14	0.6	0.2	3.6	0.4	0.9	0.9	6.4	6.8
TVM-15	0.3	2.4	0.4	1.7	0.2	0.9	5.2	15.2
TVM-16	0.3	0.8	0.4	0.6	0.3	0.7	1.2	7.1
JNP-MOP	0.4	0.2	0.4	0.9	0.7	0.2	16.3	8.7
NTPC-MOP	0.5	0.4	0.4	0.5	0.7	1.0	11.4	20.9

**Table 7.2d: Spatial variability in total petroleum hydrocarbon concentrations (TPHC;  $\mu\text{g/L}$ ) in surface and bottom waters off Tikkavanipalem coast during post monsoon season**

Station Name	PHC ( $\mu\text{g/L}$ )	
	Surface	Bottom
JNP-MOP	54.0	4.3
NTPCMOP	4.0	19.9
TVM-1	8.7	-
TVM2	18.1	12.8
TVM3	6.4	2.4
TVM4	5.7	3.0
TVM5	18.4	7.0
TVM6	-	3.0
TVM7	15.2	3.7
TVM8	1.5	10.1
TVM9	9.8	5.9
TVM10	-	-
TVM11	<b>4.2</b>	<b>10.3</b>
TVM12	-	<b>37.5</b>
TVM13	<b>9.9</b>	<b>38.8</b>
TVM14	<b>27.6</b>	<b>5.1</b>
TVM15	<b>7.1</b>	<b>28.6</b>
TVM16	-	-

**Table 7.3: Comparison of data obtained for various physico-chemical parameters during pre monsoon and post monsoon seasons of 2011 and 2018 (present study) in the coastal waters off Tikkavanipalem.**

Parameter	Pre monsoon		Post monsoon	
	2011	Present study	2011	Present study
Temperature	26.9 – 27.9	25.8 – 27.3	29.3 – 30.1	23.2 – 25.3
Salinity	30.9 – 33.7	33.3 – 34.0	17.9 – 22.5	28.9 – 30.4
TSM	8.8 – 14.2	14.5 – 33.8	8.9 – 22.3	8.0 – 21.7
pH	7.9– 8.3	7.3 – 8.1	8.0 – 8.3	8.1 – 8.6
DO	6.5 – 8.3	3.9 – 6.7	6.2 – 8.9	6.4 – 7.8
BOD	1.0 – 3.3	2.5 – 4.4	2.6 – 4.4	0.2 – 1.4
Ammonium	0.03 – 0.54	0.1 – 3.1	0.9 – 2.5	0.1 – 0.6
Nitrite	0.04 – 0.54	0.1 – 0.5	0.04 -0.54	0.1 – 3.4
Nitrate	1.5 – 13.6	0.6 – 2.3	2.9 – 15.0	0.1 – 3.6
Phosphate	0.3 – 1.1	0.4 – 2.6	0.8 – 2.5	0.1 – 1.5
Silicate	3.2 – 10.6	0.26– 26.9	10.9 – 28.1	0.3 – 20.9
PHC	4.9 – 34.1	-	1.0 – 11.5	1.5 – 54.0

## 7.2 Biological parameters

### 7.2.1. Chlorophyll *a*

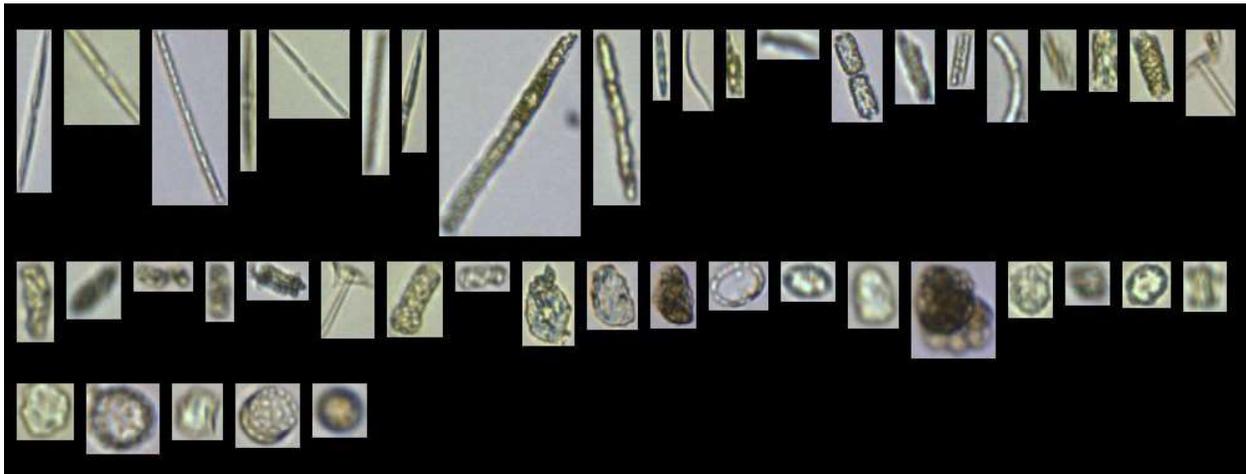
During the pre monsoon period, Chl-*a* concentration varied from 2.17 to 7.54 mg/m<sup>3</sup> in surface and from 1.38 to 10.16 mg/m<sup>3</sup> in bottom waters of this region. Whereas, Chl-*a* concentration ranged from 0.49 to 4.14 mg/m<sup>3</sup> in surface and from 0.38 to 3.96 mg/m<sup>3</sup> in bottom waters during post monsoon season. Relatively higher Chl-*a* concentration was found during the pre monsoon season compared to the post monsoon season. This observation is concurrent with those reported previously in coastal waters of this region and along east coast of India. Elevated concentrations of Chl-*a* was reported in coastal waters of the central east coast of India during pre monsoon season (February – April) due to the occurrence of mild coastal upwelling during

this period. Coastal upwelling brings nutrient-rich sub surface waters into the surface and enhances primary production in euphotic zone of the region. It is a seasonal phenomenon and it does not occur during the post monsoon season.

Altogether, 44 phytoplankton species/forms are reported from this region in the present study. The number of species varied from 14 to 29 during pre monsoon and from 20 to 21 during post monsoon. These ranges are comparable during pre monsoon and slightly lower during post monsoon when compared to those obtained in 2011 study in this region (Table 7.6). Diatoms were dominant over dinoflagellates in this region during both pre and post monsoon seasons. The dominance of diatoms was seen at every station. Some of the major species found in this region are: *Nitzschia*, *Navicula*, *Skeletonema*, *Thalassiosira*, *Rhizosolenia*, *Coscinodiscus*, *Chaetoceros*, *Gyrosigma*, *Pleurosigma*, *Cerastium*, *Prorocentrum*, *Trichodesmium* and *Leptocylindrus*

Phytoplankton abundance ranged from 4200 to 10450 No./L in the surface and from 2300 to 14000 No./L in bottom waters during the pre monsoon season (Table 7.4). Phytoplankton abundance during post monsoon period varied from 4400 No./L to 8600 No./L in the surface and from 4600 to 8740 No./L in bottom waters (Table 7.5). MOP of NTPC recorded considerably lower phytoplankton abundance in both surface (5800 No./L) and bottom (5600 No./L) compared to the surrounding stations in this region (mean: 7103 No./L and 7158 No./L, respectively) during pre monsoon season (Fig. 7.2a). However, station at MOP of JN Pharma City Ltd recorded higher phytoplankton abundance in the surface (8650 No./L) and lower abundance in the bottom waters (6450 No./L) during pre monsoon than the surrounding stations in this region (7103 No./L and 7158 No./L, respectively) (Fig. 7.2a). Similarly, during post monsoon season also MOP of NTPC Ltd. recorded considerably lower phytoplankton biomass both in surface (4400 No./L) and bottom (4600 No./L) compared to the surrounding stations in

this region (5730 No./L and 7199 No./L, respectively) (Fig. 7.2b). Consistent with pre monsoon season, MOP of JNP recorded higher phytoplankton abundance in the surface (7400 No./L) and lower abundance in the bottom waters (5200 No./L) than the surrounding stations in this region (5730 No./L and 7199 No./L, respectively) (Fig. 7.2b). Contrasting to surface waters, bottom waters at MOP of JN Pharma City Ltd. recorded lower phytoplankton biomass during pre monsoon (6450 No./L) and post monsoon (5200 No./L) than the surrounding stations in this region (7158 No./L and 7199 No./L, respectively). Compared to 2011 study conducted in this region, phytoplankton abundance was significantly higher in this study than those found in 2011 study during both pre monsoon and post monsoon seasons (Fig. 7.4a) (Table 7.6).



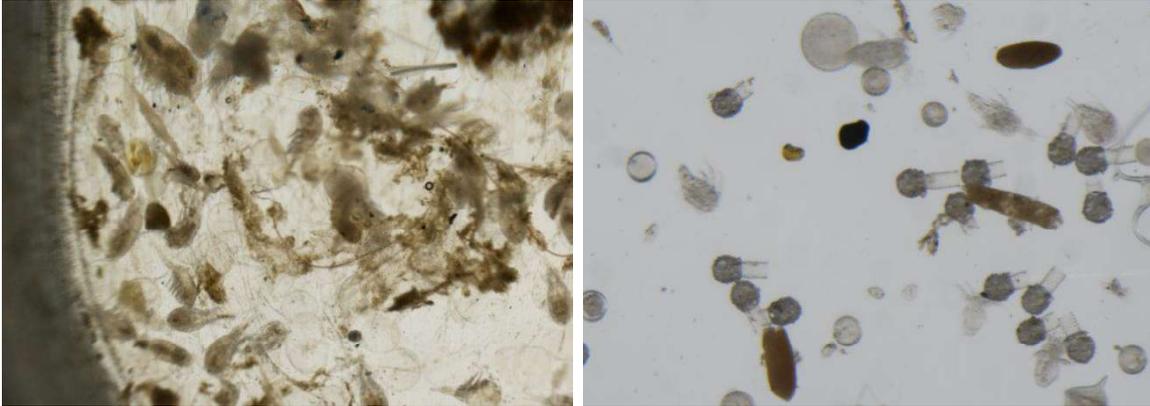
**Plate 7.1: Microscopic images of some phytoplankton**

Zooplankton, which feed on phytoplankton, is the secondary producer in the marine food chain. Zooplankton abundance in the sampling stations of this zone was presented in Table 7.4 and 7.5 for pre monsoon and post monsoon seasons, respectively. Copepods are the most dominant species in the zooplankton abundance. The other groups reported during the study

period were Hydromedusae, siphonophores, chaetognatha, decapods larvae, polychaete larvae, gastropod larvae, lucifers, cladocerans, and fish eggs and larvae. Zooplankton abundance ranged from 600 to 2600 No./m<sup>3</sup> during pre monsoon season (Table 7.4), and significantly lower abundance was recorded at the MOP of NTPC Ltd. (600 No./m<sup>3</sup>) and JN Pharma City Ltd. (960 No./m<sup>3</sup>) compared to the mean zooplankton abundance in this zone (1795 No./m<sup>3</sup>) (Fig. 7.3a). During the post monsoon season, numerical abundance of zooplankton varied from 625 No./m<sup>3</sup> to 1324 No./m<sup>3</sup>. MOPs of NTPC Ltd and JN Pharma City Ltd have recorded slightly lower abundance of zooplankton (789 No./m<sup>3</sup> and 860 No./m<sup>3</sup>, respectively) compared to the adjacent stations in this region (938 No./m<sup>3</sup>) during post monsoon season (Fig. 7.3b). However, during both pre monsoon and post monsoon seasons, MOPs of NTP Ltd. and JN Pharma City Ltd. recorded relatively lower values of zooplankton abundance compared to the mean abundance in this zone.

Seasonal variations of the zooplankton abundance show that the zooplankton abundance was high during pre monsoon season compared to post monsoon season. Zooplankton abundance is mainly regulated by the phytoplankton abundance, which was found to be relatively low during the post monsoon period compared to pre monsoon. The same pattern of the distribution of zooplankton abundance was also found in the previous monitoring study conducted in this region in 2011. The results of the zooplankton abundance suggest that zooplankton abundance were in line with the phytoplankton abundance. Relatively low zooplankton abundance MOP locations than the surrounding locations, suggest that the impact of industrial effluent on zooplankton is considerable but it is localized as the impact of effluent decreases rapidly with increasing distance from MOP (<2 km from MOP). Compared to 2011 observations in this region, zooplankton abundance found in this study was considerably higher during post monsoon

(Fig. 7.4b) (Table 7.6). Data is not available during pre monsoon season of 2011 to compare our results during pre monsoon season.



**Plate 7.2: Microscopic images of some zooplankton**

Benthos play a significant role in transitional ecosystems, by filtering phytoplankton and then offer a food source for fish, thereby linking primary producers with higher trophic levels. Benthic monitoring is a comparatively effective and reliable technique that can serve as early indicators of environmental changes. Benthic organisms are generally divided into two categories, namely, macro benthos and meio benthos, based on their size structure. The distribution and abundance of macro fauna in different locations of this zone during the pre and post monsoon seasons are given in Table 7.4 and Table 7.5, respectively. A total of 38 macro benthic groups/genus/ species are reported in the present study that all are belongs to 8 major groups. Polychaets are the most dominant form of macro benthos. Members of families commonly found in the study region are Megalonidae, Cirratulidae, glyceridae, Spionidae and Capitellidae. Glycera sp., Prionospiopinnata, Lumbrinereis sp., Eunice sp. and Magelona sp. Among crustaceans, amphipods and cumaceans were dominant. The mollusca were represented

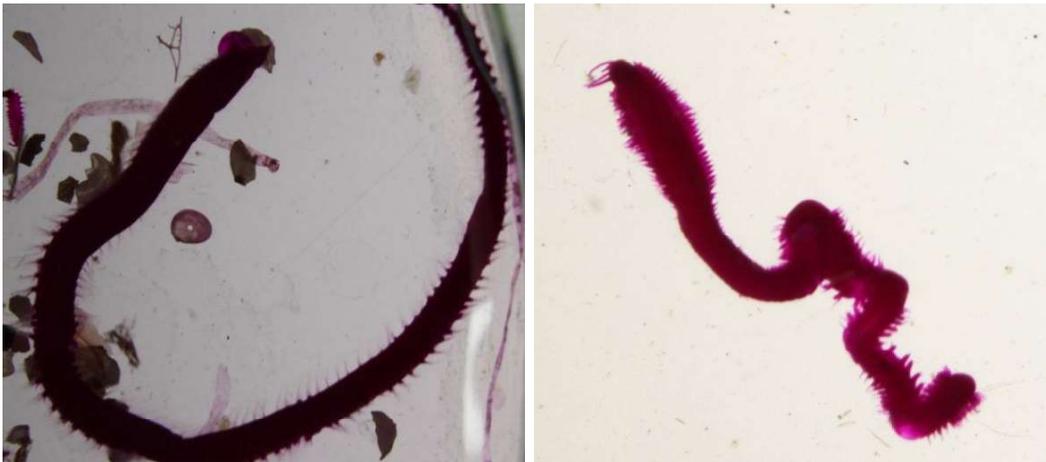
by bivalves and gastropods. No endangered species or invasive species was found during the present study.

Macro benthos abundance ranged from 600 No./m<sup>2</sup> to 2900 No./m<sup>2</sup> during pre monsoon (Table 7.4) and from 800 No./m<sup>2</sup> to 1600 No./m<sup>2</sup> during the post monsoon (Table 7.5) seasons. Seasonally, macro benthos abundance was higher during the pre monsoon period (mean: 2512 No./m<sup>2</sup>) compared to post monsoon period (1300 No./m<sup>2</sup>). The macro faunal abundance was significantly less at marine outfall point of JN Pharma City Ltd. (600 No./m<sup>2</sup> and 900 No./m<sup>2</sup> during pre and post monsoon seasons, respectively) and NTPC Ltd. (650 No./m<sup>2</sup> and 800 No./m<sup>2</sup> during pre and post monsoon seasons, respectively) compared to surrounding stations in this region (2512 No./m<sup>2</sup> and 1300 No./m<sup>2</sup> during pre and post monsoon seasons, respectively) (Fig. 7.3a and b). Relatively less macro faunal density at the MOP locations and the high abundance in the adjacent locations within the zone indicate that the effect of industrial effluent on macro faunal density was considerable but localized. Dilution of industrial effluent with increasing distance from the MOP might have decreased its influence on macro benthic density in the surrounding locations of MOP than at MOP.

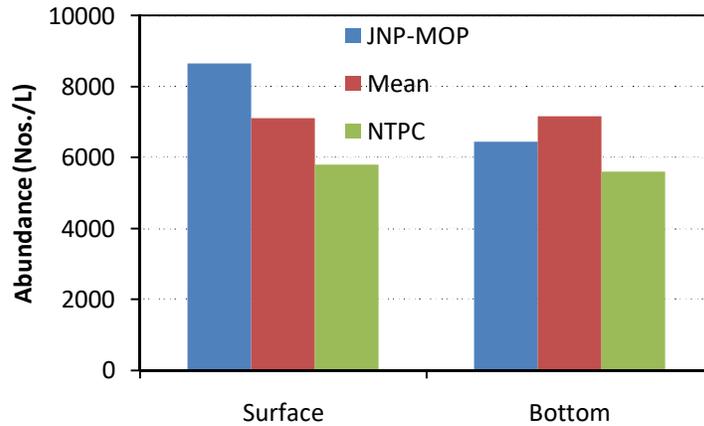
Numerical counts of the meio-fauna were in the range of 220 to 780 No./10cm<sup>2</sup> during pre monsoon (Table 7.4) and 400 to 940 No./10cm<sup>2</sup> during post monsoon season (Table 7.5). Nematodes were found to be the most dominant species. Total meio faunal abundance was significantly low at the MOPs of JN Pharma City Ltd. and NTPC Ltd. during both pre monsoon (238 No./10cm<sup>2</sup> and 220 No./10cm<sup>2</sup>, respectively) and post monsoon seasons (500 No./10cm<sup>2</sup> and 400 No./10cm<sup>2</sup>, respectively), compared to the mean abundance of the adjacent locations in this zone (650 No./10cm<sup>2</sup> and 765 No./10cm<sup>2</sup>, respectively) (Fig. 7.3a and b). Total meio-faunal abundance was less at the MOP locations compared to the surrounding locations within the

zones, indicating that considerable impact of the industrial effluents on meio faunal abundance in the study region. However, relatively higher meio faunal abundance at locations within the 2 km from MOP locations suggest that the impact of industrial effluent on meio faunal abundance was localized and limits up to less than 2 km from MOP.

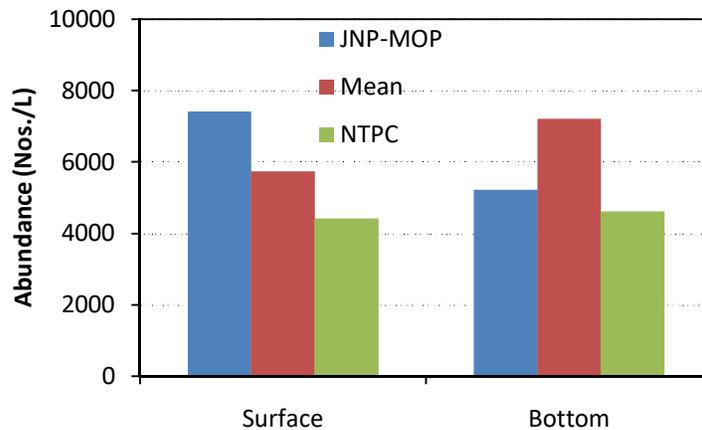
Compared to 2011 observations from this region, both macro and meio faunal abundance found during post monsoon season of the present study were considerably higher compared to those found during the post monsoon season of 2011 study (Fig. 7.4b) (Table 7.6). However, macro and meio faunal abundance data is not available for the pre monsoon season of 2011 to compare our results of pre monsoon season (Fig. 7.4b) (Table 7.6). Significant increase in abundance of phytoplankton, zooplankton, macro benthos and meio benthos in our study compare to 2011 data indicate that the impact of treated effluent release from M/s JN Pharma City Ltd. and NTPC Ltd. is not significant on the abundance of phytoplankton, zooplankton, macro benthos and meio benthos in this region.



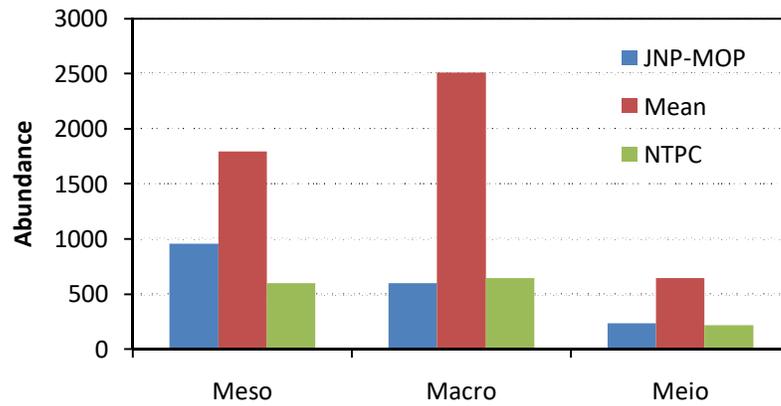
**Plate 7.3: Microscopic images of some benthic organisms**



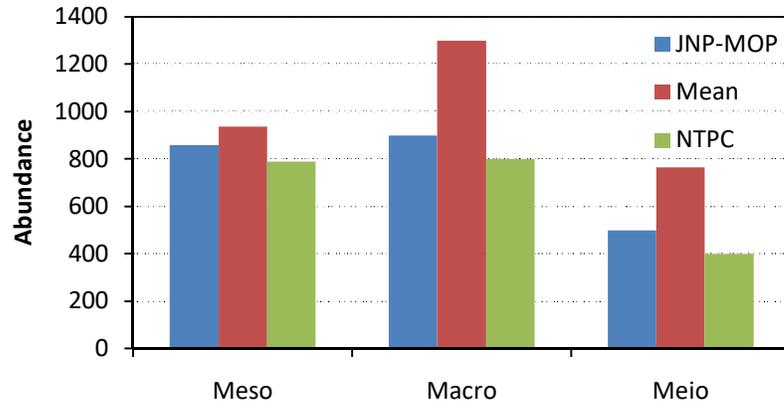
**Fig. 7.2a: Comparison of phytoplankton abundance (No./L) at marine outfall points of JN Pharmacy Ltd. (JNP-MOP) and NTPC Ltd. with that of the mean phytoplankton abundance in surrounding stations of this zone during pre monsoon season**



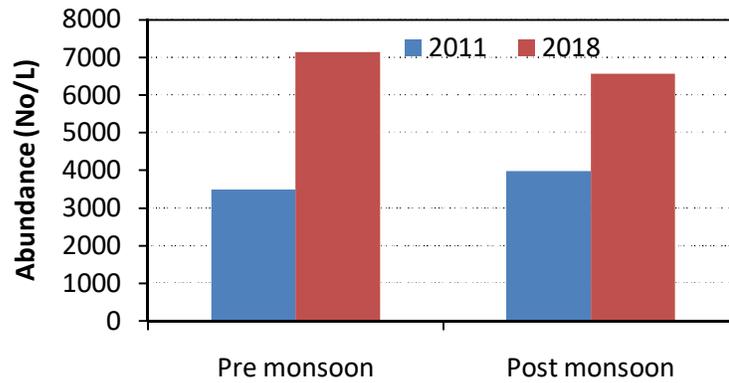
**Fig. 7.2b: Comparison of phytoplankton abundance (No./L) at marine outfall points of JN Pharmacy Ltd. (JNP-MOP) and NTPC Ltd. with that of the mean phytoplankton abundance in surrounding stations of this zone during post monsoon season**



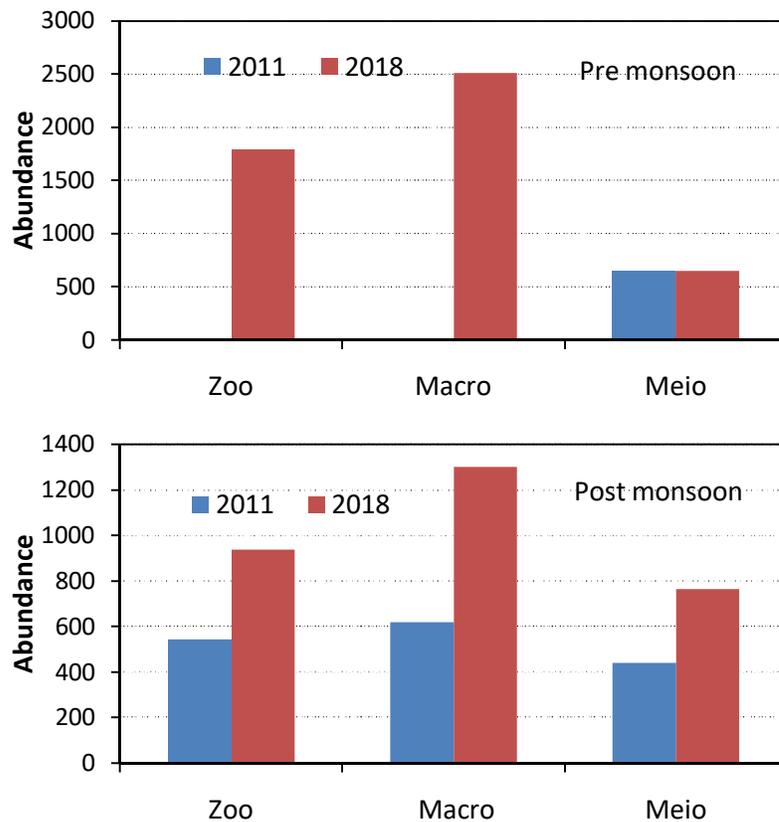
**Fig. 7.3a: Comparison of abundance of Meso zooplankton (Meso; No./m<sup>3</sup>), macro benthos (Macro; No./m<sup>2</sup>) and meio benthos (Meio; No./10cm<sup>2</sup>) at marine outfall points of JN Pharma City Ltd. (JNP-MOP) and NTPC Ltd. with that of the mean phytoplankton abundance in surrounding stations of this zone during pre monsoon season**



**Fig. 7.3b: Comparison of abundance of Meso zooplankton (Meso; No./m<sup>3</sup>), macro benthos (Macro; No./m<sup>2</sup>) and meio benthos (Meio; No./10cm<sup>2</sup>) at marine outfall points of JN Pharma City Ltd. (JNP-MOP) and NTPC Ltd. with that of the mean phytoplankton abundance in surrounding stations of this zone during post monsoon season**



**Fig. 7.4a: Comparison of mean phytoplankton abundance (No./L) found in coastal waters off Tikkavanipalem during pre monsoon and post monsoon seasons of the present study with that of the study conducted in 2011 in this region**



**Fig. 7.4b: Comparison of mean abundance of zooplankton (No./m<sup>3</sup>), macro benthos (No./m<sup>2</sup>) and meio benthos (No./10cm<sup>2</sup>) found in coastal waters off Tikkavanipalem during pre monsoon and post monsoon seasons of the present study with that of the study conducted in 2011 in this region**

