

DEENDAYAL PORT AUTHORITY
(Erstwhile: DEENDAYAL PORT TRUST)



www.deendayalport.gov.in

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EG/WK/4751/Part (3 remaining facilities-II)

Dated: 13/03/2024

To,
Shri T. C. Patel,
Unit Head, Kachchh,
Gujarat Pollution Control Board,
Paryavaran Bhavan,
Sector 10A, Gandhinagar- 382 010.

Sub: Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Authority (Erstwhile: Deendayal Port Trust) at Gandhidham, Kutch, Gujarat - **Submission of compliance report of stipulated conditions mentioned in the CTE issued by the GPCB req.**

Ref.:

1. Amendment to NOC/CTE issued by the GPCB (CTE - 89537) vide no. PC/CCA-KUTCH-1231 (2)/GPCB ID 44000/429717 dated 4/12/2017 for inclusion of the following three projects in the CTE granted for seven projects vide CTE - 74334 dated 22/12/2015 and CTE validity extension (CTE-125870) from GPCB vide Order dated 27/04/2023 with validity up to 15/11/2025.
2. DPT letter no. EG/WK/4751/Part (3 remaining facilities-II) dated 13/07/2021.
3. DPT letter no. EG/WK/4751/Part (3 remaining facilities-II) dated 8/2/2022.
4. DPA letter no. EG/WK/4751/Part (3 remaining facilities-II)/134 dated 06/07/2022
5. DPA letter no. EG/WK/4751/Part (3 remaining facilities-II)/284 dated 18/04/2023
6. DPA letter no. EG/WK/4751/Part (3 remaining facilities-II)/284 dated 18/04/2023
7. DPA letter no. EG/WK/4751/Part (3 remaining facilities-II)/356 dated 12/09/2023

Sir,

It is requested to kindly refer above cited references for the said subject.

In this connection, it is relevant to mention here that, the GPCB vide above mentioned letter no. PC/CCA-KUTCH-1231 (2)/GPCB ID 44000/429717 dated 4/12/2017 has issued amendment to NOC/CTE (CTE-89537) for inclusion of 3 remaining integrated facilities (Container terminal Tuna Tekra, Railway Line (NH 8 A to tuna - 11km) and Construction of Port Craft Jetty & SNA Section), proposed by DPA and validity up to 15/11/2022. Further, GPCB issued CTE validity extension (CTE-125870) vide Order dated 27/04/2023 with validity up to 15/11/2025.

It is also to submit here that, based on the CRZ Recommendation granted by the GCZMA dated 29/6/2016, the MoEF&CC, GoI had accorded EC & CRZ Clearance dated 18/2/2020 for remaining 3 integrated facilities as mentioned above. Accordingly, DPA had submitted compliance report vide aforementioned letter to the GPCB.

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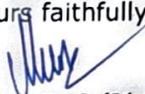
Now, please find enclosed herewith compliance report of conditions stipulated in CTE Order (period up to November, 2023) along with necessary enclosures as **Annexure I**, for kind perusal & record please.

Further, as per the MoEF&CC, Notification S.O.5845 (E) dated 26.11.2018, stated that **"In the said notification, in paragraph 10, in sub-paragraph (ii), for the words "hard and soft copies" the words "soft copy" shall be substituted"**. Accordingly, we are submitting herewith soft copy of the same through e-mail ID kut-uh-gpcb@gujarat.gov.in.

This has the approval of the Chief Engineer, Deendayal Port Authority.

Encl.: As above

Yours faithfully,


SE (PL) & EMC (I/c)
Deendayal Port Authority

Copy to: Regional Officer,
Gujarat Pollution Control Board,
Regional office,
East Kutch, Gandhidham-370201.
Email Id. ro-gpcb-kute@gujarat.gov.in

Annexure -I

Subject: Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Authority (Erstwhile: Deendayal Port Trust) at Gandhidham, Kutch, Gujarat – **Environmental & CRZ Clearance.**

CURRENT STATUS OF WORK (up to November, 2023)

Sr.No.	Name of Project	Status
1	<p>Development of Container Terminal at Tuna off-Tekra on BOT Basis:</p> <p><i>(Jetty: T-shape 1100m X 54m, Capacity: 2.19 Million TEUs/Annum, Capital Dredging: 13,56,000 M3, Maintenance Dredging 271200 M3/year, Land Area req.: 84 ha, Break water: Length of 1400 m, with 20 m of height, Estimated Cost: 3097 cr.)</i></p>	<p>The Concession Agreement was signed on 25.08.2023. The Project is in the Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024, and the Planned Construction End Date is February 2027.</p>
2	<p>Providing Railway Line from NH 8A to Tuna Port.</p> <p><i>(Length – 11 km, Estimated cost: 94 cr.)</i></p>	<p><u>Work completed.</u></p>
3	<p>Construction of Port Craft Jetty & Shifting of SNA Section.</p> <p><i>(Dredging: 27357.00 m3, Estimated Cost: 23.17 cr.)</i></p>	<p><u>Work completed.</u></p>

Annexure 1

COMPLIANCE REPORT (up to November 2023)

Subject: Compliance report of conditions stipulated in Consent to Establish (CTE/NOC) issued by GPCB for the proposal "Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Authority (Erstwhile: Kandla Port Trust) at Gandhidham, Kutch, Gujarat".

Ref.: Amendment to NOC/CTE issued by the GPCB (CTE – 89537) vide no. PC/CCA-KUTCH-1231 (2)/GPCB ID 44000/429717 dated 4/12/2017 for inclusion of the following three projects in the CTE granted for seven projects vide CTE – 74334 dated 22/12/2015. Further, DPA had obtained CTE validity extension (CTE-125870) from GPCB vide Order dated 27/04/2023 with validity up to 15/11/2025.

Sr. No.	Specific Condition	Compliance
Subject to the following Specific Conditions.		
1	You shall not commence of any construction activities of project, till obtaining EC clearance from MoEF&CC, GoI.	The MoEF&CC, GoI accorded EC & CRZ Clearance for "Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Trust (Erstwhile: Kandla Port Trust) at Gandhidham, Kutch, Gujarat" vide letter dated 18/2/2020 <u>(Copy once again attached – Annexure A).</u>
2	You shall have to comply with the all conditions stipulated in ToR of MoEF in order of EC no. F. No. 10-9/2017-IA.III dated 6/6/2017.	Based on the ToR issued by the MoEF&CC, GoI dated 6/6/2017, the NABET accredited EIA Consultant had prepared EIA/EMP report as per ToR and accordingly, the MoEF&CC, GoI had accorded the EC & CRZ Clearance dated 18/2/2020.
3	You shall have to comply with the all conditions of CRZ vide order no. ENV-10-2015-248-E (T Cell), dated 29/6/2016.	The compliance report of the stipulated conditions in the CRZ Recommendation dated 29/6/2016 is attached herewith as <u>Annexure B.</u>
3. Conditions under Water Act 1974.		
3.1	There shall be no industrial effluent generation from the loading and unloading activities at Port and other ancillary operations.	N/A Project at Sr. No.1, i.e., Development of Container Terminal at Tuna off-Tekra on BOT Basis – Containerized cargo will be handled. Project at Sr. no. 2, i.e., Providing a Railway Line from NH 8A to Tuna Port. – For cargo movement in connection with the Dry Bulk Terminal at Tuna Tekra. Project at Sr. no.3, i.e. Construction of

		Port Craft Jetty & Shifting of SNA Section – For parking of Port crafts.										
3.2	(a) The total water consumption for shall not exceed 11 KL/day. (b) The quantity of Domestic waste water (sewage) shall not exceed 8 KL/Day	Agreed with the condition. Agreed with the condition.										
3.3	The quantity of sewage shall conform to the following standards: <table border="1" data-bbox="293 485 902 657"> <thead> <tr> <th>Parameters</th> <th>GPCB Norms</th> </tr> </thead> <tbody> <tr> <td>PH</td> <td>6.5 to 9</td> </tr> <tr> <td>BOD (5 days at 20 *C)</td> <td>30 mg/L</td> </tr> <tr> <td>Suspended solid</td> <td>100 mg/L</td> </tr> <tr> <td>Fecal Coliform</td> <td>1000</td> </tr> </tbody> </table>	Parameters	GPCB Norms	PH	6.5 to 9	BOD (5 days at 20 *C)	30 mg/L	Suspended solid	100 mg/L	Fecal Coliform	1000	DPA has been appointing a NABL-accredited laboratory for monitoring environmental parameters, and reports are being submitted from time to time to the GPCB, IRO, MoEF&CC, GoI, and Gandhinagar. Recently, DPA appointed GEMI, Gandhinagar, to regularly monitor environmental parameters vide Work Order dated 15/02/2023. The work is in progress, and the latest environmental monitoring report submitted by GEMI, Gandhinagar, is attached herewith as Annexure C . For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.
Parameters	GPCB Norms											
PH	6.5 to 9											
BOD (5 days at 20 *C)	30 mg/L											
Suspended solid	100 mg/L											
Fecal Coliform	1000											
3.4	The treated domestic sewage conforming to the above standards shall be utilized for plantation/gardening within premises.	Agreed with the condition. Further, it is also relevant to mention here that the generated sewage is treated in the STP of 1.5 MLD. The treated sewage from STP of DPA is utilised for plantation / Gardening. For monitoring of environmental parameters, DPA has been appointing NABL Accredited laboratory and reports are being submitted from time to time to the GPCB, IRO, MoEF&CC, GoI, Gandhinagar. Recently, DPA appointed GEMI, Gandhinagar for regular monitoring of environmental parameters vide Work Order dated 15/02/2023. The work is in progress and the latest environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as Annexure C . For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply										

		with the condition.																				
3.5	The unit shall install flow meter at utilities for measuring category wise (category as given in water cess act – 1977 schedule II) consumption of water.	Point noted																				
4	Conditions Under Air Act 1981.																					
4.1	There shall be no use of fuel hence there shall be no flue gas emission from storage handling activity and other ancillary operations.	Not applicable.																				
4.2	The applicant shall provide portholes, ladder, platform etc. at chimney (s) for monitoring the air emission and shall be open for inspection to and for use of Boards staff. The chimney(s) vents attached to various sources of emission shall be designed by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.	Not applicable																				
4.3	<p>The concentration of the following parameters in the ambient air within the premises of the industry shall not exceed the limits specified hereunder as per national Ambient Air Quality Emission Standards issued by Ministry of Environment and Forest dated 16th November, 2009.</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Pollutant</th> <th>Time weighted Average</th> <th>Concentration in Ambient air in $\mu\text{g}/\text{M}^3$</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Sulphur Dioxide (SO₂)</td> <td>Annual 24 Hours</td> <td>50 80</td> </tr> <tr> <td>2</td> <td>Nitrogen Dioxide (NO₂)</td> <td>Annual 24 Hours</td> <td>40 80</td> </tr> <tr> <td>3</td> <td>Particulate Matter (Size less than 10 μm) OR PM₁₀</td> <td>Annual 24 Hours</td> <td>60 100</td> </tr> <tr> <td>4</td> <td>Particulate Matter (Size less than 2.5 μm) OR PM_{2.5}</td> <td>Annual 24 Hours</td> <td>40 60</td> </tr> </tbody> </table>	Sr. No	Pollutant	Time weighted Average	Concentration in Ambient air in $\mu\text{g}/\text{M}^3$	1	Sulphur Dioxide (SO ₂)	Annual 24 Hours	50 80	2	Nitrogen Dioxide (NO ₂)	Annual 24 Hours	40 80	3	Particulate Matter (Size less than 10 μm) OR PM ₁₀	Annual 24 Hours	60 100	4	Particulate Matter (Size less than 2.5 μm) OR PM _{2.5}	Annual 24 Hours	40 60	<p>DPA has been appointing a NABL-accredited laboratory for monitoring environmental parameters, and reports are being submitted from time to time to the GPCB, IRO, MoEF&CC, GoI, and Gandhinagar. Recently, DPA appointed GEMI, Gandhinagar, to regularly monitor environmental parameters vide Work Order dated 15/02/2023. The work is in progress, and the latest environmental monitoring report submitted by GEMI, Gandhinagar, is attached herewith as Annexure C.</p> <p>For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.</p>
Sr. No	Pollutant	Time weighted Average	Concentration in Ambient air in $\mu\text{g}/\text{M}^3$																			
1	Sulphur Dioxide (SO ₂)	Annual 24 Hours	50 80																			
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4	Particulate Matter (Size less than 2.5 μm) OR PM _{2.5}	Annual 24 Hours	40 60																			

3.4	<p>The concentration of Noise in ambient air within the premises of industrial unit shall not exceed following levels:</p> <p>Between 6 A.M. and 10 P.M.: 75 dB (A)</p> <p>Between 10 P.M. and 6 A.M.: 70 dB (A)</p>	<p>DPA has been appointing a NABL-accredited laboratory for monitoring environmental parameters, and reports are being submitted from time to time to the GPCB, IRO, MoEF&CC, GoI, and Gandhinagar. Recently, DPA appointed GEMI, Gandhinagar, to regularly monitor environmental parameters vide Work Order dated 15/02/2023. The work is in progress, and the latest environmental monitoring report submitted by GEMI, Gandhinagar, is attached herewith as Annexure C.</p> <p>For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.</p>
5 Conditions Under Hazardous Waste		
5.1	<p>The applicant shall provide temporary storage facilities for each type of hazardous waste as per hazardous waste (management, handling & trans boundary movement) Rule, 2008 as amended from time to time.</p>	<p>DPA issued Grant of License/Permission to collect and dispose of "Hazardous Waste/Sludge/Waste Oil" from Vessels calling at Deendayal Port" through DPA contractors. Further, all ships are required to follow DG Shipping circulars regarding the reception facilities at the Swachh Sagar portal.</p> <p>For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.</p>
5.2	<p>The applicant shall be obtain membership of common TSDF site for disposal Hazardous waste as categorized in Hazardous waste (Management, Handling & trans boundary Movement) Rules, 2008 as amended from time to time.</p>	<p>Not applicable</p>
6 General Conditions		
6.1	<p>Any change in personnel, equipment or working conditions as mentioned in the consent form / order should immediately be intimated to this Board.</p>	<p>Agreed with the condition. In case of any change in personnel, equipment or working conditions as mentioned in the consent form/order, DPA will inform to the GPCB.</p>
6.2	<p>The waste generator shall be totally</p>	<p>DPA has entered into a 'Selling</p>

	responsible for (i.e collection, storage, transportation and ultimate disposal) of the waste generated.	Agency' agreement with M/s. MSTC (Govt. of India Enterprise), Vadodara on 04/01/2022 for disposal of scrap, surplus items, unserviceable equipment etc. The copy of the MoU has already been communicated with the last compliance report submitted. For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.
6.3	Records of waste generation, its management and annual returns shall be submitted to Gujarat Pollution Control Board in Form – 4 by 31 st January of every year.	DPA regularly submitted annual return Hazardous waste in Form IV to the Gujarat Pollution Control Board. The annual return for the year 2022-23 is attached herewith as Annexure D .
6.4	In case of any accident of the same shall be submitted in form – 5 to Gujarat Pollution Control Board.	Agreed with the condition.
6.5	Applicant shall comply relevant provision of "Public liability insurance act – 91".	Not applicable
6.6	Unit shall take all concrete measures to show tangible result in waste generation reduction, avoidance, reuse and recycle. Action taken in this regard shall be submitted within 03 months and also along with form 4.	Hazardous waste is disposed of by selling it to registered recyclers/re-processors. DPA regularly submitted the annual return of hazardous waste in Form IV to the GPCB. The annual return for the year 2022-23 is attached herewith as Annexure D . For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.
6.7	Industry shall have to display on – line data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant, including wastewater and air emission and solid hazardous waste generated within the factory premises.	Agreed with the Condition. The necessary display boards are already provided at the entry gates, showing the required details as mentioned in the condition. Further, DPA invited a tender for 'Online Continuous Ambient Air Quality Monitoring (CAAQM) For the Period of Three Years at Deendayal Port Authority'. The same is under the evaluation stage. For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.

6.8	<p>Adequate plantation shall be carried out all along the periphery of the industrial premises in such a way that the density of plantation is at least 1000 trees per acre of land and a green belt of 10 meters width is developed.</p>	<p>DPA entrusted work of green belt development in and around the Port area to the Forest Department, Gujarat, for Rs. 352 lakhs (Area 32 hectares). The work is completed.</p> <p>Further, DPA has appointed the Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-I)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022. The final report submitted by GUIDE, Bhuj, is attached herewith as Annexure E.</p> <p>Further, DPA has accorded the work of "Green belt development in DPA and its surrounding area (Phase II) to Gujarat Institute of Desert Ecology (GUIDE), Bhuj, for the plantation of 10000 saplings of suitable species vide work order dated 23/06/2023. The same is in process.</p> <p>For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.</p>
6.9	<p>The applicant shall have to submit the returns in prescribed form regarding water consumption and shall have to make payment of water cess to the Board under the water (prevention & control of pollution) Cess Act-1977.</p>	<p>DPA regularly submitted the Environmental Statement in Form V. The annual return for 2022-23 is attached as Annexure F.</p> <p>For a project at Sr. No. 1, a Container terminal to be developed on a BOT Basis, the BOT Operator shall comply with the condition.</p>

Annexure -A

F.No.10-9/2017-IA-III
Government of India
Ministry of Environment, Forest and Climate Change
(IA.III Section)

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi - 3

Date: 18th February, 2020

To,

**The Chief Engineer,
M/s Kandla Port Trust**
Administrative Office Building,
Annexe Building, First Floor,
Gandhidham - 370201, Gujarat
E Mail: kptemc@gmail.com

Subject: Development of 3 remaining integrated facilities (Stage I) within the existing Kandla Port Trust at Gandhidham, Kutch, Gujarat by M/s Kandla Port Trust - Environmental & CRZ Clearance - reg.

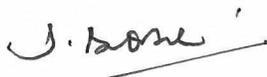
Sir,

This has reference to your online Proposal No. IA/GJ/MIS/61975/2017 dated 8th September, 2017, submitted to this Ministry for grant of Environmental and CRZ Clearance in terms of the provisions of the Environment Impact Assessment (EIA) Notification, 2006 and Coastal Regulation Zone (CRZ) Notification, 2011, under the Environment (Protection), Act, 1986.

2. The proposal for 'Development of 3 remaining integrated facilities (Stage I) within the existing Kandla Port Trust at Gandhidham, Kutch, Gujarat by M/s Kandla Port Trust was considered by the Expert Appraisal Committee (Infra-2) in the Ministry in its 27th meeting held during 25th January, 2018 and 33rd meeting held during 9-10 August, 2018.

3. The details of the project, as per the documents submitted by the project proponent, and also as informed during the above said EAC meeting, are reported to be as under:-

- (i) Deen Dayal Port is situated at Latitude 23°01'N and Longitude 70°13'E on the shores of the Kandla Creek, Gulf of Kutch at a distance of 90 nautical miles from the Arabian Sea. The width of the channel varies from 200 meters to 1,000 meters. The total length of the Kandla Port approach Channel is around 23 km.
- (ii) Kandla Port Trust (renamed as Deendayal Post Trust) had obtained Terms of Reference for conducting EIA studies from MoEF&CC, vide letter F.No. 10-9/2017-IA.III dated 06.06.2017.
- (iii) Public Hearing was exempted by the Ministry as per para-7(ii) of EIA Notification, 2006, because public hearing has already been conducted by the Gujarat Pollution Control Board on 18.12.2013.
- (iv) CRZ recommendations have been received from SCZMA, Gujarat vide their letter no ENV-10-2015-248-E (T Cell) dated 29.06.2016 for the projects.
- (v) The project involves following components:
 - Development of Container Terminal at Tuna off Tekra on BOT basis
Jetty T shape 1100m x 54m, capacity 2.19 Million TEUs/annum, Dredging: Capital 13,56,000 m³ Maintenance 2,71200 m³/year, Land Area : 84 Ha Break water: Length of 1400 m with 20m ht.
 - Construction of Port Craft Jetty & shifting of SNA Section at Kandla Port Trust
 - Railway Line from NH-8A to Tuna Port- 11.00 km



- (vi) 5.0 KLD water will be used for various purposes during the project.
- (vii) Solid wastes generated from the colony will be taken care by the waste disposal plan. The construction waste may pose impacts on land environment by contamination of soil and hence the wastes shall be utilized for PCC works, Road construction, and other filling requirement etc. The accidental spillage of fuels and lubricants oils will be minimized by proper care.
- (viii) There will be temporary influx of people to the area who will be involved directly and indirectly during the construction of Jetty.
- (ix) The total land requirement for the project is 95 Ha. There is no land acquisition as land belongs to Kandla Port Trust.
- (x) Total project cost is Rs. 3214.17 crores.
- (xi) Benefits of the project: Faster evacuation of Cargo, thereby Increase in cargo evacuation capacity, Earning through special port charges on rail bound / rail borne cargo passing through the Railway line. Enhances the possibility of receiving higher revenue share quotes for various BOT projects to be developed nearby Tuna port.
- (xii) Employment potential: The indirect employment potential of the projects would be significantly beneficial for the area. The project requires recruiting numbers of skilled, semi-skilled and un-skilled manpower during the construction phase and indirect employment through contracts for civil construction, Mechanical erection, electrification, plumbing works and associated amenities. The proposed project is expected to employ about 200 people per day of various skills which would mean income to about 200 people.

4. The project/activity is covered under category 'A' of item 7 (e) i.e. 'Ports, harbours, break waters, dredging' of the schedule to the EIA Notification, 2006 and its subsequent amendments, and requires appraisal at Central level.

5. The Expert Appraisal Committee (Infra-2) deliberated on the proposal its 27th meeting held on 25th January, 2018 and 33rd meeting held on 9-10 August, 2018. The EAC also deliberated on the certified compliance report letter F. No. 6-37/2008(ENV)/311 dated 26.05.2017 issued by the MoEF&CC's Regional Office (WR), Bhopal and noted the observations/remarks of the Regional office as well as the action taken by project proponent.

6. The EAC, after detailed deliberations on the proposal and submissions made by the project proponent, recommended the project for grant of Environmental and CRZ Clearance. As per recommendations of the EAC, the Ministry of Environment, Forest and Climate Change hereby accords Environmental and CRZ Clearance for the project 'Development of 3 remaining integrated facilities (Stage I) within the existing Kandla Port Trust at Gandhidham, Kutch, Gujarat by M/s Kandla Port Trust', under the provisions of the EIA Notification, 2006 and CRZ Notification, 2011 and amendments thereto and circulars issued thereon and subject to the compliance of the following specific and general conditions as under:-

A. SPECIFIC CONDITIONS:

- (i) Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.
- (ii) The project proponents will submit a declaration under Oath that the Railway line will not pass through mangrove area.

J. Rose

- (iii) A detailed traffic management and traffic decongestion plan to ensure that the current level of service of the roads within a 05 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 05 Kms radius of the site in different scenarios of space and time and the traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D. and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.
- (iv) A detailed marine biodiversity impact assessment report and plan shall be drawn up and implemented to the satisfaction of the State Biodiversity Board and the CRZ authority. This shall be prepared through the NIOS or any other institute of repute on marine, brackish water and fresh water ecology and biodiversity. The report shall be based on a study of the impact of the project activities on the intertidal biotopes, corals and coral communities, molluscs, sea grasses, sea weeds, sub-tidal habitats, fishes, other marine and aquatic micro, macro and mega flora and fauna including benthos, plankton, turtles, birds etc. as also the productivity. The data collection and impact assessment shall be as per standards survey methods and include underwater photography.

The project proponent shall obtain all the documents/certificate mentioned in para (i) to (iv) above and submitted/uploaded online to the Ministry's Regional Office, Bhopal before starting implementation of the project.

The Ministry also stipulated the following specific conditions along with other environmental conditions while considering the grant of Environmental and CRZ Clearance:

- (v) Construction activity shall be carried out strictly according to the provisions of the CRZ Notification, 2011. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.
- (vi) All the recommendations and conditions specified by the Gujarat Coastal Zone Management Authority who has recommended the project vide letter No. ENV-10-2015-249-E (T cell) dated 19.06.2017 shall be complied with.
- (vii) The project proponent shall ensure that the project is in consonance with the new CZMP prepared by the State Government under the provisions of the CRZ Notification, 2011.
- (viii) Notification GSR 94(E) dated 25.01.2018 of MoEF&CC regarding Mandatory Implementation of Dust Mitigation Measures for Construction and Demolition Activities for projects requiring Environmental Clearance shall be complied with.
- (ix) The Project proponent shall ensure that no creeks or rivers are blocked due to any activities at the project site and free flow of water is maintained.
- (x) No solid, semi solid cargos would be handled.
- (xi) Dredging shall not be carried out during the fish breeding season.
- (xii) Dredging, etc shall be carried out in the confined manner to reduce the impacts on marine environment including turbidity.
- (xiii) Dredged material shall be disposed safely in the designated areas.
- (xiv) Shoreline should not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary. The details shall be submitted along with the six monthly monitoring report.



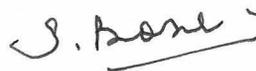
- (xv) While carrying out dredging, an independent monitoring shall be carried out by Government Agency/Institute to check the impact and necessary measures shall be taken on priority basis if any adverse impact is observed.
- (xvi) Water will be received from high service reservoir near Bhachau and Narmada Canal through pipeline of Gujarat Water supply and Sewerage Board. 5.0 KLD water will be used for various purposes during the project. Rain water harvesting shall be followed as per local byelaw and harvested water shall be stored, treated and reused to reduce the additional water requirement since Chennai is a water deficient area, besides use of water efficient appliances.
- (xvii) The concerns expressed during the public hearing held by the M/s Kandla Port Trust for development of 3 remaining integrated facilities (Stage I) within the existing Kandla Port needs to be addressed during the project implementation. These would also cover socio-economic and ecological and environmental concerns, besides commitment by the management towards employment opportunities.
- (xviii) The Marine biodiversity impact assessment report and management plan prepared by Gujarat Institute of Desert Ecology (GUIDE), Bhuj and approved by NIO and its mitigation measures for protection of sand dune vegetation, mangroves, sea grasses, macrophytes and phytoplankton etc. as given in the EIA-EMP Report shall be complied with in letter and spirit.
- (xix) A continuous monitoring programme covering all the seasons on various aspects of the coastal environs need to be undertaken by a competent organization available in the State or by entrusting to the National Institutes/renowned Universities/accredited Consultant with rich experiences in marine science aspects. The monitoring should cover various physico-chemical parameters coupled with biological indices such as sand dune vegetation, mangroves, sea grasses, macrophytes and phytoplankton on a periodic basis during construction and operation phase of the project. Any deviations in the parameters shall be given adequate care with suitable measures to conserve the marine environment and its resources.
- (xx) Continuous online monitoring of for air and water covering the total area shall be carried out and the compliance report of the same shall be submitted along with the 6 monthly compliance report to the regional office of MOEF&CC.
- (xxi) Ambient air quality shall be maintained at prescribed levels. The existing ambient air quality stations shall have a system of reporting exceedances separately to the Pollution Control Board.
- (xxii) The project configuration should integrate and dovetail with the State Plan and not implemented unless the state plan is prepared and dovetailing ratified.
- (xxiii) Marine ecology shall be monitored regularly also in terms of sea weeds, sea grasses, mudflats, sand dunes, fisheries, echinoderms, shrimps, turtles, corals, coastal vegetation, mangroves and other marine biodiversity components as part of the management plan. Marine ecology shall be monitored regularly also in terms of all micro, macro and mega floral and faunal components of marine biodiversity.
- (xxiv) Spillage of fuel / engine oil and lubricants from the construction site are a source of organic pollution which impacts marine life, particularly benthos. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.
- (xxv) The handling of Hazardous Cargo should follow the provisions of the MSIHC Rules 1989 as amended. An onsite management plan shall be drawn up and integrated with that off site management plan. This shall be to the satisfaction of the state pollution control board, the Factory Department and the District Management.

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- (xxvi) Necessary arrangements for the treatment of the effluents and solid wastes/ facilitation of reception facilities under MARPOL must be made and it must be ensured that they conform to the standards laid down by the competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986. The provisions of Solid Waste Management Rules, 2016, E-waste Management Rules, 2016, and Plastic Waste Management Rules, 2016 shall be followed.
- (xxvii) Compliance to Energy Conservation Building (ECBC-2017) shall be ensured for all the building complexes. Solar/wind or other renewable energy shall be installed to meet energy demand of 1% equivalent.
- (xxviii) All the recommendations mentioned in the rapid risk assessment report, disaster management plan and safety guidelines shall be implemented.
- (xxix) Measures should be taken to contain, control and recover the accidental spills of fuel and cargo handle.
- (xxx) Necessary arrangement for general safety and occupational health of people should be done in letter and spirit.
- (xxxi) KPT shall take up massive greenbelt development activities in and around Kandla and also within the KPT limits.
- (xxxii) All the mitigation measures submitted in the EIA report shall be prepared in a matrix format and the compliance for each mitigation plan shall be submitted to the Regional Office, MoEF&CC along with half yearly compliance report.
- (xxxiii) As per the Ministry's Office Memorandum F.No. 22-65/2017-IA.III dated 1st May 2018, an amount of Rs. 8.04 Crore (@0.25% of project Cost) shall be earmarked under Corporate Environment Responsibility (CER) for the activities such as drinking water, sanitation, health, education, skill development, roads, solar power, rain water harvesting, avenue plantation and plantation in the community areas. The activities proposed under CER shall be restricted to the affected area around the project. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half yearly compliance report, and to the District Collector. It should be posted on the website of the project proponent.
- (xxxiv) The project is recommended for grant of Environmental and CRZ Clearance subject to final outcome/legal opinion on the Order dated 22nd November, 2017 of Hon'ble NGT in the Original Application No. 424 of 2016 (Earlier O.A. No. 169 of 2015) and Original Application No. 11 of 2014 in the matter of M/s. Mehdad & Anr. Vs. Ministry of Environment, Forests & Climate Change & Ors. and Shamsunder Shridhar Dalvi & Ors. Vs. Govt. of India & Ors.

B. GENERAL CONDITIONS:

- (i) Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.
- (ii) Full support shall be extended to the officers of this Ministry/Regional Office at Bhopal by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.
- (iii) A six-Monthly monitoring report shall need to be submitted by the project proponents to the Regional Office of this Ministry at Bhopal regarding the implementation of the stipulated conditions.



- (iv) Ministry of Environment, Forest and Climate Change or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with.
- (v) The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry.
- (vi) In the event of a change in project profile or change in the implementation agency, a fresh reference shall be made to the Ministry of Environment, Forest and Climate Change.
- (vii) The project proponents shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.
- (viii) A copy of this clearance letter shall also be displayed on the website of the concerned State Pollution Control Board.

7. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities.

8. The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environmental and CRZ Clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen on the website of the Ministry of Environment, Forest and Climate Change at <http://www.envfor.nic.in>. The advertisement should be made within Seven days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional office of this Ministry at Bhopal. The Clearance letter shall also be displayed at the Regional Office, District Industries Centre and Collector's Office/ Tehsildar's office for 30 days.

9. A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zilla Parisad/Municipal Corporation, Urban Local Body and the Local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the company by the proponent.

10. This clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation Vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may be applicable to this project.

11. Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

12. Status of compliance to the various stipulated environmental conditions and environmental safeguards will be uploaded by the project proponent in its website

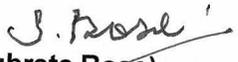
13. The proponent shall upload the status of compliance of the stipulated Clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF&CC, the respective Zonal Office of CPCB and the SPCB.

S. Bose

14. The project proponent shall also submit six monthly reports on the status of compliance of the stipulated Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF&CC, the respective Zonal Office of CPCB and the SPCB.

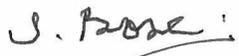
15. The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of Clearance conditions and shall also be sent to the respective Regional Office of MoEF&CC by e-mail.

16. The above stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public Liability (Insurance) Act, 1991 and EIA Notification 1994, including the amendments and rules made thereafter.


(Dr. Subrata Bose)
Scientist F

Copy to:

- 1) The Secretary to Government (Environment and Ecology), Forests & Environment Department, Government of Gujarat Block 14, 8th floor, Sachivalaya, Gandhinagar - 382 010, Gujarat.
- 2) The Addl. Principal Chief Conservator of Forests (Central) Ministry of Environment, Forest and Climate Change, Regional Office (WZ) E-5, Kendriya Paryavaran Bhawan, E-5 Arera Colony, Link Road-3 Ravishankar Nagar, Bhopal - 462016, Madhya Pradesh.
- 3) The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032.
- 4) The Member Secretary, Gujarat Pollution Control Board, Paryavaran Bhavan, Sector-10A, Gandhinagar - 382010, Gujarat.
- 5) Monitoring Cell, MoEF&CC, Indira Paryavaran Bhavan, New Delhi.
- 6) Guard File/ Record File/ Notice Board.
- 7) MoEF&CC website.


(Dr. Subrata Bose)
Scientist F

Annexure -B

Annexure 1

COMPLIANCE REPORT (up to November, 2023)

Subject: Compliance of conditions stipulated in CRZ recommendations issued by GCZMA for the proposal "Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Authority (Erstwhile: Deendayal Port Trust) at Gandhidham, Kutch, Gujarat".

CRZ Recommendations: Letter No. ENV-10-2015-248-E (T - Cell) dated 29/6/2016 of Director (Environment) & Member Secretary, GCZMA, Forest & Environment Department, GoG.

Sr. No.	Conditions in CRZ Recommendation Letter	Compliance
	Specific Conditions	
1	The provisions of the CRZ notification of 2011 shall be strictly adhered to by the KPT. No activity in contradiction to the Provisions of the CRZ Notification shall be carried out by the KPT.	<p>For a project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in the Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024, and the Planned Construction End Date is February 2027.</p> <p>The Projects at Sr. No. 2 & 3 of the EC & CRZ Clearance have already been completed.</p> <p>However, it is assured that DPA will strictly adhere to the provisions of the CRZ Notification, 2011 and no activity other than those permissible in Coastal Regulation Notification, 2011 shall be carried out in the CRZ area.</p>
2	All necessary permissions, under various laws/Rules/Notifications issued there under from different Government Departments/agencies shall be obtained by M/s KPT before commencing any enabling activities for proposed project.	DPA obtained CTE/NOC from the GPCB vide No. PC.CCA-KUTGH-1231(2) I GPCB ID 44000 dated 4/12/2017 (Copy of the same has been communicated with the last compliance report submitted). Further, DPA had obtained CTE validity extension (CTE-125870) from GPCB vide Order dated 27/04/2023 with validity up to 15/11/2025 (Copy enclosed as Annexure A). MoEF&CC, GoI accorded EC & CRZ Clearance for the subject proposal of DPA dated 18/2/2020.

