Deendayal Port Authority
(Erstwhile :Deendayal Port Trust)

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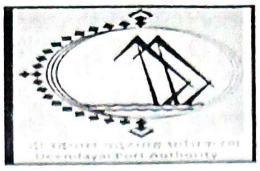

Office of the Dy.CE & EMC (i/c),
ANNEX, Administrative Office
Gandhidham - Kutch
Pin – 370 201.

ISO 9001 – 2015 &
ISO 14001 –2015 Certified Port

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EG/WK/4751/Part (Revamping – EC onwards)/102 Dated:29/07/2024

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

Sub: "Augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA Through Modernisation of Existing Pipeline Network at Oil Jetty Area, Deendayal Port Trust, Kandla – **Pointwise Compliances of the conditions stipulated in NOC (CTE – 115467) issued by the GPCB reg.**

Ref.: NOC/CTE order issued by the GPCB vide letter no. PC/CCA-KUTCH-812(5)/GPCB ID 28494/609592 dated 23/12/2021.

Sir,

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

In this connection, it is to state that, the Gujarat Pollution Control Board had granted Consent to Establish (CTE- **115467**) for the subject proposal of DPA with a validity period up to 11/02/2026.

In this regard, it is relevant to mention here that, DPA had already obtained Environmental & CRZ Clearance for the subject project from the MoEF&CC,GoI dated 01/01/2024 .

Now, as per the statutory requirement to submit the compliance of stipulated conditions in the CTE – 115467, we are submitting herewith pointwise compliance report (Period up to May 2024) of the stipulated conditions mentioned in the CTE order 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 compliance of stipulated conditions mentioned in the CTE – 115467 through e-mail in ID: kut-uh-gpcb@gujarat.gov.in.

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

Yours faithfully,

29/7/24

Dy. Chief Engineer & EMC(I/c)
Deendayal Port Authority

Encl.: As above

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

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Annexure I

CTE Compliance

Compliance Report Up to June, 2024

Subject: Point wise compliance report of stipulated conditions mentioned in the Consent to Establish no CTE - 115467 dated 23/12/2021 to Deendayal Port Authority, (New Name) PCB ID -28494

Reference: CTE amendment issued vide consent order no. PC/CCA-Kutch-812(5)/GPCB ID-28494/609592 dated 23/12/2021

Sr. No	Conditions	Compliance Status
1	**Specific Conditions**	
1.	Industry shall not start any activities wrt augmentation of liquid cargo handling capacity from 8 MMTPA to 23.8 MTPA without prior Environment Clearance & CRZ clearance of the competent authority	Point Noted for the compliance.
2.	Unit shall strictly comply with all conditions of Terms of Reference granted by MoEF & CC vide order dated 10-26/2018-1A-lll dated 14/06/2018 & 11/06/2020	Compliance of the conditions stipulated in Terms of reference (ToR) granted by the MoEF&CC vide order dated 14/06/2018 and revised ToR dated 11/06/2020 prepared by M/s Mecon, Ranchi and submitted in the Final EIA report (January 2022). A copy of same is attached herewith as **Annexure A**
3.	Unit shall strictly adhere all conditions of Environment Clearance vide order no. 11-82/2011-IA-III, dated 19/12/2016	The compliance reports of stipulated conditions mentioned in the EC & CRZ Clearance accorded by the MoEF&CC,GoI vide File no. 11-82/2011-IA-III dated 19/12/20216, are being submitted regularly, to the concerned authorities viz. Regional Office, MoEF&CC,GoI, Bhopal with a copy to the MoEF&CC,GoI, New Delhi, RO,CPCB, Vadodara, GPCB, Gandhinagar as well as GPCB Regional Office, Gandhidham. Last compliance report submitted on 20/02/2024 is attached herewith as **Annexure-B**
4.	There shall be no change in existing water consumption, waste water generation, fuel consumption, flue gases emission & process gases emission & hazardous waste category & quantity, due to proposed CTE-Amendment.	Point Noted for the compliance.
5.	Unit shall also strictly adhere to all conditions of Environment and CRZ Clearance issued by MoEF vide letter no. F. no. 11-70/2006-IA-III dated 01/10/2008	The compliance reports of stipulated conditions mentioned in the EC & CRZ Clearance accorded by the MoEFCC,GoI vide File no. 11-70/2006-IA.III dated September, 2008, are being submitted regularly, to the concerned authorities viz. Regional Office, MoEF&CC,GoI, Bhopal with a copy to the MoEF&CC,GoI, New Delhi, RO,CPCB, Vadodara, GPCB, Gandhinagar as well as GPCB Regional Office, Gandhidham. Last compliance report submitted on 19/03/2024 is attached herewith as **Annexure-C**

6.	Applicant shall comply with Manufacture, storage and import of Hazardous Chemicals Rules-1989 (MSIHC) as amended time to time.	As per the Lease deed all the statutory clearance and its compliance needs to be done by the plot allotee/BOT operator. All plot allotees/BOT operators are complying with the said rules
7.	Applicant shall ensure that all storage terminal located within DPT area shall strictly comply with MSIHC rules including site notification & submit details periodically to board with relevant details.	As per the Lease deed all the statutory clearance and its compliance needs to be done by the plot allotee/BOT operator. All plot allotees/BOT operators are complying with the said rules
8.	Applicant shall renew Public Liability Insurance time to time & submit a copy to this Board.	The copy of Public Liability Insurance is kept at **Annexure-D** , which is valid till 23/07/2024. It is assured that, the PLI will be maintained.
9.	Unit shall notify site under MSIHC Rule – 1989 from component authority as mentioned in Schedule – 5 of MSIHC notification.	As per the Lease deed all the statutory clearance and its compliance needs to be done by the plot allotee/BOT operator. All plot allotees/BOT operators are complying with the said rules
10.	Industry shall not withdraw groundwater without prior NOC from CGWA as per Hon. National Green tribunal order.	Point noted. The Water requirement is being met through GWSSB (Narmada Pipeline) & through private tankers.
11.	Industry shall manage Solid waste generated from Industrial activities as per Solid Waste Management Rules-2016 (Solid waste as defined in Rule -3 (46))	Garbage facility is provided as per MARPOL Act 73/78 to the vessel berthed at Deendayal Port Trust. A copy of "Grant of Permission / License for removal of Dry Solid Waste(Non-Hazardous) from Vessels calling at Deendayal Port" is attached herewith as **Annexure-E.** 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 Trust. In additional to the above, DPA has accorded work for "Preparation of Plan for Management of Plastic Wastes, Solid waste including C&D wastes, E-wastes, Hazardous wastes including Biomedical". To Gujarat Environment Management Institute (GEMI), Gandhinagar vide work order dated 24/01/2023. The said work is in process.
12.	Industry shall comply with Plastic Waste Management Rules – 2016 and amendments made therein. If applicable	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, DPA had issued a circular regarding plastic waste minimization, source segregation, recycling etc. In additional to the above, DPA has accorded work for "Preparation of Plan for Management of Plastic Wastes, Solid waste including C&D wastes, E-wastes, Hazardous wastes including Biomedical". To Gujarat Environment Management Institute (GEMI), Gandhinagar

		vide work order dated 24/01/2023. The said work is in process.
13.	Industry shall strictly comply with coal handling guidelines of this board.	Deendayal Port Authority 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 (circular no. TF/SH/Circulars/2019/1256 dated 10/10/2019) . A copy of circular is attached herewith as **Annexure F** It is submitted that, the continuous steps are being taken by DPA to control/minimize dust pollution within Port area, which are enumerated as under: 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. Continues water sprinkling is being carried out on the heap of coal, at regular intervals to prevent dusting, fire and smoke DPA has undertaken the project of dust supersession sprinkling system for the 34 hectare coal storage yard. Two Road sweeper machines with compressor have been deployed along with two mist cannon machine for a contract period of 3 years, which are being operated continuously. Protection wall along the periphery of coal storage yard is made Further, to control dust pollution in other area, regular sprinkling through tankers on roads and other staking yards is being done Regular sweeping of spilled cargo from roads is done by parties on regular basis Most of the roads and plots inside Port area are paved in order to prevent dusting The directions have already been issued from time to time to all the traders in order to ensure that all trucks before leaving the storage yards will be covered with tarpaulin, no overloading of trucks are allowed and there should not be spillage of cargo during transportation. DPA has appointed 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 work completed. 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. DPA has appointed Gujarat Environment Management Institute (GEMI), Gandhinagar for regular monitoring of environmental parameters for the whole port area including Air Quality Monitoring vide work order dated 15/02/2023. Annual monitoring report is attached herewith as **Annexure G**
14.	Industry shall provide dedicated storage facility for dry cargo and ensure to take adequate measure to prevent dusting.	DPA has provided dedicated storage facilities for all type of Cargo including 33 warehouse and 67 open storage space. DPA vide its circular no. TF/SH/Circulars/2019/1256 dated 10/10/2019 has issued a circular for "controlling of Dust pollution arising out of Coal Handling". The same is already attached at **Annexure-F**. It is relevant to mention here that DPT has installed Mist Canon at the Port area to minimize the coal dust. The work related to construction of protection wall with wind screen to prevent coal dust deposition in building has already been completed during the year 2011-2012. Continues water sprinkling is being carried out on the top of the heap of coal, at regular intervals to prevent dusting, fire and smoke. DPT 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 croes. The DPA is taking all the required measures to reduce coal dust by implementing the Coal Handling Guidelines through Port users. DPA has appointed Gujarat Environment Management Institute (GEMI), Gandhinagar for regular monitoring of environmental parameters for the whole port area including Air Quality Monitoring vide work order dated 15/02/2023.

		Annual monitoring report is attached herewith as **Annexure G**
15.	Applicant shall ensure that there shall be no damage to the existing mangrove patches near site and also ensure the free flow of water to avoid damage to the mangroves.	As per the directions of the GCZMA and MoEF&CC,GoI, till date, DPA had already undertaken Mangrove Plantation in an area of 1600 Ha. till date since the year 2005.A statement showing details of mangrove plantation at various locations with cost incurred is placed at **Annexure H.** It is also relevant to submit here that, as per the direction of the Gujarat Coastal Zone Management Authority, DPA had already prepared &submitted a report on mangrove conservation and management plan formulated by Gujarat Institute of Desert Ecology during the study period of Jan-April, 2015 (Report attached as **Annexure I**). In addition to the above, DPA appointed M/s GUIDE, for "Regular Monitoring of Mangrove Plantation carried out by DPA" since 2017 In continuation of same DPA appointed M/s GUIDE, for "Regular Monitoring of Mangrove Plantation carried out by DPA" vide work order dated 10/06/2024 (Period 10/06/2024 to 09/06/2025) copy of work order is attached herewith as **Annexure J**
16.	Applicant shall ensure as per EC condition that no creeks or rivers are blocked due to any activities at the site and free flow of water is maintained.	No creeks or rivers are blocked, due to any activities undertaken at the project site and free flow of water is maintained.
17.	Applicant shall provide proper system for collection, storage and treatment and disposal of waste water generated by vessel as per MARPOL & maintain records & submit periodically to this office.	DPA has a dedicated Sewage Treatment Plant (STP)at Deendayal Port, Kandla Township, Gandhidham for treatment of waste water. The water is being stored at underground tanks at various locations at Kandla.
18.	Applicant shall install storm drainage catch basin to avoid directly discharge into surface water.	Point Noted. Necessary surface drainage system including storm water network has already been provided for proper drainage.
19.	Waste effluent accumulated with port activities including storm water & sewage from port operation including sewage ballast water, bilge water & clean waste from ships shall be as per MARPOL norms.	Point Noted for compliance. A copy of Grant of License/Permission to carry out the work of collection and disposal of "Hazardous Waste/Sludge/ Waste Oil" from Vessels calling at Deendayal Port" is already attached at **Annexure-K**
20.	Applicant shall make separate records regarding generation, collection, transportation and disposal of waste generation from ship & maintain its records.	Point noted for the compliance.
21.	Applicant shall made necessary arrangement for plastic waste, solid waste or other waste generation due to port activities & for facilitation of reception facilities under	Complied with the condition. A copy of "Grant of Permission / License for removal of Dry Solid Waste (Non Hazardous)

	MARPOL & Environment (Protection) Act – 1986 rules etc.	from Vessels calling at Deendayal Port" is attached herewith as **Annexure-E.** It is relevant to mention here, that DPA has invited tender for Appointment of Advisor for "Preparation of Plan for Management of Plastic Wastes, Solid waste including C&D wastes, E-wastes, Hazardous wastes including Biomedical". The tender is under evaluation.
22.	Ports shall obtain approval of their oil spill contingency plan (OSCP) as required under national oil spill disaster contingency plan (NOS-DCP) of coast guard. Ministry of defense, govt. of India.	DPT is already having Oil Spill Contingency Plan Copy placed at **Annexure-L**
23.	Best environmental practices by ports may be uploaded on "Indian ports Association" as well as the same may be linked to websites of CPCB and respective SPCBs.	DPA is ISO 14001:2015 certified port for "Providing port facility and related maritime services for vessel and Cargo handling including storage" As per the directions of the GCZMA and MoEF&CC,GoI, till date, DPA had already undertaken Mangrove Plantation in an area of 1600 Ha. till date since the year 2005. A statement showing details of mangrove plantation at various locations with cost incurred is placed at **Annexure H.** 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 In addition to the above, DPA has been submitting regularly the compliance of the conditions stipulated in Environmental & CRZ Clearance, CRZ recommendation and CTE to MoEF&CC along with all statutory bodies. The same is being uploaded in MoEF&CC parivesh portal on regular basis. DPA also has been regularly submitting Annual Return of Hazardous waste in Form IV and Environmental Statement in Form V for the entire port area and uploading the same in GPCB site on regular basis. Form IV and V for the year 2023-24 is attached herewith as **Annexure-M & N respectively.** It is relevant to mention here that DPA is regularly sharing the details of Best Environmental Practices to the "Ministry of Ports Shipping and Water Ways" under the Green Port Initiatives, Maritime India Vision 2030 etc.

24.	Manually handling of cargo should be converted into mechanized system, in time bound manner.	DPA is in process for mechanization of cargo handling. In view of the same, DPA has invited tenders for "Development of Mechanized Fertilizer & Other Clean Cargo Handling Facilities on DBOT basis under PPP mode". The same is under Planning stage. DPT has also invited tender for "Appointment of consultant for the study & preparation of techno economical feasibility report for mechanized handling of cargo at DPT". The same is under Planning stage.
25.	Industry shall not carry out any activities, which may attract the applicability of EIA notification-2006 & its amendment.	Not Applicable. This CTE is granted against the Terms of reference (ToR) granted by the MoEF&CC vide order dated 14/06/2018 and revised ToR dated 11/06/2020. EC is in process
26.	No ground water shall be withdrawal without prior permission from CGWA as per Hon'ble NGT order.	Point Noted
27.	Industry shall renew Public Liability insurance Policy time to time & submit a copy of the same to this office	The copy of Public Liability Insurance is kept at **Annexure-D** , which is valid till 23/07/2024. It is assured that, the PLI will be maintained
3.	**CONDITIONS UNDER HAZARDOUS WASTE RULES:**	
3.1	The applicant shall have to comply with provisions of Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.	Point Noted
3.2	The applicant shall obtain membership of common TSDF site for disposal of Hazardous waste as categorized in Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.	DPA appointed GPCB approved vendors for collection and recycling of the hazardous waste.
3.3	The applicant shall obtain membership of common Hazardous Waste incinerator for disposal of incinerable waste.	DPA appointed GPCB approved vendors for collection and recycling of the hazardous waste
3.4	The applicant shall provide temporary storage facilities for each type of Hazardous Waste as per Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016	Point Noted
3.5	The applicant shall obtain registration/authorization for recycling/reprocessing any hazardous waste before procuring material/starting production as per HW Rules 2016	DPA appointed GPCB approved vendors for collection of hazardous waste and they are collecting it regularly
3.6	The applicant shall obtain authorization for recovery/reuses of any hazardous waste material as per HW Rules 2016	DPA appointed GPCB approved vendors for collection and recycling of the hazardous waste
6.	**Specific Conditions: -**	
4.	**General Conditions: -**	
4.1	Adequate plantation shall be carried out all along the periphery of the industrial	Point noted for compliance.

	premises in such a way that the density of plantation is at east 1000 trees per acre of land and a green belt of 03 meters'width is developed	
4.2	Any change in personnel, equipment or working conditions as mentioned in the consents from order should immediately be intimated to this Board.	Point noted for compliance.
4.3	ln case of change of ownership/management the name and address of the new owners/partners/directors/proprietor should immediately be intimated to the Board	Point Noted.
4.4	The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emission or sewage waste from the proposed industrial plant. The applicant is required to make applications to this Board for this purpose in the prescribed forms under the provisions of the Water Acl-1974, the Air Act-1981 and the Environment (Protection) Act-1986	Point Noted.
4.5	The concentration of Noise in ambient air within the premises of industrial unit shall not exceed following levels: Between 6 A.M. and 10 P.M.: 75 dB(A) Between 10 P.M and 6 A.M.: 70 dB(A)	DPA has appointed Gujarat Environment Management Institute (GEMI), Gandhinagar for regular monitoring of environmental parameters for the whole port area including Air Quality Monitoring vide work order dated 15/02/2023. Annual monitoring report is attached herewith as **Annexure G**
4.6	Applicant is required to comply with the manufacturing, Storage and import of Hazardous Chemicals Rules-1989 framed under the Environment (Protection) Act-1986	Point Noted.
4.7	lf it is established by any competent authority that the damage is caused due to their industrial activities to any person or his property in that case, they are obliged to pay the compensation as determined by the competent authority	Point Noted.

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Annexure A

ToR Compliance

COVERAGE OF TERMS OF REFERENCE

Sl. No.	ToR	Chapters	Pages	Remarks
	Specific and General Condition			
i	Importance and benefits of the project	8	202 - 203	Old redundant pipelines will be scrapped creating space for new pipelines of higher capacity. Liquid cargo handling capacity of port will increase to 23.8 MTPA from 8 MTPA. Safety will improve due to improved layout & use of corrosion resistant material in new pipes . Greater mix of cargo will be handled. Employment generation
ii	Submit a copy of layout superimposed on HTL/LTL Map demarcated by an authorized agency in 1:4000 scale	7 Clause 7.1	124	HTL/LTL Map demarcated by Institute of Remote Sensing, Anna University, Chennai. Enclosed as Annexure 7.1.
iii	Recommendation of SCZMA	7 Clause 7.1	124	Carry out mangrove plantation in 50 ha. area with consultation of concerned District Forest Office of Forest District & Gujarat Ecology Commission
iv	Submit a complete set of documents required as per para 4.2 (i) of CRZ Notification, 2011	CRZ Report & Map attached as Annexure 7.1. GCZMA has decided to recommend the project to MoEFCC vide Letter File No. ENV-10-2021-41-T dated 25-08-22 (copy enclosed as Annexure 7.2)		
v	Certified compliance report issued by the MoEF&CC, Regional Office or concerned Regional Office of Central Pollution Control Board or Member Secretary of the respective State Pollution Control Board for the conditions stipulated in the earlier environmental clearance issued for the project along with an action taken report on issues which have been stated to be partially complied or non / not complied	Enclosed As APPENDIX - I		
vi	The project proponents shall satisfactorily address to all the complaints / suggestions that have been received against the project till the date of	Till date no complaints have been received against the proposed pipeline revamping project.		

Sl. No.	ToR	Chapters	Pages	Remarks
	submission of proposals for appraisal			
vii	Various dock and ship building facilities with capacities for existing and proposed project	2 Clause 2.4.1	11	Deendayal Port presently has a steel floating dry dock of 95 m LOA, 5.4 m draft, 20 m beam & 2700 t capacity. No existing or proposed ship building facilities.
viii	Study impact of dredging on shoreline	2 Clause 2.5.2	20	Present project does not envisage any dredging
ix	A detailed analysis of rock dredging		20	
x	The EIA would provide an item wise compliance of the proposals to the ECBC norms.		20	No applicable as the proposed project does not envisage construction of any new building.
xi	A Certificate from the competent authority for discharging treated effluent / untreated effluents into the public sewer / drainage systems along with the final disposal point.	2 Clause 2.6.1	23	Utlisation of sewage for plantation / gardening in the GPCB's Consent Order No. AWH – 72820 dated 31/08/2015, which is valid up to 21/07/2020 (copy enclosed as Annexure 2.1)
xii	A Certificate from the local body supplying water, specifying the total annual water availability with the local authority, the quantity of water already committed, the quantity of water allotted to the project under consideration and the balance water available. This should be specified separately for ground water and surface water sources, ensuring that there is no impact on other users.	2 Clause 2.6.1	23	The source of water is Gujarat Water Supply and Sewerage Board - an agency of the Govt. of Gujarat. Domestic water requirement for the port area is estimated to be 200 m^3/day and it will remain unchanged after the proposed pipeline revamping and replacement project.
xiii	A certificate of adequacy of available power from the agency supplying power to the project along with load allowed for the project.	2 Clause 2.6.2	24	Power requirement for the proposed activity will not change from the existing requirement. Power is supplied by Paschim Gujarat Vij Company Limited – a Govt. of Gujarat organisation. Contract Demand for electricity is 4.1 MW. Scheduling is 2.1 MW. 2 x 1000 KVA DG Sets have been installed for emergency power supply.
xiv	A certificate from the competent authority handling municipal solid wastes indicating the existing civic capacities of handling their adequacy to cater to the	4	100	At present, ships calling at the port who wish to discharge solid wastes have to submit advance

Sl. No.	ToR	Chapters	Pages	Remarks
	M.S.W generated from the project.			information and hand over the waste(s) to any one of the Port's licensed waste disposal contractors, who have authorization from GPCB. This practice shall continue.
xv	The air quality index shall be calculated for base level air quality	3 Clause 3.4.2	40, 41	Air Quality at 7 out of 8 locations classified as "Moderately Polluted". At the 8th Station its "Poor". AQI values are high primarily because of high levels of PM_{10}.
xvi	The EIA would study the impact of dewatering and draw up an action plan for disposal of excess water.	4 Clause 4.1.2	97	The project does not envisage digging of any foundations. Thus the question of dewatering construction pits does not arise. The project also does not envisage any drawal of ground water. .
xvii	The EIA would study the impact of demolition and conformance to the Construction and Demolition Rules under E.P. Act 1986.	4 Clause 4.1.3	97	The only solid wastes are likely to be generated during the revamping of the existing pipelines are scrapped steel pipes and structurals (estimated to be ~4000 t), which will be temporarily stacked in a designated area before being auctioned off as scrap metal. Demolition of any building or masonry structure is not envisaged in the present project.
xviii	The EIA would include a chapter on how the project conforms to the CRZ management plan being drawn up by the State Government in compliance with NGT orders.	7 Clause 7.12	199 - 201	DPT is arranging to plant mangroves along the coasts of Gulf of Kutch. Regular monitoring of sea-water, sediments and DPT has been undertaking Socio-Economic Development of communities in Kandla as well Vadinar areas under its CSR programme.
xix	Study the impacts of dredging and dumping on marine ecology and draw up a management plan through NOI or any other institute specializing in marine ecology	2 Clause 2.5.2	20	Present project does not envisage any dredging
xx	A detailed analysis of the physic-chemical and biotic components in the highly	3		

Sl. No.	ToR	Chapters	Pages	Remarks
	turbid waters around the project site (as exhibited in Google Map shown during the presentation), compare it with physic-chemical and biotic components in the adjacent clearer (blue) waters both in terms of baseline and impact assessment and draw up a management plan.	Clauses 3.4.3 3.4.7	 40 – 46 54 - 87	
xxi	Details of emission, effluents, solid waste and hazardous waste generation and their management in existing and proposed facilities	4 Clauses 4.1.4 4.2.1 4.2.2 4.2.4	 97 97 – 101 101 102 - 110	No air emissions except NOx generation during construction. No solid or liquid waste generation during regular operation of pipelines. Ships wishing to discharge onboard solid & liquid wastes shall hand over wastes only to DPT's licensed waste disposal contractors. At the proposed expanded project only liquid cargo shall be handled by pumping through pipelines i.e. there shall be no fugitive dust emissions on handling of dry bulk cargo or emissions from vehicles transporting the cargo between the ships and the cargo stacking area. There shall be no fuel burning in the cargo handling area. However, some increase in road traffic is anticipated. Although the existing roads are well maintained asphalt roads, some fugitive dust will be generated from the roads and NOx shall be emitted from diesel powered trucks. The maximum predicted GLCs are limited to 101 µg/m^3, 35 µg/m^3, 26 µg/m^3 and 176 µg/m^3 for PM_{10}, $PM_{2.5}$, SO_2 and NOx respectively at the centre of the roads.. The values decrease drastically as the distance from roads increase.
xxii	The existing project shall avail of and submit consent to operate from the State Pollution Control Board	Noted and Complied with. The Consent Order is enclosed as Annexure 2.1		

Sl. No.	ToR	Chapters	Pages	Remarks
xxiii	Requirement of water, power with source of supply, status of approval, water balance diagram, manpower requirement (regular and contract)	2 Clause 2.6 Clause 2.8	23 - 24 24	The source of water is Gujarat Water Supply and Sewerage Board. The domestic water requirement for the port area is estimated to be 200 m^3/day and it will remain unchanged after proposed revamping project. 160 m^3/day of treated sewage is utilised for dust suppression & horticulture in the port area. Power requirement for the proposed activity will not change from the existing requirement. Power is supplied by Paschim Gujarat Vij Company Limited (PGVCL) – a Govt. of Gujarat organisation. Contract Demand for electricity is 4.1 MW. Scheduling is 2.1 MW. 2 x 1000 KVA DG Sets have been installed for emergency power supply. Presently Deendayal Port Trust employs 2634 persons. It is expected that maximum ~200 workers will be engaged at any given time during construction. These will be contractors' workers. The revamped pipelines will be operated by an external O&M agency hired by DPT.
xxiv	Waste water management plan	4 Clause 4.2.1.2	99 - 101	Ships have to comply with IMO's Ballast Water Management Convention. DPT does not allow discharge of slops and oily waste waters from ships into the harbour in accordance with IMO Regulations. Ships wishing to discharge onboard liquid wastes shall hand over wastes only to DPT's licensed waste disposal contractors. Township sewage treated in STP. Treated sewage used for industrial purposes in port.
xxv	Details of Environment Monitoring Plan	6	116 - 123	Environmental monitoring covering micro-meteorology, air quality, water quality, sediment quality & noise levels, being carried out through accredited laboratory. Marine

Sl. No.	ToR	Chapters	Pages	Remarks
				ecology studies being carried out by Gujarat Inst. of Desert Ecology. Annual cost: Rs.1.47 crores.
xxvi	To prepare detailed bio-diversity impact assessment reports and management plan through the NIOS or any other institute of repute on marine, brackish water and fresh water ecology and biodiversity. The report shall study the impact on the rivers, estuary and the sea and include the inter-tidal biotopes, corals and coral communities, mollusks, sea grasses, sea weeds, sub-tidal habitats, fishes and 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 standard survey methods.	3 Clause 3.4.7	54 - 87	Detailed marine biodiversity studies carried out by Gujarat Institute of Desert Ecology (GUIDE), Bhuj. GUIDE has a dedicated “Coastal and Marine Ecology Division”.
xxvii	An assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, shall be made for traffic densities and parking capabilities in a 05 km radius from the site. A detailed traffic management and a specific decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted with the EIA. The Plan to be implemented to the satisfaction of the State Urban Development and Transport Departments shall also include the consent of all implementing agencies.	4 Clause 4.2.3	101 - 102	The proposed project envisages increasing liquid cargo handling by 15.8 Mt/yr. The liquids will be pumped to shore based storage tanks and from there despatched through trucks or pipelines. It is assumed that 50% of the additional 15.8 Mt/yr (~7.9 Mt/yr) cargo shall be transported by road; the balance will be transported through pipelines & railway wagons. It is also considered that the additional cargo will be transported 12 t capacity trucks. Transport will be carried out over 365 days per year. It is thus estimated that additional 1804 trucks shall be transported daily i.e. 3608 truck-trips (equivalent to 10824 PCUs considering 1 truck is equivalent to 3 PCUs) per day. Truck movement will take place for 24 hours per day. Considering, that 50% of the additional road traffic will use the direct road to Gandhidham and balance 50% of the additional traffic will use the road towards the Dry Cargo Berths, the traffic on the Oil-Jetty

Sl. No.	ToR	Chapters	Pages	Remarks
				Area to Dry Cargo Berths is expected to increase by ~5420 PCUs per day to ~9270 PCUs per day. The traffic on the direct road towards Gandhidham will probably increase by ~5420 PCUs per day to ~11020 PCUs per day. Thus the resultant traffic on both roads shall nonetheless remain well within the rated capacity for such roads as specified in Clause 11.1 of IRC:64 (35,000 PCUs per day). It is to be noted that during the traffic survey it was observed that ~40% of the trucks being used for liquid cargo transport have capacity more than 12 t. So it is likely that the actual increase in number of vehicles will be less than the above estimated values.
xxviii	A Disaster Management Plan for the above terminal	7 Clause 7.10	183 - 199	
xxix	Layout plan of existing and proposed green belt	4 Clause 4.2.6.2	110 - 111	Enclosed as DPT's Drawing no. KPH/2013/
xxx	Status of court cases pending against the project	1 Clause 1.3	4	No court cases pending
xxxi	A tabular chart with index for point-wise compliance of the above ToRs	Noted and Complied		
xxxii	Public hearing to be conducted and issues raised and commitments made by the project proponent on the same should be included in EIA/EMP report in form of tabular chart with financial budget for complying with the commitments made.	Will be included in Final Report		
xxxiii	Plan for Corporate Environment Responsibility (CER) as specified under Ministry's Office Memorandum vide F. No. 22-65/2017-IA.III dated 1st May, 2018 shall be prepared and submitted along with EIA Report	7 Clause 7.5	133	DPT will spend ~Rs.1.53 crores towards works under Corporate Environmental Responsibility. The exact works to be undertaken under this head will decided in consultation with local villagers during the Environmental

Sl. No.	ToR	Chapters	Pages	Remarks
				Public Hearing.
General Guidelines				
i	The EIA Document shall be printed on both sides as far as possible	Noted and Complied with		
ii	All documents should be properly indexed, page numbered	Noted and Complied with		
iii	Period / date of data collection should be clearly indicated	Noted and Complied with		
iv	Authenticated English translation of all material provided in Regional languages	Noted and Complied with		
v	The letter / application for EC should quote the MoEF&CC File No. and also attach copy of the letter prescribing ToR	1	3, 4	ToR Approved vide Letter no. F. No. 10-26/2018-IA-III dated 14th June, 2018 (enclosed as Annexure 1.1). ToR amended vide letter no. no. F. No. 10-26/2018-IA-III dated 11th June, 2020 (enclosed as Annexure 1.1A).
vi	The copy of the letter received from the Ministry on the ToR prescribed for the project should be attached as Annexure to the Final EIA/EMP Report			
vii	The final EIA/EMP Report submitted to the Ministry must incorporate the issues in the ToR and that raised in the Public Hearing. The index of the Final EIA/EMP Report must indicate the specific Chapter and page no. of the EIA-EMP Report where the specific ToR prescribed by the Ministry and the issue raised in the P.H. have been incorporated. Questionnaire related to the project (posted on MoEF&CC website) with all sections duly filled in shall also be submitted at the time applying for EC	Noted and Complied with		
viii	Grant of ToR does not mean grant of EC	Noted and understood		
ix	The status of accreditation of the EIA consultant with NABET / QCI shall be specifically mentioned. The consultant shall certify that his accreditation is for the sector for which this EIA is prepared.	12 Clause 12.2	214 - 215	MECON Limited is accredited by QCI/NABET for preparing EIA/EMP reports in 17 sectors, including “Ports, harbours, jetties, marine terminals, break waters and dredging” vide their certificate no. NABET/EIA/2023/RA 0195, which is valid up to 09-02-2023. A copy of this NABET certificate along with

Sl. No.	ToR	Chapters	Pages	Remarks
				extension letters is attached as Annexure 12.1.
x	The front page of EIA / EMP Reports, the name of the consultant / consultancy firm along with their complete details including their accreditation, if any, shall be indicated. The consultant while submitting the EIA / EMP Report shall give an undertaking to the effect that the prescribed TORs (TOR proposed by the project proponent and additional TOR given by the MoEF) have been complied with and the data submitted is factually correct (Refer MoEF office memorandum dated 4th August, 2009).	Noted and Complied With		
xi	While submitting the EIA / EMP Reports, the name of the experts associated with / involved in the preparation of these reports and the laboratories through which the samples have been got analysed should be stated in the report. It shall clearly be indicated whether these laboratories are approved under the Environment (Protection) Act, 1986 and the rules made there under (please refer MoEF Office Memorandum dated 4th August, 2009). The project leader of the EIA Study shall also be mentioned.	Noted and Complied with		
xii	All the ToR points as presented before the Expert Appraisal Committee (EAC) shall be covered	Noted and Complied with		
Standard ToR				
i	Reasons for selecting the site with details of alternate sites examined / rejected / selected on merit with comparative statement and reason / basis for selection. The examination should justify site suitability in terms of environmental angle, resources sustainability associated with selected site as compared to rejected site. The analysis should include parameters considered along with weightage criteria for short listing selected site.	5	115	The proposed project envisages increasing the liquid cargo handling capacity of the port by Replacement and Revamping of existing pipeline network leading from the existing oil jetties to the shore based storage facilities. There is no question of examining any alternate site.
ii	Details of the land use break up for the proposed project. Details of the land use	3	26 - 28	The project area is located in the oil jetty area of

Sl. No.	ToR	Chapters	Pages	Remarks
	around 10 km radius of the project site. Examine and submit detail of land use around 10 km radius of the project site and map of the project area and 10 km area from the boundary of the proposed / existing project area, delineating project areas as notified under the Wildlife (Protection) Act, 1972 / critically polluted areas as identified by the CPCB from time to time / notified eco-sensitive areas / interstate boundaries and international boundaries. Analysis should be made based on latest satellite imagery for land use with raw images	Clause 3.3.4		Deendayal Port, Kandla. This entire area is within the premises of Deendayal Port. Existing land cover in the area within 10 km radius has been studied through satellite image (LISS-IV of 8th February, 2018 with 5 m resolution) processing. There is no Biosphere Reserve, Tiger Reserve, National Park, Wildlife Sanctuary, Elephant Reserve, Elephant Corridor or Defence Installation in the study area. The area is also not classified as "Critically Polluted" by Central Pollution Control Board.
iii	Submit the present land use and permission required for any conversion such as forest, agriculture etc. land acquisition status, rehabilitation of communities / villages and presence status of such activities.	2 Clause 2.4 Clause 2.5.2	7 20	The project area is located in the existing oil jetty area of Deendayal Port, Kandla. This entire area is within the existing premises of Deendayal Port and hence no acquisition of additional land will be necessary.
iv	Examine and submit the water bodies including the seasonal ones within the corridor of impacts along with their status, volumetric capacity, quality likely impacts on them due to the project.	4 Clause 4.1.2	96	There is no possibility of shore-line changes as no new off shore structures will be constructed or dredging will be carried out. As there will be no dredging, or construction of new structures offshore or close to the shore changes in water quality due to dredging & dumping of dredge spoils offshore or near-shore excavations is ruled out.
v	Submit a copy of the contour plan with slopes, drainage pattern of the site and surrounding area.	2 Clause 2.4.1	11	Layout of Deendayal Port is presented as Drawing No. KPH/14.
vi	Submit the details of terrain, level with respect to MSL, filling required, source of	2	20	The new pipelines will be laid on the existing pipe bridges after

Sl. No.	ToR	Chapters	Pages	Remarks
	filling materials and transportation details etc.	Clause 2.5.2		scrapping some of the existing pipelines. No land filling will be necessary.
vii	Examine / road / rail connectivity to the project site and impact on the existing traffic network due to the proposed project / activities. A detailed traffic and transportation study should be made for existing and projected passenger and cargo traffic.	2 Clause 2.4.2	11	Deendayal Port, Kandla can be approached from Gandhidham by NH-8A. Gandhidham is linked to the national road network. The nearest railway station is at Gandhidham (~8 km away) on Western Railway's Ahmedabad - Bhuj broad gauge line. Deendayal Port is linked to Gandhidham through its own railways. The nearest airport is also at Gandhidham (~14.5 km away)
viii	Submit details regarding R & R involved in the project.	2 Clause 2.5.2	20	No R & R required.
ix	Submit a copy of the layout superimposed on the HTL / LTL map demarcated by an authorized agency on 1:4000 scale along with recommendation of SCZMA	7 Clause 7.1	124	HTL/LTL Map demarcated by Institute of Remote Sensing, Anna University, Chennai. Enclosed as Annexure 7.1.
x	Submit the status of shoreline changes at the project site	4 Clause 4.1.2	96	There is no possibility of shore-line changes as no new off shore structures will be constructed or dredging will be carried out.
xi	Details of the layout plan including details of channel, breakwaters, dredging, disposal and reclamation	2 Clause 2.4.1	7 - 11	Layout of Deendayal Port is presented as Drawing No. KPH/14.
xii	Details of handling of each cargo, storage, transport along with spillage control, dust prevention measures. In case of coal, mineral cargo, details of storage and closed conveyance, dust suppression and prevention filters.	2 Clause 2.5.2 Clause 2.5.8	20 23	At the present project, only liquid cargo will be handled. The cargo will be transported between the ships and onshore storage tanks only through pipelines. Imported liquid cargo is pumped from ships to onshore storage tanks operated by various terminal operators. From the storage tanks, liquid cargo is sent to the users /

Sl. No.	ToR	Chapters	Pages	Remarks
				consumers through pipelines, railway tank wagons and road trucks. For export cargo, the process works in reverse. It is expected that ~50% of the additional cargo will be moved by railway wagons & pipelines and the rest will be moved by road trucks. The same arrangements shall continue. Additional storage tanks, pipelines and wagon loading / unloading facilities are being built by the terminal operators.
xiii	Submit the details of fishing activity and likely impacts on the fishing activity due to the project. Specific study on effects of construction activity and pile driving on marine life.	4 Clause 4.2.6.1	110	The project does not envisage any dredging or activities in water. Fishing is not permitted within the area of Deendayal Port. Since the proposed project will be implemented entirely on land, impacts on any attribute in the aquatic environment is ruled out.
xiv	Details of oil spill contingency plan	7 Clause 7.8	168 - 181	The port has the necessary resources and SOPs for dealing with Tier – I oil spills.
xv	Details of bathymetry study	2 Clause 2.4.1	7	Enclosed as DPT's Drawing No. H.S.3607
xvi	Details of ship tranquility study	2 Clause 2.4	7	Deendayal Port, Kandla is a Natural Harbour being located in Kandla Creek at the apex of the triangular Gulf of Kutch >100 km from the mouth of the Gulf of Kutch. OJ-1 is located ~6.6 km upstream of the creek mouth. The other oil jetties are further upstream. This has provided calm waters necessary for mooring of ships and cargo operations.
xvii	Examine the details of water requirement, impact on competitive user, treatment details, use of treated waste water. Prepare a water balance chart.	2 Clause 2.6.1	23	The domestic water requirement for the port area is estimated to be 200 m^3/day. This water is supplied by Gujarat Water Supply and Sewerage Board. The water is

Sl. No.	ToR	Chapters	Pages	Remarks
				of potable quality. Sewage generated at the township is treated in sewage treatment plant. The entire quantity of treated sewage is used for meeting the requirements of industrial water of the port.
xviii	Details of rainwater harvesting and utilization of rain water	4 Clause 4.2.1.2	101	No rain-water harvesting has been envisaged for the present project.
xix	Examine details of solid waste generation, treatment and its disposal	4 Clauses 4.1.3, 4.2.2.1	96 101	During the construction of the project, ~4000 t of redundant steel pipelines & steel structurals will be scrapped. These will be temporarily stacked in designated area prior to being auctioned off as scrap. No solid wastes to be generated during normal operation of pipelines. Ships' wastes will be disposed off through licensed waste disposal contractors.
xx	Details of desalination plant and the study for outfall and intake	There is no water desalination plant at Deendayal Port nor there is any proposal at present to build one.		
xxi	Examine baseline environmental quality along with projected incremental load due to the proposed project / activities.	3, Clauses 3.3, 3.4, 3.5, 3.6 4, Clauses 4.1, 4.2	26 – 95 96 - 111	No effect on water quality. Change in ambient air quality & noise levels in vicinity of roads but not at human habitations which are well away from roads.
xxii	The air quality monitoring should be carried out according to the notification issued on 16th November, 2009.	3 Clause 3.4.2	33 - 40	AAQ monitored at 8 locations during Summer, 2018
xxiii	Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.	4, Clauses 4.1, 4.2 6	96 – 110 116 - 123	Presently Rs.2.84 crores per year being spent twards pollution control; Rs.1.47 crores per year being spent towards environmental monitoring.
xxiv	Submit the details of a comprehensive Risk Assessment and Disaster Management Plan including emergency evacuation during natural and man-made disasters	7 Clause 7.7 Clause 7.10	133 – 169 183 - 199	

Sl. No.	ToR	Chapters	Pages	Remarks
xxv	Submit the details of trees to be cut including their species and whether it also involves any protected or endangered species. Measures taken to reduce the number of trees to be removed should be explained in detail. Submit the details of compensatory plantation. Explore the possibilities of relocating the existing trees.	2	20	Proposed project will come up at the site of existing pipelines. The land part project area is devoid of vegetation except some grasses and herbs. Mangrove vegetation is present in the intertidal zone but these are well below the pipelines which cross the intertidal zone over steel & concrete bridges No tree felling will be required; only some grasses and bushes will have to be cleared
xxvi	Examine the details of afforestation measures indicating land and financial outlay. Landscape plan, green belts and open spaces may be described. A thick green belt should be planned all around the nearest settlement to mitigate noise and vibrations. The identification of species / plants should be made based on botanical studies.	4 Clauses 4.2.6, 4.5	110, 111 114	DPT has planted ~17500 trees since 2014. In addition DPT has created about 1750 ha of mangrove plantations in the area through Gujarat Ecology Commission and Forest Department, Govt. of Gujarat. More are planned. In Aug., 2019 DPT assigned the task of plantation development over ~32 ha to Gujarat Forest Deptt.
xxvii	The public hearing should be conducted for the project in accordance with provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan. The public hearing should be conducted based on the ToR letter issued by the Ministry and not on the basis of Minutes of he Meeting available on the website.	The replies furnished by Deendayal Port Trust to the querries / issues raised during the Environmental Public Hearing shall be included in Chapter 7 of the Final EIA/EMP Report on completion of the Environmental Public Hearing		
xxviii	A detailed draft EIA/EMP Report should be prepared in accordance with the above additional ToR and should be submitted to the Ministry in accordance with the Notification	Noted and Complied With		
xxix	Details of litigation pending against the project, if any, with direction / order	1		No court cases pending

Sl. No.	ToR	Chapters	Pages	Remarks
	passed by any Court of Law, against the project should be given	Clause 1.3	4	
xxx	The cost of the project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	2 Clause 2.7.2 6 Clause 6.4	22 123	Capital Cost of Project: Rs.170.32 Crores. At present DPT is spending ~Rs.2.84 Crores per year towards environmental control measures. Another ~Rs.1.5 Crores per year is spent towards environmental monitoring
xxxi	Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website http://moef.nic.in/Manual/Port and harbour.			

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Annexure B

Compliance to EC dated 19/12/2016

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/Part (Comp. 1)/ 95

Dated: 25/07/2024

To,
The Deputy Director General of Forests (C),
Ministry of Environment, Forest & Climate Change,
Integrated Regional Office,
Gandhinagar, A wing-407 & 409,
Aranya Bhavan Near CH-3 Circle,
Sector 10 A, Gandhinagar -382010
Email : ecompliance-guj@gov.in

Sub: "Development of 7 Integrated facilities (Stage I) within the existing Kandla Port Trust limit at District Kutch (Gujarat) by M/s Kandla Port Trust Limited" – Environmental & CRZ Clearance – **Pointwise Compliances of the conditions stipulated in the EC&CRZ Clearance and Monitoring Report in Datasheet reg.**

Ref.:
1) MoEF&CC, GoI letter F. No. 11-82/2011-IA.III dated 19/12/2016
2) Ministry's letter vide F.No. 6-1/2017 (ENV) dated 1/5/2017.
3) KPT letter no. EG/WK/4751/Part (Compliance)/77 dated 3/6/2017.
4) DPT letter no. EG/WK/4751/part(Compliance)/610 dated 13/12/2017-Submission of Six Monthly Compliance Report (June, 2017 to Nov., 2017).
5) DPT letter no. EG/WK/4751/part (Compliance)/315 dated 14(21)/6/2018-Submission of Six Monthly Compliance Report (Dec, 2017 to May, 2018).
6) DPT letter no. EG/WK/4751/part (Compliance)/115 dated 30(2)/3(4)/2019– Submission of Six Monthly Compliance Report (up to March, 2019).
7) DPT letter no. EG/WK/4751/part (Compliance 1)/155 dated 14/11/2019– Submission of Compliance Report (up to October, 2019).
8) DPT letter no. EG/WK/4751/part (Compliance 1) dated 29/12/2020– Submission of Compliance Report (up to November, 2020).
9) DPT letter no. EG/WK/4751/part (Comp. 1)/95 dated 07/10/2021– Submission of Compliance Report (up to May, 2021).
10) DPA letter no. EG/WK/4751/part (Comp. 1)/221 dated 30/01/2023– Submission of Compliance Report (up to May, 2022).
11) DPA letter no. EG/WK/4751/part (Comp. 1)/286 dated 20/04/2023– Submission of Compliance Report (up to November, 2022).
12) DPA letter no. EG/WK/4751/part (Comp. 1)/359 dated 12/09/2023– Submission of Compliance Report (up to May, 2023).
13) DPA letter no. EG/WK/4751/part (Comp. 1)/26 dated 20/2/2024– Submission of Compliance Report (up to November, 2023).

Sir,

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

In this regard, it is to state that, Ministry of Environment, Forest and Climate Change (MoEF&CC), GoI vide F. No. 11-82/2011-IA.III dated 19/12/2016 has accorded Environmental and CRZ Clearance for the 7 project activities of Deendayal Port Authority.

.....cont...

Subsequently, DPA vide above referred letter dated 3/6/2017 had submitted details/information (including point-wise compliance of stipulated conditions & duly filled in data sheet) asked by the Regional Office, MoEF&CC, GoI, Bhopal in connection with the EC & CRZ Clearance granted by the MoEF&CC, GoI dated 19/12/2016 for the subject mentioned above. Further, DPA vide above referred letters had submitted compliance report of stipulated conditions.

Now, as directed in above referred letter dated 1/5/2017 of the Regional Office, MoEF&CC, GoI, Bhopal, please find enclosed herewith compliance report of stipulated conditions mentioned in the EC & CRZ Clearance granted by the MoEF&CC, GoI dated 19/12/2016 **(Annexure 1)** & Monitoring Report in Data Sheet **(Annexure 2)** (for the period up to May, 2024) for kind information and 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 in ID eccompliance-guj@gov.in.

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

Thanking You.

Yours faithfully,

Encl.: As above

Dy.CE & EMC(I/c)
Deendayal Port Authority

Copy along with point wise compliance of stipulated conditions, to:

1) Shri Amardeep Raju,
Scientist E, Ministry of Environment,
Forest and Climate Change,
& Member Secretary (EAC-Infra.1),
Indira Paryavaran Bhawan,
3rd Floor, Vayu Wing, Jor Bagh Road,
Aliganj,
New Delhi- 110 003;
E-mail:ad.raju@nic.in

2) Shri Prasoon Gargava,
Scientist E &Regional Director,
Central Pollution Control Board,
Parivesh Bhawan,
Opp. VMC Ward Office No.10,
Subhanpura,
Vadodara – 390 023.
Email Id.Prasoon.cpcb@nic.in

3) Shri T. C. Patel,
The Unit Head, Kachchh,
Gujarat Pollution Control Board,
Paryavaran Bhavan,
Sector 10A,
Gandhinagar- 382 010.
Email-kut-uh-gpcb@gujarat.gov.in

4) The Regional Officer,
Gujarat Pollution Control Board,
Regional Office (East Kutch)
Administrative Office Building,
Deendayal Port Authority,
Gandhidham 370201
Email Id. ro-gpcb-kute@gujarat.gov.in

Annexure 1

CURRENT STATUS OF WORK (up to May, 2024)

Subject: Development of 7 integrated facilities (Stage I) within existing Deendayal Authority at Kandla.

Reference: Environmental and CRZ Clearance granted by MoEF&CC, GoI vide letter F. No. 11-82/2011-IA-III dated 19/12/2016.

Name of Project	Status
1. Development of oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode (jetty: 300m x 15m, approach 450 m X 10 m, back up area 5.5 HA, capacity – 3.39 MMTPA, capital dredging 1,73,660 m^3 maintenance dredging 1,56,294 m^3 (Estimated cost: 276.53 Cr.).	The Concession Agreement was executed between DPA and M/s KOTPL on 16/11/2013 to implement the project on Built, Transfer & Operate (BOT- PPP) Basis by M/s KOTPL. The award of concession was issued on 11/12/2020 to M/s KOTPL by DPA. **The Project is under construction phase.**
2. Multipurpose Cargo Terminal at Tekra off Tuna on BOT basis (T shape jetty 600m X 80 m Capacity 18MMTPA, back up area 101 Ha capital dredging 1,26,57,175 m3 maintenance dredging 18,98,576. 25 m^3 Estimated cost: 1686.66 Cr.	The Board of DPA approved the Feasibility Report in its meeting on 19.02.2021. The MoPSW, GoI vide communication dated 21/10/2022 has conveyed approval granted by the Cabinet Committee on Economic Affairs to the project. The project is under bidding stage. **No construction activity has started yet.**
3. Up gradation of Barge handling capacity at Bundar basis at Kandla capacity 3.33 MMTA back-up area 5 Ha, Estimated cost: 109.59 Cr.	The up-gradation work was completed.
4. Construction of Rail over Bridge at NH 8 A near Nakti Bridge (crossing of NH 8 A Estimated cost: 32.17 Cr.	**Construction activity has not yet started.**
5. Mechanization of Dry Cargo handling capacity at Kandla Port (Berth 7 and 8 capacity 7.35 MMTPA estimated cost 80.61 Cr.	Mechanization work already completed.
6. Strengthening of Oil jetty 1 (Estimated cost: 7.5 Cr.	The strengthening work completed.
7. Modification and strengthening of Cargo berth No. 6 at Kandla Port Estimated cost: 11.5 Cr.	The modification & strengthening work completed.

Out of a total of 7 project activities, construction activities of 4 projects (i.e. Sr. No. 3, 5, 6 & 7 mentioned in the EC & CRZ Clearance) have already been completed. Whereas construction activity of the project at Sr. No. 2 & 4 have not yet started.

For the current compliance period up to May, 2024, construction activity related to project No. 1 is ongoing. The compliance report submitted by the Concessionaire M/s KOTPL is attached herewith as Annexure A.

COMPLIANCE REPORT (for the period up to May, 2024)

Subject: Compliance of conditions stipulated by the Ministry of Environment, Forests & Climate Change (MoEF&CC), GoI in Environmental & CRZ Clearance granted for "**Development of 7 integrated facilities (Stage I) within existing Deendayal Authority at Kandla**".

Reference: Environmental and CRZ Clearance granted by MoEF&CC, GoI vide letter F. No. 11-82/2011-IA-III dated 19/12/2016.

Sr. No	EC Conditions	Compliance status
	A. Specific conditions	
I.	Construction activity shall be carried out strictly according to the provisions of CRZ Notification, 2011. No construction work other than those permitted in Costal Regulation Notification shall be carried out in coastal regulation zone area.	a) For Project at Sr. No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**. b) Further, w.r.t. project at Sr. No. 2 & 4 (construction not yet started), it is assured that no activity other than those permissible in Coastal Regulation Notification shall be carried out in the CRZ area.
II.	The Project Proponent shall ensure that there shall be no damage to the existing mangrove patches near site and also ensure the free flow of water to avoid damage to the mangroves.	a) For Project at Sr. No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) Further, w.r.t. project at sr.no. 2 & 4 (construction not yet started), it is assured that due care shall be taken to protect existing mangrove patches near the site and also the free flow of water to avoid damage to the mangroves.
III.	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.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) Further, w.r.t. project at sr.no. 2 & 4 (construction not yet started), it is assured that no creeks or rivers shall be blocked due to any activities at the project site, and the free flow of water shall be maintained.
IV.	Shoreline should not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary. The detail shall be submitted along with the six monthly monitoring report.	Deendayal Port Authority (Erstwhile, Deendayal Port Trust) vide Work order no. EG/WK/4751/Part (EC–Shoreline study)/98 dated 12/10/2021 had appointed NCSCM, Chennai for carrying out the work "**Shoreline Change Study for Deendayal Port Trust, Kandla, Kachchh District, Gujarat, to Study the Effect of Dumping, if any**". The study is completed and the final report submitted by NCSCM, Chennai has already been communicated to the MoEF&CC, GoI, Gandhinagar with six monthly compliance report submitted vide letter dated 30/1/2023.
V.	The foreshore facilities shall be set up in the stable / low or medium eroding site as demarcated in the shoreline change map by NCSCM. Further, NCSCM shall be authorized to monitor the project during construction and operation phases so as to ensure that the foreshore facilities cause minimum or no impact to the geomorphological systems.	Necessary CRZ recommendation from the Gujarat Coastal Zone Management Authority had already been obtained for establishment of 7 project facilities dated 1/7/2015 **(Copy submitted along with earlier compliance report submitted)** and accordingly, the MoEF&CC, GoI had accorded EC &

		CRZ Clearance dated 19/12/2016 for the proposed 7 project facilities.
VI.	The PP should take measures to ensure that construction materials / debris (Mortar, cementing materials etc.) do not fall into the water. Construction materials including labour camps should be located at adequate distance from CRZ areas.	a) For project no. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**. b) Further, w.r.t. project at sr.no. 2 & 4 (construction not yet started), it is assured that, the construction activities shall be carried out, with due care so that construction material /debris do not fall into the water. Further, it is also assured that, construction materials including labour camps will be located outside CRZ areas.
VII.	Dredged materials should be analyzed for presence of contaminants and also to decide the disposal options. Monitoring of dredging activities should be conducted and the findings should be shared with the Gujarat SPCB and regional office of the ministry.	Dredged Material will be disposed of at designated location as identified by the CWPRS, Pune. DPA assigned 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. In continuation of same, DPA had issued work order to GUIDE, Bhuj for "Study on dredged material for presence of Contaminants for year 2021-2024. The Third final report submitted by M/s GUIDE, Bhuj for the period 2022-2023 is attached herewith as **Annexure- B.**
VIII.	PP in consultation with GCZMA should prepare a regional strategic Impact Assessment Report with a special focus on region where the PP started construction without permission. The cost towards the study should be borne by the PP.	Based on the ToR finalized by the GCZMA vide letter dated 13/10/2022, M/s GUIDE, Bhuj had prepared and submitted final RSIA report dated 12/01/2024 (Copy attached as **Annexure C)** Further, a copy of final RSIA report has already been submitted to the GCZMA vide DPA letter dated 30/01/2024 (**Annexure D**) and to the MoEF&CC, GOI vide DPA letter dated 30/01/2024 (**Annexure E)**
IX.	A comprehensive and integrated conservation plan including detailed Bathymetry Study and protection of Creeks / Mangrove area including buffer zone, mapping of coordinates, running length, HTL, CRZ boundary should be put in place. The plan should take note of all the conditions of approvals granted to all the project Proponents in this area, and the reported cases of disappearance of Mangroves near project site. The preservation of entire area to maintain the fragile ecological conditions should be a part of the plan in relation to the creek and Mangrove conservation.	The final report submitted by M/s GUIDE, Bhuj (vide letter dated 21/5/2018) had already been communicated to the MoEF&CC, GoI, Bhopal & copy to the MoEF&CC, GoI, New Delhi, along with six monthly compliance report submitted vide letter dated 21/06/2018.
X.	The commitments made during the Public Hearing and recorded in the minutes shall be complied with letter and spirit. A hard copy of the action taken shall be submitted to the ministry.	The commitments made during the Public Hearing has already been complied with letter & spirit. In this regard, the details of CSR Activities implemented as well as proposed are enclosed herewith as **Annexure F.**
XI.	All the conditions stipulated in the earlier clearance including the recommendations of Environment	a) DPA has already taken necessary steps for compliance with all the conditions stipulated in the earlier clearance, including the recommendations

	Management Plan, Disaster Management Plan shall be strictly complied with.	of the Environment Management Plan, Disaster Management Plan. DPA already has an updated Disaster Management Plan. 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 annual environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as **Annexure G.** b) Further, w.r.t. Project at Sr.No.1, kindly refer to the Monitoring reports submitted by M/s KOTPL along with compliance report placed at **Annexure A**.
XII.	Disposal sites for excavated materials should be so designed that the revised land use after dumping and changes in the land use pattern do not interfere with the natural drainage.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**. b) For the remaining projects Sr.No 2 & 4 (construction not y et started), it is assured that the land use pattern will not interfere with the natural drainage.
XIII.	PP shall install a continuous automatic ambient air quality monitoring system (24 x 7) for all relevant parameters at two locations to monitor the ambient air quality status of the project area. Data should be transferred online to CPCB and SPCB websites.	a) 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 annual environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as **Annexure G.** DPA has already initiated the action for inviting the tenders for carrying out online ambient air quality monitoring system (24 X 7). However, no response received. DPA again planning to re invite the same. b) Further, w.r.t. Project at Sr.No.1, kindly refer to the Monitoring reports submitted by M/s KOTPL along with compliance report placed at **Annexure A**.
XIV.	The ground water shall not be tapped within the CRZ areas by the PP to meet with the water requirement in any case.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by

		M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) Further, w.r.t. Project at Sr. no.2 & 4 (construction not yet started), Water requirement will be met through procurement from GWSSB or private tankers. No ground water will be tapped.
XV.	Necessary arrangements for the treatment of the effluents and solid wastes must be made and it must be ensured that they confirm to the standards laid down by competent authorities including the state or Central Pollution Control Board and under the Environmental (Protection) Act, 1986.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) Further, it is also relevant to submit here that, w.r.t. completed projects (modification/ strengthening/ up-gradation of existing facilities), Sewage is being treated in the STP of Kandla (1.5 MLD). The treated sewages from STP of DPA are utilized for plantation / Gardening. DPA has entered into 'Selling Agency' agreement with M/s. MSTC (Govt. of India Entreprise), Vadodara since 04/01/2022 for collection, transporting and disposal of scrap, surplus items, unserviceable equipment etc. 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.
XVI.	All the operational areas will be connected with the network of liquid waste collection corridor comprising of storm water, oily waste and sewage collection pipelines.	The 4 projects completed are of modification/strengthening/up-gradation of existing facilities, having already developed network of storm water drainage & other facilities. Further, oil wastes are being disposed of by selling to the authorized vendor of GPCB/CPCB, as per norms. However, for the operational phase of the ongoing as well as the remaining projects, DPA/BOT operator will provide the necessary facilities.
XVII.	Automatic/Online monitoring system (24 x 7 monitoring devices) for water pollution in respect of flow measurement and relevant pollutants in the treatment system to be installed. The data to be made available to the respective SPCB and in the company's website.	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 annual environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as **Annexure G.**

VIII.	Marine ecology shall also be monitored regularly in terms of sea weeds, grasses, mudflats, sand dunes, fisheries, echinoderms, shrimps, turtles, corals, coastal vegetation, mangroves and other marine bio diversity 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.	DPA assigned work to M/s GUIDE, Bhuj, for regular monitoring of Marine Ecology since the year 2017 and final reports prepared by GUIDE,Bhuj have already been communicated to the Integrated Regional Office, MoEF&CC, GoI, Gandhinagar as well as to the MoEF&CC, GoI, New Delhi along with compliance reports submitted from time to time. (Period from 2017 to 2021). Further, it is again 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 alongwith compliance report submitted dated 07/10/2021 The final report for the year 2023-24 is attached herewith as **Annexure H.** In continuation of the same, DPA issued a work order to M/s GUIDE vide its letter no. EG/ WK/ 4751/ Part (Marine Ecology Monitoring) /72 dated 10/06/2024 for further period of 2024 – 27 (Work order attached as **Annexure I)**
XIX.	Measure should be taken to contain, control and recover the accidental spills of fuel and cargo handle.	DPA already having Oil Spill Contingency Plan. An adequate control measure has already been taken to control and recover accidental fuel and cargo handle spills.
XX.	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 RO, MoEF&CC along with half yearly compliance report.	Compliance of mitigation measures suggested in the EIA report in the matrix format is attached herewith as **Annexure J.**
XXI.	Ship/barges shall not be allowed to release any oily bilge waste or ballast water in the sea. Any effluent from the jetty which have leachable characteristics shall be segregated and recycled/disposed as per SPCB guideline.	It is assured that Ships/barges shall not be allowed to release any oily bilge waste or ballast water in the sea. It is assured that any effluent from the jetty which has leachable characteristics shall be segregated, treated and recycled/disposed of as per SPCB guidelines. DPA issued a Grant of License/Permission to collect and dispose of "Hazardous Waste/Sludge/ Waste Oil" 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.
XXII.	Location of DG sets and other emission generating equipment shall be decided keeping in view the predominant wind direction so that emission do not effect nearby resident areas. Installation and operation of DG Sets shall comply with the guideline of CPCB	a) DG sets will be installed keeping in view the predominant wind direction; as per prescribed guidelines, DG sets shall be used in case of power failure only. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by

		M/s KOTPL (concessionaire of the project) placed at **Annexure A**.
XIII.	All the mechanized handling systems and other associated equipments such as hoppers, belt conveyors, stacker cum reclaimers shall have integrated dust suppression system. Dust suppression system shall be provided at all transfer point.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) DPA being an old establishment and the area is quite big, possibilities of mechanization is being explored. Further, it is relevant to mention here that, DPA invited the tender for "Appointment of consultant for the study & preparation of techno economic feasibility report for mechanized handling of cargo at DPA". The tender is in scrutiny stage. Further, w.r.t. Project at Sr.No.2 (construction not yet started), BOT operator will take the necessary step to provide all the mechanised handling systems and other associated equipment, such as hoppers, belt conveyors, and stacker cum reclaimers with integrated dust suppression systems. DPA/BOT operator will provide a Dust suppression system at all transfer points. DPA has already installed a water sprinkling system in the Port area for coal handling areas.
XIV.	No products other than permitted under the CRZ Notification, 2011 shall be stored in the CRZ area.	It is hereby assured that only products permitted under the CRZ Notification, 2011 shall be stored in the CRZ area.
XXV.	It shall be ensured by the Project Proponent that the activities does not cause disturbance to the fishing activity, movement of fishing boats and destruction to mangroves during the construction and operation phase.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) Further, it is assured that, due care is being taken so that the activities do not cause disturbance to the fishing activity, movement of fishing boats and destruction to mangroves.
XVI.	As proposed, green belt over an area of 36.8 ha shall be developed with at least 10 meter wide green belt on all sides along the periphery of the project area, in downward direction and along road side etc. Selection of plant species shall be as per the CPCB guidelines in consultation with the DFO.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) 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, already submitted along with compliance report submitted on 12/04/2023.