**Table 7.4: Details of the biological parameters in coastal waters off Tikkavanipalem during pre monsoon season**

Stations	Chlorophyll <i>a</i>		Phytoplankton		Meso	Macro	Meio
	(mg/m <sup>3</sup> )		(No./L)		zooplankton	benthos	benthos
	Sur	Bot	Sur	Bot	abundance (No./m <sup>3</sup> )	abundance (No./m <sup>2</sup> )	abundance No./10cm <sup>2</sup>
TVM1	4.08	4.89	10450	8450	1100	-	-
TVM2	5.14	5.37	8650	6400	2140	-	-
TVM3	7.2	7.92	9600	3450	2160	-	-
TVM4	6.2	5.4	8400	10750	1080	2250	740
TVM5	7.54	10.16	7500	10560	-	-	-
TVM6	6.25	4.9	6800	8400	2450	-	-
TVM7	-	5.83	-	6450	-	-	-
TVM8	3.58	4.58	4200	10580	1900	-	-
TVM9	-	6.03	-	11450	2200	-	-
TVM10	3.01	2.87	5640	5400	2100	2250	600
TVM11	4.45	2.6	4800	6800	2600	2650	480
TVM12	4.71	1.92	5600	2600	1400	-	-
TVM13	2.17	1.38	4800	2300	1600	-	-
TVM14	6.19	9.17	9400	14000	1400	2900	780
TVM15	4.9	2.88	6400	2600	1600	-	-
TVM16	5.45	4.69	7200	4350	1400	-	-
NTPC - MOP	5.05	5.05	5800	5600	600	650	220
JNP-MOP	6.3	4.36	8650	6450	960	600	238

**Table 7.5: Details of the biological parameters in coastal waters off Tikkavanipalem during post monsoon season**

Station Name	Chlorophyll <i>a</i>		Phytoplankton		Meso	Macro	Meio
	(mg/m <sup>3</sup> )		(No./L)		zooplankton	benthos	benthos
	Surface	Bottom	Surface	Bottom	abundance No./m <sup>3</sup>	abundance (No./m <sup>2</sup> )	abundance No./10cm <sup>2</sup>
TVM 1	-	1.15	4600	6800	920	-	-
TVM 2	0.49	1.32	5200	7200	1140	-	-
TVM 3	3.72	2.9	4600	6400	1060	-	-
TVM 4	2.49	2.44	5400	8000	1040	1600	760
TVM 5	1.25	2.14	6400	8200	860	-	-
TVM 6	0.78	1.55	7600	8400	1324	-	-
TVM 7	4.14	1.13	4600	5400	625	-	-
TVM 8	3.84	3.96	5200	8460	860	-	-
TVM 9	1.25	1.82	5640	6400	1014	-	-
TVM 10	0.58	0.96	4600	5600	945	1400	940
TVM 11	1.71	1.09	5100	8740	780	1200	600
TVM 12	4.11	0.38	8600	5600	820	-	-
TVM 13	-	1.55	6450	8100	890	-	-
TVM 14	-	0.57	4600	7100	920	1000	760
TVM 15	2.79	2.55	5040	6140	840	-	-
TVM 16	1.9	2.61	8060	8640	965	-	-
NTPC MOP	2.22	2.14	4400	4600	789	800	400
JNP- MOP	1.94	1.44	7400	5200	860	900	500

Comparison of biological characteristics observed in this study with that of the study conducted in this region during 2011 was given in Table 7.6

**Table 7.6: Comparison of biological characteristics found in present study with earlier studies conducted in the coastal waters off Tikkavanipalem**

Parameter	2009-2010	2011		Present study	
		Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
Phytoplankton abundance (x10 <sup>4</sup> cells/ L)	0.42-1.80	0.25-1.47	0.19-1.26	0.42-1.40	0.44-0.87
Species richness	11-18	13-28	12-25	14-29	20-21
Zooplankton abundance (No./m <sup>3</sup> )	73-146	-	317-683	600-2600	625-1324
Macro benthos abundance (No./m <sup>3</sup> )	450-2100	-	125-1650	600-2900	800-1600
Meio faunal abundance (No./m <sup>3</sup> )	440-1344	-	267-825	220-780	400-940

### 7.3 Microbiological parameters

Both surface and bottom water samples collected from the study area were analyzed for the following microbiological parameters:

1. Total viable count (TVC) – R2A Agar seawater medium,
2. Total Coliform (TC) – Mac Conkey's Agar,
3. *Escherichia coli* like organisms (ECLO) – Mac Conkey's Agar,
4. *Enterococcus faecalis* like organisms (EFLO) – Mac Conkey's Agar,
5. *Pseudomonas aeruginosa* like organisms (PALO) – Cetrinide Agar,
6. *Vibrio* like organisms (VLO) – TCBS Agar,
7. *Vibrio cholerae* like organisms (VCLO) – TCBS Agar,
8. *Vibrio parahaemolyticus* like organisms (VPLO) – TCBS Agar

Certain aquatic microbes serve as excellent indicator of pollution. Microbes, in particular bacteria react quickly to changes in the environmental conditions. An assessment of the microbial activity is possible by the determination of the microbial biomass (total viable count). Therefore the total viable counts implies an indirect measure of *in situ* activity in contrast to number of specific indicator microbes, and this has been used as one of the principal criteria of pollution in natural water. Besides the pollution indicator bacteria such as total coliforms (TC), *Escherichia coli* like organisms (ECLO) and *Enterococcus faecalis* like organisms (EFLO) occurring the coastal waters have also been included. These indicator bacteria will presumably shows that sewage discharge with human faecal matter is present, which also indicates that possible presence of pathogenic bacteria in the water samples. Apart from that some pathogenic bacteria such as *Pseudomonas aeruginosa* like organisms (PALO), *Vibrio cholerae* like organisms (VLO) and *Vibrio parahaemolyticus* like organisms (VPLO) abundance was also studied.

Bacterial counts of the water samples collected during pre and post monsoon seasons in the coastal waters off Tikkavanipalem are given in Tables 7.7 and 7.8. The values of TVC in the surface and bottom water were in the range of 0.3 to 4.0 and 1.3 to 5.6 CFUx10<sup>3</sup>/ml during pre monsoon season (Table 7.7a). The values during post monsoon season were 0.8 to 18.7 and 0.8 to 24.0 CFUx10<sup>3</sup>/ml, in the surface and bottom water respectively (Table 7.8a). Total Coliform counts in the surface and bottom water were in the range of 0.4 to 3.9 and 1.4 to 6.3 CFUx10<sup>2</sup>/ml during pre monsoon season (Table 7.7a). The values during post monsoon season were 0.1 to 25 and 0.1 to 39.2 CFUx10<sup>2</sup>/ml, in the surface and bottom water respectively (Table 7.8a). Similarly the *Escherichia coli* like organism counts in the surface and bottom water were in the range of 0.1 to 0.9 and 0.2 to 1.1 CFUx10<sup>1</sup>/ml during pre monsoon season (Table 7.7a). The values during

post monsoon season were 1.0 to 126.0 and 1.0 to 392 CFUx10<sup>1</sup>/ml, in the surface and bottom water respectively (Table 7.8a). *Enterococcus faecalis* like organism counts in the surface and bottom water were in the range of 0.1 to 2.6 and 0.5 to 2.0 CFUx10<sup>1</sup>/ml during pre monsoon season (Table 7.7a). The values during post monsoon season were 1.0 to 10 and 1.0 to 50 CFUx10<sup>1</sup>/ml, in the surface and bottom water respectively (Table 7.8a). *Pseudomonas aeruginosa* like organism counts in the surface and bottom water were in the range of 0.2 to 4.3 and 2.1 to 9.4 CFUx10<sup>3</sup>/ml during pre monsoon season (Table 7.7b). The values during post monsoon season were 0.2 to 9.2 and 0.6 to 65 CFUx10<sup>3</sup>/ml, in the surface and bottom water respectively (Table 7.8b). *Vibrio* like organism counts in the surface and bottom water were in the range of 0.1 to 2.0 and 0.2 to 0.9 CFUx10<sup>1</sup>/ml during pre monsoon season (Table 7.7b). The values during post monsoon season were 1.0 to 2.0 and 1.0 to 11.0 CFUx10<sup>1</sup>/ml, in the surface and bottom water respectively (Table 7.8b). *Vibrio cholerae* like organism counts in the surface and bottom water were in the range of 1.5 to 9.0 and 0.1 to 0.2 CFUx10<sup>1</sup>/ml during pre monsoon season (Table 7.7b). The VCLO count during post monsoon season were 2.0 and 3.0 CFUx10<sup>1</sup>/ml, in the surface and bottom water respectively (Table 7.8b). *Vibrio parahaemolyticus* like organism counts in the surface and bottom water were in the range of 0.1 to 0.3 and 0.1 to 0.2 CFUx10<sup>1</sup>/ml during pre monsoon season (Table 7.7b). The VPLO counts during post monsoon season were 1.0 and 1.0 to 8.0 CFUx10<sup>1</sup>/ml, in the surface and bottom water respectively (Table 7.8b).

**Table 7.7a. Spatial variability in total viable count (TVC; CFU/ml), total coli forms (TC, CFU/ml), *Escherichia coli* like organism (ECLO, CFU/ml) and *Enterococcus faecalis* like organism (EFLO, CFU/ml) in surface and bottom waters off Tikkavanipalem coast during pre monsoon season**

Station	TVC		TC		ECLO		EFLO	
	(CFU*10 <sup>3</sup> /ml)		(CFU*10 <sup>2</sup> /ml)		(CFU*10 <sup>1</sup> /ml)		(CFU*10 <sup>1</sup> /ml)	
	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT
TVM1	2.6	2.2	2.9	2.5	0.6	0.4	0.8	0.8
TVM2	1.5	-	1.6	-	0.4	-	0.4	-
TVM3	2.3	2.6	2.5	2.9	0.5	0.5	0.7	0.9
TVM4	1.9	3.1	1.8	3.7	0.9	0.6	1.1	1.2
TVM5	1.1	1.6	1.0	1.9	0.5	0.3	0.6	0.6
TVM6	0.3	1.8	0.4	2.0	0.1	0.3	0.1	0.7
TVM7	2.4	3.4	2.6	3.8	0.6	0.6	0.7	1.2
TVM8	2.2	2.0	2.4	2.2	0.5	0.4	0.6	0.7
TVM9	1.5	-	1.7	-	0.4	-	0.4	-
TVM10	3.3	1.7	3.6	2.0	0.8	0.3	1.0	0.6
TVM11	1.7	5.6	1.9	6.3	0.4	1.1	0.5	2.0
TVM12	2.0	2.7	2.2	3.0	0.5	0.5	0.6	1.0
TVM13	1.0	4.2	1.1	4.7	0.3	0.8	0.3	1.5
TVM14	2.3	5.3	2.5	6.0	0.6	1.0	0.7	1.9
TVM15	1.9	1.9	2.0	2.2	0.5	0.4	0.5	0.7
TVM16	1.7	3.2	1.8	3.6	0.4	0.6	0.5	1.1
NTPC-MOP	0.8	1.3	0.9	1.4	0.2	0.2	0.2	0.5
JNP-MOP	4.0	2.1	3.9	2.3	2.2	0.6	2.6	1.1

**Table 7.7b. Spatial variability in *Pseudomonas aeruginosa* like organism (PALO, CFU/ml), *Vibrio* like organism (VLO, CFU/ml), *Vibrio cholerae* like organism (VCLO, CFU/ml) and *Vibrio parahaemolyticus* like organism (VPLO, CFU/ml) in surface and bottom waters off Tikkavanipalem coast during pre monsoon season**

Station	PALO		VLO		VCLO		VPLO	
	(CFU*10 <sup>3</sup> /ml)		(CFU*10 <sup>1</sup> /ml)		(CFU*10 <sup>1</sup> /ml)		(CFU*10 <sup>1</sup> /ml)	
	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT
TVM1	1.6	3.7	0.6	0.3	0.1	0.1	0.1	0.1
TVM2	0.9	-	0.3	-	0.1	-	0.1	-
TVM3	1.3	4.4	0.5	0.4	0.1	0.1	0.1	0.1
TVM4	1.6	4.9	0.8	0.5	0.2	0.1	0.2	0.1
TVM5	0.9	2.5	0.4	0.3	0.1	0.1	0.1	0.1
TVM6	0.2	3.1	0.1	0.3	-	0.1	-	0.1
TVM7	1.4	5.6	0.5	0.5	0.1	0.1	0.1	0.1
TVM8	1.3	3.3	0.5	0.3	0.1	0.1	0.1	0.1
TVM9	0.9	-	0.3	-	0.1	-	0.1	0.-
TVM10	1.9	2.9	0.7	0.3	0.2	0.1	0.1	0.1
TVM11	1.0	9.4	0.4	0.9	0.1	0.2	0.1	0.2
TVM12	1.2	4.5	0.4	0.4	0.1	0.1	0.1	0.1
TVM13	0.6	7.0	0.2	0.6	0.1	0.2	-	0.1
TVM14	1.4	8.9	0.5	0.8	0.1	0.2	0.1	0.2
TVM15	1.1	3.2	0.4	0.3	0.1	0.1	0.1	0.1
TVM16	1.0	5.3	0.4	0.5	0.1	0.1	0.1	0.1
NTPC-MOP	0.5	2.1	0.2	0.2	-	-	-	-
JNP-MOP	4.3	3.5	2.0	0.3	0.5	0.1	0.2	0.1

**Table 7.8a. Spatial variability in total viable count (TVC; CFU/ml), total coli forms (TC, CFU/ml), *Escherichia coli* like organism (ECLO, CFU/ml) and *Enterococcus faecalis* like organism (EFLO, CFU/ml) in surface and bottom waters off Tikkavanipalem coast during post monsoon season**

Station	TVC		TC		ECLO		EFLO	
	(CFU*10 <sup>3</sup> /ml)		(CFU*10 <sup>2</sup> /ml)		(CFU*10 <sup>1</sup> /ml)		(CFU*10 <sup>1</sup> /ml)	
	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT
TVM1	0.9	3.9	-	-	-	-	-	-
TVM2	0.8	2.0	-	0.4	-	4	-	-
TVM3	5.2	0.9	4.0	39	0	392	-	-
TVM4	11.4	13.2	2.9	-	105	-	-	-
TVM5	3.1	10.6	2.4	-	-	-	-	-
TVM6	15.3	8.8	0.4	-	1.0	-	1	-
TVM7	1.5	9.6	0.1	0.9	-	9	-	12
TVM8	1.3	0.8	-	2.8	10	28	10	1
TVM9	-	-	-	-	-	-	-	-
TVM10	18.7	4.5	0.8	0.1	32	1	-	-
TVM11	0.9	3.7	21.4	-	-	-	-	-
TVM12	16.8	24	9	1.2	4	12	-	-
TVM13	11.7	13.5	6.6	0.4	15	4	-	-
TVM14	13.4	10.1	5.1	-	11	-	-	-
TVM15	-	11.3	-	-	-	-	-	-
TVM16	15.0	5.3	25	-	-	-	-	-
NTPC-MOP	1.1	7.8	19	1.4	126	14	-	50
JNP-MOP	-	-	-	-	-	-	-	-

**Table 7.8b: Spatial variability in *Pseudomonas aeruginosa* like organism (PALO, CFU/ml), *Vibrio* like organism (VLO, CFU/ml), *Vibrio cholerae* like organism (VCLO, CFU/ml) and *Vibrio parahaemolyticus* like organism (VPLO, CFU/ml) in surface and bottom waters off Tikkavanipalem coast during post monsoon season**

Station	PALO		VLO		VCLO		VPLO	
	(CFU*10 <sup>3</sup> /ml)		(CFU*10 <sup>1</sup> /ml)		(CFU*10 <sup>1</sup> /ml)		(CFU*10 <sup>1</sup> /ml)	
	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT
TVM1	1.2	-	-	-	-	-	-	-
TVM2	1.2	0.6	-	-	-	-	-	-
TVM3	2.5	8.5	1	11	-	3	1	8
TVM4	7.7	-	2	1	2	-	-	1
TVM5	0.6	1.2	-	2	-	-	-	2
TVM6	5.3	3.4	-	-	-	-	-	-
TVM7	0.6	5.6	-	-	-	-	-	-
TVM8	0.2	6.2	-	-	-	-	-	-
TVM9	-	-	-	-	-	-	-	-
TVM10	3.7	1.5	-	-	-	-	-	-
TVM11	9.2	1.7	-	-	-	-	-	-
TVM12	1.3	2.6	-	-	-	-	-	-
TVM13	6.6	5.3	-	5	-	-	-	5
TVM14	3.8	3.4	-	7	-	-	-	7
TVM15	-	2.9	-	-	-	-	-	-
TVM16	5.3	-	-	-	-	-	-	-
NTPC-MOP	1.6	65	-	-	-	-	-	-
JNP-MOP	-	-	-	-	-	-	-	-

**Table 7.9: Comparison of microbial populations found during the pre monsoon and post monsoon seasons of this study (2018) with those obtained during the previous monitoring study conducted in this region in 2011.**

Region	Type of bacteria	This study (2018)		Previous study (2011)	
		Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
<b>Tikkavanipalem (zone 5)</b>	TVC (CFUx10 <sup>3</sup> /ml)	0.3-5.6	0.8-24	2.9-19	3.1-9
	TCC (CFUx10 <sup>2</sup> /ml)	0.4-6.3	0.1-39	0.6-5	0.1-1.5
	ECLO (CFUx10 <sup>1</sup> /ml)	0.1-1.1	1.0-392	0.1-15	0.8-5
	VLO (CFUx10 <sup>1</sup> /ml)	0.1-2.0	1.0-11	0.9-214	0.7-82

TVC counts are more during post monsoon season compared to pre monsoon season. When compared to 2011 data, TVC counts found in this study are lower during pre monsoon season and higher during post monsoon season. TC counts are more during post monsoon season. These counts are more or less similar during pre monsoon season and higher during post monsoon season compared 2011 data. ECLO counts are more during post monsoon season and these counts are lower during pre monsoon season and higher during post monsoon season compared to 2011 data. EFLO, PALO and VLO counts are more during post monsoon than pre monsoon season. VCLO and VPLO counts are very low and no considerable seasonal variability was found.

Microbiological quality of the seawater in this region is not good as the presence of indicator bacteria and some pathogenic bacteria in higher concentrations than the standard levels. The presence of indicator bacteria and some pathogenic bacteria in concentrations higher than the standard levels in coastal waters in this region indicated that coastal waters of this region is considerably contaminated with untreated domestic sewage.

## Chapter 13

### RECOMMENDATIONS

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Present study region, the coastal waters of north Andhra coast extending from off Pydibhimavaram to off Kesavaram was investigated during pre and post monsoon seasons for physico-chemical, biological, micro biological and sedimentological parameters in order to assess the impact of industrial effluent release through the marine outfall points (MOPs) on the seawater quality and ecosystem of the region, if any. The *in-situ* observations and sample collection was carried from 17<sup>th</sup> February to 08<sup>th</sup> March 2018 during the pre monsoon season and from 08<sup>th</sup> December 2018 to 1<sup>st</sup> January 2019 during the post monsoon season. Results of our investigations in the study region during both the seasons (pre and post monsoon) were described in detail in chapters 3 to 12. Based on findings of this study the following recommendations have been made to maintain the seawater quality and the health of the ecosystem in the coastal waters of north Andhra coast.

- ✓ Since the dissolved oxygen concentrations are depleted and ecosystem at MOPs is impacted, continuous yearly monitoring of the north Andhra coast is very much required, at least for the next two years, to monitor the DO levels and to understand the expansion/compression of impacted area around the MOP location, and to take necessary timely precautions to protect the seawater quality and the health of the ecosystem in the region
- ✓ Time series experiments (continuous daily measurements at MOP and surrounding locations for one week; before, during and after effluent release) should be conducted at

least for two industries (one in the south and the other in the north of Visakhapatnam) to understand the impact of effluent release on the ecosystem in the region.

- ✓ Since the seasonal variability in all the parameters is very high in the study region, monitoring should be conducted with high temporal resolution, at least 4 times in a year, for example, February, May, September and December.
- ✓ In order to assess the impacted area around the MOP location, it should be covered at least 5km (instead of 2km in the present study) from the MOP in both the directions along the coast.
- ✓ Further treatment for industrial effluents is required to reduce their toxicity before discharging into the sea because the treated effluents from all the industries are mildly acute toxic.
- ✓ Bio assay tests for industrial effluents must be conducted on monthly time scale at least for one year to understand the variability in the quality of effluent because the composition of the treated effluent is highly variable with time for any industry.
- ✓ Trace metals (chromium, manganese, cobalt, nickel, copper, cadmium, zinc etc) concentrations should be determined in the treated effluents of industries before discharging in to the sea, coastal waters, and benthic organisms along with surface sediments in order to assess the trace metal contamination in the food chain.
- ✓ Sludge remained in the guard ponds should be removed on regular time intervals to avoid its transport into the sea along with effluent.
- ✓ Since, fish is more susceptible to contamination of organic compounds the major organic compounds present in the treated effluent should be understood before discharging into the sea.

- ✓ Antibiotic resistivity of the indicator and pathogenic bacteria present in the waters of the study region should be investigated
- ✓ As microbiological studies indicated significant input of untreated domestic sewage to the present study region, it is strongly recommended to take necessary steps to prevent the transport of untreated domestic sewage into the sea.

**Consolidated Analysis Reports of Monitoring Borewells TSDf, Tadi & Tanam Villages, Parawada Mandal, Anakapalli District -2024**

Bore well sample collected at MPP School, Tadi (V)																
Date	pH	EC	TDS	CI	TH	TA	P	SO4	F	NO2-N	NO3	NH3-N	Ca	Mg	Na	K
16.02.2024	7.13	544	356	24.99	192	248	BDL	11.62	1.12	BDL	1.26	BDL	36.8	24.3	27	28.86
30.04.2024	7.34	551	358	44.9	204	205	BDL	36.7	1.27	BDL	17.3	BDL	49.6	19.40	34.8	32.7
29.06.2024	6.80	605	396	55	220	223	<0.1	14.30	0.75	<0.02	1.6	0.05	51.2	22.3	27.2	27.8
01.08.2024	7.06	1259	836	40	108	140	0.01	51.00	1.14	0.02	18.4	0.05	72	36	54.9	29.4
18.10.2024	7.26	538	356	50	180	180	<0.1	17.00	0.87	2	<0.02	<0.1	112	68	22	33
Permissible Std	NR	--	2000	1000	600	600	--	400	1.5	--	--	--	200	100	--	--
Bore well sample collected at Tadi (V)																
Date	pH	EC	TDS	CI	TH	TA	P	SO4	F	NO2-N	NO3	NH3-N	Ca	Mg	Na	K
16.02.2024	7.23	754	492	84.97	320	264	BDL	19.44	0.76	0.14	11.99	BDL	28.8	60.2	38.65	2.19
30.04.2024	7.22	913	596	139.9	328	180	BDL	24.8	BDL	0.2	29	BDL	73.6	34.90	42.7	3.2
29.06.2024	6.92	939	612	150	332	163	<0.1	36.7	1.24	0.03	15.5	0.05	97.6	18.9	38.9	1.9
01.08.2024	7.16	1476	972	135	196	100	0.02	55.00	1.52	0.04	20.8	0.06	144	52	72.8	2.1
18.10.2024	7.21	805	532	100	352	256	<0.1	20.00	0.85	13	0.07	<0.1	192	160	30	1.2
Permissible Std	NR	--	2000	1000	600	600	--	400	1.5	--	--	--	200	100	--	--
Bore well sample collected at BC Colony, Tadi (V)																
Date	pH	EC	TDS	CI	TH	TA	P	SO4	F	NO2-N	NO3	NH3-N	Ca	Mg	Na	K
16.02.2024	6.93	963	628	124.96	344	240	BDL	27.73	1.18	0.2	22.66	BDL	56	49.5	45.58	3.74
30.04.2024	7.13	1012	660	149.9	372	195	BDL	42.3	BDL	0.18	33.4	BDL	94.4	33	50.3	2.1
29.06.2024	6.80	1073	700	155	352	208	0.01	35.3	0.81	0.05	22.9	0.03	102.4	23.3	51.6	2.5
01.08.2024	7.55	2240	1468	145	216	104	0.03	88.00	1.26	0.06	28.6	0.07	152	64	93	3.8
18.10.2024	7.15	944	620	140	380	224	<0.1	34.00	0.86	17	<0.02	<0.1	252	128	36	2.1
Permissible Std	NR	--	2000	1000	600	600	--	400	1.5	--	--	--	200	100	--	--

Note: NR: No Relaxation

Bore well sample collected at Tanam (V)																
Date	pH	EC	TDS	Cl	TH	TA	P	SO4	F	NO2-N	NO3	NH3-N	Ca	Mg	Na	K
16.02.2024	7.63	2156	1404	259.91	160	604	BDL	183.44	1.37	BDL	22.04	BDL	16	29.1	435.9	1.82
30.04.2024	8.09	2250	1464	279.9	248	344	BDL	188.7	1.82	BDL	41.4	BDL	52.8	28.10	318.7	3.9
29.06.2024	7.34	2460	1604	290	156	740	<0.1	117.2	2.84	0.03	18.2	0.05	33.6	17.5	521.8	0.46
01.08.2024	6.93	1037	688	290	112	370	0.1	97.00	1.56	0.02	15.6	0.04	60	52	348.2	1.3
18.10.2024	7.30	1971	1288	215	260	292	<0.1	110.00	1.58	36	<0.02	<0.1	112	148	220	6.2
Permissible Std	NR	--	2000	1000	600	600	--	400	1.5	--	--	--	200	100	--	--
Bore well sample collected at ZP High School, Tanam (V)																
Date	pH	EC	TDS	Cl	TH	TA	P	SO4	F	NO2-N	NO3	NH3-N	Ca	Mg	Na	K
16.02.2024	7.26	1540	1010	104.96	284	496	BDL	110.98	1.1	BDL	26.16	BDL	20.8	56.40	225.4	5.52
30.04.2024	7.56	1388	904	119.9	256	248	BDL	125	1.26	BDL	37.5	BDL	56	28.10	144.2	5.2
29.06.2024	7.03	1511	984	115	260	478	0.01	96.4	1.13	0.29	13.8	0.03	70.4	20.4	222.5	1.4
01.08.2024	6.94	918	608	110	144	347	0.1	65.00	0.92	0.18	16.3	0.02	84	60	194.8	1.2
18.10.2024	7.32	1555	1020	120	312	432	<0.1	99.00	1.11	28	<0.02	<0.1	108	204	184	1.6
Permissible Std	NR	--	2000	1000	600	600	--	400	1.5	--	--	--	200	100	--	--
Bore well sample collected at NTR Statue Main Road, Tanam (V)																
Date	pH	EC	TDS	Cl	TH	TA	P	SO4	F	NO2-N	NO3	NH3-N	Ca	Mg	Na	K
16.02.2024	7.04	2700	1758	439.86	896	456	BDL	160.46	0.7	BDL	36.38	BDL	166.4	116.6	154.57	5.17
30.04.2024	7.63	1105	720	99.9	192	170	BDL	76.5	BDL	BDL	31.6	BDL	41.6	21.30	98.2	4.3
29.06.2024	7.01	1199	780	100	248	293	0.01	68.4	0.9	0.04	13.6	0.05	67.2	19.4	117	1.7
01.08.2024	6.95	596	392	125	188	173	0.1	49.00	0.84	0.05	14.2	0.03	112	76	96.4	1.5
18.10.2024	7.47	1177	776	105	256	336	<0.1	50.00	0.74	14	<0.02	<0.1	88	168	126	1.7
Permissible Std	NR	--	2000	1000	600	600	--	400	1.5	--	--	--	200	100	--	--