3	The KPT shall have to ensure that there shall not be any damage to the existing mangrove area.	<p>For Project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024 and Planned Construction End Date is February 2027.</p> <p>The Projects at Sr. No. 2 & 3 of the EC & CRZ Clearance have already been completed.</p> <p>Further, DPA has already prepared a mangrove preservation plan for the entire Kandla area.</p>
4	The KPT shall effectively implement the Mangrove Development, Protection & Management Plan for control of indirect impact on mangrove habitat.	<p>DPA has undertaken Mangrove Plantation in an area of 1600 Hectares since the year 2005. The copy of the details has already been communicated with the earlier compliance reports submitted.</p> <p>Further, the Study on the present Status, Conservation and Management Plan for Mangroves of Kandla Port region submitted by M/s GUIDE, Bhuj, had already been communicated to the GCZMA & to the MoEF&CC, GoI.</p> <p>In addition to the above, DPA appointed M/s GUIDE, Bhuj for "Regular Monitoring of Mangrove Plantation carried out by DPA" (period 15/9/2017 to 14/9/2018 vide work order dated 1/9/2017 and 24/5/2021 to 23/5/2022 vide work order dated 3/5/2021). The final report submitted by M/s GUIDE, Bhuj, for the years 2017 to 2018 and 2021 to 2022 has already been communicated with the earlier six monthly compliance submitted.</p>
5	The KPT shall have to make a provision that mangrove areas get proper flushing water and free flow of water shall not be obstructed.	It is hereby assured that necessary provisions will be made so that mangrove areas get proper flushing water and free flow of water shall not be obstructed.
6	The KPT shall have to abide by whatever decision taken by the GCZMA for violation of CRZ Notification.	Point noted

7	<p>No dredging, reclamation or any other project related activities shall be carried out in the CRZ area categorized as CRZ I (i) and it shall have to be ensured that the mangrove habitats and other ecologically important and significant areas, if any, in the region are not affected due to any of the project activity.</p>	<p>For Project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024 and Planned Construction End Date is February 2027.</p> <p>The Projects at Sr. No. 2 & 3 of the EC & CRZ Clearance have already been completed.</p> <p>DPA had authorised the work to M/s GUIDE, Bhuj for continuous monitoring of Marine Ecology since the year 2017 and the final reports are being submitted from time to time to the Regional Office, MoEF&CC, GoI, Gandhinagar & to the MoEF&CC, GoI, New Delhi along with six monthly compliance reports submitted.</p> <p>Further, DPA issued a work order to M/s GUIDE vide its letter no. EG/ WK/ 4751/ Part (Marine Ecology Monitoring) /11 dated 03/05/2021 for Regular monitoring of Marine Ecology in and around Deendayal Port Authority (Erstwhile Deendayal Port Trust) and continuous Monitoring Program covering all seasons on various aspects of the Coastal Environs for the period 2021-24. The final Report for the period 2020-21 has already been submitted along with compliance report submitted dated 07/10/2021</p> <p>The final report for the years 2021-2022, 2022-2023 and the Inception report for the years 2023-24 submitted is attached herewith as Annexure B, Annexure C and Annexure D resp</p>
8	<p>The KPT shall participate financially in installing and operating the Vessel Traffic Management System in the Gulf of Kachchh and shall also take the lead in preparing and operational sing and regularly updating it after getting it vetted by the Indian Coast Guard.</p>	<p>Deendayal Port Authority had already contributed Rs. 41.25 crores for installing and operating the VTMS in the Gulf of Kachchh.</p>
9	<p>The KPT shall strictly ensure that no creeks or rivers are blocked due to any activity at Kandla.</p>	<p>For Project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024 and Planned Construction End Date is February 2027.</p>

		The Projects at Sr. No. 2 & 3 of the EC & CRZ Clearance have already been completed.
10	Mangrove plantation in an area of 50 ha. Shall be carried out by the KPT within 2 years in time bound manner on Gujarat coastline either within or outside the Kandla port Trust area and six monthly compliance reports along with the satellite images shall be submitted to the Ministry of Environment and Forest as well as to this Department without fail.	<p>As per the directions of the GCZMA and MoEF&CC, GoI, till date, DPA has undertaken Mangrove Plantation in an area of 1600 Hectares since the year 2005, which includes 50 Hectares mangrove plantation as per stipulated condition.</p> <p>Further, DPA appointed M/s GUIDE, Bhuj for "Regular Monitoring of Mangrove Plantation carried out by DPA" (period 15/9/2017 to 14/9/2018 vide work order dated 1/9/2017 and 24/5/2021 to 23/5/2022 vide work order dated 3/5/2021). The final report submitted by M/s GUIDE, Bhuj, for the years 2017 to 2018 and 2021 to 2022 have already been submitted in the six monthly compliance communicated vide letter 06/07/2022.</p>
11	No activities other than those permitted by the competent authority under the CRZ Notification shall be carried out in the CRZ area.	<p>For Project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024 and Planned Construction End Date is February 2027.</p> <p>The Projects at Sr. No. 2 & 3 of the EC & CRZ Clearance have already been completed.</p> <p>However, no activities other than those permitted by the competent authority under the CRZ Notification shall be carried out in the CRZ area.</p>
12	No ground water shall be tapped for any purpose during the proposed expansion modernization activities.	Water requirements will be met through procurement from GWSSB or private tankers. It is hereby assured that no groundwater shall be tapped.
13	All necessary permissions from different Government Departments / agencies shall be obtained by the KPT before commencing the expansion activities.	DPA has already obtained the necessary Environmental & CRZ Clearance for three project activities dated 18/2/2020. Further, Consent to Establish from GPCB had already been obtained from GPCB (CTE - 89537) vide no. PC/CCA-KUTCH-1231 (2)/GPCB ID 44000/429717 dated 4/12/2017. Further, DPA had obtained CTE

		validity extension (CTE-125870) from GPCB vide Order dated 27/04/2023 with validity up to 15/11/2025 (Copy enclosed as Annexure A).
14	No effluent or sewage shall be discharged into sea/creek or in the CRZ area and it shall be treated to conform to the norms prescribed by the GPCB and would be reused /recycled within the plant premises.	DPA already has a Sewage Treatment Plant capacity of 1.5 MLD. The treated wastewater is utilized for plantation/gardening purposes. Further, BOT Operator will provide necessary arrangements for a sewage treatment facility.
15	All the recommendations and suggestion given by the Mantec Consultants Pvt. Ltd. in their Comprehensive Environment Impact Assessment report for conservation / protection and betterment of environment shall be implemented strictly by the KPT.	<p>DPA has installed Mist Canon at the Port area to minimize the dust.</p> <p>Further, to control dust pollution in other area, regular sprinkling through tankers on roads and other staking yards is being done.</p> <p>For monitoring of environmental parameters, DPA has been appointing NABL Accredited laboratory and reports are being submitted from time to time to the GPCB, IRO, MoEF&CC, GoI, Gandhinagar. Recently, DPA appointed GEMI, Gandhinagar for regular monitoring of environmental parameters vide Work Order dated 15/02/2023. The work is in progress and the latest environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as Annexure E.</p> <p>For ship waste management, DPA issued Grant of License/Permission to carry out the work of collection and disposal of "Hazardous Waste/Sludge/ Waste Oil" and "Dry Solid Waste (Non- Hazardous)" from Vessels calling at Deendayal Port" through DPA contractors. Further, it is to state that, all ships are required to follow DG Shipping circulars regarding the reception facilities at Swachch Sagar portal.</p> <p>Further, DPA has appointed GEMI, Gandhinagar for the work of "Preparation of Plan for Management of Plastic Wastes, Solid Waste, including C&D waste, E-waste, Hazardous waste, including Biomedical and Non-Hazardous Waste in the Deendayal Port Authority" vide Work Order dated 24/01/2023. The work is in progress.</p> <p>DPA assigned work to M/s GUIDE, Bhuj, for regular monitoring of Marine Ecology since the year 2017 (From 2017 – 2021), and final reports of the same are being submitted regularly to the Regional Office, MoEF&CC, GoI, Gandhinagar as well as to the MoEF&CC, GoI, New Delhi along with compliance reports submitted.</p>

Further, it is to submit that DPA issued a work order to M/s GUIDE vide its letter no. EG/ WK/ 4751/ Part (Marine Ecology Monitoring) /11 dated 03/05/2021 for Regular monitoring of Marine Ecology in and around Deendayal Port Authority (Erstwhile Deendayal Port Trust) and continuous Monitoring Program covering all seasons on various aspects of the Coastal Environs for the period 2021-24. Final Report for the period 2020-21 has already been submitted along with compliance report submitted dated 07/10/2021

The final report for the year 2021-2022, 2022-2023 and Inception report for the year 2023-24 submitted is attached herewith as **Annexure B, Annexure C** and **Annexure D** resp

As already informed, DPA entrusted work of green belt development in and around the Port area to the Forest Department, Gujarat at Rs. 352 lakhs (Area 32 hectares). The work is completed.

Further, DPA has appointed the Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-I)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022. The final report submitted by GUIDE, Bhuj is attached herewith as **Annexure F.**

Further, DPA has accorded the work of "Green belt development in DPA and its surrounding area (Phase II) to Gujarat Institute of Desert Ecology (GUIDE), Bhuj for the plantation of 10000 saplings of suitable species vide work order dated 23/06/2023. The same is in process

For dredged material management, DPA has been assigning work to M/s GUIDE, Bhuj for analysis of dredged material since the year 2017 and the reports are being submitted from time to time along with compliance reports submitted. The final Report submitted by M/s GUIDE, Bhuj for the period 2022-2023 is attached herewith as **Annexure G.**

Further, Dredged Material will be disposed of at designated location as identified by the CWPRS, Pune.

		<p>For energy conservation measures, DPA is already generating 20 MW of Wind energy. In addition to it, DPA has commissioned a 45 kW Solar Plant at Gandhidham. Further, it is relevant to mention that, two out of four Nos. of Harbour Mobile Crane (HMC) made electric operated. Balance 02 Nos. shall be made electric operated by 2023-2024. Four Nos. of Deisel operated RTGs converted to e-RTGs. Retrofitting of hydrogen fuel cell in Tug Kalinga and Pilot Boat Niharika to be done as a pilot project under the guidance of MoPSW. Also, 14 Nos. of EV cars to be hired in this year and 03 Nos. EV Bus to be procured by the year 2023-24.</p> <p>Further, for Oil Spill Management, DPA is already having Oil Spill Contingency Plan in place and Oil Response System as per the NOS-DCP guidelines.</p>
16	<p>The construction and operational activities shall be carried out in such a way that there is no negative impact on mangroves and other coastal /marine habitats. The construction activities and dredging shall be carried out only under the constant supervision and guidelines of the Institute of National repute like NIOT.</p>	<p>For Project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024 and Planned Construction End Date is February 2027.</p> <p>The Projects at Sr. No. 2 & 3 of the EC & CRZ Clearance have already been completed.</p> <p>Further, DPA has already prepared a mangrove preservation plan for the entire Kandla area.</p>
17	<p>The KPT shall contribute financially for any common study or project that may be proposed by this Department for environmental management / conservation / improvement for the Gulf of Kutch.</p>	<p>Point noted.</p>
18	<p>The construction debris and / or any other of waste shall not be disposed of into the sea, creek or the CRZ areas. The debris shall be removed from the construction site immediately after the construction is over.</p>	<p>For Project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024 and Planned Construction End Date is February 2027.</p> <p>However, the construction debris and/ or any other waste will not be disposed of into the sea and the debris will be removed from the construction site after construction is over.</p> <p>Further, it is relevant to mention here that, DPA had already issued general circular vide dated 3/9/2019 regarding Construction and Demolition</p>

		Waste Management for strict implementation in DPA (Copy has already been communicated with the last compliance report submitted).
19	The construction camps shall be located outside the CRZ area and the construction labour shall be provided with the necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by the construction labours.	For Project at Sr. No. 1, the Concession Agreement was signed on 25.08.2023. The Project is in Conditions Precedent Stage. Both the Parties are fulfilling their respective CPs. The Planned Construction Start Date is February 2024 and Planned Construction End Date is February 2027. However, construction camps with necessary amenities will be located in the already nearby developed areas. Further, due care shall be taken so that the environmental conditions are not deteriorated by the construction labours.
20	The KPT shall regularly updates its Local Oil Spill Contingency and Disaster management Plan in accordance with the National Oil Spill and Disaster Contingency Plan and shall submit the same to the MoEF, GoI and this department after having it vetted through the Indian Coast Guard.	Point noted. <ul style="list-style-type: none"> ▪ Deendayal Port already has an updated Disaster Management Plan (A copy of the Plan has already been submitted with the earlier compliances). ▪ Further, the Local Oil Spill Contingency Plan is already available with Deendayal Port Authority. ▪ DPA has also executed MOU with Oil Companies, i.e., IOCL, HPCL, BPCL etc., for combating the Oil Spill at Kandla
21	The KPT shall bear the cost of the external agency that may be appointed by this Department for supervision/monitoring of proposed activities and the environmental impacts of the proposed activities.	Agreed with the condition
22	The KPT shall take up massive greenbelt development activities in and around Kandla and also within the KPT limits.	DPA has planted about one lakhs trees in roadside dividers, colony areas at Kandla and Gopalpuri, in the greenbelt area of Gandhidham & Adipur Township, Sewage Treatment Plants at Gopalpuri & Kandla and extensive green belt development plans initiated at different locations in Township areas. DPA entrusted work of greenbelt development in and around the Port area to the Forest Department, Gujarat, at the cost of Rs. 352lakhs (Area 32 hectares), and the work is completed. Further, DPA has appointed the Gujarat Institute of Desert Ecology (GUIDE) for "Green belt development in Deendayal Port Authority and its Surrounding Areas, Charcoal site' (Phase-I)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022. The final report submitted by GUIDE, Bhuj is attached herewith as Annexure F .

		Further, DPA assigned work to GUIDE, Bhuj vide work order dated 23/06/2023 for "Green belt development in Deendayal Port Authority and its Surrounding Areas (Phase II) (10000 plants). The work is in progress.
23	The KPT shall have to contribute financially for talking up the socio-economic upliftment activities in this region in construction with the Forest and Environment Department and the District Collector/District Development Officer.	Already CSR works are being attended to by DPA. The details of CSR activities undertaken/to be undertaken by DPA are placed in <u>Annexure H.</u>
24	A separate budget shall be earmarked for environmental management and socioeconomic activities and details there of shall be furnished to this Department as well as the MoEF, GOI. The details with respect to the expenditure from this budget head shall also be furnished.	DPA has already kept Rs. 274 lakhs in B.E. 2023-24 under the scheme "Environmental Services & Clearance thereof".
25	A separate environmental management cell with qualified personnel shall be created for environmental monitoring and management during construction and operational phases of the project.	<p>DPA is already having Environment Management cell. Further, DPA has also appointed expert agency for providing Environmental Experts from time to time. Recently, DPA appointed M/s Precitech Laboratories, Vapi for providing Environmental Experts vide work order dated 5/2/2021. In addition, it is relevant to submit here that, DPA has appointed Manager (Environment) on contractual basis for the period of 3 years and further extendable to 2 years (Copy of the details has already been communicated with the last compliance report submitted).</p> <p>Further, for monitoring of environmental parameters, DPA has been appointing NABL Accredited laboratory and reports are being submitted from time to time to the GPCB, IRO, MoEF&CC, GoI, Gandhinagar. Recently, DPA appointed GEMI, Gandhinagar for regular monitoring of environmental parameters vide Work Order dated 15/02/2023. The work is in progress and the latest environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as <u>Annexure E.</u></p>
26	An Environmental reports indicating the changes, if any, with respect to the baseline environmental quality in the coastal and marine environment shall be submitted every year by the KPT to this Department as well as to the MoEF&CC,GOI.	For monitoring of environmental parameters, DPA has been appointing NABL Accredited laboratory and reports are being submitted from time to time to the GPCB, IRO, MoEF&CC, GoI, Gandhinagar. Recently, DPA appointed GEMI, Gandhinagar for regular monitoring of environmental parameters vide Work Order

		<p>dated 15/02/2023. The work is in progress and the latest environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as Annexure E.</p> <p>DPA has been submitting the environmental monitoring report along with the six-monthly compliance report to IRO, MoEF&CC, GoI.</p>
27	The KPT shall have to contribute financially to support the National Green Corps Scheme being implemented in Gujarat by the GEER Foundation, Gandhinagar, in construction with Forests and Environment Department.	Agreed with the condition.
28	A six monthly reports on compliance of the conditions mentioned in this letter shall have to be furnished by the KPT on regular basis to this department/MoEF, GOI.	DPA has been regularly submitting six monthly compliance reports of the stipulated conditions to GCZMA and the Regional Office, MoEF&CC, GoI.
29	Any other condition that may be stipulated by this department from time to time for environmental protection/management purpose shall also have to be complied with by the KPT.	Agreed with the condition.

Annexure -C

Environmental Monitoring Report (EMR)

prepared under

“Preparing and monitoring of environmental monitoring and management plan for Deendayal Port Authority at Kandla and Vadinar for a period of 3 years”

(Monitoring Period: October-November, 2023)



Document Ref No.: GEMI/DPA/782(2)(2)/2023-24/54

Submitted to:

Deendayal Port Authority (DPA), Kandla



Gujarat Environment Management Institute (GEMI)

(An Autonomous Institute of Government of Gujarat)

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“AN ISO 9001:2015, ISO 14001:2015 AND ISO 45001:2018 Certified Institute”



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Disclaimer:

Gujarat Environment Management Institute (GEMI) has taken all reasonable precautions in the preparation of this report. The data presented in this report have been collected as per the relevant Standard Operating Procedures, Protocols and Guidelines. GEMI believes that the information and facts presented in the report are accurate as on the date it was written. However, it is impossible to dismiss absolutely, the possibility of errors or omissions. GEMI therefore specifically disclaims any liability resulting from the use or application of the information contained in this report. The information is not intended to serve as legal advice related to the individual situation.



About this Document

Gujarat Environment Management Institute (GEMI) has been assigned with the work of “Preparing and monitoring of Environmental monitoring and Management plan for Deendayal Port Authority (DPA) at Kandla and Vadinar for a period of 3 years” by DPA, Kandla. Under the said project the report titled “*Environment Monitoring Report (October-November, 2023)*” is prepared.

- **Name of the Report:** *Environment Monitoring Report (October-November, 2023)*
- **Date of Issue:** 19/12/2023
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List of Abbreviations

A	Acceptable Limits as per IS: 10500:2012
AAQ	Ambient Air Quality
AWS	Automatic Weather monitoring stations
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BQL	Below Quantification Limit
CCA	Consolidated Consent & Authorization
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DO	Dissolved Oxygen
DPA	Deendayal Port Authority
EC	Electrical Conductivity
EMMP	Environmental monitoring and Management Plan
EMP	Environment Management Plan
FPS	Fine Particulate Sampler
FY	Financial Year
GEMI	Gujarat Environment Management Institute
IFFCO	Indian Farmers Fertiliser Cooperative Limited
IMD	India Meteorological Department
IOCL	Indian Oil Corporation Limited
LNG	Liquefied Natural Gas
MGO	Marine Gas Oil
MMPA	Million Metric Tonnes Per Annum
MoEF	Ministry of Environment & Forests
MoEF&CC	Ministry of Environment, Forest and Climate Change
NAAQS	National Ambient Air Quality Standards
NO_x	Nitrogen oxides
NTU	Nephelometric Turbidity Unit
OOT	Off Shore Oil Terminal
OSR	Oil Spill Response
P	Permissible Limits as per IS: 10500:2012
PAH	Poly Aromatic Hydrocarbons
PM	Particulate Matter
PTFE	Polytetrafluoroethylene
RCC	Reinforced Concrete Cement
RDS	Respirable Dust Sampler
SAR	Sodium Adsorption Ratio
SBM	Single Bouy Mooring
SO_x	Sulfur oxides
STP	Sewage Treatment Plant
TC	Total Coliforms
TDS	Total Dissolved Solids
TOC	Total organic Carbon
TSS	Total Suspended Solids
VOC	Volatile Organic Compounds



CHAPTER 1: INTRODUCTION

1.1 Introduction

Kandla Port, also known as the Deendayal Port is a seaport in Kachchh District near the city of Gandhidham in Gujarat state in western India. Located on the Gulf of Kachchh, it is one of major ports on the western coast, and is located at 256 nautical miles southeast of the Port of Karachi in Pakistan and over 430 nautical miles north-northwest of the Port of Mumbai (Bombay). It is the largest port of India by volume of cargo handled. Deendayal Port's journey began in 1931 with the construction of RCC Jetty by Maharao Khengarji. Kandla was constructed in the 1950s as the chief seaport serving western India, after the independence of India. On 31st March 2016, Deendayal Port created history by handling 100 MMT cargo in a year and became the first Major Port to achieve this milestone. Deendayal Port Authority (DPA), India's busiest major port in recent years, is gearing up to add substantial cargo handling capacity with private sector participation. DPA has created new record by handling 137 MMTPA (at Kandla and Vadinar) during the financial year 2022-23. The DPA had commissioned the Off-shore Oil Terminal facilities at Vadinar in the year 1978, for which M/s. Indian Oil Corporation Limited (IOCL) provided Single Bouy Mooring (SBM) system, with a capacity of 54 MMTPA. Further, significant Quantum of infrastructural upgradation has been carried out & excellent maritime infrastructure has been created at Vadinar for the 32 MMTPA Essar Oil Refinery in Jamnagar District.

1.2 Green Ports Initiative

DPA is committed to sustainable development and adequate measures are being taken to maintain the Environmental well-being of the Port and its surrounding environs. Weighing in the environmental perspective for sustained growth, the Ministry of Shipping had started, Project Green Ports" which will help in making the Major Ports across India cleaner and greener. "Project Green Ports" will have two verticals - one is "Green Ports Initiatives" related to environmental issues and second is "Swachh Bharat Abhiyaan".

The Green Port Initiatives include twelve initiatives such as preparation and monitoring plan, acquiring equipment required for monitoring environmental pollution, acquiring dust suppression system, setting up of sewage/waste water treatment plants/ garbage disposal plant, setting up Green Cover area, projects for energy generation from renewable energy sources, completion of shortfalls of Oil Spill Response (OSR) facilities (Tier-I), prohibition of disposal of almost all kind of garbage at sea, improving the quality of harbour wastes etc.

DPA had also appointed GEMI as an Advisor for "Making Deendayal Port a Green Port-Intended Sustainable Development under the Green Port Initiatives. DPA has also signed MoU with Gujarat Forest Department in August 2019 for Green Belt Development in an area of 31.942 Ha of land owned by DPA. The plantation is being carried out by the Social Forestry division of Kachchh.

1.3 Importance of EMP

Port activities can cause deterioration of air and marine water quality in the surrounding areas due to multifarious activities. The pollution problems usually caused by port and harbour activities can be categorized as follows:

1. Air pollutant emissions due to ship emissions, loading and unloading activities, construction emission and emissions due to vehicular movement.
2. Coastal habitats may be destroyed and navigational channels silted due to causeway construction and land reclamation.
3. Deterioration of surface water quality may occur during both the construction and operation phases.
4. Harbour operations may produce sewage, bilge wastes, solid waste and leakage of harmful materials both from shore and ships.
5. Human and fish health may be affected by contamination of coastal water due to urban effluent discharge.
6. Oil pollution is one of the major environmental hazards resulting from port/harbour and shipping operations. This includes bilge oil released from commercial ships handling non-oil cargo as well as the more common threat from oil tankers.
7. Unregulated mariculture activities in the port and harbour areas may threaten navigation safety.

Hence, for the determination of levels of pollution, identification of pollution sources, control and disposal of waste from various point and non-point sources and for prediction of pollution levels for future, regular monitoring and assessment are required during the entire construction and operation phase of a major port. As per the Ministry of Environment, Forest and Climate Change (**MoEF&CC**), The Environmental Management Plan (EMP) is required to ensure sustainable development in the area surrounding the project. Hence, it needs to be an all encompasses plan consist of all mitigation measures for each item wise activity to be undertaken during the construction, operation and the entire life cycle to minimize adverse environmental impacts resulting from the activities of the project. for formulation, implementation and monitoring of environmental protection measures during and after commissioning of projects. The plan should indicate the details of various measures are taken and proposed to be taken for appropriate management of the environment of Deendayal Port Authority.

It identifies the principles, approach, procedures and methods that will be used to control and minimize the environmental and social impacts of operational activities associated with the port. An EMP is a required part of environmental impact assessment of a new port project but could also be evolved for existing ports. It is useful not only during the construction and operational phases of the new port but also for operation of existing ports to ensure the effectiveness of the mitigation measures implemented and to further provide guidance as to the most appropriate way of dealing with any unforeseen impacts.

It is extremely essential that port and harbour projects should have an Environmental Monitoring and Management Plan (EMMP), which incorporates monitoring of Ambient

Air, Drinking Water, Noise, Soil, Marine (water, sediment, ecology) quality along with the collection of online meteorological data throughout the duration of the project.

To ensure the effective implementation of the EMP and weigh the efficiency of the mitigation measures, it is essential to undertake environmental monitoring both during construction and operation period. In view of the above, Gujarat Environment Management Institute (GEMI) has been awarded with the work “**Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Kandla and Vadinar for a period of 3 years**” vide letter No. EG/WK/EMC/1023/2011/III/239 dated: 15/02/2023 by DPA.

This document presents the Environmental Monitoring Report (EMR) for Kandla and Vadinar for the monitoring period of 17th October-16th November, 2023.

1.4 Objectives and scope of the Study

In line with the work order, the key objective of the study is to carry out the Environmental Monitoring and preparation the Management Plan for Kandla and Vadinar for a period of 3 years". Under the project, Environmental monitoring refers to systematic assessment of ambient air, water (drinking and surface), soil, sediment, noise and ecology in order to monitor the performance and implementation of a project in compliance with Environmental quality standards and/or applicable Statutory norms.

The scope of work includes not limited to following:

1. To review the locations/stations of Ambient Air, Ambient Noise, drinking water, and Marine Water, Soil and Sediments monitoring within the impacted region in-and-around DPA establishment, in view of the developmental projects.
2. To assess the Ambient Air quality, quality at 6 stations at Kandla and 2 at Vadinar in terms of gases and particulate matter.
3. To assess the DG stack emissions (gases and particulate matter).
4. To assess Drinking water quality at twenty locations (18 at Kandla and 2 at Vadinar) in terms of Physical, Chemical and Biological parameters viz., Color, Odor, turbidity, conductivity, pH, Total Dissolved Solids, chlorides, Hardness, total iron, sulfate, NH₄, PO₄, and bacterial count on a monthly basis.
5. To assess the Marine water quality in terms of aquatic Flora and Fauna and Sediment quality in terms of benthic flora and fauna.
6. To assess Marine Water Quality and sediment in term of physical and chemical parameter.
7. To assess the trends of water quality in terms of Marine ecology by comparing the data collected over a specified time period.
8. Weekly sample collection and analysis of inlet & Outlet points of the Sewage Treatment Plant (STP) to check the water quality being discharged by DPA as per the CC&A.
9. Carrying out monthly Noise monitoring; twice a day at the representative stations for a period of 24 hours.

10. Meteorological parameters are very important from air pollution point of view, hence precise and continuous data collection is of utmost importance. Meteorological data on wind speed, wind direction, temperature, relative humidity, solar radiation and rainfall shall be collected from one permanent station at DPA, Kandla and one permanent station at Vadinar.
11. To suggest mitigation measures, based on the findings of this study and also check compliance with Environmental quality standards, Green Port Initiatives, MIV 2030, and any applicable Statutory Compliance.
12. To recommend Environment Management Plans based on Monitoring programme and findings of the study.



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CHAPTER 2: METHODOLOGY

2.1 Study Area

Under the study, the locations specified by Deendayal Port Authority for the areas of Kandla and Vadinar would be monitored. The details of the study area as follows:

a. Kandla

Deendayal Port (Erstwhile Kandla Port) is one of the twelve major ports in India and is located on the West Coast of India, in the Gulf of Kutch at 23001'N and 70013'E in Gujarat. The Major Port Authorities Act 2021 is the governing statute for Administration of Major Ports, under which, Deendayal Port Trust (DPT) has become Deendayal Port Authority (DPA). At Kandla, DPA has sixteen (16) cargo berths for handling various types of Dry Bulk Cargo viz, fertilizer, food grains, Coal, sulphur, etc.

- **Climatic conditions of Kandla**

Kandla has a semi-desert climate. Temperature varies from 25°C to 44°C during summer and 10°C to 25°C during winter. The average annual temperature is 24.8 °C. The average rainfall is 410 mm, most of which occurs during the monsoon from the months of June-to-September.

b. Vadinar

Vadinar is a small coastal town located in Devbhumi Dwarka district of the Gujarat state in India located at coordinates 22° 27' 16.20" N - 069° 40' 30.01". DPA had commissioned the Off Shore Oil Terminal (OOT) facilities at Vadinar in the year 1978, for which M/s. Indian Oil Corporation Limited (IOCL) provided Single Bouy Mooring (SBM) system, with a capacity of 54 MMTPA. The OOT of the DPA contributes in a large way to the total earnings of this port. Vadinar is now notable due to the presence of two refineries-one promoted by Reliance Industries and Essar Oil Ltd.

DPA also handled 43.30 MMT at Vadinar (which includes transshipment), the containerized cargo crossed 4.50 lakh TEU, grossing a total of 100 MMT overall. Major commodities handled by the Deendayal Port are Crude Oil, Petroleum product, Coal, Salt, Edible Oil, Fertilizer, etc.

- **Climatic conditions of Vadinar**

Vadinar has a hot semi-arid climate. The summer season lasts from March-to-May and is extremely hot, humid, but dry. The climatic conditions in Vadinar are quite similar to that recorded in its district head quarter i.e., Jamnagar. The annual mean temperature is 26.7 °C. Rainy season with extremely erratic monsoonal rainfall that averages around 630 millimetres. The winter season is from October-to-February remains hot during the day but has negligible rainfall, low humidity and cool nights.

The Kandla and Vadinar port have been depicted in the **Figure 1** as follows:

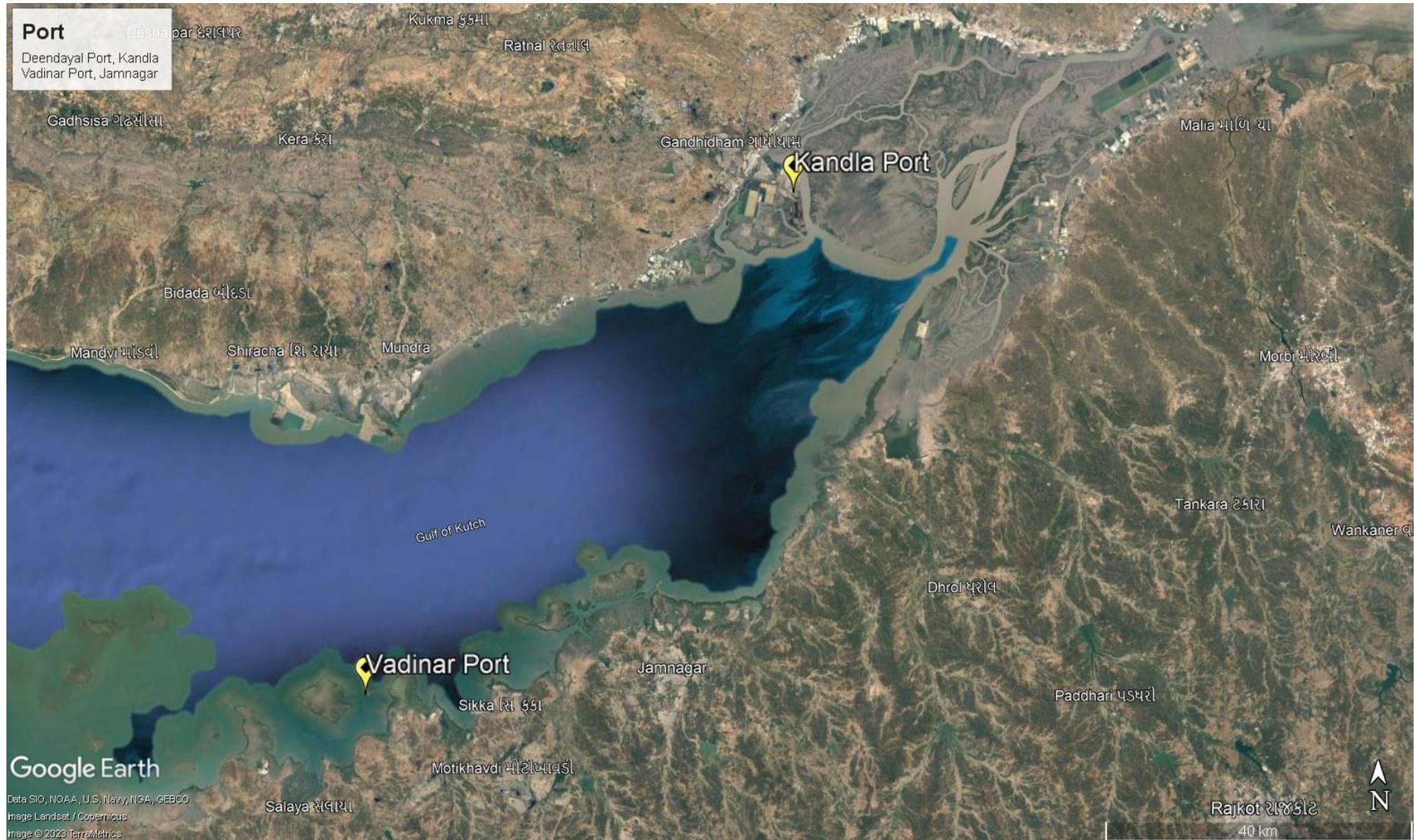


Figure 1: Locations Map of Kandla and Vadinar



Figure 2: Map of Kandla Port

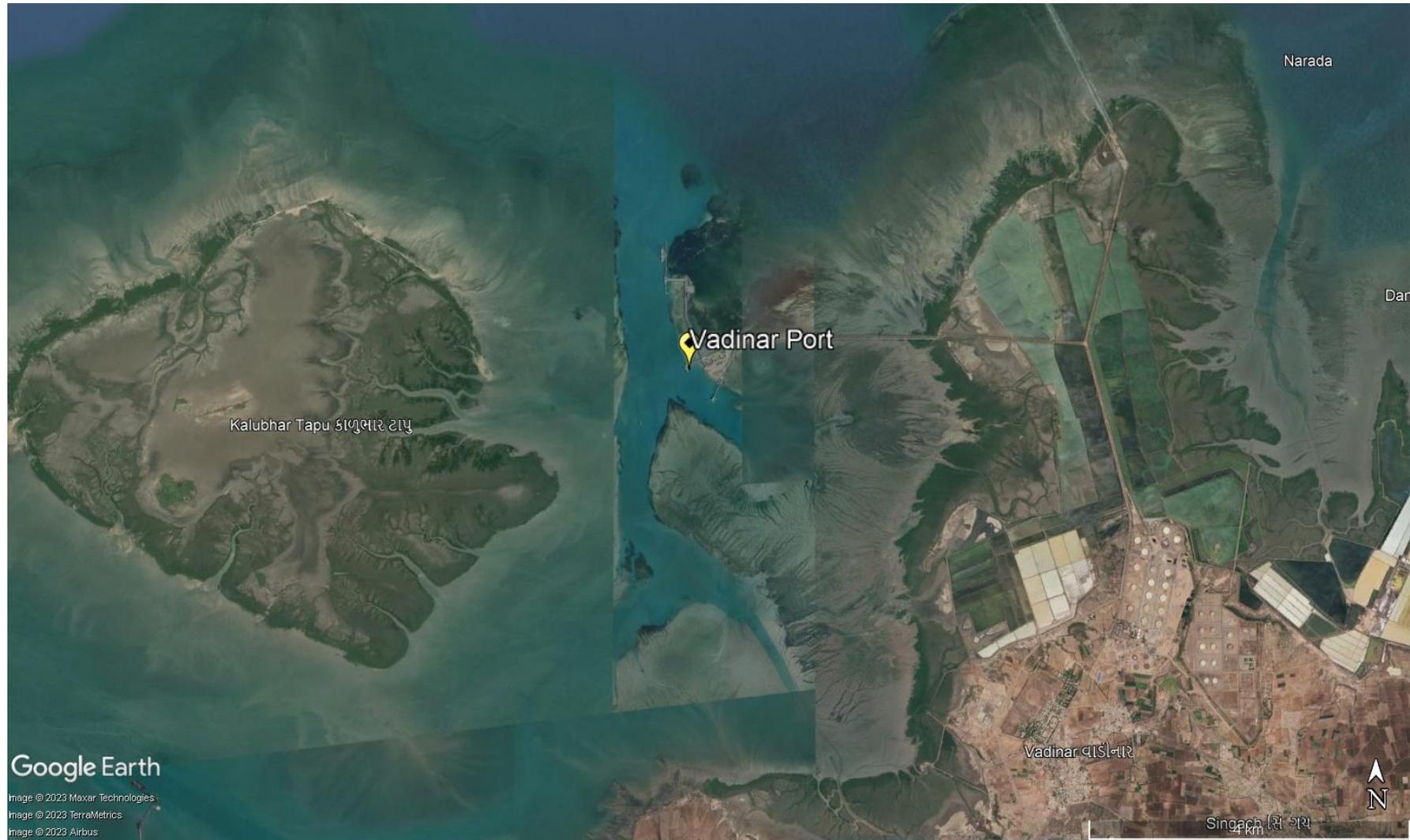


Figure 3: Map of Vadinar Port

2.2 Environmental Monitoring at Kandla and Vadinar

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operation. With the knowledge of baseline conditions, the monitoring programme will serve as an indicator for identifying any deterioration in environmental conditions, thereby assist in recommending suitable mitigatory steps in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can only be determined by a well-defined monitoring program. Environmental Monitoring is vital for monitoring the environmental status of the port for sustainable development. The list of main elements for which Environmental monitoring is to be carried out have been mentioned below:

- Meteorology
- Ambient Air
- DG Stack
- Noise
- Soil
- Drinking Water
- Sewage Treatment Plant
- Marine (Surface) water
- Marine Sediments
- Marine Ecology

GEMI has been entrusted by DPA to carry out the monitoring of the various aforementioned environmental aspects at the port, so as to verify effectiveness of prevailing Environment Management plan, if it confirms to the statutory and/or legal compliance; and identify any unexpected changes. Standard methods and procedures have been strictly adhered to in the course of this study. QA/QC procedures were strictly followed which covers all aspects of the study, and includes sample collection, handling, laboratory analyses, data coding, statistical analyses, interpretation and communication of results. The analysis was carried out in GEMI's NABL/MoEF accredited/recognized laboratory.