		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
XVII.	Mangrove plantation in an area of 100ha shall be carried out by KPT within 2 years in a time bound manner. Action taken report shall be submitted to the Regional Office of MoEF&CC.	DPA has undertaken Mangrove Plantation in an area of 1600 Hectares since the year 2005. carried out through various agencies. The copy of the details has already been communicated with the earlier compliance reports submitted.
VIII.	Municipal Solid Waste and Hazardous wastes shall be managed as per Municipal Solid Waste Rule, 2016 and Hazardous Waste Management Rules 2016	Municipal solid waste and hazardous waste management by DPA are undertaken by appointing GPCB authorized vendor per the Municipal solid waste Rule, 2016 and Hazardous waste management Rules, 2016, for further treatment. 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.
XIX.	The project Proponent shall take up and earmark adequate fund for socio-economic development and welfare measure as proposed under the CSR programmed. This shall be taken up on priority.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**. b) The details of the fund earmarked under CSR activities and CSR activities undertaken by DPA to date & proposed activities are placed at **Annexure F.**
XXX.	The Project Proponent shall set up separate Environmental Management Cell for effective implementation of the stipulated environmental safeguards under the supervision of a senior executive	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**. b) 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).
XXI.	The funds earmarked for environmental management plan shall be included in the budget and this shall not be diverted for any other purpose.	a) The allocation made under the "Environmental Services & Clearance of other related Expenditure" scheme during BE 2023-24 is Rs. 657 Lakhs. b) The funds earmarked for EMP by the Concessionaire M/s KOTPL w.r.t. project at Sr.No.

		1 are delineated in the compliance report submitted (**Annexure A**).
XXII.	The proponent shall abide by all the commitments and recommendations made in the EIA/EMP reports so also during their presentation to the EAC.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**. b) DPA has installed Mist Canon at the Port area to minimize the dust. Further, DPA has already installed continuous sprinkling system in coal stack yard in DPA (40 ha. area) to prevent dust pollution. Further, to control dust pollution in other area, regular sprinkling through tankers on roads and other staking yards is being done. Regular sweeping of spilled cargo from roads is done by parties on regular basis. DPA has undertaken the project of dust supersession sprinkling system for the 34 hectare coal storage yard 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 annual environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as **Annexure G.** 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. 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 submitted by GUIDE, Bhuj has already been communicated to the Regional Office, MoEF&CC, GoI, Gandhinagar as well as to the MoEF&CC, GoI, New Delhi along with compliance reports submitted. Further, it is again 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 alongwith compliance report submitted dated 07/10/2021 The final report for the year 2023-24 is attached herewith as **Annexure H.** In continuation of the same, DPA issued a work order to M/s GUIDE vide its letter no. EG/ WK/ 4751/ Part (Marine Ecology Monitoring) /72 dated 10/06/2024 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-l)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE, dated 31st May 2022. The work has been completed and the final report submitted by GUIDE, Bhuj has already been communicated with the last compliance report. 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 DPA assigned 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. In continuation of same, DPA had issued work order to GUIDE, Bhuj for "Study on dredged material for presence of Contaminants for year 2021-2024. The final report submitted by M/s GUIDE, Bhuj for the period 2022-2023 is attached herewith as **Annexure- B.** Further, Dredged Material will be disposed of at designated location as identified by the CWPRS, Pune. For energy conservation measures, DPA is already generating 20 MW of Wind energy. In addition to it, DPA has commissioned a 45 kWP 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.

		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.
XIII.	Company shall prepare operating manual in respect of all activities. It shall cover all safety & environment related issues and system. Measure to be taken for protection. One set of environmental manual shall be made available at the project site. Awareness shall be created at each level of the management. All the schedules and results of environmental monitoring shall be available at the project site office.	The operating manual plan in respect of all activities has already been communicated along with the compliance report submitted vide letter dated 2/4/2019.
XIV.	Corporate Social Responsibility a. The company shall have a well laid down Environmental Policy approved by the Board of Directors b. The Environmental policy shall prescribe for standard operating process/procedure to bring into focus any infringements / deviation/violation of the environmental or forest norms c. The system or Administrative order of the hierarchical company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions shall be furnished. d. To have proper checks and balances, the company shall have a well laid down system of reporting of non compliances / violations of environmental norms to the board of directors of the company and/or share holders or stake holders at large.	The DPA has an Environmental Policy approved by the Board of Directors. The Environmental policy has already prescribed standard operating processes/procedures, bringing into focus any infringements/deviations/violations of the environmental or forest norms. DPA already has a well-established environmental Cell for ensuring proper checks on non-compliances/violations of Environmental norms. The organogram has already been communicated with the last compliance report submitted.
B. <u>General Condition</u>		
i.	The Project Authorities must strictly adhere to the stipulations made by the State Pollution Control Board (SPCB), State Govt. and any other statutory authority.	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**.
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.	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**.
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.	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**.

iv	Ministry of Environment Forest and Climate Change or any other competent authority may stipulate any other additional conditions or modify the existing one, if necessary in the interest of environment and the same shall be complied with.	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**.
v	The ministry reserves the right to revoke this clearance if any of the condition stipulated are not complied with the satisfaction of the ministry	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**.
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.	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**.
vii	The Project Proponents shall inform the regional office as well as the ministry, the date of the financial closure and final approval of the project by the concerned authorities and the date of start of Land Development work.	DPA vide letter dated 14/12/2020 w.r.t. project No.1, i.e***. "Development of Oil Jetty to Handle Liquid Cargo and Ship Bunkering Terminal at Old Kandla under PPP Mode"***, has already informed the Regional Office, MoEF&CC, GoI, Bhopal & copy to MoEF&CC, GoI, New Delhi about the award of the concession granted to the Concessionaire M/s Kandla Oil Terminal Limited dated 11/12/2020, and the project implementation work has commenced .
viii	A copy of the clearance letter shall be marked to concerned panchayat / local NGO, if any, from whom any suggestion/representation has been made received while processing the proposal	DPA vide letter dated 29/12/2016 had already informed to Conservation Action Trust & Paryavaran Mitra (from whom DPA received the representation during the Public Hearing).
ix	A copy of the environmental clearance letter shall also be displayed on the website of the concerned State Pollution Control Board. The EC letter shall also be displayed at the Regional Office, District Industries Centre and Collector's Office / Tehsildar's office for30 days.	Point Noted.
11	The 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.	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 annual environmental monitoring report submitted by GEMI, Gandhinagar is attached herewith as **Annexure G.** For Project at Sr.No. 1 which is under construction, kindly refer monitoring data submitted by M/s KOTPL along with compliance submitted placed at **Annexure A.**
12	All other statutory clearance 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	DPA/BOT Operator will obtain all other statutory clearance applicable as per the condition stipulated.

	obtained, as applicable by project proponents from the respective competent authorities.	
13	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 and Forests at http://www.envfor.nic.in. the advertisement should be made within 10 days from the date if receipt of the clearance letter and a copy of the same should be forwarded to the Regional Office of this Ministry at Bhopal.	Deendayal Port had already given advertisement in two newspapers, i.e., in KUTCHMITRA (Gujarati) & in The Indian Express (Ahmedabad Edition) (English) dated 20/12/2016. Further, DPA forwarded the copies to the Regional Office, MoEF&CC, GoI, Gandhinagar vide letter dated 22/12/2016.
14	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.	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.**
15	Status of compliance to the various stipulated Environmental conditions and environmental safeguards will be uploaded by the project proponent in its website.	Status of compliance with the various stipulated Environmental conditions being uploaded on the website of DPA. The present compliance report has already been uploaded to the website www.deendayalport.gov.in.
16	Any appeal against this clearance shall be 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.	a) Point Noted. b) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A**.
17	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.	DPA vide letter dated 29/12/2016 had already informed to Conservation Action Trust & Paryavaran Mitra (from whom KPT received the representation during the Public Hearing).
18	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, the respective Zonal Office of CPCB and the SPCB.	The status of compliance with the various stipulated Environmental conditions is being uploaded on the website of DPA. The present compliance report has already been uploaded to the website www.deenbdayalport.gov.in. Copy of the compliance report has also been marked to the Regional Office of MoEF&CC, GoI, the respective Zonal Office of CPCB and the SPCB.
19	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 by e – Mail.	a) For Project at Sr.No. 1 which is under construction, kindly refer compliance submitted by M/s KOTPL (concessionaire of the project) placed at **Annexure A.** b) As informed earlier, out of 7 projects, the projects mentioned at Sr. No. 3, 5, 6 & 7 in the EC Letter dated 19/12/2016 are not new projects (strengthening/ upgradation work). These projects are already covered under consent to operate granted by the GPCB for the whole DPA area (GPCB ID 28494 –Renewed Consent Order no-AWH-110594 dated issue-8/12/2020- Valid up to 21/7/2025) and for which DPA regularly submitted the Environmental statement in Form V to the GPCB. A copy of the Environmental Statement

		submitted to the GPCB (the year 2023-24) for the entire DPA area is attached herewith as **Annexure J** .Further, DPA also uploaded the said Environmental statement in Form V in the website www.deendayalport.gov.in.

Monitoring the Implementation of Environmental Safeguards
Ministry of Environment, Forest & Climate Change
Regional Office, Gandhinagar
(for the period up to May, 2024)

DATA SHEET

1.	Project type: –River-valley/ Mining / Industry / Thermal / Nuclear / Other (specify)		:	Infrastructure & miscellaneous projects + CRZ
2.	Name of the project		:	Development of 7 Integrated facilities (Stage I) within existing KPT by Deendayal Port Authority (Erstwhile: Deendayal Port Trust).
3.	Clearance letter (s) / OM No. and Date		:	Environment and CRZ clearance by MoEF&CC vide file no. 11-82/2011-IA III dated 19/12/2016.
4.	Location		:	
	a.	District (s)	:	Kutch
	b.	State (s)	:	Gujarat
	c.	Latitude/ Longitude	:	$23^0$01' N, $70^0$13' E
5.	Address for correspondence			
	a.	Address of Concerned Project Chief Engineer (with pin code & Telephone/telex/fax numbers	:	Chief Engineer, Deendayal Port Trust, P.O. Box no. 50. A.O. Building, Gandhidham- 370 201.Phone: 02836 233192 02836 220050
	b.	Address of Project: Engineer/Manager (with pin code/ Fax numbers)	:	Same as above
6.	Salient features			
	a.	of the project		1) Development of Oil Jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode (jetty: 300mx15m, back up area 5.5HA, capacity – 3.39MMTPA, as per the concession agreement Tank farm capacity - 1,64,500 KL & Allied facilities, Capital dredging 1,73,660m^3 maintenance dredging 1,56,294m^3; Estimated cost: 233.5 Cr., Revised Cost: 343.0 Cr. 2) Multipurpose cargo Terminal at Tekra off Tuna on BOT basis (T shape jetty 600mX80m Capacity 18MMTPA, back up area 101Ha capital dredging 1,26,57,175m^3 maintenance dredging 18,98,576. 25 m^3 Estimated cost: 1686.66 Crore 3) Construction of Rail over Bridge at NH8-A near Nakti Bridge (crossing of NH8-A Estimated cost: 32.17Cr.) 4) Mechanization of Dry Cargo handling capacity at Kandla Port (Berth 7 and 8 capacity 7.35MMTPA). 5) Strengthening of Oil jetty 1. 6) Modification and strengthening of Cargo berth No. 6 at Kandla Port.
	b.	of the environmental management plans	:	The salient features of the EMP had already been communicated in earlier compliance reports submitted.
7.	Production details during the compliance period and (or) during the previous financial year		:	It is under Infrastructure & miscellaneous projects so production is not involved
8.	The breakup of the project area		:	~111.5 Ha

	a.	submergence area forest &non-forest	:	NIL
	b.	Others	:	NIL
9.	The breakup of the project affected the Population with an enumeration of Those losing houses/dwelling units Only agricultural land only, both Dwelling units & agricultural Land &landless labours/artisan		:	NIL
	a.	SC, ST/Adivasis	:	Nil
10.	Financial details		:	
	a.	Project cost as originally planned and subsequently revised estimates and the year of price reference:		
	1.	Estimated Cost of the Project	:	Total Estimated Project Cost: Rs. 2271.03 Crore 1) Development of oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode - Estimated cost: 233.5 Crore, Revised Estimated Cost: 343.0 Cr. 2) Multipurpose cargo Terminal at Tekra off Tuna on BOT basis - Estimated cost: 1686.66 Crore. 3) Upgradation of Barge handling capacity at Bundar basis at Kandla: Estimated cost: 109.59 Crore 4) Construction of Rail over Bridge at NH 8 A near Nakti Bridge (crossing of NH 8 A - Estimated cost: 32.17 Crore 5) Mechanization of Dry Cargo handling capacity at Kandla Port (Berth 7 and 8)- Estimated cost 80.61 Crore. 6) Strengthening Oil jetty 1 (Estimated cost: 7.5 Crore). 7) Modification and strengthening of Cargo berth No. 6 at Kandla Port Estimated cost: 11.5 Crore
	b.	The allocation made for environmental management plans with item-wise and year-wise Break-up.	:	a) The allocation made by DPA under the scheme of "Environmental Services & Clearance thereof other related Expenditure" during BE 2024-25 is Rs. 657 Lakhs. b) The allocation made by the Concessionaire M/s KOTPL of the project "Development of oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode" - EMP: Rs. 07 Lacs
	c.	Benefit-cost ratio / Internal rate of Return and the year of assessment	:	1) Development of an oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode (Project IRR 14.01% and EIRR 14.53%). 2) Multipurpose cargo Terminal at Tekra off Tuna on BOT basis (Project IRR 16.03% and equity IRR 17.4%). 5) Mechanization of Dry Cargo handling capacity at Kandla Port (Project IRR 18.3% and equity IRR23.6%). Rests of the projects are of up-gradation/strengthening/modification.

	d.	Whether (c) includes the Cost of environmental management as shown in above.	:	Yes
	e.	Actual expenditure incurred on the project so far	:	1) Development of oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode - Actual expenditure incurred on the project: 57.35 Cr 2) Multipurpose cargo Terminal at Tekra off Tuna on BOT basis - Actual cost: NIL (Project under bidding stage). 3) Upgradation of Barge handling capacity at Bundar basis at Kandla: Actual cost: 109.59 Crore. 4) Construction of Rail over Bridge at NH 8 A near Nakti Bridge (crossing of NH 8 A) - Actual cost: NIL – Construction activity has not started yet. 5) Mechanization of Dry Cargo handling capacity at Kandla Port (Berth 7 and 8)- Actual cost: 80.61 Crore 6) Strengthening of Oil jetty 1 - Actual cost: 7.5 Crore 7) Modification and strengthening of Cargo berth No. 6 at Kandla Port Actual cost: 11.5 Crore
	f.	Actual expenditure incurred on the environmental management plans so far		a) The expenditure made by DPA under the scheme of "Environmental Services & Clearance thereof other related Expenditure" is Rs.330 Lakhs from Dec, 2023 to May 2024. b) The expenditure made by the Concessionaire M/s KOTPL of the project "Development of oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode" - EMP: Rs. 3 Lakhs
11.	Forest land requirement		:	
	a.	The status of approval for the diversion of forest land for non-forestry use	:	NIL
	b.	The status of clearing felling	:	NIL
	c.	The status of compensatory afforestation it any	:	NIL
	d.	Comments on the viability & sustainability of the compensatory afforestation program in light of actual field experience so far	:	NIL
12.	The status of clear felling in non-forest areas (such as the submergence area of the reservoir and approach roads) is any with quantitative information.		:	NIL
13.	Status of construction		:	
	a.	Date of commencement (Actual and/or planned)	:	1) Development of oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode – Award of the concession granted on 11/12/2020; **Project is under Construction Stage** 2) Multipurpose cargo Terminal at Tekra off Tuna on BOT basis - Construction activity not started yet – **Project is under bidding stage**

				3) Upgradation of Barge handling capacity at Bundar basin at Kandla – **Work Completed**. 4) Construction of Rail over Bridge at NH 8 A near Nakti Bridge - **Construction activity has not started yet.** 5) Mechanization of Dry Cargo handling capacity at Kandla Port –**Mechanization work already completed.** 6) Strengthening of Oil jetty 1 – **Work Completed.** 7) Modification and strengthening of Cargo berth No. 6 at Kandla Port –**Work completed**.
	b.	Date of completion (Actual and/or planned)	:	1) Development of oil jetty to handle liquid cargo and ship bunkering terminal at old Kandla under PP mode – Construction Schedule – December, 2020 Planned date of completion: **M/s KOTPL committed vide letter dated 02/08/2023 and 22/08/2023 to complete the project on or before 05/09/2024** 2) Multipurpose cargo Terminal at Tekra off Tuna on BOT basis - Construction activity not started yet – **Project is under bidding stage.** 3) Upgradation of Barge handling capacity at Bundar basis at Kandla– **Work Completed (May 2017).** 4) Construction of Rail over Bridge at NH 8 A near Nakti Bridge - Construction activity not started yet 5) Mechanization of Dry Cargo handling capacity at Kandla Port– work completed **(April, 2017).** 6) Strengthening of Oil jetty 1 – Work Completed **(May, 2017)** 7) Modification and strengthening of Cargo berth No. 6 at Kandla Port – Work completed **(May, 2017).**
14.	Reasons for the delay if the Project is yet to start		:	a) Out of a total of 7 project activities, construction activities of 3 projects (project at Sr. No. 3, 5, 6 & 7 mentioned in the EC & CRZ Clearance) have already been completed. Projects at Sr. No. 2 & 4 are still under the planning stage. b) For the Project at Sr. No. 1, reason for delay matter is pending adjudication before Arbitration Tribunal .
15. Date of the site visit				
	a)	The dates on which the regional office monitored the project on pervious occasion. if any		**----------**

	b)	The date site visit for this monitoring report.	----------
16.	Details of correspondence with project authorities for obtaining action plans/ information on status of compliance to safeguards other than the routine letters for logistic support for site visit. (The first monitoring report may contain the details of all the letters issued so far but the later reports may cover only the letters issued subsequently).		----------

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Annexure C

Compliance to EC dated 01/10/2008

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/4660 (EC)/ Part – V/93

Date:24/07/2024

To,
The Deputy Director General of Forests,
Ministry of Environment, Forest & Climate Change,
Integrated Regional Office,
Gandhinagar, A wing-407 & 409
Aranya Bhavan Near CH-3 Circle
Sector 10A, Gandhinagar - 382010
Email: iro.gandhingr-mefcc@gov.in

Sub: "Construction of 13th to 16th Cargo Berths at Kandla" by M/s Deendayal Port Authority (Erstwhile Deendayal Port Trust) – **Compliance Report of conditions stipulated in Environmental & CRZ Clearance and Monitoring Report in Data Sheet reg.**

Ref.: 1) EC & CRZ Clearance granted by MoEFF, GoI vide F.No. 11-70/2006-IA-III dated 1/10/2008.
2) KPT letter no.EG/WK/4660 (EC)/654 dated 6/10/2010.
3) KPT letter no.EG/WK/4660 (EC)/ 112 dated 4/2/2012.
4) KPT letter no. EG/WK/4660(EC)/223 dated 4/9/2012.
5) KPT letter no. EG/WK/4660(EC)/144 dated 16 (17) /5/2013.
6) KPT letter no. EG/WK/4660 (EC)/Part 111/1087 dated 9/12/2013.
7) KPT letter no. EG/WK/4660 (EC)/Part 111/250 dated 17/05/2014.
8) KPT letter no. EG/WK/4660 (EC)/Part 111/198 dated 14/11/2014.
9) KPT letter no. EG/WK/4660 (EC)/Part 111/256 dated 11/05/2015.
10) KPT letter no. EG/WK/4660 (EC)/Part 111/162 dated 15/10/2015.
11) KPT letter no. EG/WK/4660 (EC)/Part 111/133 dated 09/05/2016.
12) KPT letter no. EG/WK/4660 (EC)/Part IV/167 dated 26/12/2016.
13) DPT letter no. EG/WK/4660 (EC)/Part IV/325 dated 26/06/2018.
14) DPT letter no. EG/WK/4660 (EC)/Part V/53 dated 14(16)/2/2019.
15) DPT letter no. EG/WK/4660 (EC)/Part V/205 dated 30(6)/11 (12)/2019.
16) DPT letter no. EG/WK/4660 (EC)/Part V dated 15/01/2021.
17) DPT letter no. EG/WK/4660 (EC)/Part V/92 dated 30(07)/9(10)/2021.
18) DPT letter no. EG/WK/4660 (EC)/Part V dated 28/03/2022
19) DPA letter no. EG/WK/4660 (EC)/Part V/149 dated 19/07/2022
20) DPA letter no. EG/WK/4660 (EC)/Part V/230 dated 02/02/2023
21) DPA letter no. EG/WK/4660 (EC)/Part V/350 dated 14/08/2023
22) DPA letter no. EG/WK/4660 (EC)/Part V/37 dated 19/03/2024

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

.....cont.....

In this connection, it is to state that, as directed under above referred letter dated

5/8/2009 of MoEF, Regional Office, Gandhinagar, Deendayal Port Authority (Erstwhile Deendayal Port Trust) vide above referred letters had regularly submitted Six Monthly compliance report of stipulated conditions and Monitoring report in Data Sheet, in connection with subject project.

Now, as directed in above referred letter dated 5/8/2009 of MoEF, GoI, please find enclosed herewith point wise compliance to various stipulation in Environmental & CRZ Clearance granted by MoEF, GoI vide letter 11-70/2006-IA.III dated Sept, 2008 (**Annexure 1**) & Monitoring Report in Data Sheet (**Annexure 2**), for the period uptom May, 2024 for kind information and 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 via e-mail ID iro.gandhingr-mefcc@gov.in

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

Thanking You.

Yours faithfully,

24/5/24

Dy. Chief Engineer & EMC(I/c)
Deendayal Port Authority

Copy along with point wise compliance of stipulated conditions, to:

1) Shri Amardeep Raju, MoEF&CC,GoI
and Member Secretary (EAC-Infra.1),
Indira Paryavaran Bhavan,
Ministry of Environment, Forest and Climate Change
Jor Bagh Road, Aliganj,
New Delhi-110003.
Email: ad.raju@nic.in

2) Shri Prasoon Gargav,
Scientist E & Regional Director,
Central Pollution Control Board,
Parivesh Bhawan, Opp. VMC Ward Office No.10, Subhanpura,
Vadodara – 390 023.
Email: prasoon.cpcb@nic.in

3) Shri T. C. Patel,
Unit Head, Kachchh,
Gujarat Pollution Control Board,
Paryavaran Bhavan,
Sector 10A, Gandhinagar- 382 010.
Email-kut-uh-gpcb@gujarat.gov.in

4) The Regional Officer,
Gujarat Pollution Control Board,
Regional Office (East Kutch),
Administrative Office Building,
Deendayal Port Trust, Gandhidham.
Email Id. ro-gpcb-kute@gujarat.gov.in

Annexure -1

Annexure 1

Compliance Report for the period upto May, 2024

Subject: - Compliance of conditions stipulated in Environmental & CRZ Clearance granted by the MoEF&CC, GoI for "Construction of 13th to 16th Cargo Berths at Deendayal Port Authority (Erstwhile: Deendayal Port Trust)".

- The MoEF, GoI granted Environmental & CRZ Clearance for the subject project vide no. F. No. 11-70/2006-IA-III dated Sep 2008.

- 7/2/2014 – The MoEF&CC, GoI extended the validity period of Environmental & CRZ Clearance for a further period of 5 years, i.e. up to 30/9/2018.

STATUS OF Berths:

13th Cargo Berth: Under operation since 18/2/2013.
15th Cargo Berth: Under Operation since 16/11/2013.
14th Cargo Berth: Under Operation since 8/4/2019.
16th Cargo Berth: Under Operation since 10/3/2019.

CONSENT TO OPERATE:

DPA obtained Consolidated Consent & Authorisation (CC&A) for whole port area including 13th to 16th Cargo Berth from the GPCB vide Consent Order no-AWH-110594 dated of issue-8/12/2020, with a validity period upto 21/7/2025. Detailed Order issued by the GPCB vide outward no. 581914 dated 22/1/2021 & subsequently, issued Correction in CC&A order vide letter no. PC/CCA-KUTCH-812(5)/GPCB ID 28494/588116 dated 9/4/2021. Further an amendment has issued by GPCB vide letter no. PC/CCA-KUTCH-812(6)/GPCB ID-28494/781072 dated 11/01/2024.

Sr. No.	Conditions	Remarks
A	**Specific Condition**	
1	All measures indicated in the letter dated 4/8/2008 shall be strictly complied with.	Compliance Report of conditions stipulated in the CRZ recommendation granted by Forest & Environment Department, GoG vide letter dated 14/02/2008 is placed in **Annexure A.**
2	Necessary clearances from the Gujarat State Pollution Control Board shall be obtained before initiating the project.	GPCB vide order no. PCC/CCA-BHUJ-179(3)/575 dated 9/1/2009 granted a No Objection Certificate to the said project. Currently, all the 4 berths are under operation. Further, GPCB vide order dated 22/1/2021 has issued Consolidated Consent & Authorization (Valid up to 21/7/2025). Subsequently, GPCB issued a Correction in the CC&A order vide letter no. PC/CCA-KUTCH-812(5)/GPCB ID 28494/ 588116 dated 9/4/2021. A copies of the above have already been communicated with the earlier compliance reports submitted**.** Further an amendment has issued by GPCB vide letter no. PC/CCA-KUTCH-812(6)/GPCB ID-28494/781072 dated 11/01/2024.
3	The project proponent shall not undertake any destruction of mangroves during construction and operation of project.	Point noted. All the 4 berths are under operation. As per the directions of the GCZMA and MoEF&CC, GoI, to date, DPA has undertaken a Mangrove Plantation in an area of 1600 Hectares since the year 2005. The details have already been communicated with the earlier compliance reports submitted. It is also relevant to mention here that, as per the direction of the Gujarat Coastal Zone Management Authority, DPA has already prepared & submitted a report on the mangrove conservation and management plan formulated by the Gujarat Institute of Desert Ecology during the study period of Jan-April, 2015 (Report already submitted along with earlier compliance reports submitted). For regular monitoring, DPA vide work order dated 3/5/2021 has assigned work to M/s GUIDE, Bhuj for Monitoring of mangrove

		plantation carried out by DPA (Period from 24/5/2021 to 23/5/2022). The final report submitted by M/s GUIDE has already been communicated with the earlier compliance report submitted**.** Further DPA has assigned work to M/s GUIDE, Bhuj vide work order dated 10/06/2024 for "Monitoring of Mangrove Plantation 1600 Ha carried out by DPA" for the Period of 10/06/2024 to 09/06/2025. The work order is attached herewith as **Annexure B**
4	Sewage arising in the Port area shall be treated to conform to the standards stipulated by Gujarat State Pollution Control Board and shall be utilized/ recycled or gardening, plantation and irrigation.	The sewage generated in the port area is treated in the 1.5 MLD STP at Kandla. The treated wastewater is utilized for gardening and plantation purposes. In addition to that, it also has septic tanks at places where STP is inaccessible. DPA has been appointing a NABL-accredited laboratory to monitor environmental parameters, and reports are being submitted from 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 Annual report (2023-24) submitted by GEMI, Gandhinagar, is attached herewith as **Annexure C.**
5	Project proponent shall prepare Disaster Management Plan covering emergency evacuation mechanisms etc. deal with natural disaster events and regularly update from time to time.	DPA is already having a Disaster Management Plan. A copy of the same has been communicated with earlier submitted compliance reports.
6	There shall be no withdrawal of groundwater in the COASTAL REGULATION ZONE area for this project. The proponent shall ensure that as a result of the proposed constructions, ingress of saline water into ground water does not take place. Piezometers shall be installed for regular monitoring for this purpose at appropriate locations on the project site.	All the 4 berths are currently under operation.

7	The facilities to be constructed in the COASTAL REGULATION ZONE area as part of this project shall be strictly in conformity with the provisions of the COASTAL REGULATION ZONE Notification, 1991 as amended subsequently.	All the 4 berths are currently under operation.
8	Green belt area shall be developed along the project and budget earmarked.	DPA had entrusted the work to the Forest Department, Gujarat, for developing a green belt in and around the Port area at a cost of Rs. 352 lakhs in an area of about 32 hectares, and the work is already 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-l)" vide Work Order No.EG/WK/4757/Part [Greenbelt GUIDE], dated 31st May 2022. The final report has already been communicated with the last compliance report. DPA has assigned the Greenbelt development in Deendayal Port Authority and its surrounding areas, Phase II, to M/s GUIDE vide Work order EG/WK/4751/Part (Greenbelt)/327 dated 23.06.2023. The Progress report submitted by M/s GUIDE, Bhuj, is attached herewith as **Annexure D.**
9	No product other than those permissible in the COASTAL REGULATION ZONE Notification, 1991 shall be stored in the COASTAL REGULATION ZONE area.	Point Noted. Cargo is being stored at the backup area of berths, viz. 13th to 16th CB, as per the EC & CRZ Clearance accorded by the MoEF&CC, GoI.
B	**General Conditions**	
I	Construction of the proposed structures shall be undertaken meticulously conforming to the existing Central/Local rules and regulations including COASTAL REGULATION ZONE Notification, 1991 & its amendments. All the construction design/drawings relating to the proposed construction activities must have approvals of the concerned State Government Department/Agencies.	Currently, all the 4 berths are under operation.
II	Adequate provisions for	All the 4 berths are currently under

	infrastructure facilities such as water supply, fuel, sanitation etc. shall be ensured for construction workers during the construction phase of the project so as to avoid feeling of trees / mangroves and pollution of water and surroundings.	operation.
iii	The project authorities must make necessary arrangement for disposal of solid wastes and for the treatment of Effluents by providing a proper wastewater treatment plant outside the COASTAL REGULATION ZONE area. The quality of treated effluents, solid wastes and noise level etc. must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and the Union Ministry of Environment and Forests under the Environment (Protection) Act, 1986, whichever are more stringent.	Companies authorized by the State Pollution Control Board (SPCB) have been awarded the work of collecting, transporting, and disposing of solid waste by the Deendayal Port Authority. 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. 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. Generated sewage is treated in DPA's existing STP (1.5 MLD capacity). In addition to that, it also has septic tanks at places where STP is inaccessible. DPA has been appointing a NABL-accredited laboratory to monitor environmental parameters, and reports are being submitted from 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 Annual report (2023-24) submitted by GEMI, Gandhinagar, is attached herewith as **Annexure C.**
Iv	The proponents shall provide for a regular monitoring mechanism as	DPA has been appointing a NABL-accredited laboratory to monitor environmental

	to ensure that the treated effluents conform to the prescribed standards. The records of analysis reports must be properly maintained and made available for inspection to the concerned State/Central officials during their visits.	parameters, and reports are being submitted from 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 Annual report (2023-24) submitted by GEMI, Gandhinagar, is attached herewith as **Annexure C.**
V	In order to carry out the environmental monitoring during the operational phase of the project, the project authorities shall provide an environmental laboratory well equipped with standard equipment and facilities and qualified manpower to carry out the testing of various environmental parameters.	DPA has been appointing a NABL-accredited laboratory to monitor environmental parameters, and reports are being submitted from 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 Annual report (2023-24) submitted by GEMI, Gandhinagar, is attached herewith as **Annexure C.**
vi	The sand dunes if any on the site shall not be disturbed in any way.	No sand dunes at project site prevail.
Vii	A copy of the clearance letter will be marked to the concerned Panchayat/local NGO, if any from whom any suggestion/ representation has been received while processing the proposal.	No suggestion/ representation has been received while processing the proposal.
Viii	The Gujarat Pollution Control Board shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Controller's Office/Tehsildar's Office for 30 days.	-------
ix	The funds earmarked for environment protection measures shall be maintained, in a separate account and there shall be no diversion of these funds for any other purpose. A year-wise expenditure on environmental safeguards shall be reported to this Ministry's Regional Office at Bhopal and the State Pollution Control Board.	Point noted. The allocation made under the scheme of "Environmental Services & Clearance thereof other related Expenditure" during BE 2024-25 is Rs. 657 Lakhs. The expenditure made under the "Environmental Services & Clearance of other related Expenditure" is Rs. 330 Lakhs from December 2023 to May 2024. The yearly expenditure on environmental safeguards is regularly submitted in the monitoring datasheet to the Ministry's Regional Office at Bhopal (Now Gandhinagar).

X	Full support shall be extended to the officers of this Ministry's Regional Office at Bhopal and the officers of the central and State Pollution Control Board by the project proponents during their inspection for monitoring purpose, by furnishing full details and action plans including the action taken reports in respect of mitigate measures and other environment protection activities.	DPA had given the required support to the officer of the Ministry's Regional Office, Bhopal, during a site inspection carried out on 29/12/2016 for the purpose of certifying EC Conditions. DPA has also given required support to the officials of the Gujarat Pollution Control Board during their visits to DPA for inspection, etc. Further, it is also assured that DPA shall extend full support in future to the officials of the Ministry's Regional Office at Bhopal (Now Gandhinagar) and the officers of the Central and State Pollution Control Board during their inspection.
xi	In case of deviation of alteration in the project including the implementing agency, a fresh reference shall be made to this Ministry for modification in the clearance conditions or imposition of new ones for ensuring environment protection.	Point Noted.
Xii	This ministry reserves the right to revoke this clearance, if any of the conditions stipulated are not complied with to satisfaction of this ministry.	Point Noted.
Xiii	This Ministry or any other competent authority may stipulate any other additional conditions subsequently, if deemed necessary, for environment protection, which shall be complied with.	Point Noted.
Xiv	The project proponent shall advertise in at least two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality Concerned, informing that the project has been accrued environment clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen at website of the Ministry of Environment & Forests at http;//www.envfornic.in. The advertisement shall be made within 7 days from the date of issue	Advertisements had already been made in Kutch Mitra on 21/10/2008 and Kutch Uday on 22/10/2008. Further, Newspaper cuttings had already been sent to the Regional Office, MoEF&CC, Bhopal, vide DPA letter No.: EG/WK/4660(EC)/01 dated 31/10/2008.

	of the clearance letter and a copy of the same shall be forwarded to the Regional office of this Ministry at Bangalore.	
xv	The project proponent shall inform the Regional office at Bhopal as well as the Ministry the date of financial closer and final approval of the Project by the concerned authorities and the date of Start of Land Development work.	The necessary details have already been provided by the DPA from time to time, along with the earlier compliance reports submitted. Now, all the 4 berths are under operation.
10	The above-mentioned stipulations will be enforced among others under the water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act 1986, the Hazardous Chemicals (Manufactures, storage and Import) Rules, 1989, the Coastal Regulation Zone Notification, 1991 and its subsequent amendments and the Public Liability Insurance Act, 1991 and the Rules made there under from time to time. The project proponents shall also ensure that the proposal complies with the provisions of the approved Coastal Zone Management Plan of Gujarat State.	DPA has obtained consolidated consent and authorization vide GPCB (Consent Order no-AWH-110594 dated of issue-8/12/2020, with a validity period up to 21/7/2025)– Detailed Order issued by the GPCB vide outward no. 581914 dated 22/1/2021 & subsequently, issued Correction in CC&A order vide letter no. PC/CCA-KUTCH-812(5)/GPCB ID 28494/ 588116 dated 9/4/2021. A copy of the same has already been communicated with the earlier compliance reports submitted. Further an amendment has issued by GPCB vide letter no. PC/CCA-KUTCH-812(6)/GPCB ID-28494/781072 dated 11/01/2024. DPA has been appointing a NABL-accredited laboratory to monitor environmental parameters, and reports are being submitted from 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 Annual report (2023-24) submitted by GEMI, Gandhinagar, is attached herewith as **Annexure C.** Public Liability Insurance is renewed from time to time as required. The Public Liability Insurance has been renewed and is valid till 23/07/2024. A copy of the same has already been communicated with the earlier compliance report submitted. Deendayal Port Authority had already obtained Coastal Regulation Zone Recommendations dated 14/02/2008 from the State Forest &Environment Department, Government of Gujarat, for the project.

		All the 4 berths are under operation.

/

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Annexure D

PLI

दि न्यू इन्डिया एश्योरन्स कं. लि.
(भारत सरकार का उपक्रम)
बृहत कॉर्पोरेट एवं ब्रोकर्स कार्यालय : 920000
न्यू इन्डिया सेंटर, 11वीं मंजिल, 17/ए, कूपरेज रोड,
डॉ. बी.आर. आंबेडकर चौक, मुंबई - 400 001.
फोन : 022-22044973 / 2204 4976 / 2204 4977 / 2204 4974

THE NEW INDIA ASSURANCE CO. LTD.
(A Govt. of India Undertaking)
Large Corporate & Broker's Office : 920000
New India Centre, 11th Floor, 17/A, Cooperage Road,
Dr. B.R. Ambedkar Chowk, Mumbai - 400 001
Phone : 022 - 2204 4973 / 2204 4976 /2204 4977 / 2204 4974

RISK DETAILS

TYPE: MARINE PORT PACKAGE INSURANCE POLICY

INSURED: **DEENDAYAL PORT AUTHORITY,** (hereinafter referred as DPA) and/ or associated and/ or affiliated and/ or interrelated and/ or subsidiary companies and/ or corporations as they now are or may hereafter be created and/ or constituted and/ or for whom the Assured receive instructions to insure and/ or for whom the Assured have or assume a responsibility to arrange insurance, whether contractually or otherwise, as their respective rights and interests may appear hereinafter known as the Assured and/ or as original

PRINCIPAL ADDRESS: Address of the Original Insured
Administrative Office Building, Near Madhuban Hotel, Gandhidham, Kutch, Gujarat.

INSURANCE INTERMEDIARY: Marsh India Insurance Brokers Pvt. Ltd.

PERIOD: 12 months with effect from 24th July 2024 till 23rd July 2025, both days included

INTEREST:

Section 1
Port Authority Liabilities including liability of contractor and subcontractors and wreck removal.

Section 2
Real and Personal Property - In respect of all properties, owned by / under custody of Insured(s) hereunder including adjacent warehouses associate structures.

Section 3
Port Equipment including all Cargo Handling Equipment /Vehicles, Machineries and spares

Section 4
Business Interruption consequent upon Property damage (including cargo handling equipment, machineries etc.)
-

For Business interruption of the Port operation (wholly or partly) due to/consequent upon or arising out of:

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Regd. & Head Office : New India Assurance Bldg, 87, Mahatama Gandhi Road, Fort, Mumbai - 400 001.
Website : www.newindia.co.in
CIN : L66000MH1919GOI000526

(a) Interruption of electric supply to insured properties Or insured handling equipment, which is beyond the control of the assured.

(b) Blockage of Channel/ Waterways due to any cause

(c)Blockage of any land access within the immediate Vicinity* of the Port/ Terminals.
*(immediate vicinity will mean at least 8 km radii from main entrance of Port's operational area applicable for both Kandla as well as for Vadinar)

LIMIT OF LIABILITY

Section 1
Overall Limit of Liability: INR 40,00,00,000 any one accident or occurrence and in the aggregate
Sublimit for liability arising out of wreck removal: INR 5,00,00,000

Sections 2, 3 & 4

Loss Limit: INR 760,00,00,000 any one accident or occurrence and in the aggregate

TOTAL SUM INSURED FOR PROPERTIES (excludes owned vessels): **INR 66,018,944,786.**

Sections 4

Indemnity Period: 12 Months
Annual Revenue – INR 27,107,385,666
Annual Gross Profit – INR 25,759,485,666
Loss limit – INR 100,00,00,000

Combined Single Limit for PD /BI / Liability across all sections is INR 800,00,00,000

LOCATION:

Insured Location addresses as under:

1. Administrative Office Buildng, Near Madhuban Hotel, Gandhidham, Kutch, Gujarat -370201
2. Custom Bounded Area Port of Kandla – 370210.
3. Port Colony, KDLB colony, FCI colony, Residential quarters-400 quarters, Gopalpuri, Gandhidham -370201.
4. Office Buildings and Residential Quarters outside port area, Kandla – 370210
5. Dispensary at Adipur-370205
6. Baba Saheb Ambedkar Convention Centre Gandhidham

7. Jetty Area, Vadinar-361010 – Latitude : 220 44' N ; Longitude : 690 67' E

8. Port Colony, Vadinar-361010 – Latitude : 230 01' N ; Longitude : 700 13' E

POLICY CONDITIONS:

Section 1

Ports and Terminals Consortium Section 1 – Liability Wording Amended.
Clause 2.3 (Insuring Clause) amended.

Ports and Terminals Consortium Fire Extension (Liability).
Ports and Terminals Consortium Advice and Information Extension (Liability).

Ports and Terminals Consortium Fines and Duty Extension (Liability).
Ports and Terminals Consortium Infringement of Personal Rights Extension (Liability).
Ports and Terminals Consortium Wrongful Delivery of Cargo Extension (Liability).

Subject to Joint Liability Committee War and Terrorism Exclusion Clause JL2002/02 17/01/02 plus Joint Liability Committee

Deductible:
For Liability (including environmental pollution): Flat: INR 5,00,000

Section 2

Ports and Terminals Consortium Section 2 – Property Damage Wording Amended.
Clause 2.1 (Insuring Clause) amended to include electrical and machinery breakdown.
Exclusion 4.8 (Safe working load) amended.
Exclusion 5.2 (Road) deleted.
Exclusion 5.4 (Stock) does not apply to stock of spare parts.
Exclusion 4.9 (Communication Equipment) deleted.
Clause 5.1 amended to include land development cost
Clause 8.1 (Automatic Acquisition) amended to 90 days. Clause 8.2 (Automatic Acquisition) amended to 10%.

Ports and Terminals Consortium Earthquake Extension Clause (Property) Amended, 1/04 LSW1517.
Clause A amended to include Tsunami. Clause B amended to include Tsunami.
48 hours amended to 72 hours.

Deductible:
(A) Other than AOG peril & Vessel Impact: 2% of claim amount subject to Minimum **INR 3,00,000 each and every claim**

(B) AOG Peril: 2% of claim amount subject to **Minimum INR 20,00,000 each and every claim (including losses affecting breakwater)**

(C) Vessel impact: 2% of claim amount subject to **Minimum INR 20,00,000 each and every claim (including losses affecting breakwater)**

Section 3
Ports and Terminals Consortium Section 3 – Handling Equipment Wording Amended.
Clause 2.1 (Insuring Clause) amended to include electrical and machinery breakdown.
Clause 2.4 (Removal of Wreck/Debris) included
Exclusion 4.7 (Communication Equipment) deleted.
Exclusion 4.9 (Safe working load) amended.
Exclusion 4.15 (Mechanical or Electrical Breakdown) deleted.
Clause 8 (Protective Maintenance) amended.
Clause 9.1 (Automatic Acquisition) amended to 90 days
Clause 9.2 (Automatic Acquisition) amended to 10%
Ports and Terminals Consortium Earthquake Extension Clause (Handling Equipment) Amended 1/04 LSW1520. Clause A amended to include Tsunami.
Clause B amended to include Tsunami.
48 hours amended to 72 hours.

Deductible: 2% of claim subject to **Minimum INR 3,00,000**

Section 4
Ports and Terminals Consortium Section 4 Business Interruption Wording Amended 1/04 LSW1522.
Clause 2.3 (Interruption to Utility Supply) amended to include gas, fuel or water supply.
Additional Clause 2.4 interruption due to damage and/or blockage of pipeline.

Deductible: 7days

Applicable to Sections 2, 3 & 4
Subject to Expediting Expenses Clause

Subject to Architects, Surveyors', Legal and Consulting Engineers' Fees Clause

Subject to Minor Works Clause

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Regd. & Head Office : New India Assurance Bldg. 87, Mahatama Gandhi Road, Fort, Mumbai - 400 001.
Website : www.newindia.co.in
CIN : L66000MH1919GOI000526

दि न्यू इन्डिया एश्योरन्स कं. लि.
(भारत सरकार का उपक्रम)
बृहत कॉर्पोरेट एवं ब्रोकर्स कार्यालय : 920000
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डॉ. बी.आर. आंबेडकर चौक, मुंबई - 400 001.
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Subject to Public Authority Clause

Subject to Reinstatement Clause

Subject to Temporary Removal Clause

Subject to Additional Increased Cost of Working Clause.

Subject to Prevention of Ingress/Egress Clause.

Subject to Professional Accountants Fees Clause

Subject to Average Clause (85%)
Pollution Clean-up Costs Clause
Claims Preparation Costs Clause
Minimization of Loss Clause
Designation of Property Clause
Listed Perils resulting from seepage and/or pollution and/or contamination clause
Limited seepage &/or pollution &/or contamination resulting from physical damage caused by listed perils clause

Waiver of under-insurance upto 15% of Sum Insured under property damage and BI Sum Insured
Marine Impact Insurance Clause
Specialized / Heavy Lift/ Oversize Lifting clause
Toxic Mould Exclusion Clause
Claims Control Clause
NMA 2919 War and Civil War and Terrorism Exclusion Clause

<u>Applicable to All Sections</u>

General Policy Provisions LSW1524 01/04 Amended
Clause 5 (Radioactive Contamination, etc) deleted
Clause 6.1 B. amended to delete 'strike, lock-out, labour disturbance, riot, civil commotion'.
Clause 11 (Notice of Potential Claims) amended. Clause 18 (Premium Payment Clause) deleted.
Clause 21 (Governing Law) amended to India.
Clause 10 (Electronic Exclusion Clause) deleted.
Employment Practices Clause
Simultaneous Payment Clause (Losses)
Waiver of Subrogation and Additional Assured Clause
Special Termination Clause.
Continuity Clause

Subject to Institute Radioactive Contamination, Chemical, Biological, Bio-chemical and Electromagnetic Weapons Exclusion

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Clause CL.370 10/11/03, and Marine Cyber Exclusion LMA5402 and Marine Cyber Endorsement LMA5403.

Subject to Sanction Limitation and Exclusion Clause LMA3100 15th September 2010.

Subject to Unintentional Errors and Omission Clause.

Notwithstanding anything contained elsewhere, insurance shall be governed by and construed in accordance with the laws of India and the exclusive jurisdiction of India.

Payment on account clause - Payment on account of any loss recoverable under this insurance will be promptly made by the insurers to the insured if so desired, provided that such payment are deducted from the finally agreed claim settlement figures.

Paneled surveyor clause: In the event of a claim, the surveyors shall be appointed only from the panel of agreed surveyors as mentioned below:

a) Proclaim Insurance Surveyors and Loss Assessors Private Limited

b) McLarens Insurance Surveyors And Loss Assessors India Pvt. Ltd

c) Alex Stewart International (India) Private Limited

In case above surveyors are not available, the appointment of alternate surveyor by insurance company will be done in agreement and after consent of the assured.

EXPRESS WARRANTIES: None

CONDITIONS PRECEDENT: None

SUBJECTIVITIES: None

PREMIUM: Total Premium inclusive of sections 1,2,3 &4:

INR 14,30,39,825 plus 18% GST of INR 2,57,47,168.50

Total premium of INR 16,87,86,993.50

Paid in full prior to inception

दि न्यू इन्डिया एश्योरन्स कं. लि.
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Phone : 022 - 2204 4973 / 2204 4976 /2204 4977 / 2204 4974

Terrorism Cover

Insured:	**DEENDAYAL PORT AUTHORITY,** (hereinafter referred as MPT) and/ or associated and/ or affiliated and/ or interrelated and/ or subsidiary companies and/ orcorporations as they now are or may hereafter be created and/ or constituted and/ or for whom the Assured receive instructions to insure and/ or for whom the Assured have or assume a responsibility to arrange insurance, whether contractually or otherwise, as their respective rights and interests may appear hereinafter known as the Assured and/ or as original.
Insurance Intermediary:	Marsh India Insurance Brokers Pvt. Ltd.
Risk Location:	Insured Location addresses as under: 1. Administrative Office Buildng, Near Madhuban Hotel, Gandhidham, Kutch, Gujarat -370201 2. Custom Bounded Area Port of Kandla – 370210. 3. Port Colony, Gopalpuri, Gandhidham -370201. 4. Office Buildings and Residential Quarters outside port area, Kandla – 370210 5. Dispensary at Adipur-370205 6. Baba Saheb Ambedkar Convention Centre Gandhidham 7. Jetty Area, Vadinar-361010 – Latitude : 220 44' N ; Longitude : 690 67' E 8. Port Colony, Vadinar-361010 – Latitude : 230 01' N ; Longitude : 700 13' E
Occupancy:	**Marine Port**
Cover:	Terrorism and Sabotage with third party liability limit
Period:	24th July 2024 to 23rd July 2025
Total Insured Values:	Property Damage and handling equipment- INR 66,018,944,786. Sections 4 Indemnity Period: 2 Months Annual Revenue – INR 27,107,385,666 Annual Gross Profit – INR 25,759,485,666 Loss limit – INR 100,00,00,000

पंजीकृत एवं प्रधान कार्यालय : न्यू इन्डिया एश्योरन्स बिल्डींग, 87, महात्मा गांधी रोड, फोर्ट, मुंबई - 400 001.
Regd. & Head Office : New India Assurance Bldg, 87, Mahatama Gandhi Road, Fort, Mumbai - 400 001.
Website : www.newindia.co.in
CIN : L66000MH1919GOI000526

Limit:

Combined Single Limit for Property Damage, handling equipment and Business Interruption – INR 760,00,00,000

Third party liability limit of INR 40,00,00,000

Combined Single Limit for Property Damage, handling equipment and Business Interruption and liability – INR 800,00,00,000

Deductibles:

Material damage – 2% claim amount subject to minimum of INR 300,000

Business Interruption – 7 days

Third Party Liability – INR 500,000 any one accident / occurrence

Total Premium:

INR 21,92,181 plus 18% GST of INR 3,94,592.58 totaling to

INR 25,86,773.58

For The New India Assurance Co. Ltd.

बृहत कॉर्पोरेट एवं ब्रोकर्स कार्यालय 920000

Authorized Signatory

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Annexure E

Lic.of Solid waste recycler

GPCB

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

By R.P.A.D

One Time Authorization as importer for importing Non-Hazardous waste under Part – D of Schedule – III on behalf of actual users.

(See Rule-13)(2)(C)

The authorization is hereby granted to **V. K. Enterprise** having **IEC No. ACAPN6790N** Located at **2, Plot No.16, Sector 1/A, Shakti Nagar Road, Gandhidham, Kutch-370201** for import of the following waste listed in part D of schedule III of Hazardous and Other Waste (M&TM) Rules-2016.

Sr.No.	Description of Non Hazardous waste to be imported.
1.	Iron and Steel Scrap, Brass Scrap, Aluminium Scrap, Copper Scrap, Zinc Scrap-500MTPA(Under B-1010, Part-D of Schedule – III of Hazardous and Other Waste (M&TM) Rules-2016)

Specific condition;

1. Unit shall strictly comply with all the conditions mentioned in Memorandum of Understanding No.KC0000733170 dated 01/04/2021.
2. The Applicant / Importer shall have to submit Performa Invoice within 30 days from the date of issue of this letter.

The authorization is subjected to following conditions:

1 The import is permitted only for sale to actual users/manufactures who are registered & have valid consent & Authorization of the State Pollution Control Board/Pollution Control Committee.

2 In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous and Other Waste (M&TM) Rules-2016, the waste has to be **re-exported by the importer** at his own cost within a period of 90 days from the date of its arrival in India.

3 The importer of the hazardous and other wastes shall maintain records of the hazardous and other waste imported by him in Form 3 and the record so maintained shall be made available for inspection.

4 The importer of the hazardous and other wastes shall file an annual return in **Form 4** to the State Pollution Control Board on or before the **30th day of June** following the financial year to which that return relates.

5 The Board reserves right to cancel/amend/Revoke the authorization at any point of time as per the provision of Hazardous and Other Waste (M&TM) Rules-2016 and subsequent amendment thereof.

6 The importers shall have to comply with the provisions of the Environment protection Act, 1986 and the Rules made therein.

7 The importer shall [illegible] Hazardous and Other Waste (M&TM) Rules-2016 in line with EPA-1986.

For and on behalf of
Gujarat Pollution Control Board

(D. M. Thaker)
Environment Engineer
Unit Head Hazardous Waste Cell

No GPCB/HAZ-R-Kutch-332/ 60|158/ 18 SEP 2021

Issued to:
V. K. Enterprise
2, Plot No. 16, Sector 1/A,
Shakti Nagar Road, Gandhidham,
Kutch - 370 2[illegible]

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

GPCB

TRUE COPY

By R.P.A.D

One Time Authorization as importer for importing Non-Hazardous waste under Part – D of Schedule – III on behalf of actual users.

(See Rule-13)(2)(C)

The authorization is hereby granted to **Green Earth Marine Solutions** having **IEC No. CIOPS1894Q** Located at **Office No.202, Plot No.578, Ward 12/c, Second Floor, Shakti Avenue, Gandhidham, Kutch-370201** for import of the following waste listed in part D of schedule III of Hazardous and Other Waste (M&TM) Rules-2016.

Sr. No.	Name and Basel No. of Other Waste as per the SCHEDULE-III, Part-D of Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016	Quantity (Ton/ Annum)	List and detailed address of actual or prospective users
1.	Iron and Steel Scrap [B-1010]	600 MTPA	V M Industries (GPCB ID 13236) Plot No.210/3, Shramjivi Vasahat, Opp. Rajendra Park, Rakhiyal, Ahmedabad
2.	Copper Scrap [B-1010]	1000 MTPA	Jayshree Agro Industries (GPCB ID 11910), Plot No.1211, GIDC Dholka, Ahmedabad

This authorization is granted as per the provisions of clause (c) of sub-rule (2) of rule 13, of Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016.

This authorization is subject to the following general and specific conditions:-

1. Unit shall strictly comply with all the conditions mentioned in Memorandum of Understanding No.KC0031050896-897 dated 25/01/2022.
2. The Applicant / Importer shall have to submit Performa Invoice within 30 days from the date of issue of this letter.
3. The authorized person shall comply with the provisions of the Environment (Protection) Act, 1986 (29 of 1986), and the rules made there under.
4. This authorization shall be produced for inspection at the request of an officer authorized by the State Pollution Control Board.
5. The person authorized shall not import, store and trade in the imported other wastes other than those wastes permitted through this authorization.
6. Authorized person shall intimate the State Pollution Control Board regarding change in the storage location or closure of storage facility.

NOTARY SAPNA D. DADLANI Area Gandhidham-Kutch Regd. No. 7910/2019 GUJARAT INDIA Expiry Date 12-05-2025 GOVT. OF INDIA

TRUE COPY

7. The waste which gets generated during storage and trading of imported other wastes shall be treated and disposed of as per prevailing regulations.
8. The importer shall bear the cost of import and mitigation of damages if any caused during the process of import, storage and trading.
9. Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or the Central Pollution Control Board, as the case may be, from time to time.
10. Annual return as per FORM 4 shall be filed by June 30th for the period ensuring 31st March of the year.
11. The Authorized Trader shall be responsible to obtain other statutory permissions as may be required.
12. The import is permitted only for sale to actual users/manufactures who are registered & have valid consent & Authorization of the State Pollution Control Board/Pollution Control Committee.
13. In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous and Other Waste (M&TM) Rules-2016, the waste has to be re-exported by the importer at his own cost within a period of 90 days from the date of its arrival in India.
14. The importer of the hazardous and other wastes shall maintain records of the hazardous and other waste imported by him in Form 3 and the record so maintained shall be made available for inspection.
15. The Board reserves right to cancel/amend/Revoke the authorization at any point of time as per the provision of Hazardous and Other Waste (M&TM) Rules-2016 and subsequent amendment thereof.

For and on behalf of
Gujarat Pollution Control Board

D. M. Thaker 1/2/2022
(D. M. Thaker)
Environment Engineer
Unit Head Hazardous Waste Cell

No.GPCB/HAZ-R-Kutch-366/ 622193

02 FEB 2022

Issued to:
Green Earth Marine Solutions
Office No.202, Plot No.578, Ward 12/c,
Second Floor, Shakti Avenue, Gandhidham,
Kutch-370201

COLOUR XEROX
- 9 FEB 2022
TRUE COPY
(SAPNA D. DADLANI)
ADVOCATE & NOTARY
Gandhidham-Kutch

NOTARY
SAPNA D. DADLANI
Area Gandhidham-Kutch
Regd. No. 7919/2019
GUJARAT, INDIA
Expiry Date
12-05-2024
GOVT. OF INDIA

GPCB

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

By R.P.A.D

One Time Registration as importer for importing Non-Hazardous waste under Part – D of Schedule – III on behalf of actual users.

(See Rule-16)

The registration is hereby granted to **Chitrakut Trading and Industries** having **IEC No. 3714001654** Located at **Ranko, Ward-29, Navawas, Madhapar, Bhuj, Kutch-370020** for import of the following waste listed in part D of schedule III of Hazardous waste (Management, Handling & Transboundary Movement) Rules-2008 read with third amendment dated 30/3/2010.

Sr. No.	Description of Non Hazardous waste to be imported.
1.	Aluminum Scrap, Iron & Steel Scrap, Copper Scrap, Zinc Scrap, Brass Scrap @ 80000 MTPA Under B-1010, Part-D of Schedule - III

The registration is subjected to following conditions:

1 The import is permitted only for sale to actual users/manufactures who are registered &have valid consent& Authorization of the State Pollution Control Board/Pollution Control Committee.