Note: NR: No Relaxation

  
SENIOR ENVIRONMENTAL SCIENTIST

**A REPORT ON THE HYDROGEOLOGICAL AND HYDROLOGICAL  
INVESTIGATION AT COMMON EFFLUENT TREATMENT PLANT  
(CETP) AREA OF M/S. RAMKY PHARMACY(INDIA) LTD,  
JAWAHARLAL NEHRU PHARMA CITY (JNPC), PARAWADA,  
VISA KHAPATNAM DISTRICT, ANDHRA PRADESH**

**SUBMITTED TO  
RAMKY PHARMA CITY (INDIA) LIMITED  
JNPC, Commercial hub, Road No.13/RNB, Visakhapatnam**



2021

TECHNICAL REPORT

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VISAKHAPATNAM DISTRICT, ANDHRA PRADESH**

Name of the Client	:	M/s RAMKY PHARMA CITY (INDIA) LIMITED JNPC, Commercial hub, Road No.13/RNB Visakhapatnam
Site of Investigation	:	CETP Area Ramky Pharmacy, Parawada Visakhapatnam
Reference	:	WO NO: 0400058852, dated 05-11-2020 PR No.: 3000060065
Investigation period	:	November, 2020 to April, 2021

### **1. INTRODUCTION (Very Brief Activity about the Industry):**

In response to a communication received from M/s Ramky Pharma City (India) Pvt. Ltd., JNPC, Parawada, Visakhapatnam Dt. to conduct Hydrogeological and Hydrological investigation around its Common Effluent Treatment Plant (CETP), investigation has been taken up on behalf of Centre for Scientific and Industrial Consultancy, Andhra University. Common Effluent Treatment Plant (CETP) is one of the Environmental monitoring unit in M/s Ramky Pharma City (India) Limited Industrial unit located in JNPC, at Parawada village, Parawada mandal in Visakhapatnam district. CETP receives effluents from User Industries of Pharma City for treatment and disposal. The following treatment systems are provided:

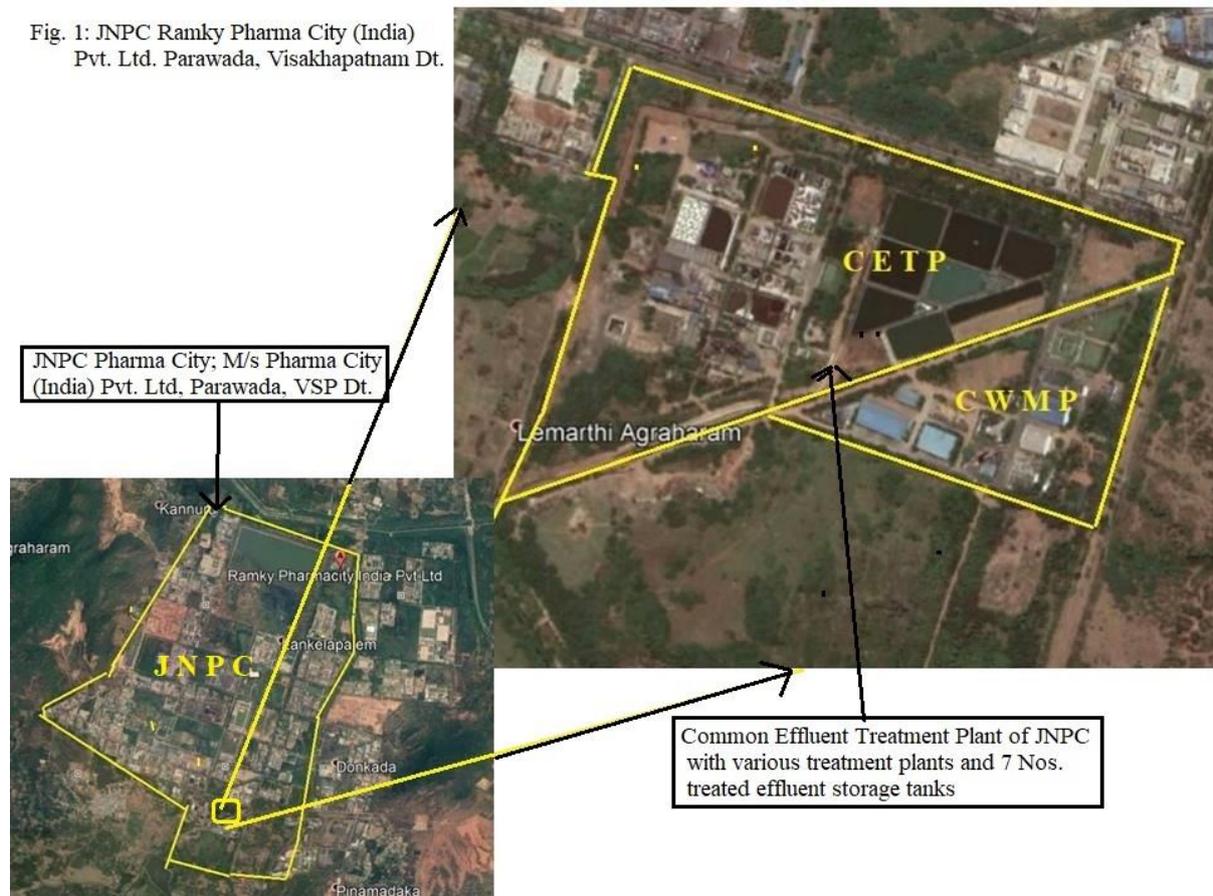
1. Low TDS treatment system
2. High TDS treatment system
3. Treatment for cyanided bearing effluents
4. Treatment for Heavy metal (Chromium) bearing effluents.

Effluent Conveyance network with HDPE pipelines is provided in JNPC for conveyance of effluents from industries to CETP. This conveyance system is designed to carry Low TDS and High TDS effluents separately through two conveyance lines. Cyanide and Heavy Metal bearing wastes which will be relatively very low in volume are conveyed through road tankers to CETP. Limits of various parameters for discharge into the above conveyance systems are as per PCB guide lines.33.

Low TDS effluent Treatment system is designed to treat 3.5 MLD (3500 M<sup>3</sup> / day) of effluents. High TDS effluent Treatment system is designed to treat 1.5 MLD (1500 M<sup>3</sup> / day) of effluents. Wastes containing traces of Cyanide and heavy metals like chromium effluents are taken to high TDS stream for further treatment.

### Guard Ponds

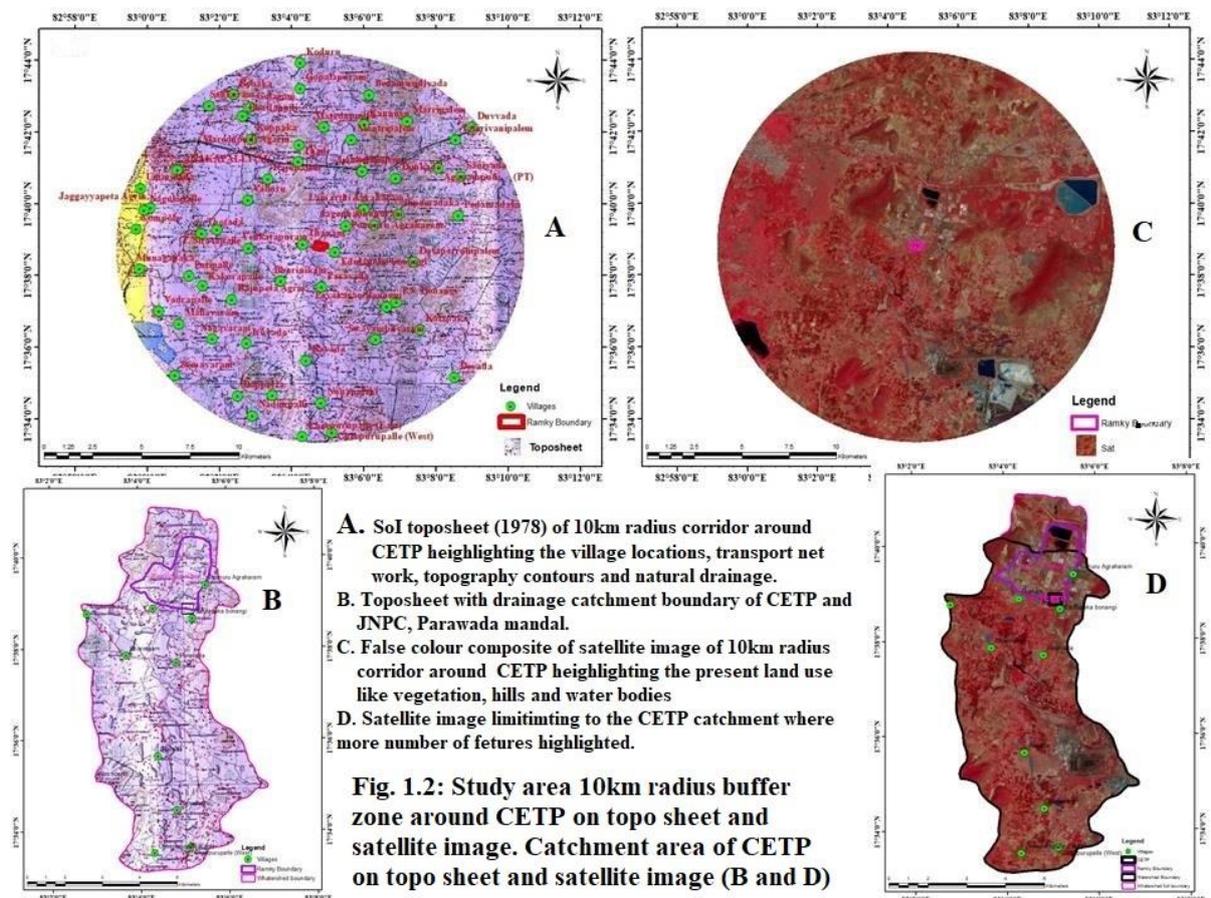
Nine Guard Ponds are provided with total 47200m<sup>3</sup> capacities to hold treated effluents. Effluent collected in ponds will be tested by PCB for outlet parameters for discharge to marine coastal areas (sea). During this period effluent will be collected in next Guard Pond. After conformity of the parameters for discharge standards, effluents will be pumped to Marine Out Fall through a conduit after getting clearance from PCB in the presence of PCB officials. If the treated effluents from Guard Ponds are rejected by PCB, the treated water will be taken back for further treatment. Satellite image of the JNPC and CETP areas are shown in fig. 1.1 JNPC Ramky



Pharma City (India) Pvt. Ltd. Spread in an area of about 693 Hectares as per the boundary marked in fig. 1.1 Common Effluent Treatment Plant (CETP) is part of JNPC and its area is about 16.6 Hec. as marked above that consists of 9 guard ponds and effluent treatment units.

The treated effluent will be delivered into marine fall (Sea) after getting permission from APPCB.

**1.1 Proposed Studies:** Purpose of the Hydrogeological investigation is to establish base line data on groundwater parameters like water table fluctuations, broadly present status of groundwater potential and exploration at regional and local level, quality of groundwater, identification of aquifer zones, geological and geomorphological features. The other related themes like drainage, catchment divisions, water bodies and present land use/ land cover also required. Rainfall of the region and rainwater harvesting for improvement of groundwater potential also dealt. Number of thematic maps will be prepared at small scale maps taking the study area CETP as centre and data will be collected and consolidated to 10km radius corridor from the centre point. Similarly large scale thematic maps will be prepared considering the drainage catchment of CETP area. Base maps of small scale and large scale are shown in the following image mosaics of topo sheet updated up to 1978 and satellite image of 2020. All the themes prepared further on the proposed objectives are both on the 10km radius as well study



area catchment is shown in fig. 1.2. Ten kilometres corridor area is about 314 sq.km and the selected catchment area is about 65 sq.km. Influence of the effluents on hydro mostly limited to the watershed catchment of the CETP as shown B and D.

**1.1.1 Objectives:**

- To study the land forms and drainage pattern with special reference to ground water regime.
- To study ground water conditions and fluctuations with respect to seasons.
- To study the impact of CETP activity on ground water regime.
- To study the characteristics of environmental hydrology and their vulnerability to Effluent treatment activity.
- Suggestions to improve the quality and quantity of groundwater through Rainwater harvesting.

**1.1.2 Scope of Study:**

- To map and characterize the drainage network from the SOI topo sheets up to 10km buffer zone for regional analysis and catchment area on large scale where CETP located.
- To observe the hydrogeomorphological features from the available recent remote sensing data from Google Earth. Land use/ land cover mapping from the remote sensing data.
- Collection, collation and compilation of hydro-geological information with special reference to ground water storage, sub-surface geology, hydrochemical behavior, climate characteristics. The data need to be processed for presentation and prediction of future behavior activity in the region.
- Detailed investigation parameters will be limited to 1.0km radius- identification of more number of observation wells/ bore wells, groundwater levels, groundwater quality analysis.
- To study hydrological aspects of existing streams, tanks etc. with respect to effluent treatment plant surroundings.
- Implementation of Rainwater harvesting in the CETP as per the site condition. Ultimately suggest designs of rainwater harvesting for total rainwater conservation within the site.

## 1.2. Methodology:

The magnitude of impact shall depend upon size of the ETP, collection, treatment processes, storage and disposal from end to end and contact with the natural drains, water bodies, soil etc. intervention of the disciplines is necessary in impact assessment. While establishing the data base, primary as well secondary data is essential for which data has been collected from the various government published records, maps of last few decades and also digital data being gathered and updated from time to time through remote sensing technology. Primary data is collected around the study area regarding surface hydrology and subsurface hydrogeology.

- Survey of India topo sheets have the very accurate information regarding topography, elevation contours, natural drainage network, transportation network, villages, land use etc. The above said information has been extracted from the 1:25,000 scale maps and produced as thematic maps. Remote sensing data is also to be extracted after geocoding the images with topo sheets. Geological survey has prepared geology maps with to the district level and the geology information has been obtained by geocoding the GSI maps and extracted to the required scale. Mandal wise groundwater potential estimations and exploitation levels were prepared and updated up to 2015 by the state and Central Ground water Boards and published data has been utilised in this report. Climatic data such as rainfall and temperature has been collected from secondary sources.
- Present land use/ land cover, hydrogeomorphology, changes in water bodies and slope thematic maps have been prepared from the remote sensing data. Depth to water table, chemical analysis of groundwater and some chemical parameters themes are prepared from the primary data collected during the investigation. Resistivity soundings have been conducted within CETP area and subsurface geology, aquifer zones have been identified through field investigation during investigation. Groundwater recharge due to rainfall has been estimated based on the Andhra Pradesh state hydrograph network stations and field observations.
- Groundwater resource and its utilization has been worked out as per norms prescribed by the Ground Water Estimation Committee (GEC-2015), Government of India.

## 1.3 Location and Communication:

The study area Common Effluent Treatment Plant (CETP) is located in Jawaharlal Nehru Pharma City (JNPC) is located in Parawada mandal, abutting GVMC, Visakhapatnam district, Andhra Pradesh.

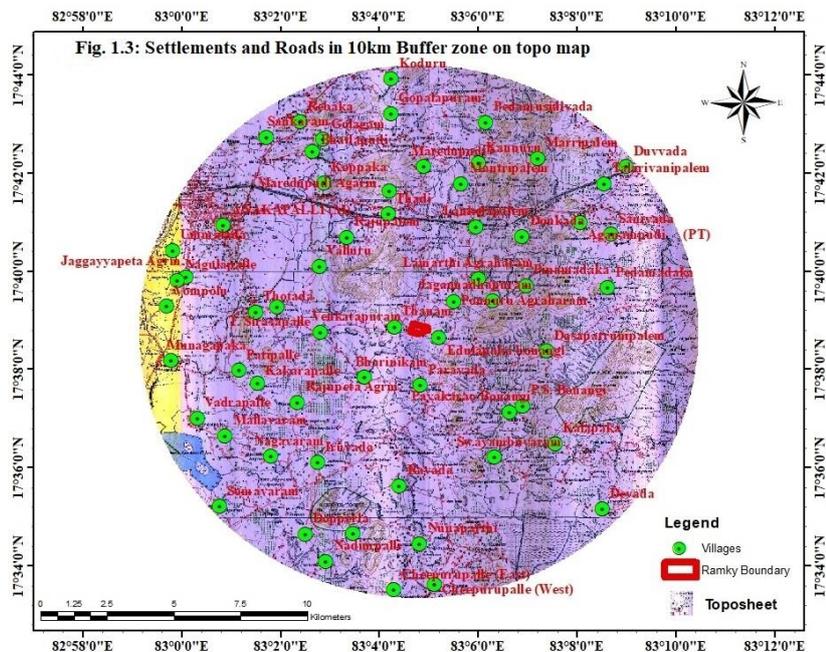
The CETP area falls under the topo sheet No. 65 O/2 and the geographical coordinates are:

Latitude: 17°38'58.7"N to 17°38'48.40"N and Longitude: 83°04'39.80"E to 83°05'02.00"E

The CETP area is a part of the JNPC and concerned to almost all the units in the Pharma City from which liquid waste is collected, processed and suppose to dispose safely into the marine fall. Geographical coordinates of the JNPC are: Latitude: 17°40'27.3"N to 17°38'36.40"N and Longitude: 83°04'47.60"E to 83°05'38.40"E.

Regional analysis on certain parameters is required and as per ToR, the extension is 10km radius. Regional scaled map available is the topo sheet prepared by Survey of India. A 10km radius topo sheet along with mandal boundaries and village locations area marked on the fig.

1.3. The mandals that cover the CETP and its physiographic catchment where the impact of the industry may suppose to influence are partly Parawada and Pedagantyada. All the village locations in 10 km radius are marked in fig. 1.3. The villages that falls in the CETP catchment area are: Tanam,

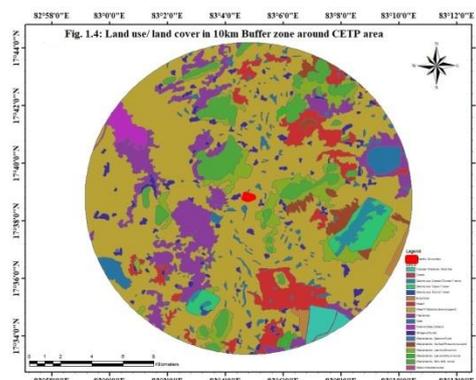


E.Bonangi, Venkatapuram, Bharanikam, Parawada, Dharmaraayudupalem Vennelapalem, Somunaidupalem, Mula swayambhuvaram etc. National High-way- 16 is just 4km from CETP and 2km from JNPC north boundary. Nearest is town Anakapalli through which NH-16 as well GT Railway track is connected. Nearest Air port is Visakhapatnam which is about 17km from the Pharma city.

#### 1.4. Land Utilization:

Land use/ Land cover (LULC) pattern of any region is an outcome of various physical and cultural factors and their utilization by man in time and space.

The CETP area (16.6 Ha.) is meant for treating the common effluent from all the industries belong to JNPC. Land use/ land cover of the study area as well buffer zone of 10 km radius around the study area is to be studied to know the impact of CETP as per the ToR, MoEF. Present land use/ land cover of the buffer zone is mapped using the recent satellite image, i.e., march, 2020. Ten kilometer radius high resolution satellite image is shown in fig. 1.4.



##### 1.4.1 Land Use Land Cover Statistics of CETP Buffer Zone:

The core and buffer area Land use classes of Buffer zone 10 km radius statistics of the CETP is listed in table 1.1. The area covered with Agricultural land (kharif, kharif+Rabi, plantation and fallow) is major area around

72.52 % of the total area, followed by waste land categories- uplands with or without scrub, gullied and ravenous land of about 14.42 % and built-up land include industrial, urban and rural area is about 4.76%. There is considerable area under coastal wet land and mudflats about 1.21% and area under forest is about 1.05%. Water bodies include irrigation

S.No	Name	Area Sq.km	Area in %
1	Coastal Wetland, Mud-flat	3.81	1.21
2	Creek	0.23	0.07
3	Deciduous Dense/Closed Forest	3.29	1.05
4	Deciduous Open Forest	6.53	2.08
5	Industrial	2.03	0.65
6	Kharif	22.08	7.04
7	Kharif+Rabi(double-cropped)	171.44	54.67
8	Plantation	33.91	10.81
9	Tank	11.98	3.82
10	Towns/cities(Urban)	3.76	1.20
11	Villages(Rural)	9.12	2.91
12	Wastelands, Barren-Rock	0.041	0.01
13	Wastelands, Gullied/Ravenous-Land	5.39	1.72
14	Wastelands, hills with scrub	19.72	6.29
15	Wastelands, Land-without-scrub	0.79	0.25
16	Wastelands, Land-with-scrub	19.31	6.16
17	Water-channel-area	0.17	0.05
	Total	313.601	100.00

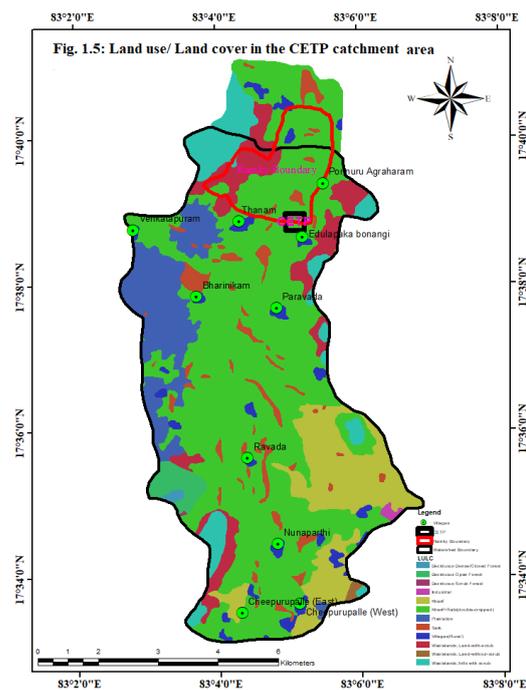
tanks, channels and other drainage is about 3.86%. The area under different land use/ land cover is represented in a pie diagram shown below.

**1.4.1.1 Land area:** The catchment area of the CETP include the natural drainage boundary around CETP and the main drain that joins with back water drain up to NTPC at Mula swayambhuvaram near the coast.

Five types of land use/ land cover categories have been identified in the catchment area and listed in table- 1.2. Land use/ land cover map of CETP catchment area is shown in fig. 1.5. Maximum coverage area is agricultural land that include khari, kharif&rabi and plantation is about 42.88 sq.km, built up land include industrial and rural

is about 9.17 sq.km and is 14.14%. Waste land categories hills with and without scrub is about 8.87sq.km and is about 13.68%. Deciduous forest area is 1.24sq.km ans 1.91%. Water bodies include tanks, ponds and stream courses cover about 2.67 sq.km and is about 4.12%.

S.No	Name	Area (sq.km)	Area in %
1	Deciduous Dense/Closed Forest	0.13	0.20
2	Deciduous Open Forest	1.11	1.71
3	Industrial	7.14	11.01
4	Kharif	7.28	11.23
5	Kharif+Rabi(double-cropped)	29.48	45.47
6	Plantation	6.12	9.44
7	Tank	2.67	4.12
8	Villages(Rural)	2.03	3.13
9	Wastelands, hills with scrub	4.19	6.46
10	Wastelands, Land-without-scrub	4.68	7.22
	total	64.83	100.00



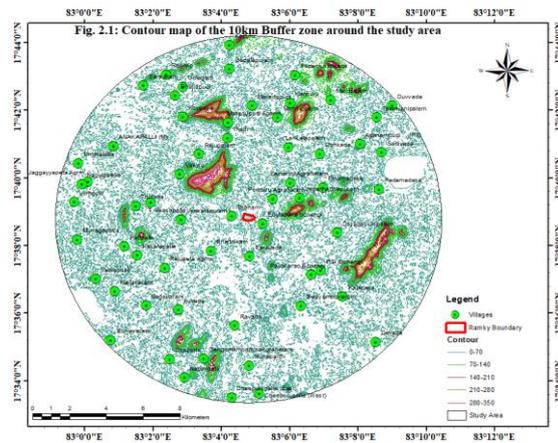
## 2.0 GEOMORPHOLOGY

It is the study on origin and evolution of land forms by physical, chemical and biological process by natural agents like air, rivers, oceans, glaciation and biological activities. Hydro-geomorphology is the study of groundwater occurrence, storage and movement in these land forms and depends on their presence in various climatological conditions.

### 2.1 Physiography

Physical geography also known as physiography is one of the two fields of geography. Here it is described the surface topography mapped and recorded in the topo sheets is presented in fig.

2.1. The map shows the present topography in the 10km corridor of the study area. After the weathering process has taken place on the earth, the present status of the topography is shown as contour map fig. nearest hill range is Tadi konda on the west and NW side of the CETP and JNPC areas and its strike/ alignment direction is NE-SW and its maximum elevation is 346m.



CETP area is in between 20m and 40m contour and is in the valley portion. Another hill (203m) range striking N-S direction is near Gorla Anakapalli on the west side of the CETP. Koppaka konda is on the north side of JNPC on the north side of railway track with max elevation of 306m. Kannuru konda with max elevation of 291m, Devikonda with strike of NE-SW direction and max elevation of 259m are on the east side. Doppet konda with max elevation of 184m with forest cover over it is on the south side of the CETP. Isolated hills near Parawada is 204m, Vennelapalem hills 170m and 158m on the south east side. Near to NTPC at Swayambhuvaram village max elevation of the hill is 130m. However within 4km to 5km radius there are number of hill ranges indicates the corridor area is highly undulating.

Within the CETP watershed, Tadikonda hill on the west, Devikonda hill on the east, Doppet konda on south and Vennelapalem hills and Swayambhuvaram hill on the east and SE side as shown in fig. Drainage originating from the east and west side hills formed as main drain near Bharanikam and there onwards it is well formed stream and its local name is Kharjurapugedda till it reaches the NTPC boundary and from there it is back water area.

## 2.2 Hydrogeomorphology:

Various geomorphological features have been identified and mapped from the high resolution satellite image in the 10km corridor are shown in fig. 2.2. Mainly, they are six categories of geomorphological features covering the corridor area and listed in table 2.1. Each geomorphic feature is explained with reference to groundwater occurrence and potential.