Methodology adopted for the study

Methodology is a strictly defined combination of practices, methods and processes to plan, develop and control a project along the continuous process of its implementation and successful completion. The aim of the project management methodology is to allow the control of whole process of management through effective decision-making and problem solving. The methodology adopted for the present study is shown in **Figure 4** as given below:

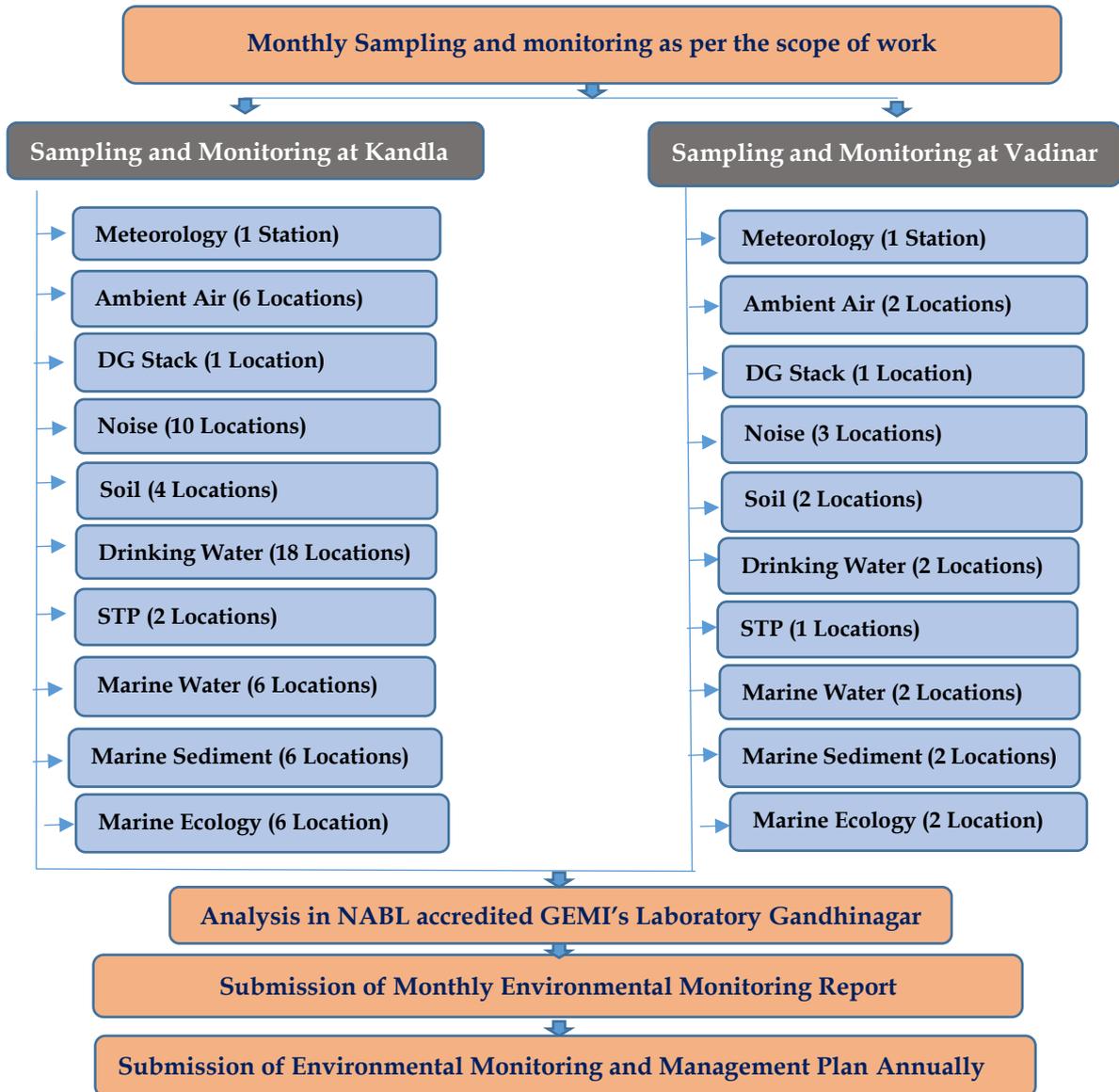


Figure 4: Methodology flow chart

The details of various sectors of Environment monitoring are described in subsequent chapters.



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CHAPTER 3: METEOROLOGY MONITORING

3.1 Meteorology Monitoring

Meteorological conditions play a crucial role in dispersion of air pollutants as well as in environmental pollution studies particularly in pollutant transport irrespective of their entry into the environment. The wind speed and direction play a major role in dispersion of environment pollutants. In order to determine the prevailing micro-meteorological conditions at the project site an Automatic Weather Monitoring Stations (AWS) of Envirotech make (Model: WM280) were installed at both the sites of Kandla and Vadinar at 10 m above the ground. The details of the AWS installed have been mentioned in **Table 1** as follows:

Table 1: Details of Automatic Weather Station

Sr. No.	Site	Location Code	Location Name	Latitude Longitude
1.	Kandla	AWS-1	Environment Laboratory (DPA)	23.00996N 70.22175E
2.	Vadinar	AWS-2	Canteen Area	22.39994N 69.716608E

Methodology

During the study, a continuous automatic weather monitoring station was installed at both the sites to record climatological parameters such as Wind speed, Wind Direction, Relative Humidity, Solar Radiation, Rainfall and Temperature to establish general meteorological regime of the study area. The methodology adopted for monitoring meteorological data shall be as per the standard norms laid down by Bureau of Indian Standards (BIS) and the India Meteorological Department (IMD). The details of Automatic Weather Monitoring Station have been mentioned in **Table 2**.

Table 2: Automatic Weather Monitoring Station details

Sr. No.	Details of Meteorological Data	Unit of Measurement	Instrument	Frequency
1.	Wind Direction	degree	Automatic Weather Monitoring Station (Envirotech WM280)	Hourly Average
2.	Wind Speed	Km/hr		
3.	Rainfall	mm/hr		
4.	Relative Humidity	% RH		
5.	Temperature	°C		
6.	Solar Radiation	W/m ²		

The Meteorological parameters were recorded at an interval of 1 hour in a day and the average value for all the Meteorological parameters were summarized for the sampling period of at both the observatory site.

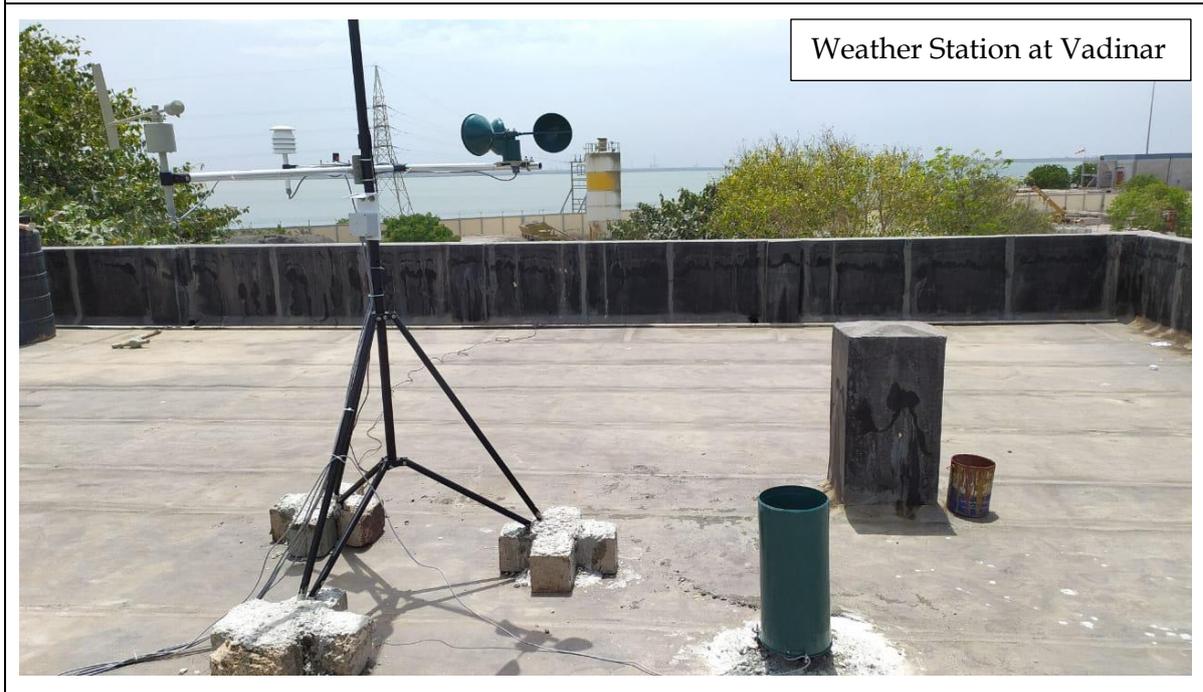


Figure 5: Photographs of Automatic Weather Monitoring Station at Kandla and Vadinar

3.2 Results and discussion

The summary of hourly climatological observations recorded at Kandla and Vadinar during the monitoring period, with respect to significant parameters has been mentioned in **Table 3** as follows:

Table 3: Meteorological data for Kandla and Vadinar

Details of micro-meteorological data at Kandla Observatory												
Monitoring Period	Wind Speed (Km/h)			Temperature (°C)			Relative humidity (%)			Solar Radiation (W/m ²)	Wind Direction (°)	Rainfall (mm)
Stat.	Mean	Max.	Min	Mean	Max	Min	Mean	Max	Min			
September-October 2023	1.15	9.85	0.025	30.41	31.24	29.63	52.18	55.40	49.02	65.11	North	0.012
Details of micro-meteorological data at Vadinar Observatory												
Monitoring Period	Wind Speed (Km/h)			Temperature (°C)			Relative humidity (%)			Solar Radiation (W/m ²)	Wind Direction (°)	Rainfall (mm)
Stat.	Mean	Max.	Min	Mean	Max	Min	Mean	Max.	Min			
September-October 2023	4.17	13.80	1.77	27.28	27.89	27.10	61.15	63.61	59.58	81.61	North-east	0.18

3.3 Data Interpretation and Conclusion

- **Temperature**

- a. **Kandla:** The ambient temperature for the monitoring period varies between the range of 29.63-31.24°C for Kandla, with average temperature of 30.41°C.
- b. **Vadinar:** The ambient temperature for the monitoring period varies between the range of 27.1-27.89°C for Vadinar, with average temperature of 27.28°C.

- **Relative Humidity**

- a. **Kandla:** The Relative Humidity recorded between the range of 49.02-55.40%, with average Humidity of 52.18%.
- b. **Vadinar:** During the study period, the Relative Humidity varies between 59.58-63.61%, with average Humidity of 61.15%.

- **Rainfall**

- a. **Kandla:** The average rainfall during the monitoring period was found to be 0.012 mm.
- b. **Vadinar:** The average rainfall was found to be 0.18 mm.

- **Wind Speed**

Wind speed and Direction play a significant role in transporting the pollutants and thus decides the air quality.

- a. **Kandla:** Wind speed recorded ranges between 0.025-9.85 Km/hr.
- b. **Vadinar:** During the monitoring period, the Wind speed recorded ranges between 1.77-13.80 Km/hr.

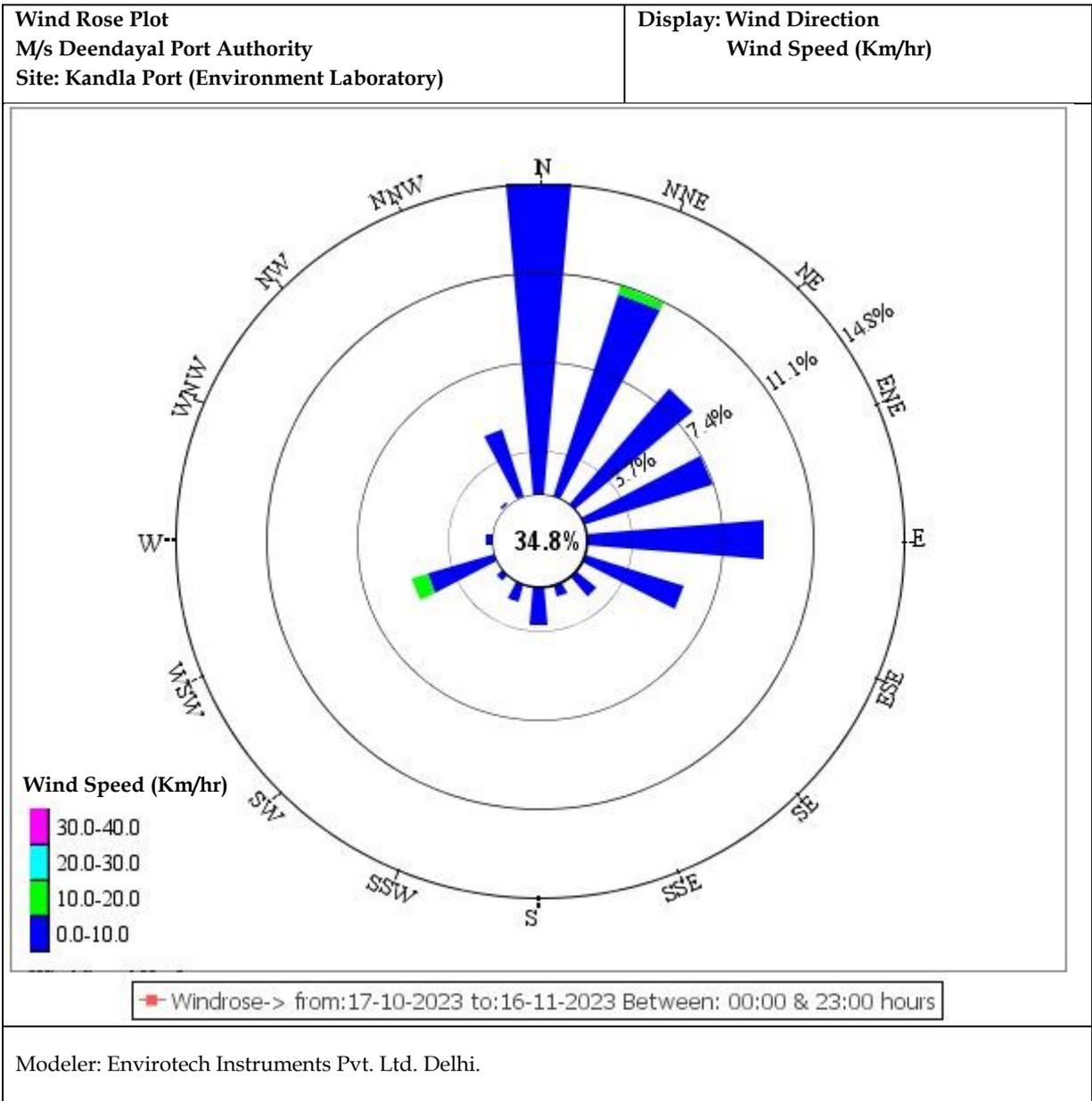
- **Solar Radiation:**

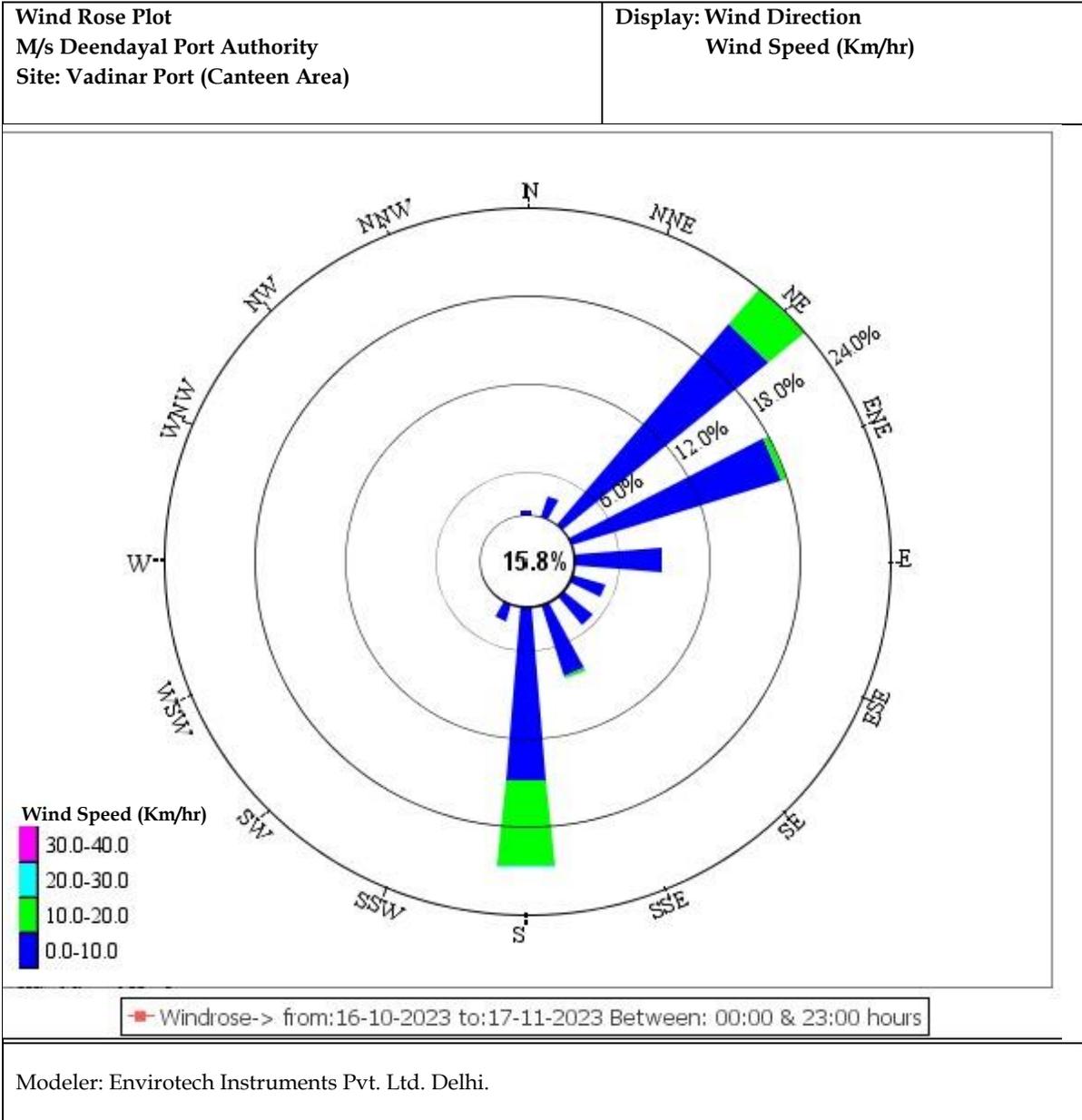
- a. **Kandla:** The average Solar Radiation for the monitoring period was recorded as 65.11 W/m².
- b. **Vadinar:** The average Solar Radiation was recorded as 81.61 W/m².

- **Wind rose diagram -**

The wind-rose diagram for the monitoring period has been drawn on the basis of hourly wind speed and direction data.

This Wind Rose Diagram reveals that at Kandla, during the period the prevailing winds predominantly blow from the North direction. Whereas the winds at Vadinar were observed to blow mainly from North-east and South directions.







CHAPTER 4: AMBIENT AIR QUALITY MONITORING

4.1 Ambient Air Quality

It is necessary to monitor the ambient air quality of the study area, in order to determine the impact of the shipping activities and port operations on the ambient air quality. The prime objective of ambient air quality monitoring is to assess the present air quality and its conformity to National Ambient Air Quality Standards i.e. NAAQS, 2009. Ambient air quality has been monitored from 17th October to 16th November, 2023.

Methodology

The study area represents the area occupied by DPA and its associated Port area. The sources of air pollution in the region are mainly vehicular traffic, fuel burning, loading & unloading of dry cargo, fugitive emissions from storage area and dust arising from unpaved village roads. Considering the below factors, under the study, as per the scope specified by DPA eight locations wherein, 6 stations at Kandla and 2 at Vadinar have been finalized within the study area

- Meteorological conditions;
- Topography of the study area;
- Direction of wind;
- Representation of the region for establishing current air quality status
- Representation with respect to likely impact areas.

The description of various stations monitored at Kandla and Vadinar have been specified in **Table 4**.

Table 4: Details of Ambient Air monitoring locations

Sr. No.	Location Code	Location Name	Latitude Longitude	Significance
1.	Kandla	A-1	Oil Jetty No. 1	23.029361N 70.22003E Liquid containers and emission from ship
2.		A-2	Oil Jetty No. 7	
3.		A-3	Kandla Port Colony	Vehicular activity and dust emission
4.		A-4	Marine Bhavan	23.007653N 70.222197E Construction and vehicular activity, road dust emission,
5.		A-5	Coal Storage Area	23.000190N 70.219757E Coal Dust, Vehicular activity
6.		A-6	Gopalpuri Hospital	23.081506N 70.135258E Residential area, dust emission, vehicular activity
7.	Vadinar	A-7	Admin Building	22.441806N 69.677056E Vehicular activity
8.		A-8	Vadinar Colony	22.401939N 69.716306E Residential Area, burning waste, vehicular activity

The monitoring locations at Kandla and Vadinar have been depicted in map in **Figure 6 and 7** respectively.

Ambient Air monitoring and sampling photographs

Kandla



A-1: Oil Jetty No. 1



A-2: Oil Jetty No. 7



A-3: Kandla Port Colony



A-4: Marine Bhavan



A-5: Coal Storage Area



A-6: Gopalpuri Hospital

Vadinar



A-7: Admin Building



A-8: Vadinar Colony



Figure 6: Location Map for Ambient Air Monitoring at Kandla

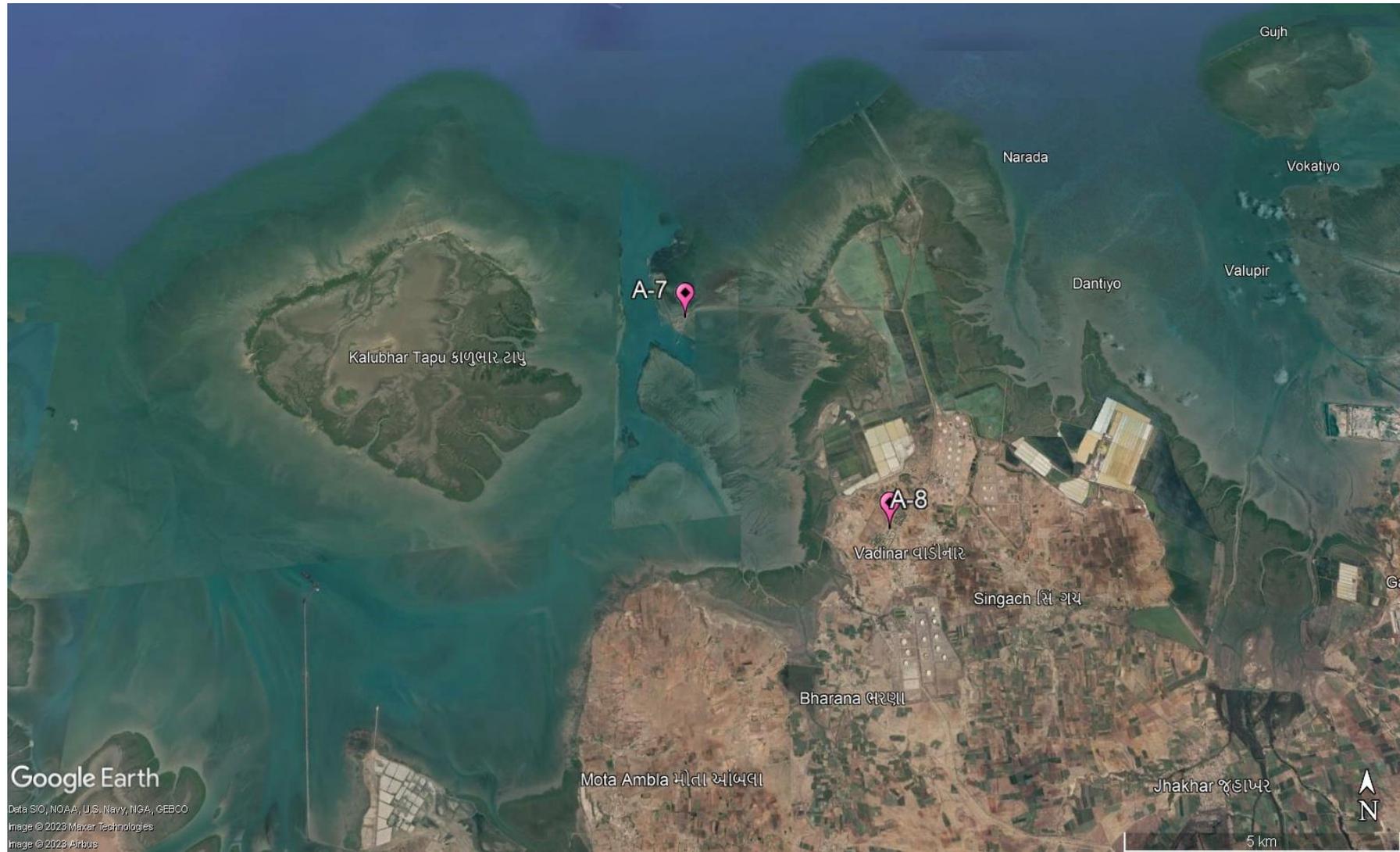


Figure 7: Location Map for Ambient Air Monitoring at Vadinar

Frequency

The sampling for Particulate matter i.e. PM₁₀ and PM_{2.5} and the gaseous components like SO_x, NO_x, CO as well as the Total VOCs were monitored twice in a week for a period of 24 hours a day. Whereas, the sampling for the components of PAH, Benzene and non-Methane VOCs was conducted on monthly basis.

Sampling and Analysis

The Sampling of the Ambient Air Quality parameters and analysis is conducted as per the CPCB guidelines of National Ambient Air Quality Monitoring. The sampling was performed at a height of 3.5 m (approximately) from the ground level. For the sampling of PM₁₀, calibrated 'Respirable Dust Samplers' were used, where Whatman GF/A microfiber filter paper of size 8" x 10" were utilized, where the Gaseous attachment of the make Envirotech instrument was attached with Respirable Dust Sampler for the measurement of SO_x and NO_x. The Fine Particulate Sampler for collection of PM_{2.5} was utilized for the particulate matter of size <2.5 microns. A known volume of ambient air is passed through the cyclone to the initially pre-processed filter paper. The centrifugal force in cyclone acts on particulate matter to separate them into two parts and collected as following:

- Particles <10 μ size (Respirable): GF/A Filter Paper
- Particles <2.5 μ size (Respirable): Polytetrafluoroethylene (PTFE)

Sampling and analysis of ambient SO₂ was performed by adopting the 'Improved West and Gaeke Method'. The ambient air, drawn through the draft created by the RDS, is passed through an impinger, containing a known volume of absorbing solution of Sodium tetrachloromercurate, at a pre-determined measured flow rate of 1 liter/minute (L/min). Similarly, NO_x was performed by adopting the 'Jacob Hochheister Modified' (Na arsenite) method. The impinger contains known volume of absorbing solution of Sodium Arsenite and Sodium Hydroxide.

Data has been compiled for PM₁₀, PM_{2.5}, SO_x and NO_x samples of 24-hour carried out twice a week. In case of CO, one hourly sample were taken on selected monitoring days using the sensor-based CO Meter. For the parameters Benzene, Methane & Non-methane and Volatile Organic Carbons (VOCs), the Low Volume Sampler is used, where the charcoal tubes are used as sampling media. The sampling in the Low Volume Sampler (LVS) is carried out as per IS 5182 (Part 11): 2006 RA: 2017, where the ambient air flow rate is maintained at 200 cc/min, the volume of air that passes through the LVS during two hours monitoring is approx. 24 L.

The sampling of PAHs is carried out as per IS: 5182 (Part 12): 2004. Where, the EPM 2000 Filter papers are utilized in the Respirable Dust Sampler (RDS). For the parameters, Benzene, PAH & Non-methane VOC's, monthly monitoring is carried out. The details of the parameters with their frequency monitored are mentioned in **Table 5**:

Table 5: Parameters for Ambient Air Quality Monitoring

Sr. No.	Parameters	Units	Reference method	Instrument	Frequency
1.	PM ₁₀	µg/m ³	IS 5182 (Part 23): 2006	Respirable Dust Sampler (RDS) conforming to IS:5182 (Part-23): 2006	Twice in a week
2.	PM _{2.5}	µg/m ³	IS:5182 (Part:24):2019	Fine Particulate Sampler (FPS) conforming to IS:5182 (Part-24): 2019	
3.	Sulphur Dioxide (SO _x)	µg/m ³	IS 5182 (Part:2): 2001	Gaseous Attachment conforming to IS:5182 Part-2	
4.	Oxides of Nitrogen (NO _x)	µg/m ³	IS:5182 (Part-6): 2006	Gaseous Attachment conforming to IS:5182 Part-6	
5.	Carbon Monoxide	mg/m ³	GEMI/SOP/AAQM /11; Issue no 01, Issue date 17.01.2019: 2019	Sensor based Instrument (Make: Vaibhav Instruments)	
6.	VOC	µg/m ³	IS 5182 (Part 17): 2004	Low Flow Air Sampler	
8.	PAH	µg/m ³	IS: 5182 (Part 12): 2004	Respirable Dust Sampler (RDS) conforming to IS:5182 (Part-12): 2004	Monthly
7.	Benzene	µg/m ³	IS 5182 (Part 11): 2006 RA: 2017	Low Flow Air Sampler	
9.	Non-methane VOC	µg/m ³	IS 5182 (Part 11): 2006	Low Volume Sampler	

4.2 Result and Discussion

The summarized results of ambient air quality monitoring for the study period are presented in **Table-6 to 9** along with the graphical representation from **Graph 1 to Graph 6**. Various parameters monitored during the study have been presented by their maximum, minimum, average and Standard deviation.

Table 6: Summarized results of PM₁₀, PM_{2.5}, SO₂, NO_x, VOC and CO for Ambient Air quality monitoring at Kandla and Vadinar

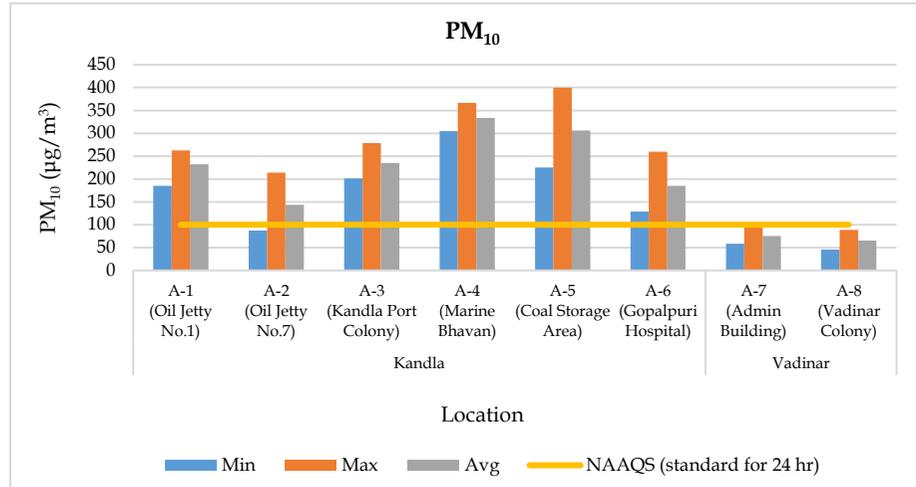
Station Code & Name	Unit of Average Concentration	Average Pollutant Concentration $\mu\text{g}/\text{m}^3$ except for CO in mg/m^3					
	Pollutants	PM ₁₀ $\mu\text{g}/\text{m}^3$	PM _{2.5} $\mu\text{g}/\text{m}^3$	SO ₂ $\mu\text{g}/\text{m}^3$	NO _x $\mu\text{g}/\text{m}^3$	VOC $\mu\text{g}/\text{m}^3$	CO mg/m^3
	Duration	(24 hr)				(2 hr)	(1 hr)
NAAQS by CPCB		100	60	80	80	-	2
A-1: Oil Jetty No.1, Kandla	20-Oct-23	232.58	40.91	4.7	7.76	2.14	0.88
	21-Oct-23	213.22	35.08	3.25	13.53	2.69	0.81
	25-Oct-23	185.15	36.29	2.23	4.72	3.14	0.89
	27-Oct-23	227.56	37.27	3.78	3.22	2.58	0.87
	30-Oct-23	245.15	53.43	1.26	4.12	1.67	0.86
	06-Nov-23	262.34	89.64	2.29	3.25	2.69	0.77
	07-Nov-23	231.86	77.44	3.47	5.71	2.47	0.80
	13-Nov-23	261.03	42.61	4.12	4.12	1.54	0.78
	Minimum	185.15	35.08	1.26	3.22	1.54	0.77
	Maximum	262.34	89.64	4.70	13.53	3.14	0.89
	Average	232.36	51.58	3.14	5.80	2.37	0.83
Std. Deviation	25.36	20.79	1.13	3.46	0.55	0.05	
A-2: Oil Jetty No.7, Kandla	20-Oct-23	127.03	36.73	3.32	4.21	3.17	0.76
	21-Oct-23	87.15	32.02	3.68	14.2	2.17	0.75
	25-Oct-23	104.01	38.91	2.65	4.35	1.07	0.79
	27-Oct-23	141.01	32.25	4.12	2.14	1.06	0.77
	30-Oct-23	180.20	61.97	2.88	3.46	2.17	0.80
	06-Nov-23	213.56	91.63	2.32	3.41	4.21	0.80
	07-Nov-23	150.32	61.32	1.79	5.34	2.59	0.69
	13-Nov-23	143.77	33.12	2.49	5.21	1.94	0.74
	Minimum	87.15	32.02	1.79	2.14	1.06	0.69
	Maximum	213.56	91.63	4.12	14.20	4.21	0.80
	Average	143.38	48.49	2.91	5.29	2.30	0.76
Std. Deviation	40.20	21.41	0.76	3.75	1.05	0.04	
A-3: Kandla Port Colony, Kandla	20-Oct-23	238.95	39.23	2.43	19.46	2.14	0.89
	21-Oct-23	265.34	53.14	2.92	26.17	1.16	0.71
	25-Oct-23	210.38	39.27	3.37	33.6	1.52	0.72
	27-Oct-23	228.56	52.00	4.12	30.06	1.90	0.85
	30-Oct-23	278.39	68.57	3.82	<6	2.67	0.82
	06-Nov-23	242.11	41.16	16.50	80.67	2.17	0.94
	07-Nov-23	214.63	77.18	51.15	63.63	2.91	0.82
	13-Nov-23	201.36	54.11	4.19	2.36	2.31	0.85
	Minimum	201.36	39.23	2.43	2.36	1.16	0.71
	Maximum	278.39	77.18	51.15	80.67	2.91	0.94
	Average	234.97	53.08	11.06	36.56	2.10	0.83
Std. Deviation	26.90	13.87	16.84	26.77	0.57	0.08	
A-4: Marine Bhavan, Kandla	20-Oct-23	366.89	38.55	2.86	10.37	1.69	0.85
	21-Oct-23	353.17	37.76	1.53	12.77	1.75	0.85
	25-Oct-23	304.36	43.36	3.09	5.12	3.16	0.73
	27-Oct-23	312.04	36.10	3.94	10.14	2.71	0.87
	30-Oct-23	342.55	62.65	4.15	13.57	1.84	0.88
	06-Nov-23	349.61	62.15	7.93	41.39	1.69	1.04