2 The registered trader shall have to submit the details of such import and particulars of actual users along with quantities to this Board on a **quarterly basis** as per prescribed format enclosed herewith as Annexure – A and registration would be liable for cancellation on failure to furnish these details/quarterly report to this Board.

3 In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous waste (Management, Handling & Transboundary Movement),Third Amendment Rules 2010, the waste has to be **re-exported by the importer** at his own cost within a period of 90 days from the date of its arrival in India.

4 The Board reserves right to cancel/amend/Revoke the registration at any point of time as per the provision of Hazardous waste (M,H&TM) Rules – 2008 and subsequent amendment thereof.

28 OCT 2022

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(MADHUKANT J. SHAH)
B.Com., LL.B.(Sp.)
ADVOCATE & NOTARY
Gandhidham (Kutch) 370201, India

NOTARY Madhukant J. Shah Dist. Kutch. Area REG. No. 324/2002 Expiry Date 29-08-2027 GOVT. OF GUJARAT

5 The importers shall have to comply with the provisions of the Environment protection Act, 1986 and the Rules made therein.

6. The Importer shall strictly adhere with Environmental stipulation of Hazardous Waste (Management & Handling) Rules, 2008 in line with EPA-1986.

For and on behalf of
Gujarat Pollution Control Board

(V. R. Ghadge)
Senior Environmental Engineer

No.GPCB/HAZ-R-Kutch-171/ 23061 14 NOV 2014

Issued to:
Chitrakut Trading and Industries
Ranko, Ward-29, Navawas,
Madhapar, Bhuj,
Kutch-370020

TRUE COPY
28 OCT 2022
(MADHUKANT J. SHAH)
B.Com., LL.B.(Sp.)
ADVOCATE & NOTARY
Gandhidham (Kutch) 370201, India

NOTARY Madhukant J. Shah Regn. No. 324/2002 Expiry Date 24-06-2027 GOVT. OF GUJARAT

GUJARAT POLLUTION CONTROL BOARD

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

By R.P.A.D

One Time Authorization as importer for importing Non-Hazardous waste under Part – D of Schedule – III on behalf of actual users.

(See Rule-13)(2)(C)

The authorization is hereby granted to **Golden Shipping Services** having **IEC No. 3716500208** Located at **Kidana Nirmal Nagar, Survey No.133, Plot No.83, Kidana, Kutch-370205** for import of the following waste listed in part D of schedule III of Hazardous and Other Waste (M&TM) Rules-2016.

Sr. No.	Name and Basel No. of Other Waste as per the SCHEDULE-III, Part-D of Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016	Quantity (Ton/ Annum)	List and detailed address of actual or prospective users
1.	Iron and Steel Scrap [B-1010]	600 MTPA	Vega Alloys (GPCB ID 44804) S.No.22/1 & 2, Maglana-364240, Tal: Sihor, Dist: Bhavnagar

This authorization is granted as per the provisions of clause (c) of sub-rule (2) of rule 13, of Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016.

This authorization is subject to the following general and specific conditions:-

1. Unit shall strictly comply with all the conditions mentioned in Memorandum of Understanding No.KC0033840599 dated 07/05/2022.
2. The Applicant / Importer shall have to submit Performa Invoice within 30 days from the date of issue of this letter.
3. The authorized person shall comply with the provisions of the Environment (Protection) Act, 1986 (29 of 1986), and the rules made there under.
4. This authorization shall be produced for inspection at the request of an officer authorized by the State Pollution Control Board.
5. The person authorized shall not import, store and trade in the imported other wastes other than those wastes permitted through this authorization.
6. Authorized person shall intimate the State Pollution Control Board regarding change in the storage location or closure of storage facility.
7. The waste which gets generated during storage and trading of imported other wastes shall be treated and disposed of as per prevailing Regulations.
8. The importer shall bear the cost of import and mitigation of damages if any caused during the process of import, storage and trading.

NOTARY Madhukant J. Shah Area : Dist. Kutch. REG. No. 334/2002 Expiry Date 24-08-2027 GOVT. OF GUJARAT

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30 MAY 2022
(MADHUKANT J. SHAH)
B.Com., LL.B.(Sp.)
ADVOCATE & NOTARY
Gandhidham (Kutch) 370201, India.

9. Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or the Central Pollution Control Board, as the case may be, from time to time.
10. Annual return as per FORM 4 shall be filed by June 30th for the period ensuring 31st March of the year.
11. The Authorized Trader shall be responsible to obtain other statutory permissions as may be required.
12. The import is permitted only for sale to actual uscrs/manufactures who are registered & have valid consent & Authorization of the State Pollution Control Board/Pollution Control Committee.
13. In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous and Other Waste (M&TM) Rules-2016, the waste has to be re-exported by the importer at his own cost within a period of 90 days from the date of its arrival in India.
14. The importer of the hazardous and other wastes shall maintain records of the hazardous and other waste imported by him in Form 3 and the record so maintained shall be made available for inspection.
15. The Board reserves right to cancel/amend/Revoke the authorization at any point of time as per the provision of Hazardous and Other Waste (M&TM) Rules-2016 and subsequent amendment thereof.

For and on behalf of
Gujarat Pollution Control Board

D. M. Thaker 17/5/2022

(D. M. Thaker)
Environment Engineer
Unit Head Hazardous Waste Cell

No.GPCB/HAZ-R-Kutch-374/ 672663

18 MAY 2022.

Issued to:
Golden Shipping Services
Kidana Nirmal Nagar, Survey No.133,
Plot No.83, Kidana,
Kutch-370205

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30 MAY 2022
(MADHUKANT J. SHAH)
B.Com., LL.B.(Sp.)
ADVOCATE & NOTARY
Gandhidham (Kutch) 370201, India.

NOTARY
Madhukant J. Shah
Area : Dist. Kutch.
REG. No. 324/2002
Expiry Date 24-06-2027
GOVT. OF GUJARAT

GUJARAT POLLUTION CONTROL BOARD
Paryavaran Bhavan
Sector-10-A, Gandhinagar-382 010.
Phone : (079) 23226295
Fax : (079) 23232156
Website : www.gpcb.gov.in

RPAD

Registration as importer for importing on behalf of actual users.

(See Rule-16)

The registration is hereby granted to M/s. **Harish A. Pandya** having IEC No.3700000260 Located at Office No.15,Brahm Samaj Building,Plot No.106, Sector-08,B/H-Oslo Cinema,Gandhidham For import of the following waste listed in part-B of Schedule III of Hazardous waste (Management, Handling & Transboundary Movement) Rules, 2008.

Description of waste	Quantity of Waste to be Imported
All kind of ferrous & & non ferrous scrap under B-1010 Of Schedule-III **Alluminium Scrap** **Stainless steel scrap** **Copper scrap –** **Zink scrap -** **Brass Scrap**	**80,000MT/Annum**

The registration is subjected to following conditions:

1 The import is permitted only on behalf of actual users, registered traders who have valid consent & Authorization of the Gujarat Pollution Control Board.

2 The importer shall submit the quarterly report stating the details of import including the names of actual users and quantity of waste to the Board.

3 In case of illegal import or import other than mentioned in Part-B of Schedule-III of the Hazardous waste (Management, Handling & Tran boundary Movement) Rules, 2008, the waste has to be re-exported by the importer at his own cost within a period of 90 days from the date of its arrival in India.

NOTARY Madhukant J. Shah Area Dist. Kutch. REC No. 324/2002 Expiry Date 24-06-2007 GOVT. OF GUJARAT

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11 JAN 2023
(MADHUKANT J. SHAH)
B.Com., LL.B.(Sp.)
ADVOCATE & NOTARY
Gandhidham (Kutch) 370201, India.

GUJARAT POLLUTION CONTROL BOARD
Paryavaran Bhavan
Sector-10-A, Gandhinagar-382 010.
Phone : (079) 23226295
Fax : (079) 23232156
Website : www.gpcb.gov.in

4 The Board reserves right to cancel/amend/Revoke the registration/Authorization at any time as per the policy of the Board/ Government

5 The importers shall comply with the provisions of the Environment protection Act, 1986 and the Rules made there under.

For and on behalf of
Gujarat Pollution Control Board

(R. C. Tamboli)
Environment Engineer

GPCB/Haz/R/Kutch-39/ 4812 /2010

1 APR 2010

Issued to:
M/s **Harish A. Pandya**
Office No.15,Brahm Samaj Building,
Plot No.106, Sector-08,
B/H-Oslo Cinema,
Gandhidham

NOTARY Madhukant J. Shah Area: Dist. Kutch. REG. No. 224/2002 Expiry Date 24-05-2027 GOVT. OF GUJARAT

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(MADHUKANT J. SHAH)
B.Com., LL.B.(Sp.)
ADVOCATE & NOTARY
Gandhidham (Kutch) 370201, India.

GUJARAT POLLUTION CONTROL BOARD

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

By R.P.A.D

One Time Authorization as importer for importing Non-Hazardous waste under Part – D of Schedule – III on behalf of actual users.

(See Rule-13)(2)(C)

The authorization is hereby granted to **New India Marine Works** having **IEC No. 3712001673** Located at **Plot No.378, Ward 11-A, Bharat Nagar, Gandhidham, Kutch-370201** for import of the following waste listed in part D of schedule III of Hazardous and Other Waste (M&TM) Rules-2016.

Sr.No.	Name and Basel No. of Other Waste as per the SCHEDULE-III, Part-D of Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016	List and detailed address of actual or prospective users	Quantity (Ton/ Annum)
1.	Aluminium Scrap [B-1010]	Pyramid Industries, Survey No.322 paiki 1, NR B.V. Oil Mill,Chhatral Kadi Road, Vill:Indrad, Tal: Kadi, Dist: Mehsana	3000MTPA
2.	Zinc Scrap [B-1010]		3000MTPA
3.	Brass Scrap [B-1010]	Indu Extrusion & Alloys Pvt Ltd, Plot No.3657/58, GIDC Phase-III, Dared, Jamnagar	1000MTPA
4.	Copper Scrap [B-1010]		1000MTPA
5.	Iron and Steel Scrap [B-1010]	Sardar Casting Pvt Ltd, 15, Plot No.6,7,8, Kangasiyali Road, Gondal Road, Vavdi, Rajkot	1000MTPA

This authorization is granted as per the provisions of clause (c) of sub-rule (2) of rule 13, of Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016.

This authorization is subject to the following general and specific conditions:-

1. Unit shall strictly comply with all the conditions mentioned in Memorandum of Understanding No.KC0019531774, KC0017892708-709 dated 05/01/2022, 17/01/2022.
2. The authorized person shall comply with the provisions of the Environment (Protection) Act, 1986 (29 of 1986), and the rules made there under.
3. This authorization shall be produced for inspection at the request of an officer authorized by the State Pollution Control Board.

4. The person authorized shall not import, store and trade in the imported other wastes other than those wastes permitted through this authorization.
5. Authorized person shall intimate the State Pollution Control Board regarding change in the storage location or closure of storage facility.
6. The waste which gets generated during storage and trading of imported other wastes shall be treated and disposed of as per prevailing regulations.
7. The importer shall bear the cost of import and mitigation of damages if any caused during the process of import, storage and trading.
8. Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or the Central Pollution Control Board, as the case may be, from time to time.
9. Annual return as per FORM 4 shall be filed by June 30th for the period ensuring 31st March of the year.
10. The Authorized Trader shall be responsible to obtain other statutory permissions as may be required.
11. The import is permitted only for sale to actual users/manufactures who are registered & have valid consent & Authorization of the State Pollution Control Board/Pollution Control Committee.
12. In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous and Other Waste (M&TM) Rules-2016, the waste has to be re-exported by the importer at his own cost within a period of 90 days from the date of its arrival in India.
13. The importer of the hazardous and other wastes shall maintain records of the hazardous and other waste imported by him in Form 3 and the record so maintained shall be made available for inspection.
14. The Board reserves right to cancel/amend/Revoke the authorization at any point of time as per the provision of Hazardous and Other Waste (M&TM) Rules-2016 and subsequent amendment thereof.

For and on behalf of
Gujarat Pollution Control Board

D. M. Thaker 19/01/2022

(D. M. Thaker)
Environment Engineer
Unit Head Hazardous Waste Cell

No.GPCB/HAZ-R-Kutch-363/21336

19 JAN 2022

Issued to:
New India Marine Works
Plot No.378, Ward 11-A, Bharat Nagar,
Gandhidham. Kutch-370201

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

GPCB

By R.P.A.D

One Time Authorization as importer for importing Non-Hazardous waste under Part – D of Schedule – III on behalf of actual users.

(See Rule-13(2)(C)

The authorization is hereby granted to **K M Enterprise** having **IEC No. BGJPH6692D** Located at **Plot No.63, Ward-3B, Adipur, Gandhidham, Kutch-370201** for import of the following waste listed in part D of schedule III of Hazardous and Other Waste (M&TM) Rules-2016.

Sr.No.	Description of Non Hazardous waste to be imported.
1.	Iron and Steel Scrap, Brass Scrap, Aluminium Scrap, Copper Scrap, Zinc Scrap-200MTPA [Under B-1010, Part-D of Schedule-III of Hazardous and Other Waste (M&TM) Rules-2016]

Specific condition;

1. Unit shall strictly comply with all the conditions mentioned in Memorandum of Understanding No.KC0001032237 dated 06/03/2021.
2. The Applicant / Importer shall have to submit Performa Invoice within 30 days from the date of issue of this letter.

The authorization is subjected to following conditions:

1 The import is permitted only for sale to actual users/manufactures who are registered & have valid consent & Authorization of the State Pollution Control Board/Pollution Control Committee.

2 In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous and Other Waste (M&TM) Rules-2016, the waste has to be **re-exported by the importer** at his own cost within a period of 90 days from the date of its arrival in India.

3 The importer of the hazardous and other wastes shall maintain records of the hazardous and other waste imported by him in Form 3 and the record so maintained shall be made available for inspection.

4 The importer of the hazardous and other wastes shall file an annual return in **Form 4** to the State Pollution Control Board on or before the **30th day of June** following the financial year to which that return relates.

TRUE COPY
(U. K. JOSHI)
NOTARY
DIST. KUTCH- (GUJARAT)
Reg. No 5848

NOTARY
UMED K. JOSHI
GOVT. OF INDIA

5 The Board reserves right to cancel/amend/Revoke the authorization at any point of time as per the provision of Hazardous and Other Waste (M&TM) Rules-2016 and subsequent amendment thereof.

6 The importers shall have to comply with the provisions of the Environment protection Act, 1986 and the Rules made therein.

7 The Importer shall strictly adhere with Environmental stipulation of Hazardous and Other Waste (M&TM) Rules-2016 in line with EPA-1986.

For and on behalf of
Gujarat Pollution Control Board

D. M. Thaker 10/3/2021

(D. M. Thaker)
Environment Engineer
Unit Head Hazardous Waste Cell

No.GPCB/HAZ-R-Kutch-327/58557 10 M 2021

Issued to:
K M Enterprise
Plot No.63, Ward-3B,
Adipur, Gandhidham,
Kutch-370201

Copy to:
1. Regional Officer,
Kutch (East)

TRUE COPY
(U. K. JOSHI)
NOTARY
DIST. KUTCH- (GUJARAT)
Reg. No.5848

NOTARY
UMED K. JOSHI
Area: Dist. Kutch
Regd. No. 5848
GUJARAT STATE
(INDIA)
GOVT. OF INDIA

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector 10-A, Gandhinagar 382010
Phone : (079) 23226295
Fax : (079) 23232156
website : www.gpcb.gov.in

By R.P.A.D

One Time Registration as importer for importing Non-Hazardous waste under Part – D of Schedule -III on behalf of actual users.

(See Rule-16)

The registration is hereby granted to **Naaz Shipping Services Enterprise** having **IEC No. 3707001466** Located at **Off.No-35, 1st Floor, Grain Merchant Assn. Building, Plot No-297, Ward 12/B, Gandhidham Kutch 370201** for import of the following waste listed in part D of schedule III of Hazardous waste (Management, Handling & Trans boundary Movement) Rules-2008 read with third amendment dated 30/3/2010.

Sr.No.	Description of Non Hazardous waste to be imported.
1.	Iron & Steel Scrap @ 50,000 MTA Under B-1010, Part-D of Schedule - III

Specific condition;

The Applicant / Importer shall have to submit the following details within 7(seven) days or else registration shall be treated as cancelled without prior intimation.

1. Copy of ID proof of the Proprietor of the Company i.e. COPY of Pancard etc.

NOTARY R.L.GADHVI Area: Gandhidham Taluka Regd. No. 1323/2010 Gujarat State Expiry Date 09/02/2025 Govt. of Gujarat

The registration is subjected to following conditions:

1 The import is permitted only for sale to actual users/manufacturer who are registered & have valid consent & Authorization of the Gujarat Pollution Control Board.

2 The registered trader shall have to submit the details of such import and particulars of actual users along with quantities to this Board on a **quarterly basis** as per prescribed format enclosed herewith as Annexure – A and registration would be liable for cancellation on failure to furnish these details/quarterly report to this Board.

3 In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous waste (Management, Handling &

TRUE COPY
R.L.GADHVI
ADVOCATE & NOTARY
Gandhidham-Kutch

Transboundary Movement), Third Amendment Rules 2010, the waste has to be **re-exported by the importer** at his own cost within a period of 90 days from the date of its arrival in India.

4 The Board reserves right to cancel/amend/Revoke the registration at any point of time as per the provision of Hazardous waste (M,H&TM) Rules – 2008 and subsequent amendment thereof.

5 The importers shall have to comply with the provisions of the Environment protection Act, 1986 and the Rules made therein.

6. The Importer shall strictly adhere with Environmental stipulation of Hazardous Waste (Management & Handling) Rules, 2008 in line with EPA-1986.

For and on behalf of
Gujarat Pollution Control Board

(V. R. Patel)
Senior Environment Engineer

GPCB/HAZ-R-KUTCH-124/ 130332 17 NOV 2012

Issued to:
Naaz Shipping Services Enterprise
Off.No-35, 1st Floor, Grain Merchant Assn. Building,
Plot No-297, Ward 12/B, Gandhidham
Kutch-370201

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R.L.GADHVI
ADVOCATE & NOTARY
Gandhidham-Kutch

NOTARY
R.L. GADHVI
Area: Gandhidham
Taluka
Regd. No. 1323/2010
Gujarat State
Expiry Date
09/02/2024
Govt. of Gujarat

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

GPCB

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By R.P.A.D

One Time Authorization as importer for importing Non-Hazardous waste under Part – D of Schedule – III on behalf of actual users.

(See Rule-13)(2)(C)

The authorization is hereby granted to **Omega Marine Services** having **IEC No. 3713001812** Located at **Office No.2, Bhraham Samaj Building, Plot No.106, Sector-8, Gandhidham, Kutch-370201** for import of the following waste listed in part D of schedule III of Hazardous and Other Waste (M&TM) Rules-2016.

Sr.No.	Description of Non Hazardous waste to be imported.
1.	Iron and Steel Scrap-50000MTPA [Under B-1010, Part-D of Schedule – III of Hazardous and Other Waste (M&TM) Rules-2016]

Specific condition;

1. Unit shall strictly comply with all the conditions mentioned in Memorandum of Understanding No.86029169441 dated 06/08/2020.
2. The Applicant / Importer shall have to submit Performa Invoice within 30 days from the date of issue of this letter.

The authorization is subjected to following conditions:

1 The import is permitted only for sale to actual users/manufactures who are registered & have valid consent & Authorization of the State Pollution Control Board/Pollution Control Committee.

2 In case of illegal import or import other than mentioned in Part-D of Schedule-III of the Hazardous and Other Waste (M&TM) Rules-2016, the waste has to be **re-exported by the importer** at his own cost within a period of 90 days from the date of its arrival in India.

3 The importer of the hazardous and other wastes shall maintain records of the hazardous and other waste imported by him in Form 3 and the record so maintained shall be made available for inspection.

4 The importer of the hazardous and other wastes shall file an annual return in **Form 4** to the State Pollution Control Board on or before the **30th day of June** following the financial year to which that return relates.

NOTARY GOVT. OF INDIA PANKAJ J. JOSHI Area: Gandhidham Taluka Regd. No. 1907/2018 GUJARAT STATE Expiry Date 31-1-2023

Clean Gujarat Green Gujarat

ISO-9001-2008 & ISO-14001 - 2004 Certified Organisation

TRUE COPY (PANKAJ J. JOSHI) NOTARY (Gandhidham-Kutch)

OMEGA MARINE SERVICES Gujarat India

TRUE COPY

5 The Board reserves right to cancel/amend/Revoke the authorization at any point of time as per the provision of Hazardous and Other Waste (M&TM) Rules-2016 and subsequent amendment thereof.

6 The importers shall have to comply with the provisions of the Environment protection Act, 1986 and the Rules made therein.

7 The Importer shall strictly adhere with Environmental stipulation of Hazardous and Other Waste (M&TM) Rules-2016 in line with EPA-1986.

For and on behalf of
Gujarat Pollution Control Board

D. M. Thaker 13/8/2020

(D. M. Thaker)
Environment Engineer
Unit Head Hazardous Waste Cell

No.GPCB/HAZ-R-Kutch-305/ 565808 | 13 AUG 2020

Issued to:
Omega Marine Services
Office No.2, Bhraham Samaj Building,
Plot No.106, Sector-8, Gandhidham,
Kutch-370201

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(PANKAJ J. JOSHI)
NOTARY (Gandhidham-Kutch)

OMEGA MARINE SERVICES Gujarat India

NOTARY
GOVT. OF INDIA

/

/

Annexure F

coal handling (circular no. TF/SH/Circulars/2019/1256 dated 10/10/2019)

DEENDAYAL PORT TRUST

(AN ISO 9001:2008 & ISO 14001:2004 CERTIFIED PORT)
(आईएसओ9001:2008 एवआईएसओ14001:2004प्रमाणितपोर्ट)

SAGARMALA

Telegram : PORT TRUST
तार : पोर्टट्रस्ट
टेलीफोन : 02836-270625
फैक्स : 02836-270475

SIPC KANDLA

यातायात प्रबंधक का कार्यालय
कंडलापोर्टट्रस्ट
पीएंडसीबिल्डिंग
नवाकंडला (कच्छ) 370210

TF/SH/Circulars/2019/1256

Date: 10/10/2019

CIRCULAR

In supersession of earlier Circulars notably No.TF/SH/2019/5362 dtd.23-24/01/2019 and No.TF/SH/Circulars/2019/1004 dtd. 18/09/2019 issued with regard to controlling the dust pollution arising out of coal handling as also ensuring safety in cargo handling so as to avoid damage to port infrastructure, in consultation with Port Users the following Standard Operating Procedures (SOPs) is formulated for due compliance :

1. During the course of discharging coal from the vessels at berth, the grab should invariably be opened at a lower height at Wharf.
2. Trucks/Dumpers are transporting coal from wharf to storage yard, storage yard to railway siding/for final delivery by road, as the case may be, should load coal below the brim/body level to avoid spillage enroute.Trucks, dumpers loaded for delivery of coal while moving from plot to weighbridge or weighbridge to plot and moving out should be covered by tarpaulin.
3. Storage of coal at yard shall not exceed above 5Mtrs height.
4. Water sprinkling on Indonesian coal heaps at plots at regular intervals to be undertaken by respective Port Users.
5. Sweeping machines should be deployed by the Port Users for their respective vessels at wharf and on roads during Coal handling operations.Spillage cargo on road/s should be cleaned immediately.
6. The residual cargo at wharf should be swept immediately on completion of dischargeof vessel to ensure the wharf is clean for next incoming vessel.
7. The internal roads at coal storage yard should be cleaned by the respective Port Users adjacent to their plots.

Further, damages are reportedly being caused to Port properties due to deployment of chain mounted heavy equipments by port users. To avoid such damages and adhering to safety norms, it has been decided not to permit deployment of such chain mounted heavy equipments / vehicles to come into direct contact with the surface on following areas:

1. Chain mounted equipments shall not be allowed to come into direct contact with the surface at wharfs neither for cargo loading nor barge unloading including Bunder area.Such equipments are permittedto be used/moved at Wharfs only on rubber mats/Steel plate and/or on cargo heaps of one meter height and above.
2. At no point of time,the Chain/ Crawler mounted equipments are allowed tocome into direct contact with Concrete/Bitumen surfaceeither whilemoving, loading, unloadingof such equipments, except on rubber mats/steel plates or directly on to cargo heaps of minimum one meter height and above.
3. While cleaning coal spillage on Railway Tracks, equipments like Pay Loaders/Escavators (Hitachis) are not to be used.

4. Dumping and/or Storage of cargo within three meters distance from Cable Ducts, Highmast Light Towers, Drainages, Railway Lines, Waterspringling system, Fire fighting installations is not permitted / allowed.

5. While handling of coal and other bulk cargoes, especially with Ship's Cranes, a temporary precautionary barrier should be made available to avoid spillage of cargo into the sea.

6. Plying of Vehicles, Equipments other than at designated places/areas is not permitted.

All Port Users/stake holders are requested to take note of the above and strictly adhere to the aforestated SOPs. CHA's are requested to inform their respective transporters of these SOP's and give wide publicity amongst them.

Any violation of above circular with regard to non adherence of precautions to be taken whilst deploying chain mounted equipment/s, a penalty of Rs. 25000/- and for any other violationsa penalty of Rs 10000/- shall be imposed for each violation of above rules. If the violation is repeated thrice, it could lead to suspension of licence/authorization for a period 10 days. Repeated and habitual violations could lead to cancellation of licence/ authorization. Road Trafffic, parking, covering of coal by Tarpauling and other safety related violations will be delt with as per Circular of life saving Rules and other Safety Rules DPT and procedure for traffic Safety Management in DPT. Any damage to port property by port user a penality of two times of assessed cost will be recorved from the port users.

This will come into effect from 10/10/2019. The same will be reviewed after three months.

The stakeholder's kind co-operation is solicited.

The Circular is issued with approval of competent authority.

Traffic Manager (I/c)
Deendayal Port Trust

To:

All Port Users/Trade Associations

Copy to :

1. **Sr.PS to Chairman – for kind information of Chairman**
2. **PS to Dy.Chairman – for kind information of Dy.Chairman**
3. **Chief Engineer**
4. **Chief Mechanical Engineer**
5. **ALL Officers of Traffic Department - for implementation**
6. **Sr.DD(EDP) - for uploading on website**

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Annexure F

Annual monitoring report

Environmental Monitoring Annual Report

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: 15th April 2023 -15th April 2024

Document Ref No.: GEMI/DPA/782(2)(2)/2024-25/78

Submitted to:

Deendayal Port Authority (DPA), Kandla

Gujarat Environment Management Institute (GEMI)

(An Autonomous Institute of Government of Gujarat)

GEMI Bhavan, 246-247, GIDC Electronic Estate, Sector-25, Gandhinagar-382025

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

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 Annual Report (Monitoring Period: April 2023 - April 2024)"* is prepared.

- **Name of the Report:** *Environment Monitoring Report (Monitoring Period April 2023-April 2024)*
- **Date of Issue:**
- **Version:** 1.0
- **Report Ref.:** GEMI/DPA/782(2)(2)/2024-25/78

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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
MMTPA	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 Environmental monitoring and management plan (EMMP)

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 environmental monitoring done during the period from 15th April 2023-15th April 2024.

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 monthly monitoring and 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, sulphate, NH_4, PO_4, 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.

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 transhipment), 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 **Map 1 & 2** as follows:

Map 1: Locations of Kandla and Vadinar Port

Map 2: Locations of Kandla Port

Map 3: Locations 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 1** as given below:

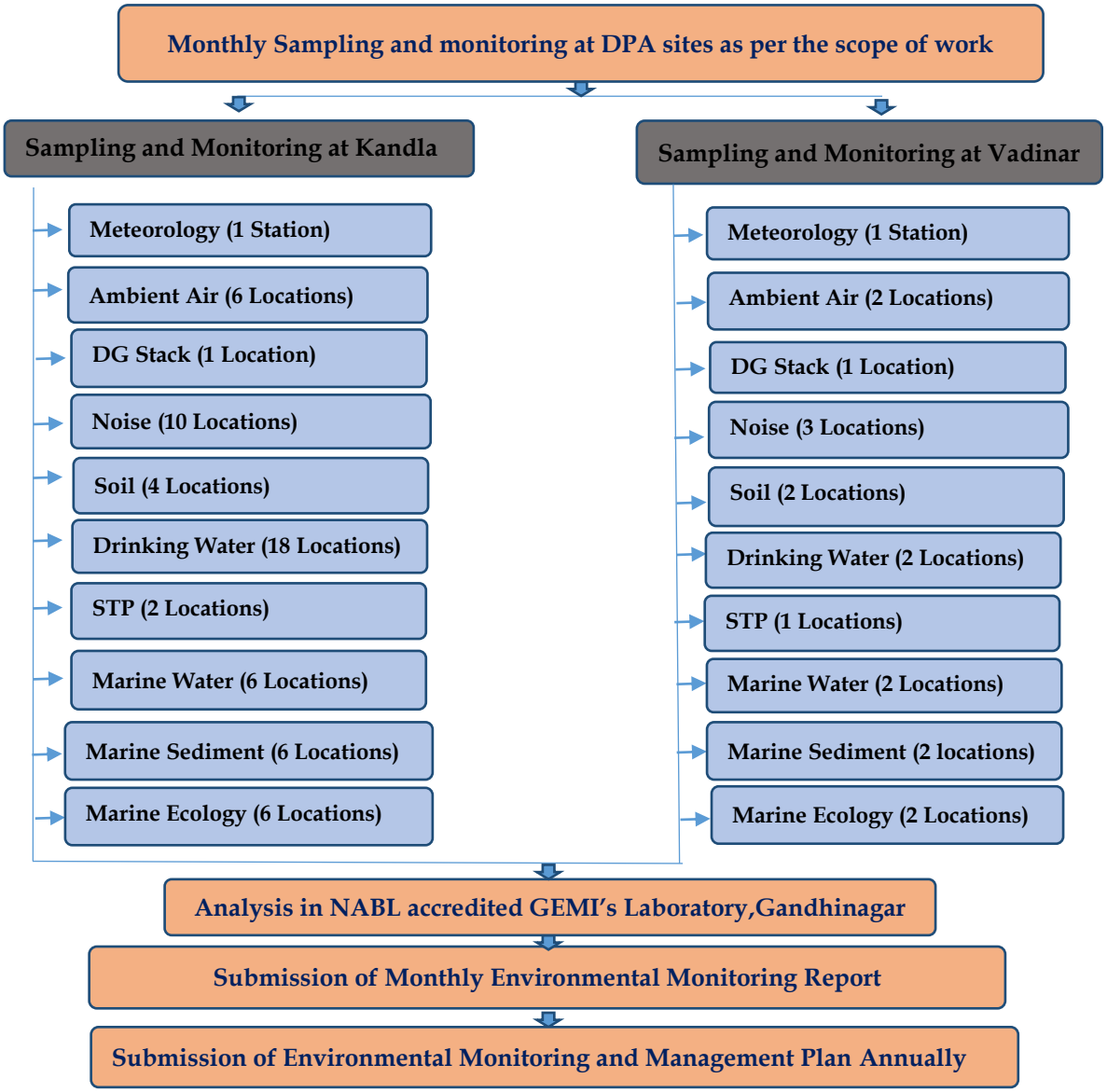


Figure 1: Methodology flow chart

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

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	^{o}C		
6.	Solar Radiation	W/m^2		

Monitoring Frequency:

The Meteorological parameters were recorded at an interval of 1 hour in a day for the period of 15th April 2023 to 15th April 2024 and the average value for all the Meteorological parameters were summarized for the sampling period of at both the observatory site.

Figure 2: 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 of **April 2023 to April 2024,** 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/m²)**	**Wind Direction (°)**	**Rainfall (mm)**
	Max.	**Min**	**Avg.**	**Max.**	**Min**	**Avg.**	**Max.**	**Min**	**Avg.**			
April-May 23	27.02	1.54	8.78	32.21	30.4	31.31	64.12	61.07	57.76	105.42	S.S.E	0.05
May-June 23	48.85	3.07	12.94	32.64	31.23	31.93	70.33	65.93	68.17	90.14	N & N.N.W	0.37
June- July 23	38.99	1.23	9.71	31.54	30.27	30.89	76.32	72.43	74.47	67.76	E.W.E & W.S.W	3.56
July-Aug 23	35.4	1.47	7.67	30.51	29.32	29.91	77.72	73.87	75.78	57.4	W.S.W	14.94
Aug-Sep 23	37.52	0.63	6.55	48.44	30.33	38.43	84.57	69.18	75.59	73.28	W.S.W	21.89
Sep- Oct 23	20.36	0.16	4.75	31.01	29.66	30.32	71.62	66.85	69.32	74.08	W.S.W	2.87
Oct- Nov 23	9.85	0.025	1.15	31.24	29.63	30.41	55.4	49.02	52.18	65.11	North	0.012
Nov- Dec 23	14.72	0	2.09	25.76	24.32	25.03	59.69	54.6	57.1	54.28	N.E	0.96
Dec- Jan 24	15.75	0	1.87	23.22	21.68	22.44	56.5	51.11	53.78	60.66	North	0
Jan- Feb 24	15.29	0.131	3.147	24.83	23.18	24	56	50.51	53.19	65.32	North	0
Feb- Mar 24	22.41	0.44	5.12	26.7	25.06	25.86	51.55	45.91	48.64	78.46	North	0.04
Mar- Apr 24	33.09	0.025	5.43	48.44	26.87	30.08	73.25	30.59	55.06	89.43	W.S.W	0

Details of Micro-meteorological data at Vadinar Observatory												
Monitoring Period	**Wind Speed (Km/h)**			**Temperature (°C)**			**Relative humidity (%)**			**Solar Radiation (W/m²)**	**Wind Direction (°)**	**Rainfall (mm)**
	Max.	**Min**	**Avg.**	**Max.**	**Min**	**Avg.**	**Mean**	**Max.**	**Min**			
April-May 23	26.33	7.78	13.24	28.74	28.04	28.17	73.47	70	71.08	110.76	W & South	0.02
May-June 23	34.08	7.63	16.76	29.96	29.22	29.34	71.77	69.03	69.83	102.95	S.S.E	0.19
June- July 23	12.31	1.62	5.19	29.51	28.86	28.94	77.68	75.42	75.95	78.26	South	0.27
July-Aug 23	31.69	5.39	13.12	28.62	27.99	28.06	79.51	77.31	77.77	60.86	South	0.22
Aug-Sep 23	28.07	5.2	12.96	27.75	27.18	27.22	75.13	72.87	73.42	88.14	South & S.W	0
Sep- Oct 23	21.82	4.64	9.59	28.12	27.5	27.56	77.12	74.66	75.32	87.51	South	0.06
Oct- Nov 23	13.8	1.77	4.17	27.89	27.1	27.28	63.61	59.58	61.15	81.61	N.E	0.18
Nov- Dec 23	19.37	3	4.84	24.79	24.11	24.24	64.12	60.47	61.79	70.68	S.S.E	0.03
Dec- Jan 24	16.76	1	4.18	22.94	22.14	22.34	63.13	59.25	60.71	73.37	South	0
Jan- Feb 24	10.62	1.99	3.94	23.24	22.92	22.7	65.66	64.19	64.9	87.29	South	0
Feb- Mar 24	16.92	5.36	8.55	24.16	23.6	23.82	62.34	60.91	61.51	101.99	N.N.W	0
Mar- Apr 24	29.61	0.31	11.63	29.8	24.96	26.5	82.36	57.41	71.08	114.77	N.N.W	0

3.3 Data Interpretation and Conclusion

1) Kandla:

a. The ambient temperature for the summer season varies in the range of **21.68** to **48.44** °C; in the monsoon season, the temperature varies between **29.32** and **33.38** °C; and in the winter season, the temperature varies between **21.68** and **31.24** °C. The yearly average temperature at Kandla is observed to be around **29.217** °C, with a standard deviation of 4.31.
b. The relative humidity for the summer season was recorded in the range of **30.59**% to **76.32**%; in the monsoon season, relative humidity was recorded in the range of **66.85**% to **84.57**%; and in the winter season, relative humidity was recorded in the range of **49.02** to **59.69**%; the yearly average humidity at Kandla was **61.75**% with a standard deviation of **10.635**.
c. The maximum rainfall at Kandla was observed at **21.89** mm for the monitoring period of August to September 2023; the yearly average rainfall was found to be **3.72** mm.
d. Wind speed and direction play a significant role in transporting pollutants and thus determining the air quality. In the summer season, wind blew from the North and North North West directions; in the monsoon season, wind blew from the West South West; and in the winter season, wind blew from the North direction.
e. The wind speed recorded ranges from **0.025** to **48.85** km/h in the summer season; in the monsoon season, the wind speed recorded ranges from **0.16** to **37.52** km/h; and in the winter season, the wind speed recorded ranges from **0** to **15.75** km/h. The yearly average wind speed at Kandla is **5.77** km/h, with a standard deviation of 3.55.
f. The **maximum** solar radiation at Kandla was observed at **105.42** W/m^2 during the monitoring period **April to May 2023**; the **minimum** solar radiation at Kandla was observed at 54.**28** W/m^2 for the monitoring period **November to December 2023; and** the yearly **average** solar radiation was found to be **73.445** W/m2 with a standard deviation of 15.19.

2) Vadinar:

a. The ambient temperature for the summer season varies between **23.6** and **29.96** °C; in the monsoon season, it varies between **27.18** and **28.62** °C; and in the winter season, it varies between **22.14** and **27.89** °C. The yearly average temperature at Vadinar is **2.347** °C with standard deviation of **2.4**.
b. The relative humidity for the summer season was recorded in the range of **57.41**% to **82.36**%; in the monsoon season, relative humidity was recorded in the range of **72.87**% to **79.51**%; and in the winter season, relative humidity was recorded in the range of **59.25**% to **65.66**%; the yearly average humidity at Vadinar was **68.7**% with a standard deviation of 6.38.
c. The **maximum** rainfall at Vadinar was observed at **0.27** mm for the monitoring period from **June to July 2023**; the yearly **average** rainfall was found to be **0.08** mm.
d. In Summer Season wind blew from South Direction, in Monsoon season wind blew from South and in Winter Season wind blew from South and South West direction. The recorded wind speed ranges from **0.31** to **34.08** km/hr in the summer season, **4.64** to **31.69** km/hr, and in the monsoon season, the recorded wind speed ranges from **1** to **19.37** km/hr. The yearly average wind speed at Vadinar is 9.014 km/h with a standard deviation of **4.49**.

e. The maximum solar radiation at Vadinar was observed at **114.77** W/m2 for the monitoring period April to May 2024; the minimum solar radiation at Vadinar was observed at **60.86** W/m2 for the monitoring period July to August 2023; and the yearly average solar radiation was found to be **88.182** W/m2.

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(1).

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 air quality 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	23.043538N 70.218617E	
3.		A-3	Kandla Port Colony	23.019797N 70.213536E	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 **Map 4 and 5** respectively.

Ambient Air monitoring photos

Kandla

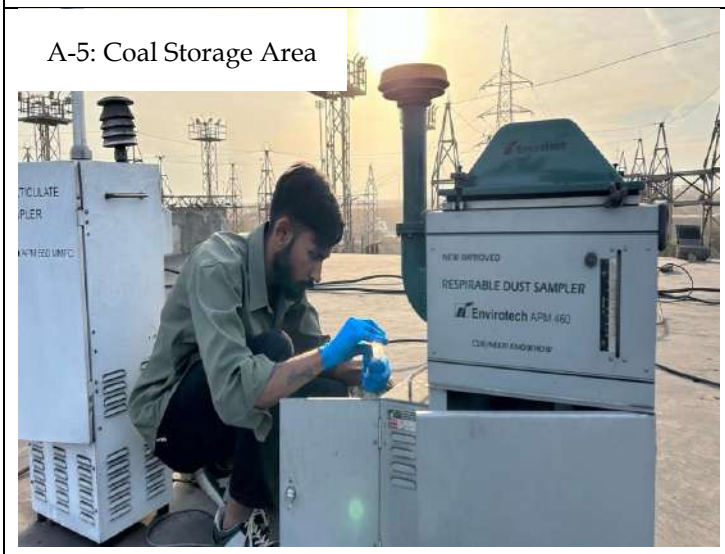
A-1: Oil Jetty No. 1

A-2: Oil Jetty No. 7

A-3: Kandla Port Colony

A-4: Marine Bhavan

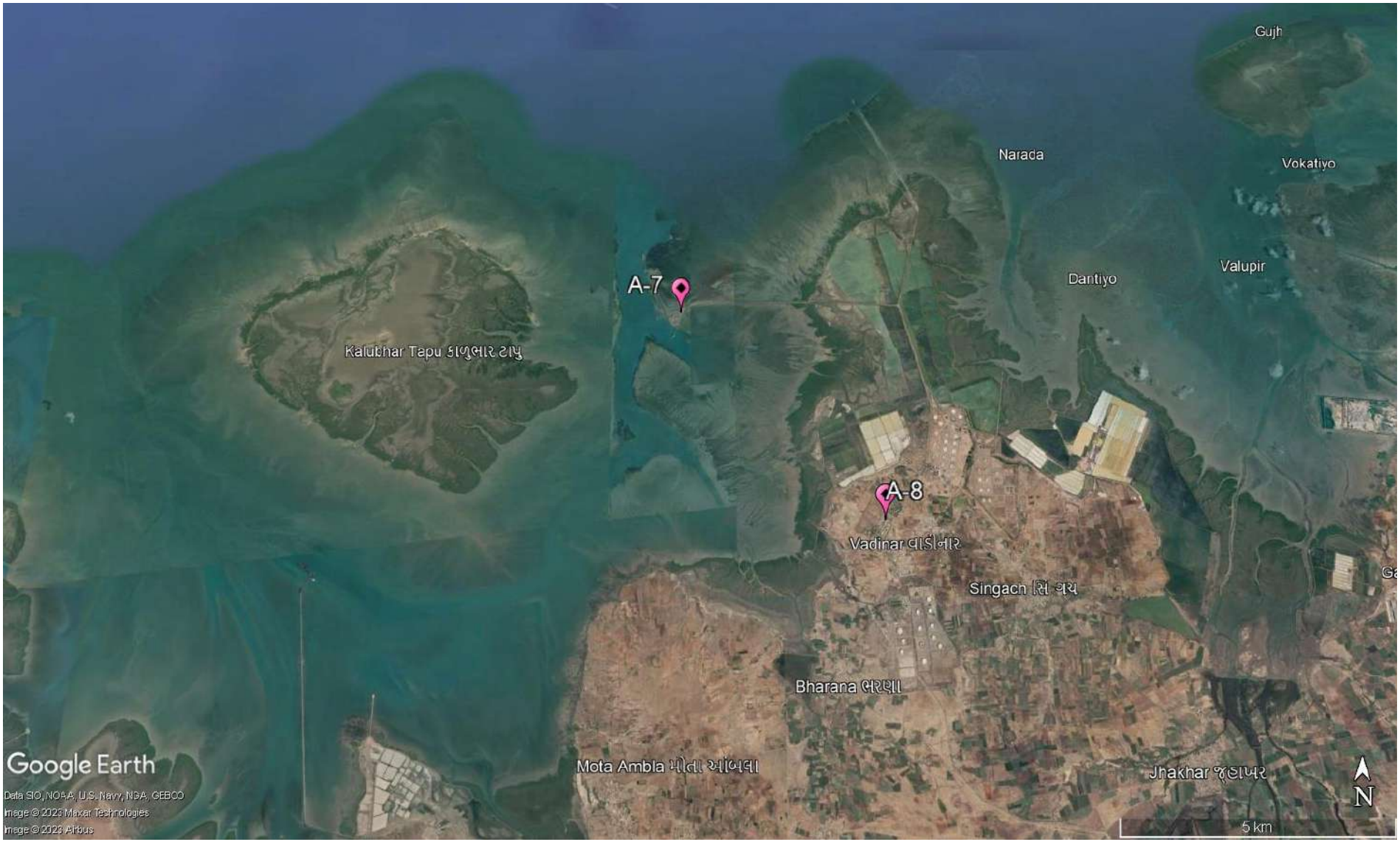
A-5: Coal Storage Area



A-6: Gopalpuri Hospital

Vadinar	
A-7: Admin Building 	A-8: Vadinar Colony 

Map 4: Ambient Air Monitoring locations at Kandla



Map 5: Ambient Air Monitoring locations at Vadinar

Monitoring Frequency

The sampling for Particulate matter, i.e., PM_{10} and $PM_{2.5}$, and gaseous components like SO_x, NO_x, and CO, as well as the total VOCs, was monitored twice 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 a monthly basis. The monitoring period for this study is from April 15, 2023, to April 15, 2024. During this period, 95 air samples were taken from six locations in Kandla, and 97 samples were taken from two locations in Vadinar.

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 PM_{10}, 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 SO_2 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 PM_{10}, $PM_{2.5}$, 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/m³	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/m³	IS:5182 (Part:24):2019	Fine Particulate Sampler (FPS) conforming to IS:5182 (Part-24): 2019	
3.	Sulphur Dioxide (SO_x)	µg/m³	IS 5182 (Part:2): 2001	Gaseous Attachment conforming to IS:5182 Part-2	
4.	Oxides of Nitrogen (NO_x)	µg/m³	IS:5182 (Part-6): 2006	Gaseous Attachment conforming to IS:5182 Part-6	
5.	Carbon Monoxide (CO)	mg/m³	GEMI/SOP/AAQM/11; Issue no 01, Date 17.01.2019: 2019	Sensor based Instrument	
6.	VOC	µg/m³	IS 5182 (Part 17): 2004	Low Flow Air Sampler	
8.	PAH	µg/m³	IS: 5182 (Part 12): 2004	Respirable Dust Sampler (RDS) conforming to IS:5182 (Part-12): 2004	Monthly
7.	Benzene	µg/m³	IS 5182 (Part 11): 2006 RA: 2017	Low Flow Air Sampler	
9.	Non-methane VOC	µg/m³	IS 5182 (Part 11): 2006	Low Volume Sampler	

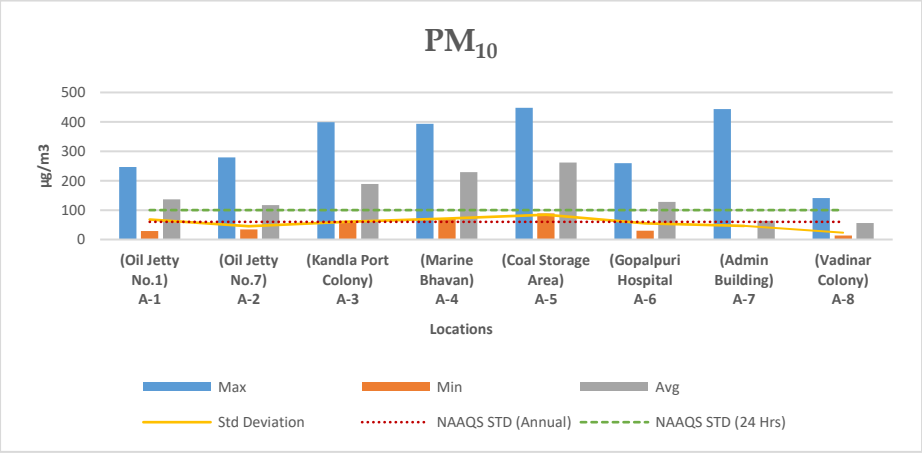
4.2 Result and Discussion

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**.**

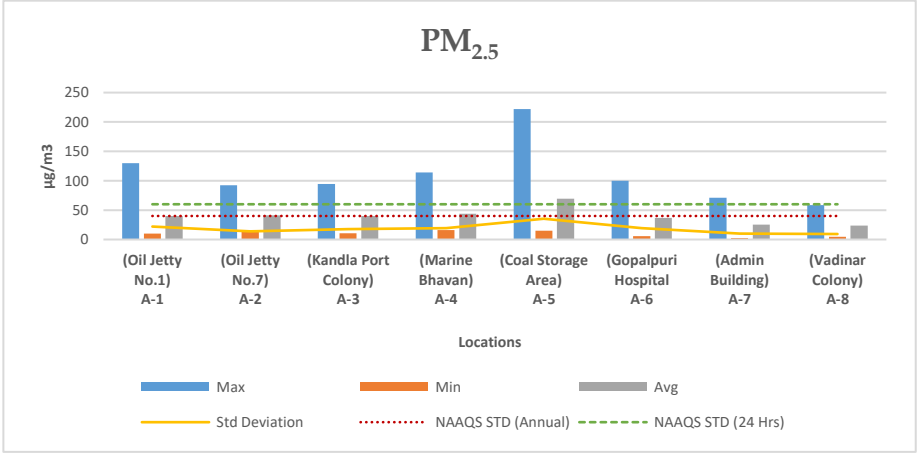
Table 6: Summarized results of PM_{10}, $PM_{2.5}$, SO_2, NO_x, VOC and CO for Ambient Air quality monitoring

Parameters / Locations	NAAQS by CPCB		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
PM_{10} (µg/m3)	24 Hours -100 Annual -60	Max	247.03	279.33	399.25	393.74	448.12	259.88	443.2	140.7
		Min	28.68	34.39	63.28	71.77	89.21	30.3	1.45	13.89
		Avg	136.50	116.67	188.36	229.41	262.04	127.95	63.49	56.54
		Std Deviation	68.203	44.97	60.56	71.74	84.18	55.43	46.36	23.15
$PM_{2.5}$ (µg/m3)	24 Hours -60 Annual -40	Max	129.77	92.24	94.51	114.34	221.9	99.82	71.18	58.73
		Min	10.03	12.85	10.84	15.97	14.85	5.51	2.36	4.7
		Avg	40.27	41.2	40.26	43.70	69.70	36.95	25.11	23.73
		Std Deviation	22.049	13.87	17.52	19.15	35.36	19.04	10.06	9.33
SO_2 (µg/m3)	24 Hours -80 Annual -50	Max	51.87	151.58	79.24	55.04	283	49.89	59.69	69.81
		Min	0.65	1.18	1.1	1.19	1.1	1.12	0.52	1.4
		Avg	11.076	20.01	14.63	11.82	16.82	11.56	12.59	13.69
		Std Deviation	12.142	28.41	17.15	12.25	30.85	12.08	13.35	14.90
NO_X (µg/m3)	24 Hours -80 Annual -40	Max	54.33	52.54	80.67	55.39	80.94	79.88	52.76	33.79
		Min	2.29	1.11	2.36	1.29	1.97	1.01	2.89	0.9
		Avg	14.75	14.58	22.91	20.52	28.12	15.24	12.84	9.70
		Std Deviation	11.68	9.85	14.98	10.53	17.98	13.59	8.62	5.73
VOC (µg/m3)	-	Max	4.85	5.67	17.43	4.41	3.97	4.12	4.52	6.62
		Min	0.01	0.01	0.01	0.02	0.04	0.01	0.01	0.01
		Avg	1.20	1.226	1.52	0.98	0.94	0.96	0.96	0.95
		Std Deviation	1.155	1.298	2.275	0.99	0.94	0.99	0.93	1.12
CO (mg/m3)	8 Hours -2 1 Hour -4	Max	0.98	4.21	2.91	3.16	3.21	2.18	3.14	2.74
		Min	0.08	0.09	0.14	0.39	0.36	0.32	0.03	0.45
		Avg	0.73	0.848	0.89	0.95	1.13	0.74	0.78	0.94
		Std Deviation	0.194	0.557	0.41	0.39	0.53	0.32	0.46	0.36

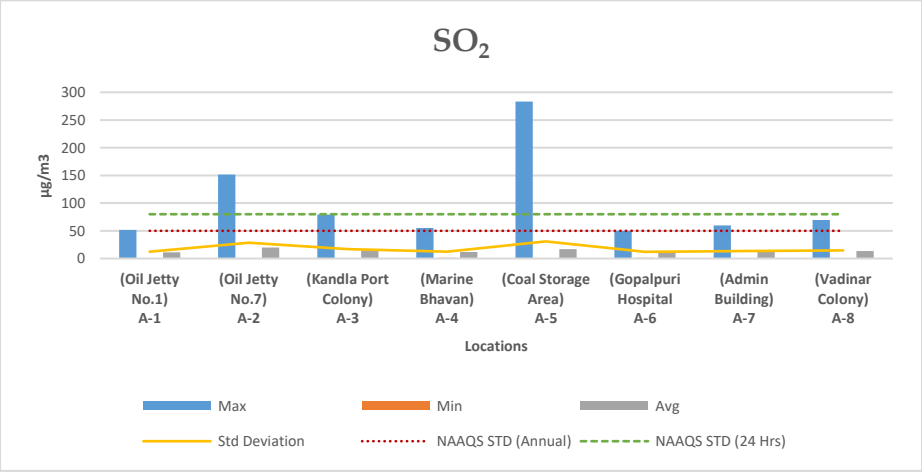
Graphs 1-6 shows spatial trend of ambient air parameter at all the eight-monitoring location (six at Kandla and 2 at Vadinar



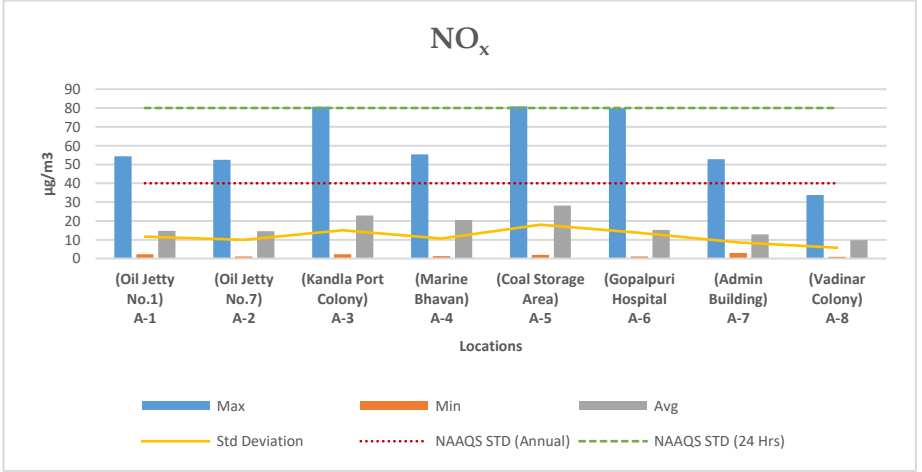
Graph 1 Spatial trend in Ambient PM_{10} Concentration



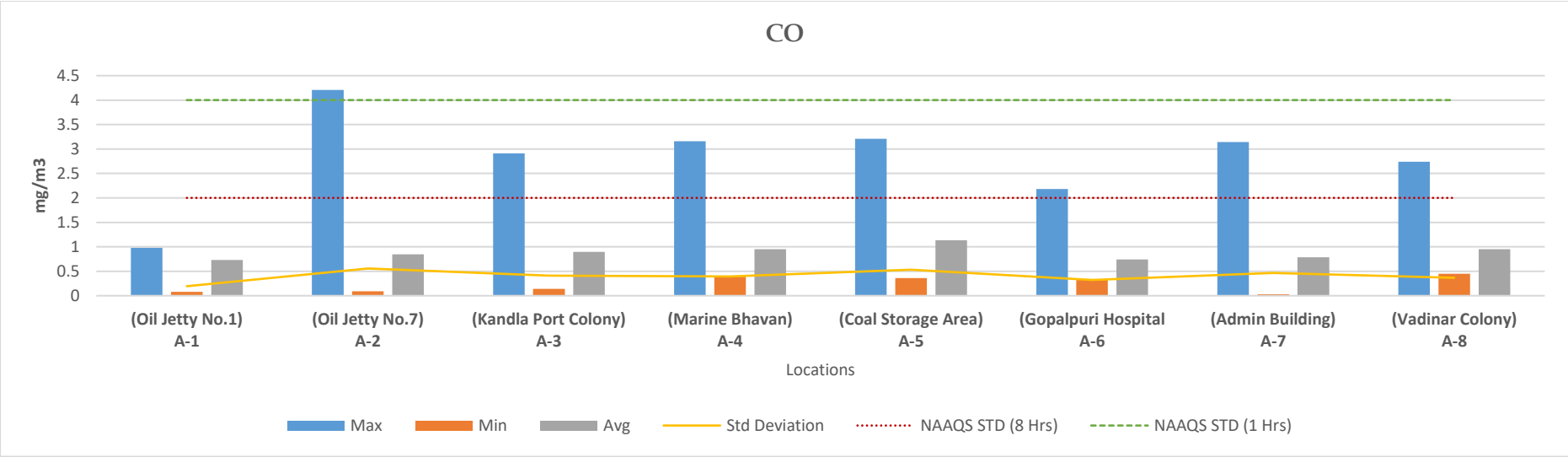
Graph 2 Spatial trend in Ambient $PM_{2.5}$ Concentration



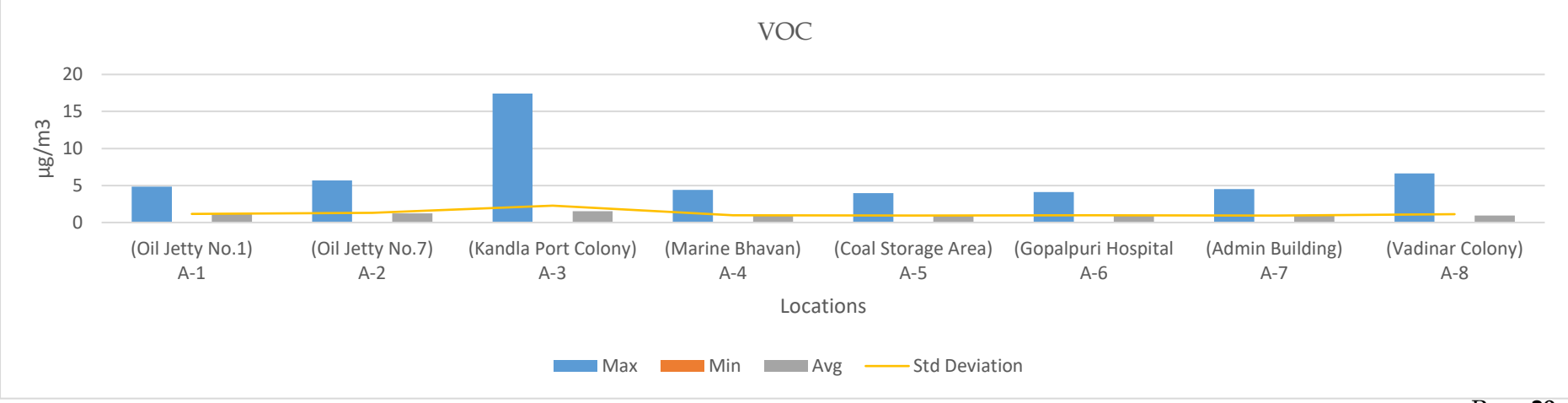
Graph 3 Spatial trend in Ambient SOx Concentration



Graph 4 Spatial trend in Ambient NOx 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

Parameters / Locations	NAAQS by CPCB		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
Benzene (µg/m3)	Annual - 5	Max	3.8	1.84	1.43	1.95	1.11	1.97	1.03	0.95
		Min	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.01
		Avg	0.83	0.46	0.42	0.32	0.41	0.49	0.33	0.229

Table 8: Summarized results of Polycyclic Aromatic Hydrocarbons

Parameters / Locations		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
Napthalene (µg/m3)	Max	1.57	17.31	5.24	5.55	7.8	39.82	1.98	1.84
	Min	0.02	0.21	0.04	0.14	0.37	0.02	0.1	0.13
	Avg	0.40	3.29	0.58	1.05	2.01	4.96	0.45	0.42
Acenaphthylene (µg/m3)	Max	0.8	0.67	0.54	0.95	0.53	0.86	0.84	0.65
	Min	0.01	0.01	0.01	0.02	0.007	0.02	0.005	0.005
	Avg	0.15	0.20	0.17	0.31	0.15	0.18	0.19	0.17
Fluorene (µg/m3)	Max	0.39	0.39	22.99	178.72	10.88	27.22	7.57	11.64
	Min	0.01	0.05	0.04	0.11	0.01	0.06	0.01	0.01
	Avg	0.14	0.19	3.435	19.99	1.25	3.52	0.82	1.18
Anthracene (µg/m3)	Max	0.87	0.91	1.25	5.05	2.02	3.78	0.85	0.57
	Min	0.09	0.09	0.07	0.09	0.03	0.01	0.02	0.02
	Avg	0.3	0.42	0.40	0.94	0.94	0.69	0.23	0.19
Phenanthrene (µg/m3)	Max	0.9	0.82	0.84	0.91	1	0.99	0.82	0.74
	Min	0.01	0.009	0.01	0.01	0.01	0.01	0.07	0.06
	Avg	0.23	0.20	0.15	0.22	0.33	0.20	0.25	0.22
Fluoranthene (µg/m3)	Max	2.65	0.84	1.59	19.54	4.16	20.36	0.68	1.71
	Min	0.06	0.15	0.2	0.24	0.2	0.01	0.01	0.01
	Avg	0.43	0.36	0.74	3.61	1	2.12	0.24	0.30
Pyrene (µg/m3)	Max	3.52	1.13	2.4	42.23	40.25	51.22	0.87	0.74
	Min	0.01	0.14	0.23	0.15	0.02	0.01	0.01	0.01
	Avg	0.54	0.48	0.90	7.46	4.37	7.98	0.16	0.14
Chrycene (µg/m3)	Max	4.59	1.03	3.01	6.27	5.51	5.82	0.61	0.79

	Min	0.08	0.15	0.44	0.42	0.08	0.06	0.05	0.05
	Avg	0.78	0.51	1.01	1.50	1.47	1.22	0.19	0.22
Banz(a)anthracene (µg/m3)	Max	5.64	2.84	3.7	15.42	6.57	16.73	1.01	0.97
	Min	0.17	0.17	0.04	0.14	0.05	0.06	0.01	0.01
	Avg	0.89	0.65	0.88	2.66	1.44	2.93	0.25	0.31
Benzo[k]fluoranthene (µg/m3)	Max	7.67	1.99	5.98	4.81	4.06	6.89	0.84	0.69
	Min	0.15	0.38	0.14	0.48	0.05	0.06	0.03	0.03
	Avg	1.32	0.99	1.34	1.21	0.89	1.76	0.35	0.21
Benzo[b]fluoranthene (µg/m3)	Max	7.89	1.93	6.15	5.12	4.73	7.29	0.59	0.71
	Min	0.12	0.04	0.21	0.17	0.07	0.01	0.06	0.01
	Avg	1.09	0.62	1.053	1.43	1.06	1.65	0.17	0.20
Benzopyrene (µg/m3)	Max	10.9	2.79	8.42	7.25	8.91	9.19	0.96	0.69
	Min	0.24	0.08	0.39	0.39	0.01	0.04	0.01	0.01
	Avg	1.64	0.87	1.66	1.75	1.58	1.31	0.30	0.27
Indeno [1,2,3-cd] fluoranthene (µg/m3)	Max	2.39	6.67	0.95	2.46	1.68	4.61	0.52	0.98
	Min	0.13	0.07	0.42	0.26	0.11	0.09	0.07	0.06
	Avg	0.71	1.02	0.57	0.72	0.70	1.25	0.22	0.42
Dibenz(ah)anthracene (µg/m3)	Max	1.82	1.2	0.91	1.25	2.24	0.99	1.34	2.48
	Min	0.11	0.08	0.16	0.1	0.07	0.04	0.08	0.05
	Avg	0.47	0.32	0.35	0.46	0.54	0.24	0.31	0.4
Benzo[ghi]perylene (µg/m3)	Max	16.3	9.7	27.2	13.6	9.4	12.2	8	2.3
	Min	0.1	0.07	0.04	0.06	0.06	0.17	0.07	0.13
	Avg	2.049	2.63	2.95	2.55	1.61	2.13	0.83	0.47
Acenaphthene (µg/m3)	Max	0.69	0.45	15.1	119.08	2.54	11.8	0.67	2
	Min	0.01	0.05	0.04	0.11	0.01	0.06	0.01	0.01
	Avg	0.14	0.22	2.63	11.34	0.369	1.55	0.14	0.33

Table 9: Summarized results of Non-methane VOC

Parameters \ Locations		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
Non- Methane VOC (µg/m3)	Max	2.11	2.67	3.54	1.35	1.8	2.01	2.15	1.67
	Min	0.12	0.09	0.1	0.08	0.13	0.11	0.07	0.1
	Avg	0.73	0.79	0.87	0.79	1.09	0.93	0.91	0.74s

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).