### 2.2.1 Denudational origin

Landform of denudational origin is formed where the denudation process dominates over the other process. Most of the landform resulting due to this process is the combined effect of mechanical and chemical weathering. Denudation is the process of removal of material by erosion and weathering. Land forms of such origin are:

**Pediment zone:** The pediment and related group consists of i) Pediment, ii) Pediment Inselberg Complex (PIC), iii) Pediplain Shallow Weathered (PPS), 0-10m, iv) Pediplan Moderate weathered (PPM), 10-20m, Total pediment zone is 224.30sq.km which about 71.21% with in corridor area. Sub classes pediment and pediment inselberg complex cover about 21042 sq.km which is 67.10%, with respect to groundwater occurrence and potential it is poor potential zone due to occurrence of semi-weathered rock and hard rock at surface level or at very shallow depth. These areas are the steep slopes of the hill ranges, elevated places with or without

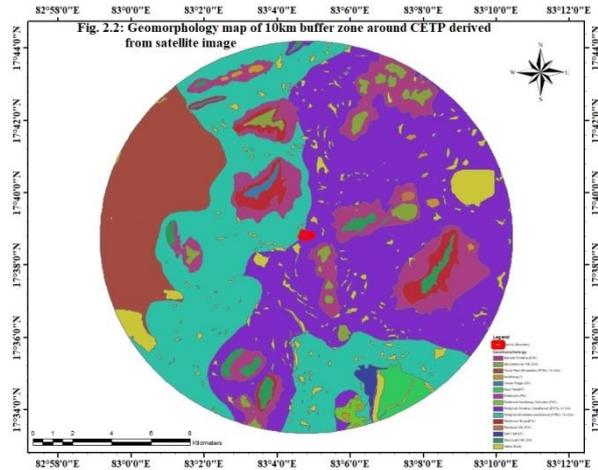


Table 2.1: Geomorphological Feature areas in the 10km Radius corridor

S.No	Names	Area Sq.km	%
1	Bazada Shallow(BJS)	0.23	0.07
2	Denudational Hill (DH)	3.29	1.05
3	Flood Plain Moderate (FPM), 10-20m	6.53	2.08
4	Inselberg (I)	2.03	0.65
5	Linear Ridge (LR)	22.08	7.04
6	Mud Flat(MF)	2.28	0.73
7	Pediment (PD)	198.44	63.28
8	Pediment Inselberg Complex (PIC)	11.98	3.82
9	Pediplain Shallow Weathered (PPS), 0-10m	3.76	1.20
10	Pediplan Moderate weathered (PPM), 10-20m	9.12	2.91
11	Piedmont Slope(PS)	33.91	10.81
12	Residual Hill (RH)	5.39	1.72
13	Salt Flat(SF)	3.52	1.12
14	Structural Hill (SH)	8.26	2.63
15	Water Body	2.79	0.89
		313.61	100.00

scrub. Pediplain shallow and pediplan moderate weathered zones have water bearing zones up

to 10m to 20m depth and these two cover about 11.98 sq.km which is 3.82%. These zones are extended between middle slopes to near to flood plains. With respect to groundwater potential, these zones come under moderate to good water potential aquifer zones.

Piedmont slope cover about 33.91sq.km which is about 10.81% of the corridor. It is weathered and semi-weathered rock buried under soil and mostly occurs in the mid slopes to foot hill region. The zone may have poor to moderate groundwater potential.

**Denudational and Structural Hills:** It is a highly dissected hill which has obliterated the structures. Denudational hills occupy an area of 3.29 sq.km and is about 1.05%. Residual hill is a small remnant hill, which has witnessed all forms of denudation. These hills covered 5.39 sq.km and is about 1.72%. Groundwater potential point of view, there may be very little dependable source.

Landform of structural origin is related to structural aspect of the area. Most of the landforms under this class have genesis related to underlying structure. The structural control could be active structures whose form is directly impressed on the modern landscape or ancient structural features whose influence on a modern landscape is due primarily to differential erosion. Structural hills cover an area of 8.26 sq.km and are 2.63% of the corridor. Major fracture/ fault zones in these structural hills are potential zones of groundwater, but their areal extent may be limited few tens of meters and length may be in kilometers.

**Land forms of fluvial origin:**

The word fluvial is used in Earth science to refer to processes and landforms produced by running water. As with other surficial processes, running water can either erode material from the earth's landscape, or deposit layers of sediment. The resulting landforms can thus be classified as either erosional landforms or depositional landforms. The incredible power of running water in carving various erosional and depositional landforms is well known. The fluvial dissection of the landscape consists of valleys and their included channel ways organized into a system of connection known as a drainage network. Drainage networks display many types of quantitative regularity

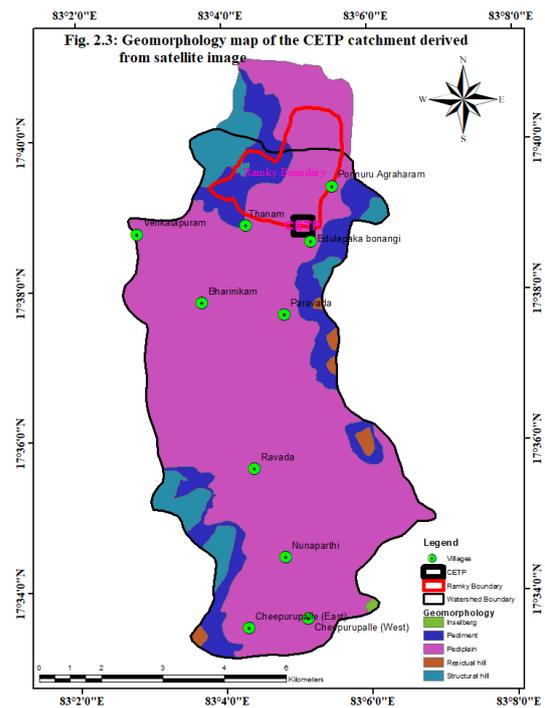
**Flood plain:** The surface or strip of relatively smooth land adjacent to a river channel formed by the present river in its existing regimen and covered with water when the river overflows its banks at times of high water. It is built of alluvium carried by the stream/river during floods and deposited in the sluggish water beyond the influence of the swiftest current. Identified flood plain- Flood Plain Moderate (FPM), 10-20m along the well-developed streams in the corridor area is about 6.53sq.km which is about 2.08%. Flood plains are supposed to be good

groundwater potential area and shallow water table is expected. Aquifer gets recharged from stream flows as well from the applied irrigation.

**Land forms of Marine Origin:** As the site of investigation is abutting coast, there is marine action continuously. In the 10km corridor it is extended to the coast. Within this corridor area the coastal land form- mud flat exists and is about 2.28 sq.km that come to 0.73%. Because the land form is marine origin, groundwater may be saline.

**2.3 Hydrogeomorphology of the CETP Catchment:** The dominant land form in the CETP catchment is pediment occupies 59.77 sq.km which is 92.15% of the catchment and the remaining area is hilly terrain that consists of inselbergs, pediplain, residual hill and structural hills shown in fig. 2.3. Areal extent of each feature is listed in table However, the pediment zone area may have poor to moderate groundwater potential.

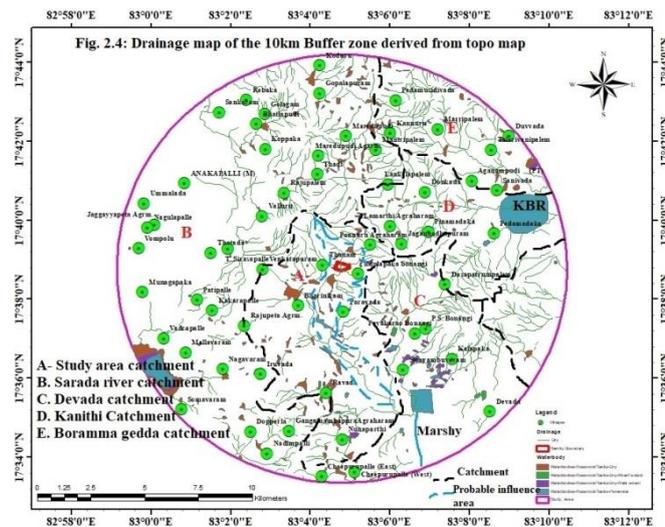
S.No	Name	Area Sq.km	Area in %
1	Inselberg	0.07	0.11
2	Pediment	59.77	92.15
3	Pediplain	0.05	0.08
4	Residual hill	2.66	4.10
5	Structural hill	2.31	3.56
		64.86	100.00



## 2.4 Drainage

Drainage discussed here is the water ways formed naturally by removal of a surface's water from an area with excess of water. A drainage basin is any area of land where precipitation collects and drains off into a common outlet, such as into a stream/ river/ bay, or other body of water. The drainage basin includes all the surface water from rain runoff and nearby streams that run downslope towards the shared outlet, as well as the groundwater underneath the earth's surface. Drainage basins connect into other drainage basins at lower elevations in a hierarchical pattern, with smaller sub-drainage basins, which in turn drain into another common outlet.

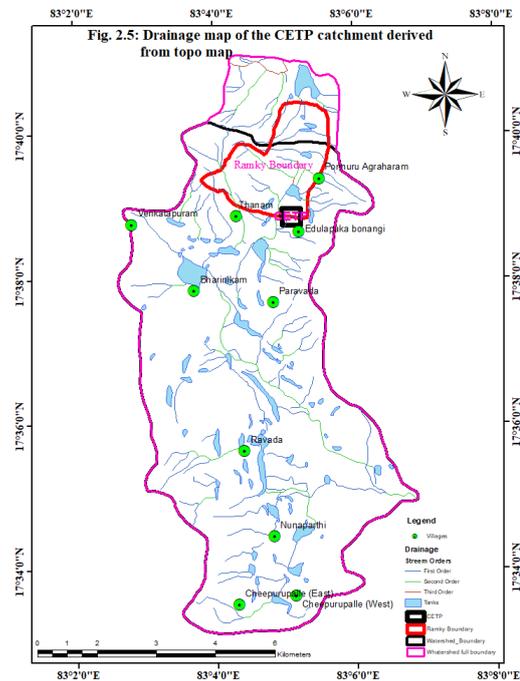
Drainage pattern and catchment areas of the 10 km corridor is shown in fig. 2.4. Broadly the corridor area is divided into 5 catchments. The watershed where CETP is located is marked as catchment-A, originating from the hills around JNPC, Parawada area and finally join with the mud flats/ marshy land at NTPC.



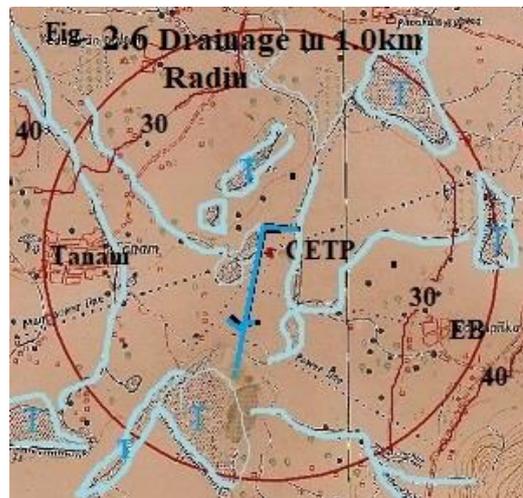
Catchment- B comes under Sarada river basin and nearly 40% of the corridor area falls in this basin. Main stream from this catchment join with the Kondakarla lake located in the SW edge part of the corridor. Catchment- C originate from some part of Devi konda, pedda konda and hillocks around Vennelapalem. Main stream from all these hills join in the mud flats at Devada and Palavalasa where NTPC ash ponds exists. Stagnated water from this region join with the salt water creek and finally join with sea at Mutyalampalem. Drainage for Catchment- D originates from northern parts of Devokonda and Peddakonda and southern part of Kannuru konda. The main drain is Pamu gedda that used to join Kanithi cheruvu but it is by passed the tank after converting it as Kanithi Balancing Reservoir (KBR). Borammagedda stream originates from Kannuru konda and drains along northern edge of the Steel Plant and joins into Pamu gedda down below the KBR near Peda Gantyada.

### 2.4.1. Drainage description of the Study area- Catchment - A:

The catchment where CETP located is about 65 sq.km that includes JNPC at the northern boundary, some industrial units around Parawada and NTPC at the southern end of the catchment is shown in fig.2.5. Catchment shape looks like a fern leaf extending from north to south for about 12.5 km up to NTPC and about 4.5km in the east-west. JNPC is at the northern boundary and is extending about 3.2km in N-S and 2.2km to 2.8km in E-W direction. CETP is at the southern boundary of JNPC. Blue lines are the streams of 1st, 2nd and 3<sup>rd</sup> streams and blue polygons are water bodies/tanks extracted from topo sheet. Before the industrialisation of that area there are at least 40 to 50 tanks used for irrigation. Satellite image of the some area show that some missing due to land conversion. Main drain of this catchment join became the creek at NTPC boundary due to sea water intrudes along the creek up to the ash ponds of NTPC.



**2.4.2: Drainage around CETP:** Drainage pattern 1.0km around the CETP is extracted from the topo sheet is shown in fig. 2.6. First order streams originate from some part of the Tadi konda on the west side and some part of Devikonda on the east side shown with light blue colour lines and water bodies with blue polygons. Surface topography contours 30m and 40m are present on the east and west side of CETP. Topographic contours show that the CETP is located in the centre of the localised valley through which the main stream originating from JNPC traverse across.



However, a drain is constructed along the north boundary of CETP to divert surface run off from the JNPC main stream catchment as well from the hill slopes of Edullapalli Bonangi from east side. All the runoff/ storm water is diverted through the newly constructed drain towards west direction and at the end point of the CETP site, the drain is along the west boarder of CETP till it reaches a tank which is about 200m distance from southern border as shown in fig.

2.6. Natural drain which is abandoned within the CETP is used to transport the effluent from the other Ramky industries through a HDPE conduit to various effluent treatment units for processing. Treated effluent is stored in 9 lined ponds in CETP area for required time to release it into specified place in the sea. Another HDPE conduit run through subsurface along the drain to carry the treated water from the ponds further for about few kilometres towards sea till it reached the destination.

After establishing the various industrial units in the Ramky Pharma (JNPC), surface runoff/ storm water from various units join the lined drains made outside each industry along the roads. Runoff/ storm water may consists of rainwater mix with effluent spills from the individual units and finally join with the main natural drain that travers from north to south in JNPC which is diverted along the north and west border of CETP. Thus the storm water/ runoff from each unit in most part of the JNPC drain through the main drain that traversing through the north and west boarder of CETP and finally join a tank/ pond located at the southern tip of the JNPC.

### 3. HYDROMETEOROLOGY

**3.1 Rainfall & Climate of District:** Climatologically the district experiences tropical sub-humid type of climate with moderate summer and good seasonal rainfall. The southwest monsoon sets in the second week of June and lasts till September end. October and November receive rainfall from northeast monsoon. Winter season with cool and fine weather prevails from December to February followed by summer season upto early June. The average annual rainfall of the district is 1116 mm. and monthly rainfall ranges from nil rainfall in January to 207.5 mm in October. October is the wettest month of the year. The mean seasonal rainfall distribution is 673.5 mm. in southwest monsoon (June-September), 271.8 mm. in northeast monsoon (October-December), 10.9 mm. rainfall in Winter (Jan-Feb) and 159.6 mm in summer (March – May). The percentage distribution of rainfall, season-wise, is 60.36% in southwest monsoon, 24.36 % in northeast monsoon, 0.97 percentage in winter and 14.3 % in summer. The annual rainfall ranges from 708 mm in 2002 to 1703 mm in 2010. The annual rainfall departure ranges from -37 % in 2002 to +53% in 2010. The southwest monsoon rainfall contributes about 60 % of annual rainfall. It ranges from 459 mm in 2002 to 864 mm in 2006. The year 2002 and 2009 experienced drought conditions in the district as the annual rainfall recorded in these two years is 37 % and 34% less than the long period average (LPA) respectively. The cumulative departure of annual rainfall from LPA indicates that the rainfall departure as on 2011 is negative i.e. 40%, showing deficit rainfall. The annual rainfall during 2012 is 1218 mm.

### 3.2 Rainfall in the Parawada Mandal

The district has the benefit of receiving rainfall during both the South-West and North-East Monsoon periods. While the Normal Rainfall of the district for the South-West Monsoon period is 673.5 mm. and for the North-East Monsoon period is 271.8 mm. The Rainfall received during the Winter Period and Hot Weather Period is negligible, their respective normal being 10.9 mm. and 159.6 mm. The Annual Normal Rainfall of the district is 1116 mm. The nearest rain gauge to the study area is Parawada and rainfall data of neighbouring mandala is presented in table 3.1.

Table 3.1 Rainfall data for Parawada and surrounding Mandals that cover the study area

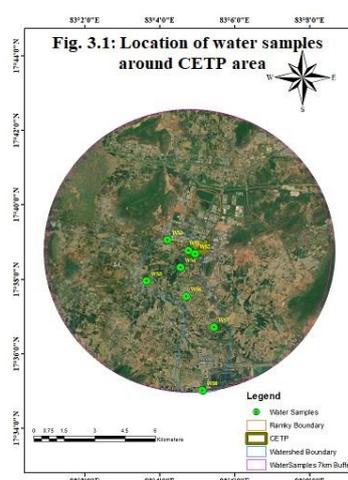
S.No	Mandal	Geographical coordinates		Normal rainfall(mm)
		Latitude	Longitude	
1	Parawada	N17 <sup>0</sup> 37'35"	E83 <sup>0</sup> 04'55"	1130.5
2	Pedagantyada	N17 <sup>0</sup> 39'46"	E83 <sup>0</sup> 12'29"	1086.3
3	Munagapaka	N17 <sup>0</sup> 38'05"	E82 <sup>0</sup> 59'47"	1183.0
4	Anakapalli	N17 <sup>0</sup> 40'48"	E82 <sup>0</sup> 01'04"	1105.7
5	Average			1126.4

Source: Statistical Hand book of Visakhapatnam District

The above data showing that the average annual rainfall of the study area is 1126.4mm is near to the district average annual rainfall of 1116mm.

### 3.3 WATER QUALITY OF THE STUDY AREA

The water resources, both surface and groundwater play an important role in the development of the area. Likewise, the water resources of the area have been studied to establish the current status of water quality in the area. The parameters of prime importance were selected under physical, chemical inorganic, chemical organic groups. Groundwater samples are collected from 6 open wells, one bore well and surface water source from the downstream pond of CETP are collected. The water samples were collected in pre-treated sampling cans and transported to laboratory for analysis. Samples are collected during post monsoon of 2020 in the November month and pre monsoon of 2021 during the last week of March 2021. Due care was taken during sampling & transportation of these samples. Locations of the water samples are shown in fig. 3.1.



Sampling locations were selected on basis of:

- a) Drainage pattern and catchment
- b) Location of residential, irrigation and industrial areas representing different activities
- c) Likely areas those can represent baseline conditions

Ground water samples were collected from 7 locations and surface water samples were collected from one location. The locations of the water samples collected in the study area are furnished in the table 3.2.

**Table: 3.2 Water Sampling Stations**

<b>Code</b>	<b>Station</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Source of collection</b>
WS1	CETP	83.04'47.67	17.38'46''.48	Ground water Bore well
WS2	CETP	83.04'58''.26	17.38'40''.82	Ground water Open well
WS3	Thanam	83.04'14''.02	17.39'3''.90	Ground water Open well
WS4	Bharanikam	83.03'40''.47	17.37'57''.04	Ground water Open well
WS5	Parawada	83.04'43''.56	17.37'32''.28	Ground water Open well
WS6	Vennelapalem	83.05'28''.16	17.36'43''.00	Ground water Borewell
WS7	NTPC	83.05'09''.36	17.35'00''.69	Ground water Open well
WS8	Thanam	83.04'34''.79	17.38'19''.04	Surface water Tank

The collected samples were analyzed in accordance with “Standard Methods for Examination of Water and Wastewater Analysis” published by APHA. Analysis results are listed in table 3.3

Table: 3.3 Ground water quality results of post monsoon- 2020 and pre-monsoon of 2021

Table 3.3 contd...

Sampl ing Site	pH		Conductivity ( $\mu$ mhos)		TDS mg/l		HCO <sub>3</sub>		Cl mg/l	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre
WS1	8.30	8.5	1951	1340	1101	884	353	250	371	55.3
WS2	8.40	8.5	2142	1360	1359	898	231	110	85	110
WS3	7.90	8.6	2340	1450	1544	957	73	50	96	147
WS4	7.90	8.0	1690	2280	1115	1504	268	60	443	60
WS5	8.10	7.5	1770	1820	1168	1201	73.2	150	31.9	100
WS6	8.20	8.0	1864	1780	1208	1175	140	70	130	154
WS7	8.00	8.1	1890	1640	1247	1082	250	1.4	220	43.4
WS8	8.10	8.4	1856	2340	1308	1544	345	50	167	30

WS1 (Bore well) and WS2 (Open well) are in the CETP site

Sampli ng Site	NO <sub>3</sub> mg/l		Na mg/l		K mg/l		Ca mg/l		Mg mg/l		TH mg/l	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre
WS1	0.074	0.01	139	138	51.7	0.8	38.40	48	102.65	127.9	384	644
WS2	0.078	-	63.94	74.0	1.17	1.2	41.60	89.6	103.46	66.4	326	496
WS3	0.080	-	736	31	1.95	3.2	44.80	30.4	104.43	59.5	292	320
WS4	0.051	-	287.5	6.9	5.46	0.39	54.40	118.4	70.31	77.1	288	612
WS5	0.070	0.06	12.19	73.3	2.73	1.56	33.60	57.6	109.31	171.8	276	848
WS6	0.062	0.02	87	87	63	35	34.20	48	95.60	104.4	292	548
WS7	0.060	-	158	135	20	1.2	32.00	38.4	200.08	52.7	492	312
WS8	0.068	0.02	80	14	20	0.78	34.20	75.2	110.62	154.2	248	820

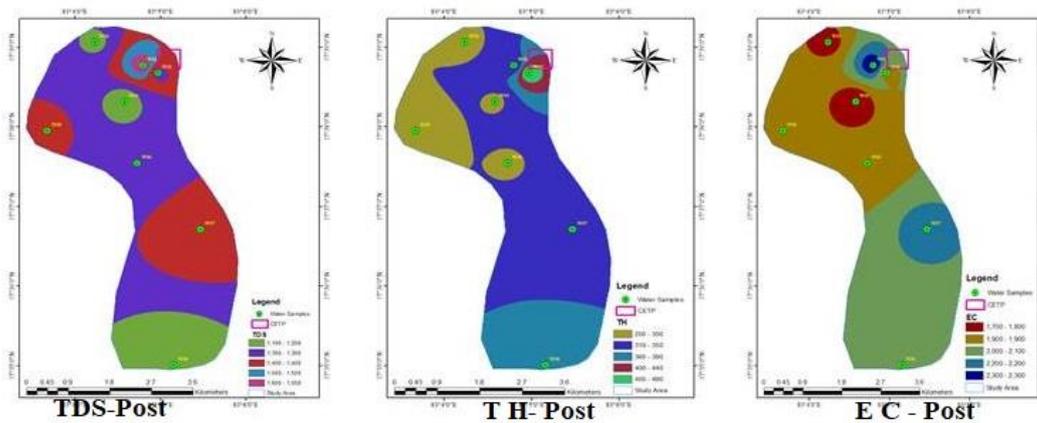
### 3.3.1 Ground Water Quality of the Study Area

The above listed parameters aerial distribution thematic maps for selected parameters for post and pre monsoon are shown in fig. 3.2.

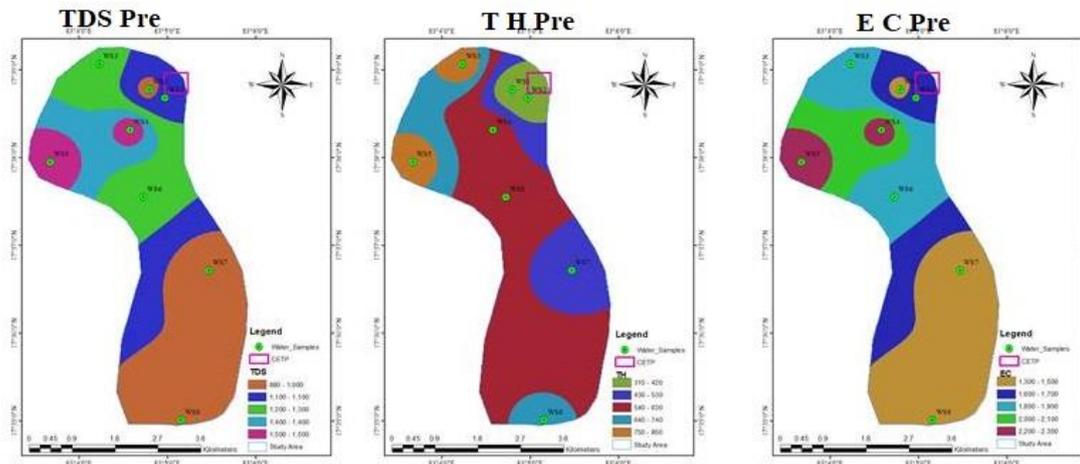
- The pH limit fixed for drinking water samples as per IS:10500 is 6.5 to 8.5. During the study period, the pH of the groundwater was found varying between 7.9 and 8.4 during post monsoon and the same variable between 7.5 and 8.6. The pH values for all the samples collected in the study area during study period were found to be within the acceptable limits.
- The desirable limit for total dissolved solids as per IS:10500 is 500 milligrams per litre (mg/l) whereas the permissible limits in absence of alternate source is 2000mg/l. In groundwater samples collected from the study area, the total dissolved solids (TDS) were found to be varying between 1101 mg/l and 1544 mg/l during post monsoon and varies between 884 mg/l and 1504 mg/l indicates

TDS values are beyond desirable limits. The TDS of all the samples were below the permissible limit of 2000 mg/l.

- The desirable limit for Chloride is 250 mg/l as per IS: 10500 whereas the permissible limit of the same is 1,000mg/l. The Chloride levels in the groundwater samples collected in the study area were ranging from 85-443 mg/l during post monsoon and during pre-monsoon it is between 30mg/l and 147mg/l. Five samples are within the desirable limits and 3 samples are within the permissible limits during post monsoon and all the samples are within desirable limits during pre-monsoon. All the samples are within permissible limits.
- The desirable limit as per IS:10500 for hardness is 300 mg/l, where as the



**Fig. 3.2: Aerial distribution of some chemical parameters in CETP Catchment Area**



permissible limit for the same is 600 mg/l. In the groundwater samples collected from the study area, the hardness was found to be varying from 248 mg/l to 492 mg/l in which 5 samples are within desirable limits during post monsoon and 3 samples are within the permissible limits. During pre-monsoon samples value range between 312mg/l to 848mg/l indicates all are above desirable limits but within the permissible limits.

- Nitrates (NO<sub>3</sub>) in both the seasons is less than 0.08mg/l indicates that the parameter is within the permissible limits.

An overview of the results obtained reveals that none of parameters were found beyond the permissible limits of IS: 10500 Drinking Water Standards during post monsoon of 2020 and pre-monsoon of 2021.

#### 4. HYDROLOGY AND SURFACE WATER UTILIZATION

**4.1 Irrigation Sources in the District:** Visakhapatnam district is covered with 2 major basins Sarada, Varaha and Mehadrigedda, completely within the district and Gosthani and Thandava basins covered partially. All the above said rivers originate from the eastern part of the eastern ghats in Visakhapatnam Dt. Reservoirs are constructed across the above said rivers in the foot hill regions and water being used for irrigation and water supply to Visakhapatnam town from Thatipudi, Raiwada and Mehadrigedda reservoirs. Besides the above said reservoirs there are hundreds of irrigation tanks, canals from river diversions, tube wells and open wells and small lift irrigation sources. The area irrigated under various modes of source is given below:

Canals	:	53657 Hec.
Tanks	:	32587 Hec.
Tube wells	:	27,667 Hec.
Dug wells	:	11,921 Hec.
Lift	:	89 Hec.
Other sources	:	24,655 Hec.
Gross Irrigated area:		1,51,251 Hec.

Data source: Statistical hand book of Visakhapatnam Dt.