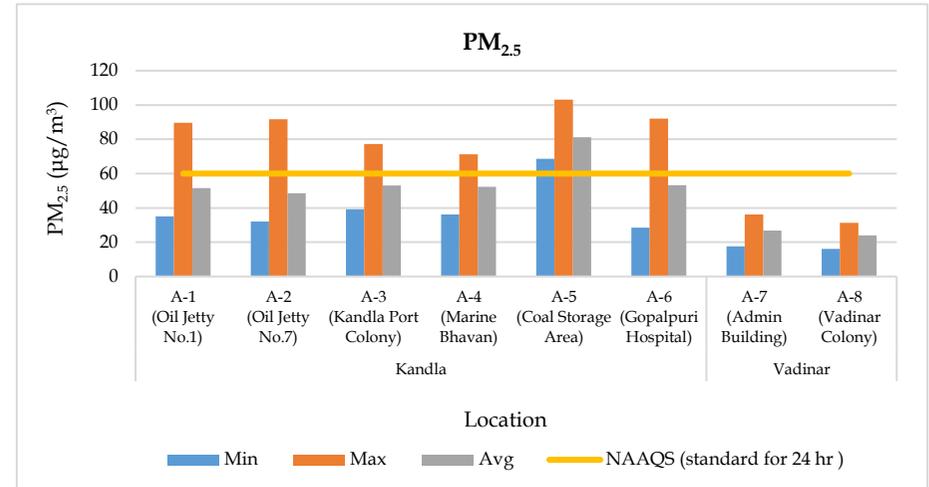
Station Code & Name	Unit of Average Concentration	Average Pollutant Concentration $\mu\text{g}/\text{m}^3$ except for CO in mg/m^3					
	Pollutants	PM ₁₀ $\mu\text{g}/\text{m}^3$	PM _{2.5} $\mu\text{g}/\text{m}^3$	SO ₂ $\mu\text{g}/\text{m}^3$	NO _x $\mu\text{g}/\text{m}^3$	VOC $\mu\text{g}/\text{m}^3$	CO mg/m^3
	Duration	(24 hr)				(2 hr)	(1 hr)
NAAQS by CPCB		100	60	80	80	-	2
	07-Nov-23	320.23	71.27	5.30	45.28	2.17	0.96
	13-Nov-23	321.20	66.74	4.89	23.54	1.74	0.86
	Minimum	304.36	36.10	1.53	5.12	1.69	0.73
	Maximum	366.89	71.27	7.93	45.28	3.16	1.04
	Average	333.76	52.32	4.21	20.27	2.09	0.88
	Std. Deviation	22.30	14.71	1.92	15.18	0.56	0.09
A-5: Coal Storage Area, Kandla	20-Oct-23	302.65	88.49	3.34	13.78	1.47	0.96
	21-Oct-23	225.34	70.72	2.86	4.98	1.52	0.94
	25-Oct-23	229.36	103.06	2.19	14.22	2.90	0.89
	27-Oct-23	399.32	76.10	1.91	25.48	2.14	0.98
	30-Oct-23	383.09	86.11	2.58	18.12	3.21	1.03
	06-Nov-23	265.80	73.95	3.31	6.06	2.67	1.17
	07-Nov-23	303.82	68.67	4.02	8.49	2.84	1.13
	13-Nov-23	341.86	82.13	4.48	15.88	1.76	0.96
	Minimum	225.34	68.67	1.91	4.98	1.47	0.89
	Maximum	399.32	103.06	4.48	25.48	3.21	1.17
	Average	306.41	81.15	3.09	13.38	2.31	1.01
	Std. Deviation	65.41	11.35	0.88	6.80	0.68	0.10
A-6: Gopalpuri Hospital, Kandla	20-Oct-23	165.34	35.6	5.05	3.54	1.26	0.68
	21-Oct-23	161.65	32.84	4.62	5.13	1.47	0.86
	25-Oct-23	128.59	28.57	4.01	4.25	2.10	0.59
	27-Oct-23	157.05	36.63	3.81	4.33	1.69	0.68
	30-Oct-23	209.53	75.71	2.84	5.78	2.18	0.66
	06-Nov-23	259.88	88.11	2.38	6.24	1.11	0.71
	07-Nov-23	250.67	91.97	3.58	4.87	1.69	0.78
	13-Nov-23	146.34	36.14	4.19	12.91	2.07	0.74
	Minimum	128.59	28.57	2.38	3.54	1.11	0.59
	Maximum	259.88	91.97	5.05	12.91	2.18	0.86
	Average	184.88	53.20	3.81	5.88	1.70	0.71
Std. Deviation	49.15	27.06	0.88	2.97	0.40	0.08	
A-7: Admin Building, Vadinar	20-Oct-23	67.21	30.27	16.32	12.03	2.14	0.21
	21-Oct-23	79.45	27.45	18.53	8.12	3.14	0.67
	25-Oct-23	72.18	24.12	12.11	16.28	2.74	0.44
	27-Oct-23	58.39	25.69	9.18	32.17	2.01	0.54
	30-Oct-23	95.17	21.85	10.78	14.82	1.47	0.43
	06-Nov-23	88.21	36.15	15.14	12.67	2.03	0.74
	07-Nov-23	71.64	31.52	19.42	13.74	1.49	0.65
	13-Nov-23	69.17	17.55	14.72	13.11	1.71	0.62
	Minimum	58.39	17.55	9.18	8.12	1.47	0.21
	Maximum	95.17	36.15	19.42	32.17	3.14	0.74
	Average	75.18	26.83	14.53	15.37	2.09	0.54
	Std. Deviation	11.90	5.86	3.63	7.19	0.59	0.17
	20-Oct-23	53.17	24.52	22.47	9.34	2.74	0.25

Station Code & Name	Unit of Average Concentration	Average Pollutant Concentration $\mu\text{g}/\text{m}^3$ except for CO in mg/m^3					
	Pollutants	PM ₁₀ $\mu\text{g}/\text{m}^3$	PM _{2.5} $\mu\text{g}/\text{m}^3$	SO ₂ $\mu\text{g}/\text{m}^3$	NO _x $\mu\text{g}/\text{m}^3$	VOC $\mu\text{g}/\text{m}^3$	CO mg/m^3
	Duration	(24 hr)				(2 hr)	(1 hr)
NAAQS by CPCB		100	60	80	80	-	2
A-8: Vadinar Colony, Vadinar	21-Oct-23	78.29	19.67	18.6	14.28	2.16	0.74
	25-Oct-23	88.34	26.34	12.70	6.45	2.30	0.69
	27-Oct-23	64.21	28.41	15.90	15.14	2.10	0.54
	30-Oct-23	47.13	31.25	11.36	12.07	1.47	0.64
	06-Nov-23	86.42	16.12	16.12	11.94	1.08	0.52
	07-Nov-23	57.95	21.66	17.82	14.75	1.75	0.42
	13-Nov-23	45.87	23.71	21.13	13.95	2.10	0.47
	Minimum	45.87	16.12	11.36	6.45	1.08	0.25
	Maximum	88.34	31.25	22.47	15.14	2.74	0.74
	Average	65.17	23.96	17.01	12.24	1.96	0.53
Std. Deviation	17.14	4.84	3.83	3.02	0.52	0.16	

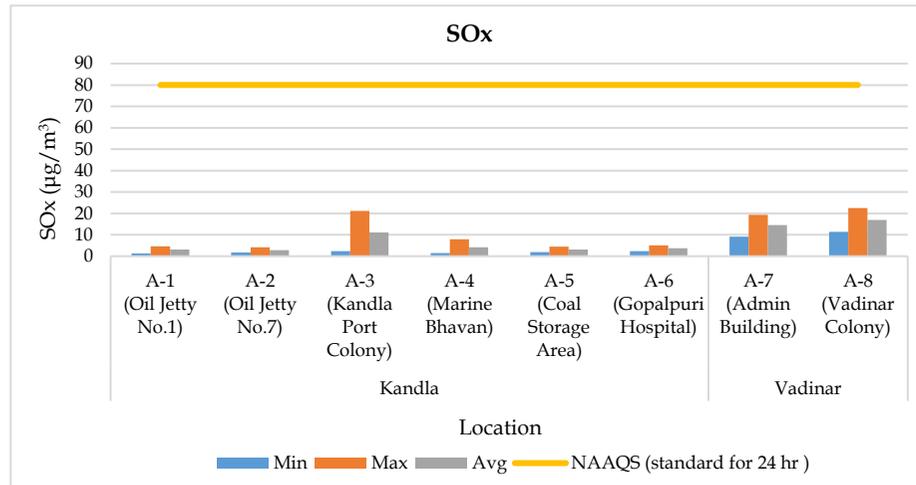
Graphs 1-6 shows spatial trend of ambient air parameter at all the eight-monitoring location (six at Kandla and 2 at Vadinar)



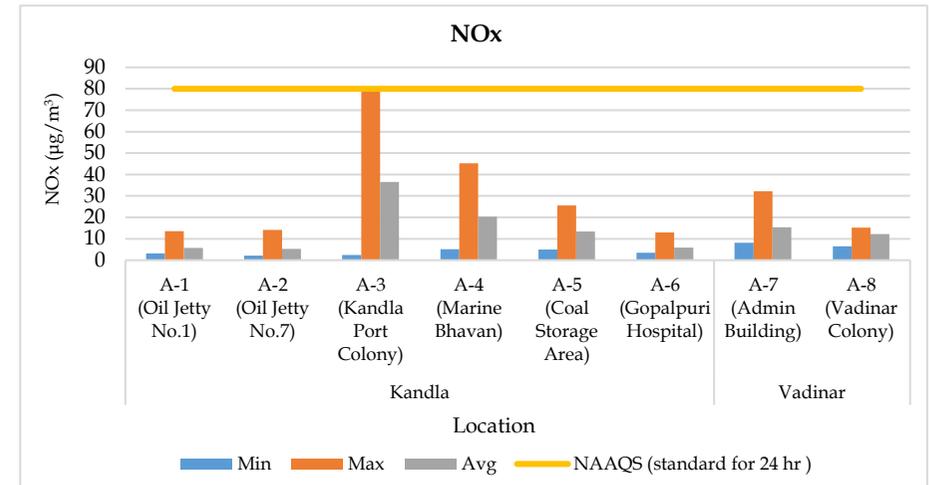
Graph 1: Spatial trend in Ambient PM₁₀ Concentration



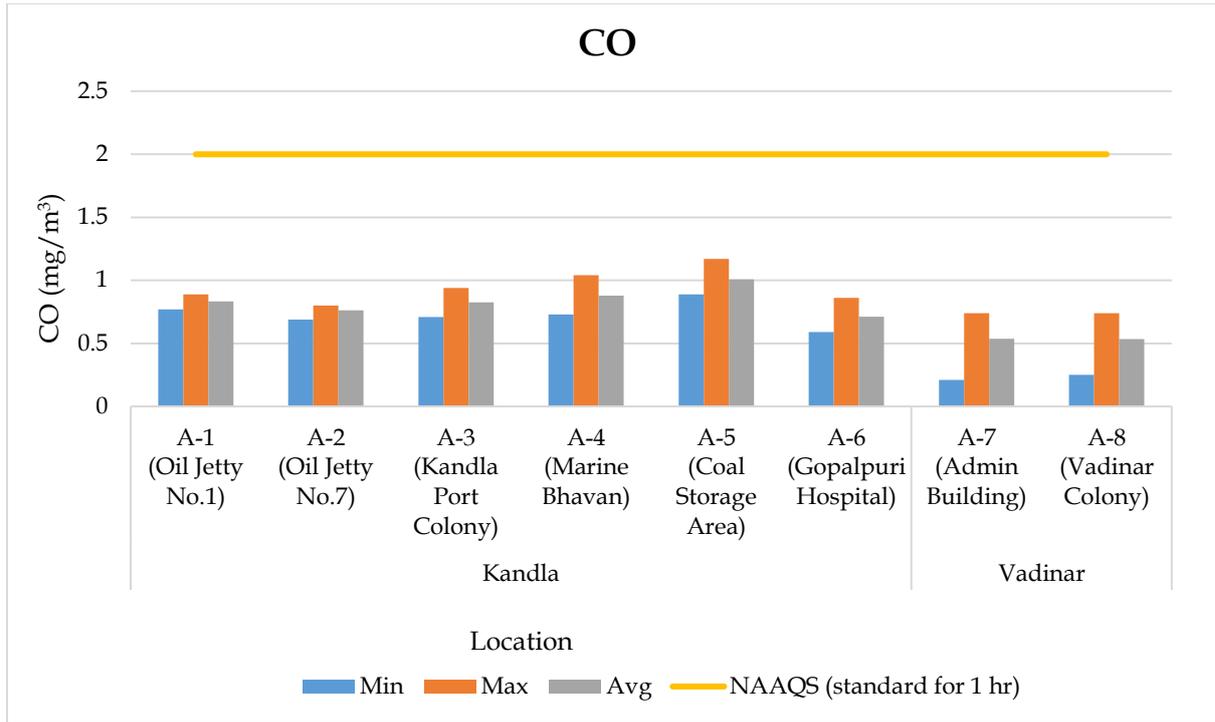
Graph 2: Spatial trend in Ambient PM_{2.5} Concentration



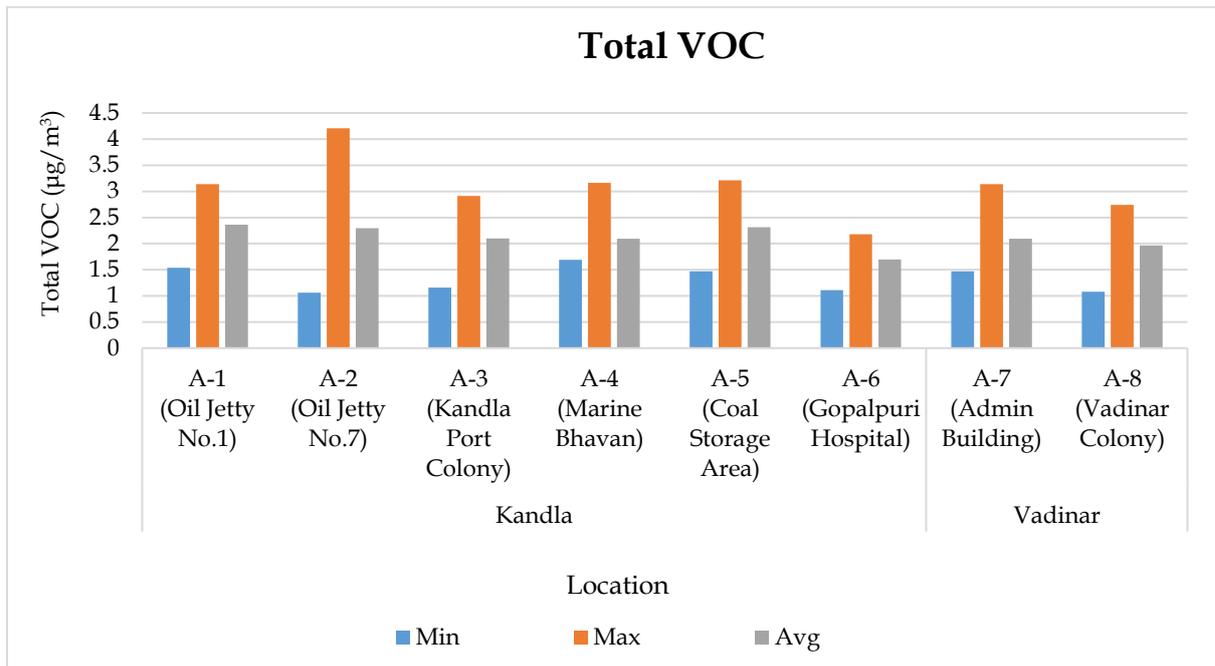
Graph 3: Spatial trend in Ambient SO_x Concentration



Graph 4: Spatial trend in Ambient NO_x Concentration



Graph 5: Spatial trend in Ambient CO Concentration



Graph 6: Spatial trend in Ambient Total VOCs

Table 7: Summarized results of Benzene for Ambient Air quality monitoring

Benzene ($\mu\text{g}/\text{m}^3$)									
Sr. No	Kandla						Vadinar		NAAQS standards (24 hr)
	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	
1	0	0	0	0	0	0	0.12	0.14	5 $\mu\text{g}/\text{m}^3$

Table 8: Summarized results of Polycyclic Aromatic Hydrocarbons

Sr No	Components	Kandla						Vadinar	
		A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8
1	Napthalene	1.02	0.9	0.12	0.14	0.37	0.77	0.65	0.28
2	Acenaphthylene	0.49	0.37	0.54	0.95	0.14	0.46	0.28	0.44
3	Acenaphthene	0.12	0.09	0.13	0.66	0.41	0.12	0.41	0.61
4	Fluorene	0.39	0.34	0.46	0.37	0.57	0.45	0.39	0.14
5	Anthracene	0.13	0.42	0.97	0.28	0.62	0.91	0.41	0.43
6	Phenanthrene	0.00	0.00	0.00	0.03	0.17	0.00	0.82	0.28
7	Fluoranthene	0.24	0.19	0.97	0.63	0.14	0.28	0.03	0.64
8	Pyrene	0.36	0.14	0.67	0.55	0.28	0.34	0.07	0.11
9	Chrycene	0.16	0.22	0.96	0.42	0.19	0.54	0.14	0.06
10	Banz(a)anthracene	0.47	0.94	0.45	0.14	0.52	0.63	1.01	0.74
11	Benzo[k]fluoranthene	0.54	0.61	0.74	0.93	0.56	0.41	0.7	0.39
12	Benzo[b]fluoranthene	0.12	0.46	0.62	1.08	0.41	0.67	0.25	0.45
13	Benzopyrene	0.9	0.33	0.49	0.75	0.27	0.41	0.96	0.63
14	Indeno [1,2,3-cd] fluoranthene	0.13	0.77	0.42	0.48	0.73	0.67	0.52	0.46
15	Dibenz(ah)anthracene	0.11	0.14	0.69	0.13	0.51	0.28	0.17	0.71
16	Benzo[ghi]perylene	0.31	0.24	0.21	0.46	0.61	0.76	0.22	0.63

Table 9: Summarized results of Non-methane VOC

Sr No	Kandla						Vadinar	
	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8
1	2.11	2.67	3.54	1.07	1.19	2.01	2.15	1.67

4.3 Data Interpretation and Conclusion

The results were compared with the National Ambient Air Quality Standards (NAAQS), 2009 of Central Pollution Control Board (CPCB).

- The concentration of PM_{10} at Kandla varies in the range of 87.15 to 399.89 $\mu\text{g}/\text{m}^3$. PM_{10} exceeded NAAQS at all the monitoring locations of Kandla. Whereas, at Vadinar, the concentration varies 45.87 to 95.17 $\mu\text{g}/\text{m}^3$ where majority of the monitoring days complies with the stipulated norm (100 $\mu\text{g}/\text{m}^3$) for both monitoring locations.

- The highest concentration of PM_{10} at locations A-3 i.e. Kandla Port Colony could be attributed to the presence of heavy vehicular traffic in upwind areas which bring higher impact causing the dispersion of emitted particulate matter in the ambient air. The unloading of coal directly in the truck, using grabs causes the coal to disperse in the air as well as coal dust to fall and settle on the ground. This settled coal dust again mixes with the air while trucks travel through it. Also, the coal-loaded trucks are generally not always covered with tarpaulin sheets and this might result in increased suspension of coal from trucks/dumpers during its transit from vessel to yard or storage site. This might increase the PM_{10} in and around the Coal storage area and Marine bhavan.
- The $PM_{2.5}$ concentrations at Kandla monitoring location varies from 28.57 to 103.06 $\mu\text{g}/\text{m}^3$. $PM_{2.5}$ exceeded NAAQS limit at location A-1 (Oil Jetty No.1), A-5 (Coal Storage Area) and A-6 (Gopalpuri Hospital). Whereas, at Vadinar its concentration varies at Vadinar from 16.12 to 36.15 $\mu\text{g}/\text{m}^3$ which falls within the limit of NAAQS i.e. 60 $\mu\text{g}/\text{m}^3$.
- The concentration of SO_x varies from 1.26 to 21.15 $\mu\text{g}/\text{m}^3$ at Kandla and 9.18 to 22.47 $\mu\text{g}/\text{m}^3$ at Vadinar. The range falls within the prescribed limit of NAAQS of 80 $\mu\text{g}/\text{m}^3$ for both the monitoring site.
- The concentration of NO_x varies from 2.14 to 80.67 $\mu\text{g}/\text{m}^3$ at Kandla and 6.45 to 32.17 $\mu\text{g}/\text{m}^3$ at Vadinar. The range falls within the prescribed limit of NAAQS i.e. 80 $\mu\text{g}/\text{m}^3$ at both the monitoring site of Kandla and Vadinar.
- The concentration of CO varies from 0.59 to 1.17 mg/m^3 at Kandla and 0.21 to 0.74 mg/m^3 at Vadinar. The range falls within the norm of 2 mg/m^3 specified by NAAQS.
- The concentration of **Total VOCs** levels was recorded in range of 1.06 to 4.21 $\mu\text{g}/\text{m}^3$ at Kandla and 1.08 to 3.14 $\mu\text{g}/\text{m}^3$ at Vadinar. The main source of VOCs in the ambient air may be attribute to the burning of Gasoline and Natural gas in Vehicle exhaust and burning fossil fuels, wood, and garbage all release VOCs into the atmosphere. During the monitoring period, the wind flows towards West-south-west direction at Kandla, and hence the wind direction and speed also contribute to increased dispersion of pollutants from the upward areas towards the downward areas.
- The concentration of **Benzene** was not detected for the Ambient Air Monitoring locations of Kandla, whereas at Vadinar the Benzene concentration falls within the range of 0.12-1.04 $\mu\text{g}/\text{m}^3$. The said concentration complies with the specified limit of 5 $\mu\text{g}/\text{m}^3$ for both the study areas.
- **Polycyclic Aromatic Hydrocarbons (PAHs)** are ubiquitous pollutants in urban atmospheres. Anthropogenic sources of total PAHs in ambient air emissions are greater than those that come from natural events. Comparative higher concentration of PAH was detected at location A-4 i.e. Marine Bhavan and A-5 i.e. Coal Storage area, which is a commercial area. PAHs are a class of chemicals that occur naturally in coal, crude oil, and gasoline. They the higher concentration which result from burning coal, oil, gas, road dust, etc might be attributed to higher traffic density in the area. Other outdoor sources of PAHs may be the industrial plants in-and-around the DPA premises.

- The Ambient air Monitoring location of Kandla recorded the **Non-methane VOC** (NM-VOC) concentration in the range of 1.07 to 3.54 $\mu\text{g}/\text{m}^3$. While at Vadinar, the NM VOC concentration falls in the range of 1.67 to 2.15 $\mu\text{g}/\text{m}^3$.

With reference to the Ambient Air Quality monitoring conducted under the study, it may be concluded that the particulate matter PM_{10} and $\text{PM}_{2.5}$, were reported in higher concentration and apparently exceeds the NAAQS particularly at locations of Kandla. The gaseous pollutants (NO_x , SO_x , CO, VOCs etc.) falls within the permissible limit. The probable reason contributing to these emissions of pollutants into the atmosphere in-and-around the port area are summarized as follows-

1. **Port Machinery:** Port activities involve the use of various machinery and equipment, including cranes, for lifts, tugboats, and cargo handling equipment. These machines often rely on diesel engines, which can emit pollutants such as NO_x , Particulate matter, and CO. Older or poorly maintained equipment tends to generate higher emissions.
2. **Port Vehicles:** Trucks and other vehicles operating within port and port area contributes to air pollution. Similar to port machinery, diesel-powered vehicles can emit NO_x , PM, CO, and other pollutants such as PAH, VOCs etc. Vehicle traffic and congestion in and around port areas can exacerbate the air quality issues.

4.4 Remedial Measures:

Efficient mitigation strategies need to be implementation for substantial environmental and health co-benefits. To improve air quality, DPA has implemented a number of precautionary measures, such as maintaining Green zone, initiated Inter-Terminal Transfer of tractor-trailers, Centralized Parking Plaza, providing shore power supply to tugs and port crafts, the use of LED lights at DPA area helps in lower energy consumption and decreases the carbon foot prints in the environment, time to time cleaning of paved and unpaved roads, use of tarpaulin sheets to cover dumpers at project sites etc. are helping to achieve the cleaner and green future at port. To address air pollution from port shipping activities, various measures that can be implemented are as follows:

- Practice should be initiated for using mask as preventative measure, to avoid Inhalation of dust particle-Mask advised in sensitive areas. Covering vehicles with tarpaulin during transportation will help to reduce the suspension of pollutants in air.
- Ensuring maintenance of engines and machinery to comply with emission standards.
- Frequent water sprinkling on roads to reduce dust suspension due to vehicular movement, this can be use during transporting coal to avoid suspension of coal dust.
- Use of proper transport methods, such as a conveyor belt, for excavated material and screens around the construction site.
- Temporary pavement of roads in construction site could considerably reduce dust emission. Prohibition of use of heavy diesel oil as fuel could be possibly reduce pollutants. Encouraging use of low-sulfur fuels (viz. Marine Gas Oil (MGO)/Liquefied Natural Gas (LNG), can significantly reduce sulfur and PM emissions from ships.



- Retrofitting ships with exhaust gas cleaning systems can help reduce sulfur emissions. Engine upgrades, such as optimizing fuel combustion and improving engine efficiency, can reduce overall emissions.
- Investing in infrastructure for cold ironing allows ships to connect to the electrical grid while docked, reducing the need for auxiliary engines and associated emissions.
- Implementing efficient cargo-handling processes, optimizing logistics to reduce congestion and idling times, and encouraging use of cleaner port machinery and vehicles can all contribute to reducing air pollution in port areas.



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CHAPTER 5: DG STACK MONITORING

5.1 DG Stack Monitoring

A diesel generator is a mechanical-electrical machine that produces electrical energy (electricity) from diesel fuel. They are used by the residential, commercial, charitable and governmental sectors to provide power in the event of interruption to the main power, or as the main power source. Diesel generating (DG) sets are generally used in places without connection to a power grid, or as an emergency power supply if the grid fails. These DG sets utilize diesel as fuel and generate and emit the air pollutants such as Suspended Particulate Matter, SO₂, NO_x, CO, etc. from the stack during its functioning. The purpose of stack sampling is to determine emission levels from plant processes to ensure they are in compliance with any emission limits set by regulatory authorities to prevent macro environmental pollution. The stack is nothing but chimney which is used to disperse the hot air at a great height, emissions & particulate matters that are emitted. Hence, monitoring of these stacks attached to DG Sets is necessary in order to quantify the emissions generated from it.

As defined in scope by DPA, the monitoring of DG Stack shall be carried out at two locations, one at Kandla and one at Vadinar. The details of the DG Sets at Kandla and Vadinar have been mentioned in **Table 10** as follows:

Table 10: Details of DG Stack monitoring locations

Sr. No.	Location Code	Location Name	Latitude/ Longitude
1.	DG-1	Kandla	22.98916N 70.22083E
2.	DG-2	Vadinar	22.44155N 69.67419E

The map depicting the locations of DG Stack Monitoring to be monitored in Kandla and Vadinar have been mentioned in **Map 8 and 9** as follows:



Figure 8: Location Map for DG Stack monitoring at Kandla



Figure 9: Location Map for DG Stack monitoring at Vadinar

Methodology:

Under the study, the list of parameters to be monitored under the projects for DG Stack Monitoring has been mentioned in **Table 11** as follows:

Table 11: Parameters to be monitored under the study

Sr. No.	Parameter	Unit	Instrument
1.	Suspended Particulate Matter	mg/Nm ³	Stack Monitoring Kit
2.	Sulphur Dioxide (SO ₂)	PPM	Sensor based Flue Gas Analyzer (Make: TESTO, Model 350)
3.	Oxides of Nitrogen (NO _x)	PPM	
4.	Carbon Monoxide	%	
5.	Carbon Dioxide	%	

The methodology for monitoring of DG Stack has been mentioned as follows:

The monitoring of DG Stack is carried out as per the IS:11255 and USEPA Method. The Stack monitoring kit is used for collecting representative samples from the stack to determine the total amount of pollutants emitted into the atmosphere in a given time. Source sampling is carried out from ventilation stack to determine the emission rates/or characteristics of pollutants. Sample collected must be such that it truly represents the conditions prevailing inside the stack. Whereas the parameters Sulphur Dioxide, Oxides of Nitrogen (NO_x), Carbon Monoxide and Carbon Dioxide, the monitoring is carried out by using the sensor-based Flue Gas Analyzer.

Frequency

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar.

5.2 Result and Discussion

The sampling and monitoring of DG stack emission was carried out at Kandla and Vadinar and its comparison with CPCB or Indian standards for Industrial Stack Monitoring the flue gas emission from DG set has given in **Table 12**.

Table 12: The results of DG Sets for Kandla and Vadinar

Sr. No.	Stack Monitoring Parameters for DG Sets	Stack Monitoring Limits / Standards As per CPCB	DG- 1 (Kandla)	DG-2 (Vadinar)
1.	Suspended Particulate Matter (SPM) mg/Nm ³	150	98.47	41.96
2.	Sulphur Dioxide (SO ₂) (PPM)	100	6.45	N.D.
3.	Oxides of Nitrogen (NO _x) (PPM)	50	52.19	22.75
4.	Carbon Monoxide (CO) (%)	1	0.18	0.016
5.	Carbon Dioxide (CO ₂) (%)	-	2.57	1.24

Data Interpretation and Conclusion

The results of DG stack emission are compared with the permissible limits mentioned in the consent issued by GPCB, and have been found within the prescribed limit for SPM, SO₂, NO_x and CO.



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CHAPTER 6: NOISE MONITORING

6.1 Noise Monitoring

Noise can be defined as an unwanted sound, and it is therefore, necessary to measure both the quality as well as the quantity of environmental noise in and around the study area. Noise produced during operation stage and the subsequent activities may affect surrounding environment impacting the fauna and as well as the human population. Under the scope, the noise monitoring is required to be carried out at 10 locations in Kandla and 3 locations in Vadinar. The sampling locations for noise are not only confined to commercial areas of DPA but also the residential areas of DPA.

The details of the noise monitoring stations are mentioned in **Table 13** and locations have been depicted in the **Figure 10 and 11** as follow:

Table 13: Details of noise monitoring locations

Sr. No.	Location Code	Location Name	Latitude/ Longitude
1.	N-1	Oil Jetty 7	23.043527N 70.218456E
2.	N-2	West Gate No.1	23.006771N 70.217340E
3.	N-3	Canteen Area	23.003707N 70.221331E
4.	N-4	Main Gate	23.007980N 70.222525E
5.	N-5	Main Road	23.005194N 70.219944E
6.	N-6	Marin Bhavan	23.007618N 70.222087E
7.	N-7	Port & Custom Building	23.009033N 70.222047E
8.	N-8	Nirman Building	23.009642N 70.220623E
9.	N-9	ATM Building	23.009985N 70.221715E
10.	N-10	Wharf Area/ Jetty	22.997833N 70.223042E
11.	N-11	Near Main Gate	22.441544N 69.674495E
12.	N-12	Near Vadinar Jetty	22.441002N 69.673147E
13.	N-13	Port Colony Vadinar	22.399948N 69.716608E



Figure 10: Location Map for Noise Monitoring at Kandla



Figure 11: Location Map for Noise Monitoring at Vadinar

Methodology:

The intensity of sound energy in the environment is measured in a logarithmic scale and is expressed in a decibel (dB(A)) scale. The ordinary sound level meter measures the sound energy that reaches the microphone by converting it into electrical energy and then measures the magnitude in dB(A). Whereas, in a sophisticated type of sound level meter, an additional circuit (filters) is provided, which modifies the received signal in such a way that it replicates the sound signal as received by the human ear and the magnitude of sound level in this scale is denoted as dB(A). The sound levels are expressed in dB(A) scale for the purpose of comparison of noise levels, which is universally accepted. Noise levels were measured using an integrated sound level meter of the make Envirotech Sound Level Meter (Class-I) (model No. SLM-109). It has an indicating mode of Lp and Leq. Keeping the mode in Lp for few minutes and setting the corresponding range and the weighting network in “A” weighting set the sound level meter was run for one-hour time and Leq was measured at all locations.

Frequency

Monitoring was carried out at each noise monitoring station for Leq. noise level (Day and Night), which was recorded for 24 hours continuously at a monthly frequency with the help of Sound/Noise Level Meter (Class-1). The details of the noise monitoring have been mentioned in **Table 14**.

Table 14: Details of the Noise Monitoring that carried out at Kandla and Vadinar

Sr. No.	Parameters	Units	Reference Method	Instrument
1.	Leq (Day)	dB(A)	IS 9989: 2014	Noise Level Meter (Class-I) model No. SLM-109
2.	Leq (Night)	dB(A)		

Standard for Noise

Ministry of Environment & Forests (MoEF) has notified the noise standards vide the Gazette notification dated February 14, 2000 for different zones under the Environment Protection Act (1986). The day time noise levels have been monitored from 6.00 AM to 10.00 PM and night noise levels were measure from 10.00 PM to 6.00 AM at all the thirteen locations (10 at Kandla and 3 at Vadinar) monthly. The specified standards are as mentioned in **Table 15** as follows:

Table 15: Ambient Air Quality norms in respect of Noise

Area Code	Category of Area	Noise dB(A) Leq	
		Daytime	Night time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

6.2 Result and Discussion

The details of the Noise monitoring conducted during the monitoring period have been summarized in the **Table 16** as below:

Table 16: The Results of Ambient Noise Quality

Sr. No.	Station Code	Station Name	Category of Area	Standard	Day Time			Standard	Night Time		
					Max.	Min.	Leq dB(A) Total		Max.	Min.	Leq dB(A) Total
1	N-1	Oil Jetty 7	A	75	55.2	38.9	49.6	70	42.6	33.0	40.0
2	N-2	West Gate No.1	A	75	66.1	48.0	60.5	70	50.1	41.1	46.3
3	N-3	Canteen Area	B	65	60.2	44.2	55.5	55	49.2	37.2	43.2
4	N-4	Main Gate	A	75	58.4	46.9	54.9	70	45.4	37.9	42.1
5	N-5	Main Road	A	75	61.5	39.4	55.7	70	47.6	35.6	43.2
6	N-6	Marin Bhavan	B	65	62.3	39.5	56.9	55	42.0	34.6	38.9
7	N-7	Port & Custom Building	B	65	54.6	39.4	49.5	55	46.6	36.4	42.4
8	N-8	Nirman Building	B	65	54.5	42.6	50.7	55	44.3	38.6	41.4
9	N-9	ATM Building	B	65	58.1	41.6	53.9	55	45.9	37.2	41.9
10	N-10	Wharf Area/ Jetty	A	75	61.5	42.6	56.3	70	47.2	40.6	44.6
11	N-11	Near Main Gate	A	75	71.1	57.5	59.0	70	68.9	57.0	57.8
12	N-12	Near Vadinar Jetty	A	75	72.8	59.0	62.1	70	62.1	53.0	55.4
13	N-13	Port Colony Vadinar	C	55	60.1	49.0	50.1	45	62.8	48.0	49.4

6.3 Data Interpretation and Conclusion

The noise level at both the locations (Kandla and Vadinar) was compared with the standard limits specified in NAAQS by CPCB. The Day Time the average noise level at all 10 locations at Kandla ranged from 49.5 dB(A) to 60.5 dB(A), while at Vadinar, the noise levels for the three-location ranged from 50.1 dB(A) to 62.1 dB(A). Whereas, during Night Time the average Noise Level ranged from 38.9 dB(A) to 46.3 dB(A) at Kandla and 49.4 dB(A) to 57.8 dB(A) at Vadinar which was within the permissible limits for the industrial, residential and commercial area except for location N-13 which exceeds the stipulated norms for night time.

6.4 Remedial Measures

As per the noise level found within the norms thus no need to bring it down from the existing level however, the noise could be considerably reduced by adoption of low noise equipment or installation of sound insulation fences. Green belt of plants can be a good barrier. If noise exceeds the applicable norms, then the Working hours may be altered as a possible means to mitigate the nuisances of construction activities.



CHAPTER 7: SOIL MONITORING

7.1 Soil Quality Monitoring:

The purpose of soil quality monitoring is to track changes in the features and characteristics of the soil, especially the chemical properties of soil occurring at specific time intervals under the influence of human activity. Soil quality assessment helps to determine the status of soil functions and environmental risks associated with various practices prevalent at the location.

As defined in scope by Deendayal Port Authority (DPA), Soil Quality Monitoring shall be carried out at Six locations, four at Kandla and two at Vadinar. The details of the soil monitoring locations within the Port area of DPA are mentioned in **Table 17**:

Table 17: Details of the Soil quality monitoring locations

Sr. No.	Location Code	Location Name	Latitude Longitude
1.	Kandla	S-1	Oil Jetty 7
2.		S-2	IFFCO Plant
3.		S-3	Khori Creek
4.		S-4	Nakti Creek
5.	Vadinar	S-5	Near SPM
6.		S-6	Near Vadinar Jetty

Methodology

As per the defined scope by Deendayal Port Authority (DPA), the sampling and analysis of Soil quality has been carried out on monthly basis.

The samples of soil collected from the locations of Kandla and Vadinar and analyzed for the various physico-chemical parameter. Collection and analysis of these samples was carried out as per established standard methods and procedures. The samples were analyzed for selected parameters to get the present soil quality status and environmental risks associated with various practices prevalent at the location. GEMI has framed its own guidelines for collection of soil samples titled as '*Soil Sampling Manual*'. Soil samples were collected from 30 cm depth below the surface using scrapper, filled in polythene bags, labelled on-site with specific location code and name and sent to GEMI's laboratory, Gandhinagar for further detailed analysis. The samples collected from all locations are homogeneous representative of each location. The list of parameters to be monitored under the projects for the Soil Quality Monitoring been mentioned in **Table 18** as follows:

Frequency

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar.