1) Kandla:

Particulate matter:

- The concentration of PM_{10} varies very widely and is reported in the range of **28.68** to **448.12** µg/m3, with a yearly average value of **176.83** with standard deviation **64.185** µg/m^3. As shown in Graph 1, the highest concentration (value) of PM_{10} is reported at location A-5 (coal storage area) during the winter. It can be seen that PM_{10} exceeds the NAAQS annual limit, i.e., 60 µg/m^3, in all locations. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-1 (oil jetty No. 1) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 100 µg/m^3.
- The concentration of PM2.5 varies in the range of 5.51 to 221.9 µg/m^3, with a yearly average value of 45.35 with standard deviation 21.16 µg/m^3. As shown in Graph 2, the highest concentration of $PM_{2.5}$ is at location A-5 (the coal storage area) in winter. It can be seen that $PM_{2.5}$ exceeds the NAAQS annual limit, i.e., 40 µg/m3, on five locations, and location A-6, i.e., Gopalpuri hospital, falls within the NAAQS annual limit. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-6 (Gopalpuri hospital) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 60 µg/m^3.
- The highest concentration of Particulate matter at locations **A–5, (the coal storage area)**, could be attributed to the presence of heavy vehicular traffic in upwind areas, which have a higher impact, causing the dispersion of emitted particulate matter in the ambient air. Ther activities observed in the surrounding such as The unloading of coal directly into the truck using grabs, construction in the vicinity causes the dust 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 or dumpers during their transit from vessel to yard or storage site. This might increase the PM in and around the coal storage area and Marine Bhavan.

Gaseous Pollutants:

- The concentration of SOx varies from **0.52** to **283** µg/m^3, with a yearly average concentration of **14.029** with standard deviation **18.85** µg/m^3. As shown in Graph 3, the highest concentration of SOx is at location **A-5 (the coal storage area)** in winter. It can be seen that at all locations, SOx are within the NAAQS annual limit, i.e., 50 µg/m^3. It can be seen that location A-2 **(Oil Jetty No. 7)** had the maximum percentage exceedance, i.e., **7.36**%, which is about 7 days out of 95 days of monitoring, and the other five locations comply with the standards (compliance more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m^3. The concentration of NOx varies from **1.01** to **80.94** µg/m3, with a yearly average concentration of **19.35** with standard deviation **13.10**

µg/m3. As shown in Graph 4, the highest concentration of NOx is at location A-5 (the coal storage area) in winter. It can be seen that on all locations's NOx within the NAAQS annual limit, i.e., 40 µg/m^3, it can be seen that all locations comply with the standards (complied more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m^3.

- The concentration of CO varies from **0.08** to **4.21** mg/m^3, with a yearly average concentration of **0.884** with standard deviation **0.40** mg/m^3. As shown in Graph 5, the highest concentration of CO is at location A-2 (Oil Jetty No. 7) in winter. It can be seen that at all locations, they're complying (more than 98% of the time) with the NAAQS 1 hour limit, i.e., 4 mg/m^3. Location A-5 (the coal storage area) had the maximum percentage exceedance, i.e., **7.36**%, which is about 7 days out of 95 days of monitoring, and other locations such as Location A-2 (Oil Jetty No. 7), Location A-3 (Kandla Port Colony), Location A-4 (Marine Bhavan), and Location A-6 (Gopalpuri Hospital) had percentage exceedances of **5.26, 5.26, 2.85**, and **2.85**, respectively. And location A-1 (oil jetty no. 1) comply with the standards (compliance more than 98% times) while comparing with the NAAQS 8-hour limit, i.e., 2 mg/m3.
- The concentration of total VOC levels was recorded in the range of **0.01** to **17.43** µg/m3, with a yearly average value of **1.14** with standard deviation 1.21 µg/m3 at Kandla. As shown in graph 6, the highest concentration of VOCs is at location **A-3, (Kandla port colony)**; this is the only spike observed in the whole monitoring period for VOCs at this location. The main source of VOCs in the ambient air may be attributed to the burning of gasoline and natural gas in vehicle exhaust, burning fossil fuels, and garbage that releases VOCs into the atmosphere. During the monitoring period, the wind flows in the south 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.

  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. These locations are commercial areas where Vehicular activity and dust emission is common. PAHs are a class of chemicals that occur naturally in coal, crude oil, and gasoline. The higher concentration which results from burning coal, oil, gas, road dust, etc. Other outdoor sources of PAHs may be the industrial plants in-and-around the DPA premises.
- The concentration of Benzene levels was recorded in the range of **0.02** to **3.8** µg/m^3, with a yearly average value of **0.84** with standard deviation **0.64** µg/m^3. The highest concentration of Benzene is at location **A-1, (Oil Jetty No. 1)** in summer. It can be seen that at all locations, Benzene within the NAAQS annual limit, i.e., 5 µg/m3.
- The ambient air monitoring location of Kandla recorded the non-methane VOC (NM-VOC) concentration in the range of **0.08** to **3.54** µg/m3, with a yearly average value of **0.86** µg/m3 at Kandla. The highest concentration is at location **A-3, (Kandla Port Colony** in Winter.

2) Vadinar:

Particulate matter: The concentration of PM10 at Vadinar varies in the range of **1.45 to 443.2** µg/m^3, with a yearly average value of **63.49** with a standard deviation of **34.76** µg/m3. As shown in Graph 1, the highest concentration of PM_{10} is at location A-7 (Admin Building Vadinar) in the winter. It can be seen that at location A-7 (Admin Building Vadinar), PM_{10} exceeds the NAAQS annual limit, i.e., 60 µg/m^3, and at location A-8 (Vadinar Colony), it falls within the annual standards. It can be seen that locations A-7 (Admin Building Vadinar) and A-8 (Vadinar Colony) had a 5.15% percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 100 µg/m^3.

- The concentration of $PM_{2.5}$ varies in the range of **2.36** to **71.18** µg/m^3, with a yearly average value of **24.42** with a standard deviation **of 9.69** µg/m^3. As shown in Graph 2, the highest concentration of $PM_{2.5}$ is at location **A-7 (Admin Building Vadinar)** in winter. It can be seen that in all two locations, $PM_{2.5}$ is within the NAAQS annual limit, i.e., 40 µg/m^3. it can be seen that on both locations, **A-7 (building Vadinar)** and **A-8 (Vadinar Colony)** comply with the standards (complimented more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 60 µg/m^3.

Gaseous Pollutants:

- The concentration of SOx varies from **0.52** to **69.91** µg/m3, with a yearly average concentration of 13.146 with a standard deviation of 14.14 µg/m3. As shown in Graph 3, the highest concentration of SOx is at location A-8 (Vadinar Colony) in the winter. It can be seen that in all locations, SOx are within the NAAQS annual limit, i.e., 50 µg/m^3. It can be seen that both locations comply with the standards (compliance more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m^3.
- The concentration of NOx varies from **0.9** to **52.76** µg/m^3, with a yearly average concentration of **11.28** with a standard deviation of **7.17** µg/m^3. As shown in Graph 4, the highest concentration of NOx is at location A-7 (Admin Building Vadinar) in the winter. It can be seen that in all locations, NOx is within the NAAQS annual limit, i.e., 40 µg/m^3. It can be seen that all locations comply with the standards (compliance more than 98% of the time) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m^3.
- The concentration of CO varies from **0.03** to **3.14** mg/m3, with a yearly average concentration of **0.87** with a standard deviation **0.41** mg/m^3. As shown in Graph 5, the highest concentration of CO is at location **A-7, (Admin Building Vadinar)** in winter. it can be seen that at all locations they are complying (Complied more than 98% times) with the NAAQS 1 hour limit, i.e., 4 mg/m^3. Both **locations A-7, (Admin building Vadinar)** and **A-8,(Vadinar Colony)** had **5.16**% exceedance, which is about 5 days out of 97 days of monitoring, while comparing with the NAAQS 8-hour limit, i.e., 2 mg/m3.
- The concentration of **Total VOCs** levels was recorded in a range of **0 to 6.62** µg/m^3 with a yearly average value of **0.96** with a standard deviation of **1.051** µg/m^3 at Vadinar. As shown in graph 6, the **highest** concentration of **VOCs** is at

location A-8, (Vadinar Colony), this is the only spike observed in the whole monitoring period for VOCs at this location.

Polycyclic Aromatic Hydrocarbons (PAHs):

- The concentration of **Benzene** levels was recorded in a range of **0.01 to 1.03** µg/m^3, with a yearly average value of **0.28** with a standard deviation of 0.36 µg/m^3. the **highest** concentration of Benzene is at **location A-7, (Admin building Vadinar)** in Winter. It can be seen that in all locations **Benzene** within the NAAQS annual limit, i.e., 5 µg/m^3.
- **Non-methane VOC** (NM-VOC) concentration at Vadinar was observed in the range of **0.07 to 2.15** µg/m^3 with a yearly average value of **0.82** with a standard deviation **0.085** µg/m^3. the **highest** concentration is at **A-7, (Admin building Vadinar)** in Winter.

With reference to the Ambient Air Quality monitoring conducted under the study, it may be concluded that the particulate matter PM_{10}, were reported in higher concentration and apparently exceeds the NAAQS particularly at locations of Kandla., whereas $PM_{2.5}$ complies with the NAAQS at majority of the locations. For both the ambient air monitoring parameters (PM_{10} and $PM_{2.5}$), the major exceedance was observed at location A-5 i.e. Coal Storage Area. The gaseous pollutants (NO_x, SO_x, CO, VOCs etc.) falls within the permissible limit. The probable reasons 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.
3. **Coal Handling:** Resuspension of dust occurs due to the transportation of coal and the handling of coal.
4. **Construction Activities:** Another reason for the high particulate matter content in this area is due to high construction activities in the surrounding area.

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.
- End to End 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.
- Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.
- Dust collectors shall be deployed in all areas where blasting (surface cleaning) and painting operations are to be carried out, supplemented by stacks for effective dispersion.
- Periodic vacuum-sweeping mechanisms shall be adopted.

CHAPTER 5: DG STACK MONITORING

5.1 DG Stack Monitoring

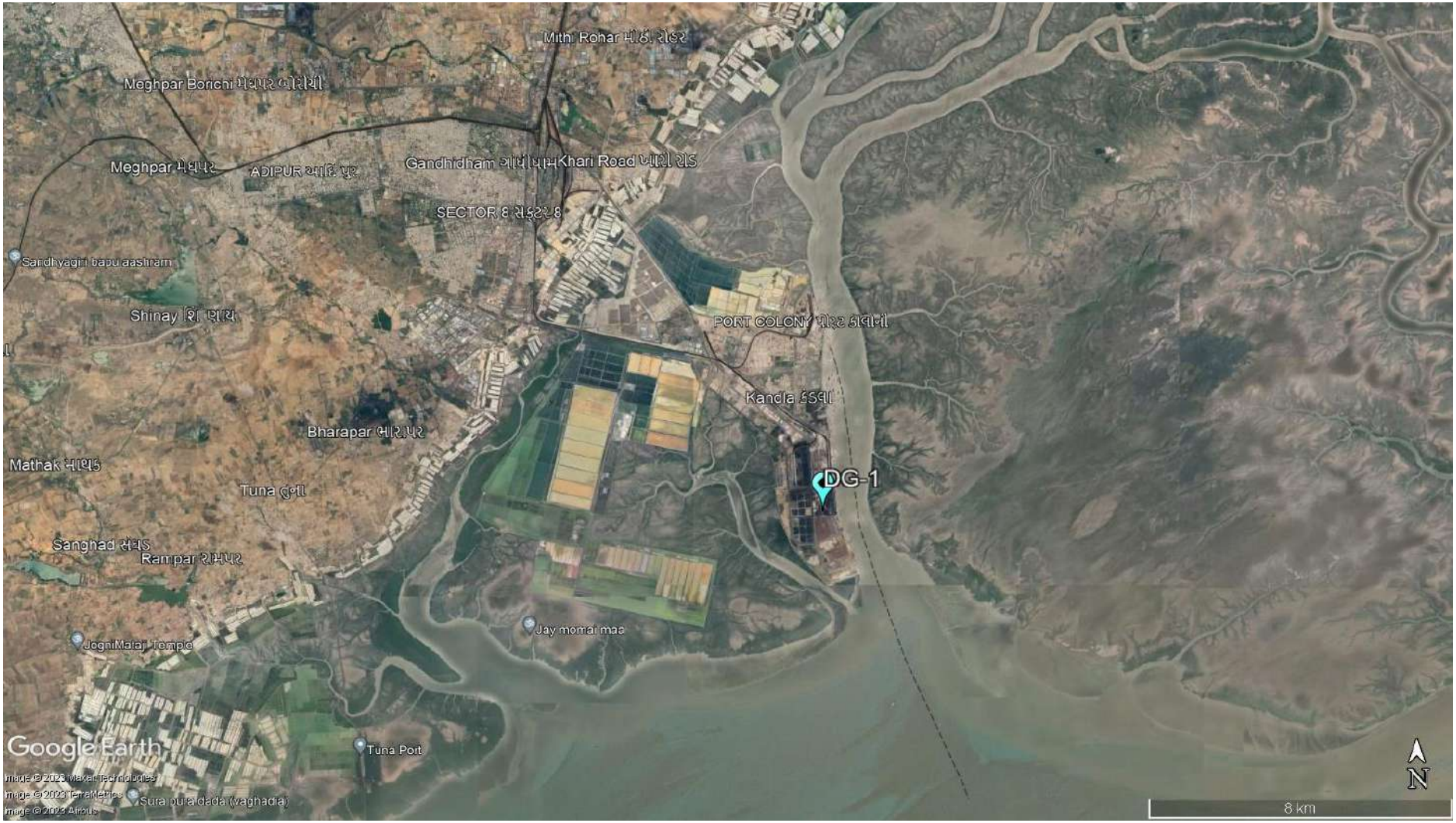
A diesel generator is a mechanical-electrical machine that produces electrical energy (electricity) from diesel fuel. They are used by the residential, commercial, charitable and governmental sectors to provide power in the event of interruption to the main power, or as the main power source. Diesel 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, SO_2, 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:

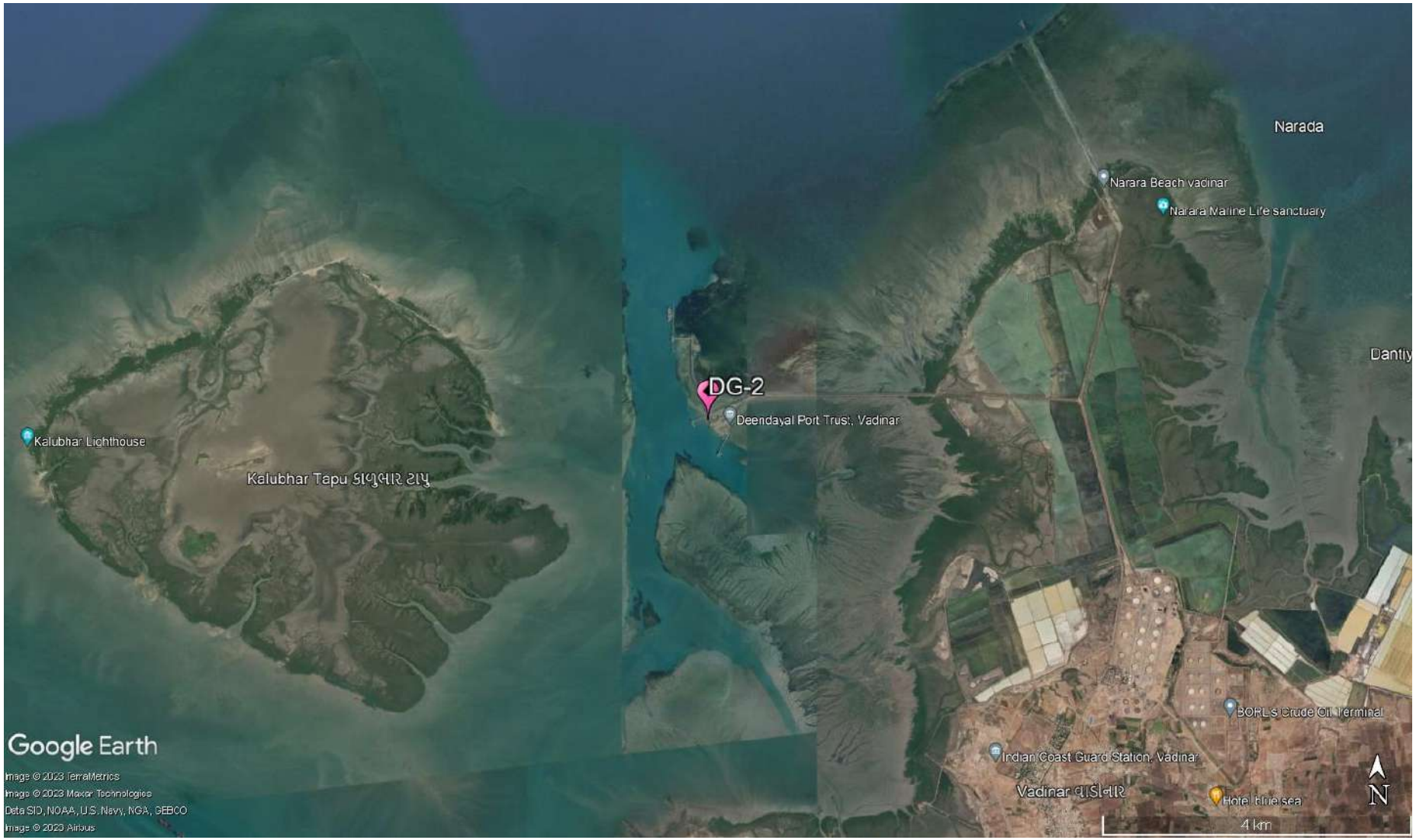
Table 10: Details of DG Stack monitoring locations

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 6 and 7** as follows:



Map 6: DG Stack monitoring Locations at Kandla



Map 7: DG Stack monitoring Locations 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: DG stack parameters

Sr. No.	Parameter	Unit	Instrument
1.	Suspended Particulate Matter	**mg/Nm³**	**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.

Monitoring Frequency

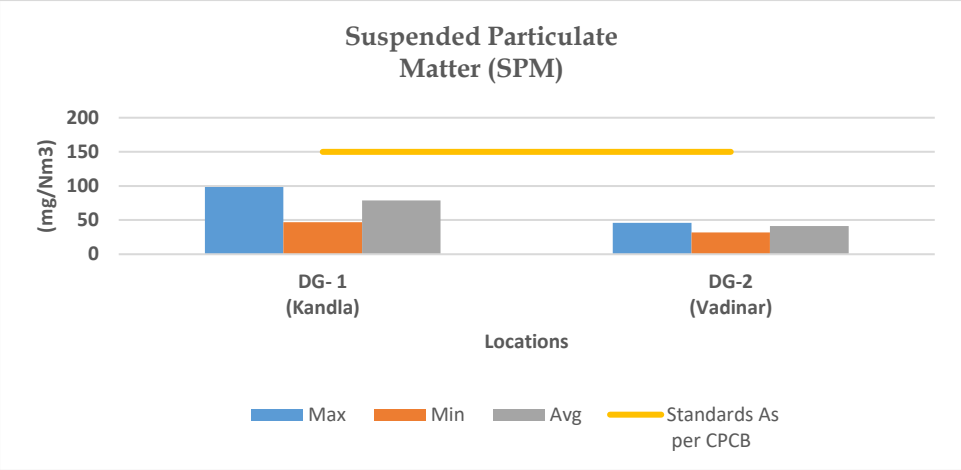
Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar for a period of 15th April 2023 to 15th April 2024.

5.2 Result and Discussion

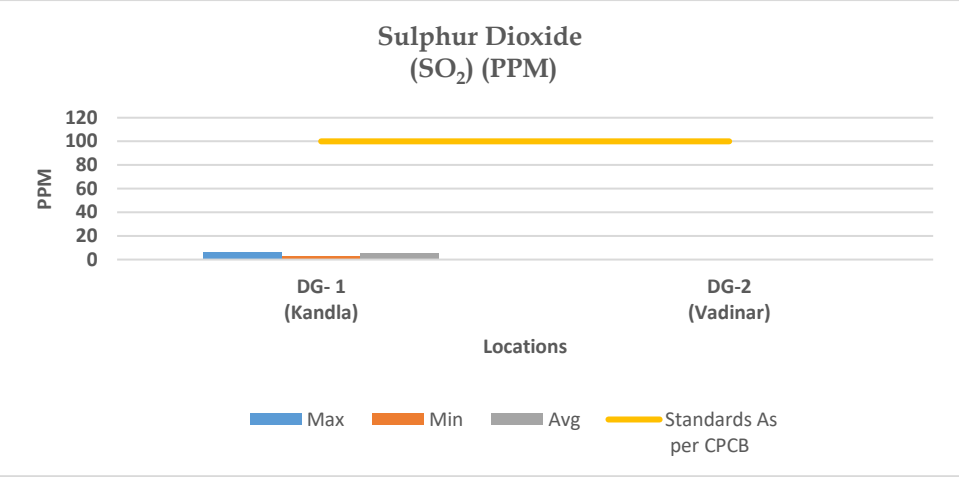
The sampling and monitoring of DG stack emission was carried out for monitoring period at Kandla and Vadinar and its comparison with CPCB or Indian standards for Industrial Stack Monitoring the flue gas emission from DG set has given in **Table 12.**

Table 12: DG monitoring data

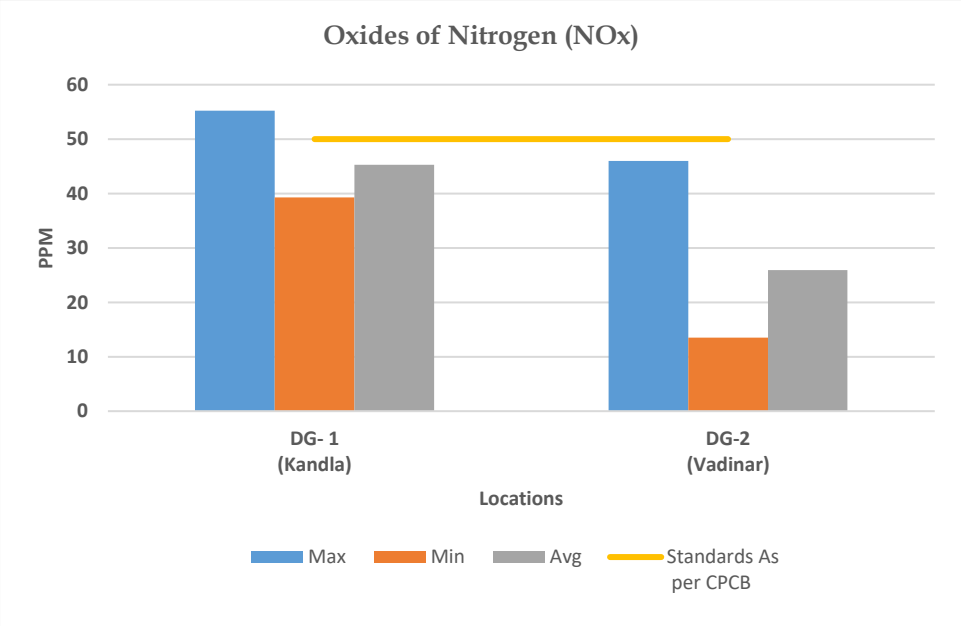
Sr. No.	Stack Monitoring Parameters for DG Sets		DG- 1 (Kandla)	DG-2 (Vadinar)	Stack Monitoring Limits /Standards As per CPCB
1.	**Suspended Particulate Matter (SPM) (mg/Nm³)**	**Max**	98.47	45.32	**150**
		Min	46.82	31.85	
		Avg.	78.96	41.33	
2.	**Sulphur Dioxide (SO2) (PPM)**	**Max**	6.45	N.D.	**100**
		Min	3.25	N.D.	
		Avg.	4.95	N.D.	
3.	**Oxides of Nitrogen (NO_x) (PPM)**	**Max**	55.2	46	**50**
		Min	39.27	13.52	
		Avg.	45.31	25.92	
4.	**Carbon Monoxide (CO) (%)**	**Max**	0.34	0.016	**1**
		Min	0.007	0.002	
		Avg.	0.16	0.01	
5.	**Carbon Dioxide (CO_2) (%)**	**Max**	3.09	1.42	**-**
		Min	1.21	1.03	
		Avg.	1.92	1.19	



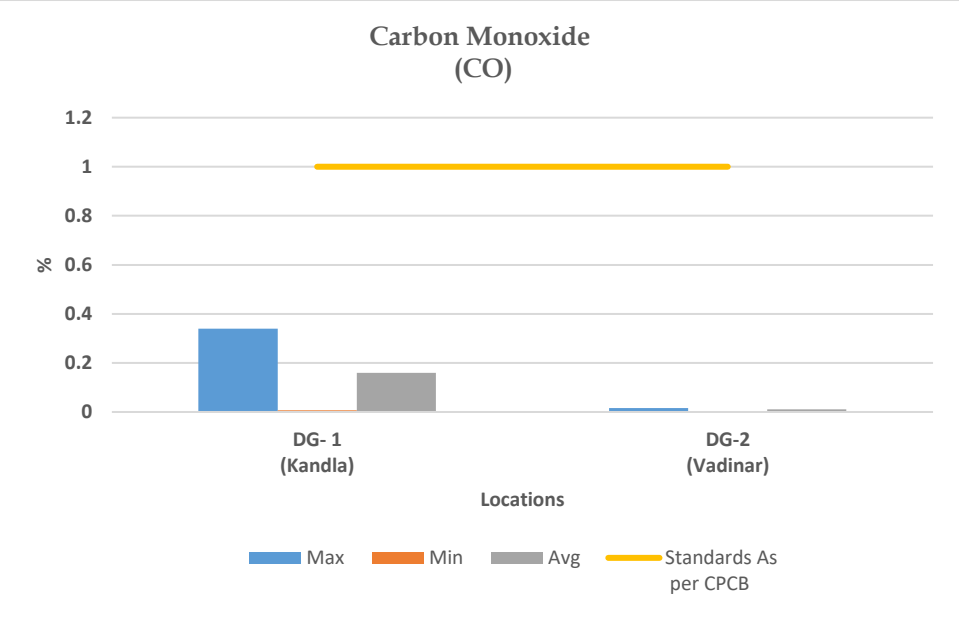
Graph 7 Spatial trend in SPM Concentration



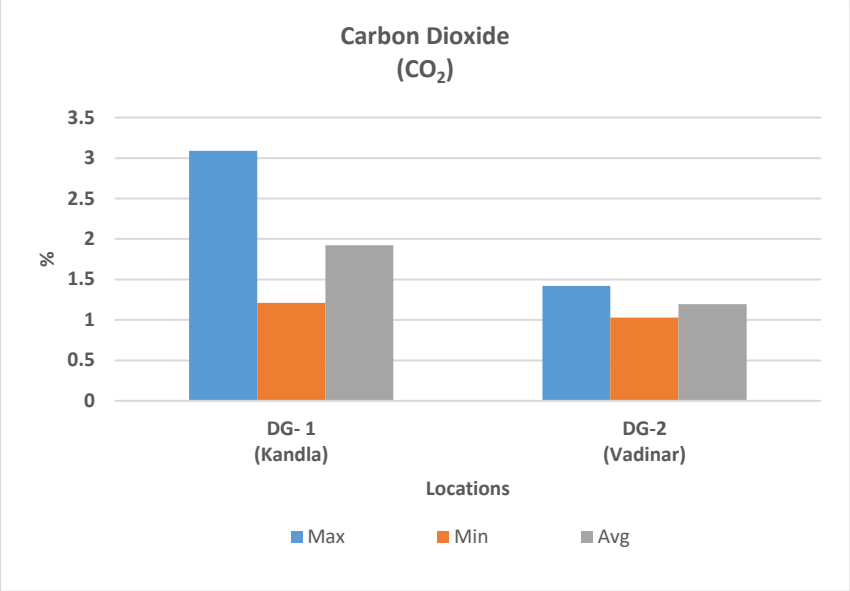
Graph 8 Spatial trend in SO_x Concentration



Graph 9 Spatial trend in NOx Concentration



Graph 10 Spatial trend in CO Concentration



Graph 11 Spatial trend in CO_2 Concentration

5.3 Data Interpretation and Conclusion

1) Kandla:

The Suspended Particulate Matter (SPM) varies in the range of **46.82** to **98.47** mg/m^3. The yearly average SPM of D.G stack-1 is **78.96** mg/m^3. The maximum concentration for SPM was observed in the monitoring period of October to November 2023. The Sulphur dioxide (SO_x) varies in the range of **3.25** to **6.45** PPM. The yearly average SO_x of D.G stack-1 is **4.95** PPM. The maximum concentration of SO_x observed in the monitoring period of October to November 2023.

The NO_x varies in the range of **39.27** to **55.2** PPM. The yearly average of NO_x of D.G stack-1 at Kandla is **45.31** PPM. The maximum concentration of NO_x observed in the monitoring period of July to August 2023.

The CO at Kandla varies in the range of **0.007** to **0.34** %. The yearly average of CO of D.G stack-1 at Kandla is **0.16** % The maximum concentration of CO observed in the monitoring period of March to April 2024.

The CO_2 at Kandla varies in the range of **1.21** to **3.09** %. The yearly average of CO_2 of D.G stack-1 at Kandla is **1.92** % The maximum concentration of CO_2 observed in the monitoring period of March to April 2024.

The results of all the above parameters of DG stack-1 at Kandla emission are compared with the permissible limits mentioned in the consent issued by GPCB, and have been found within the prescribed limit for all the monitored parameters.

2) Vadinar:

The Suspended Particulate Matter (SPM) in the range of **31.85** to **45.32** mg/m^3. The yearly average SPM of D.G stack-2 at Vadinar is **41.33** mg/m^3. The maximum concentration of SPM was observed in the monitoring period of March to April 2024. There is no Sulphur dioxide (SO_x) concentration detected at Vadinar.

The NO_x at Vadinar varies in the range of **13.52** to **46** PPM. The yearly average of NO_x of D.G stack-2 at Vadinar is **25.928** PPM. The maximum concentration of NO_x observed in the monitoring period of June to July 2023.

The CO at Vadinar varies in the range of **0.002** to **0.016** %. The yearly average of CO of D.G stack-2 at Vadinar is **0.0106** % The maximum concentration of CO observed in the monitoring period of October to November 2023.

The CO_2 at Vadinar varies in the range of **1.03 to 1.42** %. The yearly average in CO_2 of D.G stack-2 at Vadinar is **1.92** % The maximum concentration of CO_2 observed in the monitoring period of June to July 2024.

The results of all the above parameters of DG stack-2 at Vadinar emission are compared with the permissible limits mentioned in the consent issued by GPCB, and have been found within the prescribed limit for all the monitored parameters.

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 **Map 8 and 9** as follow:

Table 13: Details of noise monitoring locations

Sr. No.	Location Code		Location Name	Latitude/ Longitude
1.	Kandla	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.	Vadinar	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

Map 8: Locations for Noise Monitoring at Kandla

Map 9: Locations 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.

Monitoring 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

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[2]

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 April 2023 to April 2024 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 in dB(A)			Standard	Night Time in dB(A)		
					Max.	Min.	Avg.		Max.	Min.	Avg.
1	N-1	Oil Jetty 7	A	75	65.7	36.5	47.75	70	57.5	33	41.801
2	N-2	West Gate No.1	A	75	68.4	36.5	54.35	70	54.2	36.1	47.02
3	N-3	Canteen Area	B	65	66.2	38	52.61	55	52.1	33	43.46
4	N-4	Main Gate	A	75	61.4	35.3	50.69	70	50.8	36.1	43.33
5	N-5	Main Road	A	75	66.1	33.5	51.67	70	55.5	33.6	43.7
6	N-6	Marin Bhavan	B	65	62.3	38.9	52.52	55	52.3	31.9	43.23
7	N-7	Port & Custom Building	B	65	66.3	37.6	50.89	55	54.3	33.9	38.91
8	N-8	Nirman Building	B	65	60.8	40.9	51	55	58.9	35.2	43.02
9	N-9	ATM Building	B	65	65.1	35.1	49.7	55	53.4	34.1	39.25
10	N-10	Wharf Area/ Jetty	A	75	74.5	36.9	52.9	70	52.7	36	42.3
11	N-11	Near Main Gate	A	75	72.3	34	62.51	70	71.2	34.3	55.71
12	N-12	Near Vadinar Jetty	A	75	76.3	39.2	64.98	70	68.5	34.7	56.38
13	N-13	Port Colony Vadinar	C	55	77.5	37.7	50.05	45	65.9	36.2	49.5

6.3 Data Interpretation and Conclusion

1) **Kandla:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 10 locations at Kandla ranged from **33.5** dB(A) to **74.5** dB(A) while, during Night Time the average Noise Level ranged from **31.9** dB(A) to **58.9** dB(A), of which six locations out of ten locations, noise level were within the permissible limits for the industrial, commercial area and residential zone for Day time and night time.
   Other Four locations such as i.e., **N-3 (Canteen Area)**, **N-7 (Port & Custom Building), N-8 (Nirman Building)** and **N-9 (ATM building)** which are Commercial areas, slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period of **April to May 2023 and May to June 2023**.

2) **Vadinar:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 3 locations at Vadinar ranged from **34** dB(A) to **77.5** dB(A) while, during Night Time the average Noise Level ranged from **34.3** dB(A) to **71.2** dB(A) at Vadinar, on location **N-11 (Near main gate)** noise level was within the permissible limits for the industrial zone for Day time and night time.
   On locations of Vadinar such as i.e., **N-12 (Near Vadinar jetty)**, which are considered as industrial area slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period **of June to July 2023**. And on location **N-13 (Port Colony Vadinar)**, most frequently exceed the permissible limit during the day time as well as night time.

6.4 Remedial Measures

The noise levels detected at the locations of Kandla and Vadinar, are found within the prescribed norms. The noise can further 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

Sr. No.	Location Code		Location Name	Latitude Longitude
1.	Kandla	S-1	Oil Jetty 7	23.043527N 70.218456E
2.		S-2	IFFCO Plant	23.040962N 70.216570E
3.		S-3	Khori Creek	22.970382N 70.223057E
4.		S-4	Nakti Creek	23.033476N 70.158461E
5.	Vadinar	S-5	Near SPM	22.400026N 69.714308E
6.		S-6	Near Vadinar Jetty	22.440759N 69.675210E

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:

Monitoring Frequency

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar. The monitoring was done from April 15th 2023, to April 15th, 2024

Table 18: Soil parameters

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, 6th 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 10 and 11** as follows:

Map 10: Soil Quality Monitoring Locations at Kandla

Map 11: Soil Quality Monitoring Locations at Vadinar

7.2 Result and Discussion

The analysis results of physical analysis of the soil samples collected during environmental monitoring period during 15th April 2023 to 15th April 2024 mentioned in **Table 19** are shown below:

Table 19: Soil Quality for the Monitoring period

Sr. No	Parameters / Location		Kandla				Vadinar	
			S-1 (Oil Jetty 7)	S-2 IFFCO Plant)	S-3 (Khori Creek)	S-4 (Nakti Creek)	S-5 (Near SPM)	S-6 (Near Vadinar Jetty)
1	pH	Max	9.53	8.8	8.88	9.48	8.69	9.36
		Min	7.3	6.48	6.52	7.86	7.19	8.16
		Avg.	8.24	8.20	7.96	8.52	8.14	8.55
2	Conductivity (µS/cm)	Max	71500	36500	75700	17850	501	625
		Min	587	526	586	204	63	127
		Avg	26881.17	11442	20646.33	5470	177.13	281.54
3	Inorganic Phosphate (Kg/ha)	Max	13.32	619.89	20.31	15.87	5.64	8.67
		Min	0.39	0.43	1.24	0.32	0.35	0.26
		Avg	4.21	57.15	5.64	4.71	2.39	2.25
4	Organic Carbon (%)	Max	2.83	2.54	3.83	3.35	0.85	2.48
		Min	0.03	0.08	0.14	0.27	0.06	0.14
		Avg	0.91	0.79	1.06	0.92	0.33	0.59
5	Organic Matter (%)	Max	4.88	4.38	6.6	5.78	1.47	4.28
		Min	0.06	0.14	0.24	0.32	0.09	0.241
		Avg	1.57	1.36	1.82	1.48	0.57	1.01
6	SAR (meq/L)	Max	41.45	22.91	31.51	10.01	0.25	0.45
		Min	0.81	0.36	0.5	0.36	0.05	0.09
		Avg	13.24	6.56	11.71	2.57	0.10	0.17
7	Aluminium (mg/Kg)	Max	8643.04	9065.97	10298.7	9286.91	15921.7	14806.19
		Min	812.75	830.95	840.71	916.4	735.77	754.58
		Avg	2223.8	2322.3	2517.4	2470.4	2848.2	2762.2
8	Chromium (mg/Kg)	Max	92.23	90.7	86.18	87.07	106	91.88
		Min	28.213	28.91	31.57	24.7	71.68	60.93
		Avg	52.28	58.79	59.005	53.30	82.46	70.91
9	Nickel (mg/Kg)	Max	33.32	36.66	38.1	45.41	41.425	42.68
		Min	13.17	11.82	11.91	10.43	27.14	25.52
		Avg	19.17	19.22	22.72	21.72	33.29	32.353
10	Copper (mg/Kg)	Max	92.51	88.31	150.7	192.72	123.18	104.64
		Min	12.42	14.71	14.74	12.8	81.14	60.57
		Avg	49.94	61.10	84.93	56.708	103.06	82.37
11	Zinc (mg/Kg)	Max	210.35	1755.44	188.29	142.71	88.14	97.36
		Min	16.46	42.93	29.9	23.57	37.03	15.33
		Avg	73.75	283.57	99.49	81.77	62.53	49.70
12	Cadmium (mg/Kg)	Max	0.397	23.47	0.59	0	3	0
		Min	0.397	0.5	0.59	0	3	0
		Avg	0.397	6.608	0.59	0	3	0
13	Lead (mg/Kg)	Max	50.28	277.82	47.87	26.48	1.58	21.07
		Min	3.79	2.58	1.29	2.26	0.59	0.89
		Avg	12.09	32.75	15.59	8.88	1.08	6.66

Sr. No	Parameters / Location		Kandla				Vadinar	
			S-1 (Oil Jetty 7)	S-2 IFFCO Plant)	S-3 (Khori Creek)	S-4 (Nakti Creek)	S-5 (Near SPM)	S-6 (Near Vadinar Jetty)
14	Arsenic (mg/Kg)	Max	4.87	8.4	5.28	6.62	0.4	5.05
		Min	0.1	0.29	0.88	0.3	0.099	0.59
		Avg	2.38	3.04	2.97	2.26	0.22	2.82
15	Mercury (mg/Kg)	Max	0	0	0	0	0	0
		Min	0	0	0	0	0	0
		Avg	0	0	0	0	0	0
16	Water Holding Capacity (%)	Max	54	77.92	61.99	75.84	60	66
		Min	35.8	34	23.74	15.9	39.85	44
		Avg	42.66	46.48	43.95	48.34	47.70	60.01
17	Sand (%)	Max	77.61	77.7	85.46	82.36	62.4	78.46
		Min	44.4	46.57	48.27	13.39	42.26	42.25
		Avg	59.26	65.74	62.96	65.03	51.61	60.59
18	Silt (%)	Max	53.28	47.28	41.25	57.98	49.27	53.27
		Min	9.77	9.28	9.93	9.28	12.24	12
		Avg	30.41	26.40	28.84	24.13	34.72	29.17
19	Clay (%)	Max	19.53	14.32	22.35	28.63	35.92	21.02
		Min	2.32	0.63	0.64	0.48	1.75	1.74
		Avg	10.29	7.86	8.19	10.83	13.66	10.23
20	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	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 parameters have been given an interpretation based on the observations as follows:

1) Kandla:

- The value of **pH** ranges from **6.48** to **9.53**, with the highest at location **S-1 (Oil Jetty 7)** and the lowest at **location S-2 (IFFCO plant),** while the average pH for Kandla was observed to be **8.23**. The pH in Kandla varies from **Slightly alkaline to strongly alkaline**

- At all monitoring locations, the value of **Electrical Conductivity** ranges from **204 to 75,700** µs/cm, with the highest at **location S-3 (Khori Creek**) and the lowest at **S-4 (Nakti Creek).** The average Electrical Conductivity is **16,109.87** µs/cm.

- The concentration of inorganic phosphate varied from **0.32** to **619.89** kg/ha, with an average of **17.93** kg/ha. The highest concentration of inorganic phosphate was found at **S-2 (IFFCO plant)** and the lowest concentration was found at **S-4 (Nakti Creek)**. The availability of phosphorus in the soil solution is influenced by several factors, such as organic matter, clay content, pH, temperature, and more.

- The concentration of **Total Organic Carbon** ranges from **0.03% to 3.86%,** with an average TOC of **0.92%** detected. The highest concentration was found at **location S-3 (Khori Creek),** and the minimum concentration was found **at S-1 (Oil Jetty 7).**
- The **Sodium Adsorption Ratio** ranges from **0.36** to **41.45** meq/L, with an average value of **8.25** meq/L at Kandla. The highest concentration of SAR is found at **S-1 (Oil Jetty 7)** and the lowest concentration at **S-4 (Nakti Creek)**.
- The **Water Holding Capacity (WHC)** in the soil samples of Kandla varies from **15.9% to 77.92%**, with an average of **45.36%**. The highest concentration of WHC was observed at **S-2 (IFFCO plant)** and the lowest concentration at **S-4 (Nakti Creek)**.
- The Soil Texture was observed as "**Sandy loam**" to "**loamy sand**" at all the monitoring locations in Kandla.

Heavy Metals

- During the sampling period, the concentration of **Aluminium** varied from **812.75** to **10,298.7** mg/kg. The average **Aluminium** concentration was observed to be **2,383.475** mg/kg at the Kandla monitoring station. The **highest concentration** was observed at **S-3 (Khori Creek)**, and the **lowest concentration** was observed at **S-1 (Oil Jetty 7)**.
- The concentration of **Chromium** varied from **24.7 to 92.23** mg/kg, with an average value of **55.848** mg/kg observed at the Kandla monitoring station. The highest concentration was observed at **S-1 (Oil Jetty 7)**, and the lowest concentration was observed at **S-4 (Nakti Creek)**.
- The concentration of **Nickel** varied from **10.43** to **45.41** mg/kg at Kandla, with an average value of **20.71** mg/kg at the Kandla monitoring station. The highest concentration was observed at **S-4 (Nakti Creek)**, while the lowest concentration was also observed at **S-4 (Nakti Creek)**.
- The concentration of **Zinc** varied from **16.46** to **1755.4** mg/kg at Kandla, with an average value of **134.64** mg/kg at the Kandla monitoring station. The highest concentration was observed at **S-2 (IFFCO plant)**, which was the only spike observed during the entire monitoring period at Kandla. The lowest concentration was observed at **S-1 (Oil Jetty 7)**.
- The concentration of **Copper** varied from **12.42** to **192.72** mg/kg, with an average value of **13.667** mg/kg observed at the Kandla monitoring station. The highest concentration was observed at **S-4 (Nakti Creek)** and the lowest concentration was observed at **S-1 (Oil Jetty 7)**.
- The concentration of Lead varied from **1.29 to 277.82** mg/kg, with an average value of **17.33** mg/kg. The highest concentration was observed at **S-2 (IFFCO plant)**; this was the only spike observed during the entire monitoring period, while the lowest concentration was observed at **S-3 (Khori creek)**.
- The concentration of A**rsenic** varied from **0.1 to 8.4** mg/kg, with an average value of **2.67** mg/kg. The highest concentration was observed at **S-1 (Oil Jetty 7)**, and the lowest concentration was observed at **S-3 (Khori Creek)**.
- The concentration of **Cadmium** varied from **0** to **23.47** mg/kg, with an average value of **1.89** mg/kg. The highest concentration was observed at **S-2 (IFFCO plant)**. During the monitoring period, it was observed that cadmium was mostly found **Below**

Quantification Limit (BQL) at all locations, with only one spike observed at **S-2 (IFFCO plant)** throughout the entire monitoring period.

- During the monitoring period, it was observed that the concentration of **Mercury** was mostly found **below the quantification limit (BQL)** at all locations.

2) Vadinar:

- The value of **pH** ranges from **7.675** to **9.36**, with the highest at location **S-6 (Near Vadinar jetty)** and the lowest at **location S-5 (Near SPM),** while the average pH for Vadinar was observed to be **8.34**. pH of Soil at Vadinar was found to be **moderately alkaline**.
- At all monitoring locations in Vadinar, the value of **Electrical Conductivity** ranges from **63 to 625** µs/cm, with the highest at **S-6 (Near Vadinar jetty)** and the lowest at **location S-5 (Near SPM).** The average Electrical Conductivity is **229.33** µs/cm.
- The concentration of **inorganic phosphate** varied from **0.26** to **8.67** kg/ha, with an average of **2.32** kg/ha. The highest concentration of inorganic phosphate was found at **S-6 (Near Vadinar jetty)** and the lowest concentration was found at **location S-5 (Near SPM)**.
- The concentration of **Total Organic Carbon** ranges from **0.06% to 2.48%,** with an average TOC of **0.46%** detected at Vadinar. The highest concentration was found at **S-6 (Near Vadinar jetty),** and the minimum concentration was found **at S-5 (Near SPM).**
- The **Sodium Adsorption Ratio** ranges from **0.05** to **0.45** meq/L, with an average value of **0.143** meq/L at Vadinar. The highest concentration of SAR is found at **6 (Near Vadinar jetty)** and the lowest concentration at **S-5 (Near SPM)**.
- The **Water Holding Capacity (WHC)** in the soil samples of Vadinar varies from **39.85% to 66%**, with an average of **53.85%**. The highest concentration of WHC was observed at **S-6 (Near Vadinar jetty)** and the lowest concentration at **S-5 (Near SPM)**.
- The soil texture of Vadinar varies from "loam" to "slit loam".

Heavy Metals

- During the sampling period, the concentration of **Aluminium** varied from **735.77** to **15921.72** mg/kg. The average **Aluminium** concentration was observed to be **2,805.2** mg/kg at the Vadinar monitoring station. The **highest concentration** was observed at **S-5 (Near SPM)**, and the **lowest concentration** was observed at **S-5 (Near SPM) but during different months**.
- The concentration of **Chromium** varied from **60.93 to 106** mg/kg, with an average value of **76.69** mg/kg observed at the Vadinar monitoring station. The highest concentration was observed at **S-5 (Near SPM)**, and the lowest concentration was observed at **S-6 (Near Vadinar jetty)**.
- The concentration of **Nickel** varied from **25.62** to **42.68** mg/kg, with an average value of **32.825** mg/kg at the Vadinar monitoring station. The highest concentration was observed at **S-6 (Near Vadinar jetty)**, and the lowest concentration was also observed at **S-6 (Near Vadinar jetty)** but during different months.

- The concentration of **Zinc** varied from **15.33** to **97.36** mg/kg, with an average value of **56.118** mg/kg at the Vadinar monitoring station. The highest concentration was observed at **S-6 (Near Vadinar jetty)**, and the lowest concentration was also observed at **S-6 (Near Vadinar jetty)** but during different months.
- The concentration of **Copper** varied from **60.57** to **123.18** mg/kg, with an average value of **92.71** mg/kg observed at the Vadinar monitoring station. The highest concentration was observed at **S-5 (Near SPM)** and the lowest concentration was observed at **S-6 (Near Vadinar jetty)**.
- The concentration of **Lead** varied from **0.59 to 21.07** mg/kg, with an average value of **3.875** mg/kg. The highest concentration was observed at **S-6 (Near Vadinar jetty)**; this was the only spike observed during the entire monitoring period at Kandla, while the lowest concentration was observed at **S-5 (Near SPM)**.
- The concentration of A**rsenic** varied from **0.099 to 0.59** mg/kg, with an average value of **5.05** mg/kg. The highest concentration was observed at **S-6 (Near Vadinar jetty)**, and the lowest concentration was observed at **S-5 (Near SPM)**.
- The concentration of **Cadmium** varied from **0** to **3** mg/kg, with an average value of **3** mg/kg. The highest concentration was observed at **S-5 (Near SPM)**. During the monitoring period, it was observed that cadmium was mostly found **Below Quantification Limit (BQL)** at all locations.
- During the monitoring period, it was observed that the concentration of **Mercury** was mostly found **below the quantification limit (BQL)** at all locations.

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 **Map 12 and 13.**

Table 20: Details of Drinking Water Sampling Locations

Sr. No.	Location Code		Location Name	Latitude/ Longitude
1.	Kandla	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.	Vadinar	DW-19	Near Vadinar Jetty	22.440759N 69.675210E
20.		DW-20	Near Port Colony	22.401619N 69.716822E

Map 12: Drinking Water Monitoring Locations at Kandla

Map 13: Drinking Water Monitoring Locations 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[3]

Sr. No.	Parameters	Units	Reference method	Instrument
1.	pH	-	APHA, 23rd Edition (Section-4500-H^+B):2017	pH Meter
2.	Colour	Hazen	APHA, 23rd Edition, 2120 B:2017	Color Comparator
3.	EC	µS/cm	APHA, 23rd Edition (Section-2510 B):2017	Conductivity Meter
4.	Turbidity	NTU	APHA, 23rd Edition (Section -2130 B):2017	Nephlo Turbidity Meter
5.	TDS	mg/L	APHA, 23rd Edition (Section-2540 C):2017	Vaccum Pump with filtration assembly and Oven
6.	TSS	mg/L	APHA, 23rd Edition, 2540 D: 2017	
7.	Chloride	mg/L	APHA, 23rd Edition (Section-4500-Cl-B):2017	Titration Apparatus
8.	Total Hardness	mg/L	APHA, 23rd Edition (Section-2340 C):2017	
9.	Ca Hardness	mg/L	APHA, 23rd Edition (Section-3500-Ca B):2017	
10.	Mg Hardness	mg/L	APHA, 23rd Edition (Section-3500-Mg B):2017	
11.	Free Residual Chlorine	mg/L	APHA 23rd Edition, 4500	
12.	Fluoride	mg/L	APHA, 23rd Edition (Section-4500-F-D):2017	UV- Visible Spectrophotometer
13.	Sulphate	mg/L	APHA, 23rd Edition (Section 4500-SO4-2-E):2017	
14.	Sodium	mg/L	APHA, 23rd Edition (Section-3500-Na-B):2017	Flame Photometer
15.	Potassium	mg/L	APHA,23rd Edition, 3500 K-B: 2017	
16.	Salinity	mg/L	APHA, 23rd Edition (section 2520 B, E.C. Method)	Salinity /TDS Meter
17.	Nitrate	mg/L	APHA, 23rd Edition, 4500 NO3- B: 2017	UV- Visible Spectrophotometer
18.	Nitrite	mg/L	APHA, 23rd Edition, 4500 NO2-B: 2017	
19.	Hexavalent Chromium	mg/L	APHA, 23rd Edition, 3500 Cr B: 2017	
20.	Manganese	mg/L	APHA,23rd Edition, ICP Method 3120 B: 2017	ICP-OES

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

Monitoring Frequency

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar. Sample Collected from this location during the monitoring period 15th April 2023 to15thApril2024.