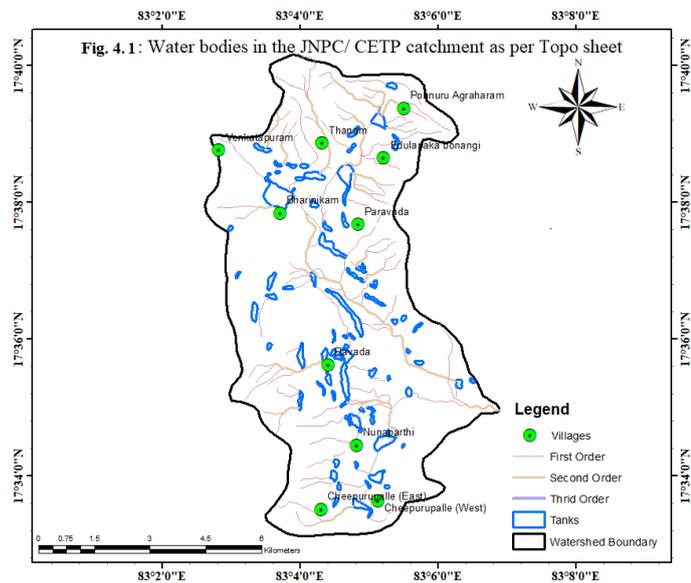
**4.2 Water Sources from Outside the District:** Surface water source from the reservoirs Thatipudi, Raiwada and Mehadrigedda that exists within the district not only irrigating thousands of acres in their ayacut but also became prime drinking water supply sources to Visakhapatnam city. Total water required for the Visakhapatnam Steel Plant is about 70 MGD being supplied from the Yeleru reservoir is around 150km distance through a open canal located in East Godavari. During summer when there is insufficient reserves in the reservoir, required quantity of water being augmented from Godavari river bed which is about 50km further upstream from Yeleru canal through infiltration wells. This is the major source drawn from inter district. JNPC also drawing about 10 MLD from Yeleru canal.

**4.3 Surface water Utilisation in Parawada mandal:** Irrigation in Parawada mandal is through surface water bodies like tanks and ponds and groundwater source from tube wells and open wells. Area irrigated under various sources is listed below.

Canals	:	Nil
Tanks	:	171 Hec.
Tube wells	:	183 Hec.
Dug wells	:	39 Hec.
Lift	:	Nil
Other sources	:	Nil
Gross Irrigated area:		608 Hec.

Data source: Statistical hand book of Visakhapatnam Dt. (2016)

The above data shows that irrigation in the mandal being carried through tanks, tube wells and open wells. Water bodies present in the JNPC/ CETP catchment area is shown in fig. 4.1. Blue polygons are the tanks mostly concentrated in the central part of the watershed along the main stream course. There are more than 60 water bodies shown in the topo sheet, but at present these may be reduced to less than 20 due to industrialization/ urbanization as well the agricultural land also converted as

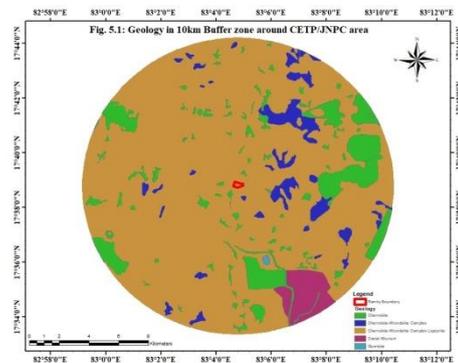


settlement area. However, irrigation area is limited to change of land use and at present the gross irrigated area is only 608 Hec. Even though some water bodies are not disturbed, the ayacut area under these converted as urban land. These surface water bodies may be getting polluted by the liquid/ solid waste being generated in the urbanized lands. However, stored water in these water bodies may be useful for groundwater recharge.

## 5. GEOLOGY

### 5.1 Geology in the 10km Radius:

It is very essential to know the geology of the region where hydrogeological investigations being carried because groundwater occurrence, distribution and movement depend on the type of rock and its weathering nature. Secondary data on geology is acquired from GSI published maps. Besides the secondary data, primary data is also collected during our field visits for land use hydrogeomorphology and water table observations. A buffer zone map of 10km radius around the JNPC/ CETP area is presented in fig. 5.1. The area



consists of Crystalline Basements complexes of Archaean age as well coastal environment. Crystalline rocks consists of khondalite, charnockite, quartzite and leptynite rocks is shown in fig. . Geomorphology of the area is buried pediment, inslebergs complex with isolated hills and hill ranges of khondalite rock with NE to SW and E to W strike direction with dip variable between  $60^{\circ}$  to  $80^{\circ}$  due south. Nearly 80% of the area consists of khondalite- charnockite-leptinite rock complex is shown in dark brown colour. In this rock complex zone top layer of the rock formations consists of khondalite and charnockite/ leptinite may present as intrusive rocks at shallow or deeper depth. As per the field observations, this rock is present in the north and NW part between 5km and 10km radius. Hill ranges present around Rabaka village are charnockite hills where black stone road metal being quarried. At Lankelapalem junction the hill range belong to khondalite rock between 290m and 40m altitude and below the 40m black rock (charnockite) being quarried below 20m altitude. Leptinite rock is present as inselberg complex (rock outcrops at ground level) between lankelapalem and Aganampudi.

Charnockite rock area is shown in green colour where the entire rock formation from top surface to deeper the same rock exists. Blue colour area is khondalite-charnockite complex area where top layers of geological formation consists of khondalite followed by charnockite rock as intrusion body at shallow or deeper depth. At Edullapalli Bonangi small hill mounds cross section shows that top 10m to 12m consists of khondalite rock followed by charnockite rock where black metal being quarried. Quartzite rock appears as intrusive veins in khondalite rock. These are observed in some parts of Thadikonda and Devi konda.

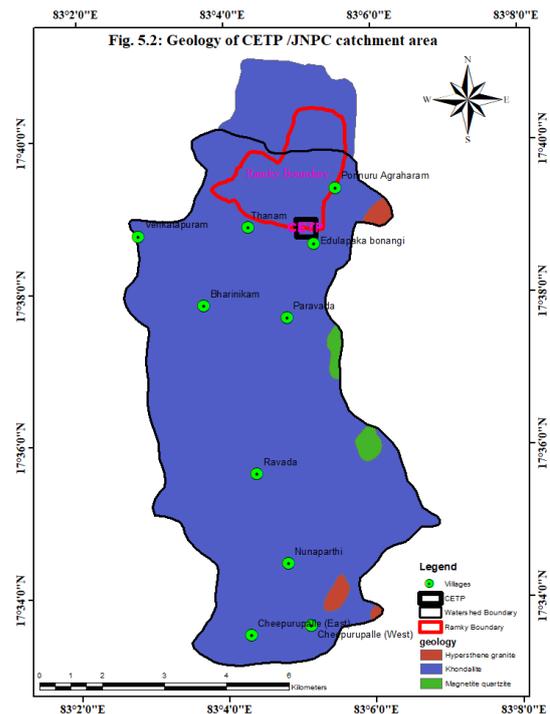
Coastal alluvium is shown in purple colour and is to the SE of the study area between 8km and 10km distance.

## 5.2 Geology in the JNPC/CETP Catchment: The study area surrounded by Thanam hill

village on the west, bodi konda on the south, parawada hill and devikonda on the east side. Geology map of the CETP catchment is shown in fig.5.2, Nearly 95% of the catchment area covered by khondalite rock. Small patches of hypersthene granite and magnetite quartzite are observed along the eastern part of the catchment.

With respect to groundwater occurrence, khondalite rock will have good potential due to its high weathering and fracturing nature to deeper depth of rock mantle. Charnockite and leptinite rocks are hard and prone to low weathering and groundwater potential may be limited. Coastal

alluvium consists of mud flats, salt pans and beach sands. Groundwater in this zone mostly saline and freshwater in the coastal sands may be very shallow and thin layer.



## 6 HYDRO-GEOLOGICAL ASPECTS

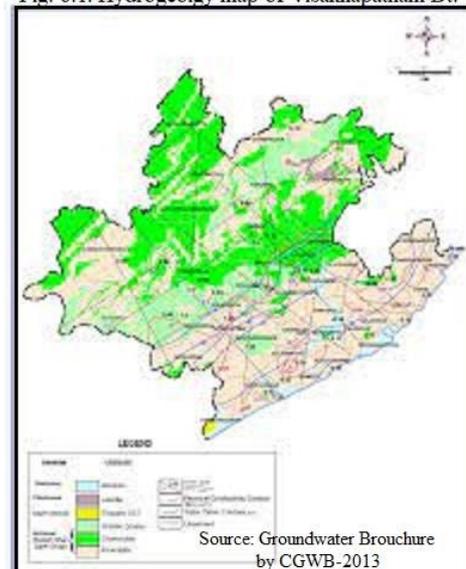
### 6.1 Hydrogeology at District level: The district is underlain by variety of geological

formations from the oldest Archaeans to Recent Alluvium. The Archaean group of rocks includes Khondalites and Charnockites of Eastern Ghat super group and Granitic gneisses of Migmatite group. The Gondwana rocks which are represented by sandstones are in very limited aerial extent. The recent alluvium is prevalent along the rivers. Prominent lineaments are trending in NE-SW, NW-SE and ENE-WSW (Fig.6.1).

Groundwater occurs in almost all geological formations. From the ground water point of view, the aquifers in the district can be broadly classified into

hard formations (khondalites, charnockites, quartzites, granitic gneisses etc.) and soft formations (sand stones and alluvium). Ground water occurs under unconfined to semi-confined conditions in the hard formations, while it occurs under unconfined to confined conditions in soft formations. The yields in the weathered zones of hard formations range from

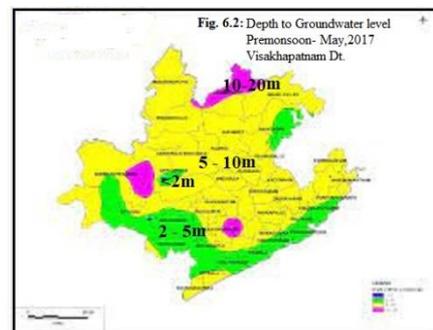
Fig. 6.1: Hydrogeology map of Visakhapatnam Dt.



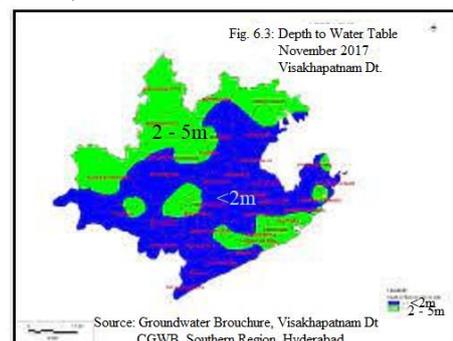
25 to 100 m<sup>3</sup>/day. The bore wells drilled in the hard formations, generally tap the fractured and fissured zones. The yields of the bore wells in these formations range between 5 to 25 m<sup>3</sup>/hr. Sand stones are exposed in the small isolated places around Nakkavanipalem and Elamanchili. In these formations, ground water occurs under both unconfined and confined conditions. The depth of dug wells in alluvium formations ranges from 2 to 10 mbgl and the yields generally ranges from 40 to 250 m<sup>3</sup>/day. The depth of filter points/tubewells varies from 9 to 35 m with discharges ranging from 15 to 30 m<sup>3</sup>/hour. The transmissivity values of the aquifers in the consolidated formations generally vary from 1 to 772 m<sup>2</sup>/day, whereas specific capacity ranges from 1 to 290 lpm/mdd.

## 6.2 Water Level Fluctuation

Based on the water level data (year 2017) of ground water monitoring wells, pre monsoon depth to water levels map is prepared and presented in Fig.no.6.2. The depth to water level maps show varied water level zones due to underlying terrain and also different geological set up with complex type of hydrogeomorphical structures present in the district. Premonsoon (May, 2017) depth to water level map reveals, in general, the water levels are deep particularly in the hilly area of the district. Depth to water levels varies from 5 to 10 mbgl, except at Chintapalli, where water level recorded 15.78 mbgl. In the southern part of the district i.e., near to the coast, the water levels are comparatively shallow- 2m to 5m along the coast and adjacent to the river courses.



During the post monsoon period (November, 2017), in general, the water levels follow nearly same trend as shown fig. 6.3. Water levels in the most part of northern area show less than 5 m. except at Potinamallaya Palem (5.80 m). The Shallow water levels, <2m were observed in South-Western part of the district. The shallow water level was recorded at Addaroddu (0.30 m). The shallow water levels in the area might be due to location of wells close to surface water bodies/ in topographic low levels. From the trend of both pre and post monsoon levels it can be safely concluded that the area, in general, is not prone to water logging. The seasonal water level fluctuation varies from 0.03 m. (G.K.vedhi) to 14.22m. (Chintapallii). In general, the seasonal fluctuation is more in the hilly area compared to coastal plains.



### 6.3 Ground Water Resources:

As per the present ground water resource estimation (2008-2009) the total annual ground water recharge in the district is estimated to be 78,383 ha.m. (Command area = 11,794 ham and Non Command area = 66,689 ham) and the net annual ground water availability in the district after allowing the unavoidable natural discharges is 71689 ham (command area 10683 ham. and in Non command area 61,006 ham.). The gross ground water draft for all purposes is estimated as 23,100 ham out of which 6300 ham is in command area and 16,800 ham is in Non Command area. Thus the ground water available for future irrigation needs after allocating the ground water for future domestic and industrial needs is 38,264 ham in the entire district, which is 3,282 ham in command area and 34,982 ham in non command areas of the district. Groundwater potential in the surrounding mandals of the study area is given in Table- 6.1

Table 6.1: Mandal Wise Ground Water Resources in 10km Radius around study area  
(As on March 2009)

1	Administrative unit/ District	Sub unit	Net annual ground water availability (ham)	Existing gross ground water draft for all uses(ham)	Ground water balance (ham)	Stage of ground water development %	Category
1	Parawada	Command	0	0	0	0	
		Non Com	1459	486	973	33	Safe
		Total	1459	486	973	33	Safe
2	Munagapaka	Command	225	132	93	59	Safe
		Non Com	665	302	363	45	Safe
		Total	890	434	456	49	Safe
3	Pedagantyada	Command	0	0	0	0	
		Non Com	1212	81	1131	7	Safe
		Total	1212	81	1131	7	Safe
4	Anakapalli	Command	746	444	302	60	Safe
		Non Com	1076	495	581	46	Safe
		Total	1822	939	883	52	safe

Ground water utilization in the district is 32% of the total groundwater potential for all the purposes. Average groundwater utilization in 10km radius of the study area is around 35% in which Anakapalli and Munagapaka mandals utilization is about 50% due to heavy irrigation. However, district and mandals groundwater utilization is in safe zone and lot of groundwater potential available for future exploration.

### 6.4 Hydrogeological Condition in the JNPC/ CETP Catchment

Entire catchment of JNPC/CETP catchment comes under khondalite terrain. Nearly 20% of the catchment area consists of settlements and real estates and equal area under hills and forest. Still there is little area being used for agricultural activity. Earlier irrigation was carried through tank storage water and groundwater from open wells. In the recent years groundwater being

used through tube wells for irrigation as well for industrial and domestic needs in the residential area. However, JNPC drawing about 10 MLD from Yeleru canal for industrial needs. Groundwater also being explored by the individual industrial units for their domestic and industrial needs.

### 6.5 Water Level Fluctuation around JNPC/CETP area

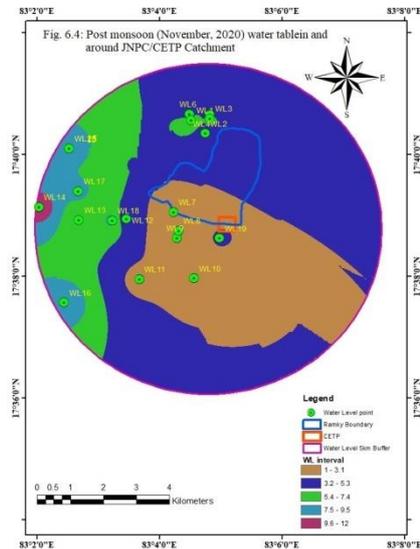
Water table measurements have been carried in the observation wells established in and around the catchment area during the post monsoon of 2020 (November, 2020) and pre monsoon season of 2021 (April, 2021). Nineteen open wells are selected for water level observations and the data is presented in table 6.2.

Table 6.2: Post and Pre monsoon Groundwater levels in and around JNPC/CETP Catchment

Well No.	Village	Type of well	Latitude	Longitude	Total Depth (m)	Water Level -Post (m)	Water Level -Pre (m)	WL diff. post& pre(m)
WL1	Kothapalem	OW	83 <sup>0</sup> 04'42.8"	17040'18.9"	11.82	5.42	11.2	5.78
WL2	Thadi Colony	OW	83 <sup>0</sup> 04'44.9"	17 <sup>0</sup> 40 '20.8"	11.48	8.95	11.02	2.07
WL3	ChinnaThadi	OW	83 <sup>0</sup> 04'49.6"	17 <sup>0</sup> 40'35.6"	10.64	3.5	8.60	5.10
WL4	ChinnaThadi	OW	83 <sup>0</sup> 04'49.5"	17 <sup>0</sup> 40'35.4"	9.00	6.8	8.70	1.90
WL5	ChinnaThadi	OW	83 <sup>0</sup> 04'49.4"	17 <sup>0</sup> 40'35.5"	7.25	5.85	6.21	0.36
WL6	PeddaThadi	OW	83 <sup>0</sup> 04'29.8"	17 <sup>0</sup> 40'39.8"	8.00	2.20	7.90	5.70
WL7	Thanam	OW	83 <sup>0</sup> 04'14.1"	17 <sup>0</sup> 39'03.25"	10.60	2.50	8.50	6.00
WL8	Thanam	OW	83 <sup>0</sup> 04'18.9"	17 <sup>0</sup> 38'44.9"	6.50	1.10	3.25	2.15
WL9	Thanam	OW	83 <sup>0</sup> 04'17.4"	17 <sup>0</sup> 38'37.4"	6.50	1.00	6.40	5.40
WL10	Paravada	OW	83 <sup>0</sup> 04'34.1"	17 <sup>0</sup> 37'58.1"	6.30	2.10	5.00	2.90
WL11	Bharnikam	OW	83 <sup>0</sup> 03'40.9"	17 <sup>0</sup> 37'57.1"	5.40	2.50	4.40	2.90
WL12	Venkantapuram	OW	83 <sup>0</sup> 03'28.0"	17 <sup>0</sup> 38'56.4"	6.40	3.25	5.40	2.15
WL13	Venkantapuram	OW	83 <sup>0</sup> 02'41.36"	17 <sup>0</sup> 38'41.55"	7.90	6.00	7.80	1.80
WL14	Sirasapalli	OW	83 <sup>0</sup> 02'02.38"	17 <sup>0</sup> 39'08.36"	14.0	11.65	13.60	1.95
WL15	GorlaAnakapalli	OW	83 <sup>0</sup> 01'25.67"	17 <sup>0</sup> 39'26.51"	7.75	2.85	4.00	1.25
WL16	Rajupet	OW	83 <sup>0</sup> 02'16.86"	17 <sup>0</sup> 37'22.0"	13.45	8.90	10.90	2.00
WL17	Ramarayadupeta	OW	83 <sup>0</sup> 02'40.86"	17 <sup>0</sup> 39'23.77"	10.00	7.75	9.90	2.15
WL18	Valluru	OW	83 <sup>0</sup> 02'32.02"	17 <sup>0</sup> 40'06.00"	8.70	4.30	8.50	4.20
WL19	CETP	OW	83 <sup>0</sup> 04'58.6"	17 <sup>0</sup> 38'40.86"	7.62	3.30	5.45	2.15

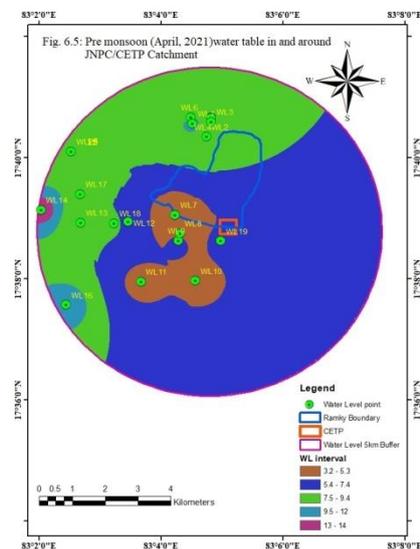
Even though there are bore wells in the study area, it was not possible to take measurements in them. Most of the open wells were irrigation wells and because of change of land use most of them are idle. Some of them are in the low lying areas and some are in the foot hill region. During post monsoon season depth to water table varies between 1.0m at Tanam almost in the centre of the valley and 11.65m at Sirasapalli over the hill flank.

Based on the water level data (year 2020) of ground water monitoring wells, post monsoon depth to water levels map is prepared and presented in Fig.6.4. Area covered is about 2km radius from CETP. Brownish colour patch is the area where water table is between 1.0m and 3.1m that include CETP and Tanam villages and also follow the valley portion. Water table in the blue colour varies between 3.2m and 5.3m that cover entire JNPC area, Bharanikam and the area along the main stream course. More than 5m depth of water table is observed on the west side of the study area covering the villages Tadi, Sirasapalli, Rajupeta and Venkatapuram.



Water table in the pre monsoon varies between minimum depth of 3.25m and maximum depth of 13.60m is at the same locations of minimum and maximum recorded during post monsoon.

Pre monsoon period (April, 2021) water table variations are shown in fig. 6.5. depth to water table varies between 3.2m and 5.3m is recorded at the villages Tanam, Bharanikam and in the valley portion at Parawada. Blue colour represent the water table region between 5.4m and 7.5m depth that cover the south and east portion up to 2km radius of CETP. Northern part of JNPC and west side of the study area has water table more than 7.5m depth. At Sirasapalli village depth to water table is beyond 13.60m depth. Water level maps show varied water level zones due to underlying terrain and also different geological set up with complex type of hydrogeomorphical structures present. In general, the water levels are deep particularly in the hilly area of the region.



The shallow water levels near Tanam, Bharanikam and the wells adjacent to main stream course in the area might be due to location of wells close to surface water bodies/ in topographic low levels. As per the trend of the pre and post monsoon water levels it can be safely concluded that the area, in general, is not prone to water logging. The seasonal water level fluctuation

varies from 0.36 m. (China Thadi) to 6.00m. (Tanam). In general, the seasonal fluctuation is more in the hilly area compared to valley areas and coastal plains.

## 7. SUBSURFACE INVESTIGATION FOR LITHOLOGY AND AQUIFERS DELINEATION

In order to determine the subsurface lithology and identify the aquifer zones, surface geophysical method Vertical Electrical Soundings have been conducted. Detailed investigation is explained below.

**7.1 Subsurface lithological profile in CETP Area:** In the earlier chapters, land use, geology, geomorphology, climate and rainfall conditions, hydrogeological aspects- groundwater potential, water table fluctuations are dealt. This chapter mainly concentrated only in the CETP area to know the subsurface layers include aquifer zones. Geophysical surficial exploration method- Electrical resistivity soundings have been conducted at number of places and sub layers have been demarcated. In this method physical property of soil/ rock is measured that include resistivity of the material, fluid filled in the pore spaces of the material and quality of fluid. Because the industry is mainly dealing with treatment of liquid effluent discharged from all the industrial units in JNPC.

**7. 2 Resistivity Method for delineation of subsurface layers:** Vertical Electrical soundings (VES) have been conducted in the CETP area only covering the entire Plant, leaving the ponds, processing units and roads wherever concretisation is carried. VES are carried as per the IS

code 3043:1987 electrode configuration to the subsurface layers up to 70m to 80m depth. VES locations are noted with GPS and are transferred on to the google image of CETP shown in fig. 7.1. It was possible to collect conduct the VES mainly in the open areas, greenbelt and along the margins



of the roads where the soil is exposed. Broadly, different land use in CETP measured from google image are as follows:

Total CETP area: 16.6024 Hec.

Ponds area: 3.724 Hec.

Processing Units: 4.166 Hec.

Green belt& open: 5.9094Hec.

Roads& others: 2.803 Hec.

VES are conducted at 23 locations. Each sounding is interpreted and layer thicknesses are arrived and designated synthesizing the geological hydrogeological field observations. Some of the field photos in the site of investigation is shown as mosaic in fig. 7.2. Resistivity

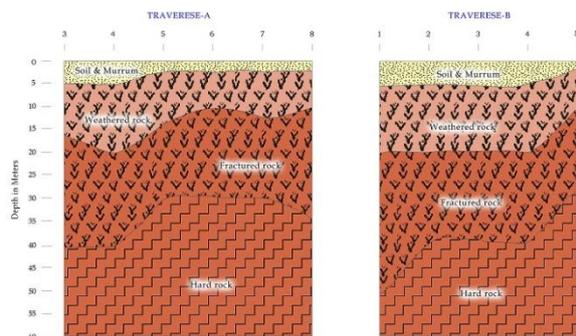


**Fig. 7.2:** Land use in the open space within the CETP area where soil exposed and can be used for Rainwater Harvesting and Greenery development  
 B. Green belt margin along Entance Road bt. processing units and ponds  
 C. Storm water drain that collecting roof and road runoff.  
 D. Road run off allowed into road margins consists of soil  
 E. Greenbelt on either side of the main entrence road also deep storm water drain in between road and greenbelt.

soundings not only help in identifying the subsurface layers, but also indicate quality of groundwater that saturated the aquifer zones. Vertical cross sections are prepared grouping the soundings as traverses. Four vertical cross sections shown in traverses A.. to D in figs, 7.3a to 7.3c.

**7.2.1 Vertical cross section along Traverses A&B:** Six soundings have been conducted along

traverse- A and the vertical cross section (Fig. 7.3a)shows that the top soil thickness varies between 3m and 5m followed by weathered rock which is the shallow unconfined aquifer zone extend up to 12m to 20m depth. Fractured rock zone which is the deep aquifer zone may be under semi confined condition noticed between 12m to 20m and 30m to 40 m depth. Beyond 40m depth hard rock is noticed.



**Fig. 7.3a:** Vertical Lithological cross sections along Traverses- A and B

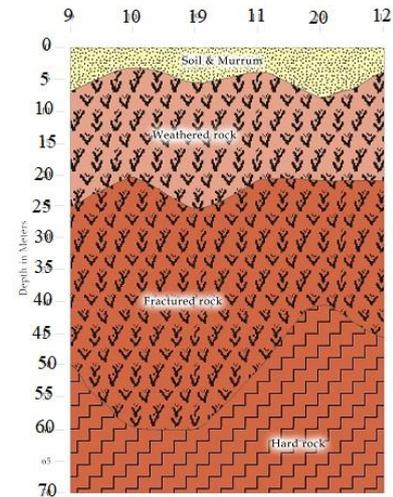
Vertical cross section of traverse- B: Five VES soundings have been conducted along this traverse. Vertical cross section (fig. 7.3a) shows that the top soil thickness varies between 2m

and 5m followed by weathered rock which is the shallow unconfined aquifer zone extend up to 15m to 20m depth. Fractured rock zone which is the deep aquifer zone may be under semi confined condition noticed between 15m to 20m and 30m to 50 m depth. Deep fracturing up to 50m depth is noticed at VES-1. Beyond 30m/50m depth hard rock is noticed.