Table 18: List of parameters to be monitored for Soil Quality

Sr. No.	Parameters	Units	Reference method	Instruments
1.	TOC	%	Methods Manual Soil Testing in India January, 2011, 09. Volumetric method (Walkley and Black, 1934)	Titration Apparatus
2.	Organic Carbon	%		
3.	Inorganic Phosphate	Kg/Hectare	Practical Manual Chemical Analysis of Soil and Plant Samples, ICAR-Indian Institute of Pulses Research 2017 Determination of Available Phosphorus in Soil	UV-Visible Spectrophotometer
4.	Texture	-	Methods Manual Soil Testing in India January 2011,01	Hydrometer
5.	pH	-	IS 2720 (Part 26): 1987	pH Meter
6.	Conductivity	μS/cm	IS 14767: 2000	Conductivity Meter
7.	Particle size distribution & Silt content	-	Methods Manual Soil Testing in India January 2011	Sieves Apparatus
8.	SAR	meq/L	Procedures for Soil Analysis, International Soil Reference and Information Centre, 6 th Edition 2002 13-5.5.3 Sodium Absorption Ratio (SAR), Soluble cations	Flame Photometer
9.	Water Holding Capacity	%	NCERT, Chapter 9, 2022-23 and Water Resources Department Laboratory Testing Procedure for Soil & Water Sample Analysis	Muffle Furnace
10.	Aluminium	mg/Kg	EPA Method 3051A	ICP-OES
11.	Chromium	mg/Kg		
12.	Nickel	mg/Kg		
13.	Copper	mg/Kg	Methods Manual Soil Testing in India January, 2011, 17a	
14.	Zinc	mg/Kg	Methods Manual Soil Testing in India January, 2011, 17a	
15.	Cadmium	mg/Kg	EPA Method 3051A	
16.	Lead	mg/Kg		
17.	Arsenic	mg/Kg		
18.	Mercury	mg/Kg		

The map depicting the locations of Soil Quality Monitoring to be monitored in Kandla and Vadinar have been mentioned in **Map 12 and 13** as follows:



Figure 12: Location Map for Soil Quality Monitoring at Kandla



Figure 13: Location Map for Soil Quality Monitoring at Vadinar

7.2 Result and Discussion

The analysis results of physical analysis of the soil samples collected during environmental monitoring mentioned in **Table 19** are shown below:

Table 19: Soil Quality for the sampling period

Sr. No	Location Parameters	Unit	Kandla				Vadinar	
			S-1 (Oil Jetty 7)	S-2 IFFCO Plant)	S-3 (Khor Creek)	S-4 (Nakti Creek)	S-5 (Near SPM)	S-6 (Near Vadinar Jetty)
1	pH		9.39	8.8	7.54	8.64	8.32	8.4
2	Conductivity	µS/cm	1847	4380	75700	704	94	127
3	Inorganic Phosphate	Kg/ha	1.92	1.7	1.24	3.15	0.95	0.77
4	Organic Carbon	%	0.06	0.14	0.98	0.49	0.25	0.65
5	Organic Matter	%	0.10	0.24	1.69	0.84	0.431	1.12
6	SAR	meq/L	5.29	6.14	29.26	0.67	0.11	0.09
7	Aluminium	mg/Kg	812.75	830.95	840.71	916.40	735.77	754.58
8	Chromium	mg/Kg	60.76	57.44	42.48	46.75	76.06	60.93
9	Nickel	mg/Kg	14.92	14.38	11.91	16.54	29.15	26.73
10	Copper	mg/Kg	78.66	74.40	62.62	16.84	102.62	70.50
11	Zinc	mg/Kg	101.93	76.19	44.26	23.57	46.12	29.32
12	Cadmium	mg/Kg	BQL	BQL	BQL	BQL	BQL	BQL
13	Lead	mg/Kg	4.67	3.27	1.29	3.46	BQL	BQL
14	Arsenic	mg/Kg	BQL	BQL	BQL	2.377	0.099	BQL
15	Mercury	mg/Kg	BQL	BQL	BQL	BQL	BQL	BQL
16	Water Holding Capacity	%	36	38	50.8	46	42	62
17	Sand	%	73.52	73.52	51.52	73.52	54.24	64.24
18	Silt	%	23.28	21.28	33.28	11.28	33.44	25.44
19	Clay	%	3.2	5.2	15.2	15.2	12.32	10.32
20	Texture	-	Loamy Sand	Loamy Sand	Loam	Sandy loam	sandy loam	Sandy loam

7.3 Data Interpretation and Conclusion

Soil samples were collected from 6 locations (4 at Kandla and 2 at Vadinar) and further analysed for its physical & chemical characteristics. Each of the following parameters has been given an interpretation based on the observations.

- The value of **pH** ranges from 7.54 to 9.39, highest at location S-1 (Oil Jetty 7) and lowest at S-3 (Khor Creek); while the average pH for Kandla was observed to be 8.59.

Whereas, at Vadinar the pH value observed at S-5 i.e., Near SPM (8.32) and at S-6 i.e., Near Jetty Area (8.4). As per the observation the pH was found to be **moderately to strongly alkaline** both the monitoring station of Kandla and Vadinar.

- At entire monitoring locations of Kandla the value of **Electrical Conductivity** ranges from 704 to 75700 $\mu\text{s}/\text{cm}$, highest at location S-3 (Khori Creek) with the average as 20657.75 $\mu\text{s}/\text{cm}$. Whereas, at Vadinar the range of conductivity was between the range of 94 to 127 $\mu\text{s}/\text{cm}$ with an average value of 110.5 $\mu\text{s}/\text{cm}$.
- At Kandla, the concentration of **Inorganic Phosphate** varied from 1.24 to 3.15 Kg/ha, with average 2 Kg/ha. Whereas, at the locations of Vadinar, the Inorganic Phosphate was observed at S-5 i.e., Near SPM (0.95 Kg/ha) and detected at S-6 i.e., near Jetty Area (0.77 Kg/ha). The phosphorus availability in soil solution is influenced by a number of factors such as Organic matter, clay content, pH, temperature, etc.
- The concentration of **Total Organic Carbon** ranges from 0.06 to 0.98% while the average TOC at Kandla was detected as 0.42%. Whereas, at Vadinar the average TOC was found to be 0.45% where the observed TOC value found at S-5 and S-6 to be 0.25 and 0.65 respectively.
- The concentration of **Water Holding Capacity** in the soil samples of Kandla and Vadinar varies from 36 to 50.8% and 42 to 62% respectively.
- The concentration of **Sodium Adsorption Ratio** ranges from 0.67 to 29.26 meq/L with an average value 10.34 meq/L at Kandla. Whereas, at Vadinar, the average SAR was found to be 0.1 meq/L where the observed SAR value found at S-5 (0.11 meq/L) and S-6 (0.09 meq/L).
- Loam to Sandy Loam **Soil Texture** was observed at all the monitoring locations of Kandla and Vadinar.

Heavy Metals

- For the sampling period, the concentration of **Aluminium** varied from 812.75 to 916.40 mg/kg at Kandla and 735.77 to 754.58 mg/kg at Vadinar and the average value was observed to be 850.20 and 745.18 mg/kg at Kandla and Vadinar monitoring station, respectively.
- The concentration of **Chromium** varied from 42.48 to 60.76 mg/kg at Kandla and 60.93 to 76.06 mg/kg at Vadinar and the average value was observed to be 51.86 and 68.496 mg/kg at Kandla and Vadinar monitoring station, respectively.
- The concentration of **Nickel** varied from 11.91 to 16.54 mg/kg at Kandla and 26.73 to 29.15 mg/kg at Vadinar and the average value was observed to be 14.43 and 27.94 mg/kg at Kandla and Vadinar monitoring station, respectively.

- The concentration of **Zinc** varied from 23.57 to 101.93 mg/kg at Kandla and 29.32 to 46.12 mg/kg at Vadinar and the average value was observed to be 61.48 and 37.72 mg/kg at Kandla and Vadinar monitoring station, respectively.
- The concentration of **Copper** varied from 16.84 to 78.66 mg/kg at Kandla and 70.50 and 102.62 mg/kg at Vadinar and the average value was observed to be 58.13 and 86.56 mg/kg at Kandla and Vadinar monitoring station, respectively.
- The concentration of **Lead** varied from 1.29 to 4.67 mg/kg at Kandla with average value 3.17 mg/Kg, whereas for Vadinar, the value recorded below the detection limit.
- The concentration of **Arsenic** found to be BQL at Kandla except for location S-4 i.e. 2.38 mg/kg. Whereas for Vadinar the value recorded for location S-5 to be 0.09 mg/kg and BQL at S-6.
- While other heavy metals in the Soil i.e., **Mercury and Cadmium** were observed “Below Quantification Limit” for majority of the soil samples collected at Kandla and Vadinar.



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CHAPTER 8: DRINKING WATER MONITORING

8.1 Drinking Water Monitoring

It is necessary to check with the drinking water sources regularly so as to know whether water quality conforms to the prescribed standards for drinking. Monitoring the drinking water quality is essential to protect human health and the environment. With reference to the scope specified by DPA, a total of 20 locations (18 at Kandla and 2 at Vadinar) were monitored to assess the Drinking Water quality.

The details of the drinking water sampling stations have been mentioned in **Table 20** and the locations have been depicted through Google map in **Figure 14 and 15**.

Table 20: Details of Drinking Water Sampling Locations

Sr. No.	Location Code	Location Name	Latitude/ Longitude
1.	DW-1	Oil Jetty 7	23.043527N 70.218456E
2.	DW-2	Port & Custom Building	23.009033N 70.222047E
3.	DW-3	North Gate	23.007938N 70.222411E
4.	DW-4	Workshop	23.009372N 70.222236E
5.	DW-5	Canteen Area	23.003707N 70.221331E
6.	DW-6	West Gate 1	23.006771N 70.217340E
7.	DW-7	Sewa Sadan -3	23.009779N 70.221838E
8.	DW-8	Nirman Building	23.009642N 70.220623E
9.	DW-9	Custom Building	23.018930N 70.214478E
10.	DW-10	Port Colony Kandla	23.019392N 70.212619E
11.	DW-11	Wharf Area/ Jetty	22.997833N 70.223042E
12.	DW-12	Hospital Kandla	23.018061N 70.212328E
13.	DW-13	A.O. Building	23.061914N 70.144861E
14.	DW-14	School Gopalpuri	23.083619N 70.132061E
15.	DW-15	Guest House	23.078830N 70.131008E
16.	DW-16	E- Type Quarter	23.083306N 70.132422E
17.	DW-17	F- Type Quarter	23.077347N 70.135731E
18.	DW-18	Hospital Gopalpuri	23.081850N 70.135347E
19.	DW-19	Near Vadinar Jetty	22.440759N 69.675210E
20.	DW-20	Near Port Colony	22.401619N 69.716822E



Figure 14: Location Map for Drinking Water Monitoring at Kandla



Figure 15: Location Map for Drinking Water Monitoring at Vadinar

Methodology

The water samples were collected from the finalized sampling locations and analyzed for physico-chemical and microbiological parameter, for which the analysis was carried out as per APHA, 23rd Edition and Indian Standard method in GEMI's NABL Accredited Laboratory, Gandhinagar. GEMI has followed the CPCB guideline as well as framed its own guidelines for the collection of water/wastewater samples, under the provision of Water (Preservation and Control of Pollution) Act 1974, titled as 'Sampling Protocol for Water & Wastewater'; approved by the Government of Gujarat vide letter no. ENV-102013-299-E dated 24-04-2014. The samples under the study were collected and preserved as per the said Protocol. The parameters finalized to assess the drinking water quality have been mentioned in **Table 21** as follows:

Table 21: List of parameters for Drinking Water Quality monitoring

Sr. No.	Parameters	Units	Reference method	Instrument
1.	pH	-	APHA, 23 rd Edition (Section-4500-H+B):2017	pH Meter
2.	Colour	Hazen	APHA, 23 rd Edition, 2120 B:2017	Color Comparator
3.	EC	µS/cm	APHA, 23 rd Edition (Section-2510 B):2017	Conductivity Meter
4.	Turbidity	NTU	APHA, 23 rd Edition (Section -2130 B):2017	Nephlo Turbidity Meter
5.	TDS	mg/L	APHA, 23 rd Edition (Section-2540 C):2017	Vaccum Pump with filtration assembly and Oven
6.	TSS	mg/L	APHA, 23 rd Edition, 2540 D: 2017	
7.	Chloride	mg/L	APHA, 23 rd Edition (Section-4500-Cl-B):2017	Titration Apparatus
8.	Total Hardness	mg/L	APHA, 23 rd Edition (Section-2340 C):2017	
9.	Ca Hardness	mg/L	APHA, 23 rd Edition (Section-3500-Ca B):2017	
10.	Mg Hardness	mg/L	APHA, 23 rd Edition (Section-3500-Mg B):2017	
11.	Free Residual Chlorine	mg/L	APHA 23 rd Edition, 4500	
12.	Fluoride	mg/L	APHA, 23 rd Edition (Section-4500-F-D):2017	UV- Visible Spectrophotometer
13.	Sulphate	mg/L	APHA, 23 rd Edition (Section 4500-SO4-2-E):2017	
14.	Sodium	mg/L	APHA, 23 rd Edition (Section-3500-Na-B):2017	Flame Photometer
15.	Potassium	mg/L	APHA,23 rd Edition, 3500 K-B: 2017	
16.	Salinity	mg/L	APHA, 23 rd Edition (section 2520 B, E.C. Method)	Salinity /TDS Meter
17.	Nitrate	mg/L	APHA, 23 rd Edition, 4500 NO3- B: 2017	UV- Visible Spectrophotometer

Sr. No.	Parameters	Units	Reference method	Instrument
18.	Nitrite	mg/L	APHA, 23 rd Edition, 4500 NO ₂ -B: 2017	
19.	Hexavalent Chromium	mg/L	APHA, 23 rd Edition, 3500 Cr B: 2017	
20.	Manganese	mg/L	APHA, 23 rd Edition, ICP Method 3120 B: 2017	ICP-OES
21.	Mercury	mg/L	EPA 200.7	
22.	Lead	mg/L	APHA ICP 23 rd Edition (Section-3120 B):2017	
23.	Cadmium	mg/L	APHA ICP 23 rd Edition (Section-3120 B):2017	
24.	Iron	mg/L	APHA ICP 23 rd Edition (Section-3120 B):2017	
25.	Total Chromium	mg/L	APHA ICP 23 rd Edition (Section-3120 B):2017	ICP-OES
26.	Copper	mg/L	APHA, 23 rd Edition, ICP Method 3120 B: 2017	
27.	Zinc	mg/L	APHA ICP 23 rd Edition (Section-3120 B):2017	
28.	Arsenic	mg/L	APHA ICP 23 rd Edition (Section-3120 B):2017	
29.	Total Coliforms	MPN/100ml	IS 15185: 2016	LAF/ Incubator

8.2 Result and Discussion

The drinking water quality of the locations at Kandla and Vadinar and its comparison with the to the stipulated standard (Drinking Water Specifications i.e., IS: 10500:2012) have been summarized in **Table 22** as follows:

Table 22: Summarized results of Drinking Water quality

Sr. No.	Parameters	Units	Standard values as per IS		Kandla																		Vadinar	
			A	P	DW-1	DW-2	DW-3	DW-4	DW-5	DW-6	DW-7	DW-8	DW-9	DW-10	DW-11	DW-12	DW-13	DW-14	DW-15	DW-16	DW-17	DW-18	DW-19	DW-20
1.	pH	-	6.5-8.5	-	7.38	6.77	6.75	7.37	7.83	7.94	7.42	7.82	6.62	6.82	8.12	6.62	7.81	8.03	7.45	7.08	7.42	7.19	7.27	7.87
2.	Colour	Hazen	5	15	1	1	1	1	5	5	1	5	1	1	5	1	1	1	1	1	1	1	1	1
3.	EC	µS/cm	-	-	260	165.2	205	42.7	1257	1181	55.7	1156	117.7	194.5	1183	194.9	81.5	818	147.3	63.2	246	63.4	178.3	132.5
4.	Salinity	mg/L	-	-	0.13	0.08	0.10	0.03	0.62	0.59	0.03	0.57	0.06	0.10	0.59	0.10	0.11	0.58	0.7	0.05	0.31	0.04	0.09	0.34
5.	Turbidity	NTU	1	5	1.20	1.48	0.93	0.90	1.6	1.1	1.13	1.14	0.97	1.23	3.4	1.02	BQL	7.01	BQL	BQL	BQL	BQL	1.5	0.7
6.	Chloride	mg/L	250	1000	57.98	42.49	37.99	12.50	262.42	259.92	16	244.92	28.99	48.98	244.92	45.99	35.47	285.40	45.4	22.1	65.2	16.3	27.49	19.1
7.	Total Hardness	mg/L	200	600	8	10	12	4	230	230	4	210	8	3	210	20	12	170	8	5	12	4	38	30
8.	Ca Hardness	mg/L	-	-	4	7	8	3	110	120	2	110	4	2	90	12	6	90	5	3	7	3	18	18
9.	Mg Hardness	mg/L	-	-	4	3	4	1	120	110	2	100	4	1	120	8	6	80	3	2	5	1	20	12
10.	Free Residual Chlorine	mg/L	0.2	1	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
11.	TDS	mg/L	500	2000	132	84	104	22	630	598	28	580	60	98	600	98	BQL	512	73	33	185	34	90	81
12.	TSS	mg/L	-	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	2	BQL	BQL	8	BQL	BQL	BQL	BQL	BQL	BQL
13.	Fluoride	mg/L	1.0	1.5	BQL	BQL	0.36	BQL	0.89	0.91	0.42	BQL	BQL	BQL	1.06	BQL	BQL	0.15	BQL	BQL	BQL	BQL	BQL	BQL
14.	Sulphate	mg/L	200	400	BQL	BQL	BQL	BQL	93.16	93.24	BQL	BQL	BQL	BQL	93.38	BQL	BQL	88.2	10.3	BQL	11.48	BQL	BQL	25.4
15.	Nitrate	mg/L	45	-	12.04	BQL	4.08	BQL	6.68	5.69	BQL	4.53	BQL	4.23	6.47	BQL	BQL	1.78	BQL	BQL	2.51	BQL	BQL	3.44
16.	Nitrite	mg/L	-	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
17.	Sodium	mg/L	-	-	46.24	28.73	32.72	11.54	135.8	117.01	10.47	109.5	18.28	34.08	115.72	24.85	21.25	88.2	15.3	BQL	46.4	9.05	20.56	35.7



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Sr. No.	Parameters	Units	Standard values as per IS		Kandla																		Vadinar	
			A	P	DW-1	DW-2	DW-3	DW-4	DW-5	DW-6	DW-7	DW-8	DW-9	DW-10	DW-11	DW-12	DW-13	DW-14	DW-15	DW-16	DW-17	DW-18	DW-19	DW-20
18	Potassium	mg/L	-	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
19	Hexavalent Chromium	mg/L	-	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
20	Odour	TON	Agreeable		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21	Arsenic	mg/L	0.01	0.05	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
22	Cadmium	mg/L	0.003	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
23	Copper	mg/L	0.05	1.5	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
24	Iron	mg/L	0.3	-	BQL	BQL	0.16	BQL	0.14	0.16	BQL	BQL	BQL	BQL	0.17	BQL	BQL							
25	Lead	mg/L	0.01	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	0.002	BQL	BQL	BQL	BQL
26	Manganese	mg/L	0.1	0.3	BQL	BQL	BQL	BQL	BQL	0.04	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
27	Mercury	mg/L	0.001	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
28	Total Chromium	mg/L	0.05	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
29	Zinc	mg/L	5	15	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
30	Total Coliform*	MPN/100ml	Shall not be detected		150	5	10	5	160	120	5	145	190	81	39	140	52	102	11	48	40	120	BQL	10

A: Acceptable, P:Permissible, BQL: Below Quantification limit Turbidity (QL=0.5 NTU), Free Residual Chlorine (QL=2 mg/L), Total Suspended Solids (QL=2 mg/L), Fluoride (QL=0.3 mg/L), Sulphate (QL=10 mg/L), Nitrate as NO₃ (QL=1 mg/L), Nitrite as NO₂ (QL=0.1mg/L), Sodium as Na (QL=5mg/L), Potassium as K (QL=5mg/L), Hexavalent Chromium (QL=0.01 mg/L), Arsenic (QL=0.005 mg/L), Cadmium (QL=0.002 mg/L), Copper (QL=0.005 mg/L), Iron (QL=0.1mg/L), Lead (QL=0.002 mg/L), Manganese (QL=0.04 mg/L), Mercury (QL=0.0005 mg/L), Total Chromium (QL=0.005 mg/L), Zinc (QL=0.5 mg/L), Total Coliforms (QL=1 MPN/ 100ml)

*Note: For Total Coliform, one MPN is equivalent to one CFU. The use of either method; MPN or CFU for the detection of bacteria are considered valid measurements for bacteria limits.

8.3 Data Interpretation and Conclusion

Drinking water samples were taken at 20 locations (18 at Kandla and 2 at Vadinar), and their physical and chemical properties were analyzed. The analysis's results were compared with standard values as prescribed in IS 10500:2012 Drinking Water Specification.

- **pH:** The pH values of drinking water samples in Kandla were reported to be in the range of 6.62 to 8.12, with an average pH of 7.35. In Vadinar, its values ranged from 7.27 to 7.87, with an average pH of 7.57. Notably, the pH levels at both project sites fall within the acceptable range of 6.5 to 8.5, as specified under IS:10500:2012.
- **Turbidity:** At the drinking water locations of Kandla, the turbidity was found in range from 0.9 to 7.01 NTU with average value 1.77 NTU. Whereas, at Vadinar the value of turbidity was reported 1.5 NTU at DW-19 and 0.7 NTU at DW-20 with average at 1.10 NTU.
- **Total Dissolved Solids (TDS):** Monitoring TDS is crucial because it provides an indication of overall quality of the water. During the monitoring period, the TDS concentrations in Kandla were observed to vary in a wide range i.e., between 22 to 630 mg/L, with an average concentration of 227.71 mg/L. while in Vadinar, it ranged from 81 to 90 mg/L, with average at 85.50 mg/L.

It is important to note that the TDS concentrations in both Kandla and Vadinar fall well within the acceptable limit of 500 mg/L except for location DW-5, DW-11, DW-14.

- **Electrical Conductivity (EC):** It is a measure of the ability of a solution to conduct electric current, and it is often used as an indicator of the concentration of dissolved solids in water. During the monitoring period, the EC values for samples collected in Kandla were observed to range from 42.7 to 1257 $\mu\text{S}/\text{cm}$, with an average value of 412.89 $\mu\text{S}/\text{cm}$. In Vadinar, the EC values showed variation from 132.5 to 178.3 $\mu\text{S}/\text{cm}$, with an average value of 155.40 $\mu\text{S}/\text{cm}$. It's important to regularly monitor EC levels in drinking water as it can provide valuable information about water quality and presence of dissolved substances.
- **Chlorides:** The concentrations in the drinking water samples collected from Kandla and Vadinar were within acceptable limits, as specified by the BIS. The chloride in Kandla varied from 12.5 to 285.4 mg/L, with an average value of 98.49 mg/L. In Vadinar, it ranged from 19.1 to 27.49 mg/L, with an average value of 23.30 mg/L. It's important to note that all the recorded chloride concentrations in both Kandla and Vadinar were well below the acceptable limit of 250 mg/L except for location DW-5, DW-11, DW-14.
- **Total Hardness (TH):** Total Hardness varied from 3 to 230 mg/L, with the average value as 64.44 mg/L. While at Vadinar, the variation was observed from 30 to 38 mg/L; with the average conc. at 34 mg/L. which was found to be within the acceptable norm of 200 mg/L as specified by IS:10500:2012 and is not harmful for local inhabitants.
- **Sulphate:** During monitoring period in Kandla and Vadinar, the sulphate concentrations were found to be within the acceptable limits i.e., 200 mg/L as per the specified norms. In Kandla, the sulphate concentrations varied from 10.3 to 93.38

mg/L, with an average value of 64.96 mg/L. In Vadinar, the sulphate concentration was observed BQL at location DW-19 and 25.4 mg/L at DW-20.

- **Sodium:** During the monitoring period, at Kandla variation in the concentration of sulphate was observed to be in the range of 9.05 to 135.8 mg/L, with the average concentration of 50.89 mg/L. While at Vadinar, the concentration recorded 20.56 mg/L at DW-19 and 35.7 mg/L at DW-20.
- **Nitrate:** During the monitoring period, at Kandla & Vadinar variation in the concentration of Nitrate was observed to be in the range of 1.78 to 12.03 mg/L, with the average concentration of 5.34 mg/L also majority of the location recorded as “BQL”. While at Vadinar, the concentration recorded BQL at DW-19 and 3.44 mg/L at DW-20, with average concentration of 3.44 mg/L.
- **Fluoride:** The concentration was found to be BQL in majority of the monitoring location except for location DW-3 (North Gate) i.e. 0.36 mg/L, DW-5 (Canteen Area) i.e. 0.89 mg/L, DW-6 (West Gate 1) i.e. 0.91 mg/L, DW-7 (Sewa Sadan-3) i.e. 0.42, DW-11 (Wharf area/Jetty) i.e. 1.06 mg/L, DW-14 (School Gopalpuri) i.e. 0.15 mg/L at Kandla. While at Vadinar its value also reported to be BQL for both the monitoring location.
- The parameters such as **Potassium, Free Residual Chlorine, Total Suspended Solids, Nitrite, Hexavalent Chromium, and the metals Arsenic, Cadmium, Copper, Iron, Lead, Manganese, Mercury, Total Chromium and Zinc** were all observed to have concentrations “Below the Quantification Limit (BQL)” at majority of the locations during the monitoring period.
- Bacteriological Analysis of the drinking water reveals that Total Coliforms were detected in small concentration at majority of the monitoring locations of Kandla and Vadinar. Reporting such concentration of Coliforms indicates certain external influx may contaminate the source. Hence, it should be checked at every distribution point.

8.4 Remedial Measures

Appropriate water treatment processes should be administered to eradicate coliform bacteria. The methods of disinfection such as **chlorination, ultraviolet (UV), or ozone** etc, apart from that, filtration systems can also be implemented to remove bacteria, sediment, and other impurities.

Furthermore, a regular monitoring to assess the quality of drinking water at various stages, including the source, purification plants, distribution network, and consumer endpoints would help in early detection of coliform bacteria or other contaminants in the drinking water.



CHAPTER 9: SEWAGE TREATMENT PLANT MONITORING

9.1 Sewage Treatment Plant (STP) Monitoring:

The principal objective of STP is to remove contaminants from sewage to produce an effluent that is suitable to discharge to the surrounding environment or an intended reuse application, thereby preventing water pollution from raw sewage discharges. As defined in the scope by Deendayal Port Authority (DPA), Kandla, the STP Monitoring is to be carried out weekly at three locations, one at Kandla, one at Gopalpuri and one STP at Vadinar. The samples from the inlet and outlet of the STP have been collected weekly. The details of the locations of STP to be monitored for Kandla and Vadinar have been mentioned in **Table 23** as follows:

Table 23: Details of the monitoring locations of STP

Sr. No..	Location Code		Location Name	Latitude Longitude
1.	Kandla	STP-1	STP Kandla	23.021017N 70.215594E
2.		STP-2	STP Gopalpuri	23.077783N 70.136759E
3.	Vadinar	STP-3	STP at Vadinar	22.406289N 69.714689E

The Consolidated Consent and Authorization (CC&A) issued by the GPCB were referred for the details of the STP for Kandla and Gopalpuri. The CC&A of Kandla and Gopalpuri entails that the treated domestic sewage should conform to the norms specified in **Table 24**. The treated effluent conforming to the norms shall be discharged on the land within the premises strictly for the gardening and plantation purpose. Whereas, no sewage shall be disposed outside the premises in any manner.

Table 24: Norms of treated effluent as per CC&A of Kandla STP

Sr. No.	Parameters	Prescribed limits
1.	pH	6.5-8.5
2.	BOD (3 days at 27°C)	30 mg/L
3.	Suspended Solids	100 mg/L
4.	Fecal Coliform	< 1000 MPN/100 ml

The detailed process flow diagram of the Kandla and Gopalpuri STP have been mentioned in **Figure 16 and 17** as follows:

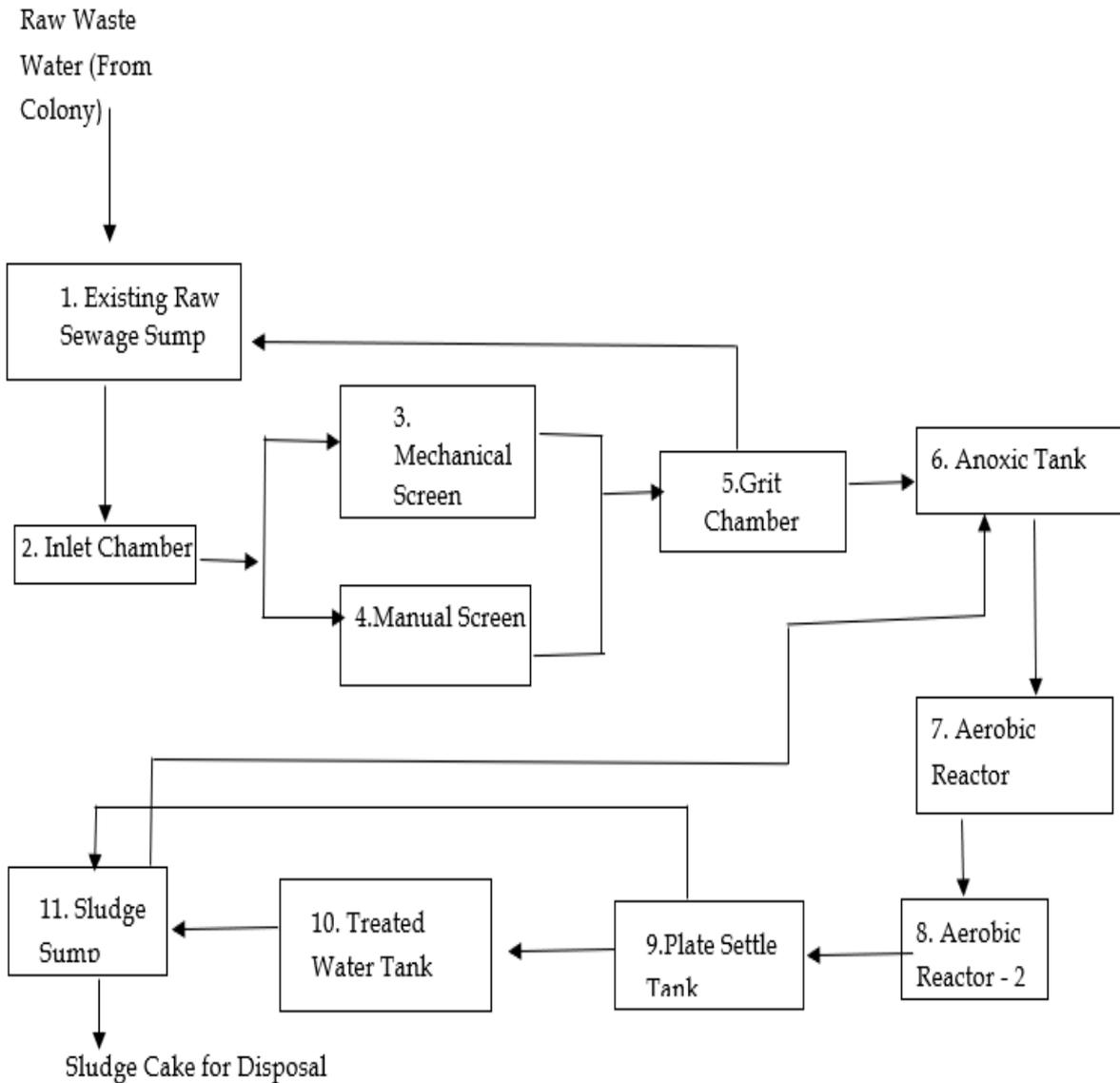


Figure 17: Process flow diagram of Gopalpuri STP

STP at Vadinar

The STP at Vadinar has been built with a treatment capacity of 450 KLD/day. The Consolidated Consent and Authorization (CC&A) issued by the GPCB has been referred for the details of the said STP. The CC&A of the Vadinar STP suggests that the domestic effluent generated shall be treated as per the norms specified in **Table 25**. The treated effluent conforming to the norms shall be discharged on the land within the premises strictly for the gardening and plantation purpose. Whereas, no sewage shall be disposed outside the premises in any manner.

Table 25: Norms of treated effluent as per CC&A of Vadinar STP

Sr. No.	Parameters	Prescribed limits
1.	pH	5.5-9
2.	BOD (3 days at 27°C)	10 mg/L
3.	Suspended Solids	20 mg/L
4.	Fecal Coliform	Desirable 100 MPN/100 ml Permissible 230 MPN/100 ml
5.	COD	50 mg/L

The detailed process flow diagram of the Vadinar STP have been mentioned in **Figure 18** as follows:

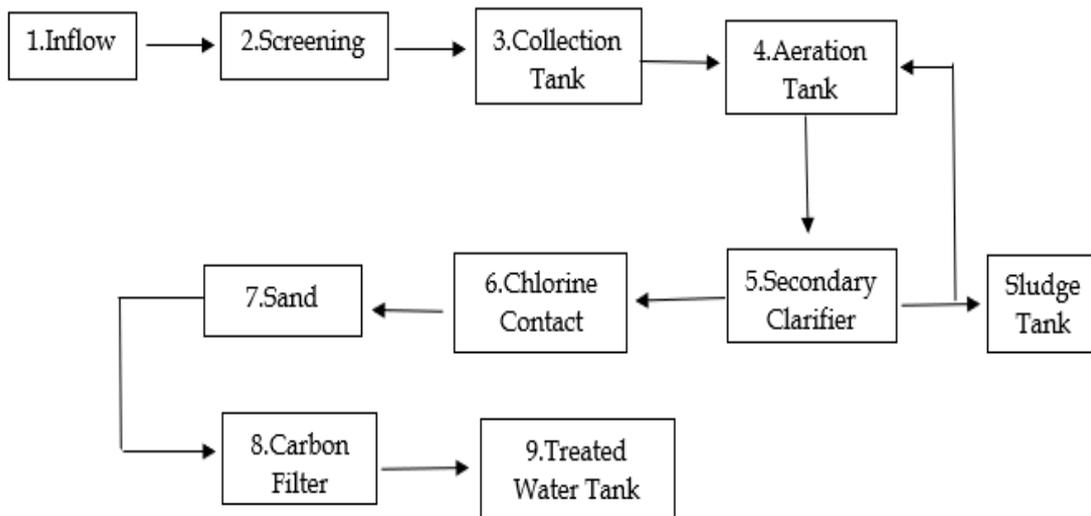


Figure 18: Process flowchart for the Vadinar STP

The map depicting the locations of STP to be monitored in Kandla and Vadinar have been shown in **Figure 19 and 20** as follows:



Figure 19: Location Map for STP Monitoring at Kandla

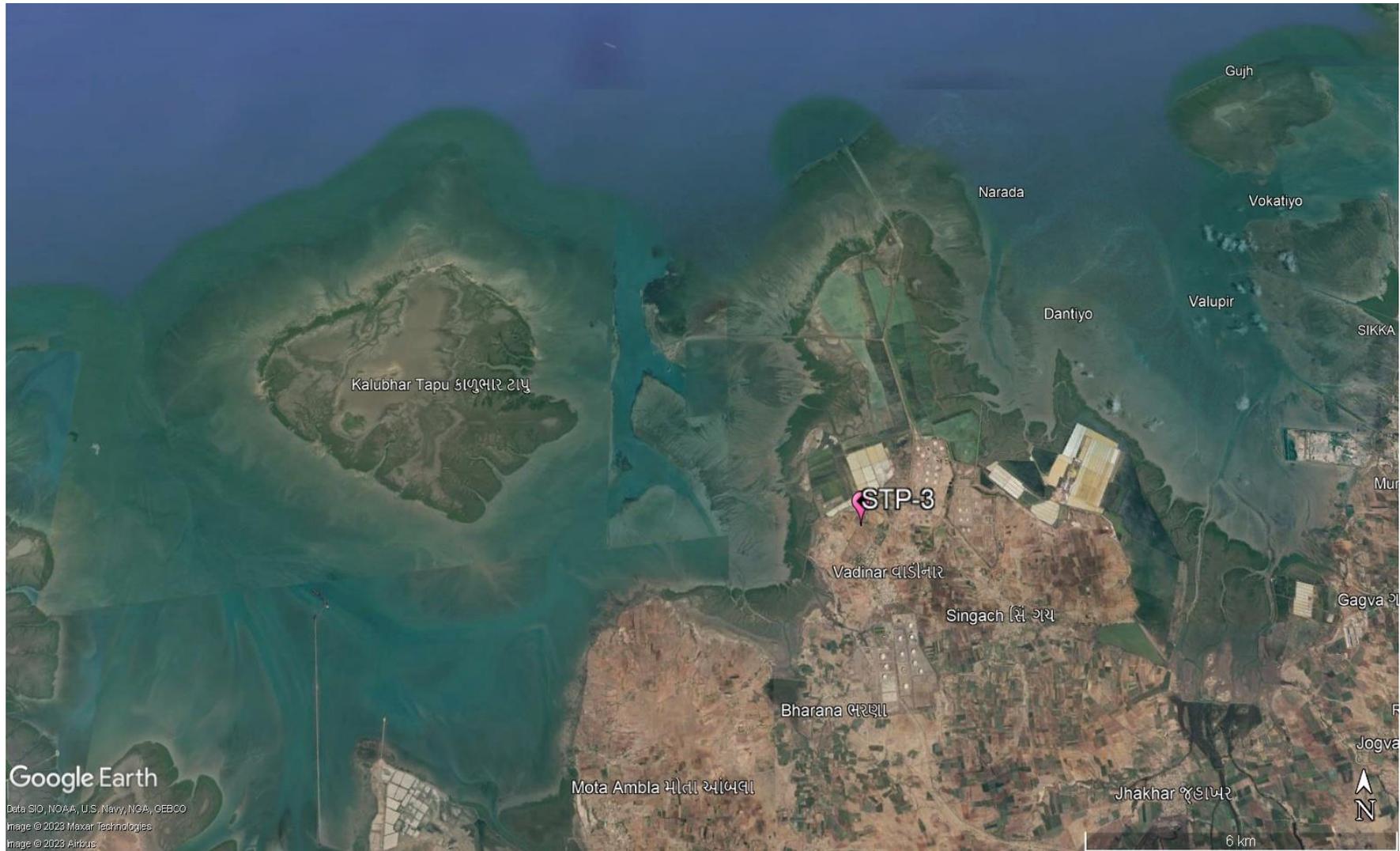


Figure 20: Location Map for STP Monitoring at Vadinar

Methodology

As per the defined scope by DPA, the sampling and analysis of water samples from the inlet and outlet of the STP's of Kandla and Vadinar are carried out once a week, i.e., four times a month.