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) [4] have been summarized in **Table 22A, 22B, 22C** as follows:

Table 22A: Drinking Water Quality for the Monitoring period

Parameters	Standard values as per IS-		DW-1 (Oil Jetty 7)			DW-2 (Port & Custom Building)			DW-3 (North Gate)			DW-4 (Workshop)			DW-5 (Canteen Area)			DW-6 (West Gate 1)			DW-7 (Sewa Sadan -3)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
pH	6.5-8.5		7.9	6.6	7.4	8.4	6.8	7.3	8.0	6.8	7.3	8.1	7.1	7.4	8.2	7.3	7.7	8.4	7.2	7.7	8.2	7.2	7.5
Colour (Hazen)	5	15	5.0	1.0	1.7	5.0	1.0	1.3	5.0	1.0	1.3	5.0	1.0	1.3	5.0	1.0	3.3	5.0	1.0	1.7	5.0	1.0	1.3
EC (µS/ cm)			370	19.4	195.6	600.	36.0	153.8	1653	27.0	259.7	401	12.8	85.6	2200	42.0	1056	1470	28.0	336.3	150	22	57.8
Salinity (PSU)			1.0	0.0	0.2	0.3	0.0	0.1	0.8	0.0	0.1	0.2	0.0	0.0	1.1	0.0	0.5	0.7	0.0	0.2	0.1	0	0.0
Turbidity (NTU)	1	5	1.2	1.1	1.1	2.0	1.5	1.8	1.9	0.7	1.2	3.7	0.9	2.3	3.1	0.9	1.9	1.5	1.0	1.2	5.9	1.1	3.5
Chloride (mg/L)	250	1000	81	5.8	41.6	92	7.5	34.1	354.9	8.0	56.9	110	3	22.9	437.4	10.3	192.0	329.9	9.0	78	42.5	6.5	15.7
Total Hardness (mg/L)	200	600	42	3	13.3	148	3	24.8	320	2.0	33.4	20.0	2	7.5	310	10	181	230	5.0	53.2	10	2	4.1
Ca Hardness (mg/L)			27	2	6.3	92	2	13.9	200	1.0	20.3	8.0	1	3.3	210.0	5	103.9	120.0	2.5	28.9	5.0	1	2.2
Mg Hardness (mg/L)			15	1	6.8	56	1	10.1	120	1.0	13.1	12	1	3.9	120.0	5	76.6	110.0	2.0	24.4	5.0	1	2
Free Residual Chlorine (mg/L)	0.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDS (mg/L)	500	2000	184	10	101.7	306	20	81.8	840	14	132.7	204	8.0	44.7	928	22	452.4	752	20.0	171.6	78	14	30.8
TSS (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0
Fluoride (mg/L)	1	1.5	0.4	0.4	0.4	0.5	0.4	0.5	0.7	0.3	0.4	0.0	0.0	0.0	0.9	0.3	0.5	0.9	0.7	0.8	0.4	0.4	0.4
Sulphate (mg/L)	200	400	15.7	15.7	15.7	35.7	35.7	35.7	73.9	73.9	73.9	0.0	0.0	0.0	113.3	2.2	64.0	97.3	2	55.3	0	0	0

Parameters	Standard values as per IS-		DW-1 (Oil Jetty 7)			DW-2 (Port & Custom Building)			DW-3 (North Gate)			DW-4 (Workshop)			DW-5 (Canteen Area)			DW-6 (West Gate 1)			DW-7 (Sewa Sadan -3)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Nitrate (mg/L)	45		26	3.7	12.5	4.2	0.5	1.8	7.5	1.3	4.6	2.4	2.4	2.4	8.8	3.4	5.8	5.7	1.3	2.8	2.1	2.1	2.1
Nitrite (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.2	0.2	0.2	0	0	0
Sodium (mg/L)			86	5	34.5	38.5	7	21.2	178.6	9.7	38.0	42.6	5.7	18.0	319.6	12.0	118.4	197.5	8.8	44.1	15.1	5.5	9.6
Potassium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	5.8	5.8	5.8	0	0	0	0	0	0
Hexavalent Chromium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odour (TON)	Agreeable			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	0.01	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium (mg/L)	0.003		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper (mg/L)	0.05	1.5	17.3	0	5.8	8.4	0.0	2.8	6.2	0.0	3.1	11.1	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iron (mg/L)	0.3		0.6	0	0.3	0.2	0.2	0.2	0.2	0.0	0.1	0.2	0.2	0.2	0.2	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1
Lead (mg/L)	0.01		3.1	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese (mg/L)	0.1	0.3	0.1	0	0.1	0	0	0	0.5	0.5	0.5	0.1	0.1	0.1	0	0	0	0.5	0	0.2	0	0	0
Mercury (mg/L)	0.001		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chromium (mg/L)	0.05		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zinc (mg/L)	5	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Coliform* (MPN/ 100ml)	Shall not be detected		630.0	5.0	118.0	12500.0	5.0	1629.3	250.0	10.0	100.7	50.0	5.0	24.0	144500	5.0	17137	4350	5.0	1407	23500	2.0	3963.3

Table 22B: Drinking Water Quality for the Monitoring period

Parameters	Standard values as per IS		DW-8 (Nirman Building)			DW-9 (Custom Building)			DW-10 (Port Colony Kandla)			DW-11 (Wharf Area/ Jetty)			DW-12 (Hospital Kandla)			DW-13 (A.O. Building)			DW-14 (School Gopalpuri)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
pH	6.5-8.5		8	7	7.5	8	6.2	7.3	7.9	6.82	7.31	8.3	6.85	7.71	7.75	6.62	7.224	8.5	7.2	7.61	8.2	7.08	7.56
Colour (Hazen)	5	15	5.0	1.0	2.3	5.0	1.0	2.0	5.0	1	2	10	1	3.083	5	1	1.67	5	1	1.33	10	1	3.28
EC (µS/ cm)			2000	40.0	403.8	2900.0	48.0	492.9	3100	105.4	554.9	2460	55	980.1	269	47	141.2	1412	23.2	187.2	1467	43.3	412.15
Salinity (PSU)			1.0	0.0	0.2	1.5	0.0	0.2	1.6	0.05	0.283	1.2	0.02	0.42	0.13	0.03	0.072	0.71	0.02	0.151	0.73	0.03	0.22
Turbidity (NTU)	1	5	3.6	1.1	1.8	4.7	1.0	2.8	2.2	0.95	1.575	3.79	1	2.09	2	1.02	1.57	9.9	0.9	3.67	13.9	0.5	5.48
Chloride (mg/L)	250	1000	499.9	10.0	93.1	689.8	12.5	108.7	504.8	21.99	75.52	404.8	13.54	173.9	67.98	12.5	31.79	307.4	7.5	44.28	332.4	11.5	93.83
Total Hardness (mg/L)	200	600	280.0	4.0	61.8	480	6.0	80.2	340.0	3	62.83	320	15	176.4	30	3	17.84	240	1.5	70.3	270	2	82.64
Ca Hardness (mg/L)			140.0	2.0	31.8	240	3.0	38.7	190.0	2	33.5	170	5	91.30	17	2	9.67	120	1	31.12	140	1.5	42.96
Mg Hardness (mg/L)			140.0	2.0	30.1	190	3.0	37.5	150.0	1	29.32	150	10	84.76	14	1	8.167	120	0.5	33.15	130	2	43.6
Free Residual Chlorine (mg/L)	0.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDS (mg/L)	500	2000	1012	22.0	205.2	1522	24.0	255.8	1064	54	165.4	872	29	403.8	138	24	73.17	718	14	101.9	742	22	218
TSS (mg/L)			2.0	2.0	2.0	12.0	2.0	7.0	2.0	2	2	2	2	2	0	0	0	0	0	0	12	8	10
Fluoride (mg/L)	1	1.5	0.0	0.0	0.0	1.5	0.6	1.1	0.5	0.416	0.433	1.06	0.367	0.57	1.108	1.108	1.108	0	0	0	0.35	0.15	0.25
Sulphate (mg/L)	200	400	100.8	45.5	73.2	142.0	41.5	80.0	115.6	3.17	59.39	134.7	1.97	59.51	0	0	0	108.7	108.77	108.7	113.4	11.55	56.304
Nitrate (mg/L)	45		4.5	1.1	2.6	5.6	2.4	3.8	7.5	1.04	3.68	8.49	3.78	5.929	2.023	1.42	1.752	3.392	1.524	2.585	4.48	1.382	2.38

Parameters	Standard values as per IS		DW-8 (Nirman Building)			DW-9 (Custom Building)			DW-10 (Port Colony Kandla)			DW-11 (Wharf Area/ Jetty)			DW-12 (Hospital Kandla)			DW-13 (A.O. Building)			DW-14 (School Gopalpuri)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Nitrite (mg/L)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.201	0.11	0.147	0	0	0	0	0	0	0	0	0
Sodium (mg/L)			109.5	9.2	39.4	396.2	8.0	75.4	105.8	11.98	37.65	356.5	12.8	106.5	31.35	11.59	20.22	83.91	8.66	21.44	173.5	6.24	46.666
Potassium (mg/L)			0	0	0	13.6	13.6	13.6	7.0	2.6	4.8	0	0	0	0	0	0	0	0	0	0	0	0
Hexavalent Chromium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odour (TON)	Agreeable			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	0.01	0.05	0	0	0	0	0	0	0	0.007	0.007	0.005	0.0039	0.004	0	0	0	0	0	0	0.015	0.015	0.015
Cadmium (mg/L)	0.003		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0.005	0.005	0.006	0.006	0.006
Copper (mg/L)	0.05	1.5	6.8	0	3.4	0	0	0	10.2	0.005	2.049	0	0	0	9.257	0.005	3.57	0.008	0.0079	0.008	0	0	0
Iron (mg/L)	0.3		0.1	0.1	0.1	0	0	0	0.3	0.0001	0.16	0.17	0.0001	0.092	0	0	0	0.13	0.13	0.13	0.0001	0.0001	0.0001
Lead (mg/L)	0.01		0.2	0	0.1	0	0	0	0	0.0033	0.003	0.004	0.0038	0.004	0.0028	0.003	0.003	0.002	0.002	0.002	4.27	4.27	4.27
Manganese (mg/L)	0.1	0.3	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0.05	0.05	0	0	0
Mercury (mg/L)	0.001		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chromium (mg/L)	0.05		0	0	0	0	0	0	0	0	0	0	0	0	0.0122	0.012	0.012	0.006	0.006	0.006	0	0	0
Zinc (mg/L)	5	15	0	0	0	0.6	0.6	0.6	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Coliform* (MPN/ 100ml)	Shall not be detected		240.0	2.0	114.7	12050	4.0	1826	37080	35	5374	25550	5	3329	140	4	47.2	685	20	166.7	4900	15	636.4

Table 22C: Drinking Water Quality for the Monitoring period

Parameters	Standard values as per IS		DW-15 (Guest House)			DW-16 (E- Type Quarter)			DW-17 (F- Type Quarter)			DW-18 (Hospital Gopalpuri)			DW-19 (Near Vadinar Jetty)			DW-20 (Near Port Colony)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
pH	6.5-8.5		7.99	6.87	7.35	7.68	6.93	7.28	8.19	6.78	7.46	8.27	7.12	7.6	8.38	7.21	7.685	8.07	7.05	7.435
Colour (Hazen)	5	15	5	1	1.67	5	1	1.67	5	1	1.67	10	1	3.5	5	1	2.333	20	1	6
EC (µS/ cm)			264	34.3	120.22	746	17.79	116.84	1337	15.93	298.6	7930	30.2	1037	537	30	199.7	1736	88.4	427.7
Salinity (PSU)			0.7	0.02	0.113	0.38	0.02	0.06	0.67	0.02	0.16	4.39	0.02	0.55	0.26	0.02	0.100	0.87	0.05	0.235
Turbidity (NTU)	1	5	2.29	0.63	1.27	2.8	0.52	1.50	1.97	1.1	1.66	3.98	0.7	2.03	1.5	1.2	1.35	5.3	0.7	3.25
Chloride (mg/L)	250	1000	60.98	10.5	26.98	124.96	4	24.58	287.41	4	61.99	163.9	9	75.28	66.98	9	27.20	407.37	13	73.15
Total Hardness (mg/L)	200	600	20	2	11.97	180	1.5	22.86	230	2	52.6	195	4	96.25	160	2	44.58	240	20	88.5
Ca Hardness (mg/L)			10	1.5	6.25	80	1	10.77	120	1	28.5	102	2	49.43	80	1.5	21.54	140	10	44.08
Mg Hardness (mg/L)			12.5	1	6.136	100	0.5	13.25	110	1	24.1	100	1	46.79	80	1	25.09	100	8	44.41
Free Residual Chlorine (mg/L)	0.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDS (mg/L)	500	2000	138	18	62.75	382	10	60.5	682	8	157.5	448	16	198.8	272	15	100.9	882	46	218.5
TSS (mg/L)			0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	12	4	8
Fluoride (mg/L)	1	1.5	0.34	0.34	0.34	0	0	0	0.5	0.37	0.43	0.51	0.38	0.44	0.35	0.35	0.35	1.06	1.06	1.06
Sulphate (mg/L)	200	400	10.62	10.3	10.46	34.35	34.35	34.35	104.64	8.37	41.20	59.94	1.81	40.82	42.2	13.07	31.87	102.92	25.4	48.22
Nitrate (mg/L)	45		5.63	1.12	2.53	1.97	1.97	1.97	6.06	1.19	3.20	16.51	1.17	5.1	15.79	1.82	5.55	18.54	1.06	6.45
Nitrite (mg/L)			0	0	0	0	0	0	0	0	0	0.20	0.11	0.16	0	0	0	1.89	1.89	1.89

Parameters	Standard values as per IS		DW-15 (Guest House)			DW-16 (E- Type Quarter)			DW-17 (F- Type Quarter)			DW-18 (Hospital Gopalpuri)			DW-19 (Near Vadinar Jetty)			DW-20 (Near Port Colony)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Sodium (mg/L)			40.46	14.3	19.38	74.46	7.06	24.85	82.61	5.75	35.30	185.2	7.08	55.81	58.37	6.08	20.49	204.04	7.18	46.23
Potassium (mg/L)			0	0	0	0	0	0	0	0	0	3.2	3.2	3.2	0	0	0	5.85	5.85	5.85
Hexavalent Chromium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0.041	0.041	0.041	0.01	0.01	0.01
Odour (TON)	Agreeable			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	0.01	0.05	0.007	0.007	0.007	0	0	0	0.008	0.008	0.008	0.015	0.01	0.012	0.08	0.08	0.08	0	0	0
Cadmium (mg/L)	0.003		0.007	0.007	0.007	0.006	0.006	0.006	0.007	0.007	0.007	0.008	0.008	0.008	0	0	0	0	0	0
Copper (mg/L)	0.05	1.5	7.24	0.006	2.42	0	0	0	0.012	0.012	0.012	7.3	0.006	3.65	16.25	0.006	7.99	15.403	0.01	3.09
Iron (mg/L)	0.3		0.25	0.0002	0.13	0	0	0	0.52	0.0001	0.213	0.11	0.0003	0.055	1.47	1.47	1.47	0	0	0
Lead (mg/L)	0.01		2.21	0.002	1.10	0	0	0	0	0	0	0	0	0	10.53	0.003	5.26	0.002	0.002	0.002
Manganese (mg/L)	0.1	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.	0.13	0	0.08
Mercury (mg/L)	0.001		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chromium (mg/L)	0.05		0	0	0	0	0	0	0	0	0	0.006	0.006	0.006	0	0	0	0	0	0
Zinc (mg/L)	5	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Coliform* (MPN/ 100ml)	Shall not be detected		200	5	57.75	7650	5	1669	57000	9	6635	310	5	131	2850	120	1485	130000	10	16647

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 NO_3 (QL=1 mg/L), Nitrite as NO_2 (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 from 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.

Physico-Chemical Parameters:

- **pH:** The pH values of drinking water samples in Kandla were reported to be in the range of **6.24 to 8.5**, with an average pH of **7.5**. In Vadinar, its values ranged from **7.05 to 8.38**, with an average pH of **7.36**. 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.
- **Colour:** The colour varies from 1 to 10 at the monitoring locations in Kandla. Locations DW-11, DW-14 and DW-10 showed the value of 10 Hazen at Kandla. At Vadinar, the color was observed within the range of 1 to 20 Hazen. the Colour levels at both project sites fall within the acceptable range of 1 to 15, as specified under IS:10500:2012, except of one location DW-20 within the monitoring period of April to May 2023
- **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 **12.83 to 7930 µS/cm**, with an average value of **708.65** µS/cm. In Vadinar, the EC values showed variation from **30 to 1736 µS/cm**, with an average value of **503.14** µS/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.
- **Salinity:** Salinity at Kandla varies from **0.02 to 4.39 PSU** with an average of **0.396** PSU, while at Vadinar, salinity was observed within the range of **0.02** to **0.87 PSU**.
- **Turbidity**: The Turbidity values of drinking water samples in Kandla were reported to be in the range of **0.5 to 13.9 NTU**, with an average of **2.32**. In Vadinar, its values ranged from **0 to 5.3**, with an average **2.21**. Notably, the Turbidity levels at both project sites fall within the acceptable range of 1 to 5 NTU, as specified under IS:10500:2012, except DW-7, in the monitoring period of July to August 2023, DW-13 in the monitoring period of May to June 2023 and DW-14 in the monitoring period of September to October and October to November 2023. On all this location most of the time Turbidity observed Below Quantification Limit
- **Chlorides:** The chloride concentrations in Kandla varied from **3 to 689.78 mg/L**, with an average value of **116.85** mg/L. At Vadinar the chloride concentration was observed within the range of **9** mg/L to **407.37** mg/L, with an average value of **99.45** mg/L. Thus, the chloride levels at both project sites fall within the Permissible limit of 1000 mg/L, as specified under IS:10500:2012.
- **Total Hardness (TH):** The concentration of Total Hardness varies from **1.5 to 480 mg/L**, with an average concentration of **88.68** mg/L. While at Vadinar, the observed values were within range of **2 to 240** mg/L. at both study areas Total Hardness found

to be within the Permissible limit norm of 600 mg/L as specified by IS:10500:2012 and is not harmful for local inhabitants.

- **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 **8** to **1522** mg/L, with an average concentration of **264.4** mg/L. which is within the permissible limit. while in Vadinar, it ranged from **6** to **882** mg/L, with an average of **255.75** mg/L. It is important to note that the TDS concentrations in both Kandla and Vadinar fall well within the Permissible limit of 2000 mg/L.
- **Fluoride:** The concentration Fluoride varies from **0** to **1.477** mg/L, with an average concentration of **0.44** mg/L. While at Vadinar Fluoride concentration was varies within range of **0** to **1.06** mg/L**,** with an average concentration of **0.708** mg/L**.** The Fluoride concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Fluoride found to be within the Permissible limit norm of 1.5 mg/L as specified by IS:10500:2012
- **Sulphate:** The concentration Sulphate varies from **0** to **141.99** mg/L, with an average concentration of **45.67** mg/L. While at Vadinar Sulphate concentration was varies within range of **13.07** to **102.92** mg/L**,** with an average concentration of **43.94** mg/L**.** 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.
- **Nitrate:** The concentration Nitrate varies from **0** to **25.96** mg/L, with an average concentration of **4.08** mg/L. While at Vadinar Nitrate concentration was varies within range of **0** to **18.54** mg/L**,** with an average concentration of **8.20** mg/L**.** The Nitrate concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Nitrate found to be within the Acceptable limit norm of 45 mg/L as specified by IS: 10500:2012.
- **Nitrite:** The concentration Nitrite varies from **0** to **0.2** mg/L. While at Vadinar Nitrite concentration was varies within range of **0** to **1.89** mg/L**,** with an average concentration of **0.945** mg/L**.** The Nitrite concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar.
- **Sodium:** During the monitoring period, at Kandla variation in the concentration of Sodium was observed to be in the range of **5.01 to 396.2 mg/L**, with the average concentration of **63.71** mg/L. While at Vadinar, the concentration recorded between **6.08** to **204.4** mg/L, with the average concentration of **57.067** mg/L.
- **Odour:** Odour values recorded 1 TON at all monitoring locations of Kandla and Vadinar.

Metals:

- **Arsenic:** The Arsenic concentrations in Kandla varied from **0 to 0.042 mg/L**. At Vadinar the Arsenic concentration was observed within the range of **0** mg/L to **0.08** mg/L. Thus, the Arsenic levels at both project sites fall within the Permissible limit of 0.05 mg/L, as specified under IS:10500:2012, except on one location at Vadinar DW-19 where Arsenic Concentration found 0.08 mg/L in the monitoring period of November to December 2023. In Kandla and Vadinar, the Arsenic concentrations were recorded

BQL for majority of the locations except the locations DW-2, DW-12, and DW-18 in Kandla and DW-20 In Vadinar.

- **Copper:** The Copper concentrations in Kandla varied from **0 to 17.3 mg/L**. At Vadinar the Copper concentration was observed within the range of **0** mg/L to **16.25** mg/L. Thus, the Copper levels at both project sites fall within the Permissible limit of 1.5 mg/L, as specified under IS:10500:2012, except for locations DW-1, DW-2, DW-4, DW-8, DW-10, DW-12, DW-15, DW-18 in Kandla and on both Locations DW-19 and DW-20 of Vadinar for some samples taken during whole monitoring period. The Copper concentrations were recorded BQL for majority of the locations in Kandla and Vadinar.
- **Iron:** The Iron concentrations in Kandla varied from **0 to 0.64 mg/L**, with an average concentration of **0.10** mg/L. At Vadinar the Iron concentration was observed within the range of **0** mg/L to **1.478** mg/L. Thus, the Iron levels at both project sites fall within the Acceptable limit of 0.3 mg/L, as specified under IS:10500:2012, except for locations DW-1, DW-10, and DW-17 in Kandla and on Location DW-19 of Vadinar for some samples taken during the whole monitoring period. The Iron concentrations were recorded by BQL for the majority of the locations in Kandla and Vadinar.
- **Lead:** The Lead concentrations in Kandla varied from **0 to 4.279 mg/L**, with an average concentration of **0.37** mg/L. While at Vadinar the Lead concentration was observed within the range of **0** mg/L to **10.53** mg/L, with an average concentration of **2.6344**. Thus, the Lead levels at both project sites fall within the Acceptable limit of 0.01 mg/L, as specified under IS:10500:2012, except for locations DW-1, DW-8, DW-14 and DW-15 in Kandla and on Location DW-19 of Vadinar for some samples taken during the whole monitoring period. The Lead concentrations were recorded in BQL for the majority of the locations in Kandla and Vadinar.
- **Manganese:** The Manganese concentrations in Kandla varied from **0 to 0.51 mg/L**, with an average concentration of **0.1** mg/L. While at Vadinar, the Manganese concentration was observed within the range of **0** mg/L to **0.13** mg/L. Thus, the Manganese levels at both project sites fall within the Acceptable limit of 0.3 mg/L, as specified under IS:10500:2012, except for locations DW-3, and DW-6 in Kandla and on Location DW-20 of Vadinar for some samples taken during the whole monitoring period. The Manganese concentrations were recorded BQL for the majority of the locations in Kandla and Vadinar.
- The concentrations of parameters such as **Free Residual Chlorine, Total Suspended Solid, Potassium Hexavalent Chromium** and **the metals (Cadmium, Mercury, Total Chromium and Zinc)** were observed to fall within the Permissible limit at both project sites. Observed "Below the Quantification Limit (BQL)" at majority of the locations during the monitoring period.
- Bacteriological Analysis of the drinking water reveals that **Total Coliforms (TC)** were detected in the range of **0** to **144500** MPN/100ml, with the average of **6964.8** MPN/100ml. While at Vadinar the observed within the range of **0** MPN/100ml to **1,30,000** MPN/100ml, with the average concentration of **25,185** MPN/100ml. And for the rest of the monitoring locations of Kandla and Vadinar were detected "Below the Quantification Limit (BQL)". Reporting such concentration of Coliforms indicates

certain external influx may contaminate the source. Hence, it should be checked at every distribution point. The higher concentration of total coliforms were observed on locations DW-2, DW-5, DW-7, DW-10, DW-11, and DW-17 in Kandla and DW-20 location in Vadinar.

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.

The following steps can be implemented to ensure that the water being supplied is safe for consumption:

- Regular monitoring should be carried out 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.
- It is necessary to carry out a system assessment to determine whether the drinking-water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets identified targets. This also includes the assessment of design criteria of the treatment systems employed.
- Identifying control measures in a drinking-water system that will collectively control identified risks and ensure that the health-based targets are met. For each control measure identified, an appropriate means of operational monitoring should be defined that will ensure that any deviation from required performance (water quality) is rapidly detected in a timely manner.
- Management and communication plan should be formulated describing actions to be taken during normal operation as well as during incident conditions (such as drinking water contamination) and documenting the same.

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:

Frequency of monitoring: weekly

Table 22A: 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 23Bs: Discharge norms (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 3 and 4** as follows:

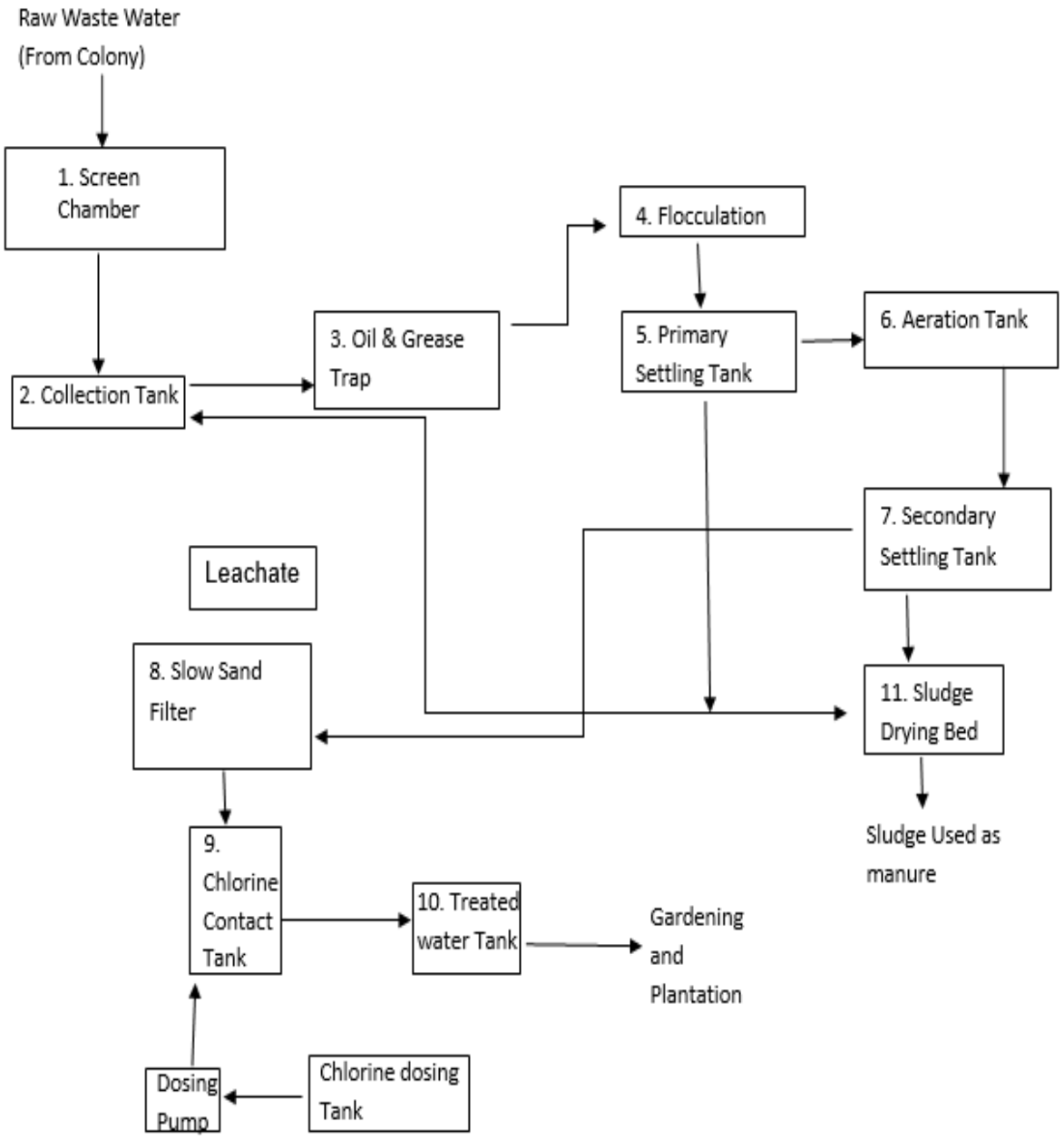


Figure 3: Process flow diagram of STP at Kandla

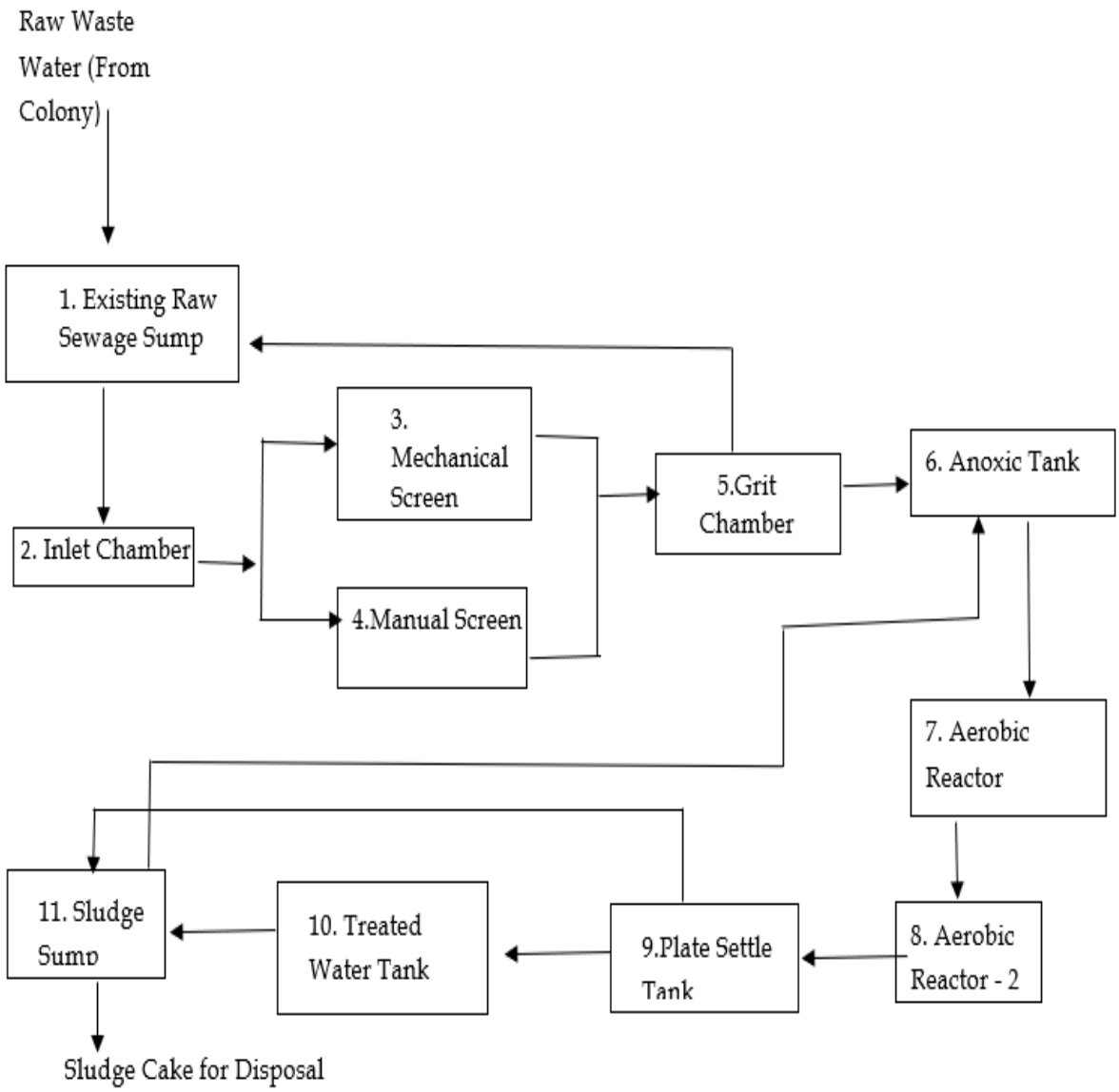


Figure 4: Process flow diagram of STP at Gopalpuri, Kandla

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

Sr. No.	Parameters	Prescribed limits
1.	pH	5.5-9

Sr. No.	Parameters	Prescribed limits
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 5** as follows:

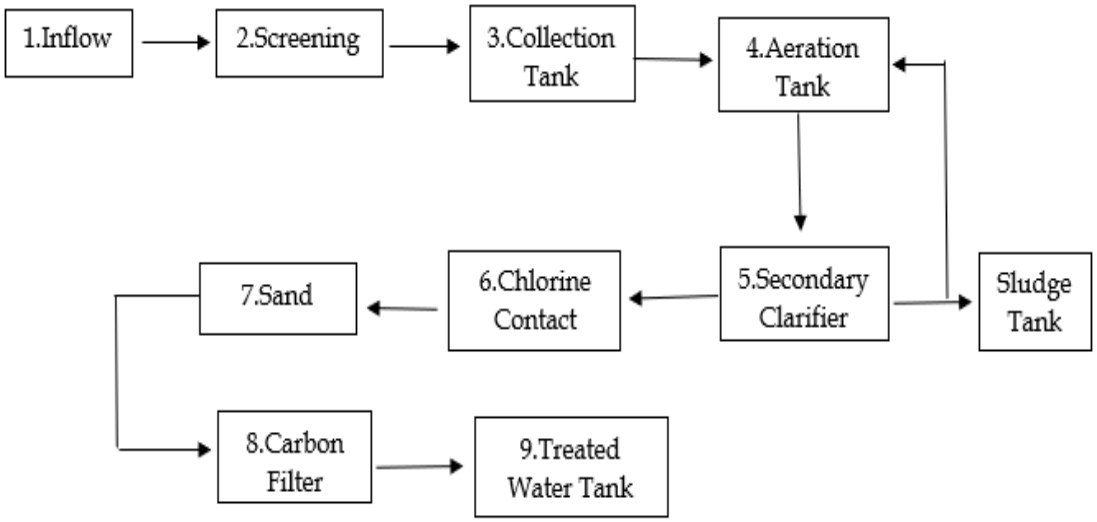
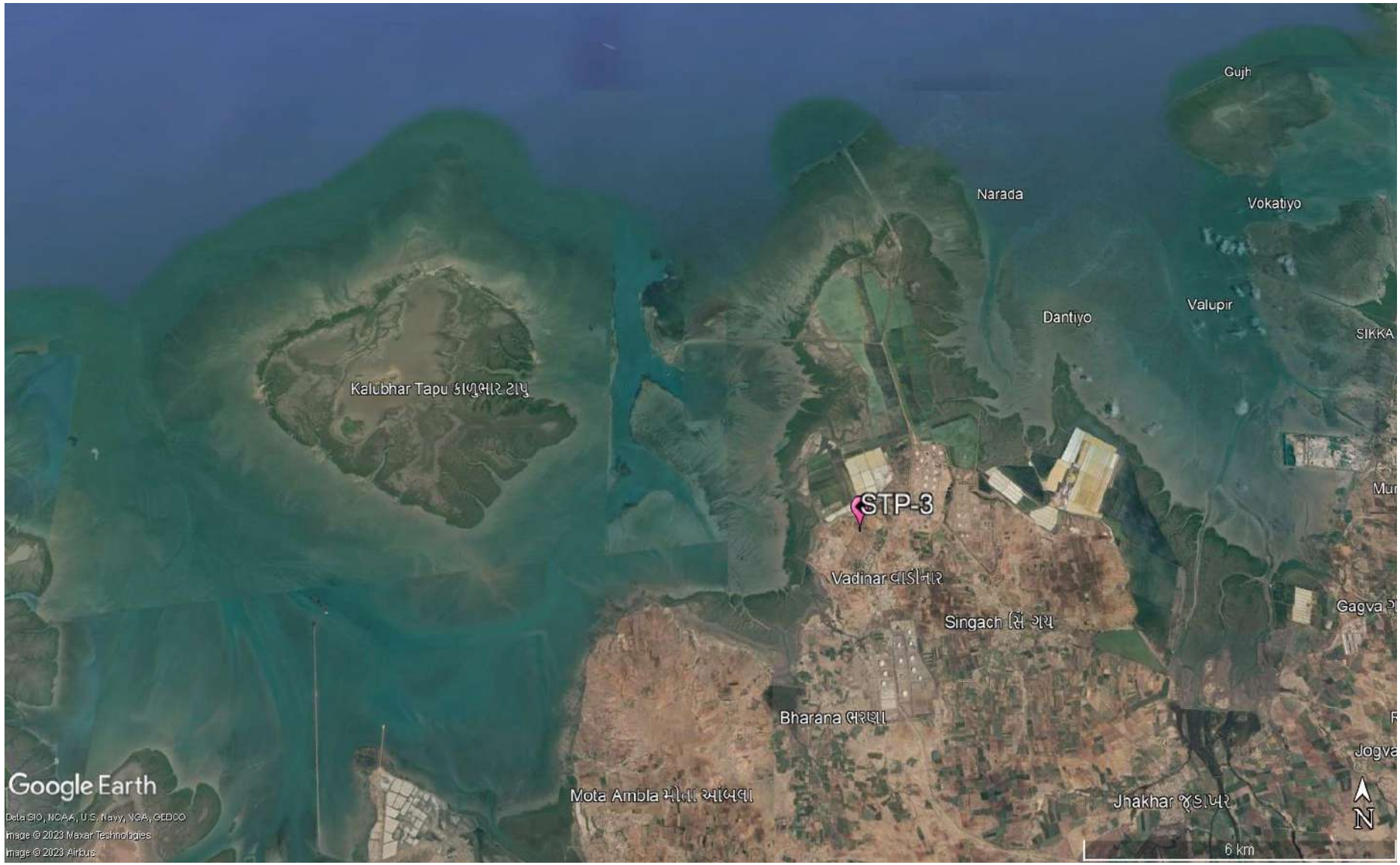


Figure 5: Process flowchart for the STP at Vadinar

The map depicting the locations of STP to be monitored in Kandla and Vadinar have been shown in **Map 14 and 15** as follows:

Map 14: STP Monitoring Locations at Kandla



Map 15: STP Monitoring Locations 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:

Monitoring 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. Sample Collected from this location during the monitoring period 15th April 2023 to 15th April 2024.

Table 25: List of parameters monitored for STP's at Kandla and Vadinar

Sr. No.	Parameters	Units	Reference method	Instruments
1.	pH	-	APHA, 23rd edition, 4500- H^+ B, 2017	pH Meter
2.	TDS	mg/L	APHA, 23rd Edition, 2540 C: 2017	Vacuum Pump with filtration assembly and Oven
3.	TSS	mg/L		
4.	DO	mg/L	APHA, 23rd Edition, 4500 C: 2017	Titration Apparatus
5.	COD	mg/L	APHA, 23rd 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

Analytical results of the STP samples collected from the inlet and the outlet of the STP's of Kandla and Vadinar have been summarized in **Table 27**. Further it was compared with the standard norms specified in the CC&A of the respective STPs.

Table 26: Water Quality of inlet and outlet of STP of Kandla

Sr No.	Parameter	Units	Kandla						Vadinar			
			GPCB Norms (Kandla)	STP-1			STP-2			GPCB Norms (Vadinar)	STP-3		
				Inlet	Outlet		Inlet	Outlet			Inlet	Outlet	
				Avg	Avg	Max	Avg	Avg	Max		Avg	Avg	Max
1.	pH	-	**6.5-8.5**	7.17	7.302	7.65	6.99	7.48	8.88	**5.5-9**	7.19	7.41	8.46
2.	TDS	mg/L	-	3065.7	2069.28	6228	1099.40	1003.3	1814	-	471.61	402.67	482
3.	TSS	mg/L	**100**	183.4	20.97	88	115.17	16.45	46	**20**	38.78	8.42	36
4.	COD	mg/L	-	184.7	32.57	133.1	213.54	25.98	88.4	**50**	138.27	16.18	40.2
5.	DO	mg/L	-	145.91	37.780	277.09	162.29	21.98	76.92	-	115.12	18.69	54.5
6.	BOD	mg/L	**30**	56.82	11.937	52.4	61.75	8.40	18.45	**10**	44.62	6.053	11
7.	SAR	meq/L	-	12.06	9.318	21.04	5.75	5.43	13.1	-	2.71	2.12	3.2
8.	Total Coliforms	MPN/ 100ml	**<1000**	1565.95	1530.66	1600	1537.02	1500.51	1600	**100-230**	1551	1492.3	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 average pH at the inlet of STP-1, STP-2, and STP-3 is, respectively, **7.17, 6.99, and 7.19**. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum pH of **7.65, 8.88, and 8.46** and an average pH of **7.302, 7.48, and 7.41**, respectively. Which conform to their respective stipulated norms of 6.5–8.5 at Kandla and 5.5–9 at Vadinar, respectively.
- The average TDS concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **3065.8, 1099.4, and 471.33** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TDS concentration of **6228, 1814, and 482** mg/L, and an average TDS concentration of **2069.3, 1003.3, and 402.67** mg/L, respectively.
- The average TSS at the inlet of STP-1, STP-2, and STP-3 is respectively **183.43, 115.17, and 38.78** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TSS of **88, 46**, and **36** mg/L, and an average TSS of **20.974, 16.452, and 8.41** mg/L, respectively. Which conform to their respective stipulated norms of 100 mg/L at Kandla and 20 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average COD at the inlet of STP-1, STP-2, and STP-3 is respectively **184.7, 213.54, and 138.27** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had maximum COD concentrations of **133.1, 88.4, and 40.2** mg/L, and average COD concentrations of **32.576, 25.97, and 16.18** mg/L, respectively. There are no discharge norms for the COD parameter in STP-1 and STP-2 at Kandla, and they conform to their respective stipulated norms of 50 mg/L at Vadinar as mentioned in their respective CCA.
- The average DO concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **145.91, 162.29, and 115.12** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum DO concentration of **277.09, 76.92, and 54.5** mg/L, and an average DO concentration of **37.78, 21.98, and 18.68,** mg/L respectively.
- The average BOD at the inlet of STP-1, STP-2, and STP-3 is respectively **56.82, 61.76, and 44.62** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum BOD of **52.4, 18.45, and 11** mg/L, and an average BOD of **11.93, 8.40, and 6.05** mg/L, respectively. Which conform to their respective stipulated norms of 30 mg/L at Kandla and 10 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average SAR concentrations at the inlet of STP-1, STP-2 and STP-3 are respectively **12.068**, **5.75** and **2.71** meq/L**.** After treatment, the treated effluent from

STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) having maximum SAR concentration **21.04**, **13.1** and **3.2** meq/L, and having Average SAR concentration **9.31**, **5.46** and **2.12** meq/L respectively.

- The **Total Coliforms** was observed to exceed the norms at the locations of the STP-1 & STP-2 for the treated effluent at Kandla and STP-3 at 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 as specified under the 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 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/H_2O_2 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.

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 27: Details of the sampling locations for Marine water

Sr. No.	Location Code		Location Name	Latitude Longitude
1.	Kandla	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.	Vadinar	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 16 and 17** as follows:

Map 16: Marine Water Monitoring Locations at Kandla

Map 17: Marine Water Monitoring Locations 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.

Monitoring 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). For the period 15th April 2023 to 15th April 2024.

Table 28: List of parameters monitored for Marine Water

Sr. No	Parameters	Units	Reference method	Instrument
1.	Electrical Conductivity	µS/cm	APHA, 23rd Edition (Section-2510 B):2017	Conductivity Meter
2.	Dissolved Oxygen (DO)	mg/L	APHA, 23rd Edition, 4500 O C, 2017	Titration Apparatus
3.	pH	-	APHA, 23rd Edition (Section-4500-H+B):2017	pH meter
4.	Color	Hazen	APHA, 23rd 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, 23rd Edition (Section-2540 C):2017	Vaccum Pump with Filtration Assembly and Oven
8.	Total Suspended Solids (TSS)	mg/L	APHA, 23rd Edition, 2540 D: 2017	
9.	Particulate Organic Carbon	mg/L	APHA, 23rd 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, 23rd Edition, 4500 C, 2017	UV- Visible Spectrophotometer
13.	Phosphate	mg/L	APHA, 23rd Edition, 4500 P-D: 2017	
14.	Sulphate	mg/L	APHA, 23rd Edition, 4500 SO4-2 E: 2017	
15.	Nitrate	mg/L	APHA, 23rd Edition, 4500 NO3-B: 2017	
16.	Nitrite	mg/L	APHA, 23rd Edition, 4500 NO2- B: 2017	
17.	Sodium	mg/L	APHA, 23rd Edition, 3500 Na-B: 2017	Flame photometer

Sr. No	Parameters	Units	Reference method	Instrument
18.	Potassium	mg/L	APHA, 23rd Edition, 3500 K-B: 2017	
19.	Manganese	µg/L	APHA, 23rd Edition, ICP Method 3120 B: 2017	ICP-OES
20.	Iron	mg/L	APHA, 23rd Edition, ICP Method 3120 B: 2017	
21.	Total Chromium	µg/L	APHA, 23rd Edition, 3500 Cr B: 2017	
22.	Hexavalent Chromium	µg/L		UV- Visible Spectrophotometer
23.	Copper	µg/L	APHA, 23rd 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, 23rd 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 29: Results of Analysis of Marine Water Sample for the sampling period

Parameters	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		
		Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Density (kg/m³)	-	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.021	1.02	1.02	1.02	1.02	1.02	1.02
pH	6.5-9.0	6.12	8.32	7.89	7.04	8.36	7.99	7.83	8.33	8.11	7.69	8.31	8.05	7.19	8.48	8.03	6.01	8.31	7.94	7.98	8.2	8.11	7.07	8.22	8.06
Colour (Hazen)	No Noticeable	1	10	5.41	1	20	7.83	1	15	7.16	5	20	9	5	15	7.41	5	20	8.27	1	10	5.66	1	10	5.08
EC (µS/ cm)	-	49700	63600	54282.5	49800	61700	54490.91	50200	60600	53767.75	50400	75300	55689.91	50100	65100	55115.58	15950	61528	50873.17	52200	56900	54239.2	52.119	57500	50312.6
Turbidity (NTU)	-	56.4	310	188.26	33.9	314	206.76	61.8	317	203.81	69	300	216.66	94.5	379	202.5	70.1	346	209.23	3.15	12.5	5.36	3.42	13.8	6.39
TDS (mg/L)	-	24800	44466	36356.3	24900	41922	36679.5	25100	41624	35690.92	25200	64721	38189.5	25000	47159	36938.58	9970	41436	32927.91	25784	38620	35400.16	26882	41790	35965.75
TSS (mg/L)	-	44	436	342.42	26	563	374.58	52	478	340.75	58	924	402.33	80	682	427.66	58	852	387.72	78	341	255.08	151	346	282.33
COD (mg/L)	-	29.2	79.37	49.62	11.98	79.37	47.81	25.41	81	47.68	22.65	81	52.12	31.56	79.37	53.76	22.97	88.8	49.34	21.28	75	50.98	17.92	75	47.63
DO (mg/L)	3.0 mg/L	4.7	6.4	5.76	5.3	6.4	6.07	4.5	6.7	5.87	3.4	6.5	5.85	5	6.6	6.07	5.6	8.4	6.49	4.3	7.6	6.25	4.4	7.9	6.48
BOD (mg/L)	5.0 mg/L	5.24	8.54	7.56	8.4	8.9	8.57	3.74	8.45	6.81	5	8.78	7.755	9.32	9.87	9.57	3.6	11.1	8.64	3.91	7.5	6.51	4.2	7.16	6.16
Oil & Grease (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphate (mg/L)	-	2056	2937.5	2529.7	2156.32	2897.7	2544.18	2083.7	2925.2	2530.85	2239	3704.9	2879.88	2334.9	2916.8	2652.42	632.62	3612.8	2561.07	1846.3	3225.8	2472.195	2039.9	3236.8	2664.27
Nitrate (mg/L)	-	1.89	5.40	4.28	1.12	5.16	3.75	3.21	5.68	4.17	3.41	5.85	4.64	3.17	6.92	4.21	3.06	6.84	4.06	2.225	5.17	3.56	1.759	5.1	3.39
Nitrite (mg/L)	-	0.12	0.12	0.12	0	0	0	0	0	0	0	0	0	0.11	0.11	0.11	0.13	0.16	0.14	0	0	0	0	0	0!
Phosphate (mg/L)		0.25	1.59	0.82	0.09	1.34	0.69	0.57	1.46	0.96	0.61	2.01	0.92	0.29	1.34	0.76	0.54	1.61	0.81	0.64	0.94	0.79	1.43	1.43	1.43
Silica (mg/L)	-	0.29	3.24	2.12	0.22	4.04	2.24	0.2	3.73	2.19	1.12	3.69	2.54	1.26	4	2.64	0.33	3.74	1.92	0.11	0.96	0.56	0.09	1.86	0.76
Sodium (mg/L)	-	7686	10625	9475.57	7811	10341	9242.42	7763	10308	9347.33	9101	10323	9724.14	8789	10278	9403.67	2086	10722	8042.71	2149.6	9485	6743.97	2349.4	9542	7244.66
Potassium (mg/L)	-	68.35	451.9	318.57	69.27	446.5	303.94	68.57	421	290.60	71.73	543.96	342.71	69.63	423.34	324.92	68.34	442.63	272.9	10.86	421.7	259.6	76.31	518	327.43
Hexavalent Chromium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	321	321	321	333	333	333
Odour	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	-	5.13	5.13	5.13	5.25	5.25	5.25	5.4	5.4	5.4	0	0	0	0	0	0	9.44	12.94	11.19	0.11	1	0.41	0.08	1	0.38
Cadmium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper (mg/L)	-	5.1	6.99	5.8175	0.006	10.9	5.79	0.005	7.7	3.85	5.34	12.01	8.224	0.0067	7.6	5.13	8.07	10.2	9.49	3.4	3.4	3.4	0	0	0
Iron (mg/L)	-	0.69	4.11	1.38	0.21	4.07	1.76	0.37	3.92	1.79	1.02	7.93	2.49	0.98	5.45	2.09	0.43	5.3	2.005	0.01	0.25	0.145	0.08	0.66	0.21
Lead (mg/L)	-	0.002	3.44	2.067	0.0029	3.44	2.29	0.0026	3.06	1.98	0.002	9.68	4.32	0.002	4.65	2.39	0.0029	3.65	2.47	0.0023	2.26	1.035	0.002	2.75	0.96
Manganese (mg/L)	-	0.082	129.91	71.47	0.12	159.78	83.88	0.1085	125.66	74.0	0.096	294.91	93.56	0.074	213.14	74.7	0.11	156.41	80.27	2.39	113.93	39.62	1.97	98.8	34.64
Total Chromium (mg/L)	-	0	0	0	5.62	7.8	6.71	5.67	5.67	5.67	5.14	15.99	12.28	5.11	9.65	7.207	0	0	0	0	0	0	45.75	45.75	45.75
Zinc (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Particulate Organic	-	0.51	900	76.22	0.51	35	3.98	0.42	10	1.94	0.58	55	6.03	0.92	30	3.89	0.85	44	5.01	0.47	4.67	1.62	0.32	4.76	1.51

Parameters	Primary	Kandla																		Vadinar					
Carbon (mg/L)																									
Total Coliform* (MPN/ 100ml)	500/100 ml	0.32	1600	159.61	0.16	120	29.76	0.56	108	31.55	0.25	47	14.02	0.35	170	37.19	0.29	50	21.86	0.36	240	39.76	0.39	240	35.28
Floating Material (Oil grease scum, petroleum products) (mg/L)	10 mg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	23	23

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:

- **Density** at Kandla was observed in the range of **1.02 to 1.03 kg/m³**, with the average of **1.022 kg/m³.** Whereas for the location of Vadinar, it was observed in the range of **1.021 to 1.026 kg/m³**, with the average of **1.022 kg/m³**.
- **pH** at Kandla was observed in the range of **6.01 to 8.48**, with the average pH as **7.78**. Whereas for the locations of Vadinar, it was observed in the range of be **7.07** to **8.22**, with the average pH as **7.94**. For the monitoring location of both the study areas, pH was found to comply with the norms of 6.5-8.5.
- **Color** range varied from **1 to 20 Hazen** at all the monitoring locations in Kandla, and for Vadinar, it varied from **1 to 10 Hazen**.
- **Electrical conductivity (EC)** was observed in the range of **15,950 to 75,300 µS/cm**, with the average EC as **54,344.32** µS/cm for the locations of Kandla, whereas for the locations of Vadinar, it was observed in the range of **52,199 to 57,500 µS/cm**, with the average EC as **45,200.67** µS/cm.
- For all monitoring locations of Kandla the value of **Turbidity** was observed in the range of **33.9 to 379 NTU**, with average value of **198.83** NTU. For Vadinar it ranges from **3.15 to 13.8 NTU**, with average of **7.43** 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.
- For the monitoring locations at Kandla the value of **Total Dissolved Solids (TDS)** ranged from **9,970 to 64,721 mg/L**, with an average value of **35,171** mg/L. Similarly, at Vadinar, the TDS values ranged from **25,784 to 41,790 mg/L**, with an average value of **34,073** mg/L.

- **TSS** values in the studied area varied between **26 to 924 mg/L** at Kandla and **78 to 346 mg/L** at Vadinar, with the average value of **362.69** mg/L and **242.23** mg/L respectively for Kandla and Vadinar.
- **COD** varied between **11.98 to 88.8 mg/L** at Kandla and **17.92 to 75 mg/L** at Vadinar, with the average value as **51.83** mg/L and **47.86** mg/L respectively for Kandla and Vadinar.
- **DO** level in the studied area varied between **3.4 to 8.4 mg/L** at Kandla and **4.3 to 7.9 mg/L** at Vadinar, with the average value of **5.86** mg/L and **6.15** mg/L respectively for Kandla and Vadinar. Which represents that the marine water is suitable for marine life.
- **BOD** observed was observed in the range of **3.6 to 11.1 mg/L**, with average of **7.76** mg/L for the location of Kandla and for the locations of Vadinar, it was observed in the range of **3.91 to 7.5 mg/L**, with an average value of **5.9** mg/L.
- **Sulphate** concentration in the studied area varied between **632.92 to 3704.9 mg/L** at Kandla and **1846.3 to 3236.8 mg/L** at Vadinar. The average value observed at Kandla was **2566.45** mg/L, whereas **2580.87** mg/L was the average value of Vadinar. Sulphate is naturally formed in inland waters by mineral weathering or the decomposition and combustion of organic matter.
- **Nitrate** in the study area was observed in the range of **1.12 to 6.92 mg/L**, with the average of **4.26** mg/L. Whereas for the Vadinar the concentration of Nitrate was observed in the range of **1.759 to 5.17** mg/L, with the average **3.53** mg/L.
- **Nitrite** in the study area was observed in the range of **0 to 0.16 mg/L**, with the average of **0.625** mg/L. Whereas for the Vadinar the concentration of Nitrite was observed Below Quantification Limit During whole monitoring period.
- **Phosphate** in the study area was observed in the range of **0.09 to 2.01 mg/L**, with the average of **0.92** mg/L. Whereas for the Vadinar the concentration of Phosphate was observed in the range of **0.64 to 1.43** mg/L, with the average **1.11** mg/L.
- **Silica** in the study area was observed in the range of **0.2 to 4.04 mg/L**, with the average of **2.19** mg/L. Whereas for the Vadinar the concentration of silica was observed in the range of **0.09 to 1.86** mg/L, with the average **0.724** mg/L.
- In the study area of Kandla the concentration of **Potassium** varied between **68.34 to 543.68 mg/L** and **10.86 to 518 mg/L** at Vadinar, with the average value as **277.71** mg/L and **268.99** mg/L respectively for Kandla and Vadinar.
- **Sodium** in the study area varied between **2,086 to 10,722 mg/L**, with average of **8948.26** mg/L, at Kandla whereas at Vadinar its value recorded within range of **2149.6 to 9542 mg/L,** with the average of **6252.43** mg/L.
- **Odour** was observed 1 for all locations of Kandla and Vadinar.
- **Arsenic** concentration observed to be BQL for majority of location for Kandla and Vadinar except locations MW-1, MW-2, MW-3, MW-6, MA-7 and MW-8 for some instant of time during whole monitoring period.
- **Copper** in the study area varied between **0.005 to 12.01 mg/L**, with average of **6.23** mg/L, at Kandla whereas at Vadinar its value recorded within range of **0 to 3.4 mg/L,**

with the average of **2.04** mg/L, on both project sites during monitoring majority of time Copper found Below Quantification Limit.

- **Iron** in the studied area varied between **0.21 to 7.93 mg/L**, with the average of **2.55** mg/L, at Kandla, and for Vadinar value were recorded within range of **0.01** to **0.66** mg/L, with average value of **0.22** mg/L.
- **Lead** concentration varied **0.002 to 9.68 mg/L**, with an average of **2.41** mg/L at Kandla. At Vadinar location within range of **0.002** to **2.753** mg/L with an average **1.17** mg/L
- **Manganese** in the studied area varied between **0.0748 to 294.91 mg/L**, with the average of **86.57** mg/L, at Kandla and for Vadinar, recorded value were observed within the range of **1.97** to **113.93 mg/L**, with the average of **48.56** mg/L.
- **Total Chromium** in the study area varied between **0 to 15.99 mg/L**, with average of **5.13** mg/L, at Kandla whereas at Vadinar its value recorded **45.76** mg/L at MW-8 in the monitoring period of January to February 2024**,** While on both project sites during monitoring majority of time Total Chromium found Below Quantification Limit
- **Particulate Organic Carbon** in the study area was observed in the range of **0.42 to 900**, with the average value of **65.27**. the maximum spike of 900 is only observed once in the period of April to May 2023 during whole monitoring period. Whereas for the Vadinar, the value observed was Within the range of **0.32** to **4.76**, with the average of **2.22**.
- **Oil & Grease, Nitrite, Phosphate, Hexavalent Chromium, Arsenic, Cadmium, Total Chromium, Zinc, Mercury and Floating Material (Oil grease scum, petroleum products)** were observed to have concentrations **"Below the Quantification Limits (BQL)"** for most of the locations of Kandla and Vadinar, majority of time during whole monitoring period.
- **Total Coliforms** were detected complying with the specified norm of 500 MPN/100ml for all the locations of Kandla and Vadinar, except on location MW-1 in the month of May to June 2023.

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 30: 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 **Map 18 and 19** as follows:

Map 18: Marine Sediment Monitoring Location at Kandla

Map 19: Marine Sediment Monitoring Locations 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 31: 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.	Titration Apparatus
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 of April 2023 to April 2024 has been summarized in the **Table 34.**

Table 32: Summarized result of Marine Sediment Quality

Parameters	Kandla																		Vadinar					
	MS-1			MS-2			MS-3			MS-4			MS-5			MS-6			MS-7			MS-8		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Inorganic Phosphate (kg/ ha)	16.85	0.86	6.6042	14.37	0.67	8.81	41.2	0.8	16.98	19.44	0.81	9.532	45.1	0.72	14.48	34.6	0.66	15.24	14.5	1.24	5.65	18.51	0.82	5.7325
Phosphate (mg/Kg)	3247.8	290.8	1280.63	2514.7	258.3	1304	3736	226.6	1515	3871	353.7	1287	3741	306.8	1442	14076	578.3	2793.9	3002	152.5	770.24	3477.29	167.93	940.70
Organic Matter (%)	1.42	0.21	0.7875	2.17	0.29	1.13	1.01	0.17	0.593	2.1	0.33	0.975	1.24	0.67	0.911	2.06	0.21	0.915	2.29	0.15	1.04	1.65	0.17	0.89
Sulphate as SO^{4-} (mg/Kg)	905.25	110.2	366.8	1022.25	98.2	370.03	571.64	95.33	275.09	650.25	97.45	268.51	768	87.28	294.27	732	96.38	249.1	296	74.07	126.31	213.4	80.06	132.03
Calcium as Ca (mg/Kg)	13800	1612	3464.3	5800	1259	2836	4200	962	2163	4200	1102	2669	10500	1089	3102	3800	1047	2274.6	3700	2200	2930.9	3974.2	2100	2805.45
Magnesium as Mg (mg/Kg)	1952	1225	1538.53	3050	826.46	1810.84	2136	764	1592.59	3172	866.94	1810.6	2440	1032	1622.80	2745	906.98	1581.95	1952	854	1385.18	14640	1167	2920.83
Silica (g/Kg)	671.25	261.3	479.11	612.51	289.4	481.7	571.5	329.1	444.8	555.2	245.7	392.1	597.1	179.2	418.6	580.4	245.3	436.12	529.8	220.9	377.71	546.08	264.92	426.66
Nitrite (mg/Kg)	0.75	0.12	0.41	0.92	0.13	0.50	0.81	0.08	0.41	0.91	0.01	0.43	0.71	0.11	0.375	0.89	0.07	0.489	0.22	0.07	0.159	0.37	0.04	0.23
Nitrate (mg/Kg)	22.34	5.86	16.58	37.12	7.59	18.29	36.47	4.51	15.50	25.94	4.31	13.99	10.34	5.24	13.17	20.38	6.34	14.52	25.33	9.54	15.36	25.21	4.75	10.52
Sodium (mg/Kg)	7860	3194	4512.43	14688	2453	5318	8612	2072	4550	18308	2612	6435	10520	2063	4665	14076	2072	5639.6	11944	3971	7904.6	13660	2719.42	9536.63
Potassium (mg/Kg)	2610.7	241	1525.98	11580	276	2320	3479	260.7	2126	4208	294	2424	3152	205	1790	3479	236.9	2233.4	3372	699	1876.1	4377	1028	2025.66
Aluminium (mg/Kg)	8371.7	2116	3827.74	10641	1237.1	4465.9	10363.1	1278.5	4370.2	12008.4	1971.2	5025.2	10361.1	1264.58	3891.23	12314.1	1273.22	4384.20	14179.7	358.3	4028.56	19356.55	479.16	4883.52
Mercury (mg/Kg)	4.71	4.71	4.71	10.74	10.74	10.74	41.29	41.29	41.29	6.44	6.44	6.44	15.21	15.21	15.21	34.69	34.69	34.69	0	0	0	0	0	0
Texture	Sandy loam	Sandy loam	Silt loam	Sandy loam	Silt loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Loam	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 April 2023 to April 2024. The detailed interpretation of the parameters is given below:

- **Inorganic Phosphate** for the sampling period was observed in range of **0.66 to 45.12** Kg/ha for Kandla. Whereas for Vadinar the value observed Within range of **0.82** to **18.51** Kg/ha. For Kandla and Vadinar the average value of Inorganic Phosphate was observed **13.77** and **7.74** Kg/ha respectively.
- The concentration of **Phosphate** was observed in range of **226.6 to 3871.15 mg/Kg** for Kandla and for Vadinar the value observed within the range of **152.53** to **3477.29** mg/Kg. For Kandla and Vadinar the average concentration of Phosphate was observed **1616.78** and **1418.5** mg/Kg respectively.
- The **Organic Matter** for the sampling period was observed in the range of **0.17 to 2.17** % for Kandla with the average value of **0.95**% and for Vadinar the value recorded Within range of **0.15 to 2.29**%, with average concentration as **1.03** %**.**
- The concentration of **Sulphate** was observed in the range of **87.28 to 1022 mg/Kg** for Kandla and for Vadinar the value observed Within range of **74.07** to **296** mg/Kg. For Kandla and Vadinar the average value of Sulphate was observed **392.10** and **153.64** mg/Kg respectively.
- The value of **Calcium** was observed in the range of **962 to 13800 mg/Kg** for Kandla and for Vadinar the value observed within the range of **2100** to **3974.5** mg/Kg. The average value of Calcium for the monitoring period was observed **3660.21** mg/Kg and **2951.76** mg/Kg at Kandla and Vadinar, respectively.
- The value of **Magnesium** for the sampling period was observed in the range of **764 to 3172 mg/Kg** for Kandla and for Vadinar the value observed Within the range of **854** to **1952** mg/Kg. For Kandla and Vadinar the average value of Magnesium was observed **1726**.35 mg/Kg and **1440.69** mg/Kg respectively.
- For the sampling period **Silica** was observed in the range of **179.25 to 671.25 mg/Kg** for Kandla with average value **432.83** mg/Kg and for Vadinar the value observed within the range of **220.98** and **546.5** mg/Kg with average **394.35** mg/Kg.
- The value of **Nitrate** was observed in the range of **4.31 to 37.12 mg/Kg** for Kandla with average value **15.47** mg/Kg and for Vadinar the value observed within the range of **4.75** to **25.33** mg/Kg. with average **15.12** mg/Kg.
- The value of **Nitrite** was observed in the range of **0.01 to 0.92 mg/Kg** for Kandla with average value **0.45** mg/Kg and for Vadinar the value observed to be within the range of **0.04** to **0.37** mg/Kg, with average **0.1828** mg/Kg.
- The value of **Sodium** was observed in the range of **2063.3 to 18308 mg/Kg** for Kandla with average value **6647.43** mg/Kg and for Vadinar the value observed within the range of **2719.42** and **13660** mg/Kg, with average **8289** mg/Kg.
- The value of **Potassium** was observed in the range of **205.08 to 11580 mg/Kg** for Kandla with average value **2357.95** mg/Kg and for Vadinar the value observed within range of **699.09** to **4377** mg/Kg, with average **2229.65** mg/Kg.