### 7.2.2 Vertical cross section along Traverses C: Six VES

have been conducted along this traverse. Vertical cross section of traverse- C (fig. 7.3b) shows that the top soil thickness varies between 3m and 6m followed by weathered rock which is the shallow unconfined aquifer zone extend up to 20m to 25m depth. Fractured rock zone which is the deep aquifer zone may be under semi confined condition noticed between 20m to 25m and 45m to 60 m depth. Deep fracturing up to 60m depth is noticed between VES-9 and 19. Beyond 45m/60m depth hard rock is noticed.

Fig. 7.3b: Vertical cross section along Traverse-C

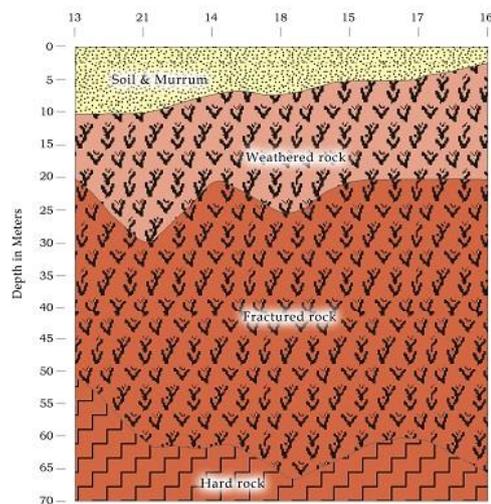


### 7.2.3 Vertical cross section of traverse- D: Seven VES have been conducted along this

traverse. Vertical cross section of traverse- D (fig.

7.3c) shows that the top soil thickness varies between 2m and 10m followed by weathered rock which is the shallow unconfined aquifer zone extend up to 20m to 30m depth. Fractured rock zone which is the deep aquifer zone may be under semi confined condition noticed between 20m to 30m and 50m to 65 m depth. Deep fracturing up to 65m depth is noticed between VES-14 and 16. Beyond 50m/65m depth hard rock is noticed. In general depth to hard rock is deeper as we approach from

Fig. 7.3c: Ver. Cross section- Traverse- D

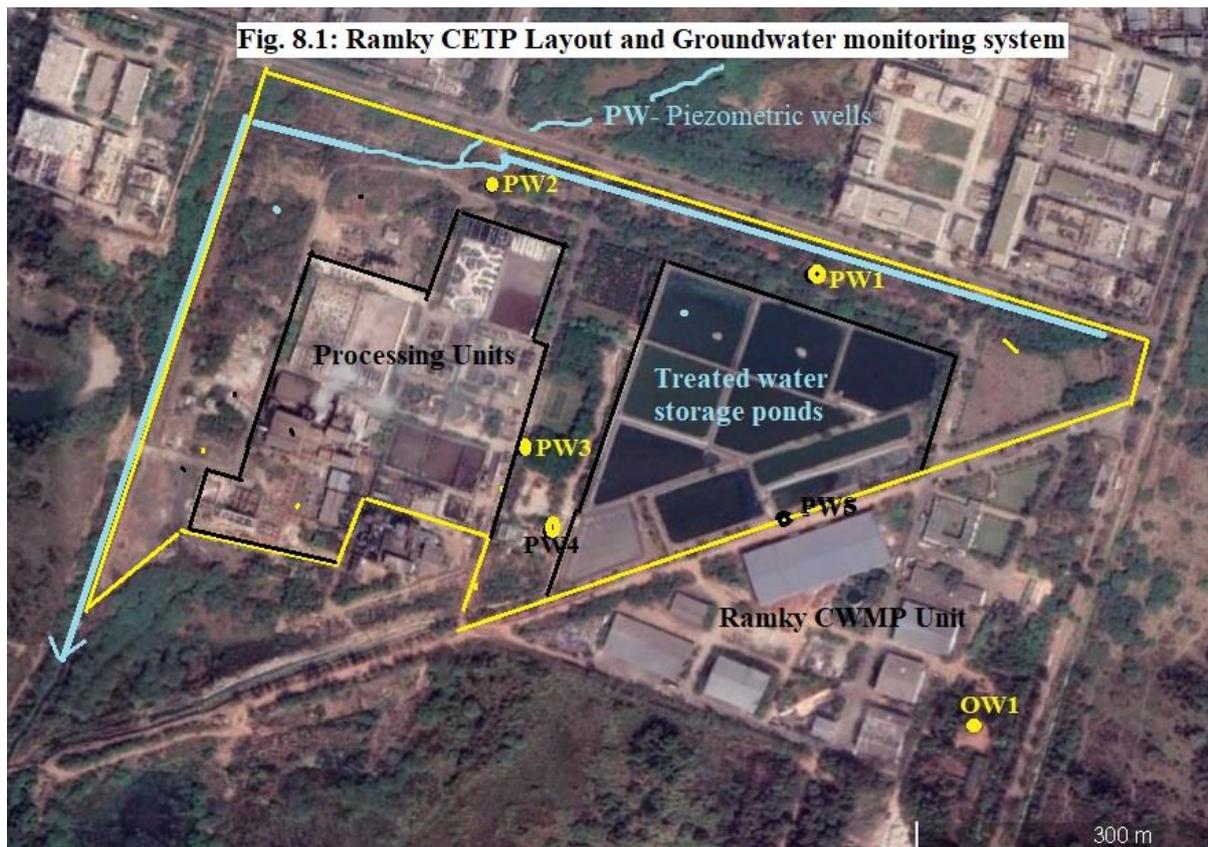


east side to west side. Similarly thickness of fractured rock zone increase towards west boarder. Resistivity sounding data revealed the subsurface layers as i) top layer- brownish clayey loam- the layer thickness varies between 2m to maximum of 10m and is thin in the east side increases towards west side of the site. ii) second layer- weathered rock- yellow/ brownish disintegrated khondalite rock. Thickness this layer varies between 10m and 25m and is thin in the east side and increase towards west border. iii) third layer- fractured rock- Thickness of fractured khondalite rock varies between 25m and 40m.

Soil layer and weathered rock can be considered as unconfined aquifer and fractured zone can be considered as semi-confined aquifer.

## 8. IMPACT OF THE COMMON EFFLUENT TREATMENT PLANT (CETP) ON GROUNDWATER REGIME

Resistivity survey revealed subsurface lithology and is discussed with respect water bearing nature as unconfined and confined conditions. Piezometers are established at 5 places in bore wells constructed for that purpose within CETP around the treated water storage ponds and an open well as shown in fig. 8.1. Piezometric wells are constructed with 200mm diameter, cased



with 150mm diameter slotted casing and drilled to 20m depth. Piezometer wells are marked as PW1...PW5 and existing open well OW1 with 6.5m diameter and total depth 7.63m located in CWMP is chosen as observation well shown in the above fig. 8.1. Broadly CETP area is marked as a) treated water storage ponds are, b) effluent treatment processing units area and c) greenbelt and open area for common facilities. Water table variations and quality being monitored for every 3 months by Ramky under third party- Andhra University supervision. Water levels observed by our team for the above said 6 wells during post monsoon of 2020 and pre monsoon of 2021 are presented in table – 8.1.

Table -8.1: Water table observation in CETP during Post and Pre monsoon seasons

		Longitude	Latitude	Total Depth (m)	Water Level-in (m)	WL diff.
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Well No.	Type of well				Post	Pre	
OW1	OW	83°04'58.4"	17°38'40.7"	7.63	4.19	5.30	1.11
WL2	PW1	83°04'54.26"	17°38'51.13"	20.12	0.95	1.72	0.77
WL3	PW2	83°04'46.8"	17°38'53.38"	18.42	1.33	3.20	1.87
WL4	PW3	83°04'47.07"	17°38'46.9"	19.53	1.42	2.45	1.03
WL5	PW4	83°04'49.4"	17°40'35.5"	7.66	1.53	3.81	2.28
WL6	PW5	83°04'29.8"	17°40'39.8"	8.15	1.25	3.90	2.65

The above data shows that water table is very shallow and depth varies between 0.95m to 1.53m during post monsoon period and the same varies between 1.72m and 3.90m during pre monsoon. Water table fluctuation varies between 0.77m and 2.65m. Shallow water table in these piezometer wells may be due to large quantity of treated water storage in the ponds. In the observation open well water table is beyond 4m and is also located about 400m away from the ponds. Groundwater fluctuation in open well is only 1.11m.

There are bore wells in CETP yielding good quantity of water being used for domestic/ green belt in little quantities.

Water samples collected from the observation wells within CETP – samples collected in PW3 and open well OW1 are analysed for chemical analysis and presented in table 8.2.

Table 8.2: Chemical Analysis of groundwater samples in PW3 and OW1

S.No	Parameters	Water sample in PW- 3		Water sample in Open well	
		Latitude	Longitude	Latitude	Longitude
		Post monsoon	Pre monsoon	Post monsoon	Pre monsoon
1	pH	8.30	8.5	8.4	8.5
2	Conductivity $\mu$ mhos/cm	1951	1340	2142	1360
3	TDS mg/l	1101	884	1359	898
4	HCO <sub>3</sub> mg/l	353	250	231	110
5	Chlorides mg/l	371	55.3	85	110
6	No <sub>3</sub> mg/l	0.074	0.01	0.078	0.02
7	Sodium mg/l	139	138	63.94	73.96
8	Potassium mg/l	51.7	0.8	1.17	1.2
9	Calcium mg/l	38.4	48	41.6	89.6
10	Magnesium mg/l	102.65	127.9	103.46	66.4
11	Total Hardness mg/l	384	644	326	496

TDS values are higher (>500), but within the permissible limits (<1500). Total hardness is higher (>300), but within the permissible limits (<600). All the chemical parameters are within the permissible limits of drinking water standards. However, post monsoon period samples chemical parameters are high during post monsoon than the pre monsoon which is supposed to be vice-versa. Quality of groundwater is within the permissible limits of drinking water standard.

All the treated effluent storage ponds are lined with concrete and supposed not to seep into subsurface. The reasons for shallowness of the water table may be i) site of investigation is in the low lying area to that region and adjacent to main surface runoff drain, of course it is now

diverted about 200m west side and parallel, ii) there is tank measuring about 15.24 Hec. about 200m downstream of CETP always filled with water either from storm water or from industrial sullage that is drained from the JNPC area via diverted drain along CETP border. All the time, area between above said tank and CETP, top soil will be in wet condition and sometimes water logging condition. Shallow water table in the CETP all the time may be shallow, because of the above said reasons.

The industry has assured water supply from Yeleru canal and being stored in big surface storage reservoir constructed at the northern border of JNPC. However, groundwater utilisation is inevitable at least to the small quantities for gardening and for some domestic needs. Some rainwater harvesting measures to be taken up to improve the groundwater quality and quantity and is discussed in the following chapter.

## 9. SUMMARY AND CONCLUSIONS

Based on the field observations and secondary data collected from various sources, the following are the conclusions from various disciplines:

- Secondary data information has been collected to the extent of 10km radius buffer zone around JNPC/ CETP area. Total buffer zone is 314 sq.km and CETP catchment is about 65 sq.km.
- Field investigations like water table observations, water samples collection have been limited to 2km to 3km as well JNPC catchment. Subsurface geophysical investigation is limited to CETP area.
- Even though CETP is a part of JNPC, it is processing all the liquid waste generated in JNPC, and the processed material being disposed to the destination after getting a green signal from P C B.
- Buffer zone covered by Parawada, Pedagantyada, Munagapaka, Anakapalli mandals of Visakhapatnam Dt. JNPC catchment is totally in Parawada mandal.
- Land use/ land cover mapping shows that agricultural land occupies about 72% and hills and forest cover 15% of the buffer zone and in the CETP catchment it is 65 % and 15% respectively. Industrial area is about 10% in Parawada manadal.
- Physiography of the study area is very undulating land with number of hill ranges, isolated hills and upland with or without scrub.
- Drainage in the buffer zone can be divided into 5 catchments and the drainage density also high indicates moderate to high rainfall runoff. Average rainfall of the district is 1116mm and ave. rainfall of Parawada mandal is 1126mm.

- Water quality of groundwater is within the permissible limits of drinking water standards. At few places along the coast groundwater quality influenced by salt water intrusion.
- There are small reservoirs and number of tanks and few groins for surface water supply for irrigation. Since last decade groundwater for irrigation through open wells and tube wells increased enormously. However, groundwater utility of the district is about 32% and around the study area it is 35%. Still there scope for groundwater development.
- Visakhapatnam city getting lot amount of surface water for its domestic and industrial usage from various reservoirs at a distance ranging between 70km to 200km in and out the district. JNPC receiving 10 MLD from Yeleru canal.
- Geology of the entire district is dominated by crystalline rock- khondalite. In the Parawada mandal nearly 95% of the area covered by khondalite rock.
- Depth to water table varies between less than 2m to 16m in the district. In the area 2km around JNPC field observations shows that post monsoon water levels varies between 1.0m and 11.6m and in the same wells, water table varies between 3.25m and 13.60m in pre monsoon season.
- Subsurface investigations in the CETP indicate that i) the top soil thickness varies between 2m to maximum of 10m and is thin in the east side increases towards west side of the site. ii) second layer- weathered rock- yellow/ brownish disintegrated khondalite rock. Thickness this layer varies between 10m and 25m and is thin in the east side and increase towards west border, iii) third layer- fractured rock- Thickness of fractured khondalite rock varies between 25m and 40m.
- Piezometric observation wells around the treated water storage ponds indicate that water table varies between 0.95m to 1.53m during post monsoon period and the same varies between 1.72m and 3.90m during pre monsoon. Water table fluctuation varies between 0.77m and 2.65m. Shallow water table all the time in the CETP may be due to its location in the low lying area as well a big perennial water body is about 200m distance. Besides that water ponds spread in an area of about 4 Hec. in the CETP may also the reason for shallow water table. Even though the ponds are lined with concrete, there may be some cracks in it percolates storage water to subsurface.
- However, quality of groundwater in the piezometric wells is within the permissible limits of drinking water standards. Groundwater levels, quality of water of the 5

piezometer wells being monitored monthly by CETP and the analysis laboratory is Coastal Waste Management Project (CWMP), of Ramky Enviro Engineers Limited, JNPC, Visakhapatnam. Twenty three parameters being assessed from the water samples that include parameters- physical, chemical, biological and metals. Post and pre monsoon samples analysed are enclosed as Annexure- 1.

## 10. Recommendations

In the hydrogeological point of view, some measures are to be taken for improving the quality and quantity of groundwater.

**10.1: Rainwater Harvesting:** Nearly 2/3 area of the Plant covered with i) treated water storage ponds, ii) Various processing units of the treatment plant and roads& others infrastructure facilities. In the 1/3<sup>rd</sup> area, there is large area under green belt along the northern border, roads side tree rows and open land along the west border as shown in fig. 10.1. Yellow colour polygon is the vacant open area. Blue polygon is the green belt area. There is scope for rainwater harvesting in the green belt as well in the open area. Considering the land use and topographical conditions of the area suitable harvesting structures are: i) trenches across the slope of the ground, ii) small dykes along the border of the green belt and iii) recharge pits along the road berms.



**10.1.1 Trench across slope:** The open area along the west border is about 350m length and 60m width consists of some bushes and plants. The diverted stream on the north border flows along the west border of the site. Five trenches are proposed in the vacant land aligning across the slope. Each trench should be excavated for about 50m to 55m length, 0.5m width and 1.0m depth. Trench should be filled to 3/4th level with permeable material like boulders at bottom,

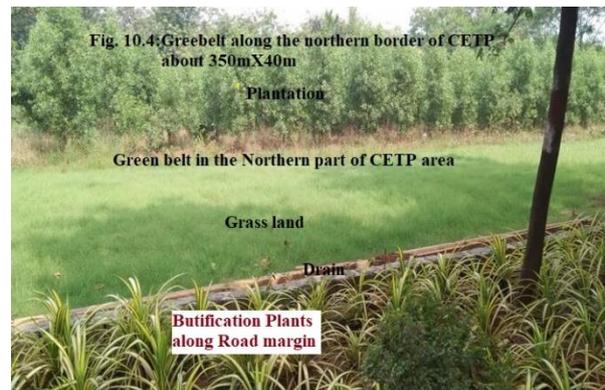
gravel at the centre and sand as top layer. Excavated soil should be placed on the downstream side of the trench as a bund. A trench constructed at one of the industry is shown in fig. 10.2 as photo mosaic. One of the sites selected for rainwater harvesting structure- Recharge trench near to the west border of the site is shown in fig. 10.3. In the above shown example, trench is



filled with sand to the top level. Instead of filling permeable material to the top level, top 25cm is to be left vacant to accommodate more water in the trench. Once in a year trench is to be maintained by removing the deposited silt and make it permeable.

**10.1.2 Mini/Micro Dykes along the Outer Border of the Green belt:** Main green belt exists along the northern border of CETP spread in an area of 350m E-W length and 40m width that include 8m road. Green belt consists of plantation of about 10m width along the border, about 15m width of grass land in between a drain and northern compound wall as shown in fig.

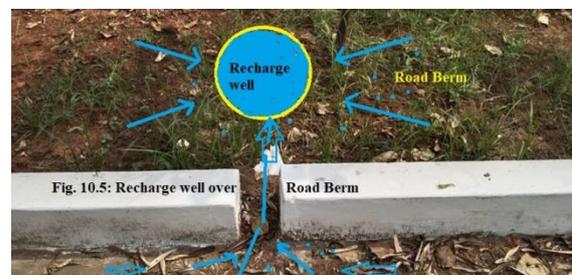
10.4. There is 8m width road and on its berms 2m to 3m width beautification plants are grown all along the road that leads to liquid waste processing Plant. There is a big drain



between road margin and grass plantation shown above to drain the excess runoff from the road and its margin as well from the grass land area. It is suggested that the walls of the drain should be at least 15cm above the soil filled level for which 15cm height brick wall (mini/micro dyke) may be constructed to store the runoff for some time which comes from the road and grass land. Storm water gets stored within the grass area and road margins and percolates within a day or two. Thus mini dykes may be constructed along the road green belt between ponds and main processing units. The structure is small, but the impact on groundwater recharge will be high.

**10.1.3 Recharge pits along the Road Berms:** There are number of roads in the processing units area with 5m width and more than a kilometre length. About 3m width of concrete/bituminous surface and 2m berm consists of soil surface on either of the road. A six inches height dyke is constructed along the road in between bituminous and soil berm as shown in fig.

10.5. Road runoff is allowed over the berms at number of places leaving small gaps in the dyke. Road runoff will be 80% of the rainfall occur and is a good amount of water for the total length of the roads. Road runoff can be harvested by construction a rainwater harvesting structure-recharge well over the berm. Fig. 10.5 shows the location of the recharge well and adjustment of the ground slope towards the well. Top surface of the recharge well should be at the lowest level



than surroundings to allow the road runoff as well runoff from surrounding berm area. Thus the road runoff also can be conserved.

As per the site conditions the above said three type of Rainwater harvesting structures are suitable.

a) Need for the Rainwater Harvesting:

- CETP is located in the lowest valley portion of the JNPC and a major stream traversing through the site but is diverted along the boundary. The industry is dealing with liquid waste treatment and management of the entire units in its upper catchment JNPC. Large quantities being stored in concrete lined ponds. Intake and outlets of the liquid waste is handled through impermeable conduits. Any spill overs in the upper catchment has to pass through the main drain which is abutting CETP.
- There is every possibility of leakage of liquid waste may be small quantities from the storage ponds and from the main stream that carries spillages or any other pollution from the upper catchment. Surface flow may directly join the 15 Hec. tank that located about 200m downstream of CETP. Piezometers observation indicates groundwater is very shallow all around storage tanks indicate that there may be some leakages from storage ponds. Mainly groundwater in the shallow aquifer zone gets influenced by the ponds and stream.
- Quality parameters of groundwater are mostly beyond desirable limits, but within the permissible limits. Instead of letting rainwater into the drains, it may be used for recharging aquifer that improves quality of groundwater, because rainwater is very good quality when it joins the aquifer which is a little inferior quality get improved by diluting with rainwater.
- It is suggested that storage tanks may be checked and treated to stop seepage cracks/ joints in the concrete when they are vacated.
- The place available for rainwater harvesting is the open area on the west part of CETP area and greenbelt. Harvesting structures cost is very little amount, but the benefit from improving the quality of groundwater will be enormous. Rainwater harvesting structures cost is only at the time of establishment, but the quantity is renewable every year.

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Visakhapatnam- 530 003

The compliance status of the external advisory committee (Task Force) directions dated 21.12.2021 is submitted below:

S.No.	Directions	Compliance
1.	The Facility shall immediately implement the recommendations made by the Committee	
	<b>Recommendations by the Committee</b>	
	i. Training of the operators on electrical, chemical, fire safety and they should know how to give the first aid. First aid box must be provided.	Complied. Safety training are being conducted for all operators once in a month. First aid box is provided.
	ii. Multi gas analysers with alarm system should be kept on top of the tank and the display should be kept outside.	Complied. Multi gas analyzer (for measuring CO, O <sub>2</sub> , LEL, H <sub>2</sub> S) are provided with alarm system and digital display outside the pump house.
	iii. Proper sign boards have to be in place.	Complied.
	iv. Tanker Level indicator should be in place. Manual opening valves should be kept outside to ensure a minimum manual intervention.	Complied.
	v. Tank opening will be covered with grills. Proper sampling practices should be followed. The necessary equipment should be used for sampling.	Complied.
	vi. Fuming hood should be arranged and it should be connected to wet scrubber.	Complied.
	vii. Exhaust fans should be arranged.	Complied.

	viii. No smoking zone area display & PPE sign boards.	Complied.
	ix. CC-Camera must be arranged.	Complied.
	x. Online Ph meters should be arranged.	Complied.
	xi. PVC casing of electrical wiring.	Complied.
	xii. Personal should enter only with proper gas masks and other PPE kits.	Provisions are made.
	xiii. Ambulance should be kept ready near the site to handle emergency.	Complied.
	xiv. On a long run, attempts should be made to pump the effluent directly to the CETP:	Complied.
	xv. Industries should also estimate the parameters of the effluent regularly at their facility, before discharging.	Complied.
	xvi. The Ramky should maintain all the above systems to the adjacent new collection system also which is under construction.	Complied.
2.	The Facility shall remove all underground pipelines if any and ensure that no effluent is bypassed from designated treatment and disposal system under any circumstances. The facility also needed to periodically (At-least once in a month) inspect the marine disposal pipe line system to ensure that there should not be any unauthorized connections.	Complied.
3.	The Facility shall fund for establishment and operation of continuous flow and effluent quality monitoring system including, on polluter pay principle, in-addition to the existing online monitoring system operated by the industry in the premises at discharge point, to have proper accountability.	Complied.  The facility provided continuous effluent quality monitoring system including camera for observing flow at sea disposal point by the Board and connected to APPCB website.

4.	The Facility shall augment treatment systems, if needed, to ensure continuous compliance of prescribed discharge standards.	Complied.
5.	The Facility shall prepare comprehensive plan of action to prevent reoccurrence of accidents / implementation of adequate safety measures in  consultation with reputed organizations and shall furnish report to the Board within 3 months along with the implementation schedule.	The facility has appointed Dupont Safety Solutions (International reputed Safety Organization) for study and implementation of safety aspects to prevent reoccurrence of accidents.

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### **Study report on Green Belt in Ramky Pharma City, Parawada Mandal, Visakhapatnam District**

This is in response to the request made by the Ramky Pharma City, Visakhapatnam, Prof.P.Jagadeeswara Rao, Dept. of Geo-Engineering and Centre for Remote Sensing, College of Engineering (A), Andhra University, Visakhapatnam and his team had been carried out study to assess the green belt (lung space) in their premises. The details of which are given below.

They reported that the Ramky Pharma City, Visakhapatnam covers an area of 2145 acres land, covering in Parawada Mandal, Visakhapatnam District, Andhra Pradesh. Out of 2145 acres land, they developed green belt in 360 acres which accounts 16.78%. With this backdrop, they approached the undersigned to assess the present green belt in the Ramky Pharma City, Visakhapatnam.

The survey team visited the area from time to time during the study for physical verification of green belt. Besides, the concerned area toposheet is geometrically rectified in the ERDAS-Imagine-9.2 software (Fig.2) and taken the study area as an Area of Interest (AOI) on the basis of their CAD drawing (Fig.1). The AOI has been digitised in ArcGIS-9.2 software and converted the shape file (.shp) in to file (.kml) file format to drape over to the Google Earth image. The study area has been extracted from the Google Earth image (Quickbird) of 1 m resolution of 2014 which is fairly good to extract vegetation from the image (Fig.3).

The Google image is rectified with the concerned area toposheet and bring the data in the common projection system to extract green belt on the Google Earth image through visual interpretation techniques.

The image is post Hud-Hud period wherein some portion of the green belt area is shown as sparse vegetated area (helipad area). From the field work, it is ascertained that the area is severely affected by the Hud-Hud cyclone in October, 2014.

In this study, 471 acres green belt has been assessed from the Google Earth image through visual interpretation techniques which accounts 21.95 % area is under green belt (Fig.4). Photos taken during field visit is also enclosed which gives fairly good chance to verify the area (Photos. 1,2, 3).

In this study, the Ramky Pharma City, Visakhapatnam area is covered = 2145 acres

In this study, Green belt covering 471 acres = 21.95% area is under green belt.

The objective of the study is to assess the area is under green belt (Vegetation). It is observed, the area is maintaining a good greenery in terms of green belt, where the area is only meant for green belt. Similarly, on either side of the roads avenue plantation has also delineated as the lung space (greenery) in the area. Observed destruction of vegetation during 2014 Hud-Hud cyclone in the 80 acre helipad area. Owing to afforestation/reforestation the same area again resampled and the trees whose branches were cut-off were grown.

The Ramky pharma left its boundary to develop exclusively green belt which is around 360 acres. In this study, avenue plantation and other areas where standing vegetation is there is also considered, which is around 471 acres.