The water samples were collected from inlet and the outlet of the STP's and analyzed for physico-chemical and microbiological parameter. Collection and analysis of these samples was carried out as per established standard methods and procedures for the examination of water. The samples were analyzed for selected parameters to establish the existing water quality of the inlet and outlet points of the STP. GEMI has framed its own guidelines for collection of water/wastewater samples titled as 'Sampling Protocol for Water & Wastewater'; which has been approved by the Government of Gujarat vide letter no. ENV-102013-299-E dated 24-04-2014 under the provision of Water (Preservation and Control of Pollution) Act 1974. The sample collection and preservation are done as per the said Protocol. Under the project, the list of parameters to be monitored for the STP have been mentioned in **Table 26** as follows:

Frequency

Monitoring is required to be carried out once a week for monitoring location of Kandla and Vadinar i.e., two STP station at Kandla and one STP station at Vadinar.

Table 26: List of parameters monitored for STP's at Kandla and Vadinar

Sr. No.	Parameters	Units	Reference method	Instruments
1.	pH	-	APHA, 23 rd edition, 4500- H ⁺ B, 2017	pH Meter
2.	TDS	mg/L	APHA, 23 rd Edition, 2540 C: 2017	Vacuum Pump with filtration assembly and Oven
3.	TSS	mg/L		
4.	DO	mg/L	APHA, 23 rd Edition, 4500 C: 2017	Titration Apparatus
5.	COD	mg/L	APHA, 23 rd Edition, 5220 B: 2017	Titration Apparatus plus Digester
6.	BOD	mg/L	IS-3025, Part 44, 1993	BOD Incubator plus Titration Apparatus
7.	SAR	meq/L	IS 11624: 2019	Flame Photometer
8.	Total Coliforms	MPN/100ml	IS 1622: 2019	LAF/ Incubator

9.2 Result and Discussion

The quality of the water samples collected from the inlet and the outlet of the STP's of Kandla and Vadinar has been summarized in **Table 27 & 28**. The said water quality has been represented in comparison with the standard values specified in the CC&A of the respective STPs.

Table 27: Water Quality of inlet and outlet of STP of Kandla

Sr No.	Parameter	Units	GPCB Norms (Kandla)	Kandla															
				Week 3 of October				Week 4 of October				Week 1 of November				Week 2 of November			
				STP-1 (Inlet)	STP-1 (Outlet)	STP-2 (Inlet)	STP-2 (Outlet)	STP-1 (Inlet)	STP-1 (Outlet)	STP-2 (Inlet)	STP-2 (Outlet)	STP-1 (Inlet)	STP-1 (Outlet)	STP-2 (Inlet)	STP-2 (Outlet)	STP-1 (Inlet)	STP-1 (Outlet)	STP-2 (Inlet)	STP-2 (Outlet)
1.	pH	-	6.5-8.5	7.09	7.42	7.45	7.11	7.43	7.12	7.12	7.55	7.70	7.34	7.13	7.59	7.40	7.52	7.16	7.45
2.	TDS	mg/L	-	1652	1128	1563	1074	1376	954	1554	1468	8702	4208	1232	1046	8668	1954	1138	1084
3.	TSS	mg/L	100	59	21	59	21	83	33	106	16	58	26	46	28	344	82	58	22
4.	DO	mg/L	-	0.65	6.25	BQL	7.41	0.94	5.36	BQL	2.8	BQL	2.8	BQL	3.8	BQL	6.9	BQL	4.1
5.	COD	mg/L	-	175	43.1	82.37	44.92	76.11	36.48	192	36	130.95	83.33	170.63	43.82	436.51	79.37	162.70	47.62
6.	BOD	mg/L	30	76.21	6.52	53.14	2.01	69.16	3.44	57.6	5.4	40.92	15.62	53.32	8.22	136.41	14.88	40.67	8.93
7.	SAR	meq/L	-	6.32	5.17	7.56	7.12	6.84	5.11	7.51	7.21	21.56	15.52	6.97	6.20	21.27	8.88	5.73	5.64
8.	Total Coliforms	MPN/100ml	<1000	1600	1600	1600	1600	1600	1600	1600	1600	1600	130	1600	1600	1600	1600	1600	1600

Table 28: Water Quality of inlet and outlet of STP of Vadinar

Sr No.	Parameter	Units	GPCB Norms (Vadinar)	Vadinar							
				Week 3 of October		Week 4 of October		Week 1 of November		Week 2 of November	
				STP-3 (Inlet)	STP-3 (Outlet)	STP-3 (Inlet)	STP-3 (Outlet)	STP-3 (Inlet)	STP-3 (Outlet)	STP-3 (Inlet)	STP-3 (Outlet)
1.	pH	-	5.5-9	7.12	7.24	7.15	7.20	7.26	7.00	7.26	7.17
2.	TDS	mg/L	-	424	352	420	354	428	354	486	372
3.	TSS	mg/L	20	26	16	46	4	18	10	18	12
4.	DO	mg/L	-	BQL	6.2	BQL	5.9	BQL	5.3	BQL	2.8
5.	COD	mg/L	50	171.31	35.86	157.48	19.69	115.08	27.78	158.73	27.78
6.	BOD	mg/L	10	53.53	4.48	47.24	4.92	35.96	3.47	49.60	5.21
7.	SAR	meq/L	-	2.19	2.22	2.23	2.15	2.72	2.53	2.54	2.24
8.	Total Coliforms	MPN/100ml	100-230	1600	1600	1600	1600	1600	1600	1600	1600

BQL: Below Quantification limit; Total Suspended Solids (QL=2), Dissolved Oxygen (QL=0.5), Biochemical Oxygen Demand (QL=3 mg/L)

9.3 Data Interpretation and Conclusion

For physicochemical analysis, the treated sewage water was gathered from the Kandla STP, Gopalpuri STP, and Vadinar STP and the analytical results were compared with the standards mentioned in the Consolidated Consent and Authorization (CC&A) by GPCB.

- The **pH** of treated effluent from STPs at Kandla conform to the standard of 6.5-8.5. Whereas, pH for STP-3 at Vadinar conforms the norm of 5.5-9 as specified in the CCA.
- The **TSS** for the STP-1 and STP-2 of Kandla and STP-3 of Vadinar falls within the stipulated norms of 100 and 20 mg/L for outlet of Kandla and Vadinar, respectively and hence conforms to the norms specified.
- As per the norms, the **Chemical Oxygen Demand** falls within the CCA norms (50 mg/L) for the STP-3 of Vadinar.
- The **BOD** of the outlet for the STPs of Kandla and Vadinar falls within the stipulated norms.
- The **Total Coliforms** were exceeding the norms at the locations of the STP-1 & STP-2 outlets of Kandla and STP-3 outlet of Vadinar.

During the monitoring period, only Total Coliforms were observed to be exceeding the limits at STPs of Kandla and Vadinar while rest of the treated sewage parameters for STP outlet were within norms of CCA at both the monitoring sites. Regular monitoring of the STP performance should be conducted on regular basis to ensure adequate treatment as per the norms.

9.4 Remedial Measures:

- The quantum of raw sewage (influent) entering the STP should be monitored by installation of the flow meter. If the quantity of the sewage exceeds the treatment capacity of the treatment plant, then provision of additional capacity of collection sump should be provided.
- The adequacy and efficacy of the stages of Sewage treatment units shall be conducted.
- The treatment parameters such as retention time, Mixed Liquor Suspended Solids (MLSS), Mixed liquor volatile suspended solids (MLVSS), Recirculation rate, sludge generation, etc should be monitored timely.
- During the treatment, the required retention time and rate of aeration should be maintained, so that the efficiency of the treatment plant is maintained.
- The dosage of chemicals administered during the treatment should be reviewed and alterations in the dosage should be done.
- The results show the presence of total coliforms; hence the method of disinfection (Chlorination) sodium or calcium Hypochlorite can be used.
- Effectiveness of any technology depends on factors such as the specific pollutants in the wastewater, plant size, local regulations, and available resources. There are several processes that may be implemented such as - Advanced oxidation process involve using strong oxidants to break down complex organic compounds. Methods like Fenton's reagent (hydrogen peroxide and iron catalyst) and UV/H₂O₂ treatment can help in reducing COD through oxidation.

- Electrochemical processes like Electrocoagulation (EC) and Electrooxidation (EO) that involve the application of an electric current to facilitate the removal of pollutants through coagulation, flocculation, and oxidation. These methods can be useful for treating sewage containing various pollutants.
- Enhanced biological treatment processes, such as Moving Bed Biofilm Reactors (MBBR), Integrated Fixed-film Activated Sludge (IFAS) systems, and Membrane Bio-Reactors (MBRs) are utilised to improve the efficiency of organic matter and nutrient removal from wastewater.



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CHAPTER 10: MARINE WATER QUALITY MONITORING

10.1 Marine Water

Deendayal Port is one of the largest ports of the country and thus, is engaged in wide variety of activities such as movement of large vessels, oil tankers and its allied small and medium vessels and handling of dry cargo several such activities whose waste if spills in water, can cause harmful effects to marine water quality.

Major water quality concerns at ports include wastewater and leakage of toxic substances from ships, stormwater runoff, etc. This discharge of wastewater, combined with other ship wastes which includes sewage and wastewater from other on-board uses, is a serious threat to the water quality as well as to the marine life. As defined in the scope by DPA, the Marine Water sampling and analysis has to be carried out at a total of eight locations, six at Kandla and two at Vadinar. The marine water sampling has been carried out with the help of Niskin Sampler with a capacity of 5L. The Niskin Sampler is a device used to take water samples at a desired depth without the danger of mixing with water from other depths. Details of the locations to be monitored have been mentioned in **Table 29**:

Table 29: Details of the sampling locations for Marine water

Sr. No.	Location Code	Location Name	Latitude Longitude
1.	MW-1	Near Passenger Jetty One	23.017729N 70.224306E
2.	MW-2	Kandla Creek (nr KPT Colony)	23.001313N 70.226263E
3.	MW-3	Near Coal Berth	22.987752N70.227923E
4.	MW-4	Khori Creek	22.977544N 70.207831E
5.	MW-5	Nakti Creek (nr Tuna Port)	22.962588N 70.116863E
6.	MW-6	Nakti Creek (nr NH-8A)	23.033113N 70.158528E
7.	MW-7	Near SPM	22.500391N 69.688089E
8.	MW-8	Near Vadinar Jetty	22.440538N 69.667941E

The map depicting the locations of Marine Water to be sampled and analysed for Kandla and Vadinar have been mentioned in **Map 21 and 22** as follows:



Figure 21: Location Map for Marine Water Monitoring at Kandla



Figure 22: Location Map for Marine Water Monitoring at Vadinar

Methodology

The methodology adopted for the sampling and monitoring of Marine Water was carried out as per the ‘**Sampling Protocol for Water & Wastewater**’ developed by GEMI. The water samples collected through the Niskin Sampler are collected in a clean bucket to reduce the heterogeneity. The list of parameters to be monitored under the project for the Marine Water quality have been mentioned in **Table 30** along with the analysis method and instrument.

Frequency

As defined in the scope by DPA, the sampling and analysis of Marine Water has to be carried out once in a month at the eight locations (i.e., six at Kandla and two at Vadinar).

Table 30: List of parameters monitored for Marine Water

Sr. No	Parameters	Units	Reference method	Instrument
1.	Electrical Conductivity	µS/cm	APHA, 23 rd Edition (Section-2510 B):2017	Conductivity Meter
2.	Dissolved Oxygen (DO)	mg/L	APHA, 23 rd Edition, 4500 O C, 2017	Titration Apparatus
3.	pH	-	APHA, 23 rd Edition (Section-4500-H*B):2017	pH meter
4.	Color	Hazen	APHA, 23 rd Edition, 2120 B: 2017	Color comparator
5.	Odour	-	IS 3025 Part 5: 2018	Heating mantle & odour bottle
6.	Turbidity	NTU	IS 3025 Part 10: 1984	Nephlo Turbidity Meter
7.	Total Dissolved Solids (TDS)	mg/L	APHA, 23 rd Edition (Section-2540 C):2017	Vaccum Pump with Filtration Assembly and Oven
8.	Total Suspended Solids (TSS)	mg/L	APHA, 23 rd Edition, 2540 D: 2017	
9.	Particulate Organic Carbon	mg/L	APHA, 23 rd Edition, 2540 D and E	TOC analyser
10.	Chemical Oxygen Demand (COD)	mg/L	IS-3025, Part- 58: 2006	Titration Apparatus plus Digester
11.	Biochemical Oxygen Demand (BOD)	mg/L	IS-3025, Part 44,1993,	BOD Incubator plus Titration apparatus
12.	Silica	mg/L	APHA, 23 rd Edition, 4500 C, 2017	UV- Visible Spectrophotometer
13.	Phosphate	mg/L	APHA,23 rd Edition, 4500 P-D: 2017	
14.	Sulphate	mg/L	APHA, 23 rd Edition, 4500 SO4-2 E: 2017	
15.	Nitrate	mg/L	APHA, 23 rd Edition, 4500 NO3-B: 2017	

Sr. No	Parameters	Units	Reference method	Instrument
16.	Nitrite	mg/L	APHA, 23 rd Edition, 4500 NO ₂ - B: 2017	
17.	Sodium	mg/L	APHA, 23 rd Edition, 3500 Na-B: 2017	Flame photometer
18.	Potassium	mg/L	APHA, 23 rd Edition, 3500 K-B: 2017	
19.	Manganese	µg/L	APHA, 23 rd Edition, ICP Method 3120 B: 2017	ICP-OES
20.	Iron	mg/L	APHA, 23 rd Edition, ICP Method 3120 B: 2017	
21.	Total Chromium	µg/L	APHA, 23 rd Edition, 3500 Cr B: 2017	UV- Visible Spectrophotometer
22.	Hexavalent Chromium	µg/L		
23.	Copper	µg/L	APHA, 23 rd Edition, ICP Method 3120 B: 2017	ICP-OES
24.	Cadmium	µg/L		
25.	Arsenic	µg/L		
26.	Lead	µg/L		
27.	Zinc	mg/L		
28.	Mercury	µg/L	EPA 200.7	
29.	Floating Material (Oil grease scum, petroleum products)	mg/L	APHA, 23 rd Edition, 5520 C: 2017	Soxhlet Assembly
30.	Total Coliforms (MPN)	MPN/ 100ml	IS 1622: 2019	LAF/ Incubator

10.2 Result and Discussion

The quality of the Marine water samples collected from the locations of Kandla and Vadinar during the monitoring period has been summarized in the **Table 31**. The said water quality has been represented in comparison with the standard values as stipulated by CPCB for Class SW-IV Waters.

Table 31: Results of Analysis of Marine Water Sample for the sampling period

Sr. No.	Parameters	Unit	Primary Water Quality Criteria for Class SW-IV Waters	Kandla						Vadinar	
				MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8
1.	Density	kg/m ³	-	1.021	1.022	1.022	1.021	1.022	1.022	1.022	1.022
2.	pH	-	6.5-9.0	8.05	8.17	8.14	8.13	8.16	8.21	8.07	8.18
3.	Color	Hazen	No Noticeable	5	5	10	5	5	5	10	10
4.	EC	μS/cm	-	51,600	52,000	51,300	51,900	52,000	51,900	54,400	55,200
5.	Turbidity	NTU	-	56.4	33.9	61.8	69.0	94.5	70.1	7.8	7.12
6.	TDS	mg/L	-	33,960	34,146	33,724	34,038	33,882	34,368	31,490	33,540
7.	TSS	mg/L	-	44	26	52	58	80	58	307	309
8.	COD	mg/L	-	45.58	40.47	40.0	40.0	38.14	37.67	43.7	33.5
9.	DO	mg/L	3.0 mg/L	6.2	6.4	4.5	6.2	6.3	6.7	5.2	6.3
10.	BOD	mg/L	5.0 mg/L	BQL	BQL	5.00	5.00	BQL	BQL	6.2	4.2
11.	Oil & Grease	mg/L	-	BQL	BQL						
12.	Sulphate	mg/L	-	2860.6	2897.7	2925.2	3029.2	2916.8	2862.6	2547.1	3016.4
13.	Nitrate	mg/L	-	4.93	4.36	5.13	5.24	6.92	6.84	4.14	4.21
14.	Nitrite	mg/L	-	0.12	BQL	BQL	BQL	0.11	0.13	BQL	BQL
15.	Phosphate	mg/L	-	0.54	BQL	0.69	0.61	0.70	0.65	BQL	BQL
16.	Silica	mg/L	-	2.13	2.47	2.47	2.58	4.00	2.48	0.47	0.62
17.	Sodium	mg/L	-	10,625	10,341	10,308	10,323	10,278	10,722	5376.25	8472
18.	Potassium	mg/L	-	311.40	310.40	311.10	306	313.50	289.70	298.3	342.2
19.	Hexavalent Chromium	μg/L	-	BQL	BQL						
20.	Odour	-	-	1	1	1	1	1	1	1	1
21.	Arsenic	μg/L	-	BQL	BQL	BQL	BQL	BQL	BQL	0.11	0.085
22.	Cadmium	μg/L	-	BQL	BQL						
23.	Copper	μg/L	-	BQL	BQL						



Sr. No.	Parameters	Unit	Primary Water Quality Criteria for Class SW-IV Waters	Kandla						Vadinar	
				MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8
24.	Iron	mg/L	-	0.88	0.77	0.90	1.05	1.57	1.19	BQL	BQL
25.	Lead	µg/L	-	BQL	BQL	BQL	BQL	3.85	BQL	BQL	BQL
26.	Manganese	µg/L	-	BQL	BQL	BQL	BQL	47.74	BQL	BQL	BQL
27.	Total Chromium	µg/L	-	BQL	BQL	BQL	BQL	5.82	BQL	BQL	BQL
28.	Zinc	mg/L	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
29.	Mercury	µg/L	-	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
30.	Particulate Organic Carbon	mg/L	-	1.17	0.61	0.59	1.88	1.51	1.43	BQL	BQL
31.	Total Coliforms	MPN/ 100ml	500/100 ml	23	50	52	2	14	22	20	17
32.	Floating Material (Oil grease scum, petroleum products)	mg/L	10 mg/L	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit; Turbidity (DL=50 NTU), Biochemical Oxygen Demand (QL=3 mg/L), Oil & Grease (QL=1 mg/L), Nitrate as NO₃ (QL=1 mg/L), Nitrite as NO₂ (QL=0.1 mg/L), Phosphorous (QL=0.5 mg/L), Silica (QL=0.05 mg/L), Sodium as Na (QL=10,000 mg/L), Hexavalent Chromium (QL=0.01 µg/L), Arsenic (QL=5 µg/L), Cadmium (QL=2 µg/L), Copper (QL=5 µg/L), Iron (QL=0.1 mg/L), Lead (QL=2 µg/L), Manganese (QL=40 µg/L), Total Chromium (QL=5 µg/L), Zinc (QL=0.5 mg/L), Mercury (QL=0.5 µg/L)

10.3 Data Interpretation and Conclusion

The Marine water quality of Deendayal Port Harbor waters at Kandla and Vadinar has been monitored for various physico-chemical and biological parameters during the monitoring 2023 at high tide. The detailed interpretation of the parameters in comparison to the Class SW-IV for Harbour Waters is as follows:

- **pH** at Kandla was observed in the range of 8.05 to 8.21, with the average pH as 8.14. Whereas for the locations of Vadinar, it was observed in the range of 8.07 to 8.18, with the average pH as 8.13. For the monitoring location of both the study areas, pH was found to comply with the norms of 6.5-8.5.
- **Color** was observed to be 5 Hazen at all the six-monitoring location of Kandla, whereas the value observed 10 Hazen at both the monitoring locations of Vadinar.
- For all monitoring locations of Kandla the value of **Turbidity** was observed in range of 33.9 to 94.5 NTU and for Vadinar it ranges from 7.12 to 7.8 NTU. Materials that cause water to be turbid include clay, silt, finely divided organic and inorganic matter, soluble coloured organic compounds, plankton and microscopic organisms. Turbidity affects the amount of light penetrating to the plants for photosynthesis.
- **Electrical conductivity (EC)** was observed in the range of 51,300 to 52,000 $\mu\text{S}/\text{cm}$, with the average EC as 51,783.33 $\mu\text{S}/\text{cm}$ for the locations of Kandla, whereas for the locations of Vadinar, it was observed in the range of 54,400 to 55,200 $\mu\text{S}/\text{cm}$, with the average EC as 54,800 $\mu\text{S}/\text{cm}$.
- For the monitoring locations at Kandla the value of **Total Dissolved Solids (TDS)** ranged from 33,724 to 34,368 mg/L, with an average value of 34019.67 mg/L. Similarly, at Vadinar, the TDS values ranged from 31,490 to 33,540 mg/L, with an average value of 32,515 mg/L.
- **TSS** values in the studied area during high Tide varied between 26 to 80 mg/L at Kandla and 168 to 307 mg/L at Vadinar, with the average value of 53 mg/L and 237.5 mg/L respectively for Kandla and Vadinar.
- **COD** varied between 37.67 to 45.58 mg/L at Kandla and 33.5 to 43.7 mg/L at Vadinar, with the average value as 40.31 mg/L and 38.6 mg/L respectively for Kandla and Vadinar.
- **DO** level in the studied area varied between 4.5 to 6.7 mg/L at Kandla and 5.2 to 6.3 mg/L at Vadinar, which represents that the marine water is suitable for marine life.
- **BOD** observed “below the detection limit” in the studied area of Kandla except for location MW-4 (Khorri Creek) i.e. 5 mg/L, whereas at Vadinar the value observed 6.2 mg/L at MW-7 and at MW-8 recorded as 4.2 mg/L.
- **Sulphate** concentration in the studied area during high Tide varied between 2860.6 to 3029.2 mg/L at Kandla and 2547.1 to 3016.4 mg/L at Vadinar. A high variation in the sulphate concentration is observed at Kandla. Sulphate is naturally formed in inland waters by mineral weathering or the decomposition and combustion of organic matter.
- **Phosphate** in the studied area varied between 0.54 to 0.7 mg/L at Kandla, while at Vadinar, the concentration of Phosphate was recorded BQL.

- In the study area of Kandla the value **Potassium** during high Tide varied between 289.7 to 313.5 mg/L and 298.3 to 342.2 mg/L at Vadinar, with the average value as 307.01 mg/L and 320.25 mg/L respectively for Kandla and Vadinar.
- **Sodium** in the study area varied between 10,278 to 10,722 mg/L at Kandla whereas at Vadinar its value recorded 5376.25 mg/L at MW-7 and 8472 mg/L at MW-8.
- **Silica** in the studied area varied between 2.13 to 4 mg/L at Kandla and 0.47 to 0.62 mg/L for Vadinar.
- **Arsenic** in the study area of Kandla recorded below the quantification while at Vadinar the value observed to be 0.11 µg/L at MW-7 and 0.08 µg/L at MW-8.
- **Iron** in the study area varied between 0.77 to 1.57 mg/L at Kandla whereas at Vadinar its value recorded BQL at both the monitoring locations (MW-7 and MW-8).
- **Manganese** recorded BQL at all the monitoring location of Kandla and Vadinar excepts MW-5 i.e. 47.74 µg/L.
- **Oil & Grease, Copper, Nitrite, Hexavalent and Total Chromium, Cadmium, Zinc, and Mercury, Floating Material (Oil grease scum, petroleum products)** were observed to have concentrations “**Below the Quantification Limits (BQL)**” for all the locations of Kandla and Vadinar.
- **Coliforms** were detected complying with the specified norm of 500 MPN/100ml for all the locations of Kandla and Vadinar.

During the Monitoring period, marine water samples were analysed and found in line with Primary Water Quality criteria for class-IV Waters (For Harbour Waters).

However, as a safeguard towards marine water pollution prevention, appropriate regulations on ship discharges and provision of reception facilities are indispensable for proper control of emissions and effluent from ships. Detection of spills is also important for regulating ship discharges. Since accidental spills are unavoidable, recovery vessels, oil fences, and treatment chemicals should be prepared with a view to minimizing dispersal. Proper contingency plans and a prompt reporting system are keys to prevention of oil dispersal. Periodical clean-up of floating wastes is also necessary for preservation of port water quality.



CHAPTER 11: MARINE SEDIMENT QUALITY MONITORING

11.1 Marine Sediment Monitoring

Marine sediment, or ocean sediment, or seafloor sediment, are deposits of insoluble particles that have accumulated on the seafloor. These particles have their origins in soil and rocks and have been transported from the land to the sea, mainly by rivers but also by dust carried by wind. The unconsolidated materials derived from pre-existing rocks or similar other sources by the process of denudation are deposited in water medium are known as sediment. For a system, like a port, where large varieties of raw materials and finished products are handled, expected sediment contamination is obvious.

The materials or part of materials spilled over the water during loading and unloading operations lead to the deposition in the harbour water along with sediment and thus collected as harbour sediment sample. These materials, serve as receptor of many trace elements, which are prone to environment impact. In this connection it is pertinent to study the concentration and distribution of environmentally sensitive elements in the harbour sediment. However, human activities result in accumulation of toxic substances such as heavy metals in marine sediments. Heavy metals are well-known environmental pollutants due to their toxicity, persistence in the environment, and bioaccumulation. Metals affect the ecosystem because they are not removed from water by self-purification, but accumulate in sediments and enter the food chain.

Methodology

As defined in the scope by DPA, the Marine Sediment sampling is required to be carried out once in a month at total eight locations, i.e., six at Kandla and two at Vadinar. The sampling of the Marine Sediment is carried out using the Van Veen Grab Sampler (make Holy Scientific Instruments Pvt. Ltd). The Van Veen Grab sampler is an instrument to sample (disturbed) sediment up to a depth of 20-30 cm into the sea bed. While letting the instrument down on the seafloor, sediment can be extracted. The details of locations of Marine Sediment to be monitored under the study are mentioned in **Table 32** as follows:

Table 32: Details of the sampling locations for Marine Sediment

Sr. No	Location Code	Location Name	Latitude Longitude	
1.	Kandla	MS-1	Near Passenger Jetty One	23.017729N 70.224306E
2.		MS-2	Kandla Creek	23.001313N 70.226263E
3.		MS-3	Near Coal Berth	22.987752N 70.227923E
4.		MS-4	Khori Creek	22.977544N 70.207831E
5.		MS-5	Nakti Creek (near Tuna Port)	22.962588N 70.116863E
6.		MS-6	Nakti Creek (near NH-8A)	23.033113N 70.158528E
7.	Vadinar	MS-7	Near SPM	22.500391N 69.688089E
8.		MS-8	Near Vadinar Jetty	22.440538N 69.667941E

The map depicting the locations of Marine Sediment sampling at Kandla and Vadinar have been mentioned in **Figure 23 and 24** as follows:



Figure 23: Location Map of Marine Sediment Monitoring at Kandla



Figure 24: Locations Map of Marine Sediment Monitoring at Vadinar

The list of parameters to be monitored under the projects for the Marine Sediment sampling been mentioned in **Table 33** as follows:

Table 33: List of parameters to be monitored for Sediments at Kandla and Vadinar

Sr. No.	Parameters	Units	Reference method	Instruments
1.	Texture		Methods Manual Soil Testing in India January 2011,01	Hydrometer
2.	Organic Matter	%	Methods Manual Soil Testing in India January, 2011, 09. Volumetric method (Walkley and Black, 1934)	Titration apparatus
3.	Inorganic Phosphates	mg/Kg	Practical Manual Chemical Analysis of Soil and Plant Samples, ICAR-Indian Institute of Pulses Research 2017	UV- Visible Spectrophotometer
4.	Silica	mg/Kg	EPA Method 6010 C & IS: 3025 (Part 35) - 1888, part B	
5.	Phosphate	mg/Kg	EPA Method 365.1	
6.	Sulphate as SO ⁴⁻	mg/Kg	IS: 2720 (Part 27) - 1977	
7.	Nitrite	mg/Kg	ISO 14256:2005	
8.	Nitrate	mg/Kg	Methods Manual Soil Testing in India January, 2011, 12	
9.	Calcium as Ca	mg/Kg	Methods Manual Soil Testing in India January 2011, 16.	
10.	Magnesium as Mg	mg/Kg	Method Manual Soil Testing in India January 2011	
11.	Sodium	mg/Kg	EPA Method 3051A	Flame Photometer
12.	Potassium	mg/Kg	Methods Manual Soil Testing in India January, 2011	
13.	Aluminium	mg/Kg	EPA Method 3051A	ICP-OES
14.	Chromium	mg/Kg		
15.	Nickel	mg/Kg		
16.	Zinc	mg/Kg		
17.	Cadmium	mg/Kg		
18.	Lead	mg/Kg		
19.	Arsenic	mg/Kg		
20.	Mercury	mg/Kg		

11.2 Result and Discussion

The quality of Marine Sediment samples collected from the locations of Kandla and Vadinar during the monitoring period has been summarized in the **Table 34**.

Table 34: Summarized result of Marine Sediment Quality

Sr No.	Parameters	Unit	Kandla						Vadinar	
			MS-1	MS-2	MS-3	MS-4	MS-5	MS-6	MS-7	MS-8
1.	Inorganic Phosphate	kg/ ha	4.02	9.47	19.32	7.82	18.36	16.81	5.39	4.48
2.	Phosphate	mg/Kg	994.23	1246.4	813.7	581.3	763.24	886.36	402.3	519.3
3.	Organic Matter	mg/Kg	0.42	BQL	BQL	0.77	0.93	0.53	0.15	0.17
4.	Sulphate as SO ⁴⁻	mg/Kg	183.25	113.50	246.90	165.50	113.65	108.30	86.36	143.40
5.	Calcium as Ca	mg/Kg	1963.62	2251.40	1463.80	2343	2347	2164	2896	2637.90
6.	Magnesium as Mg	mg/Kg	1383.23	1843.60	1573.20	1521.60	1568	1402.63	926.80	1623.80
7.	Silica	g/Kg	481.3	347.8	336.1	255.12	375.6	305.8	346.7	373.9
8.	Nitrite	mg/Kg	0.51	0.31	0.36	0.75	0.29	0.53	0.15	0.2
9.	Nitrate	mg/Kg	19.84	12.79	14.86	14.31	15.93	16.24	14.84	8.04
10.	Sodium	mg/Kg	3813	2707	3645	2643	3571	4123.95	5231.7	9291.4
11.	Potassium	mg/Kg	1823.3	1247.6	2943.5	2943.62	1546.4	3025.68	1236.7	3271.6
12.	Aluminium	mg/Kg	2442.3	2324.56	2168.9	2261.3	1316.2	1533.65	1584.3	1826.7
13.	Chromium	mg/Kg	62.13	43.9	48.32	43.5	50.23	53.65	27.9	56.72
14.	Copper	mg/Kg	2.73	3.83	3.12	4.02	5.12	3.63	3.12	5.12
15.	Nickel	mg/Kg	39.42	20.49	28.45	29.34	23.83	25.38	16.84	27.95
16.	Zinc	mg/Kg	60.76	63.26	46.3	55.53	57.36	56.64	25.89	88.74
17.	Cadmium	mg/Kg	BQL	0.60	0.87	BQL	BQL	0.15	BQL	BQL
18.	Lead	mg/Kg	5.86	5.92	4.56	5.37	4.32	3.67	5.49	8.21
19.	Arsenic	mg/Kg	3.22	2.58	3.81	3.13	2.86	2.35	2.04	3.20
20.	Mercury	mg/Kg	BQL	BQL						
21.	Texture	-	Sandy loam	Loam						

11.3 Data Interpretation and Conclusion

The Marine sediment quality at Kandla and Vadinar has been monitored for various physico-chemical parameters during the monitoring 2023. The detailed interpretation of the parameters is given below:

- **Inorganic Phosphate** for the sampling period was observed in range of 4.02 to 19.32 Kg/ha for Kandla. Whereas for Vadinar the value observed at location MS-7 i.e., Nakti creek (5.39 Kg/ha) and MS-8, i.e., Near Vadinar Jetty (4.48 Kg/ha). For Kandla and Vadinar the average value of Inorganic Phosphate was observed 12.63 and 4.94 Kg/ha respectively.
- The value of **Phosphate** was observed in range of 581.3 to 1246.4 mg/Kg for Kandla and for Vadinar the value observed at location MS-7 i.e., Nakti creek (402.3 mg/Kg)

and MS-8, i.e., Near Vadinar Jetty (519.3 mg/Kg). For Kandla and Vadinar the average value of Phosphate was observed 880.87 and 460.8 mg/Kg respectively.

- The value of **Organic Matter** for the sampling period was observed in the range of 0.42 to 0.93 % for Kandla with the average value of 0.66% and for Vadinar the value recorded at location MS-7 and MS-8 was observed 0.15% & 0.17% respectively.
- The value of **Sulphate** was observed in the range of 108.3 to 246.9 mg/Kg for Kandla and for Vadinar the value observed at MS-7 is 86.36 mg/Kg and at MS-8, is 143.40 mg/Kg. For Kandla and Vadinar the average value of Sulphate was observed 155.18 and 114.88 mg/Kg respectively.
- The value of **Calcium** was observed in the range of 1463.8 to 2347 mg/Kg for Kandla and for Vadinar the value observed at MS-7 is 2896 mg/Kg and at MS-8, is 2637.90 mg/Kg. The average value of Calcium for the monitoring period was observed 2088.80 mg/Kg and 2766.95 mg/Kg at Kandla and Vadinar, respectively.
- The value of **Magnesium** for the sampling period was observed in the range of 1383.23 to 1843.6 mg/Kg for Kandla and for Vadinar the value observed at MS-7 is 926.80 mg/Kg and at MS-8, is 1623.80 mg/Kg. For Kandla and Vadinar the average value of Magnesium was observed 1548.71 mg/Kg and 1275.3 mg/Kg respectively.
- The value of **Nitrate** was observed in the range of 12.79 to 19.84 mg/Kg for Kandla with average value 15.66 mg/Kg and for Vadinar the value observed to be 14.84 and 8.04 mg/Kg at MS-7 and MS-8, respectively with average 11.44 mg/Kg.
- The value of **Nitrite** was observed in the range of 0.29 to 0.75 mg/Kg for Kandla with average value 0.45 mg/Kg and for Vadinar the value observed to be 0.15 and 0.2 mg/Kg at MS-7 and MS-8, respectively with average 0.18 mg/Kg.
- The value of **Sodium** was observed in the range of 2643 to 4123.95 mg/Kg for Kandla with average value 3417.16 mg/Kg and for Vadinar the value observed to be 5231.7 and 9291.4 mg/Kg at MS-7 and MS-8, respectively with average 7261.55 mg/Kg.
- For the sampling period **Silica** was observed in the range of 255.12 to 481.3 mg/Kg for Kandla with average value 350.28 mg/Kg and for Vadinar the value observed to be 346.7 and 373.9 mg/Kg at MS-7 and MS-8, respectively with average 360.3 mg/Kg
- The value of **Potassium** was observed in the range of 1247.6 to 3025.68 mg/Kg for Kandla with average value 2255.01 mg/Kg and for Vadinar the value observed to be 1236.7 and 3271.6 mg/Kg at MS-7 and MS-8, respectively with average 2254.15 mg/Kg.
- The value of **Aluminium**, was observed in the range of 1316.2 to 2442.3 mg/Kg for Kandla with average value 2007.82 mg/Kg and for Vadinar the value observed to be 1584.3 and 1826.7 mg/Kg at MS-7 and MS-8, respectively with average 1705.5 mg/Kg.
- The value of **Mercury** was observed “below the quantification limit” at all the eight-monitoring location of Kandla and Vadinar.
- Texture was observed to be “**Sandy Loamy**” in both Kandla and Vadinar the sampling period, except location MS-8 which is Loamy soil.

Heavy Metals

The sediment quality of Kandla and Vadinar has been compared with respect to the Average Standard guideline applicable for heavy metals in marine sediment specified by EPA have been mentioned in **Table 35**.

Table 35: Standard Guidelines applicable for heavy metals in sediments

Sr. No.	Metals	Sediment quality (mg/kg)			Source
		Not polluted	Moderately polluted	Heavily polluted	
1.	As	<3	3-8	>8	EPA
2.	Cu	<25	25-50	>50	
3.	Cr	<25	25-75	>75	
4.	Ni	<20	20-50	>50	
5.	Pb	<40	40-60	>60	
6.	Zn	<90	90-200	>200	
7.	Cd	-	<6	>6	

ND = Not Detected

(Source: G Perin et al. 1997)

Table 36: Comparison of Heavy metals with Standard value in Marine Sediment

Sr. No.	Parameters	Unit	Kandla						Vadinar	
			MS-1	MS-2	MS-3	MS-4	MS-5	MS-6	MS-7	MS-8
1.	Arsenic	mg/Kg	3.22	2.58	3.81	3.13	2.86	2.35	2.04	3.20
2.	Copper	mg/Kg	2.73	3.83	3.12	4.02	5.12	3.63	3.12	5.12
3.	Chromium	mg/Kg	62.13	43.9	48.32	43.5	50.23	53.65	27.9	56.72
4.	Nickel	mg/Kg	39.42	20.49	28.45	29.34	23.83	25.38	16.84	27.95
5.	Lead	mg/Kg	5.86	5.92	4.56	5.37	4.32	3.67	5.49	8.21
6.	Zinc	mg/Kg	60.76	63.26	46.3	55.53	57.36	56.64	25.89	88.74
7.	Cadmium	mg/Kg	BQL	0.60	0.87	BQL	BQL	0.15	BQL	BQL

- **Arsenic** was observed in the range of 2.35 to 3.81 mg/Kg for Kandla with average value 2.9 mg/Kg and for Vadinar the value observed to be 2.04 and 3.20 mg/Kg at MS-7 and MS-8, respectively with average 2.62 mg/Kg.
- **Copper** was observed in the range of 2.73 to 5.12 mg/Kg for Kandla with average value 3.74 mg/Kg and for Vadinar the value observed to be 3.12 and 5.12 mg/Kg at MS-7 and MS-8, respectively with average 4.12 mg/Kg.
- **Chromium** was observed in the range of 43.5 to 62.13 mg/Kg for Kandla with average value 50.28 mg/Kg and for Vadinar the value observed to be 27.9 and 56.72 mg/Kg at MS-7 and MS-8, respectively with average 42.31 mg/Kg.
- **Nickel** was observed in the range of 20.49 to 39.42 mg/Kg for Kandla with average value 27.82 mg/Kg and for Vadinar the value observed to be 16.84 and 27.95 mg/Kg at MS-7 and MS-8, respectively with average 22.39 mg/Kg.