- The value of **Aluminium**, was observed in the range of **1237.13 to 12314.13 mg/Kg** for Kandla with average value **5509.23** mg/Kg and for Vadinar the value observed within the range of **358.3** to **19356** mg/Kg, with average **7214.30** mg/Kg.
- The value of **Mercury**, was observed in the range of **4.71 to 41.29 mg/Kg** for Kandla with average value **18.84** mg/Kg and for Vadinar the value of **Mercury** was observed "Below the Quantification Limit" at both two locations. During monitoring period majority of time Mercury was observed Below Quantification limit.
- Texture was observed to be "**Sandy Loam**" at location MS-1, MS-2, MS-4 and MS-6 "**Silt loam"** at location MS-3 & MS-5 in Kandla. "**Sandy Loam**" at location MS-7 & "**Silt loam"** at location MS-8 in Vadinar during sampling period.

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 33: 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 34: Comparison of Heavy metals with Standard value in Marine Sediment

Parameters	Kandla																		Vadinar					
	MS-1			MS-2			MS-3			MS-4			MS-5			MS-6			MS-7			MS-8		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Arsenic (mg/Kg)	5.13	1.09	3.527	4.43	2.11	3.264	6.17	2.06	3.92	5.86	1.28	3.75	5.2	1.75	3.458	5.78	1.98	3.67	5.36	2.04	2.84	5.17	2.5	3.69
Copper (mg/Kg)	5.6	2.13	3.282	11.4	2.14	5.013	8.1	2.08	4.49	9.8	3.48	5.71	12	2.14	5.97	8.9	2.98	4.97	6.13	2.19	4.567	412	2.1	39.05
Chromium (mg/Kg)	64.1	42.12	53.94	67.45	32.74	47.04	73.02	32.41	48.31	83.23	41.08	55.17	59.95	41.87	51.50	104.2	36.71	59.71	59.27	23.18	44.01	104.1	29.7	61.12
Nickel (mg/Kg)	51.4	16.8	31.76	38.9	10.21	23.87	36.41	4.54	22.77	40.87	7.61	27.45	31.86	21.72	25.881	50.78	4.54	25.058	36.21	12.23	22.84	43.66	12.47	29.282
Lead (mg/Kg)	7.05	1.25	5.3	7.45	4.21	5.76	28.73	2.36	6.683	8.25	3.46	5.9	14.22	1.21	6.055	5.01	2.81	7.88	7.94	2.85	4.90	10.58	2.97	5.65
Zinc (mg/Kg)	63.2	35.88	54.63	65.69	32.11	50.455	301.32	23.63	69.545	82.9	18.15	50.86	159.42	19.54	60.65	157.82	23.63	57.7	52.13	11.47	34.6	104.87	13.65	53.8595
Cadmium (mg/Kg)	1.08	0.88	0.98	0.6	0.6	0.6	1.25	0.87	1.1	1.12	0.78	1.022	1.08	0.91	0.995	7.53	0.15	2.302	0	0	0	0	0	0

- **Arsenic** was observed in the range of **1.09 to 6.17 mg/Kg** for Kandla with average value **3.58** mg/Kg and for Vadinar the value observed within range of **2.04** to **5.36** mg/Kg, with average of **3.6** mg/Kg. during monitoring period majority of time arsenic concentration found within moderately polluted class on both study area.
- **Copper** was observed in the range of **2.08 to 12 mg/Kg** for Kandla with average value **5.6** mg/Kg and for Vadinar the value observed within the range of be **2.1** to **8.33** mg/Kg, with average **4.72** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to copper falls in non-polluted class.
- **Chromium** was observed in the range of **32.41 to 104.24 mg/Kg** for Kandla with average value **55.25** mg/Kg and for Vadinar the value observed within the range of **23.18** to **104.16** mg/Kg, with average **53.57** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to chromium falls majority of time in moderately polluted and for some instance it location MS-4, MS-6, and MS-8 fall in Heavily polluted class.
- **Nickel** was observed in the range of **4.54 to 51.47 mg/Kg** for Kandla with average value **26.25** mg/Kg and for Vadinar the value observed within range of **12.23** to **43.66** mg/Kg, with average **26.115** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to nickel falls in moderately polluted class and for some instance it location MS-1, and MS-6 fall in heavily polluted class.

- **Lead** was observed in the range of **1.21 to 28.73 mg/Kg** for Kandla with average value **5.63** mg/Kg and for Vadinar the value observed within the range of **2.85** and **10.58** mg/Kg, with average **5.81** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to lead falls in not polluted class.
- **Zinc** was observed in the range of **18.15 to 301.32 mg/Kg** for Kandla with average value **73.73** mg/Kg and for Vadinar the value observed within the range of **11.47** to **104.87** mg/Kg, with average **46.997** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to zinc falls in non-polluted class and for some instance its location MS-1, MS-3, MS-6 and MS-8 fall in Moderately polluted class.
- **Cadmium** was observed in the range of **0.15 to 7.53 mg/Kg** for Kandla with average value **1.325** mg/Kg**.** During the monitoring period majority of time **Cadmium** found BQL, which falls in non-polluted. While exception on one location MS-6 fall within moderately polluted for the duration of July to August 2023. **Cadmium** was observed BQL for all locations at Vadinar during sampling period. With reference to the guidelines mentioned in table 35, the sediment quality with respect to cadmium falls in non-polluted class.

Analysis of the sediments indicates moderate 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.

The presence of anthropic activity in the coastal areas has an effect upon the marine water and sediment. One of the primary risks associated with contaminated sediments is bioaccumulation in benthic organisms, which is a route of entry into the food chain. Generally adopted sediment remediation approaches include dredging, capping of contaminated areas, and monitored natural recovery (MNR). Dredging can remove contaminated sediments, but it requires large areas of land for sediment disposal. It is expensive and may cause secondary contamination of the water column during re-suspension. MNR relies on ongoing naturally occurring processes to decrease the bioavailability or toxicity of contaminants in sediment. These processes may include physical, biological, and chemical mechanisms that act together to reduce the environmental risks posed by contaminated sediments. MNR require longer monitoring time and can be even more expensive than for dredging and capping. Capping consists of in situ covering of clean or suitable isolating material over contaminated sediments layer to limit leaching of contaminants, and to minimize their re-suspension and transport. Hence appropriate remedial measures for the polluted sediment sites may be implemented, to reduce the concentration of the heavy metals.

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 35: Details of the sampling locations for Marine Ecological

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

The map depicting the locations of Marine Ecological monitoring in Kandla and Vadinar have been mentioned in **Map 20 and 21** as follows:

Map 20 Marine Ecological Monitoring: Locations at Kandla

Map 21: Marine Ecological Monitoring Locations at Vadinar

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

Table 36: 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, ∑ = Summation symbol,

pi = 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:

$$D = 1 - \sum (p_i \hat{} 2)$$

Where, ∑ = Summation symbol, pi = 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:

$$D_{Mg} = \frac{S-1}{lnN}$$

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:

$$d = \frac{N_{max}}{\mathrm{N}_i}$$

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.

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

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.

Monitoring Frequency:

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar. Sample Collected from this location during the monitoring period 15th April 2023 to 15th April 2024.

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

Sr. No.	Parameters	Kandla						Vadinar	
		ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
		Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
1.	Biomass	115.3	115.64	95.73	141.73	101.6	120.45	78	110.64
2.	Net Primary Productivity	2.91	3.77	3.08	2.99	5.47	2.49	4.16	2.64
3.	Gross Primary Productivity	2.95	3.04	3.73	3.26	2.44	2.85	3.67	3.09
4.	Pheophytin	1.10	1.28	0.80	1.35	0.82	5.81	2.66	2.43
5.	Chlorophyll-a	2.40	1.61	1.72	1.72	2.04	12.43	2.37	3.24
6.	Particulate Oxidisable Organic Carbon	1.34	1.12	1.18	1.51	1.45	1.40	1.26	1.20
7.	Secchi Depth	0.61	0.63	0.56	0.60	0.56	0.62	3.93	2.61

- **Biomass:**

  With reference to the **Table 39**, the concentration of average **Biomass** reported during monitoring period, from location ME- to ME-6 in range between **95.73-141.73 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 **78** mg/L at ME-7 (Near SPM) and **110.64** 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. During the Monitoring Period, the monitoring location of Kandla reported

GPP value in range between **2.44 to 3.73 mg/L/48 Hr** where the highest value recorded for ME-3 (Near Coal Bearth) and lowest recorded at ME-5 (Nakti creek-near tuna port). In Vadinar, the value of **GPP** was observed **3.67** at ME-7 (Near SPM) and **3.09** mg/L/48 Hr at 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. During the monitoring period of 2023 to 2024 the Net primary productivity of the monitoring location at Kandla from (ME-1 to ME-6) has been estimated to be between **2.49 to 5.47 mg/L/48 Hr**. While in Vadinar, the value of **NPP** was observed **4.16** at ME-7 (Near SPM) and **2.64** mg/L/48 Hr at ME-8 (Near Vadinar Jetty) monitoring station.

- **Pheophytin**

  The level of Pheophytin was detected in the range from **0.8 to 5.81 mg/m^3** where the highest value observed at ME-6 (Nakti Creek (Near NH-8A)) and the lowest value observed at ME-3(Near Coral Breth), While in Vadinar, the value of Pheophytin was observed **2.66** mg/m^3 at ME-7 and **2.43** mg/m^3 at ME-8 monitoring station.

- **Chlorophyll-a**

  In the sub surface water, the value of Chlorophyll-a reported in range from **1.61 to 12.43 mg/m^3**. The highest value observed at ME-6 (Nakti Creek (Near NH-8A)), while the lowest value observed at ME-2 (Kandla Creek). In Vadinar, the value of chlorophyll-a was observed **2.37** mg/m^3 at ME-7 (Near SPM) and **3.24** mg/m^3 in ME-8 (Near Vadinar Jetty) monitoring station.

- **Particulate Oxidisable Organic Carbon**

  During the sampling period, the particulate oxidisable organic carbon falls within the range of **1.12 to 1.51 mg/L** from monitoring location ME-1 to ME-6 at Kandla, whereas for Vadinar, the value of POC observed **1.26** mg/L at ME-7 (Near SPM) and **1.20** mg/L in ME-8 (Near Vadinar Jetty) monitoring station.

- **Secchi Depth**

  In monitoring station of Kandla (ME-1 to ME-6) the level of Secchi Depth was observed between **0.56 to 0.63 ft** whereas at Vadinar, the value recorded at ME-7 i.e. Near SPM is **3.93** ft and in Near Vadinar Jetty is **2.61** 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.es. 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 38: Phytoplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Bacillaria sp.	360.55	391.28	387.28	404.75	374.33	521.333	390.12	347.6
Biddulphia sp.	492.66	340	184	542	315.25	434.5	402.8	274
Chaetoceros sp.	279.66	379.28	442.8	258.85	627.6	322.25	462.85	394.7
Chlamydomonas sp.	286.57	312.33	294	329.33	478	456	325.25	503
Cyclotella sp.	367.14	443.5	473.33	418.57	454	609	303.5	378.57
Coscinodiscus sp.	455.4	412.83	464.2	206	330.42	376.6	370.4	244
Ditylum sp	342.14	322.16	186.83	241.75	225	205.83	227.6	294.8
Fragilaria sp.	395	381.57	384.14	300.5	355	0	350.25	360.33
Bacteriastrum sp.	178.5	96	260.5	166.6	111.66	252.75	162	252.75
Pleurosigma sp.	236.66	236	233	565	276	675	352.5	219
Navicula sp.	366.28	488.5	525	393.16	420	332.71	375.25	856.87
Nitzschia sp.	309.12	272.57	349	295.5	366.57	284.77	418.71	435.75
Synedra sp.	479	328	218.66	322.83	144.5	541	192.75	327.42
Skeletonema sp.	270.66	566.66	433.33	0	488.66	536.66	521.25	495.66
Oscillatoria sp.	341	351.66	281.8	251	493.8	423.5	144	306.2
Thallassiosira	147	134.83	116	132.5	170	224.66	235.33	161.33
Gomphonema sp.	550	495.75	426.66	360	600	310	564.66	500
Planktothrix sp.	140.5	302	308.75	750	0	685	400	667.5
Gyrosigma sp.	410	560	650	0	0	500	0	0
Actinestrum sp.	0	0	0	550	0	685	700	500
Cymbella	500	500	0	650	0	800	750	0
Limnothrix sp.	0	700	0	485	0	630	0	0
Scendesmus sp.	0	0	0	8	0	20	0	4
Mougeotia sp.	0	0	0	0	0	850	0	0
Chlorella sp.	0	0	0	2918.1	3073.1	3704.3	3357.1	3576.8
Density-Units/L	3107.1	3525	3177.3	8.7	8.2	8.9	9.5	8.9
No. of genera	9.2	9.9	8.9	750	0	685	400	667.5

The phytoplankton community of the sub surface water in the Kandla and Vadinar was represented by, Diatoms, green algae and filamentous Cynobacteria. Diatoms were

represented by 15 genera; green algae were represented by 1 genera and filamentous Cynobacteria were represented by 1 genera during the sampling period.

The density of phytoplankton of the sampling stations from ME-1 to ME-6 (Kandla) varying from **2918** to **3704.3** units/L, while for Vadinar its density of phytoplankton observed **3357.1** units/L at ME-7 and **3576.6** units/L at ME-8. During the sampling, all communities were contributing in phytoplankton on both location of Kandla & Vadinar except Gyrosigma sp, Actinestrum sp, cymbella, Limnothrix sp, Scendesmus sp, Mougeotia sp and cholera sp.

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

Table 39: Species richness Index and Diversity Index in Phytoplankton

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	10.73	10.27	11.36	10.45	12.55	10.64	10.00	11.09
Individuals	5234.36	5688.36	6072.09	5832.45	6546.91	5605.09	5615.09	6223.27
Shannon diversity	2.05	1.89	1.93	1.86	1.78	1.85	1.96	1.58
Simpson 1-D	0.86	0.87	0.85	0.83	0.84	0.84	0.86	0.81
Species Evenness	0.94	0.84	0.92	0.88	0.86	0.86	0.90	0.73
Margalef richness	1.05	1.10	0.98	0.98	0.93	0.97	1.05	0.98
Berger-Parker	0.20	0.20	0.23	0.24	0.24	0.24	0.23	0.29
Relative abundance	0.41	0.44	0.37	0.43	0.38	0.40	0.40	0.41

- **Shannon- Wiener's Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wierner's index of phytoplankton communities was in the range of **1.78 to 2.5** between selected sampling stations from ME-1 to ME-6. While for Vadinar, Average Shannon Wiener's index of phytoplankton communities recorded to be **1.96** at ME-7 and **1.58** at ME-8. 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):** During the monitoring period **2023 to 2024,** average Simpson diversity index (1-D) of phytoplankton communities was ranged between **0.83 to 0.87** at all sampling stations in the Kandla creek and nearby creeks. Similarly, for Vadinar average Simpson diversity index (1-D) of phytoplankton communities was **0.86** at ME-7 and **0.81** at ME-8.
- **Margalef's diversity index** (Species Richness): During the monitoring period **2023 to 2024,** average margalef's diversity index of phytoplankton communities in Kandla and nearby creeks sampling stations was varying from **0.93 to 1.10.** While for Vadinar, average Margalef's diversity index (Species Richness) of phytoplankton communities observed **1.05** at ME-7 and **0.98** at ME-8.

- **Berger-Parker Index (d):** During the monitoring period **2023 to 2024,** average Berger-Parker Index (d) of phytoplankton communities was in the range of **0.93 to 1.10** between selected sampling stations from ME-1 to ME-6. at Kandla creek and nearby creeks.

Average Berger-Parker Index (d) of phytoplankton communities in the sampling stations of Vadinar, was in the range of **0.98** to **1.05.** All the monitoring station signifies a low diversity with an even distribution among the different species.

- The Average **Species Evenness** is observed in the range of **0.84 to 0.94** for all the six-monitoring station of Kandla and for the Vadinar the average species evenness is observed in the range of **0.73** to **0.90**.

- During the sampling period, average **Relative Abundance** of phytoplankton communities was in range of **0.37 to 0.44** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative Abundance value **0.40** at ME-7 and **0.41** at ME-8. 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 40: Zooplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Acartia sp.	1.78	1.67	1.38	2.00	2.22	1.29	2.71	1.44
Acrocalanus	1.50	1.86	2.40	2.29	2.00	1.86	2.00	3.29
Amoeba	3.00	1.57	3.22	3.33	3.44	1.57	2.88	2.14
Brachionus sp.	2.67	2.25	2.00	1.88	2.40	3.11	3.50	1.67
Calanus sp.	2.14	2.60	2.75	1.83	2.33	2.43	1.86	3.00
Cladocera sp.	2.25	2.38	4.67	2.14	2.63	1.44	2.38	2.38
Cyclopoid sp.	4.50	3.88	4.13	4.13	2.50	2.10	3.33	2.00
Copepod larvae	1.67	3.00	2.33	2.75	2.00	3.75	1.67	2.25
Diaptomus sp.	4.88	1.83	4.17	2.25	3.50	1.67	3.00	2.86
Eucalanus sp.	3.33	1.83	2.25	3.67	2.80	5.40	2.88	3.71
Mysis sp.	3.20	9.00	7.50	4.86	1.20	6.00	5.13	8.00
Oithona sp.	1	2	4	2	1	3.5	3.33	9
Paracalanus sp.	7.71	6.67	4.00	7.88	11.50	7.90	8.56	9.75
Density Unit/L	24.45	24.91	25.82	26.00	22.91	26.45	27.64	27.36
No. of genera	7.73	7.64	7.64	7.91	7.09	8.36	7.82	7.73

A total of 13 groups/taxa of zooplankton were recorded in Kandla and Vadinar during the study period which mainly constituted by *diaptomus*, *copepods*, *brachionus*, *cladocera*, fish and shrimp larval forms. *Amoeba* and *Cyclopoida* had the largest representation at all stations from (ME-1 to ME-8). The average density of Zooplankton of the sampling stations from ME-1 to ME-6 (Kandla) varying from **22.91** to **26.45** units/L, while for Vadinar its average density of zooplankton observed **27.64** units/L at ME-7 and **27.36** units/L at ME-8. During

the sampling, all communities were contributing in zooplankton except Oithana sp. in Kandla and Vadinar.

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

Table 41: Species richness Index and Diversity Index in Zooplankton

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	7.73	7.64	7.64	7.91	7.09	8.36	7.82	7.73
Individuals	24.45	24.91	25.82	26.00	22.91	26.45	27.64	27.36
Shannon diversity	1.75	1.70	1.80	1.74	1.62	1.66	1.71	1.69
Simpson (1-D)	0.83	0.84	0.83	0.83	0.82	0.82	0.84	0.81
Species Evenness	0.87	0.85	0.90	0.86	0.85	0.79	0.85	0.84
Margalef	2.14	2.19	2.07	2.21	2.06	2.34	2.20	2.17
Berger-Parker	0.34	0.32	0.32	0.34	0.35	0.37	0.31	0.35
Relative abundance	34.93	40.08	31.95	37.76	39.98	38.18	39.18	37.27

- **Shannon- Wiener's Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wierner's index of zooplankton communities was in the range of **1.62 to 1.80** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener's index of zooplankton communities recorded to be **1.71** at ME-7 and **1.69** at ME-8. 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):** During the monitoring period **2023 to 2024,** average Simpson diversity index (1-D) of zooplankton communities was ranged between **0.82 to 0.84** at all sampling stations in the Kandla creek and nearby creeks, for Vadinar average Simpson diversity index (1-D) of zooplankton communities was **0.84** at ME-7 and **0.81** at ME-8.
- **Margalef's diversity index** (Species Richness): During the monitoring period **2023 to 2024,** average margalef's diversity index of zooplankton communities in Kandla and nearby creeks sampling stations was varying from **2.06 to 2.34,** during the sampling period. While for Vadinar, average Margalef's diversity index (Species Richness) of zooplankton communities observed **2.2** at ME-7 and **2.17** at ME-8.

- **Berger-Parker Index (d):** During the monitoring period **2023 to 2024,** average Berger-Parker Index (d) of zooplankton communities was in the range of **0.32 to 0.37** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. Average Berger-Parker Index (d) of zooplankton communities in the sampling stations of Vadinar, was in the range of **0.31** to **0.35.** All the monitoring station signifies a low diversity with an even distribution among the different species.

- The average **Species Evenness** is observed in the range of **0.79 to 0.90** for all the six-monitoring station of Kandla whereas, for the Vadinar the average species evenness was observed in the range of **0.85** to **0.84**, during the monitoring period.

- During the sampling period, **average Relative Abundance** of zooplankton communities was in range of **31.95** to **40.08** between selected sampling stations from ME-1 to ME-6. at Kandla creek and nearby creeks. Whereas for Vadinar the average relative abundance value **39.18** at ME-7 and **37.27** at ME-8, 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 42: Benthic Fauna variations in abundance and diversity in sub surface sampling

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Thiaridae	2.20	1.40	2.00	2.00	1.5	2.17	1.25	2.67
Mollusca sp.	2.22	1.33	2.00	1.67	2.5	1.75	2.00	2.50
Odonata sp.	2.50	1.00	1.86	2.33	1.4	2.43	2.20	2.60
Lymnidae	1.67	2.67	5.00	1.75	1.6	1.67	2.40	1.33
Planorbidae	1.00	1.33	1.67	1.00	2.0	2.00	1.50	1.00
Atydae	1.50	2.00	1.50	1.67	1.0	1.60	1.67	1.71
Gammaridae	1.50	2.17	1.25	1.50	1.3	1.50	1.83	2.83
Portunidae	1.00	1.00	1.00	1.00	0	1.00	1.00	1.00
Turbinidae	1.67	1.00	2.33	1.00	1.0	1.33	1.50	1.33
Palaemonidae	1.25	1.00	2.20	2.50	2.4	1.00	1.33	1.67
Diapatra sp.	1.67	2.00	2.50	3.67	2.0	3.50	1.33	2.33
Coleoptera sp.	2.00	1.50	3.00	2.50	0	1.00	2.67	2.00
Crustacea sp.	3.00	1.00	2.33	3.00	2.5	2.50	1.50	1.00
Hemiptera sp.	2.33	3.33	0	2.00	1.7	1.50	2.50	1.50
Tricoptera sp.	1.33	4.00	2.33	4.00	2.5	4.50	1.50	1.00
Hydrobidae	1.00	2.50	1.00	2.00	1.0	2.50	0	2.50
Viviparidae	3.00	1.00	0	1.00	2.0	1.50	3.00	3.00
Neridae	1.50	1.00	1.50	0	4.0	2.00	1.00	2.00
Density-m^3	10.18	8.82	9.64	10.09	8.5	9.73	9.73	9.55
No of genera	5.45	4.82	4.82	5.00	4.8	4.91	4.91	4.73

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 *Atyde, Palaemonidae, Mollusca sp.*, etc. The average density of benthic fauna was varying from **8.55** to **10.18** m^3.

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

Table 43: Species richness Index and Diversity Index in Benthic Organisms

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek- near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg.	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	5.36	4.82	4.82	5.00	4.82	4.91	4.82	4.73
Individuals	10.18	8.82	9.64	10.09	8.55	9.73	8.91	9.55
Shannon diversity	1.48	1.35	1.38	1.40	1.35	1.39	1.29	1.35
Simpson 1-D	0.86	0.84	0.86	0.86	0.86	0.86	0.87	0.83
Species Evenness	0.88	0.87	0.88	0.89	0.87	0.89	0.82	0.88
Margalef	1.92	1.78	1.73	1.81	1.83	1.78	1.79	1.68
Berger-Parker	0.33	0.37	0.33	0.34	0.37	0.34	0.37	0.36
Relative abundance	55.92	57.66	53.67	56.55	60.63	56.18	57.46	51.58

- **Shannon- Wiener's Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wierner's index of benthic organism was in the range of **1.35 to 1.48** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener's index of benthic organism recorded to be **1.29** at ME-7 and **1.35** at ME-8. 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):** During the monitoring period **2023 to 2024,** average Simpson diversity index (1-D) of benthic organism was ranged between **0.84 to 0.86** at all sampling stations in the Kandla creek and nearby creeks, Similarly, for Vadinar average Simpson diversity index (1-D) of benthic organism was **0.87** at ME-7 and **0.83** at ME-8.

- **Margalef's diversity index** (Species Richness): During the monitoring period **2023 to 2024,** average margalef's diversity index of benthic organism in Kandla and nearby creeks sampling stations was varying from **1.73 to 1.92**. While for Vadinar, average Margalef's diversity index (Species Richness) of benthic organism observed to be **1.79** at ME-7 and **1.68** at ME-8.

- **Berger-Parker Index (d):** During the monitoring period **2023 to 2024,** average Berger-Parker Index (d) of benthic organism was in the range of **0.33 to 0.37** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. average Berger-Parker Index (d) of benthic organism in the sampling stations of Vadinar, was in the range of **0.36** to **0.37**. All the monitoring station signifies a low diversity with an even distribution among the different species.

- The average **Species Evenness** is observed in the range of **0.87 to 0.89** for all the six-monitoring station of Kandla and for the Vadinar the species evenness is observed in the range of **0.82** to **0.88.**

- During the sampling period, **average Relative Abundance** of Benthic organisms was in range of **53.67 to 60.63** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative abundance value **57.46** at ME-7 and **51.58** at ME-8, thus it is concluded that the studied species can be stated as neither highly dominant nor rare.

CHAPTER 13: SUMMARY AND CONCLUSION

13.1 Summary and Conclusion

The report, prepared by the Gujarat Environment Management Institute (GEMI), details the environmental monitoring and management plan for the Deendayal Port Authority (DPA) at Kandla and Vadinar. The monitoring covers the period from April 2023 to April 2024.

The primary objective is to systematically assess and monitor environmental parameters including ambient air, water (drinking and surface), soil, sediment, noise, and ecology to ensure compliance with environmental standards and statutory norms.

Methodology

Environmental monitoring was conducted using standard operating procedures, protocols, and guidelines to ensure accurate data collection. Various parameters were measured, including air quality, water quality, soil characteristics, noise levels, and meteorological data.

Based on the results obtained for both study areas, Kandla and Vadinar, during the monitoring period from April 2023 to April 2024, the following observations are concluded.

- **Ambient Air Quality Monitoring**
  Particulate matter (PM_{10} and $PM_{2.5}$) levels exceeded the national ambient air quality standards (NAAQS) at most monitoring locations, especially at the coal storage area. The high particulate matter levels were attributed to heavy vehicular traffic, loading/unloading of cargo, and dust from unpaved roads. For Gaseous monitoring, sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) were generally within the NAAQS limits.

- **DG Stack Monitoring**
  Monitoring of the diesel generator (DG) stacks was conducted at one location each in Kandla and Vadinar. Parameters like suspended particulate matter, SO_2, NO_x, CO, and CO_2 were measured and found to be within the prescribed emission limits.

- **Drinking Water Quality Monitoring**
  Drinking water samples were collected from 20 locations across Kandla and Vadinar. Most water quality parameters like pH, color, turbidity, chloride, and total hardness were within the drinking water standards (IS 10500:2012). A few locations showed slightly elevated levels of electrical conductivity, salinity, and total dissolved solids, likely due to the coastal location.

- **Marine Water and Sediment Quality Monitoring**
  Marine water and sediment samples were collected from 6 locations in Kandla and 2 locations in Vadinar. The water quality parameters like pH, salinity, dissolved oxygen, and nutrients were within the acceptable limits for coastal waters. The sediment quality in terms of heavy metals and organic contaminants was also found to be within the prescribed standards.

- **Marine Ecology Monitoring**
  Monitoring of marine Ecology was conducted at 6 locations in Kandla and 2 locations in Vadinar. The study did not find any significant adverse impacts on the marine ecosystem due to port operations.

Overall, the report concludes that the environmental monitoring conducted by the DPA during the period of April 2023 to April 2024 indicates compliance with the applicable environmental regulations, with some exceptions related to particulate matter levels in the ambient air.

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

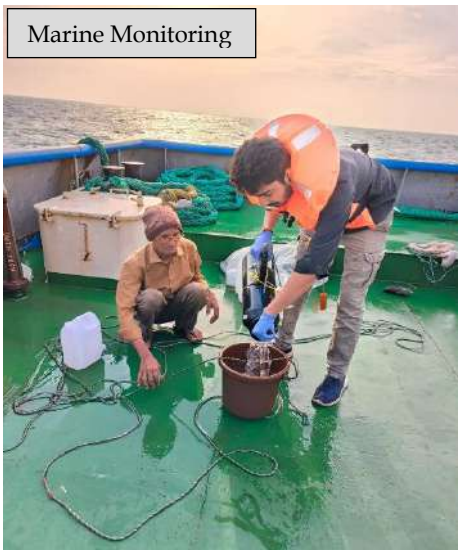
Air Monitoring

Noise Monitoring

STP Monitoring

Drinking water Monitoring

Marine Monitoring



Soil Monitoring

Source: GEMI

CHAPTER 14: REFERENCES

References:

(1) National ambient air quality standards central pollution control board, 2009

(2) Ambient Air Quality Standards in respect of Noise,2000.

(3) American Public Health Association 23rd Addition, Standard Methods for Water and Waste water analysis, 2017.s

(4) Indian Standard DRINKING WATER — SPECIFICATION (Second Revision), 2012.

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Annexure H

Mangrove plantation statement

DEENDAYAL PORT TRUST

DETAILS OF MANGROVE PLANTATION ALREDY CARRIED OUT & Proposed To be Carried Out:

Sr. No.	Name of the Organization	Total Mangrove Plantation carried out in Hectares till date and place of plantation and agency	Cost incurred
	(A)MANGROVE PLANTATION ALREDY CARRIED OUT		
1	DEENDAYAL PORT TRUST (CRZ Recommendation 13th to 16th CB issued by the GCZMA) (Total 1000 ha.)	20 Hectares – 2005-06 Satsida Bet,Kandla, by GUIDE,Bhuj 50 Hectares – 2008-09 Nakti Creek,Kandla by Patel Construction 100 Hectares – 2010-11 Nakti Creek ,Kandla by GEC. (Board 29/1/2010) 200 Hectares – 2011-12 by Forest Department, GoG at Satsaida Bet	Rs. 8.8 lakhs Rs. 27.4 lakhs Rs.24.5 lakhs Rs. 66.5 lakh Rs. 157.5 lakhs (total 630 hectares)
2	Creation of Berthing & allied Facilities off- tekra near Tuna (Outside Kandla Creek) – EC & CRZ Clearance. (Total 500 ha. – 250Ha. by DPT & 250 ha by Adani (concessionaire) MOU signed with GEC during Vibrant Gujarat	300 Hectares – 2015-17 by GEC at Kantiyajal, Bharuch District	Rs. 90.0 lakhs
3.	EC & CRZ Clearance dated 19/12/2016 for Developing 7 integrated facilities (Condition 100 Ha)	100 Ha. –2018- 20 by GEC	Rs. 45 lakhs
4.	EC and CRZ Clearance dated 18/02/2020 (Dev of 3 remaining facility) and EC and CRZ Clearance dated 19/02/2020(Development of Integrated facilities 5 projects (Stage II) Ref : CRZ recommendation GCZMA 100 ha (50+50 Ha)	100 ha by GEC 2021-22 (Kantiyajal, Bharuch)	Rs 45 Lakhs
TOTAL MANGROVE Plantation till date by DPT 1500 Ha.		**– Total 464.7 lakhs**	

	(A) Proposed Mangrove Plantation		
1.	**CRZ recommendation outfitting jetty & floating dry Dock at Vadinar by DPA**	**100 Ha by GEC (work in progress)work order dated 02/06/2022**	**Rs 50 Lakhs**

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Annexure I

Mangrove Conservation report

Study on present status, Conservation and Management Plan for mangroves of Kandla Port Region

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Bhuj – Kachchh, Gujarat

R.V. Asari, IFS (Rtd.,)
Director

Gujarat Institute of Desert Ecology

17.08.2015

Certificate

Kandla Port Trust has extensive mangrove formations within its port limits. In order to study different ecological characters of these mangroves and to draw a scientific conservation and management plan, Kandla Port Trust approached Gujarat Institute of Desert Ecology, Bhuj for undertaking an environmental assessment of the mangrove formations with regard to its ecological status, which included baseline documentation, forest structure and a detailed conservation and management plan. Thus, GUIDE undertook this study and carried out field surveys, and sampling in representative mangrove stands in order to prepare this report.

This report presents various ecological status of mangrove formations within Kandla Port area and suggest a detailed conservation and management plan to be considered by the port authorities for execution. This project report forms a baseline document indicating the baseline status and conservation plan for the mangroves which could be used to ensure long term conservation and management of Kandla Port mangroves.

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Dr. Rachna Chandra

Research Scholars

Mr. Dayesh Parmer

Mr. NithulLal

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1. INTRODUCTION:

Kandla Port is located in the Gulf of Kachchh on the northwest coast of India about 430 nautical miles northwest of the Port of Mumbai (Bombay) at the Latitude of 23° 01' N and Longitude of 70° 13' E on the shoreline of the Kandla Creek. The Kandla creek runs into the Gulf of Kachchh, approximately at a distance of 90 nautical miles from the Arabian Sea. The width of the channel varied between 200 meters to 1,000 meters. It is a leading port of India by capacity of cargo handled. Kandla Port as one of India's busiest major port, is gearing to add substantial cargo handling capacity with private sector participation. It handled 72.225 million tonnes of cargo in 2008-09, over 11% more than 64.9 million tonnes handled in 2007-08.At present, Kandla Port handled 87.005 MMTPA Cargo during 2013-2014 and 92.5 MMTPA during the financial year of 2014-2015. Against this capacity, a total of 87.005 MMTPA was handled at Kandla Port resulting in berth occupancy exceeding 80% at general cargo berths in 2013-14. Consecutively, to reduce the pressure on the existing berths and increase the capacity of dry and liquid cargo handling, Kandla Port Trust has developed new Barge Jetty at Tuna, Khori Creek and a new Oil Jetty at old Kandla. Other project for strengthening and upgrading existing facilities at Kandla Port is on the anvil.

Mangroves are a conspicuous ecological entity within Kandla Port area. Similar to other forest ecosystem they discharge multiple ecological services such as production of woody trees; provision of habitat, food, and nursery/spawning grounds for fin-fish and shellfish; provision of habitat for birds and other valuable fauna; protection of coastlines and accretion of sediment to form new land. There are also many economic benefits from mangrove resources; like as a source of firewood, self-replenishing area of fishery resources, for collecting honey and for tourism.

1.1 Origin of the Study:

Due to the major port activities and accompanying development, mangroves within the premises of KPT have possible for its vegetation structure modification over the years. Consequently, conservation and management of this mangrove formation has become imperative and an environmental responsibility of the Kandla

port authority. In view of the continued port expansion and development, Department of Forest and Environment, Government of Gujarat (GOG), Gandhinagar has mandated KPT to investigate the current ecological status of mangroves in the KPT premises through proper scientific assessment and formulate long term conservation and management plan. Kandla Port authorities assigned the task of investigating the mangrove ecology within the port jurisdiction to Gujarat Institute of Desert Ecology (GUIDE), Bhuj. The present study aims to come out with a sound conservation and management plan for mangroves of Kandla Port based on intensive field visits, analyzing the existing management practices of the port *vis-à-vis* mangroves and plantation and other conservation activities carried out by port authorities under different projects of the port.

1.2 Objective of the Present Study:

Suggesting management different management options with a view to conserve mangrove ecosystem within Kandla Port premises on a long term basis is the major objective of the present study. The present investigation is instituted with the following objectives.

1. This study aims to investigate thoroughly the present status of mangroves in terms of vegetation structure such as density, diversity, height, canopy dimensions and younger classes along with governing physical and chemical features of mangroves formations falling within the legal boundary of Kandla Port at Kandla, Gandhidham taluka of Kachchh.

2. Suggest a detailed plan for a holistic and long term management and conservation in order to ensure the long term wellbeing of mangroves of Kandla Port.

3. Review the mangrove plantation carried out so far by the port authorities, future mangrove plantation/rehabilitation plan, monitoring actions to be initiated in order to conserve/preserve the mangrove stands which will ward-off stand degradation in future.

4. Quantify the mangrove extent in terms of dense, sparse and other allied land cover such as mudflats, salt works, water etc by the application of GIS and RS technique.

2. STUDY AREA DESCRIPTION:

2.1 Location:

Kandla port is located in the northern coast of gulf of Kachchh (GoK) almost at its tail end (Map 2.1). Being in the arid zone, annual rainfall within the geographical range of Kandla Port is poor ranging from 250-350 mm which is often irregular. Mean rainfall (1932 to 2001) was 387 and 378 mm in the Gandhidham taluka where Kandla is located. Rain during monsoon is confined to only 15-20 days and occurs as an instant downpour. The weak monsoonal rainfall and high rate of evaporation not only make the area arid but also causes elevation in seawater salinity. Freshwater input into the near coastal waters is quite meagre and appears to have least influence on the ambient coastal water quality except during monsoon months, during which flash floods are discharged in the near coastal waters. Throughout the year, the winds are light to moderate in the Gulf except during late summer and southwest monsoon periods. Stronger winds are also encountered with the disturbances such as depressions and cyclones. Winter and summer temperatures range from 7- 48^{o}C with a yearly average humidity of 60% which increases to 80% during south-west monsoon and decreases to 50% during November-December. Average wind speed is 4.65 m/s with a maximum wind speed of 10.61 m/s during June. Tides in the port environment are mixed, predominantly semidiurnal type with Mean High Water Spring (MHWS) of 6.66 m and Mean High Water Neap (MHWN) of 5.17 m. Mangroves within the port limits are predominantly composed of *Avicennia marina,* a species known for its high tolerance of water salinity and other environmental stresses with sporadic distribution of *Ceriops tagal*.

Kandla is a seaport in Kachchh district of Gujarat state in western India which runs into the Gulf of Kachchh at a point about 90 nautical miles from the Arabian Sea. One the major ports on west coast, Kandla was constructed in the 1950 as the chief seaport serving western India. The total length of the Kandla Port approach channel is

about 23 Km High tidal influences with low turnover time characterize Kandla creek. Kandla creek (22^0 55'- 23^0 5' N and 70^0 05'- 70^0 02' E) is one of the major creeks along the NW coast of India supplying water to the inner GoK which is an east- west oriented indentation. GoK is 75km wide at the mouth and after running about 170km away from the Arabian sea towards east, narrows down into a constriction at 70^0 20' E at Sathsaida Bet and then bifurcates into a creek system called the Little Rann.The Little Rann has a network of so many small and large creeks, intermingled with marshy tidal flats rich in fine clays. Kandla creek is one of the major tributaries of this creek system, which empties into the inner GoK. Two large creeks , Sara and Phang creeks join the Kandla creek and act as its tributaries. Nakti creek also joins the confluence of Sara and Phang creeks. All these creeks bring water from the Little Rann into Kandla creek, which has a fairly good depth and stable banks. The width of the creek channel varies from 200 m in the upstream to 1000m at the mouth and the depth varies from 8 to 12 m, while the tidal height ranges from 0.83 to 7.2m, with tidal currents varying from 0.08 to 2 m/s (Sinha *et al*. 2006)

Kandla port is located along the western bank of Kandla creek. The protruding Indus River brings heavy sediment load into the creek lowering its primary productivity. Sampling site at Kandla is located around 100 m away from the oil jetty of the port. Ongoing expansive drive of the port and establishment of many SEZs in and around the nearby Gandhidham Township has provided renewed impetus for this coastal town to proliferate further. Various industrial- chemical manufacturing units, fertilizer- manufacturing industry (IFFCO), salt manufacturing units with salt pans rich in brines occur around the Kandla creek. There are a total of six jetties in the creek used by the KPT, Indian Oil and IFFCO for handling liquid bulks, POL, fertilizers, raw materials, industrial chemicals, iron and steel, food grains, metal and its products, mineral ore and other dry cargo, etc. The port facilitates extensive traffic of oil tankers, freighters, passenger cargo vessels, ore carriers, fishing boats and container vessels in Kandla creek.Presence of a major port with heavy vessel traffic activities are temporarly distrub the creak water quality. These activities generate different types of waste , which act as potential sources of contamination. Irrespective

of their source of contribution, these contaminants from natural as well as human activities are ultimately distrub the creek water quality.

Figure 2.1: Shows the location map of the study area

2.2 Study Period:

The present field study for KPT mangrove monitoring was carried out in January 2015to April 2015.

3. VEGETATION STRUCTURE OF MANGROVES:

Mangroves are the most important salt tolerant trees of the intertidal areas (Kathiresan and Bingham, 2001). It is one of the most productive and bio-diverse wetlands on earth. Inhabiting the inter-tidal areas and estuary mouths between land and sea, mangroves provide critical habitat for a diverse marine and terrestrial flora and fauna. They normally grow poorly in stagnant waters and have luxuriant growth in the alluvial soil substrates with fine textured loose mud or silt. The diversity variability features of mangroves that occur within the inundated areas such as creeks, mudflats, salt-flats, or partially forested areas with dwarfed or sparsely distributed trees.

Vegetation structure is determined by the species diversity, relative densities of constituent species, overall density of the stand, basal area that represents the size of the plant girth and height. The vegetation structure of mangroves provides an indication of its functional capacity which has a bearing on fisheries, forestry and global climate due to its high carbon sequestration potential (Ong et al., 1993).

3.1 Methodology:

The vegetation structure of the present investigation was carried out at diverse representative sites of mangrove formations within the legal boundary of Kandla Port. Generally, KPT mangrove formations can be classified dense and sparse mangroves. Vegetation structure assessment was carried out during low tides by quadrate method by laying plots of 10 × 10m (Figure 3.1). For assessing the mangrove formations along the creeks systems, a fishing boat was used. In total, twenty one random sampling was carried out in the mangrove formations of the port premises representing different landscapes like dense mangroves and sparse mangroves in order to render the sampling truly representative. In each plot, the total numbers of mature trees along with the corresponding height (Figure 3.2), canopy dimension and tree girth-GBH (Figure 3.3) were recorded. At few places, Point Centre Quarter method was also used for the density assessment (Cottam et al. 1953).

Figure 3.1: Analysis of density by using 10 x 10 m quadrate

Figure 3.2: Measurement of tree height

Figure 3.3: Measurement of tree girth

To enumerate younger classes such as regeneration and recruitment classes, subplots of 1×1 m and 2×2 m were laid randomly in all the bigger plots of 10 × 10m. Younger plants less than 50 cm are considered as regeneration class and recruitment class represents the well established saplings which are more than 50cm but less than 1m tall. Density of mature trees, regeneration and recruitment class for each station was expressed as number per hectare (No/ha) extrapolating the data obtained for lesser units. Frequency class was analyzed in order to distinguish the location wise distribution, diversity, structure and composition of different age classes like tree height, GBH, canopy length and canopy width.

3.2 Result:

Overall vegetative structural characteristics of mangroves such as density, height, GBH and regeneration class, recruitment class and frequency classes (in order to distinguish the location wise common vegetation structure, composition of different age and growth classes) recorded in the Kandla Port premises are presented in table 3.1 and 3.2, respectively.

3.2.1 Mangrove Diversity:

During the entire study period (January to April 2015) *Avicenna marina* was the most predominant species with the sporadic occurrence of *Cereops tagal* and *Rhizophora mucronata*. In only one study site *Aegiceros corniculatum* was observed out of the study quadrate. Mangrove diversity of KPT region is comparatively higher than any other mangroves patches of Kachchh coast.

3.2.2 Mangrove Density:

The cumulative average mature tree density of 4124/ha was recorded from 21 sampling locations (Table 3.1). The occurrence of highest density of 7800tree/ha was recorded at 23°10'41.6″N; 70°35'35.4″E. as, the site is located near the water front receiving good tidal waters. Least mature tree density of 1500 trees/ha was estimated at 23° 08' 13.2″ N; 70° 18' 19.8″ E. Generally, recorded mature tree density is comparable with other healthy mangrove formations of Gulf of Kachchh (Thivakaran *et al.,* 2003).

3.2.3 Tree Height:

Mangrove stands of Kandla port showed significant variation in tree height. The overall average height of the mangroves at 21 sampled locations was 254 cm with the highest plant height of 391 cm recorded at the location 23° 02’ 24.9 N; 70° 13’ 45.4 E (Table 3.1). The overall height frequency of the mangrove stands from 21 sampling locations, revealed that the majority of the mangrove stands fall in the height class of 51-150 cm (Figure 3.4).

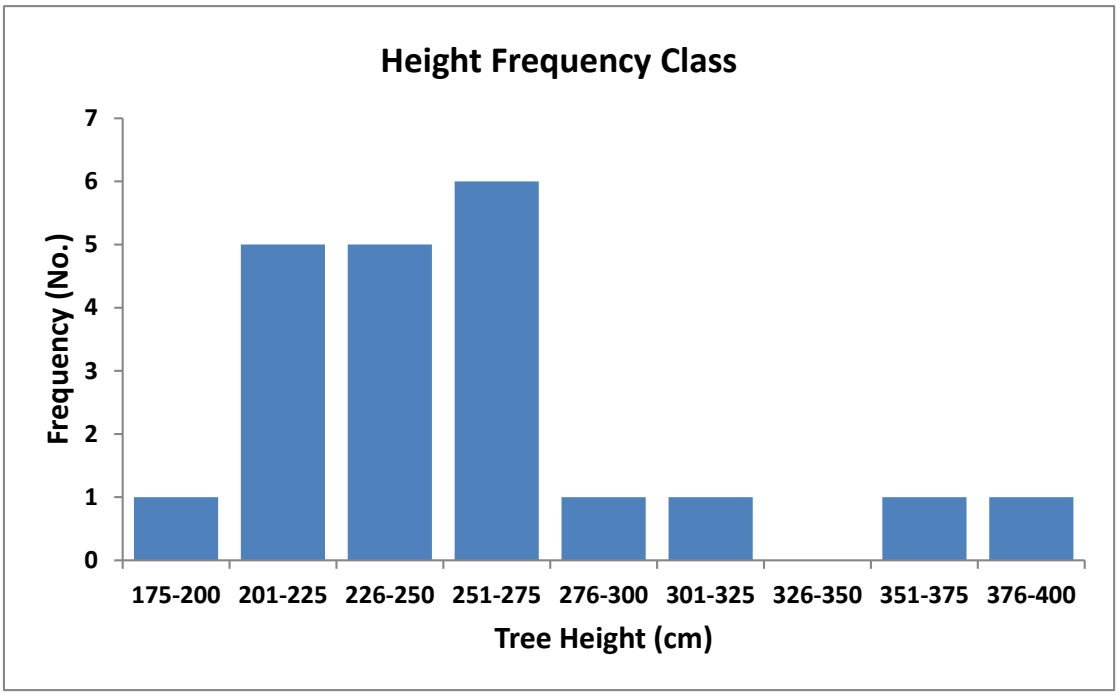

Figure 3.4: Height frequency class of sampled mangrove stands at KPT

3.2.4 Tree Girth (Girth at Breast Height-GBH):

Average tree girth (circumference) of mature trees at 21 sites ranged from 33.5 cm to 53 cm. The overall average girth based on the mean of all the 21 plots was 40.4cm (Table 3.1). During the present study very few transect showed the girth ranges of 34and 39 cm at 23° 03' 41.1″ N; 70°15'27.5″E; 23°02'48.3″N; 70°13'34.0″E, respectively. Majority of the mangrove girth were in the frequency class of 5.1 to 10cm (Figure 3.5).

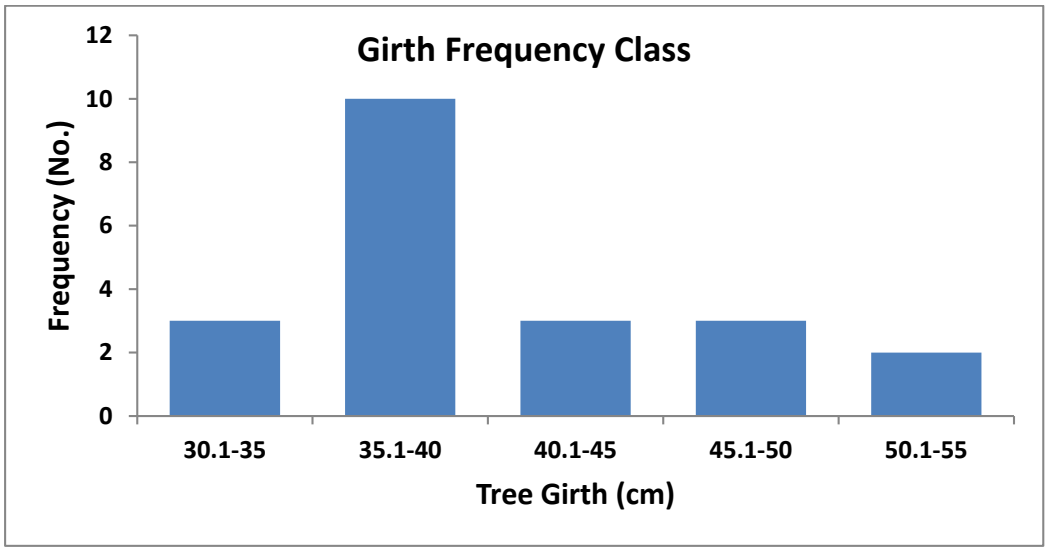

Figure 3.5: GBH freqency class ofsampled mangrove stands at KPT

3.2.5 Canopy Length (cm):

Average canopy length of mangrove was assessed at 21 sampled plots which varied from 159.5 cm to 325 cm. Cumulative average value canopy length based on the mean value of all the plots was 222.9 cm (Table 3.1). The coordinates of KPT at 23° 05'07.1N;70° 16' 25.2 E showed few trees with highest canopy length. The overall canopy length frequency class of all the mangrove formations exhibited that majority of the mangrove stands fall in the ranges of 51-100 cm (Figure 3.6).

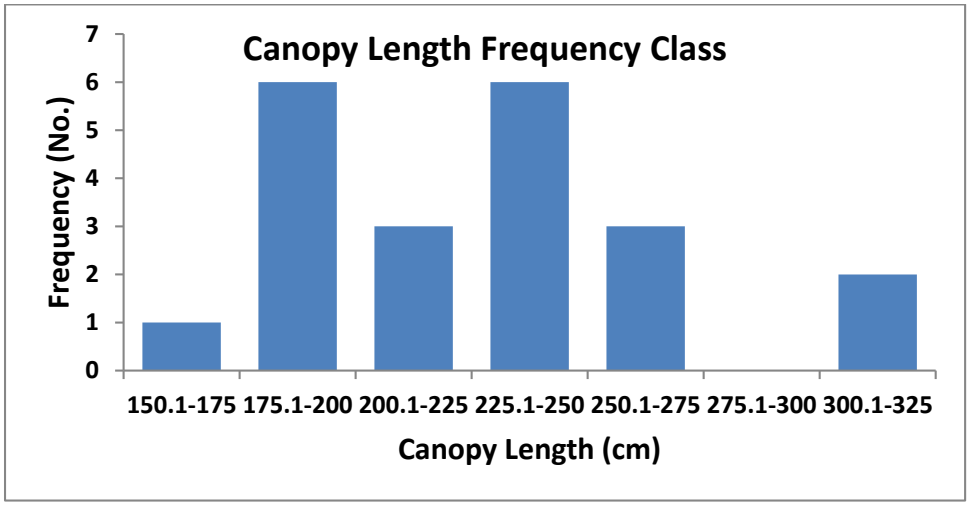

Figure 3.6: Canopy length freqency class of sampled mangrove stands at KPT

3.2.6 Canopy Width (cm):

Average canopy width of the mangrove studied at various plots ranged from 154 cm to 289.5 cm. The overall average canopy width of all the studied sampling plots was 208.4cm (Table 3.1). Mangroves at the coordinates 23° 05’ 10.4 N; 70° 16’ 25.2 E showed highest canopy width. The cumulative canopy width frequency of all the plots fall in the range of 51 to 100 cm (Figure 3.7).

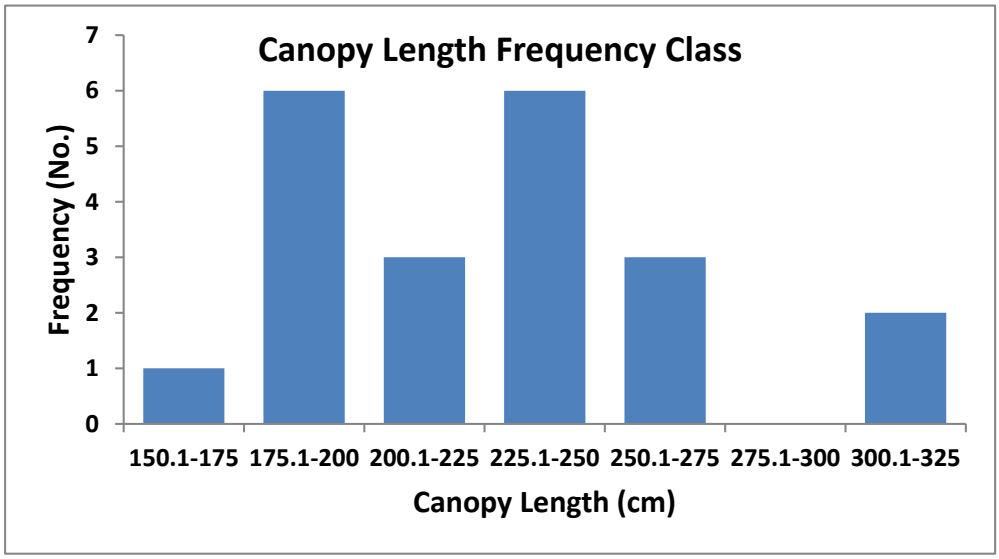

Figure 3.7: Canopy width freqency class of sampled mangrove stands at KPT

Table 3.1: Mangrove vegetation structure and classification carried out during the study

S. NO	GPS Coordinates	Density/ha	Height (cm)			Girth (cm)			Canopy Length (cm)			Canopy Width (cm)		
			Min	Max	Ave.	Min	Max	Ave.	Min	Max	Ave.	Min	Max	Ave.
1	23° 03' 41.1″ N;70° 15' 27.5″ E	3300	193	537	365	40	66	53	168	443	305.5	146	417	281.5
2	23° 02' 48.3″ N ;70° 13' 34.0″ E	2200	167	328	247.5	38	53	45.5	147	327	237	125	319	222
3	23° 02' 24.9″ N; 70° 13' 45.4″ E	3800	208	574	391	41	61	51	193	457	325	168	411	289.5
4	23° 01' 58.8″ N ;70° 15' 27.5″ E	3400	196	326	261	31.8	41.3	36.55	185	345	265	157	328	242.5
5	23° 01' 52.5″ N; 70° 15' 29.1″ E	2400	210	293	251.5	29	44	36.5	132	223	177.5	127	211	169
6	23° 02' 5.9″ N ; 70° 16' 00.7″ E	6800	157	274	215.5	30	47	38.5	98	263	180.5	89	243	166
7	23° 03' 45.3″ N; 70° 13'37.21″ E	3200	197	335	266	40	51	45.5	165	290	227.5	149	273	211
8	23° 06' 55.6″ N ;70° 16' 36.7″ E	7500	157	375	266	29	50	39.5	132	187	159.5	127	181	154
9	23° 06' 55.0″ N; 70° 16'25.5″ E	3500	154	261	207.5	28	53	40.5	130	233	181.5	119	239	179
10	23° 06' 52.5″ N; 70° 16' 25.5″ E	2100	159	335	247	28	49	38.5	138	307	222.5	126	293	209.5
11	23° 08'13.2″ N ;70° 18'19.8″ E	1500	183	302	206	31	44	37.5	156	295	225.5	143	282	212.5
12	23° 08' 20.9″ N; 70° 18' 16.6″ E	2100	165	247	213.5	28	39	33.5	139	218	178.5	127	203	165
13	23° 08' 29.7″ N ;70° 18' 17.8″ E	3500	157	270	192.5	29	40	34.5	134	242	188	122	219	170.5
14	23° 05' 03.5″ N; 70° 16' 18.0″ E	2800	155	230	272	28	40	34	136	215	175.5	124	209	166.5
15	23° 05'07.1″ N ;70° 16'23.8″ E	3400	154	390	280.5	28	48	38	128	375	251.5	111	347	229
16	23° 05' 10.4″ N; 70° 16' 25.2″ E	6800	166	395	243	28.5	65	46.75	132	383	257.5	124	369	246.5
17	23° 10' 35.9″ N ;70° 35' 28.2″ E	5900	159	330	238.5	29	50	39.5	142	327	234.5	131	314	222.5
18	23° 10' 38.6″ N; 70° 35' 31.3″ E	5700	162	324	269.5	30	48	39	145	294	219.5	128	281	204.5
19	23° 10' 30.6″ N; 70° 35' 28.3″ E	6200	163	314	254.5	30	50	40	142	311	226.5	135	303	219
20	23° 10' 36.5″ N ;70° 35' 39.0″ E	2700	165	374	229.5	33	55	44	151	257	204	139	244	191.5
21	23° 10' 41.6″ N; 70° 35' 35.4″ E	7800	160	349	214.5	28	46	37	148	332	240	129	324	226.5
Overall mean		**4124**	**171**	**341**	**254**	**31**	**49.5**	**40.4**	**144.8**	**301.1**	**222.9**	**130.7**	**286.1**	**208.4**

3.2.7 Regeneration Class:

The cumulative average density of regenerating mangroves from 21 sampled locations exhibited 24286 plants/ha (Table 3.2), which ranged from 3300 plants/ha to 100000 plants/ha. The present investigation showed that regeneration potential of mangroves in the KPT premises is good. This regeneration result indicated that the study site is healthy environment for potential mangrove growth and further succession. The co-ordinates are closure to the water front (23° 06' 55.6″ N; 70° 16' 36.7) shows maximum number of regenerating mangroves.

3.2.8. Recruitment Class:

The overall average of recruitment class in the study area was 8888 plants/ha which varied from 1000 to 56600 plants/ha (Table 3.2). The recruitment class of present study was lower than mature tree density at KPT premises due to canopy covering and the resulting low exposure to sunlight. The mature tree density and younger classes (recruitment and regeneration) at Kandla port surroundings show higher regeneration potential of the mangroves. Density Investigation of younger classes like regeneration and recruitment classes are generally indicate that future vegetation structure of the mangrove will be extended. At the coordinate 23° 06' 55.6″ N; 70° 16' 36.7 mature tree to regeneration and recruitment classes ratio is high which indicating the healthiness of the stand and its ability to perpetuate the stand characteristics in future.

In general, majority of the sampled plots shows less floral associates. Only at few plots the floral associates like *Sueda*, *Salicornea* sp. and *Salvadora* sp. are present.

Table 3.2: Regeneration and Recruitment details of the sampling points.