Ramky Pharma City, Visakhapatnam area is covered = 2445 acres

APIIC Reservoirs + R&B Roads (-) = 300 acres

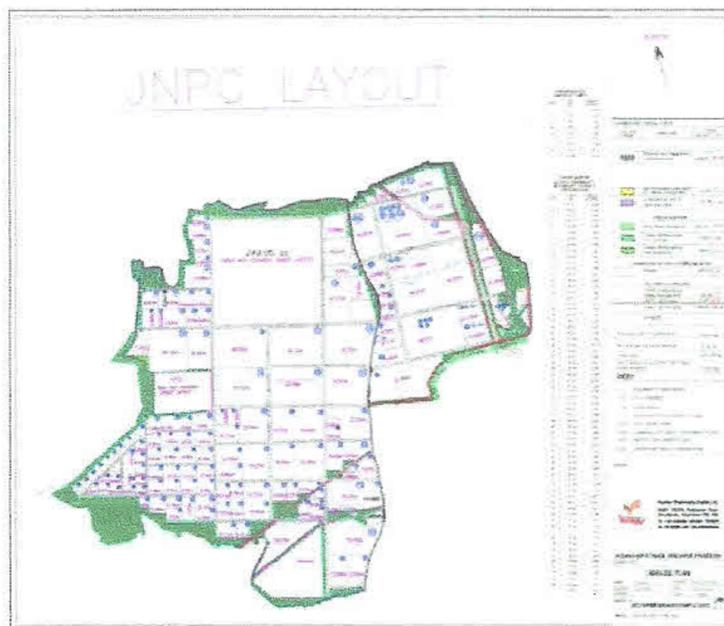
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Total = =2145 acres

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Reported by Ramky Green belt area = 360 acres (16.78%)

**Green belt assessed through remote sensing study = 471 acres (21.95%)**



1. CAD drawing



2. Geometric rectification of CAD drawing

Fig.1: Study area CAD drawing

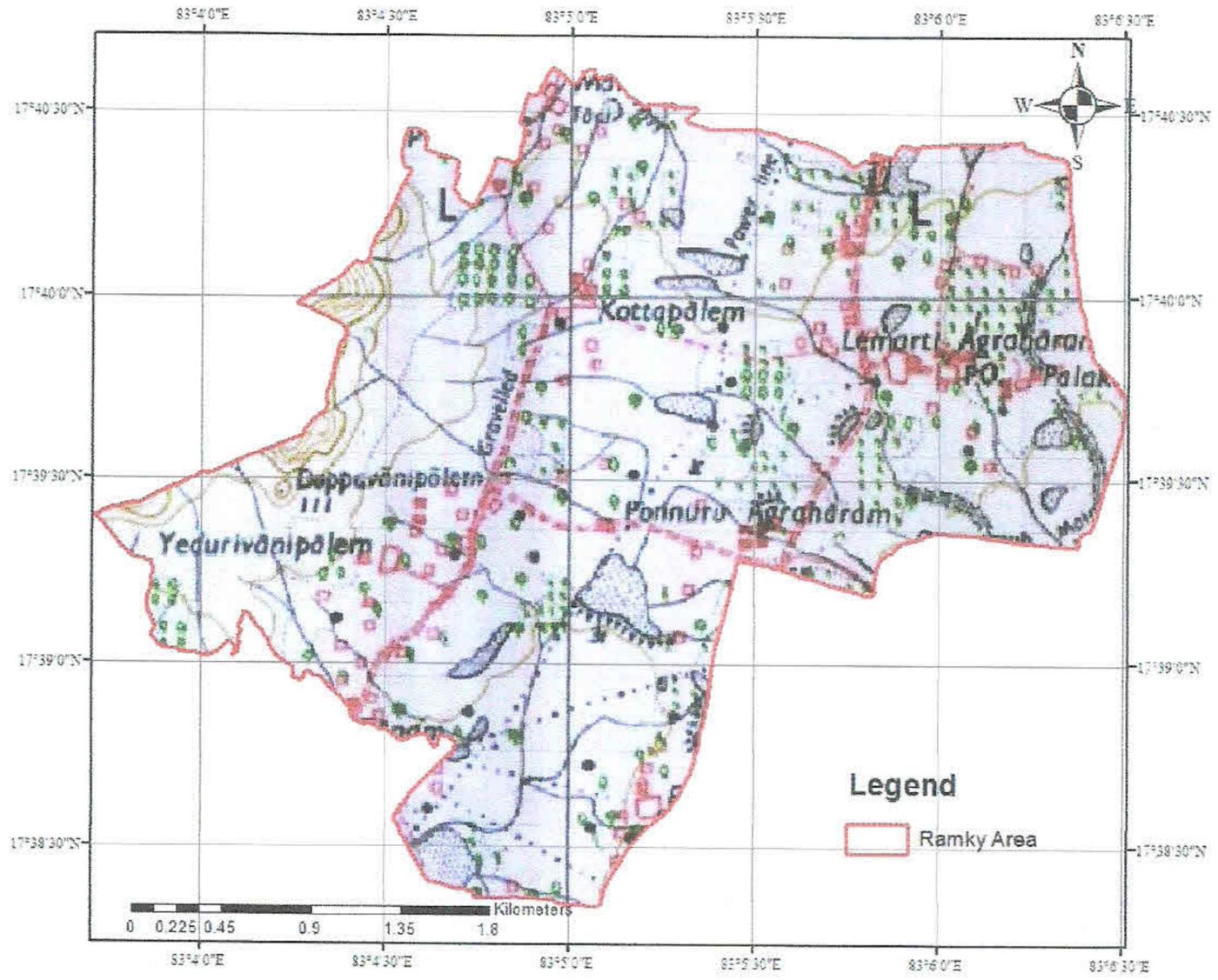


Fig.2: Ramky area as viewed on Toposheet

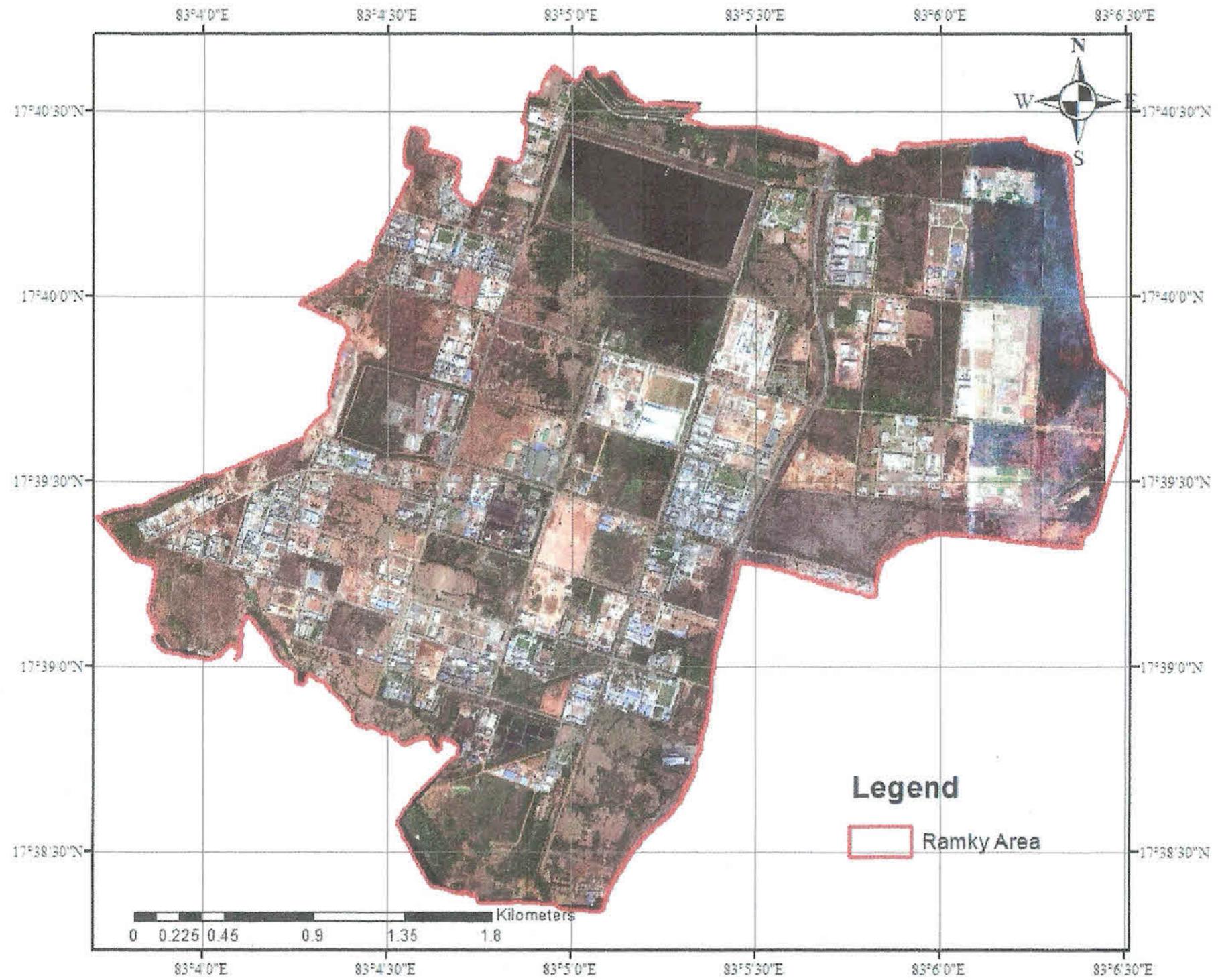


Fig.3: Ramky area as viewed on Google Earth Image

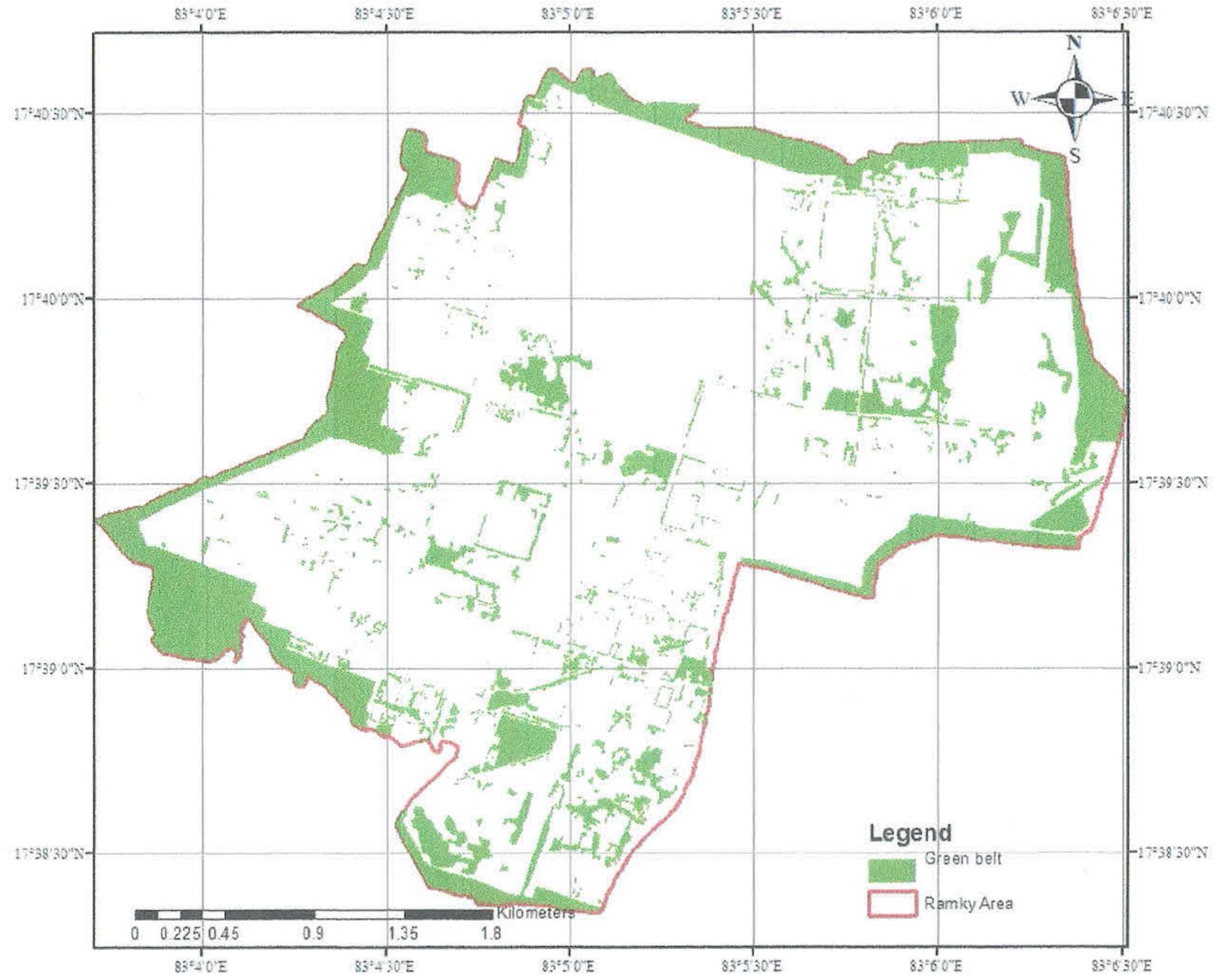


Fig.4: Green Belt map

Field Photos



Photo 1: Ramky Admin Buildings with backdrop of APIIC reservoir



Photo 2: Avenue plantation



Photo 3: Aerial view of Ramky pharma city

**Ramky Pharma City, Visakhapatnam area is covered = 2145 acres**

**Green belt assessed through remote sensing study = 471 acres (21.95%)**

(Note: It should be noted that the recommendations are based on the visual interpretations of Google Earth satellite image studies. It should be further noted that this study is only of recommendatory nature).

  
Investigator

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VISA KHAPATNAM-530 003



**ANDHRA PRADESH POLLUTION CONTROL BOARD  
ZONAL OFFICE:: VISAKHAPATNAM**

*D.No.39-33-20/4/1, Madhavadhara Vuda Colony, Visakhapatnam - 530018.*

*Ph : 0891-2719380*

**Circular Memo/APPCCB/ZO-VSP/Tech./2020**

**Date: 26.08.2020**

Sub: APPCB – ZO-VSP –Industries Operating in M/s. Ramky Pharma city –Directions Issued - Reg.

\*\*\*\*

The Board officials, during inspection of M/s. Ramky Pharma city observed that the washings generated from the non process sources in the plant premises are being disposed directly into storm water drains outside the plant premises in violation of the CFO condition. Also the contaminated storm water during rains is not contained in the premises and is also being discharged into storm water drains, thereby causing water pollution of the nearby water bodies and also ground & soil contamination in the area. As per the CFO condition the industry shall provide proper drainage system so that the rain water shall not be allowed to mix with either trade effluents or domestic effluent and shall maintain dry condition of storm water drains in the non-rainy season. The floor washings also shall be admitted into effluent collection system only and shall not be allowed to find their way into storm water drains or open areas.

In view of the above, the following directions are hereby issued to all the industries in M/s. Ramky Pharmacity, Parawada:

1. The industry shall construct a dyke of height 1 foot in the storm water drain both upstream and downstream of their industry to demonstrate the non discharge of any type of effluents into the storm water drains on non rainy days.
2. The industry shall lift the water accumulated in the storm water drains between the dykes along the boundary of the industry into their effluent storage tanks and shall be sent to CETP for further treatment.
3. The industry shall maintain the storm water drain all along the premises in dry condition on all non rainy days.

You are hereby directed to take immediate action for compliance of the above directions and submit the compliance report along with photographic evidences within a week.

**Rajendra  
Reddy Thuraka**

Digitally signed by  
Rajendra Reddy Thuraka  
Date: 2020.08.26  
16:36:41 +05'30'

**JOINT CHIEF ENVIRONMENTAL ENGINEER**

To  
All the industries.

## Annexure-XII

(Most Urgent)

Re.No.1848/2023/Magl.SA, dt: 10.2024.

Collector's Office,  
Anakapalli.From  
Smt. Vijaya Krishnan, I.A.S.,  
Collector & District Magistrate,  
Anakapalli.To  
The Superintendent Engineer,  
Irrigation Department,  
Anakapalli.The Deputy Director,  
Ground Water Department,  
Anakapalli.The Zonal Manager,  
APIIC, Atchutapuram,  
Anakapalli District.

Sir,

**Sub:** Anakapalli District – Hon'ble NGT – Original Application No.141 of 2023(SZ) before the National Green Tribunal Southern Bench, Chennai by filed by Sri. Ganiseti Satyanarayana & Anr, R/o Venkatapuram Village, Munagapaka Mandal Anakapalli District, Andhra Pradesh against M/s.Visakha Pharmacity Limited (Formerly M/s. Ramky Pharmacity (India) Pvt. Ltd.), JNPC, Parawada, Anakapalli District– Report called for - Reg.

**Ref:** Hon'ble National Green Tribunal Order dated 04.10.2023.

\*\*\*

It is inform that Sri. Ganiseti Satyanarayana & Anr, R/o Venkatapuram Village, Munagapaka Mandal Anakapalli District has filed a case before the National Green Tribunal Southern Bench, Chennai in O.A.No.141 of 2023(SZ) and the facts and circumstances, petitioner prayed that this Hon'ble Tribunal may be pleased to

- (i) Direct the Respondents to stop the illegal construction of pond in 50 acres for storing the chemical water near the Thanam village adjoining to the M/s. Ramky Pharmacity Ltd.
- (ii) Direct the Respondents to restore the irrigation tanks, water bodies and ground water by taking the corrective measures.
- (iii) Impose penalty on the responsible persons, entities for causing damage to the aquatic life in Bay of Bengal, livelihood, health of people, animals and endangering their lives at Thanam, Parawada etc villages of Anakapalli District.

In this connection, it is requested to submit the report on the above points and the status of irrigation & others drains existing in the down stream of M/s.Visakha Pharmacity Limited (Formerly M/s. Ramky Pharmacity (India) Pvt. Ltd.), JNPC, Parawada, Anakapalli District and complaints if any, so as to submit the same to the Hon'ble National Green Tribunal, Chennai.

Yours faithfully

*hdaya* 18/10/2024  
For Collector & District Magistrate  
Anakapalli

*M*  
18/10/24  
*18-10-24*  
*supdt*

## Annexure-XIII

Rc.No.1848/2023/Magl.SA, dt:05/02/2025

Collector's Office,  
Anakapalli.

From  
**Smt.Vijaya Krishnan, I.A.S.,**  
 Collector & District Magistrate,  
 Anakapalli.

To  
 The Superintending Engineer,  
 Irrigation Department ,  
 Anakapalli/Visakhapatnam.

Sir,

Sub: Hon'ble National Green Tribunal, Chennai – Anakapalli District - Original Application No.141 of 2023(SZ) before the National Green Tribunal Southern Bench, Chennai by filed by Sri. Ganiseti Satyanarayana & Anr, R/o Venkatapuram Village, Munagapaka Mandal Anakapalli District, Andhra Pradesh against M/s. Visakha Pharmacity Limited - Instructions issued – Additional report called for - Reg.

Ref: 1. Original Application No.141 of 2023(SZ) before the National Green Tribunal Southern Bench, Chennai by filed by Sri. Ganiseti Satyanarayana & others, Anakapalli District.  
 2. This Office Lr.Rc No.1848/2023/Magl.SA dated 18.10.2024.  
 3. Report of the Superintending Engineer, Irrigation Circle, Visakhapatnam, dtd:12.12.2024.

\*\*\*

It is to inform that Sri Ganiseti Satyanarayana & Anr, R/o Venkatapuram Village, Munagapaka Mandal Anakapalli District vide reference 1<sup>st</sup> cited has filed a case before the National Green Tribunal Southern Bench, Chennai in O.A.No. 141 of 2023(SZ) against M/s. Visakha Pharmacity Limited (Formerly M/s. Ramky Pharmacity (India) Pvt. Ltd.), JNPC, Parawada, Anakapalli District.

The Collector & District Magistrate, Anakapalli District vide reference 2<sup>nd</sup> cited has directed the Zonal Manager, APIIC, the Superintendent Engineer, Irrigation Department, Anakapalli District and the Deputy Director, Ground Water Department, Anakapalli District to submit the status report of the irrigation & others drains existing in the downstream of M/s. Visakha Pharma

City Limited.

In this connection, the Superintending Engineer, Irrigation Circle, Visakhapatnam has submitted a report in the ref.3<sup>rd</sup> cited reported that the Vora tank, Sanyasayya Banda, and Pedda tank serve a total of 121 acres, 29 acres, and 87 acres, respectively, in Parawada Village, Parawada Mandal. While the flow of effluents into the Vora tank is prevented as long as the left bank of the drain remains intact, the other two tanks are inevitably affected. Consequently, the surrounding ayacut (irrigated land) and the aquatic life, as well as livestock, have been suffering due to the pollution.

In view of the above, it is requested again to inquire into the contents of the affidavit and to identify the source of the contamination, provide details of the analysis conducted to support the conclusion that the downstream waterbodies and the ayukattu region have been impacted by the discharge of effluents from Ramky Pharma City and suggest remedial measures to restore the affected waterbodies located downstream of M/s. Visakha Pharmacity Limited. Additionally, any related complaints should be submitted so that the matter can be presented to the Hon'ble National Green Tribunal. Top of Form

The report on the above aspects shall be submitted immediately so as to submit this office detailed report to the Hon'ble NGT, Chennai.

Please treat this as **Most Urgent**.

Yours faithfully  
**YsvkgsI Satyanarayana Rao**  
District Revenue Officer  
For Collector  
Anakapalli

From  
Sri. D. Rama Gopal, M. E.,  
Superintending Engineer,  
Irrigation Circle,  
Visakhapatnam.

To  
The Collector & District Magistrate,  
Anakapalli District  
Anakapalli.

Letter No. 112<sup>M</sup> SE/IC/VSP/DEE(T)/AEEOD4/W/372/Dated. 07/02/2025.

Sir,

Sub: Water Resources Department – Anakapalli District – Hon'ble NGT – Original Application No.141 of 2023(SZ) before the National Green Tribunal Southern Bench, Chennai filed by Sri. Ganiseti Satyanarayana & Anr, R/o Venkatapuram Village, Munagapaka Mandal, Anakapalli District, Andhra Pradesh against M/s Visakha Pharma city Pvt Ltd (Formerly M/s Ramky Pharmacy (India) Pvt, Ltd), JNPC, Parawada, Anakapalli District - Report on status of Irrigation sources – Submission - Regarding.

- Ref: 1. District Collector, Anakapalli R.C No.1848/2023/Magl.SA Dtd 18.10.2024.  
2. This office Letter No. 1205 M SE/IC/VSP/DEE(T)/AEEOD4/W/372 dt. 12-12-2024  
3. District Collector, Anakapalli R.C No 1848/2023/Magl.SA Dtd 05.02.2025.  
4. Executive Engineer, WSM Division, Chodavaram  
Letter no. 29 SE EE/WSM/CDM/DB/AEE(T)/W/52/ Dt. 07/02/2025.

-xxxx-

In continuation of this office letter 2<sup>nd</sup> cited, it is to submit that, the District Collector, Anakapalli has instructed to identify the source of contamination and to provide analysis conducted to support the conclusion on affected water bodies due to pharma city effluents, in the reference 3<sup>rd</sup> cited.

The water bodies and sources of contamination are inspected by the concerned Water Resources Engineers and as per the report submitted by the Executive Engineer, WSM Division, Chodavaram vide reference 4<sup>th</sup> cited and the report is submitted as follows:

It is submitted that, the Voora tank of Parawada along with its surplus channel (Mallodu gedda), Sanyasayya banda tank of Parawada along with its surplus channel of Sanyasayya banda, Pedda tank of Parawada and its surplus channel are being impacted by the discharge of Effluents from Ramky Phrama city, was arrived based on the physical observation and flow pattern of the existing chain of tank system only. The flow of effluents of Pharma city i.e Green colour liquid in the drain within the tank bed area along the periphery of one

side of foreshore of the Voora tank can be physically observed. Merging of this drain into the surplus channel of the Voora tank also can be observed physically on field. As this surplus channel of Voora tank, which is also known as Mallodu gedda, crosses Bharanikam-Paravada road, the effect of Effluents on Gedda water can be observed through its color and odour at this Road bridge point also.

As these Voora tank, Sanyasayya banda and Pedda tank are Cascade (Chain) of tanks, flow of this Mallodu gedda (Surplus channel of Voora tank) automatically enters into Sanyasayya banda and after reaching its surplus level, surplus flow of Sanyasayya banda also enters Pedda tank. Other than the above mentioned physical observation and flow pattern of tank system, no additional analysis or water quality tests were conducted to arrive the conclusion. Hence, our conclusion is limited to whether the effluents enter into these water bodies or not, but not on degree of Contamination and severity of its impact.

In view of the above, the District Collector, Anakapalli is requested to kindly address the Environmental Engineer, A.P. Pollution Control Board, Visakhapatnam for conducting necessary Quality tests on the effluents as well as water in the above mentioned water bodies to conclude on degree of contamination as well as on remedial methods to restore the affected water bodies.

This is submitted for favour of information and taking further necessary action.

Yours faithfully,  
(D. Rama Gopal)  
Superintending Engineer  
Irrigation Circle, Visakhapatnam.

/t.c.f.b.o/



(A. Trinadham)  
Deputy Superintending Engineer



**ANDHRA PRADESH POLLUTION CONTROL BOARD**  
**Paryavaran Bhavan, APIIC Colony Road,**  
**Gurunanak Colony, Autonagar, Vijayawada- 520007**



**Website** : <https://pcb.ap.gov.in>

## CONSENT TO OPERATE & HAZARDOUS WASTE AUTHORIZATION ORDER

**Consent Order No : APPCB/VSP/VSP/285/HO/CTO/2025 Dt: 07-04-2025**

CONSENT is hereby granted for Operation under section 25/26 of the Water (Prevention & Control of Pollution) Act, 1974 and under section 21/22 of Air (Prevention & Control of Pollution) Act 1981 and amendments thereof and Authorisation under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundary, Movement) Rules, 2008 & Amendments thereof and the rules and orders made there under (hereinafter referred to as 'the Acts', 'the Rules') to:

**M/s. Visakha Pharmacy Limited (Expansion)**  
**(Formerly M/s. Ramky Pharmacy (India) Ltd) (CETP),**  
**JN Pharmacy, Parawada,**  
**Anakapalli District.**

**E-mail: narendrababu.k@ramky.com**  
**venkatarao.b@visakhapharmacy.com**

(Hereinafter referred to as 'the Applicant') authorizing to operate the industrial plant to discharge the effluents from the outlets and the quantity of emissions per hour from the chimneys as detailed below:

### i. Outlets for discharge of effluents:

Outlet No.	Outlet Description	Max Daily Discharge KLD	Point of Disposal
1.	High TDS effluents from member units (COD concentration more than 8000 mg/l & TDS concentration more than 12000 mg/l)*	3000 KLD	<ul style="list-style-type: none"> <li>To steam stripper, MEE followed by Spray Drier.</li> <li>Stripper distillate shall be sent to authorized cement industries for coprocessing through M/s. APEMC.</li> <li>MEE condensate to biological ETP of Pharmacy, CETP for further treatment.</li> <li>MEE concentrate to spray drier.</li> <li>Salts to TSDF through APEMC.</li> </ul>
2.	Low TDS effluents from member	7053 KLD	<ul style="list-style-type: none"> <li>Shall treat in biological ETP, followed by tertiary treatment.</li> </ul>

industries including trade and domestic streams after treatment (TDS concentration less than 12000 mg/l, industrial effluent- 4,543 KLD + Domestic - 100 KLD + MEE condensate - 2225 KLD + Cooling tower blowdown - 50 KLD + Boiler blowdown - 60 KLD + Washings - 75 KLD )		<ul style="list-style-type: none"> <li>• After treatment at CETP, Ramky to guard ponds and then into sea through marine outfall after meeting the marine discharge standards.</li> </ul>
<b>Total</b>	<b>10,053 KLD</b>	

**ii) Emissions from chimneys:**

<b>Chimney No.</b>	<b>Description of Chimney</b>
1.	Attached to 2 X 10 TPH coal fired Boiler
2.	Attached to 1 X 10 TPH coal fired Boiler
3.	Attached to 1 X 25 TPH coal fired Boiler
4.	Stack attached to 5.5 KL per hour spray drier - 2 Nos
5.	Stack attached to 5.5 KL per hour spray drier – 2Nos
6.	Stack attached to 5.5 KL per hour spray drier – 1 No.
7.	Attached to 3 X 1500 KVA D.G. Sets

**iii) HAZARDOUS WASTE AUTHORISATION (FORM – II) [See Rule 6 (2)]:**  
 M/s. Visakha Pharmacy Limited (Formerly M/s. Ramky Pharmacy (India) Ltd) (CETP), JN Pharmacy, Parawada, Anakapalli District is hereby granted an authorization to operate a facility for generation, collection, reception, storage, treatment, transport and disposal of Hazardous Wastes namely:

• **HAZARDOUS WASTES WITH DISPOSAL OPTION:**

S. No	Name of the Hazardous waste	Stream	Quantity	Method of disposal
1.	Primary Sludge	35.3 of Schedule - I	30 TPD	Shall be routed through M/s. APEMC to Coprocessing/ TSDf based on the calorific value
2.	Secondary Sludge	35.3 of Schedule - I	24 TPD	
3.	Salts from Spray drier of incinerator / MEE	35.3 of Schedule - I	200 TPD	
4.	Activated carbon	35.3 of Schedule - I	500 Kgs/day	Shall be routed through M/s. APEMC, so as to send for pre-processors / cement industries for co-processing (as utilisable waste) / To TSDf for incineration (as incinerable waste)

• **HAZARDOUS WASTES WITH RECYCLING OPTION:**

S. No	Name of the Hazardous waste	Stream	Quantity	Method of disposal
1.	Stripper solvents	28.6 of Schedule - I	60 KLD	Shall be sent to Cement industries / pre-processors through M/s. APEMC
2.	Used oil/ Waste Lubricating oil	5.1 of Schedule - I	200 LPM	Shall be routed through APEMC, so as to dispose the same to authorized re-processors / recyclers (as recyclable waste)/ pre-processors.