- **Lead** was observed in the range of 3.67 to 5.92 mg/Kg for Kandla with average value 4.95 mg/Kg and for Vadinar the value observed to be 5.49 and 8.21 mg/Kg at MS-7 and MS-8, respectively with average 6.85 mg/Kg.
- **Zinc** was observed in the range of 46.3 to 63.26 mg/Kg for Kandla with average value 56.64 mg/Kg and for Vadinar the value observed to be 25.89 and 88.74 mg/Kg at MS-7 and MS-8, respectively with average 57.32 mg/Kg.
- **Cadmium** was observed BQL for majority of locations at Kandla and Vadinar during sampling period except for location except MS-2 (0.6), MS-3 (0.87 mg/L) and MS-6 (0.15 mg/L).

Analysis of the sediments does not indicate any pollution. However, it may be noted that, the sediments are highly dynamic being constantly deposited and carried away by water currents. Hence maintaining the quality of sediments is necessary as it plays a significant role in regulating the quality of the marine water and the marine ecology.



CHAPTER 12: MARINE ECOLOGY MONITORING

12.1 Marine Ecological Monitoring

The monitoring of the biological and ecological parameters is important in order to assess the marine environment. A marine sampling is an estimation of the body of information in the population. The theory of the sampling design is depending upon the underlying frequency distribution of the population of interest. The requirement for useful water sampling is to collect a representative sample of suitable volume from the specified depth and retain it free from contamination during retrieval. Deendayal Port and its surroundings have mangroves, mudflats and creek systems as major ecological entities. As defined in the scope by DPA, the Marine Ecological Monitoring is required to be carried out once a month specifically at eight locations, six at Kandla and two at Vadinar. The sampling of the Benthic Invertebrates has been carried out with the help of D-frame nets, whereas the sampling of zooplankton and phytoplankton has been carried out with the help of Plankton Nets (60 micron and 20 micron). The details of the locations of Marine Ecological Monitoring have been mentioned in **Table 37** as follows:

Table 37: Details of the sampling locations for Marine Ecological

Sr. No.	Location Code	Location Name	Latitude Longitude
1.	Kandla	ME-1	Near Passenger Jetty One
2.		ME-2	Kandla Creek (near KPT Colony)
3.		ME-3	Near Coal Berth
4.		ME-4	Khori Creek
5.		ME-5	Nakti Creek (near Tuna Port)
6.		ME-6	Nakti Creek (near NH - 8A)
7.	Vadinar	ME-7	Near SPM
8.		ME-8	Near Vadinar Jetty

The map depicting the locations of Marine Ecological monitoring in Kandla and Vadinar have been mentioned in **Figure 25 and 26** as follows:



Figure 25: Locations Map of Marine Ecological Monitoring at Kandla



Figure 26: Locations Map of Marine Ecological Monitoring at Vadinar

The various parameters to be monitored under the study for Marine Ecological Monitoring are mentioned in **Table 38** as follows:

Table 38: List of parameters to be monitored for Marine Ecological Monitoring

Sr. No.	Parameters
1.	Productivity (Net and Gross)
2.	Chlorophyll-a
3.	Pheophytin
4.	Biomass
5.	Relative Abundance, species composition and diversity of phytoplankton
6.	Relative Abundance, species composition and diversity of zooplankton
7.	Relative Abundance, species composition and diversity of benthic invertebrates (Meio, Micro and macro benthos)
8.	Particulate Oxidisable Organic Carbon
9.	Secchi Depth

Methodology

- **Processing for chlorophyll estimation:**

Samples for chlorophyll estimation were preserved in ice box on board in darkness to avoid degradation in opaque container covered with aluminium foil. Immediately after reaching the shore after sampling, 1 litre of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm.

- **Phytoplankton Estimation**

Phytoplankton are free floating unicellular, filamentous and colonial eutrophic organisms that grow in aquatic environments whose movement is more or less dependent upon water currents. These micro flora acts as primary producers as well as the basis of food chain, source of protein, bio-purifier and bio-indicators of the aquatic ecosystems of which diverse array of the life depends. They are considered as an important component of aquatic flora, play a key role in maintaining equilibrium between abiotic and biotic components of aquatic ecosystem. The phytoplankton

includes a wide range of photosynthetic and phototrophic organisms. Marine phytoplankton is mostly microscopic and unicellular floating flora, which are the primary producers that support the pelagic food-chain. The two most prominent groups of phytoplankton are Diatoms (*Bacillariophyceae*) and Dinoflagellates (*Dinophyceae*). Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as Cyanophytes (Bluegreen algae). Algae are an ecologically important group in most aquatic ecosystems and have been an important component of biological monitoring programs. Algae are ideally suited for water quality assessment because they have rapid reproduction rates and very short life cycles, making them valuable indicators of short-term impacts. Aquatic populations are impacted by anthropogenic stress, resulting in a variety of alterations in the biological integrity of aquatic systems. Algae can serve as an indicator of the degree of deterioration of water quality, and many algal indicators have been used to assess environmental status.

- **Zooplankton Estimation**

Zooplankton includes a taxonomically and morphologically diverse community of heterotrophic organisms that drift in the waters of the world's oceans. Qualitative and quantitative studies on zooplankton community are a prerequisite to delineate the ecological processes active in the marine ecosystem. Zooplankton community plays a pivotal role in the pelagic food web as the primary consumers of phytoplankton and act as the food source for organisms in the higher trophic levels, particularly the economically essential groups such as fish larvae and fishes. They also function in the cycling of elements in the marine ecosystem. The dynamics of the zooplankton community, their reproduction, and growth and survival rate are all significant factors determining the recruitment and abundance of fish stocks as they form an essential food for larval, juvenile and adult fishes. Through grazing in surface waters and following the production of sinking faecal matters and also by the active transportation of dissolved and particulate matter to deeper waters via vertical migration, they help in the transport of organic carbon to deep ocean layers and thus act as key drivers of 'biological pump' in the marine ecosystem. Zooplankton grazing and metabolism also, transform particulate organic matter into dissolved forms, promoting primary producer community, microbial demineralization, and particle export to the ocean's interior. The categorisation of zooplankton into various ecological groups is based on several factors such as duration of planktonic life, size, food preferences and habitat. As they vary significantly in size from microscopic to metazoic forms, the classification of zooplankton based on size has paramount importance in the field of quantitative plankton research.

- **Diversity Index**

A diversity index is a measure of species diversity within a community that consists of co-occurring populations of several (two or more) different species. It includes two components: richness and evenness. Richness is the measure of the number of different species within a sample showing that more the types of species in a community, the

higher is the diversity or greater is the richness. Evenness is the measure of relative abundance of the different species with in a community.

1. Shannon-Wiener's index:

An index of diversity commonly used in plankton community analyses is the Shannon-Wiener's index (H), which emphasizes not only the number of species (richness or variety), but also the apportionment of the numbers of individuals among the species. Shannon-Wiener's index (H) reproduces community parameters to a single number by using an equation are as follow:

$$H' = \sum p_i * \ln (p_i)$$

Where, \sum = Summation symbol,

p_i = Relative abundance of the species,

\ln = Natural logarithm

More diverse ecosystems are considered healthier and more resilient. Higher diversity ecosystems typically exhibit better stability and greater tolerance to fluctuations. e.g., The Shannon diversity index values between 2.19 and 2.56 indicate relatively high diversity within the community compared to communities with lower values. It suggests that the community likely consists of a variety of species, and the species are distributed somewhat evenly in terms of their abundance.

2. Simpson's index:

A reasonably high level of dominance by one or a small number of species is indicated by the range of **0.89 to 0.91**. The general health and stability of the ecosystem may be impacted by this dominance. Community disturbances or modifications that affect the dominant species may be more likely to have an impact. The dominating species determined by the Simpson's index can have big consequences on how the community is organised and how ecological interactions take place.

The formula for calculating D is presented as:

$$D = 1 - \sum (p_i^2)$$

Where, \sum = Summation symbol, p_i = Relative abundance of the species

3. Margalef's diversity index:

The number of species is significantly related to the port's vegetation cover surface, depth, and photosynthetic zone. The habitat heterogeneity is a result of these three elements. Species richness is related to the number of distinct species present in the analysed area. Margalef's index has a lower correlation with sample size. Small species losses in the community over time are likely to result in inconsistent changes.

Margalef's index D_{Mg} , which is also a measure of species richness and is based on the presumed linear relation between the number of species and the logarithm of the number of individuals. It is given by the formula:

$$D_{Mg} = \frac{S-1}{\ln N}$$

Where, N = total number of individuals collected

S = No. of taxa or species or genera

4. Berger-Parker index:

This is a useful tool for tracking the biodiversity of deteriorated ecosystems. Environmental factors have a considerable impact on this index, which accounts for the dominance of the most abundant species over the total abundance of all species in the assemblage. The preservation of their biodiversity and the identification of the fundamental elements influencing community patterns are thus critical for management and conservation. Successful colonising species will dominate the assemblage, causing the Berger-Parker index to rise, corresponding to well-documented successional processes. The environmental and ecological features of the system after disturbance may therefore simply but significantly determine the identity of the opportunistic and colonising species through niche selection processes.

The Berger-Parker index is a biodiversity metric that focuses on the dominance or relative abundance of a single species within a community. It provides a measure of the most abundant species compared to the total abundance of all species present in the community. Mathematically, it can be represented as follows:

$$d = \frac{N_{max}}{N_i}$$

Where, N_{max} = Max no of individuals of particular genera or species

$\sum N_i$ = Total no of individuals obtained.

The resulting value of the Berger-Parker index ranges between 0 and 1. A higher index value indicates a greater dominance of a single species within the community. Conversely, a lower index value suggests a more even distribution of abundance among different species, indicating higher species diversity. The range of the Berger-Parker index can be interpreted as when the index value is close to 0, it signifies a high diversity with a more even distribution of abundances among different species. In such cases, no single species dominates the community, and there is a balanced representation of various species.

5. Evenness index-

Evenness index determines the homogeneity (and heterogeneity) of the species' abundance. Intermediate values between 0 and 1 represent varying degrees of evenness or unevenness in the distribution of individuals among species. Value of species evenness represents the degree of redundancy and resilience in an ecosystem. High species evenness = All species of a community can perform similar ecological activities or functions = even utilization of available ecological niches = food web more stable = ecosystem is robust (resistant to disturbances or environmental changes). Intermediate values between 0 and 1 represent variable degrees of evenness or unevenness.

$$EI = \frac{H}{\ln(S)}$$

Where, H= Shannon value

$\ln(S)$ = the natural logarithm of the number of different species in the community

Relative Abundance: The species abundance distribution (SAD) from disturbed ecosystems follows even/ uneven pattern. E.g., If relative abundance is 0.15, then the found species are neither highly dominant nor rare.

$$RA = \frac{\text{No. of Individuals of Sp.}}{\text{Total no. of Individual}} * 100\%$$

The basic idea of index is to obtain a quantitative estimate of biological variability that can be used to compare biological entities composed of discrete components in space and time. Biodiversity is commonly expressed through indices based on species richness and species abundances. Biodiversity indices are a non-parametric tool used to describe the relationship between species number and abundance. The most widely used bio diversity indices are Shannon Weiner index and Simpson's index.

12.2 Result and Discussion

The details of Marine Ecological Monitoring conducted for the locations of Kandla and Vadinar during the monitoring period has been summarized in the **Table 39**.

Table 39: Values of Biomass, Net Primary Productivity (NPP), Gross Primary Productivity (GPP), Pheophytin and Chlorophyll for Kandla and Vadinar

Sr. No.	Parameters	Unit	Kandla						Vadinar	
			ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8
1.	Biomass	mg/L	135	184	122	211	149	124	102	94
2.	Net Primary Productivity (NPP)	mg/L/hr	0.19	BQL	0.84	1.29	BQL	BQL	BQL	1.05
3.	Gross Primary Productivity (GPP)	mg/L/hr	1.57	BQL	1.2	2.31	BQL	0.22	1.52	2.61
4.	Pheophytin	mg/m ³	0.22	BQL	0.25	BQL	0.51	BQL	1.02	1.11
5.	Chlorophyll-a	mg/m ³	1.34	0.235	1.02	0.87	1.41	0.99	2.14	1.74
6.	Particulate Oxidisable Organic Carbon	mg/L	1.17	0.61	0.59	1.88	1.51	1.43	BQL	BQL
7.	Secchi Depth	ft	0.85	1.18	0.8	0.75	0.61	0.74	3.01	3.19

- Biomass:**

With reference to the **Table 39**, the value of **Biomass** reported from location ME-1 to ME-6 in range between 122-211 mg/L where lowest biomass presents in ME-3 (Near Coal Berth) and highest biomass present in ME-4 (Khori Creek) during sampling period. In Vadinar, the value of biomass was observed 102 mg/L at ME-7 (Near SPM) and 94 mg/L in ME-8 (Near Vadinar Jetty) monitoring station.

- **Productivity (Net and Gross)**

Gross primary productivity (GPP) is the rate at which organic matter is synthesised by producers per unit area and time (GPP). The amount of carbon fixed during photosynthesis by all producers in an ecosystem is referred to as gross primary productivity. The monitoring location of Kandla reported GPP value in range between 0.22 to 2.31 mg/L/48 Hr where the highest value recorded for Khori Creek (ME-4) and lowest recorded at Nakti creek, near to NH-8A i.e. ME-6. In Vadinar, the value of **GPP** was observed was observed 1.52 mg/L/48 Hr at ME-7 (Near SPM) and 2.61 mg/L/48 Hr in ME-8 (Near Vadinar Jetty) monitoring station.

Net primary productivity, is the amount of fixed carbon that is not consumed by plants, and it is this remaining fixed carbon that is made available to various consumers in the ecosystem. The Net primary productivity of the monitoring location at Kandla from (ME-1 to ME-6) has been estimated to be between 0.19 to 1.29 mg/L/48 Hr. While in Vadinar, the value of **NPP** was observed BQL at ME-7 and 1.05 mg/L/48 Hr at ME-8 monitoring station.

- **Pheophytin**

The level of Pheophytin was detected in the range from 0.22 to 0.51 mg/m³ where the highest value observed at ME-5 (Nakti creek) and the lowest or below quantification limit observed at ME-2, ME-4 and ME-6. While in Vadinar, the value of Pheophytin was observed 1.12 at ME-7 and 1.01 mg/L/48 Hr at ME-8 monitoring station.

- **Chlorophyll-a**

In the sub surface water, the value of Chlorophyll-a reported in range from 0.24 to 1.41 mg/m³. The highest value observed at ME-5 (Nakti creek) while the lowest value observed at ME-2 (Kandla Creek, near to KPT Colony). In Vadinar, the value of chlorophyll-a was observed 2.14 mg/m³ at ME-7 (Near SPM), monitoring station and 1.74mg/m³ in ME-8 (Near Vadinar Jetty).

- **Particulate Oxidisable Organic Carbon**

During the sampling period, the particulate oxidisable organic carbon falls within the range of 0.61 to 1.18 mg/L from monitoring location ME-1 to ME-6 at Kandla, whereas for Vadinar it recorded BQL at both the monitoring station (ME-7 and ME-8).

- **Secchi Depth**

In monitoring station of Kandla (ME-1 to ME-6) the level of Secchi Depth was observed between 0.61 to 1.18 ft whereas at Vadinar, the value recorded at ME-7 i.e. Near SPM is 3.01 ft and in Near Vadinar Jetty is 3.19 ft.

Ecological Diversity

Phytoplankton: For the evaluation of the Phytoplankton population in DPA Kandla and Vadinar within the immediate surroundings of the port, sampling was conducted during the study period. Total 8 sampling locations were studied i.e. sampling locations (6 from Kandla and two from Vadinar).

The details of variation in abundance and diversity in phytoplankton communities is mentioned in **Table 40**.

Table 40: Phytoplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8
<i>Bacillaria sp.</i>	300	40	150	184	250	-	-	-
<i>Chaetoceros sp.</i>	-	-	110	75	210	-	130	-
<i>Chlamydomonas sp.</i>	-	113	-	130	-	120	-	-
<i>Cyclotella sp.</i>	140		250	-	-	350	98	260
<i>Ditylum sp</i>	-	-	-	140	-	160	110	255
<i>Coscinodiscus sp.</i>	423	354		64	120	-	-	-
<i>Fragilaria sp.</i>	-	-	320	-	-	-	250	
<i>Bacteriastrum sp.</i>	-	-	-	260	-	310	220	210
<i>Pleurosigma sp.</i>	230	140	45	-	60	-	-	-
<i>Navicula sp.</i>	-	-	-	-	-	145	350	4167
<i>Nitzschia sp.</i>	245	120	260	-	120	42	-	-
<i>Synedra sp.</i>	-	-	-	75	-	-	150	100
<i>Planktothrix sp.</i>	170	40	130	-	-	180	-	-
<i>Oscillatoria sp.</i>	174	-	340	280	-	-	70	156
<i>Thallassiosira</i>	-	250	-	-	120	70	-	-
Density-Units/L	1682	1057	1495	1133	670	1377	1378	5148
No. of genera	7	7	7	7	5	8	8	6

The phytoplankton community of the sub surface water in the Kandla and Vadinar was represented by, Diatoms, green algae and filamentous Cyanobacteria. Diatoms were represented by 12 genera; green algae were represented by 1 genera and filamentous Cyanobacteria were represented by 2 genera during the sampling period.

The density of phytoplankton of the sampling stations from ME-1 to ME-6 (Kandla) varying from 670 to 1682 units/L, while for Vadinar its density of phytoplankton observed 1378 units/L at ME-7 and 5148 units/L at ME-8. During the sampling, phytoplankton communities were dominated by *Coscinodiscus sp.* and *Bacillaria sp.* in Kandla, while *Navicula sp.* in Vadinar.

The details of Species richness Index and Diversity Index in Phytoplankton is mentioned in **Table 41**.

Table 41: Species richness Index and Diversity Index in Phytoplankton

Indices	ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8
Taxa S	12	12	14	13	16	13	12	14
Individuals	7450	8745	9155	9100	10310	7990	8025	9650
Shannon diversity	1.88	1.37	1.90	1.64	1.23	1.73	1.77	1.02
Simpson 1-D	0.84	0.79	0.84	0.84	0.80	0.83	0.84	0.34
Species Evenness	0.97	0.70	0.91	0.79	0.69	0.83	0.85	0.57
Margalef richness	0.81	0.86	0.95	0.99	0.74	0.97	0.97	0.59
Berger-Parker	0.25	0.33	0.21	0.23	0.28	0.25	0.25	0.81
Relative abundance	0.42	0.66	0.50	0.66	0.68	0.58	0.58	0.12

- **Shannon- Wiener’s Index (H)** of phytoplankton communities was in the range of 1.23 to 1.90 between selected sampling stations from ME-1 to ME-6 with an average value of 1.63 at Kandla creek and its nearby creeks. While for Vadinar, Shannon Wiener’s index of phytoplankton communities recorded to be 1.77 at ME-7 and 1.02 at ME-8 with an average value of 0.38. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla.
- **Simpson diversity index (1-D)** of phytoplankton communities was ranged between 0.79 to 0.84 at all sampling stations in the Kandla creek and nearby creeks, with an average of 0.82. Similarly, for Vadinar Simpson diversity index (1-D) of phytoplankton communities was 0.84 at ME-7 and 0.34 at ME-8 with an average of 0.59.
- **Margalef’s diversity index (Species Richness)** of phytoplankton communities in Kandla and nearby creeks sampling stations was varying from 0.74 to 0.99 with an average of 0.89 during the sampling period. While for Vadinar, Margalef’s diversity index (Species Richness) of phytoplankton communities observed 0.97 at ME-7 and 0.59 at ME-8 with an average value of 0.78.
- **Berger-Parker Index (d)** of phytoplankton communities was in the range of 0.21 to 0.33 between selected sampling stations from ME-1 to ME-6 with an average value of 0.26 at Kandla creek and nearby creeks. Berger-Parker Index (d) of phytoplankton communities in the sampling stations of Vadinar, was in the range of 0.25 to 0.81 with an average value of 0.53. All the monitoring station signifies a low diversity with an even distribution among the different species.
- The **Species Evenness** is observed in the range of 0.69 to 0.97 for all the six-monitoring station of Kandla and for the Vadinar the species evenness is observed in the range of 0.57 to 0.85, during the monitoring month. This indicates varying degrees of evenness or unevenness in the distribution of individuals among the studied species.
- During the sampling period, **Relative Abundance** of phytoplankton communities was in range of 0.42 to 0.68 between selected sampling stations from ME-1 to ME-6 with an average value of 0.58 at Kandla creek and nearby creeks. Whereas for Vadinar the Index

value 0.58 at ME-7 and 0.12 at ME-8 with an average value 0.35, thus it is concluded that the studied species can be stated as neither highly dominant nor rare.

The details of variation in abundance and diversity in zooplankton communities is mentioned in **Table 42**.

Table 42: Zooplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8
<i>Acartia sp.</i>	1	2	1	-	2	-	-	1
<i>Acrocalanus</i>	-	-	-	-	-	2	-	-
<i>Amoeba</i>	2	-	3	4	2	-	4	1
<i>Brachionus sp.</i>	-	1	-	-	-	2	-	-
<i>Calanus sp.</i>	-	-	6	-	-	-	-	-
<i>Cladocera sp.</i>	6	1	-	1	-	2	1	2
<i>Cyclopoid sp.</i>	-	-	2	-	-	6	-	-
<i>Copepod larvae</i>	-	-	2	2	-	1	-	2
<i>Diatomus sp.</i>	5	1	-	-	2	-	5	-
<i>Eucalanus sp.</i>	-	-	8	-	-	9	-	1
<i>Mysis sp.</i>	2	-	-	1	-	-	1	-
<i>Paracalanus sp.</i>	-	2	5	-	-	2	-	2
Density Unit/L	16	7	27	8	6	24	11	9
No. of genera	5	5	7	4	3	7	4	6

A total of 12 groups/taxa of zooplankton were recorded in Kandla and Vadinar during the study period which mainly constituted by copepods, branchiopoda, monogononata, fish and shrimp larval forms. *Eucalanus sp.* had the largest representation at all stations from (ME-1 to ME-8). The density of Zooplankton of the sampling stations from ME-1 to ME-6 (Kandla) varying from 6 to 27 units/L, while for Vadinar its density of zooplankton observed 11 units/L at ME-7 and 9 units/L at ME-8. During the sampling, zooplankton communities were dominated by *Eucalanus sp.* and *Cladocera sp.* in Kandla, while *Amoeba* in both the monitoring location of Kandla and Vadinar.

The details of Species richness Index and Diversity Index in Zooplankton communities is mentioned in **Table 43**.

Table 43: Species richness Index and Diversity Index in Zooplankton

Indices	ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8
Taxa S	5	5	7	4	3	7	4	6
Individuals	16	7	27	8	6	24	11	9
Shannon diversity	1.42	1.55	1.76	1.21	1.1	1.33	1.16	1.74
Simpson (1-D)	0.78	0.9	0.83	0.75	0.8	0.86	0.71	0.92
Species Evenness	0.88	0.96	0.9	0.87	1	0.68	0.84	0.97
Margalef	1.44	2.06	1.82	1.44	1.12	1.89	1.25	2.28
Berger-Parker	0.38	0.29	0.3	0.5	0.33	0.38	0.45	0.22
Relative abundance	31.25	71.43	25.93	50	50	29.17	36.36	66.67

- **Shannon- Wiener's Index (H)** of zooplankton communities was in the range of 1.1 to 1.76 between selected sampling stations from ME-1 to ME-6 with an average value of 1.39 at Kandla creek and its nearby creeks. While for Vadinar, Shannon Wiener's index of zooplankton communities recorded to be 1.16 at ME-7 and 1.74 at ME-8 with an average value of 1.45. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla and Near SPM (Vadinar).
- **Simpson diversity index (1-D)** of zooplankton communities was ranged between 0.75 to 0.9 at all sampling stations in the Kandla creek and nearby creeks, with an average of 0.82. Similarly, for Vadinar Simpson diversity index (1-D) of zooplankton communities was 0.71 at ME-7 and 0.92 at ME-8 with an average of 0.88.
- **Margalef's diversity index (Species Richness)** of zooplankton communities in Kandla and nearby creeks sampling stations was varying from 1.12 to 2.06 with an average of 1.63 during the sampling period. While for Vadinar, Margalef's diversity index (Species Richness) of zooplankton communities observed 1.25 at ME-7 and 2.28 at ME-8 with an average value of 1.76.
- **Berger-Parker Index (d)** of zooplankton communities was in the range of 0.29 to 0.5 between selected sampling stations from ME-1 to ME-6 with an average value of 0.36 at Kandla creek and nearby creeks. Berger-Parker Index (d) of zooplankton communities in the sampling stations of Vadinar, was in the range of 0.22 to 0.45 with an average value of 0.34. All the monitoring station signifies a low diversity with an even distribution among the different species.
- The **Species Evenness** is observed in the range of 0.68 to 1 for all the six-monitoring station of Kandla and for the Vadinar the species evenness is observed in the range of 0.84 to 0.97, during monitoring month, indicate varying degrees of evenness or unevenness in the distribution of individuals among the studied species.
- During the sampling period, **Relative Abundance** of zooplankton communities was in range of 29.17 to 71.43 between selected sampling stations from ME-1 to ME-6 with an average value of 42.96 at Kandla creek and nearby creeks. Whereas for Vadinar the Index value 36.36 at ME-7 and 66.67 at ME-8 with an average value 51.52, thus it can be concluded that the studied species is stated as neither highly dominant nor rare.

The details of variation in abundance and diversity in **Benthic organism** is mentioned in **Table 44**.

Table 44: Benthic Fauna variations in abundance and diversity in sub surface sampling

Genera	ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8
<i>Thiaridae</i>	2	1	-	5	-	4	1	2
<i>Mollusca sp.</i>	2	2	2	1	-	1	2	-
<i>Odonata sp.</i>	5	1	-	2	1	1	-	-
<i>Lymnidae</i>	1	4	5	3	2	-	5	-
<i>Planorbidae</i>	-	-	2	-	-	3	-	1
<i>Atyidae</i>	1	2	-	1	-	2	-	1
<i>Gammaridae</i>	-	1	1	-	-	-	2	4
<i>Turbinidae</i>	1	-	3	-	1	1	-	2
<i>Palaemonidae</i>	-	-	-	2	-	-	-	-
Density-m³	12	11	13	14	4	12	10	10
No of genera	6	6	5	6	3	6	4	5

Few Benthic organisms were observed in the collected sample by using the Van-Veen grabs during the sampling conducted for DPA Kandla and Vadinar. Majority of the species were found under the Macro-benthic organisms during the sampling period were represented by *Lymnidae sp*, *Thiaridae*, *Mollusca sp.* etc. The density of benthic fauna was varying from 4 to 14 m². The dominating benthic communities at Kandla Creek and nearby creek (Nakti and Khori creek) were represented *Lymnidae sp.* While lowest number of benthic species was represented by *Palaemonidae*.

The details of Species richness Index and Diversity Index in Benthic Organisms is mentioned in **Table 45**.

Table 45: Species richness Index and Diversity Index in Benthic Organisms

Indices	ME-1	ME-2	ME-3	ME-4	ME-5	ME-6	ME-7	ME-8
Taxa S	6	6	5	6	3	6	4	5
Individuals	12	11	13	14	4	12	10	10
Shannon diversity	1.58	1.64	1.48	1.63	1.04	1.63	1.17	1.42
Simpson 1-D	0.82	0.85	0.81	0.84	0.83	0.85	0.73	0.82
Species Evenness	0.88	0.92	0.92	0.91	0.95	0.91	0.84	0.88
Margalef	2.01	2.09	1.56	1.89	1.44	2.01	1.3	1.74
Berger-Parker	0.42	0.36	0.38	0.36	0.5	0.33	0.5	0.4
Relative abundance	50	54.55	38.46	42.86	75	50	40	50

- **Shannon- Wiener's Index (H)** of benthic organism was in the range of 1.04 to 1.64 between selected sampling stations from ME-1 to ME-6 with an average value of 1.5 at Kandla creek and its nearby creeks. While for Vadinar, Shannon Wiener's index of benthic organism recorded to be 1.17 at ME-7 and 1.42 at ME-8 with an average value of 1.29. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla and Vadinar.
- **Simpson diversity index (1-D)** of benthic organism was ranged between 0.81 to 0.85 at all sampling stations in the Kandla creek and nearby creeks, with an average of 0.83.

Similarly, for Vadinar Simpson diversity index (1-D) of benthic organism was 0.73 at ME-7 and 0.82 at ME-8 with an average of 0.78.

- **Margalef's diversity index** (Species Richness) of benthic organism in Kandla and nearby creeks sampling stations was varying from 1.44 to 2.09 with an average of 1.83 during the sampling period. While for Vadinar, Margalef's diversity index (Species Richness) of benthic organism observed to be 1.3 at ME-7 and 1.74 at ME-8.
- **Berger-Parker Index (d)** of benthic organism was in the range of 0.33 to 0.5 between selected sampling stations from ME-1 to ME-6 with an average value of 0.39 at Kandla creek and nearby creeks. Berger-Parker Index (d) of benthic organism in the sampling stations of Vadinar, was in the range of 0.4 to 0.5 with an average value of 0.45. All the monitoring station signifies a low diversity with an even distribution among the different species.
- The **Species Evenness** is observed in the range of 0.88 to 0.95 for all the six-monitoring station of Kandla and for the Vadinar the species evenness is observed in the range of 0.84 to 0.88, during monitoring month, indicate varying degrees of evenness or unevenness in the distribution of individuals among the studied species.
- During the sampling period, **Relative Abundance** of zooplankton communities was in range of 38.46 to 75 between selected sampling stations from ME-1 to ME-6 with an average value of 51.81 at Kandla creek and nearby creeks. Whereas for Vadinar the Index value 40 at ME-7 and 50 at ME-8 with an average value 45.29, thus it is concluded that the studied species can be stated as neither highly dominant nor rare.

Annexure 1: Photographs of the Environmental Monitoring conducted at Kandla

STP Monitoring



Noise Monitoring



Soil Monitoring



Marine Monitoring



Air Monitoring



Drinking Water Monitoring

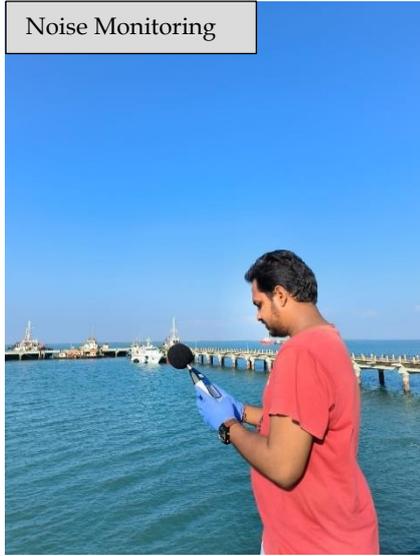


Annexure 2: Photographs of the Environmental Monitoring conducted at Vadinar

Air Monitoring



Noise Monitoring



STP Monitoring



Drinking water Monitoring



Marine Monitoring



Soil Monitoring



Source : GEMI



Gujarat Environment Management Institute (GEMI)

(An Autonomous Institute of Government of Gujarat)

'An ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 Certified Institute

Head Office

Plot No. B 246 & 247, G.I.D.C. Electronic Estate,
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"We Provide Environmental Solutions"

Annexure -D



DEENDAYAL PORT AUTHORITY (Erstwhile: DEENDAYAL PORT TRUST)

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
Ph.: (02836) 220038

www.deendayalport.gov.in

Date: 19/06/2023

EG/WK/EMC/CCA/ Part(III)/ 325

To,
The Member Secretary
Gujarat Pollution Control Board
Paryavaran Bhavan,
Sector 10A, Gandhinagar - 382010

Sub: Submission of Annual Return of Hazardous waste in format form IV for the financial year 2022-23 reg.

- Ref.:** 1) KPT letter no. EG/WK/4660(EC)/549 dated 20/6/2012
2) KPT letter no. MR/GN/1527(Part I)/2012 dated 20/5/2013
3) KPT letter no. MR/GN/1527(Part I)/336 dated 17/05/2014
4) KPT letter no. MR/GN/1527/ (Part I)/dated 27/04/2015
5) KPT letter no. EG/WK/EMC/CCA (Part II)/217 dated 27/6/2016
6) KPT letter no. EG/WK/EMC/CCA (Part II)/213 dated 19/6/2017
7) DPT letter no. EG/WK/EMC/CCA (Part II)/294 dated 13/6/2018
8) DPT letter no. EG/WK/EMC/CCA (Part II) dated 27/5/2019
9) DPT letter no. EG/WK/4751 (CCA Renewal) dated 22/5/2020
10) DPT letter no. EG/WK/4751 (CCA Renewal)/13 dated 30(4)/4(5)/2021
11) DPT letter no. EG/WK/4751 (CCA Renewal)/131 dated 06/07/2022

Sir,

It is requested to kindly refer above cited references for the said subject.

In this connection, it is to state that, the Deendayal Port Authority has obtained renewal of consent order from the GPCB Vide order no. AWH - 110594 dated 22/01/2021 valid up to 21/07/2025 for Deendayal Port Authority area.

In this regard, as per statutory requirement, the DPA has regularly submitted Annual Returns (as mentioned in reference above) in format Form IV to the GPCB.

Now please find the enclosed herewith Annual Return of Hazardous Waste in Form IV for the year 2022-23

This is for kind information and record please.