S. No.	GPS	Species	Regeneration/ha	Recruitment Class/ha
1	23° 03' 41.1″ N; 70° 15' 27.5″ E	*A. marina*	17000	9000
2	23° 02' 48.3″ N 70° 13' 34.0″ E	*A. marina*	11000	7500
3	23° 02' 24.9″ N 70° 13' 45.4″ E	*A. marina*	38000	13000
4	23° 01' 58.8″ N 70° 15' 27.5″ E	*A. marina*	13300	5000
5	23° 01' 52.5″ N 70° 15' 29.1″ E	*A. marina*	6600	8350
6	23° 02' 5.9″ N 70° 16' 00.7″ E	*A. marina*	40000	5000
7	23° 03' 45.3″ N 70° 13'37.21″ E	*A. marina*	86600	10000
8	23° 06' 55.6″ N 70° 16' 36.7″ E	*A. marina*	100000	8300
9	23° 06' 55.0″ N ; 70° 16'25.5″ E	*A. marina*	6600	5000
10	23° 06' 52.5″ N ;70° 16' 25.5″ E	*A. marina*	6600	1600
11	23° 08'13.2″ N ;70° 18'19.8″ E	*A. marina*	3300	1600
12	23° 08' 20.9″ N ;70° 18' 16.6″ E	*A. marina*	3300	1000
13	23° 08' 29.7″ N ;70° 18' 17.8″ E	*A. marina*	6600	1600
14	23° 05' 03.5″ N ;70° 16' 18.0″ E	*A. marina*	6600	3300
15	23° 05'07.1″ N ;70° 16'23.8″ E	*A. marina*	6600	1600
16	23° 05' 10.4″ N ;70° 16' 25.2″ E	*A. marina*	16600	3300
17	23° 10' 35.9″ N ;70° 35' 28.2″ E	*A. marina*	60000	5000
18	23° 10' 38.6″ N ;70° 35' 31.3″ E	*A. marina*	55000	6600
19	23° 10' 30.6″ N ;70° 35' 28.3″ E	*A. marina*	10000	3300
20	23° 10' 36.5″ N ;70° 35' 39.0″ E	*A. marina*	8300	30000
21	23° 10' 41.6″ N ;70° 35' 35.4″ E	*A. marina*	8000	56600
Cumulative Average			**23423.81**	**8888**

4. PHYSICO-CHEMICAL PARAMETRS*:*

4.1 Introduction:

Range of physico-chemical parameters determines the creek water quality and assessing these parameters are essential in order to understand the governing factors of mangrove environment (Reddi et al., 1993). The mangrove system plays a major role in the global cycle of carbon, nitrogen and sulphur and acts as reservoirs of waste materials (Kathiresan and Bingham 2001; Kathiresan, 2000). Many works are available on the physical and chemical characters of some Indian estuaries and mangroves (Satpathy, 1996; Govindasamy et al., 2000; Rajasekar et al., 2003 and Asha and Diwakar 2007). Salinity, redox potential, pH and sulphide concentration in pore-water parameters play key roles in the development of mangroves and their spatial distributions. To cope with the variation of these properties, mangroves have developed many adaptations that give them wide ranges of tolerance. Additionally, climate, tidal flooding, vegetation evolution, bioturbation and organic matter content are parameters that also contribute to the complexity of the geochemistry of mangrove soil. The physico-chemical parameters like pH, pore-water salinity, sediment texture and Total Organic carbon (TOC) are direct indicators for the healthiness of mangrove stands and also influence vegetation structure of mangroves. In the present attempt some vital parameters that influence the mangrove vegetation structure have been studied and presented below.

4.2 Methodology:

4.2.1 Water Analysis:

Standard protocols (APHA, 1995) were followed for the sample collection and analysis. Water samples were collected using sterile polyethylene containers. Salinity (ppt- $‰_o$) was estimated using a pre-calibrated Refractometer (Aatago–Japan). Collected pore water was analyzed for pH and Salinity.

4.2.2 Sediment Analysis:

Sediment samples of 1 kg weight were collected from random locations; two from each transect to cover the entire study area. The sediment texture was determined by the *Sand- Silt- Clay method* which is based on the particle size distribution after sieving the soil using grading sieves. The sediment texture results are expressed in percentage.

4.2.3 Pore-Water Analysis:

The pore water samples were collected from the random locations of the study site. About 20 cm pit was dug using a spade and water was allowed to seep inside the pit. The clean water in the pit was collected using a syringe from the surface to avoid sediment deposition (Figure 4.1).

Figure 4.1: Collection of Pore-water samples in the sampled locations of KPT

pH was measured in situ using a pre-calibrated handheld pH meter (Hanna make) and the salinity was determined by a Refractometer (Fisher Scientific). The basic nutrients (Nitrate, Nitrite and Phosphate) were determined within 6 hours of sampling. For all analysis protocol given in *Standard methods for the examination of*

water and wastewater, 17th Ed. by American Public Health Association (APHA, 1995) was followed.

4.3 Result:

4.3.1 Salinity:

Seawater salinity is the most important factor that determines many life processes of mangrove ecosystem. The surface water salinity concentration of the 21 sampled mangrove stands varied from 35 to 43‰ with an overall average value of 38.95‰ (Table 4.1). The surface salinity was maximum (43 ‰) at 23° 01' 58.8″ N 70° 15' 27.5″ E. The recorded values of surface salinity are very common in the mangrove ecosystem of Kachchh.

The pore water salinity of the present investigation ranged from 47 to 62‰ with an overall average value of 53.71 ‰. Pore-water salinity is uneven in all the 21 sampled locations of KPT. The pore water salinity was found to be maximum at 23° 05' 10.4″ N 70° 16' 25.2″ E. Pore-water salinity in general is influenced by tidal pattern.

4.3.2 Hydrogen Ion Concentration:

The water pH value was varied from 7.1 to 7.8 with a cumulative average value of 7.4. The pH concentration of the present study was maximum at 23° 06' 52.5″ N 70° 16' 25.5″ E. The pore-water pH ranged from 7.9 to 8.7 with a cumulative average value of 8.21(Table 4.1). The pore-water pH concentration is always higher than surface water pH which is very common in the mangrove environment.

Table 4.1: Physico-Chemical parameters of water in the sampled locations of KPT

		Temperature-°C		Salinity		pH	
Sample No	**Sampling Co-Ordinates**	**Surface Water**	**Porewater**	**Surface Water**	**Porewater**	**Surface Water**	**Porewater**
S1	23° 03' 41.1″ N; 70° 15' 27.5″ E	29	22	38	54	7.4	8.3
S2	23° 02' 48.3″ N; 70° 13' 34.0″ E	28.5	23.8	37	52	7.2	8.1
S3	23° 02' 24.9″ N; 70° 13' 45.4″ E	31.3	23.6	42	58	7.7	8.5
S4	23° 01' 58.8″ N; 70° 15' 27.5″ E	28	25.2	40	55	7.3	8.2
S5	23° 01' 52.5″ N; 70° 15' 29.1″ E	30.8	25.5	43	60	7.6	8.5
S6	23° 02' 5.9″ N; 70° 16' 00.7″ E	29	25.3	36	51	7.2	8.0
S7	23° 03' 45.3″ N; 70° 13'37.21″ E	31.2	28.2	35	47	7.6	8.5
S8	23° 06' 55.6″ N; 70° 16' 36.7″ E	28.2	25.5	37	49	7.3	8.1
S9	23° 06' 55.0″ N; 70° 16'25.5″ E	30.8	23.8	41	54	7.5	8.2
S10	23° 06' 52.5″ N; 70° 16' 25.5″ E	29.5	25.5	40	53	7.8	8.7
S11	23° 08'13.2″ N; 70° 18'19.8″ E	27.8	25.7	40	51	7.4	8.1
S12	23° 08' 20.9″ N; 70° 18' 16.6″ E	30	25	38	48	7.1	7.9
S13	23° 08' 29.7″ N; 70° 18' 17.8″ E	29.5	23	39	54	7.5	8.3
S14	23° 05' 03.5″ N; 70° 16' 18.0″ E	28.5	23.6	36	55	7.2	8.0
S15	23° 05'07.1″ N; 70° 16'23.8″ E	28.6	23	38	54	7.4	8.1
S16	23° 05' 10.4″ N; 70° 16' 25.2″ E	28.9	25.7	42	62	7.7	8.5
S17	23° 10' 35.9″ N; 70° 35' 28.2″ E	29.8	28.9	40	57	7.3	8.1
S18	23° 10' 38.6″ N; 70° 35' 31.3″ E	30.9	26.8	41	54	7.4	8.0
S19	23° 10' 30.6″ N; 70° 35' 28.3″ E	29.2	23	38	52	7.6	8.4
S20	23° 10' 36.5″ N; 70° 35' 39.0″ E	28	23.2	39	53	7.2	7.9
S21	23° 10' 41.6″ N; 70° 35' 35.4″ E	29.5	24.3	38	55	7.1	8.0
Cumulative Average		**29.38**	**24.79**	**38.95**	**53.71**	**7.4**	**8.21**

4.3.3 Nutrient Concentration:

During the present study, nutrient concentration was determined by estimating the nitrite, nitrate and phosphate. Nitrite concentration ranged from 0.1 to 0.9 mg/L with an overall average of 0.635 mg/L. The nitrite concentration recorded maximum at 23° 05' 07.1″ N 70° 16' 25.2″ E, while the lower concentration was recorded at 23° 03' 45.3″ N 70° 13' 37.21″ E. Nitrate content of the present study varied from 0.9 to 1.9 mg/L with a cumulative average of 1.45 mg/L. The nitrate content at 23° 01' 52.5″ N 70° 15' 29.1 shows highest level (1.9 mg/L) than that of all other sampled locations. Phosphate concentration ranged from 0.1 – 1.8 mg/L with an average of 0.75 mg/L with maximum at 23° 03' 45.3″ N 70° 13' 37.21″ E and minimum at 23° 08' 29.7″ N 70° 18' 17.8″ E. The recorded nutrient contents are sufficient to support the growth and vegetation structure of the KPT mangroves (Table 4.2).

Table 4.2: Pore-water nutrient concentration of in the KPT sampled locations

Sample ID	Location Coordinates	Nitrite (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)
S1	23° 03' 41.1″ N; 70° 15' 27.5″ E	0.4	1.4	0.8
S2	23° 02' 48.3″ N; 70° 13' 34.0″ E	0.2	1.5	0.6
S3	23° 02' 24.9″ N; 70° 13' 45.4″ E	0.6	1.2	1.3
S4	23° 01' 58.8″ N; 70° 15' 27.5″ E	0.3	1.0	1.1
S5	23° 01' 52.5″ N; 70° 15' 29.1″ E	0.2	0.9	0.9
S6	23° 02' 5.9″ N; 70° 16' 00.7″ E	0.2	1.4	1.1
S7	23° 03' 45.3″ N; 70° 13'37.21″ E	0.1	1.2	1.8
S8	23° 06' 55.6″ N; 70° 16' 36.7″ E	0.8	1.9	1
S9	23° 06' 55.0″ N; 70° 16'25.5″ E	0.1	1.6	0.8
S10	23° 06' 52.5″ N; 70° 16' 25.5″ E	0.6	1.2	0.6
S11	23° 08'13.2″ N; 70° 18'19.8″ E	0.8	1.0	0.4
S12	23° 08' 20.9″ N; 70° 18' 16.6″ E	0.7	1.4	0.2
S13	23° 08' 29.7″ N; 70° 18' 17.8″ E	0.7	1.4	0.1
S14	23° 05' 03.5″ N; 70° 16' 18.0″ E	0.8	1.8	0.8
S15	23° 05'07.1″ N; 70° 16'23.8″ E	0.9	1.6	1.3
S16	23° 05' 10.4″ N; 70° 16' 25.2″ E	0.2	1.2	1.5
S17	23° 10' 35.9″ N; 70° 35' 28.2″ E	0.5	1.4	0.8
S18	23° 10' 38.6″ N; 70° 35' 31.3″ E	0.4	1.5	1.1
S19	23° 10' 30.6″ N; 70° 35' 28.3″ E	0.8	1.8	1.0
S20	23° 10' 36.5″ N; 70° 35' 39.0″ E	0.8	1.3	0.8
9S21	23° 10' 41.6″ N; 70° 35' 35.4″ E	0.8	1.2	0.2
Cumulative Average		0.635	1.45	0.757

4.3.4. Sediment Quality:

4.3.4.1 Sediment Texture:

During the present investigation, sediment texture varied widely among all the 21 sampled stations. Sediment texture typically represents the percentage composition of sand, silt and clay. Percentage composition of sand was maximum 38.1% and minimum 20.5% at the coordinates of 23° 06' 55.0″ N, 70° 16'25.5″ E; 23° 01' 52.5″

N, 70° 15'29.1″ E; respectively (Table 4.3). Overall average of all the 21 study sites sand constituted 30.09%. The silt composition was maximum at the study site 23° 06' 55.6″ N, 70° 16' 36.7″ E (16.5%) followed by the site at of 23° 09' 5.9″ N, 70° 16' 00.7″ E (16.1%) and minimum at 23° 03' 41.1″ N, 70° 15'27.5″ E(7.6%) with a cumulative mean value of 11.89%. Percentage composition of clay varied from 47.3% to 64.6% with an average value of 58.02%. Higher composition of clay was recorded at23° 01' 52.5″ N, 70° 15'29.1″ E. The cumulative average of the sediment indicated that in all the 21 sampled locations clay was the dominant fraction followed by silt and sand.

4.3.4.2Total Organic Carbon:

The total organic carbon in the sediment ranged from 0.51% to 0.8% with a cumulative mean value of 0.644% (Table 4.3). The higher TOC value was recorded at the site at 23° 10' 41.6″ N, 70° 35' 35.4″ E (0.8%) followed by the site at 23° 10' 30.6″ N, 70° 35' 35.4″ E (0.75%) and it was lower at 23° 02' 5.9″ N, 70° 16' 00.7″ E (0.51%).

Table: Percentage of Sediment texture and TOC in the sampled locations of KPT

Sampling Point No.	Sampling Coordinates	Post-Monsoon Texture (%)			Total Organic Carbon (%)
		Sand	Silt	Clay	
S1	23° 03' 41.1″ N; 70° 15' 27.5″ E	31.1	7.6	61.3	0.6
S2	23° 02' 48.3″ N; 70° 13' 34.0″ E	35.5	11.6	52.9	0.525
S3	23° 02' 24.9″ N; 70° 13' 45.4″ E	33.1	10.9	56	0.6
S4	23° 01' 58.8″ N; 70° 15' 27.5″ E	29	15.8	55.2	0.712
S5	23° 01' 52.5″ N; 70° 15' 29.1″ E	20.5	15	64.5	0.675
S6	23° 02' 5.9″ N; 70° 16' 00.7″ E	26.9	16.1	57	0.51
S7	23° 03' 45.3″ N; 70° 13'37.21″ E	23.2	12.2	64.6	0.6
S8	23° 06' 55.6″ N; 70° 16' 36.7″ E	28.9	16.5	54.6	0.58
S9	23° 06' 55.0″ N; 70° 16'25.5″ E	38.1	10	51.9	0.8
S10	23° 06' 52.5″ N; 70° 16' 25.5″ E	32.3	15	52.7	0.721
S11	23° 08'13.2″ N; 70° 18'19.8″ E	37.5	15.2	47.3	0.628
S12	23° 08' 20.9″ N; 70° 18' 16.6″ E	22.6	14.1	63.3	0.538
S13	23° 08' 29.7″ N; 70° 18' 17.8″ E	30.1	8.7	61.2	0.6
S14	23° 05' 03.5″ N; 70° 16' 18.0″ E	33.2	9.8	57	0.712
S15	23° 05'07.1″ N; 70° 16'23.8″ E	29.2	9.5	61.3	0.52
S16	23° 05' 10.4″ N; 70° 16' 25.2″ E	31.0	11.2	57.8	0.6
S17	23° 10' 35.9″ N; 70° 35' 28.2″ E	26.5	11.5	62	0.728
S18	23° 10' 38.6″ N; 70° 35' 31.3″ E	29.2	9.5	61.3	0.73
S19	23° 10' 30.6″ N; 70° 35' 28.3″ E	28.6	10.6	60.8	0.75
S20	23° 10' 36.5″ N; 70° 35' 39.0″ E	32.2	9.3	58.5	0.61
S21	23° 10' 41.6″ N; 70° 35' 35.4″ E	33.1	9.5	57.4	0.8
Cumulative Average		**30.09**	**11.89**	**58.02**	**0.644**

4.3.5 Conclusion

Assessment of mangrove health through vegetation structure and its status and water and sediment quality in 21 sampling locations within the boundary of Kandla Port indicated that most of the governing physio-chemical parameters of mangrove formations are within the prescribed limits. Essential parameters like surface water and pore-water salinity of the present study are comparable with other mangrove environment are within the prescribed limits. The high level of salinity is mainly due to the arid condition of the zone and resulting high evapo-transpiration rates prevailing in Gulf of Kachchh waters.

The status of mangrove within Kandla Port premises were characterized by evaluating their vegetation structures such as stand density, diversity, Girth at Breast Height (GBH),Canopy length and canopy width cover in 21 sampled locations. During the present study, mangrove stand at 23° 10' 41.6″ N, 70° 35' 35.4″ E is structurally better than other stands. The cumulative average mature tree density of 4124 trees/ha recorded in all the 21 sampled stands indicated that this mangrove formations is structurally dense than other mangrove formations of Kachchh. Tree height in all the 21 sampled stands showed noticeable variation which ranged from 171 cm to 341 cm with an cumulative average of 254cm.Mangrove trees were considerably taller at 23° 05' 07.1″ N, 70° 16' 23.8″ E, which is higher than all other samplings stands of KPT. Mangroves had highest GBH of 26.5 at 23° 02' 24.9″ N, 70° 13' 45.4″ E. The canopy cover in mangroves of Kandla port is rather small and comparatively lesser than other formations of Kachchh. This is solely attributable to the prevailing ambience like high pore-water salinity and other natural factors. Overall average density of regeneration class from 21 sampling locations is 23423.81 plants/ha, which indicate that the regeneration potential of mangroves of Kandla Port is good. Similarly, overall average density of the next younger class namely recruitment class was equally good establishing the high regeneration potential of the mangrove formation. Density Investigation of younger classes like regeneration and recruitment classes of the present study generally indicated that vegetation structure of the mangroves has high potential to sustain its structural integrity in future.

5. MANGROVE LAND COVER STUDIES IN KPT AREA

5.1 Introduction:

Kachchh mangroves are the largest single stand in the west coast with the extent of 789sq.Km (FSI, 2009). An increase of 11 sq. km was reported from the earlier estimates (FSI, 2013). Harsh environmental settings like arid hinter land minimal rainfall (458mm/year) and extreme evapo-transpiration rate have rendered these mangrove formations to a single species stand comprising hardy *Avicennia marina*, though sporadic occurrence of other species such as *R. mucronata*, *C. tagal* and *A. corniculatum* has been reported in very few coastal stretches.

Gandhidham taluka of Kachchh district where Kandla port is located is estimated to have 61.97sq.kmof mangroves (GEC&BISAG, 2009). In the present study dense and sparse mangrove formations within the jurisdiction of Kandla Port have been estimated tobearound13841.4ha (13234.2 ha area located in Kandla region). In the present GIS study, land-cover estimation of within the boundary of Kandla port was carried out to understand mangrove distribution.

Kandla Port Jurisdiction includes mainly Kandla port, Tuna port, Sat Saida bet and surrounding area of the port. Kandla creek on whose bank the port is located runs into the Gulf of Kachchh at a distance of 90 nautical miles from the port. The width of the channel varies from 200 meters to 1,000 meters. The contour depth along the shipping channel is around 10 meters. The study site falls under the co-ordinates of latitude between $23^0$12’ 20.49”N to $23^0$53’ 35.64”N and Longitude between $69^0$59’ 35.64”E to $70^0$37’ 51.40”E as given in Figure 5.1 (Annexure). It encompasses an approximate area of 120206.1 ha (1202.06 sq. km). This includes terrestrial and part of Gulf systems which fall within the port boundary.

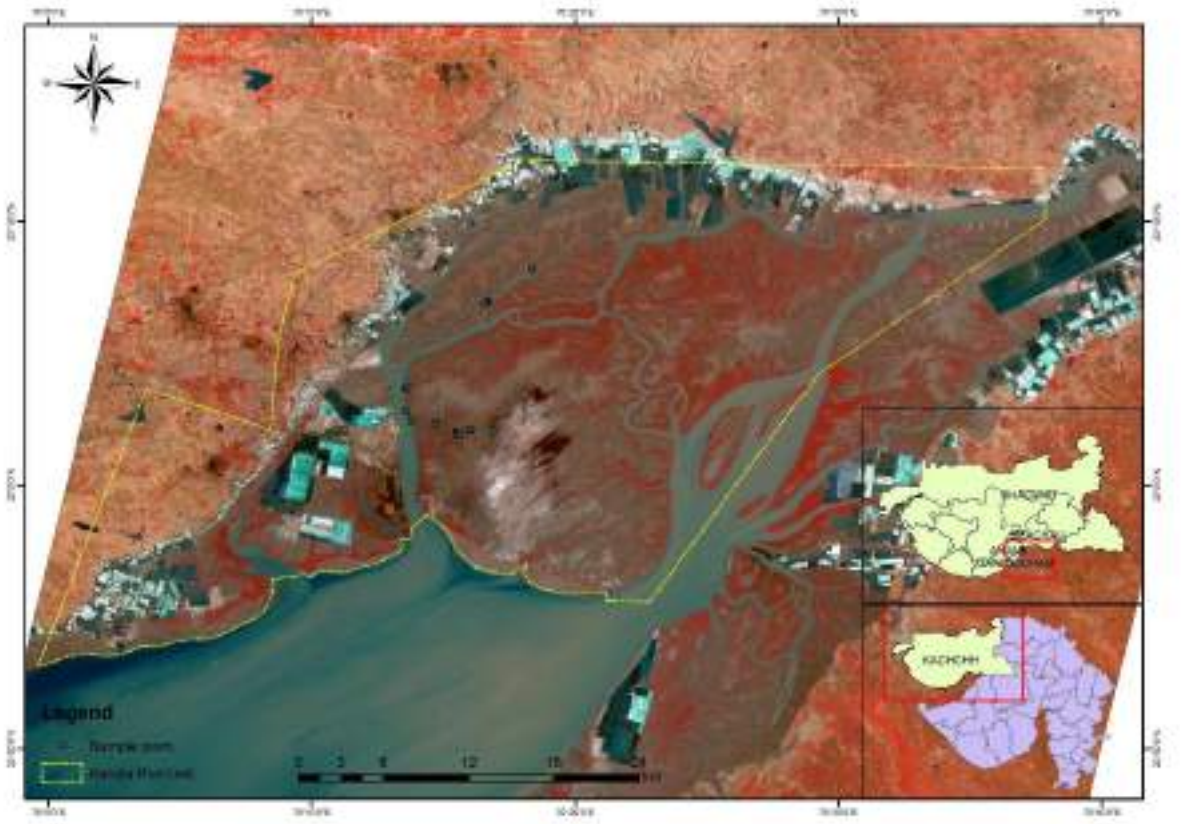

Figure 5.1: Sampling Points of Kandla Port Jurisdiction

5.2 GIS and Remote Sensing:

LISS 4 Satellite imagery of pre-monsoon season procured from NRSC, Hyderabad was used for the present study. The procured imagery has a resolution of 5.8 m with UTM projection with spheroid and datum named WGS 84 in UTM zone 42 north, which will meet the requirement of estimating the areal extent of mangroves within marked port limit area and its current status. Supervised Classification Method is applied to delineate the mangrove area and other natural areas. The details of the satellite imagery used are given below.

Satellite	Year	Month	Sensor	Bands	Pixel Resolution
IRS P6	2014	14,Dec	**LISS 4**	3	5.8 m

5.3 Pre-Processing:

Pre-processing of satellite data including geometric correction, atmospheric correction and radiometric correction and clipping of the area has been carried out. The rectification operation aims to correct distorted images to create a more faithful representation of the original scene. It typically involves the initial processing of raw image data to correct for geometric distortions.

5.3.1 Radiometric correction:

Radiometric correction addresses variations in the pixel intensities (DNs) that are not caused by the object or scene being scanned. These variations include differing sensitivities or malfunctioning of the detectors, topographic effects and atmospheric effects.

5.3.2 Geometric correction:

Geometric correction addresses errors in the relative positions of pixels. These errors are induced by sensor viewing geometry or terrain variations. Geometric correction was done based on Ground Control Points (GCPs) and the image was re-sampled using nearest neighborhood interpolation method.

5.3.3Supervised classification:

Supervised classification can be defined normally as the process of sample of known identity to classify pixels of unknown identity. Samples of known identity are those pixels located within training areas. Pixels located within these areas term the training samples used to guide the classification algorithm to assigning specific spectral values to appropriate information class.

Preliminary surveys were conducted on the ground to collect training samples for different Land cover using Garmin GPS with the help of training sample, classification map was generated based on Maximum Likelihood Supervised Classification model using ERDAS Software.

5.4 Land Cover classification for 2014:

Land Cover as observed in the imagery of December 2014 was classified in 10 classes namely Dense mangrove, sparse mangrove, Saltpan, mudflat, other vegetation,

settlement, water, agriculture, fallow land and barren land. This imagery classification was supported by ground truthing through fieldwork as it is a very important to check and collect most of the ground information required for mapping.

Reconnaissance field survey was undertaken to get acquainted with the general land cover pattern of the area. Different patches of mangrove area characteristics were recorded. The variation and tonal patterns observed in the ground truthing was recorded on the existing images. Traverses along Kandla main creek and subordinates creek of Kandla, mangrove area, saline area, saltpan and other vegetation was made for ground truthing the patterns and characters recorded in the image. Various features identified in the ground truthing were correlated with the image element and GPS observations was obtained for various land cover by superimposing on the satellite image.

5.5 Result:

5.5.1 Land Cover Mapping:

The land cover map based on supervised classification of LISS IV December 2014 is given in Fig.5.2and the area analysis of land cover is given in hectares.

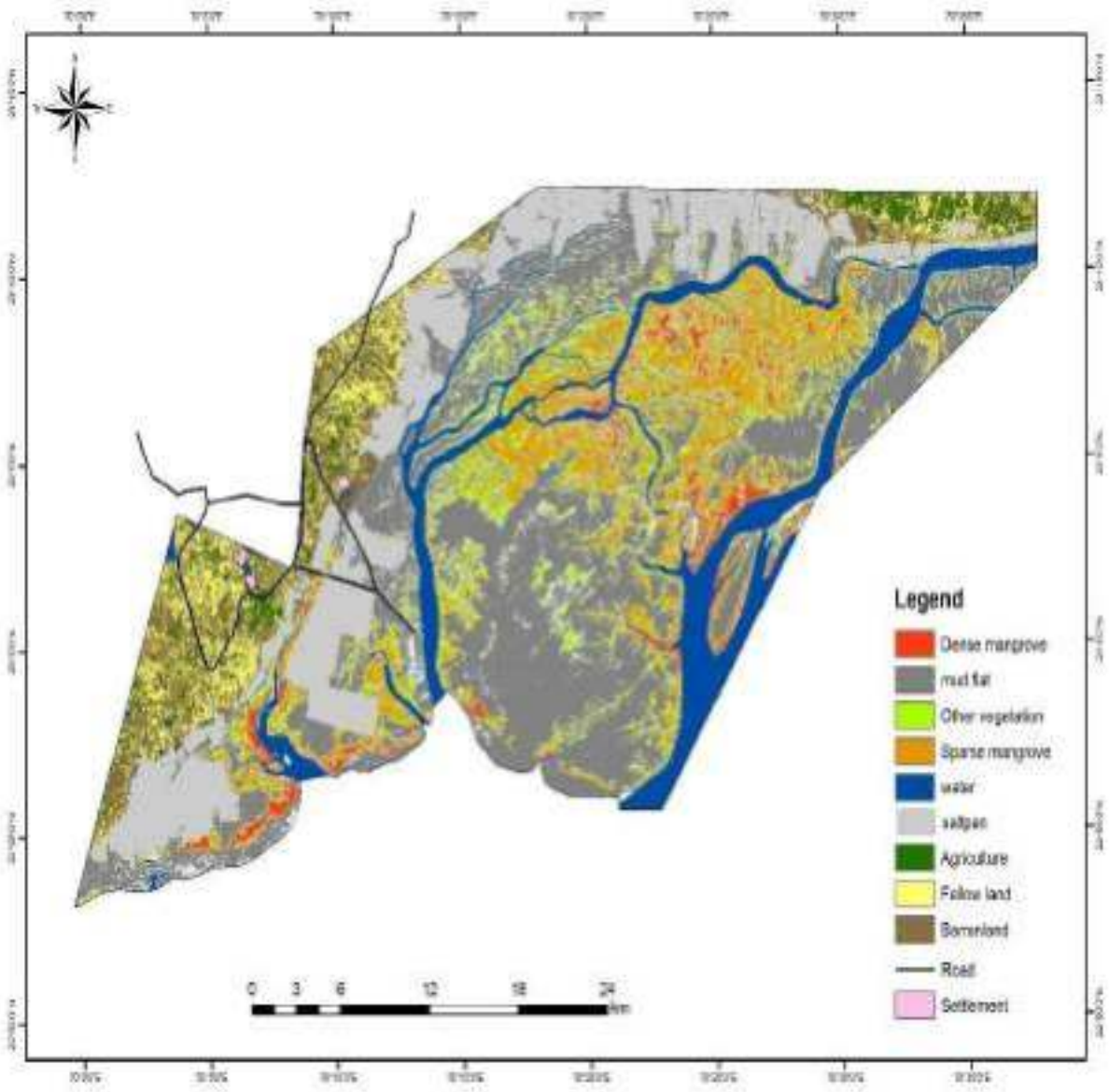

Fig.5.2: Land cover classification map of the study area -December2014

As per this classification different land cover category has been estimated in hectares (Figure 5.3). Total mangrove cover constitutes 15.3% with dense mangroves constituting 3.8% and sparse mangrove 11.5 %. Highest land cover is occupied by mudflats to the tune of 36.9% followed by water spread (11.5%) whereas cover of settlement (01%) and agriculture (1.7%) was lowest (Table 5.1).

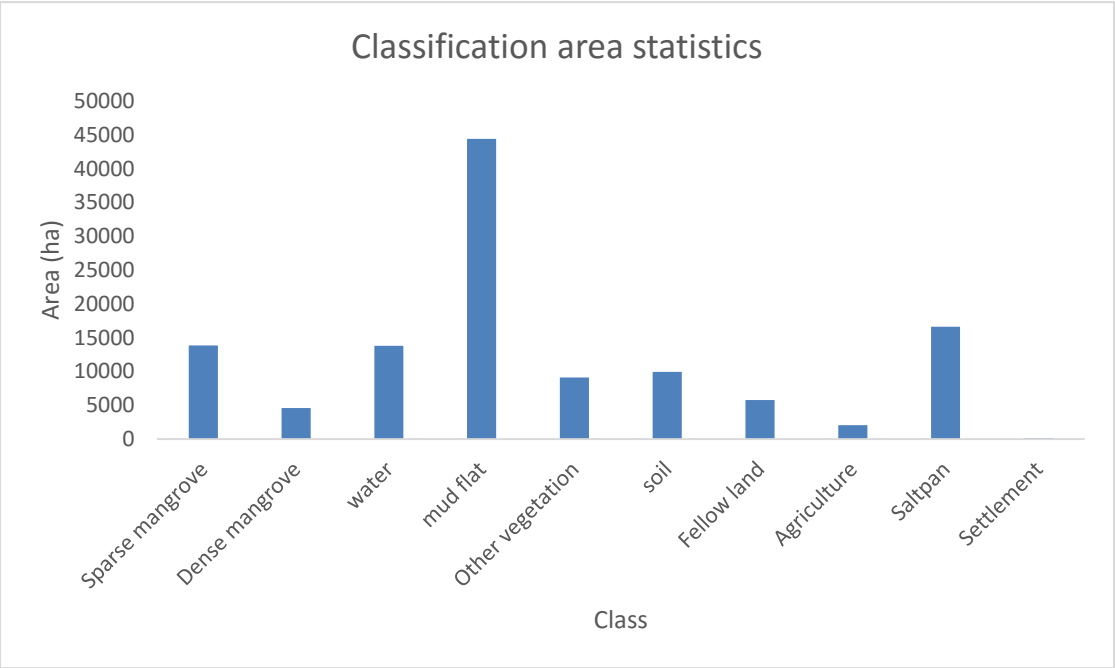

Fig. 5.3: Total Land Cover Classification Statistics in Hectares

Table 5.1: Percentage of Land Cover Classification in Kandla Port Area

Sr. No.	Class	Kandla Area (ha)	Tuna Tekra Area (ha)	Total Area (ha)	Total Area Percentage (%)
1	Sparse mangrove	13234.2	607.03	13841.2	11.5
2	Dense mangrove	4025.1	565.38	4590.4	3.8
3	Water	13117.3	671.54	13788.8	11.5
4	mud flat	41310.4	3080.69	44391.1	36.9
5	Other vegetation	8655.2	439.76	9095.0	7.6
6	Soil	5097.1	4840.60	9937.7	8.3
7	Fellow land	2582.7	3177.75	5760.4	4.8
8	Agriculture	1241.2	817.48	2058.7	1.7
9	Saltpan	12843.6	3754.50	16598.10	13.8
10	Settlement	49.7	94.96	144.7	0.1
	Total	**102156.5**	**18049.68**	**120206.18**	**100.0**

6. MANGROVE MANAGEMENT PLAN FOR KPT

6.1 Background:

The Kandla Port Trust envisages several facilities to be built at the location. The establishment of facilities over the years, buildings, etc. involves notable changes in the landscapes including natural environment as a result of intensive activities. Doubtlessly, this will alter the local ecological makeup of the area. Any long term human centered activity in any coastal belt will have serious repercussions on all its natural resources and ecosystems in the vicinity. Thus, measures should be taken to conserve and preserve KPT mangroves, thus retaining several visible and invisible ecological services of mangrove. As a first and foremost step it is imperative that no mangroves in the region are to be cleared for any activities and more mangrove plantation/ restoration work should be undertaken. Dumping of any materials such as cement, rubble, sand, steel, spilling of materials, etc. should be strictly avoided.

Regular monitoring programmes at fixed intervals are crucial to assess any change in mangrove diversity during different developmental activities. Therefore, KPT would be explored the possibility to engage an experts for monitoring the area regularly as ecological perspective. Emphasis on growth with respect to survival percentage, height, density, regeneration and recruitment classes, frequency class, etc. should be given during regular monitoring. Other phyto-sociological parameters should also be addressed during regular monitoring programme. Mangroves being a dynamic ecosystem such changes may be studied annually. Nevertheless, in areas with new mangrove growths/restoration the monitoring may be more frequent in order to arrest any adverse impact. Regular monitoring of these factors will facilitate the KPT authorities to understand the impact of the ongoing activities, if any. This would, inturn, help in mangrove conservation and management of the region. The data generated as an outcome of regular monitoring should be collected from predetermined/identified locations to avoid any sampling error. A team of expert groups should be engaged by KPT, in order to assess/evaluate the mangrove growth and vegetation structure.

The expert team may also help to conducting appropriate awareness programmes to the workers, supervisory staff and contract labours of KPT. Thus, environmental training and awareness creation should be undertaken for all jetty staff and contractors during their initial induction period. The training should involve both ecological and environmental importance of mangroves and measures to be taken in order to protect and preserve them during their activities in the areas contiguous to mangroves. Signboards and hoardings at appropriate places should be placed reflecting mangroves importance. These hoardings should be in easily understandable languages and in pictorial forms. Restricted entry/no entry boards may also be placed at appropriate places to regulate/monitor the frequency of visiting labours. This way, any illegal cutting, etc. can be immediately reported to KPT Environment Cell. This must involve a routine system of reporting such incidences. Similarly, KPT should hold an active Environment Cell to handle such problems cases. The consultancy peoples may also help in conducting awareness programs to the workers, supervisory staff and contract labours of KPT.

6.2 Other Activities:

Immense care should be taken to avoid any oil spillage from calling ships and other machineries in the vicinity of mangroves. Any unauthorized entry, cattle grazing and collection of mangrove forest products should be timely reported and entered in the register. Utmost care is required for any chemical/hydrocarbon spillage in the vicinity. Environment Division of KPT should investigate such incidences and take measures to arrest these activities. Further strengthening of this Division is essential as indicated in chapter 7.

No clearance and disturbance to soil surface in the areas close to mangrove formations should be done which would otherwise lead to increased turbidity of run-off. For such purpose it is suggested to earmark the area into buffer zone and core zone and no activity should take place in core zone including the earthmoving machineries. In some places scrub-rolling should be followed to allow resprouting/germination. No oil, loitering, rubbles, etc. should disposed off. In buffer

zone, these items are to be managed, collected, transported and disposed following GPCB norms.

Kachchh being arid zone, encounters dust storms. Thus, to minimize/avoid dust spreading into these ecologically important areas sprinklers should be used to arrest air borne dust and this frequency should be increased based on wind and weather conditions.

6.3 Significant Ecological Parameter:

Pore-water properties in mangroves ecosystem play a major role in determining the health of the mangrove forest. Alteration in the pore-water chemical and physical characteristics, especially salinity is a reliable indicator of changing physical condition in the mangrove. If any alteration in pore-water salinity and conductivity beyond the limit is reported during monitoring, immediate investigation should be carried out to identify the reason and appropriate remedial measures should be taken. For such purposes, constructing canal system to ensure increased flushing, groundwater recovery bores and interceptor channels which would facilitate increased water flushing to mangroves in the event of changed tidal pattern may be included. The construction of such a canal system should be in a well planned manner using the expertise of civil engineers. Since *Avicennia marina*, takes several years to respond to any of these changes, a long term sustained monitoring as mentioned earlier is vital.

6.4 Mangrove Rehabilitation:

At the same time KPT has carried out mangrove plantation and rehabilitation in 1000 ha (excluding 200 ha of IFFCO plantation site and 250 ha by M/S AKBTPL), the efforts are restricted to the tidal flats of Sat Saida Bet and Nakti creek (Refer Table 7.1). Thus, it is recommended to extend mangrove plantation and rehabilitation activities at Sat Saida Bet region. Such activities should be carried out through mangrove experts of consultancy.

6.5 Biodiversity Monitoring Committee:

Macrofauna is an integral part of mangrove ecosystem. Macrofaunal diversity in mangrove ecosystem reflects its health. It is well known that a steady mangrove

system supports rich faunal diversity/density. The faunal diversity in mangrove ecosystem is very sensitive to alterations in the habitat. Thus, monitoring faunal diversity would directly alert the KPT authorities about at any changes happened/ happening in the area. Thus, it is suggested to carry out regular monitoring of macrofauna in the mangrove area.

6.6 Mangrove Plantation and Restoration Activities:

It is known that mudflats experiencing favourable tidal amplitude are suitable for mangrove plantation. Sat Saida Bet area has widespread mudflats and suitable environmental conditions, Therefore, Sat Saida Bet area is recommended to carry out the future mangrove plantation and restoration activities. Being at the tail end of Gulf, the vicinity of Kandla port abounds with networks of creek systems, mudflats and tidal swamps with pronounced tidal amplitude of 6.66 m (Mean High Water Spring-MHWS) that inundates a vast intertidal belt rendering it suitable for plantation. It is noticed that the substrate nature is silty-clay which favours mangrove growth. The areas at Sat Saida Bet can be explored for mangrove plantation in available mudflats. However, this should be carried out in consultation with experts and should also involve long-term monitoring to ensure the growth of mangroves. Any impacts on mangrove health should be studied and measures should be taken to revive the growth. Such impact can be understood by studying faunal diversity as mentioned above.

KPT should undertake restoration activities to replenish the growth of mangroves in areas with stunted growth. This may be based on existence of creeks, removal of blockages in the natural minor creeks, and creation of new tidal regimes through fish bone canals. To undertake such activities, it is suggested to study the area characteristics and relate it with existing scientific knowledge. Thus, this should be carried out in consultation with the experts. It is envisaged that correlating long-term mangrove conservation and preservation with KPT's foreseen expansion would improve its greener outlook and enable KPT to get environmental clearance of its future projects/activities.

Desiltation of natural canals, increased frequency of tidal flushing, should be carried out in areas with natural stunted growth areas in order to improve mangroves

health, and ecological functions and services. Thus, for all such activities, and mangrove plantation and restoration activities creation of a Separate Mangrove Monitoring Cell under the Environmental Division is suggested. For any plantation activity the in site selection is foremost. Nevertheless, protocol involved during site identification as well as selection will play an important role in long term survival of mangroves areas and their well being. Thus, it is recommended to select the future plantation sites in consultation with experts. Experts ought to have a thorough knowledge and experience on ecology, faunal diversity, sediment quality assessment, pore-water quality assessment and impact of other factor on mangrove formations / growth.

It is suggested that other candidate species of mangroves *viz*., *Aegiceros corniculatum*, *Ceriops tagal* and *Rhizophora mucronata*, should also be attempted in natural areas. These species area likely to improve/increase the diversity of the area and thus improving mangrove health.

For any plantation activity, improved techniques as elaborated in earlier sections should be followed. Raised bed (*Otla*) method should be followed in sites experiencing high tidal currents. However, such plantation technique should be carried out in previous existing mangroves stands and new areas should be completely avoided. Also, sediment erosion monitors and in plantation areas following *Otla* method should be carried out. Kandla port premises especially Sat Saida Bet receives gentle tidal currents, therefore, open mudflats here should have nursery raised sapling or direct dibbling of seeds in a pit.

In order to ensure any negative impact on the health of mangrove ecosystem in Kandla Port region, long term planning and conservation strategies should be attempted and most vulnerable mangrove stand should be identified and exposed to conservation efforts. Thus, special efforts should be taken to conserve these stands.

7. MANGROVE PLANTATION AND REHABILITATION EFFORTS

7.1 Background:

Among Kachchh mangroves with a spread of 789 sq.km, Gandhidham taluka, where Kandla Port is located, has a mangrove formation of 61.97 sq. km. Extent of dense mangrove within this taluka is only around 2.89 sq.km whereas sparse mangroves are 59.07 sq. km (GEC & BISAC, 2009). Potential mudflat area within the taluka is estimated to be 55.47 sq.km presenting a vast scope for mangrove plantation and rehabilitation. Kandla Port Trust within its jurisdiction encompasses a total land area (excluding water) of 893.03 sq. km rendering it the largest land holder in Kachchh district. Extent of mangroves within the Jurisdiction of Kandla Port is estimated to be 18831.64ha with the inclusion of 4990.4 and 13841.2 sq.km sparse and dense mangroves, respectively; a largest patch outside the administrative jurisdiction of forest department. During early 1960s mangrove cover in Kandla-Surajbari belt was reported to be 506 sq.km which ultimately shrank to 49 sq.km during 2002 due to various human and natural factors.

Cargo handling in Kandla Port consistently recorded an increasing growth trend; the total cargo traffic handled by the port has increased from 24.5 million tons in 1993-94 to 82.5 million tons in 2011-12. Moreover, KPT handled 87.005 MMT cargo during the year of 2013-2014 and 92.5 MMT in the financial year of 2014-2015 Additionally, it is planned to construct four dry cargo berths within the Kandla creek; it is also planned to develop two Multi-Product Special Economic Zones (MPSEZ) at Kandla (3400 ha) and at Tuna Tekra (1400 ha). Out of 12 existing cargo berths, six berths have already served their lifespan of 50 years. In addition, existing vessel traffic, congestion in the main port and draft restrictions demand expansion of the port facility to adjacent creek systems.

Due to these commercial, operational and economic reasons and to meet the demands of the expanding trade, KPT has to increase its cargo handling capacity in the future while simultaneously caring for the ecological wellbeing of mangroves in its port vicinity. As expected, these developments will have their own repercussions on the surrounding port environ. Mangrove being a major ecological entity within the

port premise, it is imperative that a well planned, long term conservation measure in terms of aggressive mangrove plantation and rehabilitation has to be initiated in order to bring back the mangrove cover to the pre-port era of pristine nature and also to conserve the existing mangrove formations intact in a sustained long term basis. This calls for consistent effort both for preserving and improving the mangrove formation. This chapter narrates the ongoing mangrove plantation activities by the port authorities and recommend future plan of action for long term conservation. Recommendations on the monitoring programmes to be initiated in order to keep track of the ecosystem health and to initiate course corrections and remedies, if any impacts are felt is also narrated.

7.2 KPT-Present Mangrove Plantation/Rehabilitation Efforts:

Three different terminologies namely Rehabilitation, Restoration and Plantation are interchangeably used to denote human interventions to improve mangrove condition. Field (1999) defines 'Rehabilitation' as 'return of degraded mangrove land to a fully functional mangrove ecosystem'; the term 'Restoration' is defined by him as 'returning the degraded mangrove land to something like its presumed original state'. The term, 'Plantation' could be considered as raising mangroves in a technically suitable coastal belt where mangroves were absent earlier. Going by this definition most of the activities undertaken by Kandla port or any other stake holder agencies until now is only plantation with restoration and rehabilitation activities seldom attempted.

With a vast wide mudflat area extending up to 44391 ha and numerous network of creek systems enabling a rich and conducive environment for mangrove growth, Kandla port environ is an ideal location for mangrove plantation and restoration efforts. These possible mudflats for mangrove plantation are available along the creek systems of Sat Saida Bet. Similarly, many earlier pristine mangrove stands that are now degraded within Kandla port offers equally high opportunity to restore them.

Mangrove plantation activity by Kandla Port was initiated during 2002 as mandated by the Ministry of Environment Forests and Climate Change (MoEF). The first mangrove plantation activity was during 2002 with the development of 20 ha at

Sat Saida Bet, a vast tidally flushed area along the northern bank of Kandla creek opposite to Kandla port. Subsequently, 1200 ha of mangrove plantation has been completed till the end of 2014 in order to meet the legal mandate of Ministry of Environment, Forests and Climate Change (Table 7.1).

Table 7.1: Details of implemented Mangrove Plantation by Kandla Port Trust

Sr. no.	Year of Plantation & Site	Area-ha.	Species	Survival -%	Agency
1	2005-2006 (Sat Saida Bed)	20	*A.marina*	98	M/s Gujarat Ecology Commission
2	2008–09 (Nakti Creek)	50	*A.marina*	71	M/s Gujarat Ecology Commission
3	2010–11 (Nakti Creek)	100	*A.marina, R. mucronata, C. tagal*	68	M/s Gujarat Ecology Commission
4	2011–12 (Sat Saida Bed)	200	*A.marina*	74	Forest & Environment Department, GoG
5	2012-13 (Sat Saida Bed)	300	*A.marina*	71	Forest & Environment Department, GoG
6	2013–14 (Sat Saida Bed)	330	*A.marina*	69	Forest & Environment Department, GoG
Total Mangrove Plantation carried out by KPT – 1000 ha					
7	2013-14 (Sat Saida Bed)	250	*A.marina*	70	M/s AKBTPL
8	2013-15 (Sat Saida Bed)	200	*A.marina*	74	IFFCO through GUIDE
9	2015-17	300	-	-	MoU signed with Gujarat Ecology Comission (GEC), Government of Gujarat

In all these plantations the following three different methods were followed.

1. Raised Bed Method (Otla method)
2. Transplantation of nursery raised saplings (Nursery method)
3. Direct Seed Sowing Method

7.2.1 Otla Method:

In majority of the plantation sites raised bed method (*Otla* method) was followed as it is believed to give better results than other methods. Further, this method is perceived to be less cost and labour intensive. This method is especially suitable for sites with high tidal currents. In this method, square earthen mounts of 10-15 cm height were raised and propagules numbering 50-60 were dibbled on the surface of the mount. Generally, number of raised beds per hectare is around 1000 with a spacing of less than 1 × 1 m. In case of plantation among gaps of natural mangroves, clusters of *Otlas* mostly exceeding the density of 1500/ha were made closely.

7.2.2 Direct Propagule Dibbling:

Next to raised bed method, direct propagule dibbling (locally called '*Sing'* Plantation) was attempted in many sites. This method is less labour and cost intensive, though repeated dibbling was often required in order to obtain desirable survival rate. In this method, mature propagules are dibbled in open empty mudflats or among gaps of natural stands. Spacing maintained between each dibbled propagule varied differently and in some sites it was as close as 75×50 cm, especially in plantation raised among gaps of natural mangroves. Propagules used were collected freshly from the nearby mangrove formations which are thought to give better results and no pre-dibbling seed treatments were used. Often propagules were dibbled repeatedly in order to increase survival rates and in raised (O*tla*) bed and nursery plantation sites, dibbling propagules was resorted to increase survival.

7.2.3. Nursery Methods (Polybag Method):

Transplantation of nursery raised saplings was also followed as its success rate is much higher than any other method. Unlike raised bed and direct dibbling methods, this method is labour and cost intensive and time consuming. Nursery raised saplings are transplanted as individual plants either in open intertidal mudflats or along the banks of the creek systems. Saplings in the polythene bags were allowed to attain a height of 40-50 cm before transplantation in a period of 3-4 months. This method was found to be promising and yield better survival rate wherever it was attempted. While

transplanting, varying density, ranging from 3000 to 6000 saplings/ha as dictated by the site condition were followed.

7.3 Mangrove Plantation Targets Achieved:

The targeted plantation area of 1000 ha, Kandla Port Trust has been carried out plantation in two sites namely Sat Saida Bet on the banks of Kandla creek opposite to Kandla Port and along the Nakti creek till the end of 2013-14. Year-wise target achieved and other details of plantation are given in table 7.1. Sat Saida Bet opposite to the port bank of Kandla was chosen to implement the mangrove plantation at Sat Saida Bet, it is a vast mudflat area receiving adequate tidal flushing to support a healthy plantation. Numerous minor tidal creeks criss-cross the mudflat producing very conducive conditions for undertaking plantation activity. Out of the 1000 ha completed till 2013-14, 850 ha of plantation were carried out in Sat Saida Bet which yielded better results with high survival rate of more than 80%.

In all plantation years, except 2008-09, the candidate species was *Avicennia marina*. This is the dominant species occurring in the mangrove formations of Kachchh, though sporadic occurrence of other two species, *Rhizophora mucronata* and *Ceriops tagal* has been reported. *Avicennia marina* is known to survive in very high water and soil salinity due to its extreme tolerance to different environmental conditions. Kachchh coastal region experiences elevated water and soil salinity levels due to aridity and very high evaporation rate. In this prevailing ambiance of high salinity, growth of *A. marina* is fairly good comparing other mangrove species since it is due to its high tolerance to higher salinity ranges. Obviously, *A. marina* is the candidate species in the whole of Kachchh and Gujarat coast due to these reasons. Earlier attempts during 2008-09 to plant *Rhizophora mucronata* and *Ceriops tagal* at Sat Saida Bet yielded only very limited success rates in terms of survival.

7.4 Potential for Plantation and Restoration Activities in Kandla Port Area:

Scope for successful mangrove plantation and restoration activities in Kandla Port area is plenty as basic environmental requirements and conditions are quite conducive. Presence of extensive mudflats, favourable tidal amplitude and conducive

substrate nature favours mangrove plantation in vast areas. The vast mudflat area is around 44391 ha located in the Kandla port premises, around 20000 ha receives good tidal flushing rates which exactly located in Sat Saida Bet region. Being at the tail end of Gulf, the vicinity of Kandla port abounds with networks of creek systems mudflats and tidal swamps with pronounced tidal amplitude of 6.66 m (Mean High Water Spring-MHWS) that inundates vast intertidal belt, rendering it suitable for plantation. Substrate nature is silty-clay which favours luxuriant mangrove growth. Despite factors like high aridity, water salinity and poor rainfall (340 mm/year), growth of mangrove species, especially *A. marina* is favoured by other positive factors. It is estimated that out of available extent of 44391.1 ha of mudflats, nearly 20000 ha has high potential for mangrove plantation. About 830 ha out 1000 ha of plantation executed so far by Kandla port has been carried out at Sat Saida Bet, since it has vast extent of mudflats and tidal swamps. Network of creek systems at Sat Saida Bet and adjacent mudflats in the creek system on its northern extent has vast potential mudflats for mangrove plantation. Other than this, creek systems like Nakti and Khori has extensive mudflats along their banks which are suitable for mangrove plantation.

Similar to plantation potential, potential for mangrove restoration activities are equally high in and around Kandla port. It is estimated that out of total mangrove extent of 18431.6 ha within the port jurisdiction, 4590.4 ha are dense and 13841.2 ha are sparse. Potential for developing the sparse mangroves into a healthy and dense mangrove habitat is plenty by undertaking restoration activities such as deepening the existing minor creek systems, creating new tidal regimes through fish bone canals and removing blockages in the natural minor creeks. Most of these sparse mangroves were once reported to be dense and healthy (ICMAM, 2004) and they were rendered sparse due to micro-level changes in the topography and geomorphology due to various natural and anthropogenic factors.

Majority of the mudflat area in the Tuna region do not support mangrove growth in spite of adequate tidal flushing solely due to lack of geomorphic and tidal factors which prevent effective mangrove seed dispersal. Potential mangrove

plantation sites at Sat Saida Bet is enabling by broadcasting or by other means of most likely convert these mudflats into mangrove formations.

7.5 Recommendation for Future Mangrove Plantation:

Given the vast extent of natural mangroves within the port environ and the ecological sensitivity of mangroves, it will be in the long term commercial interest of Kandla port to ensure that a committed management plan encompassing conservation of natural stand and further areal expansion through plantation and restoration is in place with appropriate budgetary allotment. Since Kandla port is poised for further growth in the future, linking long term mangrove conservation and preservation with its entire future expansion plan will manifold enhance its greener outlook and enable easy environmental clearance of its future project activities. Sustained and planned effort with a strong will and determination will render Kandla Port a truly green port surrounded by thick, dense and luxuriant mangroves. Recommendations to this effect are presented below.

7.6 Long term Plan for Mangrove Plantation or Restoration:

Creation of a separate mangrove cell manned by scientific manpower with clearly defined timely goal could be the first step towards mangrove conservation. Kandla port may create its own cell or it could be assigned to a competent organization with adequate experience in mangrove conservation such as forest department and Gujarat Ecology Commission (GEC). With parallel planning and execution for plantation and restoration, yearly target of plantation and restoration are fixed and met with adequate fund support from port authorities. A long term plan with yearly target of plantation/restoration irrespective of ministry mandate could be drawn by this cell. This plan, to begin with, will identify and demarcate potential mangrove sites separately for plantation and restoration activities through application of GIS and RS tools. Similarly, patches that are likely to face impact due to different anthropogenic activities could be identified and appropriate mitigation measures initiated.

7.6.1 Restoration along with Plantation:

Until now, outright plantation is the sole measure of mangrove conservation while restoration of degraded stand has never been attempted. It is recommended that restoration by bio-physical amendments along with plantation could be attempted in future conservation activities; especially in identified scrubby/stunted stands facing inadequate tidal flushing this restoration effort will yield better results rather than direct plantation. Desiltation of natural canals and enhancing tidal flushing rates through canal systems and increasing number of tidal days in such natural stunted stands by physical amendments will render the scrubby formation healthy, viable and a functional mangrove ecosystem. This could be done in a cost effective manner yielding better results than direct plantation. A thorough and detailed surveillance and categorizing the sites requiring different approaches/treatments could be undertaken in future mangrove conservation efforts. Through application of GIS tools, this task could be done in a scientific manner. These restoration activities could be delinked from ministry mandated conditional plantation for different project setting/expansion and are to be carried out as per the yearly targets set out by Kandla port itself. This will be a time saving and proactive measure to meet conservation mandate that will be imposed by the ministry in future for different project implementation.

7.6.2 Improved Plantation Techniques:

As narrated in section 7.2 three basic techniques for plantation is followed namely, raised bed (Otla) method, Plantation of nursery raised saplings and direct seed dibbling. While raised (Otla) method is predominantly followed, other two methods are supplementary. Raised bed (*Otla*) method is more suitable for sites which experiences heavy tidal currents. Since raised beds control the velocity of receding tidal waters, germinating seedlings do not get dislodged. Though raised bed method initially results in high survival rate, in due course of time, sediment in the bed gets eroded in the receding tidal currents and saplings gets uprooted when their root system are exposed to the currents. In majority of the sites where raised bed method was attempted initial high survival rates is followed by heavy mortality and survival becomes poor after six months. However, this method is satisfactory if the plantation

is carried out among existing mangrove stands which effectively checks and slow down the receding tidal currents. Hence, caution is to be exercised whole adapting raised bed method of plantation. It is suggested that this method could be used as a last resort and only in sites facing heavy tidal currents. For the mudflats of Kandla port region, where tidal currents are mostly gentle due to gradual intertidal gradient raised bed method may not be suitable. Either plantation of nursery raised sapling or direct dibbling of seeds in a pit will be more appropriate method.

7.6.3 Site Selection:

By far, suitable site selection in the intertidal belt is foremost criterion determining success of mangrove plantation. A list of bio-physical parameters like gradient of the chosen intertidal belt, soil nature, number of days of tidal flushing, presence/absence of natural mangroves in the vicinity and availability of adequate intertidal extent are to be carefully considered for choosing plantation site. More emphasis is to be given to tidal flushing; only sites that receive good tidal flushing for 15-20 days in a month are to be chosen for plantation activities. A suite of 12 parameters indicated in the table 7.2 are to be meticulously considered before choosing a site. In earlier plantation attempts by Kandla Port, sites among existing natural mangrove formation with good tidal flushing and regeneration potential were taken up. In other cases, plantation was raised along the banks of natural creeks or in the gaps among scrubby mangrove formations and open mudflats close to the coastal belt after ascertaining adequate tidal inundation. In short all bio-physical characters (Table 7.2) are to be carefully considered before choosing plantation sites. Based on bio-physical characteristics of sites, few areas at Sat Saida bet was suggested here for future mangrove plantation activities (Figure 7.1).

Table 7.2: Criteria Adapted by Forest Staff for site selection

Priority Order	Criteria	Preferred Conditions
1	Site Nature- Open coast/creek/Natural Mangrove formations	Creek systems and estuaries with freshwater input is preferable- In open coast sites gentle gradient preferred. In natural mangroves, adequate gaps with good tidal flushing considered.
2	Intertidal Gradient	Intertidal extent with gentle slope preferred-Steep intertidal gradient and those with convex morphology avoided to prevent water logging.
3	Tidal inundation	Only sites with gentle gradient with minimum 15 days

		tidal flushing per month mostly preferred
4	Soil Texture	Silty-clay or muddy soil preferred
5	Water Salinity	Sites close to discharge points of run-off preferred which controls salinity fluctuations -Based on this candidate species are selected.
6	Intertidal Extent/Width	Sites with minimum 150-200 m width and gentle gradient close to the waterfront preferred
7	Tidal Currents	Sites with gentle and low velocity currents preferred
8	Mangrove Presence/ Absence in the Vicinity	Presence of natural mangroves in the vicinity is a reliable indication that the site can support good mangroves.
9	Accessibility of the site	Mostly considered in site where plantation was implemented in EDC mode.
10	Labor Availability	Availability of good labour in nearby villages was considered as a major factor
11	Seed Source	Seed source was from nearby mangroves-If new species were attempted seeds/propagulesweresacclimatized to higher salinity
12	Pressure-Grazing, Cattle visit, resource gathering etc.	Avoided through constant vigil- EDC village partners were educated not to send their cattle to the natural or planted mangroves.

Figure 7.1: Suggested plantation sites at Sat Saida Bet

7.6.4 Biodiversity Enrichment:

In most of the plantation sites, *A. marina* was the natural candidate species as they are the most predominant in all natural mangrove stands indicating nature's preference to this species. Environmental plasticity of *A. marina* to tolerate extremes of salinity, temperature and light intensity and its adaptation to different soil conditions is scientifically well proven. In addition, easy seed availability, faster

germination in high saline water, tolerance to prolonged drought situation and higher growth rates enables good success rates with *A. marina*. Nevertheless, other candidate species such as *R. mucronata, C. tagal* and *Aegiceras corniculatum* could be planted in small areas following their natural zonation pattern. *C. tagal* and *A. corniculatum* occur sporadically in Kandla port region. Though these species are less salinity tolerant, planting them close to the water front where they will get inundated daily will enhance diversity of true mangroves in Kandla port to ensure better ecosystem function.

7.6.5 Monitoring and Arresting Stand Degradation:

In the last five decades since inception of port activities during 1960s mangrove formation in and around Kandla port seems to have undergone degradation due to various human and natural factors. The stand with an extent of 506 sq.km at the tail end of GoK during 1960s has reduced to 49 sq.km during 2002 (ICMAM, 2004). This calls for immediate measures by port authorities to arrest further stand degradation by appropriate action oriented management measures. Following measures are suggested in this line.

Exhaustive GIS mapping with corresponding ground truthing to record and document different stand characteristics such as dense, sparse, moderate stands and identifying stands that are prone to immediate stand degradation.

Earmarking core pristine stands at Kandla and Tuna areas within port limits as reserve forests that are to be protected where further port activities are not to be taken up in future. This earmarked core mangrove formation deserves total protection and preservation against all developmental activities and disturbances.