The following consent orders stands cancelled from the date of issue of this order:

1. CTO & HWMA Order No: APPCB/VSP/VSP/285/HO/CTO/2021 dt. 12.08.2021.
2. CTO Amendment order No. APPCB/ VSP/VSP/65/HO/CTO /2021 dt.02.09.2021.
3. CTO Amendment order No. APPCB/ VSP/65/HO/CTO /2021 dt.13.06.2023

This consent order is valid for operation of Common Effluent Treatment Plant (CETP) of capacity mentioned below:

Sl.No	Product	Quantity
1.	Common Effluent Treatment Facility (CETP) for treatment of industrial and domestic effluents from member industries.	10,053 KLD*

\* (High TDS effluents: 3000 KLD + Low TDS effluents: 7053 KLD)

The issue of CTO&HWA Expansion to the industry was placed in the Consent Management Committee meeting held on 17.03.2025. The committee has agreed to issue CTO & HWA Expansion for a period up to **31.05.2026** subject to following conditions:

1. The industry shall construct at least 2 to 3 storm water catchment sumps at different places and shall pump the collected water to CETP for further treatment & disposal along with LTDS effluents.
2. The facility shall provide 2 Steam Strippers for the two new MEEs (No.7 & 8) by the end of April,2025 in addition to the existing 3 Strippers.
3. The facility shall install online analyzer for PM (CEMS) for 3 no of Spray Drier stacks.
4. The facility shall submit safety audit report.
5. The facility shall carryout health studies in & around 5 Kms radius through reputed organizations / institutions.
6. The facility shall ensure that contaminated water shall not join the downstream water bodies under any circumstances.
7. The facility shall provide online water quality monitoring system at outlets of catchment sumps for data connectivity to APPCB website.
8. The CETP shall comply with all norms notified by the MoEF&CC, GoI, New Delhi from time to time.
9. This order is subject to the provisions of `the Acts' and the Rules' and orders made thereunder and further subject to the terms and conditions incorporated in the schedule A, B & C enclosed to this order. This order is subject to orders of the Hon'ble National Green Tribunal (NGT), Southern Zone in Original Application No 141/2023 and 130/2024.

This combined order of consent & Hazardous Waste Authorization shall be valid for a period ending with the **31<sup>st</sup> day of May, 2026**.

**S SRI SARAVANAN**  
**MEMBER SECRETARY**

**To**

**M/s. Visakha Pharmacy Limited,  
(Formerly M/s. Ramky Pharmacy (India) Ltd.,) (CETP),  
JN Pharmacy, Parawada,  
Anakapalli District.**

**Copy to:**

1. The Joint Chief Environmental Engineer, Zonal Office, **Visakhapatnam** for information and necessary action.

2. The Environmental Engineer, Regional Office, **Visakhapatnam** for information and necessary action.

### **SCHEDULE-A**

1. Any up-set condition in any industrial plant / activity of the industry, which result in, increased effluent / emission discharge and/ or violation of standards stipulated in this order shall be informed to this Board, under intimation to the Collector and District Magistrate and take immediate action to bring down the discharge / emission below the limits.
2. The industry should carryout analysis of waste water discharges or emissions through chimneys for the parameters mentioned in this order on quarterly basis and submit to the Board.
3. The industry shall ensure that there shall not be any change in the process technology, source & composition of raw materials and scope of working without prior approval from the Board.
4. The applicant shall submit Environment statement in Form V before 30th September every year as per Rule No.14 of E(P) Rules, 1986 & amendments thereof.
5. The applicant should make applications through Online for renewal of Consent (under Water and Air Acts) and Authorization under HWM Rules at least 120 days before the date of expiry of this order, along with prescribed fee under Water and Air Acts and detailed compliance of CFO conditions for obtaining Consent & HW Authorization of the Board.
6. The industry should immediately submit the revised application for consent to this Board in the event of any change in the raw material used, processes employed, quantity of trade effluents & quantity of emissions. Any change in the management shall be informed to the Board. The person authorized should not let out the premises / lend / sell / transfer their industrial premises without obtaining prior permission of the State Pollution Control Board.
7. Any person aggrieved by an order made by the State Board under Section 25, Section 26, Section 27 of Water Act, 1974 or Section 21 of Air Act, 1981 may within thirty days from the date on which the order is communicated to him, prefer an appeal as per Andhra Pradesh Water Rules, 1976 and Air Rules 1982, to Appellate authority constituted under Section 28 of the Water(Prevention and Control of Pollution) Act, 1974 and Section 31 of the Air(Prevention and Control of Pollution) Act, 1981.
8. The conditions stipulated are without prejudice to the rights and contentions of this Board in any Hon'ble court of law.
9. The industry shall be liable to pay Environmental Compensation / Other Environmental Taxes, if any environmental damage caused to the surroundings, as fixed by the Collector & District Magistrate or any other competent authority as per the Rules in vogue.
10. The industry may explore the possibility of tapping the solar energy for their energy requirements.
11. The industry should educate the workers and nearby public of possible accidents and remedial measures.

### **SCHEDULE-B**

**The issue of CTO & HWA (Expansion) to the industry was placed in the CTO committee meeting held on 17.03.2025. the Committee recommended to issue CTO&HWA Expansion order to the facility for period upto 31.05.2026. The industry shall comply with the following conditions:**

1. The industry shall construct at least 2 to 3 storm water catchment sumps at different places and shall pump the collected water to CETP for further treatment & disposal along with LTDS effluents.
2. The facility shall provide 2 Steam Strippers for the two new MEEs (No.7 & 8) by the end of April,2025 in addition to the existing 3 Strippers.
3. The facility shall install online analyzer for PM (CEMS) for 3 no of Spray Drier stacks.
4. The facility shall submit safety audit report.
5. The facility shall carryout health studies in & around 5 Kms radius through reputed organizations / institutions.
6. The facility shall ensure that contaminated water shall not join the downstream water bodies under any circumstances.
7. The facility shall provide online water quality monitoring system at outlets of catchment sumps for data connectivity to APPCB website.
8. The CETP shall comply with all norms notified by the MoEF&CC, GoI, New Delhi from time to time.
9. This order is subject to orders of the Hon'ble National Green Tribunal (NGT), Southern Zone in Original Application No 141/2023 and 130/2024.

#### **WATER POLLUTION:**

9. The source of water is M/s. Visakha Pharmacy Limited. The following is the permitted water consumption:

Sl.No.	Purpose	Quantity (KLD)
1	Industrial cooling	526.0
2	boiler feed	1320.0
3	Washings	75.00
4	Domestic (Gardening & Civil works)	400.00
	<b>Total</b>	<b>2321.00</b>

Separate meters with necessary pipe-line shall be maintained for assessing the quantity of water used for each of the purposes mentioned above.

10. The parameters of low TDS effluents shall meet the standards mentioned below:

Parameter	Concentration in mg/l
pH	6.50 – 8.50
Temperature °C	< 45 <sup>0</sup> C
TDS ( inorganic )	12,000 mg/l
TSS	600 mg/l
BOD	3,000 mg/l
COD	8,000 mg/l
Oil and Grease	20 mg/l

Chromium Hexavalent (as Cr+6)	2 mg/l
Chromium ( total ) (as Cr)	2 mg/l
Ammonical Nitrogen (as N)	30 mg/l
Cynide (as CN)	2.0 mg/l
Lead (as Pb)	1 mg/l
Nickel (as Ni)	3 mg/l
Zinc (as Zn)	15 mg/l
Arsenic (as As)	0.20 mg/l
Mercury (as Hg)	0.01 mg/l

11. The effluents which are not meeting the standards stipulated at Sl.No.10 of schedule-B shall be treated as HTDS effluents and shall be sent to MEEs followed by spray drier after detoxification and stripping.
12. The treated effluent discharged from CETP into Guard ponds and to marine outfall shall not contain constituents in excess of the tolerance limits mentioned below:

Outlet No.	Parameter	Concentration not to exceed limits in mg/l (except pH)
2	pH	6.0 to 9.0
	COD	250
	BOD (5 (3)days at 20 7° C)	100
	Temperature at the point of discharge	Shall not exceed more than 5°C above ambient temperature of the receiving water body
	Oil and Grease	10
	Total Suspended Solids	100
	Total residual Chlorine	1.0
	Ammonical Nitrogen	50
	Total Kjeldahl Nitrogen (TKN)	50
	Nitrate- Nitrogen	50
	Arsenic (as As)	0.2
	Mercury (as Hg)	0.01
	Lead (as Pb)	0.1
	Cadimum (as Cd)	0.05
	Total Chromium (as Cr)	2.0
	Copper (as Cu)	3.0
	Zinc (as Zn)	15
	Selenium (as Se)	0.05
	Nickel (as Ni)	3.0
	Cyanide (as CN <sup>-</sup> )	0.2
	Fluoride (as F)	15
	Sulphide (as S)	5.0
	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	5.0
Bio-assay test	90% survival of fish after 96 hours in 100% effluents.	

*	<p>All Efforts shall be made to remove colour and unpleasant odour as far as possible.</p> <p>The TDS of the treated effluents discharged from CETP to marine outfall shall not be more than the TDS of sea.</p>
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**13. Roles and responsibilities notified by MoEF&CC in Notification dated 09.09.2024:**

- a. In order to manage the CETP professionally, there shall be a Special Purpose Vehicle (SPV) or Society (registered under the Societies Registration Act, 1860) or Trust (registered under an appropriate statute), which would be responsible for the entire operation and maintenance of CETP.
- b. (a) The CETP operating agencies shall distribute the total available treatment capacity among the member units in a rational and transparent manner.
 

(b) A legal agreement between the CETP and its member units clearly delineating their mutual obligations, terms and conditions of membership, membership fee, cost recovery formula developed for the installation and treatment charges, operation and maintenance of CETP, shall be executed.
- c. The CETP operating agencies shall comply with the prescribed inlet and outlet effluent standards. In order to strengthen the monitoring and compliance through self-regulatory mechanism, Online Continuous Effluent Monitoring System (OCEMS) shall be installed at the CETP and data connectivity be provided to the Central Board and concerned Board or Committee.
- d. (a) The CETP operating agencies shall develop an automated online mechanism to monitor quantity and quality of effluent (by way of installing SCADA-PLC and auto samplers or sensors,) being discharged by the member units through pipelines or sewers, at individually or in cluster, to ensure compliance.
 

(b) The connectivity of the monitored data shall be provided to the State Board or the Committee.

(c) CCTV cameras at appropriate locations shall also be installed to check bypass or unauthorised discharges.
- e. In case of transportation of effluent through tankers, CETP operating agencies shall,—
 

(a) Ensure a tri-partite interface among the CETP, member industries and tankers, through an integrated communication technology (ICT), combined with logistic system with tankers for collection and transportation of effluent to CETPs;

(b) ensure that tankers are fitted with GPS system and carry out real-time monitoring of the tankers; and

(c) ensure the sampling and quality check of the effluent upon

receipt of tanker at CETP.

- f. (a) The CETP operating agencies shall have authority to access the member industry premises, without prior notice, to collect wastewater samples.
- (b) The OCEMS system, if installed, shall also be accessible to the CETP operating agencies for cross verification of the monitored values with the online data.
- g. (a) The CETP operating agencies shall ensure that the member industries discharge their trade effluent meeting the outlet norms of their individual PETPs. In case of non-compliance of the norms and/or nonpayment of their share, within specific or agreed time limits, towards meeting operation and maintenance costs, the CETP operating agencies shall take appropriate action, such as, refusal to take effluent of defaulting member, cancellation of membership of the individual unit with CETP.
- (b) The CETP operating agency shall develop the control mechanism to regulate the flow from a member industry.
- (c) The list of such non-complying member industrial units and action taken against them shall be provided to the Board or Committee, through online mode, for further necessary action.
- h. (a) The CETP operating agencies shall ensure sludge management based on the sludge characteristics (i.e. hazardous or non-hazardous) as per the conditions mentioned in the authorisation.
- (b) Adequate linkage with Treatment, Storage and Disposal Facility (TSDF) for disposal of hazardous waste, generated from the facility, shall be ensured.
- i. (a) The CETP operating agencies, shall also monitor the upstream and downstream conveyance linkages for the physical and hydraulic status.
- (b) In case of any inadequacy, the same shall be addressed and reported to the State agencies.
- j. The CETP operating agencies shall establish the laboratory facilities on site, at least, for the core parameters, namely, pH, BOD, COD, TSS and any other parameter required by the State Board or the Committee.
- k. Alternate power backup arrangement of adequate capacity shall be installed at CETP to ensure continuous operation of CETP even during power failure.
- l. The CETP operating agencies shall be responsible for carrying regular surface and ground water quality monitoring of the receiving water and ground water along its reaches, covering all the parameters prescribed

in the stream standards at least once a year. Such analysis report shall form part of environmental audit being conducted annually.

14. The facility shall comply with the marine discharge standards specified by MoEF&CC, as per S.O. 3864(E) dated 09.09.2024.
15. The facility shall maintain flow meters preferably Electro Magnetic flow meters with totalisers for water and effluent quantity measurements for different streams of effluents and different categories of water usage stipulated in this order.
16. The facility shall take necessary measures to arrest the leakages at MEEs area.
17. The operator shall maintain daily records on characteristics of effluents and hydraulic load for each stream of cyanide & heavy metals bearing effluents and shall furnish soft copy of the consolidated records through mail to RO, VSP & ZO, VSP every week.
18. The operator of pharmacy shall own total responsibility for any illegal dumping elsewhere and for conveying the High TDS effluents to CETP and shall ensure implementation of adequate measures to prevent spillages / discharges of the effluents during loading and unloading the effluents into tankers either at the premises of member industries or at the CETP facility.
19. The operator of the CETP shall measure the quantity and characteristics industry wise of High TDS & Low TDS effluent streams receiving from the member industries. The consolidated daily records along with analysis reports of the effluents for each stream shall be submitted on daily basis along with storage quantity in each tank and disposal quantity through E-mail to RO, VSP & ZO, VSP and monthly consolidated report every month.
20. The operator of the CETP shall upgrade regularly the contingency plan to prevent any leakages or accidental discharges outside the premises even during shock load / other events and shall own total responsibility for any leakages or discharges in any form outside the premises.

#### AIR POLLUTION:

21. The emissions shall not contain constituents in excess of the prescribed limits mentioned below:

Chimney No.	Parameter	Emission Standards (in mg/Nm <sup>3</sup> )
1-6	Particulate Matter	100

22. The industry shall comply with ambient air quality standards of PM10 (Particulate Matter size less than 10mm) - 100 mg/ m<sup>3</sup>; PM2.5 (Particulate Matter size less than 2.5 mm) - 60 mg/ m<sup>3</sup>; SO<sub>2</sub> - 80 mg/ m<sup>3</sup>; NO<sub>x</sub> - 80 mg/m<sup>3</sup>, outside the factory premises at the periphery of the industry.

Standards for other parameters as mentioned in the National Ambient Air Quality Standards CPCB Notification No.B-29016/20/90/PCI-I, dated 18.11.2009.

Noise Levels: Day time (6 AM to 10 PM) - 75 dB (A)  
Night time (10 PM to 6 AM) - 70 dB (A)

23. The industry shall comply with emission limits for DG sets of capacity upto

800 KW as per the Notification G.S.R. 804(E), dated 03.11.2022 under the Environment (Protection) Act Rules. In case of DG sets of capacity more than 800 KW shall comply with emission limits as per the Notification G.S.R.489 (E), dated 09.07.2002 at serial no.96, under the Environment (Protection) Act, 1986.

24. The industry shall provide a sampling port with removable dummy of not less than 15 cm diameter in the stack at a distance of 8 times the diameter of the stack from the nearest constraint such as bends etc. A platform with suitable ladder shall be provided below 1 meter of sampling port to accommodate three persons with instruments. A 15 AMP 250 V plug point shall be provided on the platform.
25. The industry shall maintain three (3) CAAQM stations for monitoring PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>x</sub>, VOCs, and Ammonia with recording facility and transmit data to APPCB website continuously.
26. The operator shall take proper care to nullify the effect of odour nuisance due to effluents.

#### **GENERAL:**

27. The operator shall not accept the quantity beyond the permitted quantity mentioned in this order without CTE / CTO of the Board.
28. The operator shall provide stream strippers to other two MEEs instead of air strippers as at present only one steam stripper provided by the facility.
29. The drums containing chemicals shall be stored under a roof on elevated platform with a provision to collect leakages / spillages in the collection pit.
30. The operator shall take necessary measures to compact the HDPE liners in guard ponds and the facility shall construct new guard ponds above the ground level if any proposed by the facility in future.
31. The operator shall comply with CPCB directions dated 05.02.2014 / 02.03.2015 and guidelines issued regarding online monitoring systems issued from time to time.
32. The operator shall take up detailed study by IIT on the efficiency of the individual treatment units of the CETP and water balance shall be studied. The facility shall regularly carryout the CETP performance studies and undertake improvement of treatment systems.
33. The operator shall ensure maintain green belt as per CFE orders / EC orders. The operator shall maintain green belt with appropriate species of trees around the project area.
34. The operator of pharmacy shall co-ordinate with member units of the pharmacy for segregation of effluents and shall ensure that separate leak proof and non corrosive tankers are used for carrying effluents containing Cyanide and heavy metals.
35. The recommendations of the NIO for maintenance of diffuser system and monitoring of aquatic life in the sea shall be done periodically by engaging the NIO for every three months. The consolidated trend analysis report of the marine aquatic life shall be submitted to the RO, VSP & ZO, VSP every three months.
36. The pipeline carrying the treated Low TDS effluents for marine disposal shall be maintained buried at a safe depth. The operator of the CETP shall own

- total responsibility to prevent any leakages / damage of pipeline carrying the treated effluents.
37. As per the EC from MoEF, GoI order dated 10.03.2005 regarding permission obtained for marine disposal of treated effluents, the operator of the CETP shall regularly carry out monitoring of the treated effluents at discharge points i.e., once in two days. The trend of analysis reports for the effluents discharging at marine outfall shall be carried out and shall furnish softcopy to RO, VSP & ZO, VSP every week through mail.
  38. The guard ponds of each shall be bounded suitably to prevent mixing of rain water runoff with flood water from upstream of the facility. The operator shall provide flow meters with totalizer at the inlet and outlet of each guard pond to quantify the treated effluents disposed off through outfall and report compliance within two months to RO-Visakhapatnam.
  39. The operator of facility shall provide online monitoring system of the effluents for the parameters like pH, DO, TDS, COD at each outlet of the guard ponds and Bioassay testing facility. If it is found the effluents are not conforming to the prescribed standards, the effluents shall be taken back to the treatment system to provide adopting suitable treatment to achieve the prescribed standards.
  40. The operator of the CETP shall maintain Piezometric stations for monitoring of ground water quality all around the facility including effluent conveying systems from member industries, collection tanks and guard ponds. The operator shall maintain trend analysis on ground water quality and shall regularly monitor for fluctuations of the ground water quality. If any substantial changes in the ground water quality is observed and deviating from the existing data, the same shall be immediately brought to the notice of the Board along with plan of action to prevent further damage & necessary rectification works shall be taken up.
  41. The pipelines laid underground for conveying Low TDS & High TDS effluents streams from member industries shall be maintained intact and leak proof. Appropriate mechanism for cross verification for prevention of any leakages of effluents / damage of pipeline shall be followed viz., matching the meter readings at outlet of member industries and inlet of CETP.
  42. In order to avoid smell nuisance in the surrounding area, the operator of the CETP shall maintain adequate measures which includes dosing of liquid oxygen into the effluents during break down / maintenance /shut down of CETP even for short gap.
  43. The operator shall evaporate the leachate from landfill facility and scrubber blow down from incinerator in the spray drier only.
  44. The operator shall detoxify the High TDS effluents of CETP before feeding into the spray drier. The operator shall maintain flow meter for the purpose of measuring the quantity of High TDS effluents generating in the spray drying system and shall furnish consolidated weekly reports to RO, Visakhapatnam.
  45. The operator shall maintain Environment monitoring program covering AAQ for 5-Km radius and ground water quality for a distance of 3 Kms around the facility. The facility shall include monitoring of RSPM at regular intervals. The analysis reports shall be submitted to the Board every month.
  46. The operator shall maintain fire hydrant system with water storage of adequate capacity (4 hours) with two pumps one electric and one diesel of

- 1620 liters/min capacity.
47. The operator shall maintain consistent compliance of Environmental Clearance obtained from MoEF, Gol on 10.03.2005 and subsequent amendments obtained.
  48. The operator shall maintain consistent compliance of CTE obtained from the Board on 22.09.2004 & 14.10.2006 (CFE Order No.3/APPCB/CFE/Pharma/2004/1356, dated 22.09.2004 and CFE order No.3/PCB/CFE/Pharma/CFE/HO/2006, dated 14.10.2006) add subsequent amendments obtained.
  49. The operator shall install digital display boards at publicly visible places at the main gate indicating the products, effluent discharge standards, air emission standards, hazardous waste quantities and validity of CFO and exhibit the CFO order at a prominent place in the factory premises.
  50. Any other directions / circulars / notices issued by CPCB, MoEF&CC and APPCB shall be followed from time to time.

**Special conditions:**

51. The industry shall operate with valid NOC issued by the Andhra Pradesh State Disaster Response and Fire Service Dept., (APSDRFSD) and submit a copy at concerned Regional Office, APPCB.
52. The industry shall maintain valid PLI policy which includes Environmental Relief Fund (ERF) and submit copy to RO, Visakhapatnam on yearly base.
53. The industry shall prepare a safety report and carry out an independent safety audit report of the respective industrial activities including chemical storages / isolated storages by an expert not associated with such industrial activity as required under Rule 10 of MSIHC Rules, 1989 and get it approved by the Factories Dept., and submit the compliance along with copy of the safety report, safety audit report and safety certificate at concerned Regional Office, APPCB.
54. The industry shall extend training to the working personnel for the prevention of accidents and necessary antidotes to ensure safety, as per the MSIHC Rules, 1989.
55. The industry shall carryout calibration of safety equipment and leak detection systems at regular intervals and shall certify the same with the Factories Department. That certified copy shall be submitted to the APPCB, Regional Office.
56. The industry shall install fluorescent Wind Vane at the highest point in the industry premises.
57. The industry shall submit Risk analysis and risk assessment covering worst scenario clearly describing impact within the industry premises and outside the industry premises and emergency response system.
58. The industry shall submit the copy of the safety audit report and On-Site / Off Site Emergency Plans as applicable after being certified by the Factories Department to the APPCB, Regional Office from time to time, if the storage quantity of hazardous chemicals is equal to or, in excess of the threshold quantities specified in schedule 2 & 3 of MSIHC Rules, 1989.
59. The industry shall provide VOC meters with real time data transmission facility through internet of things (IoT) and link to the servers of APPCB.

60. The industry shall submit half yearly compliance reports to all the stipulated conditions in Environmental Clearance (EC), Consent to Establishment (CTE) and Consent to Operation (CTO) through website i.e., <https://pcb.ap.gov.in> by 1st of January and 1st July of every year. The first half yearly compliance reports shall be furnished by the industry and **second half yearly compliance reports shall be the audited through MoEF&CC recognized and National Accreditation Board for Laboratory Testing (NABL) accredited third party.**

### **SCHEDULE – C**

***[See rule 6(2)]***

#### **[CONDITIONS OF AUTHORISATION FOR OCCUPIER OR OPERATOR HANDLING HAZARDOUS WASTES]**

1. The authorized person shall comply with the provisions of the Environment (Protection) Act, 1986, and the rules made there under.
2. The authorization or its renewal shall be produced for inspection at the request of an officer authorized by the State Pollution Control Board.
3. The person authorized shall not rent, lend, sell, transfer or otherwise transport the Hazardous and other wastes except what is permitted through this authorization.
4. Any un authorized change in personnel, equipment or working conditions as mentioned in the application by the person authorized shall constitute a breach of his authorization.
5. The person authorized shall implement Emergency Response Procedure (ERP) for which this authorization is being granted considering all site-specific possible scenarios such as spillages, leakages, fire etc. and their possible impacts and also carry out mock drill in this regard at regular interval of time.
6. The person authorized shall comply with the provisions outlined in the Central Pollution Control Board guidelines on “Implementing Liabilities for Environmental Damages due to Handling and Disposal of Hazardous Waste and Penalty”.
7. It is the duty of the authorized person to take prior permission of the State Pollution Control Board to close down the facility.
8. An application for the renewal of an authorization shall be made as laid down under these Rules.
9. Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board from time to time.
10. The authorized person shall submit annual returns in Form- 4 as per Rule 6(5) of the Hazardous & Other Wastes (Management & Transboundary Movement) Rules, 2016 and amendments thereof to APPCB by 30<sup>th</sup> day of June of every year for the preceding period April to March. Hazardous Wastes quantities in Form- 4 shall be submitted in terms of Metric Tones/annum.
11. The authorized person shall not store hazardous waste for more than 90 days as per the Hazardous & Other Wastes (Management and Transboundary Movement) Rules, 2016.

12. The authorized person shall store Used /Waste Oil and Used Lead Acid Batteries in a secured way in their premises till its disposal to the manufacturers / dealers on buy back basis.
13. The authorized person shall maintain 7 copy manifest system for transportation of waste generated and a copy shall be submitted to concerned Regional Office of APPCB. The driver who transports Hazardous Waste should be well acquainted about the procedure to be followed in case of an emergency during transit. The transporter should carry a Transport Emergency (TREM) Card.
14. The authorized person shall maintain proper records for Hazardous & other wastes stated in Authorization in Form-3 i.e., quantity of Incinerable waste, land disposal waste, recyclable waste etc., and file annual returns in Form- 4 as per Rule 6 (5) of the Hazardous & Other Wastes (Management & Transboundary Movement) Rules, 2016 and amendments thereof by June 30<sup>th</sup> for the period ensuring 31st March of the year

**S SRI SARAVANAN**  
**MEMBER SECRETARY**

**To**

**M/s. Visakha Pharmacy Limited**  
**(Formerly M/s. Ramky Pharmacy (India) Ltd) (CETP),**  
**JN Pharmacy, Parawada,**  
**Anakapalli District.**  
**E-mail: narendrababu.k@ramky.com**  
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