Encl: As above

Yours faithfully

Manager (Environment)
Deendayal Port Authority

Enclosure – A

Annual Return of Hazardous waste Return (Form IV)
For Deendayal Port Authority, Kandla
For the FY @ 2022-2023

"FORM-IV"

[(See rule 6(%), 13(8), 16(6) and 20(21)
(To be submitted to State Pollution Control Board by 30th day of June of every
year for the preceding period April 22 to March 23)

Sr. No.	Particulars	Details
1.	Name and Address of the Facility	Deendayal Port Authority Administrative Office Building Post Box No. 50 Gandhidham Dist.: Kutch- 370201 Gujarat State Tel. No.: 02836-233192 Fax No.: 02836-220050
2.	Authorization No. and Date of issue	Consent order no. AWH – 110594 granted by the GPCB dated 22/01/2021 and correction to consent order done dated 09/04/2021
3.	Name of Authorized Person and full address with telephone, Fax number and E-Mail	Mr. Raveendra Reddy Chief Engineer Deendayal Port Authority Administrative Office Building Post Box No. 50 Gandhidham Dist.: Kutch- 370201 Gujarat State Tel. No.: 02836-233192 Fax No.: 02836-220050
4.	Production during the year (product wise) wherever applicable	NA Deendayal Port Authority has only loading & unloading activities for dry cargo and liquid cargo. During FY 2022-23 Total Cargo Handled is 137.5 MMTPA

PART A. To be filled by Hazardous Waste Generator

1.	Total quantity of waste generated category wise	Used oil/Waste residue containing oil 1. Used Spent Oil: 4758.79 MT 2. Waste residue containing oil: 9157.58 MT
2.	Quantity Dispatched a. To disposal Facility b. To recycler or co-processor or pre-processor c. Others	Used Oil/Waste residue containing oil has been disposed of through CPCB/GPCB authorized vendor (Annexure-1)
3.	Quantity utilized inhouse -if any	NA
4.	Quantity in storage at the end of the year	NA

PART B To be filled Treatment, Storage and Disposal Facility Operator

1.	Total Quantity Received 1. Direct Landfill 2. Incineration 3. Land fill after treatment	}	NA
2.	Quantity at stock at the beginning of the year 1. Direct Landfill 2. Incineration 3. Land fill after treatment		
3.	Quantity treated (Landfill) Land fill after Treatment		
4.	Quantity disposed in landfill as such and after treatment 1. Direct Landfill 2. Land fill after treatment 3. Incineration Ash 4. Salts from Spray Dryer 5. Total		
5.	Quantity incinerated (if applicable)		
6.	Quantity processed other than specified above		
7.	Quantity in storage at the end of the year 1. Incineration 2. Landfill after treatment		

PART C To be filled by recyclers or co-processor or other users

1.	Quantity of the waste received during the year 1. Domestic sources 2. Imported (if applicable)	}	NA
2.	Quantity in stock at the beginning of the year		
3.	Quantity recycled or co processed or used		
4.	Quantity of products dispatched (wherever applicable)		
5.	Quantity of waste generated		
6.	Quantity of waste disposed		
7.	Quantity re-exported (wherever Applicable)		
8.	Quantity in storage at the end of the year		

Manager (Environment)

Deendhal Port Authority

Date: 13/06/23

Place : Gondal

DEENDAYAL PORT AUTHORITY - MARINE DEPARTMENT**Statement of Hazardous & Non Hazardous Waste disposal from the vessels at Kandla & Vadinar Port Year 2022-23**

Sr.No.	MONTH	HAZARDOUS WASTE DATA for FY 2022-23		
		Total	Used spent Oil	Waste residue containing oil
Quantity Disposed (MT)				
1	Apr-22	1237.33	412.44	824.89
2	May-22	1285.56	428.52	857.04
4	Jun-22	1568.41	522.80	1045.61
5	Jul-22	1238.46	412.82	825.64
3	Aug-22	1414.94	471.65	943.29
4	Sep-22	872.60	290.87	581.73
5	Oct-22	1210.04	403.35	806.69
3	Nov-22	938.71	312.90	625.81
4	Dec-22	1286.64	428.88	857.76
5	Jan-23	1284.40	428.13	856.27
3	Feb-23	762.19	254.06	508.13
4	Mar-23	637.09	212.36	424.73
Total	--		4578.79	9157.58
Total Hazardous waste Genreted for FY 2022-23				13736.37

उप संरक्षक
दीनदयाल पत्तन प्राधिकरण
Deputy Conservator
Deendayal Port Authority

Marine Department

Statement showing the Collection and disposal of Hazardous and Non-Hazardous Wastes carried out by various parties from April - 2022 to Mar - 2023

No.	Name of Party	Type of Licence	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Total
1	Alicid Organic Industries Ltd	Hazardous	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Amar Hydrocarbon Pvt. Ltd	Hazardous	-	-	-	-	-	-	-	-	-	19.00	-	-	19.00
3	Atlas Organics Pvt. Ltd	Hazardous	21.39	35.28	-	-	34.06	-	-	18.80	10.98	-	17.06	-	137.57
4	Aviation Corporation	Hazardous	35.12	50.34	-	-	-	-	-	-	-	-	-	-	85.46
5	Fine Refiners Pvt. Ltd	Hazardous	-	14.50	53.77	21.08	-	20.11	16.32	-	43.56	-	39.65	-	208.99
6	Mahalanmi Asphalt Pvt Ltd	Hazardous	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Priyansu Corporation	Hazardous	52.91	22.44	11.38	30.33	-	30.65	-	-	17.56	-	49.18	36.05	250.50
8	Revolucion Petrochem LLP	Hazardous	874.00	965.00	964.00	710.12	1,058.06	463.81	713.57	524.23	787.61	888.73	339.75	257.12	8,546.00
9	Shana Oil Process	Hazardous	-	-	-	-	-	-	-	-	-	-	-	-	-
10	United Shipping Company	Hazardous	253.91	198.00	539.26	476.93	322.82	358.03	480.15	395.68	426.93	376.67	316.55	343.92	4,488.85
11	Chitrukut Trading & Industries	Non-Hazardous	-	0.16	0.19	0.19	0.17	0.35	6.36	-	31.38	12.42	3.94	16.54	71.70
12	Golden Shipping Services	Non-Hazardous	77.42	38.26	19.63	1.14	30.28	8.36	21.82	26.57	15.06	22.82	18.42	46.48	326.26
13	Green Earth Marine Solution	Non-Hazardous	-	39.72	3.46	2.88	3.24	2.30	-	3.60	-	1.30	2.88	-	59.38
14	Harish A. Pandya	Non-Hazardous	3.58	0.06	3.20	-	-	4.47	1.13	-	0.22	-	5.70	4.89	23.25
15	K M Enterprise	Non-Hazardous	30.15	47.56	57.24	101.56	64.00	35.28	46.08	63.36	72.93	65.02	91.77	41.82	716.77
16	Naaz Shipping Services Ent	Non-Hazardous	-	-	-	-	-	-	-	-	-	10.80	-	-	10.80
17	New India Marine Work	Non-Hazardous	1.44	2.16	-	-	-	-	-	-	-	-	2.16	1.08	6.84
18	Omega Marine Services	Non-Hazardous	350.63	73.10	42.15	-	104.40	25.46	23.69	45.97	53.31	19.80	43.32	23.29	805.12
19	V K Enterpris	Non-Hazardous	23.76	28.08	12.96	10.80	15.12	17.28	10.80	12.96	15.12	10.80	12.96	10.80	181.44
20	Vishwa Trade-link Inc	Non-Hazardous	21.92	11.74	20.65	30.10	29.38	29.88	31.48	35.44	14.59	15.91	10.52	20.02	271.63
	Hazardous Total		1,237.33	1,285.56	1,568.41	1,238.46	1,414.94	872.60	1,210.04	938.71	1,286.64	1,284.40	762.19	637.09	13,736.37
	Non-Hazardous Total		508.90	240.84	159.48	146.67	246.59	123.38	141.36	187.90	202.61	158.87	191.67	164.92	2,473.19

उप संरक्षक
 दीनदराल पतन प्राधिकरण
 Deputy Conservator
 Deendayal Port Authority



Annexure -E

Final Report

On

**Greenbelt Development for the Deendayal Port Authority at
Kandla Port**



Submitted to



Deendayal Port Authority

Administrative Office Building
Post Box No.50, Gandhidham (Kachchh)
Gujarat-370201

Prepared by



Gujarat Institute of Desert Ecology

Mundra Road, Bhuj-370 001, Kachchh, Gujarat

E-mail: desert_ecology@yahoo.com

www.gujaratdesertecology.com

Final Report

on

**Greenbelt Development for the Deendayal Port Authority at Kandla
Port, Kandla**

Co-ordinator

Dr. V. Vijay Kumar, Director

Principal Investigator

Dr. Jayesh B. Bhatt, Scientist

Co-Principal Investigator

Mr. Bhagirath Paradva, Project Fellow

Mr. Rakesh Popatani, Project Fellow

Technical Support

Mr. Prakash Patel, Executive Engineer

Mr. Ajay K. Gohel, Project Fellow



Gujarat Institute of Desert Ecology Opp.

Changleshwer Temple, Mundra Road Bhuj-370

001, Kachchh, Gujarat

www.gujaratdesertecology.com

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Introduction

Green vegetation cover surrounding human environment is a vital entity for supply of oxygen, food, fodder and medicine for the survival of all living being, and also it has played an important role in maintaining ecological balance, climate regulation, biodiversity conservation, retention of soil moisture, control of soil erosion, increasing soil fertility, maintaining pleasant micro climate of the region, etc. In addition, vegetation cover also absorbs various pollutants from the environment and thus helps in effective pollution control. However, due to the various types and extent of economic development like industrialization, mining, infrastructural development, etc. has reducing and fragmenting natural vegetation cover day-by day all over the world. The infrastructural and industrial development leads to influence the life of all the living organisms in two directions: either upwards or downwards. In the upward mode, human being gets opportunities for luxuriant life with easy accessibility to the resources while in downward, the quality of ecosystem services gets affected. Most of the industrial and infra-structural developmental activities generate pollution of one or other types with varying magnitudes, which makes susceptible to all the organisms, nevertheless, the power of resistance of each organism helps themselves to overcome the hazards caused by such pollutants.

Therefore, development of green belts alongside of industries, mines, thermal power station, roadsides, and other development unit is an effective mechanism to rejuvenate vital vegetation cover for safeguarding health of human and other living being. Green belts in and around urban and industrial areas are important to the ecological health of any given region. Greenbelt is the row of trees planted along the industrial units, mines, roadside for reducing the pollution originating from these operations (Flemming, 1967; Hanson and Throne, 1970; Warren, 1973; Ganguly, 1976). Greenbelt has developed considering following factors; (i) physical characteristics of the green belt eg. Distance from the source, width, and height and leaf surface area density (ii) aerodynamic properties eg. Wind speed through greenbelt and effective height of the incident air stream (iii) deposition velocity of the pollutant and (iv) atmospheric stability conditions (CPCB, 2000).

As per the National Forest Policy (NFP-1988), it is necessary to encourage the planting of trees alongside of roads, railway lines, rivers and streams and canals, and on other

unutilized lands under state/corporate, institutional or private ownership. NFP give emphasis on the green belt developments. It says – Green belts should be raised in urban/industrial areas as well as in arid tracts. Such a programme will help to check erosion and desertification as well as improve the microclimate.

Green infrastructure serves to provide an ecological framework for social, economic and environmental health of the surroundings. The main components of this approach include storm water management, climate adaptation, less heat stress, more biodiversity, food production, better air quality, sustainable energy production, clean water and healthy soils, as well as the more anthropocentric functions such as increased quality of life through recreation and providing shade and shelter in and around infrastructure and industrial areas. Green infrastructure is thought to be effective in such scenarios, where green plants from a surface capable of absorbing air pollutants and act as a sink for pollutants. Leaves with their vast leaf area in the tree canopy, absorb pollutants on their surface. Thus, effectively reduce their concentrations in the ambient air. Often the absorbed pollutants are incorporated in metallic streams and thus the air is purified. Plants grown in such a way as to function as pollutant sinks are collectively referred to as green infrastructure or green belts. Apart from functioning as a pollutant sink, green belts would also provide other benefits like aesthetic improvement and providing possible habitats for birds and animals along with maintain the soil moisture regime with the soil microorganisms and improve the Soil quality and ground water recharge. The greenbelts has helps in improving the ecology, maintenance of biodiversity, mitigation of dust pollution and fugitive emission, control of noise pollution, provide fresh air, mitigates soil erosion, increasing aesthetic values of an area and overall improvement of the landscape.



Rationale

Deendayal Port in Kachchh District of Gujarat State (formerly Kandla Port Trust), operated by Deendayal Port Authority (DPA), is a gateway Port to the hinterland in the western and northern states of India. It is one of the 11 major Ports of India situated at 22°59'39.77" N latitude and; 70°13'20.14" E longitude on Kandla creek at Gulf of Kachchh. The inclusion of Karachi Port in Pakistan after India's partition and heavy traffic congestion at the then Bombay Port gave impetus for promoting Deendayal Port during the year 1950s. In 1955, Deendayal Port acquired the status of a major Port in India. Because of its proximity to the Gulf countries, large quantities of crude petroleum and other assorted cargo are imported through Deendayal Port. The Port presently has 14 jetties, six oil terminals, and several allied facilities for handling dry and liquid cargo. Regular expansion/developmental activities such as the addition of jetties, allied Special Economic Zones (SEZ hereafter), industrial parks and ship bunkering facilities are underway to cope with the increasing cargo handling demands. Shri Mansukh Mandaviya, Minister of State for Ports, Shipping and Waterways (I/C) appreciated the efforts taken by Deendayal Port and added that it is indeed the major achievements in the challenging (COVID) times and it is significant indication that economy is bouncing back to achieve pre-COVID times.

Major commodities handled by the Deendayal Port are Crude Oil, Petroleum product, Coal, Salt, Edible Oil, Fertilizer, Sugar, Timber, Soya bean, Wheat. This major achievement can be attributed to the user-friendly approach of port with the Shipping fraternity / stakeholders and constant consultations with them to improve ease of doing business. An assortment of liquid and dry cargo is being handled at Deendayal Port. The dry cargo includes fertilizers, iron scrap, steel, food grain, metal products, ores, cement, coal, machinery, sugar, wooden logs, salt extractions, etc. The liquid cargo includes edible oil, crude oil and other petroleum products. DPA created a new record by handling 127.10 million metric tonnes of cargo during FY 2021-22 compared to 117.566 MMT in FY 2020-21, with a growth of 8.11%. Incidentally, DPA is the only major Indian Port to handle more than 127 MMT cargo throughput, and it has also registered as the highest cargo throughput in its history. The Port has handled 3151 vessels during FY 2021-22 compared to 3095 vessels in FY 2019-20. While the Port has flagged off several projects related to infrastructure creation, DPA has successfully awarded the work of

augmentation of Liquid cargo handling capacity by revamping the existing pipeline network at the oil jetty area in September 2021. Deendayal Port is a natural harbour located on the eastern bank of North-South trending Kandla creek at an aerial distance of 145 km from the Gulf's mouth.

Being located at the inner end of the Gulf of Kachchh (GoK), Deendayal Port has a fragile marine ecosystem with a vast expanse of mangroves, mudflats, creek systems and allied biota. The Port location is marked by a network of major and minor mangrove-lined creek systems with a vast extent of mudflats. The coastal belt in and around the Port has an irregular and dissected configuration.

There are no perennial or seasonal rivers in Gandhidham taluka where the part is located. Total rainy days during the monsoon season is limited to only 15-20 days and used to be erratic. Freshwater input into the near coastal waters is relatively meagre and appears to have less influence on the ambient coastal water quality except during monsoon months, during which freshwater through flash floods get discharged in the near coastal waters. The annual average humidity is 60%, which increases to 80% during the southwest monsoon (June to September) and decreases to 50% during the months of November and December. The drought phenomenon is common with two drought years in a cycle of 5 years.

The coastal belt in and around the Kandla region is characterized by a network of creek systems and mudflats covered by sparse halophytic vegetation, creek water and salt-encrusted land mass, which forms the major land forms. The surrounding environment in a radius of 10 km from the Port is mostly built-up areas consisting of salt works, human habitations and Port related structures on the west and north, creek system, mangrove formations and mudflats on the east and south. The Deendayal Port and its surroundings have mangroves, mudflats and creek systems as major ecological entities.

DPA is committed towards environment protection since its establishment and has taken many initiatives towards increasing green cover and greenbelt development in various areas under DPA through intensive plantation activities and developing greenbelt around its established port and jetty areas and human habitations.

In order to enhance and strengthen Greenbelt Development, the DPA has approached GUIDE to develop the greenbelt area within the port area in phase wise manner. It was finalised to raise 5000 plants at a suitable site during the first phase.

Project Site

Based on observation made by the GUIDE Team and Officials from Deendayal Port Authority, a site at adjacent to Berth 11-12 (Wood log site) have been selected on the peripheral boundary of two sides.

The area proposed for green development of Deendayal Port is barren land without any vegetation. The soil of the area is black muddy highly saline soil and with saline ground water. The area is very dry and hot during the summer. The highest temperature used to be recorded in this area.

Scope of Works

The overall objective is to Development Greenbelt at Deendayal Port. The following activities of the Greenbelt development have been carried out:

1. To make an inventory of suitable sites for greenbelt development in and around the Deendayal Port at Kandla.
2. To carryout Soil and Moisture Conservation (SMC) of the selected sites.
3. Identification of suitable native species of plants for the greenbelt plantation.
4. Adopting plantation technique of plant saplings.
5. Regular monitoring (survival and growth) of the plantation.
6. Suggest measures for management and improvement of the greenbelt.

Approach and Methodology for Greenbelt Development

Following steps have been adopted for greenbelt development:

- Removal of exotic/unwanted plants plant species from the entire area demarcated for green belt development: The entire selected site have been cleared by removing

unwanted weeds and material such as stones, plastics etc. by JCB and also with labours.

- Landscaping of the area and land preparation Trench line of 2.5x 2.5 ft. have been dig out through JCB along the boundary adjacent to birth 11 & 12 wood log area up to approximately 5000 ft.
- Soil and moisture conservation work since the port area is highly saline, SMC work was very much essential for better survival of the plants. Eight dumper of fertile soil from the field have been added.
- Identification of native species of plants for plantation in greenbelt as per the site suitability the site was very challenging for greenbelt development since the water and soil is highly saline with the extreme climatic condition, the selection of plant species for plantation has been made very carefully. 40 % of plants have been selected as native species for plantation where as 60% species of *Conocarpus*.
- Procurement of sapling of identified species or Nursery management or seeding of tree/shrub species all the saplings were procured where of 3-4 ft. in height from reliable nursery. All saplings were of tree species.
- Installation of irrigation facilities was not feasible therefore activity was planned preferably through tankers. The watering of the plantation have been schedule as per the seasons which is given in table. Regular watering as per the scheduled have been provided by the water tanker under the supervision of team expert
- Use of Manure, preferably organic fertilizer for enhancing soil fertility best quality organic manure of 12,500 kg have been provided to the saplings for better growth and survival. Weed management and trench repairing have been carried out periodically also as and when it required.
- Regular monitoring and management of the saplings by a qualified team from GUIDE the selected site is wood log site hence, the wood log used to roll down on a path for water tanker while uploading and downloading the wood log. The regular visit to the site has been made for monitoring and clearing the road for water tanker for irrigation. Gap filling were also made during the period.

Plantation Techniques:

- Site development for a plantation includes clearance for weeds and it involves, bush cutting, soil and moisture conservation works in 'nalas', construction of bunds or check dams, marking of pits for planting of saplings etc.
- After clearing the land sites for digging of pits, plantation have been marked on ground using a measuring tape to ensure the desired spacing.
- Pits of the size 45 cm x 45 cm and 45 cm depth have been dug for tree plantation. Pits have been deep enough to ensure that the roots of the plants do not curl up once the planting material is placed in it.
- Since the soil is highly saline, a fertile soil around 6 dumper have been added for better survival of plants
- Organic manure around 12,500 kg. Have been given for better growth and survival.
- The pit have been filled a little above the ground level so that after the earth settles the upper surface of the pit is level to the ground thus avoiding any water logging.
- The plantation has been out in two phase since the some areas were blocked by wood logs.
- Around 4100 saplings have been planted during the month of September 2022 at available plantation area.
- The remaining and gap filling of 1500 saplings have been planted after the clearance of the area during the month of Feb.2023. A total number of 5000 plantations, were completed in the area.

Selection of Plant Species for Plantation:

Various indigenous tree species suitable for the area have been identified and selected for plantation in suitable areas based on the assessment of soil quality, available water facility, and other environmental parameters.

Number of Sapling:

Approximate numbers of saplings to be required for the greenbelt are as follows:

- Peripheral plantation adjacent to birth 11-12 (along the boundary of the wood log area both sides): 5000 saplings

Management and Monitoring of Greenbelt:

The plantation within the identified site have been managed and monitored for a period of one year from June 2022 to June 2023. The management of plantation includes appropriate irrigation of the plantation in regular intervals, during summer and winter periods and if required even during monsoon with dry spells.

Watering have been made through tanker service at given schedule during the different seasons. (Table 1)

The all plants are growing very well and reached more 4-6 ft. height. The survival of plants have been noted very high as 98% during June 2023.



Table: 1 Time Schedule for Watering

Sr. No.	Month & Year	Number of Time
1	September 2022	4 times/month
2	October 2022	5 times/ month
3	November 2022	8 times/ month
4	December 2022	8 times/ month
5	January 2023	8 times/ month
6	February 2023	8 times/ month
7	March 2023	12 times/ month
8	April 2023	12 times/ month
9	May 2023	12 times/ month
10	June 2023	2 times/ month (end of the project 4 th June 2023)

Table: 2 List of Plants for Plantation at Site for Greenbelt Development

SI. No.	Scientific Name	Local Name	No. of Plant
1	<i>Conocarpus lancifolius</i>	Conocarpus	3500
2	<i>Ficus religiosa</i>	Piplo	100
3	<i>Azadirachta indica</i>	Limblo	200
4	<i>Peltophorum pterocarpum</i>	Pletoforam	300
5	<i>Millettia pinnata</i>	Karanj	300
6	<i>Cassia fistula</i>	Garmalo	100
7	<i>Delonix regia</i>	Gulmahor	300
8	<i>Mimusops elengi</i>	Borssalii	200



Fig. 1 Before Plantation



Fig. 2 Map of Plantation Area



Fig. 3 Digging Out Trench for Plantation



Fig. 4 Transportation of Plants to Site



Fig. 5 Fertile Soil for Better Survival of Plants



Fig. 6 Plantation Pits of Soil Filling



Fig. 7 Organic Manure for Better Growth and Survival



Fig. 8 Regular Watering of the plants by tanker



Fig. 9 Plantation in October 2022



Fig. 10 Plantation in December 2022



Fig. 11 Plantation in February 2023

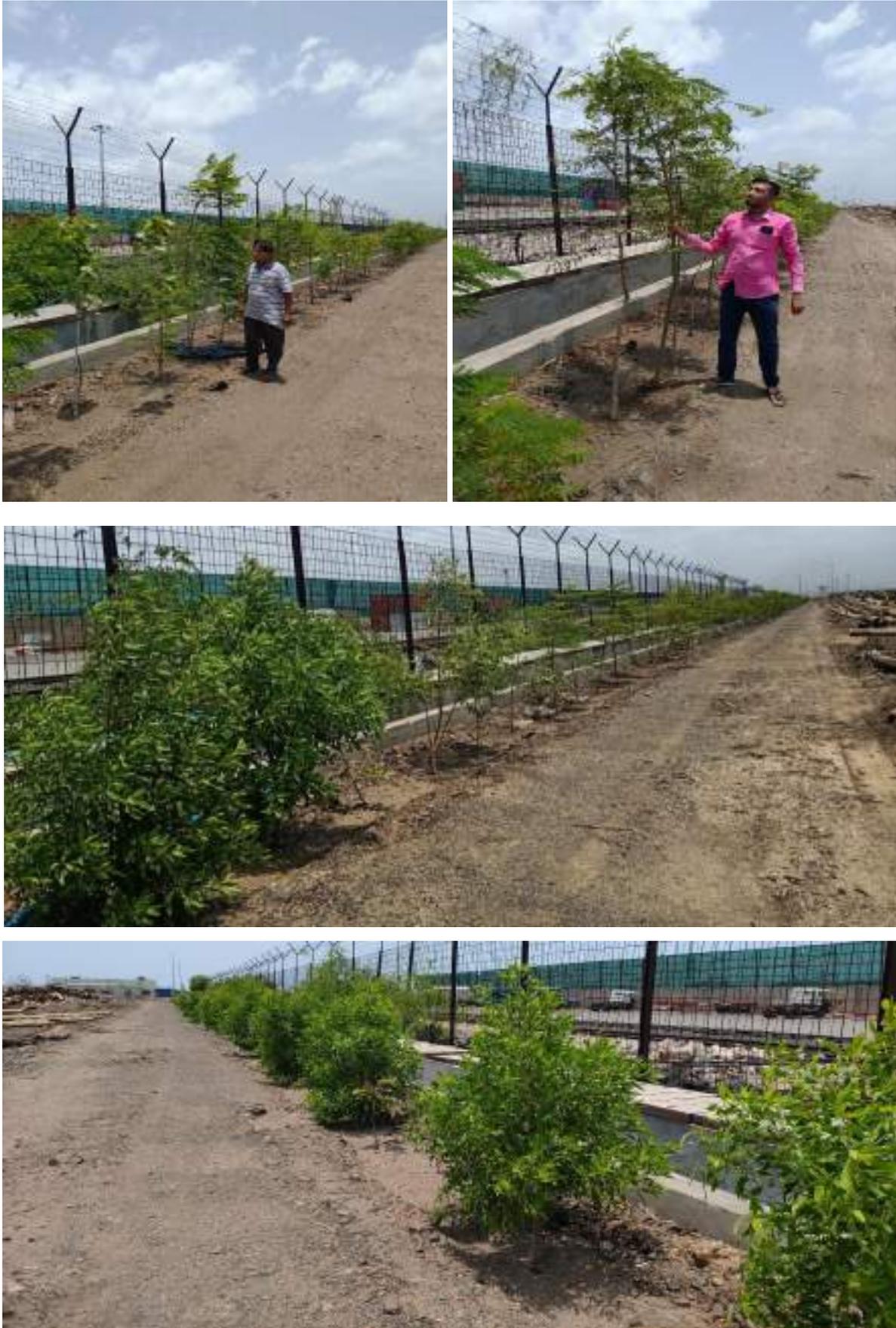


Fig. 12 Plantation in May 2023

Annexure -F



DEENDAYAL PORT AUTHORITY

(Erstwhile: DEENDAYAL PORT TRUST)

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
Ph.: (02836) 220038

www.deendayalport.gov.in

EG/WK/4751 (CCA Renewal)/ 326

Date: 19/06/2023

To,
The Member Secretary
Gujarat Pollution Control Board
Paryavaran Bhavan,
Sector 10A, Gandhinagar - 382010

Sub: Submission of Environmental statement in format form V for the financial year 2022-23 reg.

- Ref.:** 1) KPT letter no. MR/GN/1527(Part I)/535 dated 16/6/2012
2) KPT letter no. MR/GN/1527(Part I)/2011 dated 20/5/2013
3) KPT letter no. MR/GN/1527(Part I)/337 dated 17/05/2014
4) KPT letter no. MR/GN/1527/ (Part I)/dated 27/04/2015
5) KPT letter no. EG/WK/EMC/CCA (Part II)/218 dated 27/6/2016
6) KPT letter no. EG/WK/EMC/CCA (Part II)/214 dated 19/6/2017
7) DPT letter no. EG/WK/EMC/CCA (Part II)/294 dated 13/6/2018
8) DPT letter no. EG/WK/EMC/CCA (Part II) dated 27/5/2019
9) DPT letter no. EG/WK/4751 (CCA Renewal) dated 22/5/2020
10) DPT letter no. EG/WK/4751 (CCA Renewal)/14 dated (30)04/(4)5/2021
11) DPA letter no. EG/WK/4751 (CCA Renewal)/132 dated 06/07/2022

Sir,

It is requested to kindly refer above cited references for the said subject.

In this connection, it is to state that, the GPCB has renewed the consolidated consent & Authorization granted to Deendayal Port Authority (Erstwhile Deendayal Port Trust) and issued CCA order no. AWH-110594 vide PC/CA-KUTCH-812 (5)/GPCB ID 28494/581914 dated 21/01/2021 valid upto 21/07/2025

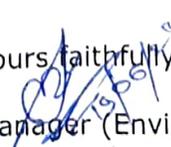
In this regard, as per statutory requirement, the DPA has regularly submitted Annual Returns (as mentioned in reference above) in format Form V to the GPCB.

Now please find the enclosed herewith Environmental Statement in Form V for the year 2022-23

This is for kind information and record please.

Encl : As above

Yours faithfully


Manager (Environment)
Deendayal Port Authority

Enclosure – A

Environmental Statement (Form V)
For Deendayal Port Authority, Kandla
For the FY @ 2022-2023

"FORM-V"
(See rule -14)

From:
Deendayal Port Authority,
Administrative Office Building,
Post Box No.: 50, Gandhidham,
Dist.: Kutch – 370 207. Gujarat State.
Tel No.: O: 02836-220038
Fax No.: 02836-220050

To,
The Member Secretary,
Gujarat Pollution Control Board,
Paryavaran Bhavan, Sector - 10A,
Gandhinagar – 382043

Environmental statement for the financial year ending the 31st March, 2023

"PART-A"

1) Name and Address of the owner/occupier of the industry or process		
➤ NAME	:	Mr. Raveendra Reddy Chief Engineer
➤ ADDRESS	:	Deendayal Port Authority Administrative Office Building, Post Box No.: 50, Gandhidham, Dist.: Kutch – 370 207. Gujarat State. Tel No.: O: 02836-220038 Fax No.: 02836-220050
➤ Industry Category Primary – (STC code) Secondary – (STC code)	:	Major port Authority under the administrative control of Ministry of Ministry of Ports, Shipping and waterways, GOI
➤ Year of Establishment	:	8th April 1955
➤ Date of the last Environment audit report submitted	:	27 th June, 2016

"PART-B"

WATER AND RAW MATERIAL CONSUMPTION

Sr.No.	WATER CONSUMPTION	(M³/Day)
1.	Process	652676.55
2.	Cooling	
3.	Domestic Purpose	
Total water consumption for the period from April 2022 to March 2023 was KL hence, average water consumption for per day – 1788 M³/day		

I. Water Consumption

Sr. No.	Name of Products	Process Water Consumption per unit of products output	
		During the current financial year 2021-22	During the current financial year 2022-23
01.	Dry Cargo Handling	127.10 MT	137.5 MT
02.	Liquid Cargo Handling		
Deendayal Port Authority has only loading & unloading activities for dry cargo and liquid cargo. Hence consumption of process water consumption per unit of output with respective to production is not applicable. During FY 2022-23 Total Cargo Handled is 137.5 MMTPA However, Details of the Domestic water consumption for the financial year 2022-23 please refer Annexure-1			

II. Raw material Consumption

Sr.No.	Name of Raw Material	Name of Products	Consumption of Raw material per unit of output	
			During the current financial year 2021-22	During the current financial year 2022-23
1.	Deendayal Port Authority has only loading & unloading activities for dry cargo and liquid cargo. Hence consumption of raw material per unit of output with respective to production is not applicable			

"PART-C"

**POLLUTION DISCHARGED TO ENVIRONMENT/UNIT OF OUTPUT
(PARAMETERS AS SPECIFIED IN THE CONSENT)**

Pollutant	Quantity of Pollutant Discharged (mass/day)	Concentration of Pollution in Discharge (mass/volume)	% of Variation from prescribed standard with reasons
------------------	--	--	---

Please Refer **Annexure -II** for Environmental Monitoring Reports of

- Ambient Air Quality Monitoring
- Drinking Water Quality Monitoring
- Marine Water Monitoring
- Noise Level Monitoring

"PART-D"

HAZARDOUS WASTE

[AS SPECIFIED UNDER HAZARDOUS WASTE (MANAGEMENT AND HANDLING) RULES -1989 & AMENDMENT RULES -2008]

Sr.No.	Hazardous Waste	Total Quantity in MT/Year	
		During the current financial year 2021-22	During the current financial year 2022-23
1.	5.1- Used Spent Oil	3195.28	4578.79
2.	5.2- Waste Residue Containing Oil	6390.57	9157.58
<ul style="list-style-type: none">• Details of Hazardous Waste generated during the financial year 2022-23 please refer Annexure-III			
a. From Process: NA			
b. From Pollution Control facility: NA			

"PART-E"
SOLID WASTE

Sr.No.	Solid Waste	Total Quantity in MT/year	
		During the current financial year 2021-22	During the current financial year 2022-23
1.	From Process	Nil	Nil
2.	From pollution Control Facility	Nil	Nil
a.	Quantity Recycled or Reutilized within the unit	Nil	Nil
b.	Sold	Nil	Nil
c.	Disposed Off	1724.08 MT	2473.19 MT
Details of Solid Waste (Non-Hazardous Waste) generated during the financial year 2022-23 please refer Annexure-IV			

"PART-F"

PLEASE SPECIFY THE CHARACTERISTICS (IN TERMS OF CONCENTRATION AND QUANTUM) OF HAZARDOUS AS WELL AS SOLID WASTES AND INDICATE DISPOSAL PRACTICE ADOPTED FOR BOTH THESE CATEGORIES OF WASTES.

Hazardous Waste:

Companies authorized by Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) have been awarded the work of collection, transporting and disposal of hazardous Waste by the Deendayal Port Authority. The same will be hand over to authorize parties for further Treatment & disposal.

Solid Waste:

Garbage facility is provided as per MARPOL Act 73/78 to the vessel berthed at Deendayal Port Authority. Companies authorized by Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) have been awarded the work of collection, transporting and disposal of solid waste by the Deendayal Port Authority. The same will be hand over to authorize parties for further treatment and disposal.

"PART-G"

IMPACT OF THE POLLUTION ABATEMENT MEASURES TAKEN ON CONSERVATION OF NATURAL RESOURCES AND ON THE COST OF PRODUCTION.

DPA has awarded the work of "Preparing and Monitoring of Environmental monitoring and management plan for Deendayal Port Authority Kandla and Vadinar to Gujarat Environment Management Institute (GEMI), Gandhinagar (An autonomous Institute of Government of Gujarat).

Further for Pollution Abatement measures taken for Conservation of Natural Resources DPA appointed renowned agency i.e M/s. GUIDE, Bhuj for the following work.

1. Regular Monitoring of Mangrove Plantation.
2. Preparation of detailed marine Biodiversity management plan for the impact of the project activities as per the requirement of EC & CRZ Clearance accorded by the MoEF&CC, GOI for the project "Creation of water front facilities (Oil jetties 8,9,10,11) and development of land of area 554 acres for associated facilities for storage at old Kandla, Gandhidham, kutch, Gujarat by M/s Deendayal Port Authority"
3. Regular monitoring of marine ecology in and around the Deendayal Port Authority area and continuous monitoring programme covering all season on various aspects of the coastal environ covering physico-chemical parameters of marine sediments samples coupled with biological indices, as per the requirement of EC & CRZ clearance accorded by the MoEF&CC,GOI to the various projects of the Deendayal port Authority.
4. Study on dredged material for presence of contaminant as per EC and CRZ clearance accorded by the MoEF&CC, GOI dated 19/12/2016 – specific condition vii

"PART-H"

ADDITIONAL MEASURES / INVESTMENT PROPOSAL FOR ENVIRONMENTAL PROTECTION INCLUDING ABATEMENT OF POLLUTION, PREVENTION OF POLLUTION

The allocation made under the scheme of "Environmental Services & Clearance there of other related Expenditure" during BE 2023-2024 is Rs. 274 Lakhs

"PART-I"

ANY OTHER PARTICULAR FOR IMPROVING THE QUALITY OF THE ENVIRONMENT

1. DPA is ISO 14001:2015 certified port for "Providing port facility and related maritime services for vessel and Cargo handling including storage
2. DPA has appointed M/s GEMI, Gandhinagar for the work "Making Deendayal Port a Green Port- Intended Sustainable Development under the Green Port Initiatives". M/s GEMI, Gandhinagar had submitted the Final Report on 10/03/2021
3. DPA has accorded the work of Afforestation project in Deendayal Port Area to Forest Department, GoG which includes plantation and maintenance work of 1100 plants per ha.
4. DPA has accorded the work of green belt development in Deendayal port Authority and its Surrounding areas charcoal site to GUIDE for the plantation of 5000 saplings of suitable species.
5. DPA has planted 7500 trees in Deendayal port trust area during the year 2014-15 6000 trees during financial year 2016-17 and the same has been regularly maintained.
6. DPA has planted 4000 trees at A.O building, Gopalpuri residential colony and along the road side at Kandla. Further, approximately 885 no. of trees have been planted since September 2015 onwards.
7. Continuous water sprinkling has been carried out on the top of the heap of coal, at regular intervals to prevent dusting, fire and smoke. DPA already installed sprinkling system inside Cargo Jetty area for coal dust suppression in coal yard (40 Ha. Area) at the cost of Rs. 14.44 crores.
8. DPA has installed Mist Canon at the Port area to minimize the coal dust.
9. Deendayal port Authority (traffic department) issued a Circular (SOP) to the trade with regard to control of dust pollution arising out of coal handling and ensuring safety in coal handling. In case of any violations of SOP, provision of impose of penalty of Rs. 10000/- has been made and if violation is repeated thrice, the same will lead to ban of concerned party into port area. The DPA is taking all the measures to reduce coal dust by implementing the coal handling guidelines through port users.

10. All trucks before leaving the storage yard have been covered with tarpaulin and also trucks are also not over loaded as well as there is no spillage during transportation and there is adequate space for movement of vehicles at the surrounding area.
11. DPA has constantly improving the house keeping in the dry cargo storage yard and nearby approved areas leading to roads. Adequate steps under the provisions of air prevention and control of pollution Act 1981, Environmental Protection Act 1986 are taken.
12. DPA commissioned STP of capacity 1.5 MLD for treatment of domestic waste water for entire DPA area. (Details of domestic waste water generation is attached herewith as **Annexure V**)
13. Deendayal Port Authority had carried out mangrove plantation in an area of 1500 ha. through various government agencies like Gujarat Ecology Commission, State Forest Department.
14. It is also relevant to mention here that, DPA entrusted work to Forest Department, GoG (Social Forestry Division, Bhuj) during August, 2019 for green belt development in and around port area 31.942 hectares (approx. 35200 plants at various locations) at a cost of Rs. 352.32 lakhs.
15. DPA is involved in various CER activities like providing the proper sanitation and development of better roads for connectivity
16. DPA is managing its plastic waste as per Plastic Waste Management Rules – 2016 and amendments made therein. In order to strictly implement the said rules, DPT had issued a circular regarding plastic waste minimization, source segregation, recycling etc. vide its Circular no. EG/WK/4751/Part 243(A) dated 03/09/2021
17. DPA has entrusted the work to GEMI, Gandhinagar for "Preparation of Plan for Management of Plastic Waste, Solid Waste, C&D Waste, E-waste, Hazardous Waste including Bio-medical Waste and Non-hazardous waste in the Deendayal Port Authority Area
18. DPA has assigned the work to TERI, New Delhi for "Transition of Business Operations to Water Neutrality – Water Neutrality of Deendayal Port, Kandla (Phase I- Study and assessment)
19. Recently, DPA has entrusted the work to GEMI, Gandhinagar for "Study of CO₂ Emission Estimation and Reduction Strategy under Maritime India Vision 2030.
20. Initiative for Installation of Continuous Ambient Air Quality Monitoring System (CAAQMS) for monitoring of Air quality is under process.