Rapid and short mangrove monitoring programs at a spatial interval of one year is to be instituted in order to keep track of changes that may happen due to further construction and operation of jetties and other port related structures. Kandla port has already generated considerable primary data on its mangrove formation through various project reports. Consolidating this data and filling the lacunae in the data through further monitoring is suffice to generate up to date baseline data on mangrove

vegetation stand of Kandla port; special attention could be paid to document segment wise data on density, tree canopy, tree diameter classes, stand dynamics, pore-water chemistry, etc. This baseline creation and further yearly monitoring will enable the port authorities on the time series changes happening in the vegetation. Table 7.3 presents different components of the monitoring program, time schedule and other details. Regular monitoring of the chosen parameters in the mangroves of port environment will enable the port authorities to gain knowledge about the impact of the ongoing activities as it is the primary step to device management options to ensure mangrove preservation and health in a holistic manner.

Table 7.3: Mangrove Monitoring Program Components and other Details

Component	Details	Inference to be derived
GIS & RS Mapping	GIS maps for Port limit procured from NRSC and mangrove distribution to be studied-Delineation of different density classes such as dense, moderately dense and sparse mangroves, potential mudflats for plantation, sparse patches for restoration could be earmarked on the map	Changes in the physical extent could be traced by overlaying the subsequent maps on the baseline maps. Changes in areal extent to be gleaned- Potential sites for plantation and restoration identified
Vegetation Structure	Mostly vegetation characters like density, Canopy cover, health in terms of regeneration potential to be established as baseline	General regeneration potential of mangrove stand inferred. This data is to be considered along with pore water parameter like salinity, pH and conductivity in subsequent monitoring to glean information on changes.
Sedimentation Process	To monitor potential changes in sedimentation rate in the mangrove proper due to port activities	To be considered in conjunction with dredging and other civil engineering activities of the port to derive possible correlation
Porewater Chemistry-Salinity, pH, conductivity	Representative samples in a gradient to be collected for better comparison with the baseline data	Produced structural and physiognomic zones to be compared for changes with the baseline data
Photographs	Photographs to be taken from a reference standard points fixed during baseline studies	Visual comparison with the earlier baseline photos establishes changes.

For gathering monitoring data, reference points fixed during baseline collection is to be strictly maintained in order to avoid ambiguous and misleading results during the monitoring activities.

For all the above mentioned parameters a threshold limit of 20% could be kept as standard margin and deviation more than this from the baseline data could be treated as the signs of degradation that calls for appropriate management plan and options to be exercised to control the impact. Some of the options are as follows.

Analyzing the causative factor(s) for the degradation such as physical, geomorphological, biological and exploring the possibility of remedial measures to mitigate the problem that cause stand degradation is the first step. Increased sedimentation due to port activity and resultant micro-level change in geomorphology is often the major cause for mangrove degradation. Other natural causative factors such as cattle grazing and mangrove resource collection is negligible in Kandla though natural coastal erosion is noticed in certain pockets.

In the event of excessive sedimentation in mangrove proper, causative factors like source of sediment load reaching mangroves is to be investigated thoroughly. Measures to ameliorate the impact like reducing the sediment load through changes in operational procedure may be considered.

Efforts to trap run-off slurry and sediment plume from the dredging area by means of silt traps may be attempted and the trapped sediments will be responsibly disposed in pre-designated sites.

Similarly, a safety exclusion zone will be required around the dredging vessel whose size will depend on the final dredging plan and will range from 150 m to 500 m in accordance with the international standards and best practices.

Altered tidal flushing due to various reasons in and around the creek system is a possibility which may affect mangroves on the creek banks leading to erosion. Tidal water flow in small intertidal canals that feed isolated mangrove stands generally get disrupted due to sedimentation with the possibility of complete filling. This could be best managed through micro-level study of the degrading patch and ensuring adequate

and proper tidal flushing through measures narrated in section 7.6. Majority of the problem of stand degradation could be addressed by ensuring adequate tidal flushing, which is the single most important factor for stand degradation.

7.6.6 Erosion:

Fringes of Sat Saida Bet as well as parts Tuna are directly exposed to high tidal currents and erosion. This ongoing natural process is taking a heavy toll of many fully grown and healthy mangrove trees on the mudflat periphery. Following actions are recommended for controlling erosion and check further uprooting of mangroves.

- ♣ Initial earmarking of erosion prone sites along all the creek system.
- ♣ Since the process of erosion is highest along Sat Saida bet, it could be controlled only by physical means by constructing appropriate civil engineering structures. Erosion control structures or constructing embankment of stones or any suitable material along the erosion site is strongly recommended if the problem is too heavy. The proposed embankment should be eco-engineering design with a gentle slope of appropriate angle to the tidal action that will allow natural flushing while totally controlling erosion.
- ♣ Oceanographic factors that cause erosion in the immediate port vicinity need to be understood. Whether the erosion is caused due to ongoing port activities and other port structures or natural cause needs to be ascertained. Coastal stretch of Kandla is stated to fall either under a low or medium erosion category (National Assessment of Shoreline changes, 2011). The erosion map prepared by Ministry of Environment and Forests (MoEF, 2011) marks certain parts of Kandla region and nearby stretches as stable or high accretion coast. Contrarily, erosion of high intensity has been witnessed during this study indicating that this might be due to ongoing port activity.
- ♣ A rapid survey through the survey department of Kandla Port could be undertaken at regular time intervals to identify coastal stretches within the port limit which are prone to high erosion. These high erosion coastal stretches could be provided with gentle slopes with stone pitching and other civil

engineering works which will reduce the rate of erosion. These measures are required only if mangroves are present in vast areas in this stretch.

8 SUMMARY:

Kandla Port is one of the biggest port of India situated in the northwestern part of Gujarat. Mangrove forest is a conspicuous ecological entity within Kandla Port area. Due to the major port activities and accompanying development, mangroves within the premises of KPT have become vulnerable, susceptible and fragile over the years. Consequently, conservation and management of this mangrove formation has become imperative and an environmental responsibility of the Kandla port authority. In view of the continued port expansion and development, Department of Forest and Environment, Government of Gujarat, Gandhinagar has mandated KPT to investigate the current ecological status of mangroves in the KPT premises through proper scientific assessment and formulate long term conservation and management plan. Kandla Port authorities assigned the task of investigating the mangrove ecology within the port jurisdiction to Gujarat Institute of Desert Ecology (GUIDE), Bhuj.

In the present study conservation and management measures for the long term wellbeing of mangroves of Kandla Port is suggested based on intensive field visits, analyzing the existing management practices of the port *vis-à-vis* mangroves and plantation and other conservation activities carried out by port authorities under different projects of the port.

In order to understand the present status in terms of overall mangrove forest structure, stand health and governing physio-chemical factors a detailed field based investigation was carried out. For delineating mangrove characteristics, 21 transects were sampled covering various patches of Kandla port premises. Parameters like density, tree height, GBH, canopy length, canopy width, vegetation frequency and regeneration and recruitment potential were investigated. The mangrove vegetation structure of 21 sampled locations shows an average tree density of 4124/ha and tree height of 254cm and GBH of 40.4 cm. During the present study, mangrove tree density in all the 21 sampled locations ranged between 1500/ha and 7800/ha. Mangrove tree height ranged from 171 cm m to 431 cm with average value of 254cm. The Girth at Breast Height (GBH)of at different patches was from 31 cm to 49.5 cm with an average value of 40.4 cm. Regeneration class density ranged between 3300 to

100000/ha whereas recruitment class density were ranged from 1000 and 56600/ha. In general, mangrove vegetation structure at KPT premises demonstrated that mangrove patches are healthy with very moderate density and with good regeneration potential as evidenced by the ratio between mature trees and younger classes (recruitment and regeneration).

Water and sediment health status of KPT premises examined indicated that majority of the parameters are well within the prescribed limits and no pollution could be distinguished showing that the water and sediment at KPT premises is clean. Important parameters like salinity and pH of both surface water and pore-water are within expected level of any mangrove formation. Observed average pore-water salinity was 53.7 ppt and pHwas8.21. Nitrite concentration ranged from 0.1 to 0.9 mg/L with an overall average of 0.63 mg/L. Nitrate content of the present study varied from 0.9 to 1.9 mg/L with a cumulative average of 1.45 mg/L. Phosphate concentration ranged from 0.1 – 1.8 mg/L with an average of 0.75 mg/L. The recorded nutrient concentrations of the present investigation are good enough to support the growth and vegetation structure of the KPT mangroves.

Land cover category of KPT jurisdictions has been estimated in hectares and area contribution are expressed in percentage. Total mangrove cover constitutes 15.3% with dense mangroves constituting 3.8% and sparse mangrove 11.5 %. Highest land cover is occupied by mudflats to the tune of 36.9% followed by water spread (11.5%) whereas cover of settlement (01%) and agriculture (1.7%) was lowest.

During the present study, following impacts were recorded due to coastal modification, tidal regime and water currents.

1. Erosion of the creek banks in the immediate vicinity of water front.
2. Reduced tidal flushing and decrease in the tidal flat in and around the construction points.

Following the forecast of impacts, effective mangrove management plan for the preservation of KPT mangroves, suggestions which covers the following three important aspects.

- Creation of Baseline Information to track subsequent changes in mangrove vegetation structure due to port activities and related development activities.
- Periodic monitoring programs are to be organized whose results in comparison with baseline data will assist to formulate appropriate management options to check any stand degradation.
- Preservation measures to be undertaken in the event of signs of impact

Mangrove monitoring programs at a regular interval of one year for gathering all baseline parameters in the same GPS referenced points is suggested. Overlaying the data generated during monitoring program with those of baseline data will help the port authorities to track changes happening in KPT mangroves. Regular monitoring of the chosen parameters in KPT mangroves will highlight the impact of the ongoing activities. Management alternatives to preserve mangroves could be contemplated based on this changes detected during monitoring phases.

Suggested mangrove preservation measures include the following. These preservation measures are parallel and consequent to monitoring programs.

Incidences that are detrimental to mangroves like Oil/fuel and other hydrocarbon spillage from earthwork machineries, fire, unauthorized entry of personnel, trespassing and grazing by cattle and collecting forest produce from mangroves are to be reported which will be investigated and appropriate follow-up action taken.

Washing frontline mangrove foliage through pressure hosing if dust deposition is notices in frontline mangroves along with a thorough review of dust control measures.

Since developmental activities in the intertidal and near intertidal regions are perceived to cause impact to a large extent, various measures to preserve mangroves from port development impact are suggested. Undertaking mangrove rehabilitation activities in the KPT premises is also recommended in technically suitable sites.

9. REFERENCES:

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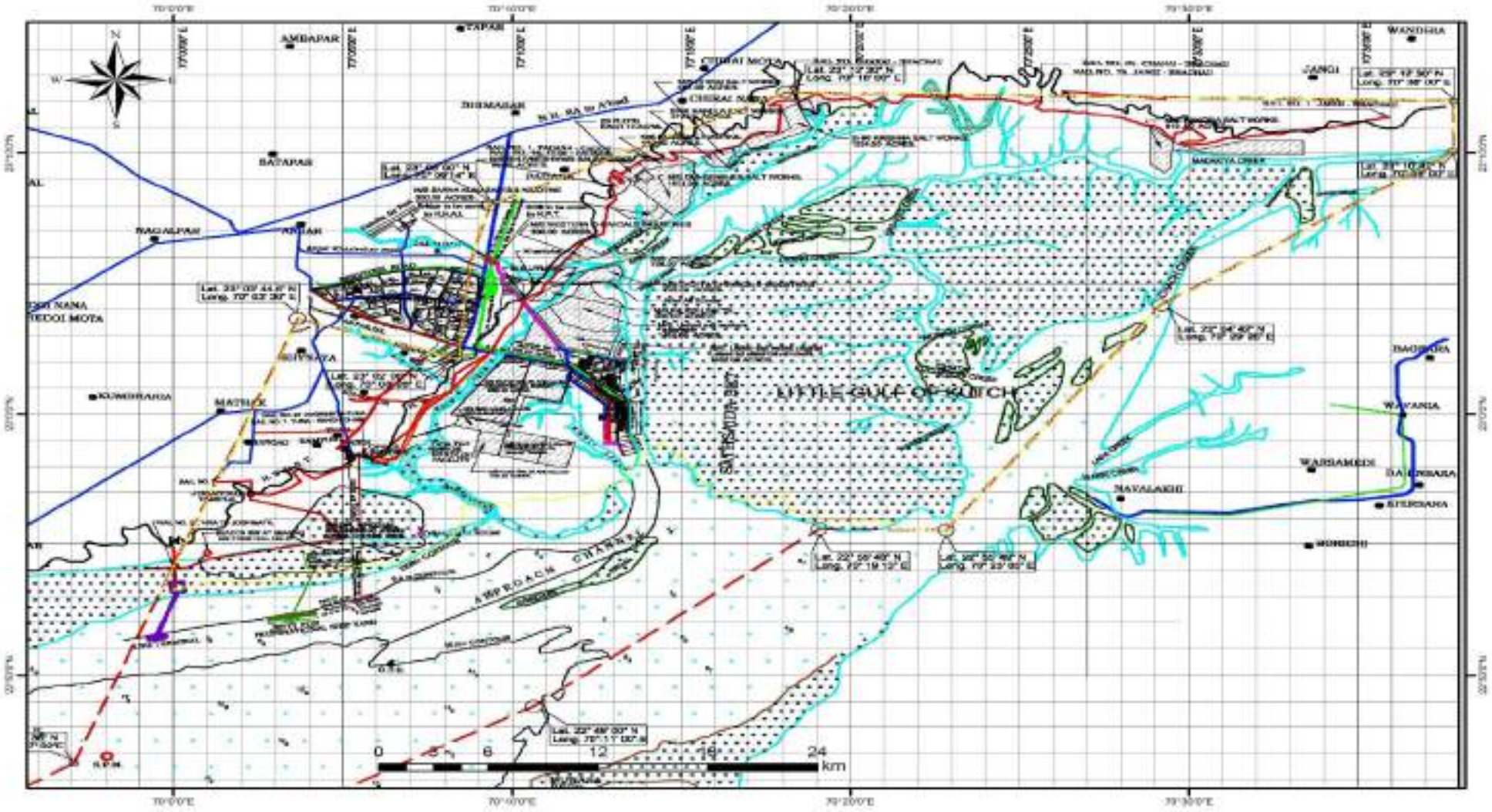
Annexure I. Location Map of the Kandla Port Premises



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Annexure J

Regular monitoring of mangrove W/O 10.06.2024

DEENDAYAL PORT AUTHORITY

दीनदयाल पत्तन प्राधिकरण
DEENDAYAL PORT AUTHORITY

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

www.deendayalport.gov.in

NO.EG/WK/4751/Part (Marine Ecology Monitoring)/70 Dated : 10 /06/2024

To,
The Gujarat Institute of Desert Ecology,
P.O.Box No. 83,
Opp. Changleshwar Temple, Mundra Road,
Bhuj (Kachchh)- 370 001,Gujarat (India).
Tel.: 02832-329408, 235025.
Tele/Fax: 02832-235027
Email: desert_ecology@yahoo.com

Kind Attn.: Dr.V.Vijay Kumar, Director, GUIDE, Bhuj.

Sub: Monitoring of Mangrove Plantation 1600 Hectares carried out by DPA (Statutory Requirement) reg.

Ref.:1) DPA request vide letter no. EG/WK/4751/Part (Marine Ecology Monitoring)/23 dated 12/2/2024.
2) Offer submitted by GUIDE, Bhuj vide letter no. GUIDE/DPA/Offer/ Mang. Plant/13 dated 4/4/2024.

Sir,

Your offer for the subject work submitted vide above referred letter dated 4/4/2024 **(Copy attached – Annexure A)** amounting to Rs. 33,60,000.00 + 18% GST (Rupees Thirty-Three Lakhs and Sixty Thousand only plus eighteen percent GST) with all terms & conditions mentioned in the offer letter, has been accepted by the competent authority in DPA.

2. Scope of work :

Monitoring of Mangrove Plantation (1600 Hectares) carried out by DPA (statutory requirement). The monitoring study will cover components such as density, diversity and abundance. Other variables such as canopy cover, GBH, height, along with the recruitment and regeneration classes will also be investigated. Additionally, carbon sequestration potential of the plantation will also be studied in view of Climate Change mitigation measures.

.....Cont.....

3. The terms of payment:

i) 50 % of the project budget should be paid within 15 days from the date of Submission of Inception Report by GUIDE, Bhuj.
ii) 25% of the project budget should be paid within 15 days from the date of submission of Draft report by GUIDE, Bhuj.
iii) 25% of the project budget should be paid within l5 days from the date of submission of Final report by GUIDE, Bhuj.

4. Obligation of DPA :

- Assistance regarding the statutory clearance from concerned authorities to be rendered by DPA for field visits.
- Study area map along with GPS co-ordinates is to be provided by the DPA.

5. Time Period: One year (One time monitoring in a year) i.e. from 10/6/2024 to 09/6/2025.

6. Kindly send the acknowledgement of this work order & start the work immediately.

Thanking you.

Yours faithfully,

10/6/24

Dy. Chief Engineer & EMC (I/c)
Deendayal Port Authority

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Annexure K

Lic of Haz Waste

Regional Office – Kutch (East)
Gujarat Pollution Control Board
Room No. 215-216-217, 2nd Floor,
Kandla Port Trust Administrative Building,
Gandhidham – 370201, Kutch.
Email:- ro-gpcb-kutc@gujarat.gov.in

By R.P.A.D.

CONSOLIDATED CONSENT AND AUTHORIZATION (CC & A)
CCA NO: AWH-64725 Appl. Type: CCA-Renewal
NO: GPCB/KUT/RO/CCA- Renewal/ID-38470/

In exercise of the power conferred under Section-25 of the Water (Prevention and Control of Pollution) Act-1974, under Section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 6(2) of the Hazardous & Other Wastes (Management and Transboundary Movement) Rules-2016, framed under the E(P)Act-1986.

And whereas Board has received consolidated application dated 13/03/2023 and inward no. 274885 for the Renewal of consolidated consent and authorization (CC & A) of this Board under the provisions / rules of the aforesaid Acts. Consolidated Consent & Authorization is hereby granted as under.

CONSOLIDATED CONSENT AND AUTHORISATION:
(Under the provisions / rules of the aforesaid Environmental Acts)

To,
M/s. United Shipping Company,
Plot NO: 46, Mithirohar-GGDC,
Vill: Mithirohar -370240,
Tal: Gandhidham, Dist: Kutch East.

1. **Consent Order No.: AWH-64725, date of Issue 30/06/2023.**
2. The consent under Water Act –1974, Air Act – 1981 and Authorization under Environment (Protection) Act, 1986 **shall be valid up to 13/03/2033** to operate industrial plant to manufacture following product:

Sr. No.	List of Product	Quantity	Unit Per Month	Remarks
1.	Re-Relined Used Oil/ Waste Oil	525.00	MT	--

SPECIFIC CONDITIONS:-

a. No ground water shall be used for the project coming under dark zone without permission of competent authority.
b. Industry shall comply with fresh water from valid source having permission of the competent authority.
c. Industry shall not carry out any activity which may attract the applicability of EIA Notification-2006 & its amendment.
d. Management of Solid Waste generated from industrial activities shall be as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46).
e. As per provision of Rule-L8 of Solid Waste Management Rules-2016 all industrial units using fuel and located within 100 km from the refused derived fuel (RDF) plant shall made an arrangement to replace at least five percent of their fuel requirement by refused derived fuel so produced.
f. You shall not receive/ reprocess the used/ spent oil without obtain necessary amendment to authorization under rule-9 of Hazardous and Other Wastes (Management and Transboundary Movement) Rules-2016 from competent Authority.

3. CONDITION UNDER THE WATER ACT:

3.1 Source of water: Tankers.

3.2 The quantity of total water consumption shall not exceed **13 KL/Day** as per below break up as mentioned in form D submitted for consent application under Water Act- 1974.

a) **Industrial: 12 KL/Day.**
b) **Domestic: 1 KL/Day.**

3.3 The quantity of total waste water generation shall not exceed **01 KL/Day** as per below break up as mentioned in form D submitted for consent application under Water Act-1974.

a) **Industrial: 0.5 KL/Day**
b) **Domestic: 0.5 KL/Day**

3.4 Industrial effluent management:

a) Mode of disposal of treated industrial effluent: **ETP.**
b) Description for treated industrial effluent disposal: **There shall be no discharge of industrial effluent. The effluent generated from the manufacturing process and other ancillary industrial operation shall be treated in Effluent Treatment Plant, giving primary treatment and shall be reused back in cooling process, in order to achieve zero liquid discharge.**

3.5 Domestic sewage management:

a) Mode of disposal of treated domestic sewage: **Soak Pit/ Septic Tank.**
b) Description for treated domestic sewage disposal: **Generated domestic waste water shall be disposed into Soak Pit/ Septic Tank.**

3.6 Industry shall provide fixed pipeline with flow meter for reuse of treated effluent in cooling process and maintain its record at site.

3.7 There shall be no discharge of the Industrial effluent which will be generated from the manufacturing process and other ancillary industrial operations, Hence the Industry shall strictly adhere to zero liquid discharge (ZLD).

3.8 Disposal system for storm water shall be provided separately. In no circumstances storm water shall be mixed with industrial effluent.

3.9 The Board reserves the right to review and/or revoke the consent and / or make modifications in the conditions which it seems fit in accordance with provisions of Water Act-1974.

4. CONDITIONS UNDER THE AIR ACT:

4.1. Industry shall use fuel as specified in this order and the flue gas emission through stack shall conform to the following standards:

Sr. No.	Stack attached to	Capacity	Name of fuel	Quantity of Fuel	Air Pollution Control Measure (APCM)	Stack Height in Meter (From G.L.)	Parameter & Permissible limit
1.	Thermic Fluid Heater	10 Lac Kcal	Diesel	15 Lit/Hr.	Cyclone Separator	30	PM 150 mg/Nm^3 SO_2 100 PPM NOX 50 PPM

4.2. There shall be no process gas emission from the manufacturing process and any other ancillary industrial operation through various stacks/ vent of reactors, process, and vessel from plant premises.

4.3. 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 Standards issued by MoEF & CC dated 16th November-2009.

Regional Office – Kutch (East)
Gujarat Pollution Control Board
Room No. 215-216-217, 2nd Floor,
Kandla Port Trust Administrative Building,
Gandhidham – 370201, Kutch.
Email:- ro-gpcb-kutc@gujarat.gov.in

Sr. No.	Parameters	Permissible Limit (microgram / m^3)	
		Annual	24 Hours Average
1.	Particulate Matter (PM_{10})	60	100
2	Particulate Matter (PM_{25})	40	60
3.	Oxides of Sulphur (SO_x)	50	80
4.	Oxides of Nitrogen (NO_x)	40	80

- **Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.**
- **24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.**

4.4 Industry shall provide portholes, ladder, platform etc. at chimney(s) for monitoring the air emissions and the same shall be open for inspection to/and for use of Board's 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.

4.5 Industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Daytime is reckoned in between 6 a.m. and 10 p.m. and nighttime is reckoned between 10 p.m. and 6 a.m.

5. AUTHORISATION FOR THE MANAGEMENT & HANDLING OF HAZARDOUS WASTES Form-2 (See rule 6(2)).

5.1. Number of authorization: **AWH-64725, date of Issue 30/06/2023.**

5.2. **M/s. United Shipping Company**, is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated at **Plot NO: 46, Mithirohar-GGDC, Vill: Mithirohar -370240, Tal: Gandhidham, Dist: Kutch East.**

Sr. No.	Name of Haz. Waste	Category Number	Quantity in MT/Yr.	Facility and Mode of Disposal
1.	Used or Spent Oil	5.1	7200.00	Collection, storage, Transportation and disposal by reuse as lubricant in plant machineries within plant premises.
2.	Discarded Containers/ Barrels/ Liners	33.3	15.00 Nos./Yr.	Collection, storage, Transportation and disposal by giving it to registered recycler.
3.	Oily Sludge/ Emulsion	4.1	30.00	Collection, storage, Transportation and disposal by giving it to registered recycler.
4.	Organic Process Residue	4.4	20.00	Collection, storage, Transportation and disposal to CHWIF.
5.	ETP Sludge	34.3	0.50	Collection, storage, Transportation and disposal to TSDF.
6.	Spent Clay	4.5	30.00	Collection, storage, Transportation and disposal to CHWIF or to actual reuser or for Co-incineration.

5.3. The authorization is granted to operate a facility for collection, storage within factory premises, transportation and ultimate disposal of Hazardous wastes as mentioned above.

5.4. The authorization shall be in force for a period as mentioned above.

5.5. The authorization is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.

5.6. **Terms and conditions of authorization:**

a. The authorized person shall comply with the provisions of the Environment (Protection) Act, 1986, and the rules made there under.

b. The authorization or its renewal shall be produced for inspection at the request of an officer authorized by the Gujarat Pollution Control Board.

c. The person authorized shall not rent, lend, sell, transfer or otherwise transport the hazardous and other wastes except what is permitted through this authorization.

d. Any unauthorized change in personnel, equipment or working conditions as mentioned in the application by the person authorized shall constitute a breach of his authorization.

e. The person authorized shall implement Emergency Response Procedure (ERP) for which this authorization is being granted considering all site specific possible scenarios such as spillages, leakages, fire etc. and their possible impacts and also carry out mock drill in this regard at regular interval of time;

f. The person authorized shall comply with the provisions outlined in the Central Pollution Control Board guidelines on "Implementing Liabilities for Environmental Damages due to Handling and Disposal of Hazardous Waste and Penalty"

g. It is the duty of the authorized person to take prior permission of the Gujarat Pollution Control Board to close down the facility.

h. The imported hazardous and other wastes shall be fully insured for transit as well as for any accidental occurrence and its clean-up operation.

i. The record of consumption and fate of the imported hazardous and other wastes shall be maintained.

j. The hazardous and other waste which gets generated during recycling or reuse or recovery or pre-processing or utilization of imported hazardous or other wastes shall be treated and disposed of as per specific conditions of authorization.

k. The importer or exporter shall bear the cost of import or export and mitigation of damages if any.

l. An application for the renewal of an authorization shall be made as laid down under these Rules.

m. Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board from time to time.

n. Annual return (Form – 4) shall be filed by June 30th for the period ensuring 31st March of the year.

5.7. The industry shall have to manage used or spent oil; empty or discarded barrels / containers / liners contaminated with hazardous chemicals / wastes, process waste as per Hazardous & Other Wastes (Management and Transboundary Movement) Rules-2016, framed under the E(P)Act-1986 and shall apply Authorization for all applicable waste.

5.8. The waste generator shall be totally responsible for (i.e. collection, storage, transportation and ultimate disposal) of the wastes generated.

5.9. In case of any accident, details of the same shall be submitted in Form - 11 to Gujarat Pollution Control Board.

6. **GENERAL CONDITION**

6.1 In case of change of ownership/ management the name and address of the new ownership/ partners/ directors/ proprietor should immediately be intimate to the Board. Also any change in equipment or working conditions as mentioned in the consent form/ order should immediately be intimated to this Board.

Regional Office – Kutch (East)
Gujarat Pollution Control Board
Room No. 215-216-217, 2nd Floor,
Kandla Port Trust Administrative Building,
Gandhidham – 370201, Kutch.
Email:- ro-gpcb-kutc@gujarat-gov.in

6.2 Industry shall put up at the entrance a board displaying the name of the Industry, particulars of the products/ process and the name of proprietor/partners /directors of the Industry and the electricity consumer number as on the record of PGVCL.

6.3 The environmental statements pertaining to the previous year shall be submitting to this State Board latest by 30th June every year.

6.4 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 5 meters width is developed.

6.5 The industry shall have to display the relevant information with regard to hazardous waste, waste water & air pollutants as indicated in the Courts Order In W.P. No.657 of 1995 dated 14th October-2003.

6.6 As per "Public Liability Insurance Act – 1991", Industry shall get Insurance Policy, if applicable.

6.7 Applicant shall also comply with the general conditions given in annexure I.

6.8 The waste generator shall be totally responsible for (I.E. Collection, storage, transportation and ultimate disposal) of the wastes generated.

6.9 Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form - 4 by 31st January of every year

6.10 In case of any accident, details of the same shall be submitted in Form - 5 to Gujarat Pollution Control Board.

6.11 Empty drums and containers of toxic and hazards material shall be treated as per guideline published for management & handling of discarded containers". Records of the same shall be maintained and forwarded to Gujarat Pollution Control Board regularly.

6.12 In no case any kind of hazardous waste shall be imported without prior approval of appropriate authority.

6.13 In case of transport of hazardous waste to a facility for (I.E. Treatment, Storage and disposal) existing in a state other than the state where hazardous waste are generated, the occupier shall obtain "No Objection certificate" from the state pollution Control Board, the Committee of the concerned state or Union territory Administration where the facility exists.

6.14 Unit shall take all concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within 03 months and also along with Form 4.

6.15 Industry shall have to display online data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant, including wastewater and air emissions and solid hazardous waste generated within the factory premises.

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(Rajesh Kumar Parmar)
Regional Officer, Kutch (East)

ISSUED TO,
M/s. United Shipping Company,
Plot NO: 46, Mithirohar-GGDC,
Vill: Mithirohar -370240,
Tal: Gandhidham, Dist: Kutch East.

GPCB ID: 38470, Inward ID: 274885.

Gujarat Pollution Control Board

REGIONAL OFFICE : MEHSANA

Plot No.. H/3-A, GIDC Estate, Phase-1, Nr FCI Godown, Modhera Road, Mehsana-384 002
Phone No.: (02762) 258294, 258106, Web: http/gpcb.gujarat.gov.in

By R.P.A.D

NO: GPCB / MEH / CCA- 46(4)/ ID-18126/ 5403/17605 **Date:08/05/2023**

In exercise of power conferred under Section –25 of the Water (Prevention & Control of Pollution) Act - 1974, under Section - 21 of the Air (Prevention & Control of Pollution) Act - 1981 and Authorization under rule 3 (c) & 5 (5) of the Hazardous Waste (Management & Handling & Trance boundary movement) Rules 2008 framed under the Environmental (Protection) Act 1986.
And Whereas Board has received Consolidated Consent Application letter No. **273092** dated **29/01/2023** for the **Consolidated Consent and Authorization** (C C & A) of this Board under the provision / rules of the aforesaid Acts. Consent & Authorization are hereby granted as under

CONSENT AND AUTHORIZATION:
(Under the provision/ rules of the aforesaid Environmental Acts.)

TO,
M/s. ALICID ORGANIC INDUSTRIES LTD
Plot No. 207, 208.
Village: Hanumant Beduva,
Ta & Dist: Mehsana - 384 002.

1. Consent Order No: **AWH-62807**, Date of issue: **19/04/2023**.
2. The consent shall be valid up to **31/03/2028** for use outlet for the discharge of trade effluent & emission due to operation of industrial plant for manufacture of the following items / products.

SR. No	Product	Quantity
1.	Re cycled Waste Oil (Industrial fuel)	1500 KL/Month
2.	Re-refine used oil	225 KL/Month

SPECIFIC CONDITION:

- **The passbook for Re-Refining of Hazarders waste for "Waste oil @ 18000 KLPD & used oil @ 2700 KLPD" shall be valid up to 31/03/2023.**
- **The unit shall not import any waste without obtaining the clearance as specified in Sch-VII of Haz. Waste Rules-2016.**
- **The unit shall quarterly and annually submit the details of waste procured and processed to the Board.**

3. **CONDITION UNDER THE WATER ACT**

3.1 There shall be no discharge of the industrial effluent from the manufacturing process and other ancillary industrial operations
3.2 The quantity of the industrial discharge shall be **NIL.**
3.3 The quantity of the domestic waste water (sewage) shall not exceed **800 Lits/day.**
3.4 Sewage shall be disposed of through **Septic tank/soak pit** system.

4. **CONDITIONS UNDER AIR ACT 1981:**

4.1 The following shall be used as fuel.

Sr. No	Fuel	Quantity
1.	LDO	65 Lit/ Hr.
2.	Wood	100 Kg/ Hr.
3.	Imported Coal	75 Kg/ Hr.
4.	CNG	175 SCM/ Hr

4.2 The applicant shall install & operate air pollution control system in order to achieve norms prescribed below.
4.3 The flue gas emission through stacks attached to boiler shall conform to the following standards:-

Stack No.	Stack Attached to	Stack Height in Meter	APCM	Parameter	Permissible Limit
1.	Thermic Fluid Heater (02 Lakh Kcal)	30	--	PM SO2 NOx	150 mg/NM3 100 ppm 50 ppm
	Thermic Fluid Heater (02 Lakh Kcal)	30	--		
2.	Thermic Fluid Heater (01 No's) (06 Lakh Kcal)		--		
3.	Thermic Fluid Heater (01 No's) (10 Lakh Kcal)		Dust collector + Bag Filter		

4.4 There shall be no process emission from the manufacturing process and other ancillary operations.
4.5 Ambient air quality within the premises of the industry shall conform to the following standards: -

PARAMETERS	PERMISSIBLE LIMIT	
	Annual	24 Hrs Average
Particulate Matter- 2.5 (PM 2.5)	40 Microgram/M3	60 Microgram/M3
Particulate Matter- 10 (PM 10)	60 Microgram/M3	100 Microgram/M3
Sulphur Dioxide (SO2)	50 Microgram/M3	80 Microgram/M3
Nitrogen Dioxide (NOx)	40 Microgram/M3	80 Microgram/M3

4.6 The applicant shall install & operate following Air pollution control equipment very efficiently & continuously so that the emission of particulate matter shall not exceed the concentration mentioned at 4.5 above.
4.7 The consent to operate the industrial plant shall lapse if at any time the parameters of the emission are not within the tolerance limits specified in the condition no-4.5.
4.8 The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

5. AUTHORISATION FOR THE MANAGEMENT & HANDLING OF HAZARDOUS WASTES FORM-2 (See rule 5 (4))

5.1 Form for grant of authorisation for occupier or operator handling hazardous waste.
5.2 M/S. **ALICID ORGANIC INDUSTRIES LTD** is hereby granted an authorisation to operate facility for following hazardous wastes on the premises situated at **Plot No. 207, 208, Village: Hanumant Heduva, Ta & Dist: Mehsana – 384 002.**

Sr. No.	Type of Waste	Quantity	Category Schedule-1	Facility
1.	Used Oil (Cat. No. 5.1)	2700 KL/Year	5.1	Reception, Collection, Storage & Re-Refining in the premises.
2.	Waste Oil (Cat. No. 5.2)	18000 KL/Year	5.2	Reception, Collection, Storage & Re-cycling in the premises.
3.	Distillation Residues (Cat. No. 20.3)	444 KL/Year	20.3	Collection, Storage, transportation, disposal at Authorized CHWIF
4.	Spent Clay Containing Oil (Cat. No. 4.5)	117 MT/Year	4.5	Collection, Storage, transportation, disposal at Authorized CHWIF
5.	Filter and filtering materials (Cat. No. 36.2)	1.2 MT/Year	33.3	Collection, Storage, Transportation, disposal at Authorized TSDF site

5.3 The authorisation is granted to operate a facility for Collection, Storage, and return back to supplier/ sale to authorized recycler.

5.4 The authorisation shall be valid up to **31/03/2028.**

5.5 The authorisation is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.

6 GENERAL CONDITION:

6.1 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 05 meters width is developed.

6.2 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 Cess Act- 1977

6.3 In case of change of ownership/management the name and address of the new owners/partners /directors/proprietor should immediately be intimated to the Board

6.4 The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emission or sewage waste from the proposed industrial plant. The applicant is required to make applications to this Board for this purpose in the prescribed forms under the provisions of the Water Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986

6.5 Any change in personnel, equipment or working conditions as mentioned in the consents form/ order should immediately be intimated to this Board. The Board reserves the right to review and/or revoke the consent and/or make variations in the conditions, which the Board deems fit in accordance with Section 27 of the Act.

6.6 If it is established by any competent authority that the damage is caused due to their industrial activities to any person or his property. In that case they are obliged to pay the compensation as determined by the competent authority

6.7 Management of Solid Waste generated from industrial activities shall be as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46).

6.8 As per provision of Rule 18 of Solid Waste Management Rules-2016 all industrial units using fuel and located within 100 km from the refused derived fuel (RDF) plant shall made an arrangement to replace at least five percent of their fuel requirement by refused derived fuel so produced

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(D.M.Ratnani)
Regional Officer

GUJARAT POLLUTION CONTROL BOARD
REGIONAL OFFICE : AHMEDABAD (RURAL)
1, Daffodils Avenue,
Nr. Zydus Research Center,
Sarkhej-Bavla N.H No-8A, Moraiya-382213
Ta: Sanand, Dist: Ahmedabad.
Website : www.gpcb.gov.in
Email: ID : [redacted]
Ph. No. : [redacted]

GPCB

NO: GPCB/RO-ABD(RURAL)

DATE:

By: R.P.A.D.

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 6(2) of the Hazardous and other Waste (Management and Transboundary Movement) Rules, 2016, framed under the Environment (Protection) Act-1986.

And whereas Board has received on line consolidated application **Inward No. 159558** dated **19/07/2019** for the Consolidated Consent and Authorization (CC&A) of this Board under the provisions / rules of the aforesaid Acts Consent & Authorization is hereby granted as under.

CONSENT AND AUTHORISATION:
(Under the provisions / rules of the aforesaid environmental acts)

NOTARY ANWARHUSSEN S. TALAT REGD.No. B669/2011 EXP. DT. 19-09-2026 AHMEDABAD (GUJ. STATE) GOVERNMENT OF INDIA

To,
M/s. Amar Hydrocarbon Pvt Ltd,
Plote no: 36, S. No. 165/1 to 180, 1+2,
Iyava – 382170,
Tal: Sanand, Dist: Ahmedabad.

1.0 **Consent Order No. : AWH-38235, Date of Issue – 04/09/2019.**

1.1 The consents shall be valid up to **30/06/2024** for the use of outlet for the discharge of trade effluent & emission due to operation of industrial plant for manufacturing of following items/products:

Sr. No	Product	Quantity
1.	Re-Cycled Waste Oil	1500 KL/Month
2.	Re-Refined Used Oil	250 KL/Month
3.	Industrial Fuel Oil	500 KL/Month
4.	Industrial Soft Oil	250 KL/Month
5.	Industrial Specialty Oil	125 KL/Month
6.	Industrial Bottom Oil	125 KL/Month

SUBJECTTO THE FOLLOWING CONDITION:

1. **Unit shall have to obtain the Environmental Clearance from the relevant authority if at any stage project activity is covered under the EIA notification dated 14-09-2006, if applicable.**
2. **Unit shall strictly maintain zero liquid discharge.**
3. **Unit shall comply with guidelines/SOP prescribed by GPCB/CPG for used oil/waste oil.**
4. **Unit shall not extract ground water without getting prior permission from CGWA.**

2.0 CONDITIONS UNDER THE WATER ACT, 1974:

2.1 The total water consumption shall not exceed **5.5 KL/day.**

2.2 The quantity of the industrial effluent to be generated from the manufacturing process and other ancillary industrial operation shall not exceed **3.7 KL/Day.**

2.3 The generated Industrial effluent shall be treated in Effluent Treatment Plant and after treatment treated waste water shall be used **2.7 KL/Day** water in cooling tower and 1 KL/Day evaporated in heat quencher. Thus, unit shall maintain zero liquid discharge.

2.4 The quantity of domestic waste water (sewage) shall not exceed **1.6 KL/day.**

2.5 Domestic effluent shall be disposed off through **Septic tank/Soak pit system.**

3.0 CONDITIONS UNDER THE AIR ACT, 1981:

3.1 The following shall be used as fuel:

Sr. No.	Fuel	Quantity
1	Wood	2 MT/Day
2	LDO/light cut oil	200 lit/day

3.2 The applicant shall install and operate air pollution control system in order to achieve following norms prescribed below:

3.3 The flue gas emission through stack shall conform to the following standards:

Sr. No.	Stack attached to	Stack height in Meter	APCM Details	Parameter	Permissible Limit
1.	Wood fired Furnace	33 Common Stack	Waste Heat Quencher	Particulate matter	150 mg/Nm^3
2.	Thermic Fluid Heater			SO_2	100 ppm
				NO_x	50 ppm

3.4 There shall be no process gas emission from the manufacturing process and other ancillary industrial operations.

3.5 The concentration of the following parameters in the ambient air within the premises of the industry shall not exceed the limits specified hereunder:

Parameters	Permissible Limit Annual	Permissible Limit 24 Hrs Average
Particulate Matter-10 (PM_{10})	60 Microgram/m^3	100 Microgram/m^3
PM 2.5 ($PM_{2.5}$)	40 Microgram/m^3	60 Microgram/m^3
SO_2	50 Microgram/m^3	80 Microgram/m^3
NO_x	40 Microgram/m^3	80 Microgram/m^3

3.6 The applicant shall provide portholes, ladder, platform etc at chimney(s) for monitoring the air emissions and the same shall be open for inspection to/and for use of Board's 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.

3.7 The applicant shall operate industrial plant/air pollution control equipment very efficiently and continuously so that the gaseous emission always conforms to the standards specified in condition no. 3.3 and 3.5 above.

3.8 The consent to operate the industrial plant shall lapse if at any time the parameters of gaseous emission are not within the tolerance limits specified in the condition no. 3.3 & 3.5.

3.9 The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75 dB(A) during day time and 70 dB (A) during night time. Daytime is reckoned in between 6 a.m. and10 p.m. and night-time is reckoned between 10 p.m. and 6 a.m.

3.10 The applicant shall at his own cost get samples of ambient air quality collected & analyzed from an approved laboratory once in for the parameters indicated in condition No. 3.3 & 3.5 and shall submit in duplicate the report there of to the Board by the 10th of the succeeding month.

4.0 **GENERAL CONDITIONS:**

4.1 Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.

4.2 Whenever due to accident or other unforeseen act or ever, such emissions occur or is apprehended to occur in excess of standards laid down such information shall be forthwith reported to Board, concerned Police Station, Office of Directorate of Health Service, Department of Explosives, Inspectorate of Factories and local body. In case of failure of pollution control equipments, the production process connected to it shall be stopped. Remedial actions/measures shall be implemented immediately to bring entire situation normal.

4.3 The Environmental Management unit/cell shall be set up to ensure implementation and monitoring of environmental safeguards and other conditions stipulated by statutory authorities The Environmental Management cell/unit shall directly report to the Chief Executive of the organization and shall work as a focal point for internalizing environmental issues. These cells/units shall also coordinate the exercise of environmental audit of environmental statements.

4.4 The environmental audit shall be carried out yearly, if the unit fall under Schedule-I and Schedule-II of Environment Audit Scheme and the environmental statements pertaining to the activities for the year ending on 31st March shall be submitted to the State Board latest by 30th September every year.

4.5 The Board reserves the right to review and/or revoke the consent and/or make variations in the conditions, which the Board deems, fit in accordance with Section 27 of the Act.

4.6 In case of change of ownership/management the name and address of the new owners/ partners/directors/proprietor should be immediately be intimated to the Board.

5.0. **AUTHORISATION FOR THE MANAGEMENT & HANDLING OF HAZARDOUS WASTES Form-2 {See rule 6 (2)}.**

5.1 **M/s. Amar Hydrocarbon Pvt Ltd,** is hereby granted an Authorization to operate facility for following hazardous and other wastes on the premises situated at **Plote no: 36, S. No. 165/1 to 180, 1+2, Iyava – 382170, Tal: Sanand, Dist: Ahmedabad.**

Sr. No.	Waste	Category	Quantity	Facility
1.	Waste Oil	5.2	18000 KL/Year	Reception, Collection, Storage and Recycling.
2.	Used Oil	5.1	3600 KL/Year	Reception, Collection, Storage and Recycling.
3.	Distillation residue	20.3	540 KL/Year	Collection, Storage, Transportation, Disposal by incineration at SEPPI Kutch.
4.	Spent clay containing oil	4.5	70 MT/Year	Collection, Storage, Transportation, Disposal by incineration at SEPPI Kutch.
5.	ETP Waste	34.3	240 Kg/Year	Collection, Storage, Transportation, Disposal at TSDF of SEPPI Kutch.
6.	Filters & Filtering materials	35.1	240 Kg/Year	Collection, Storage, Transportation, Disposal at TSDF of SEPPI Kutch.
7.	Discarded barrels	33.3	2400 Nos./Year	Collection, Storage, Transportation, and Sale to registered de-contamination facility.

5.2 The authorization is granted to operate a facility for collection, storage at factory premises and transportation and disposal of hazardous waste as above.

5.3 The **Authorization No. AWH-38235** shall be in force for a period up to **30/06/2024.**

5.4 The authorization is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.

5.5 The applicant shall have to comply with the provisions of E-Waste (Management) Rules-2016.

be specified in the rules from time to time under the Environment (Protection) Act-1986.

5.5 The applicant shall have to comply with the provisions of E-Waste (Management) Rules-2016.

6.0 TERMS AND CONDITIONS OF AUTHORISATION:

6.1 The applicant shall comply with the provisions of the Environment (Protection) Act -1986 and the rules made there under.

6.2 The authorization shall be produced for inspection at the request of an officer authorized by the Gujarat Pollution Control Board.

6.3 The persons authorized shall not rent, lend, sell, and transfer of otherwise transport the hazardous wastes without obtaining prior permission of the Gujarat Pollution Control Board.

6.4 Any unauthorized change in personnel, equipment or working conditions as mentioned in the authorization order by the persons authorized shall constitute a breach of this authorization.

6.5 It is the duty of the authorized person to take prior permission of the Gujarat Pollution Control Board to close down the facility.

6.6 An application for the renewal of an authorization shall be made as laid down in rule 6 (1).

6.7 Industry shall submit annual report within 15 days and sub squinty by 30th June every year.

6.8 Industry shall have to manage waste oil; discarded containers etc as per the Rules 2016 and shall apply Authorization/submit details for all the applicable waste as per the Rules 2016 within 15 days.

7.0 GENERAL CONDITIONS:

7.1 The waste generator shall be totally responsible for (i.e. collection, storage, encapsulation, incineration, treatment, transportation and ultimate disposal) of the wastes generated.

7.2 Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form – 4 by 30th June of every year.

7.3 In case of any accident, details of the same shall be submitted in Form-11 to Gujarat Pollution Control Board.

7.4 As per "Public Liability Insurance Act - 91 "company shall get Insurance Policy, if applicable.

7.5 Empty drums and containers of toxic and hazards material shall be treated as per guideline published for "Management & Handling of discarded containers". Records of the same shall be maintained and forwarded to Gujarat Pollution Control Board regularly.

7.6 In no case any kind of hazardous waste shall be imported without prior approval of appropriate authority.

7.7 In case of transport of hazardous wastes to a facility for (i.e. treatment, storage and disposal) existing in a State other than the State where hazardous wastes are generated, the occupier shall obtain 'No Objection Certificate' from the State Pollution Control Board or Committee of the concerned State or Union territory Administration where the facility exists.

7.8 Unit shall take all concrete measures to show tangible results in waste generation, reduction, avoidance, reuse and recycle. Action taken in this regards shall be submitted within three months and also along with Form-4.

7.9 Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Courts Order in W.P. No.657 of 1995-dated 14th October-2003.

7.10 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 waste water and air emissions and solid hazardous wastes generated within the factory premises.

For and on behalf of
Gujarat Pollution Control Board

C.A. Shah
Regional Officer

NO: GPCB/RO-A'bad (Rural)/GEN-1201/ID-11702/ 15730 **Date:** 16/01/2020

Issued To:

M/s. Amar Hydrocarbon Pvt Ltd,
Plote no: 36, S. No. 165/1 to 180, 1+2,
Iyava – 382170, Tal: Sanand, Dist: Ahmedabad.

TRUE COPY
A. S. TALAT
NOTARY
GOVT. OF INDIA

Copy to: (1) The Member Secretary, GPCB, Gandhinagar..... For information please.

Gujarat Pollution Control Board

REGIONAL OFFICE : MEHSANA

Plot No.: H/3-A, GIDC Estate, Phase-1, Nr. FCI Godown, Modhera Road, Mehsana-384 002
Phone No.: (02762) 258294, Fax No.: (02762-258106) Web: gpcb.gov.in

GPCB

In exercise of power conferred under Section –25 of the Water (Prevention & Control of Pollution) Act – 1974, under Section – 21 of the Air (Prevention & Control of Pollution) Act – 1981 and Authorization under rule 3 (c) & 5 (5) of the Hazardous Waste (Management & Handling & Trance boundary movement) Rules 2008 framed under the Environmental (Protection) Act – 1986. And Whereas Board has received Consolidated Consent Application letter No. **159886** dated **26/06/2019** for the **Consolidated Consent and Authorization** (C C & A) of this Board under the provision / rules of the aforesaid Acts. Consent & Authorization are hereby granted as under:

CONSENT AND AUTHORIZATION:
(Under the provision/ rules of the aforesaid Environmental Acts.)

TO,
M/s. ATLAS ORGANICS P. LTD
Plot No. 1460/2,
Village:Rajpur-382740,
Ta: Kadi , Dist: Mehsana.

1. Consent Order No: **AWH-37547,** Date of issue: **29/07/2019.**
2. The consent shall be valid up to **31/03/2024** for use outlet for the discharge of trade effluent & emission due to operation of industrial plant for manufacture of the following items / products.

SR. No	Product	Quantity
1	Re-cycled Waste Oil	700 KL/Month
2	Re-refined used Oil	250 KL/Month

SPECIFIC CONDITION:

- **Unit shall obtain necessary CGWA permission in case of ground water withdrawal.**

3 CONDITION UNDER THE WATER ACT

3.1 The quantity of the industrial effluent to be generated from the manufacturing process and other ancillary industrial operations shall be **10.50 KLPD** as generated industrial effluent shall be treated in proposed ETP. Treated waste water shall be reuse back in process.

3.2 The quantity of domestic sewage effluent from the factory shall not exceed **0.2 KLPD.**

3.3 The effluent treatment plant consisting of the following units shall be provided.

Sr.No.	Name of Unit
1.	Collection Tank
2.	Oil & Grease ramoval Tank
3.	Neutralization Tank
4.	Settling Tank
5.	Holding Tank
6.	Sludge Drying Beds

3.4 Domestic effluent shall be disposed of through **Septic tank/soak pit** system.

4 CONDITIONS UNDER AIR ACT 1981:

4.1 The following shall be use as fuel in boiler/furnace/heater respectively.

Sr. No	Fuel	Quantity
1	LDO(for furnace)	500 Lit/ Day
2	LDO	750 Lit/Day
3	Coal	02 MT/Day

4.2 The applicant shall install & operate air pollution control system in order to achieve norms prescribed below.

4.3 The flue gas emission through stacks attached to boiler/furnace/heater shall conform to the following standards:-

Stack No.	Stack Attached to	Stack Height in Meter	APCM	Parameter	Permissible Limit
1	Thermic Fluid Heater & Non IBR Boiler	21.	--	PM SO_2 NO_x	150 mg/NM^3 100 ppm 50 ppm,
2	Furnace	15	Bag Filter		

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Gujarat Pollution Control Board

REGIONAL OFFICE : MEHSANA

Plot No.: H/3-A, GIDC Estate, Phase-1, Nr. FCI Godown, Modhera Road, Mehsana-384 002
Phone No.: (02762) 258294, Fax No.: (02762-258106) Web: gpcb.gov.in

4.4 There shall be no process emission from the manufacturing process and other ancillary operations.

4.5 Ambient air quality within the premises of the industry shall conform to the following standards: -

PARAMETERS	PERMISSIBLE LIMIT	
	Annual	24 Hrs Average
Particulate Matter- 2.5 ($PM_{2.5}$)	40 Microgram/M³	60 Microgram/M³
Particulate Matter-10 (PM_{10})	60 Microgram/M³	100 Microgram/M³

4.6 The applicant shall install & operate Air pollution control equipment very efficiently & continuously so that the gaseous emission always conforms to the standards specified in condition no.3.3 above.

4.7 The consent to operate the industrial plant shall lapse if at any time the parameters of the emission are not within the tolerance limits specified in the condition no.3.3 & 3.5 above.

4.8 The applicant shall provide portholes, ladder, platform etc at Chimney(s) for monitoring the air emission and the same shall be open for inspection to/and for use of board's 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.

4.9 The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

5. **AUTHORISATION FOR THE MANAGEMENT & HANDLING OF HAZARDOUS WASTES FORM-2 (See rule 5 (4))**

5.1 Form for grant of authorisation for occupier or operator handling hazardous waste.

5.2 **M/s. ATLAS ORGANICS P. LTD** is hereby granted an authorisation to operate facility for following hazardous wastes on the premises situated at **Plot No. 1460/2, Village:Rajpur-382740, Ta: Kadi , Dist: Mehsana.**

Sr. No.	Type of Waste	Quantity	Category Schedule-1	Facility
1	Waste Oil	10080 KL/Year	5.2	Collection, transportation, Storage & Re - cycling
2	Used Oil/Spent Oil	3600 KL/Year	5.1	Collection, transportation, Storage & Re - cycling
3	Empty Barrels/Containers barrels.	500 Nos./year	33.1	Collection, Storage , transportation,& sale to register recycler
4	ETP Sludge	1 MT/Year	34.3	Collection, decontamination s Storage ,& disposal at TSDF
5	Spent clay containing oil	200 MT//Year	4.5	Collection, deconamination s Storage ,& send to co-processor
6	Oily sludge/ Bottom residue	180 KL/Year	4.4	Collection, decontamination s Storage ,& send to co-processor

5.3 The authorisation is granted to operate a facility for Collection, Storage, encapsulation, incineration treatment within the factory premises transportation and ultimate disposal of hazardous waste at NEPL.

5.4 The authorisation is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.

5.5 The authorisation shall be in force for a period up to **31/03/2024.**

6 **TERMS AND CONDITIONS OF AUTHORISATION**

a) The applicant shall comply with the provisions of the Environment (Protection) Act – 1986 and the rules made there under.

b) The authorisation shall be produced for inspection at the request of an officer authorized by the Gujarat Pollution Control Board.

c) The persons authorized shall not rent, lend, sell, transfer of otherwise transport the hazardous wastes without obtaining prior permission of the Gujarat Pollution Control Board.

d) Any unauthorized change in personnel, equipment or working conditions as mentioned in the authorisation by the persons authorized shall constitute a breach of this authorisation.

e) It is the duty of the authorised person to take prior permission of the Gujarat Pollution Control Board to close down the facility.

NOTARY N. RAMNANI Area-Gandhinagar Reg. No. 21071/20 GUJARAT-INDIA Expiry Date 06/03/2025 GOVT. OF INDIA

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Gujarat Pollution Control Board

REGIONAL OFFICE : MEHSANA

GPCB

Plot No.: H/3-A, GIDC Estate, Phase-1, Nr. FCI Godown, Modhera Road, Mehsana-384 002
Phone No.: (02762) 258294, Fax No.: (02762-258106) Web: gpcb.gov.in

f) An application for the renewal of an authorisation shall be made as laid down in rule 5(6)(ii).

g) Industry shall have to manager waste oil, discarded containers etc as per Amended Rules – 2003 and Shall apply authorization/submit details for all applicable waste as per Amended Rules -2003 with 15 days.

h) Industry shall submit annual report within 15 days and subsequently by 31st January every year

GENERAL CONDITION:

1 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 05 meters width is developed.

2 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 Cess Act- 1977.

3 In case of change of ownership management the name and address of the new owners/partners /directors/proprietor should immediately be intimated to the Board.

4 The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emission or sewage waste from the proposed industrial plant. The applicant is required to make applications to this Board for this purpose in the prescribed forms under the provisions of the Water Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986.

5 Any change in personnel, equipment or working conditions as mentioned in the consents form/ order should immediately be intimated to this Board. The Board reserves the right to review and/or revoke the consent and/or make variations in the conditions, which the Board deems, fit in accordance with Section 27 of the Act.

6 If it is established by any competent authority that the damage is caused due to their industrial activities to any person or his property. In that case they are obliged to pay the compensation as determined by the competent authority.

7 Management of Solid Waste generated from industrial activities shall be as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46).

8 As per provision of Rule-18 of Solid Waste Management Rules-2016 all industrial units using fuel and located within 100 km from the refused derived fuel (RDF) plant shall made an arrangement to replace at least five percent of their fuel requirement by refused derived fuel so produced.

NO:GPCB/CCA-MH- 155(3)/ID: 18145/ 1767/ 15925 Date: 05 AUG 2019

Issued to:
M/s. ATLAS ORGANICS P. LTD
Plot No. 1460/2,
Village:Rajpur-382740,
Ta: Kadi , Dist: Mehsana.

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(J.D.Priyadarshi)
Regional Officer

22 JUL 2022
TRUE COPY
(SHWETA N. RAMNANI)
ADVOCATE & NOTARY
Gandhidham - Kachchh

Clean Gujarat Green Gujarat

Regional Office – Kutch (East)
Gujarat Pollution Control Board
Room No. 215-216-217, 2nd Floor,
Kandla Port Trust Administrative Building,
Gandhidham – 370201, Kutch.
Email:- ro-gpcb-kute@gujarat.gov.in

In exercise of the power conferred under section-25 of the Waster (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 6(2) of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 framed under the E (P) Act-1986.

And whereas Board has received consolidated application no: 176383, dated 28/06/2020 for the fresh consolidated consent and authorization (CC & A) of this Board under the provision / rules of the aforesaid acts-rules. Consent & Authorization is hereby granted as under.

CONSOLIDATED CONSENT AND AUTHORISATION:
(Under the provision / rules of the aforesaid environmental acts)

To,
Aviation Corporation (PCB ID –63724),
PLOT NO: S. No. 67/2/P1,
Shikarpur- 370150
TAL: Bhachau, DIST: Kutch.

1. Consent Order No: AWH -43501; Date of Issue: 21/10/2020.

2. The consent shall be valid up to 27/06/2025 for the use of outlet for the discharge of trade effluent and emission due to operation of industrial plant for manufacture of following items/products at an above-mentioned address.

Sr No	Product	Quantity
1	Used Oil/ Waste Oil Reprocessing	300 MT/Month (Used Oil- 150 MT/Month & Waste Oil- 150 MT/Month)
2	Sodium Silicate	1500 MT/Month

Specific Condition

1. No ground water shall be withdrawn without prior approval from competent authority.
2. You shall not carry out any activity which may attract the applicability of EIA notification-2006 and its amendments.
3. Management of Solid Waste generated from industrial activities shall be as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46).
4. As per provision of Rule-18 of Solid Waste Management Rules-2016 all industrial units using fuel and located within 100 km from the refused derived fuel (ROF) plant shall made an arrangement to replace at least five percent of their fuel requirement by refused derived fuel so produced.
5. Industry shall manage Solid Waste generated from industrial activities as per Solid Waste Management Rules- 2016 (Solid Waste as defined in Rule- 3(46)).
6. Industry shall comply with Plastic Waste Management Rules- 2018 & amended therefore. (if applicable)
7. You shall have to comply with Coal Handling guideline.

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8. You shall have to comply with Fly Ash Notification- 1999 and its amendments.

3	**Condition under the Water Act**
3.1	Source of Water: Tankers
3.2	The quantity of industrial water consumption shall not exceed 07 KL/Day.
3.3	The quantity of Domestic water consumption shall not exceed 02 KL/Day.
3.4	The quantity of industrial waste water generated from manufacturing process & other ancillary operation shall not exceed 2.2 KL/Day.
3.5	The quantity the Domestic waste water (sewage) shall not exceed 1.2 KL/Day.
3.6	Industrial effluent from process plant, washing etc. shall be collected separately & treated into ETP adequately so that treated industrial effluent shall comply with following norms:

PARAMETER	PERMISSIBLE LIMIT
pH	6.5 to 8.5
Temperature	40°C
Color	100 Units
Suspended Solids	100 mg/l
Oil & Grease	10 mg/l
Phenolic Compound	01 mg/l
Amonical Nitrogen	50 mg/l
BOD (03 days At 27° C)	30 mg/l
COD	100 mg/l
Chloride	600 mg/l
Sulphates	1000 mg/l
Total Dissolved Solids	2100 mg/l
Sulphides	02 mg/l
Percent Sodium	60%
Sodium Adsorption Ratio	26

	Treated effluent confirming to the above standards shall be reuse in within plant only.
3.7	Industry shall provide fixed pipeline with flow meter for reuse of treated effluent to achieve Zero Liquid Discharge.
3.5	Sewage shall be disposed of through septic tank / soak pit system.
4	**Conditions under the Air Act**
4.1	The following shall be used as fuel.

Sr No	Fuel	Quantity
1	HSD	20 Lit/Hr.
2	LDO	290 Lit/Day
3	Fire Wood	08 MT/Day
4	Coal	05 MT/Day

4.2 The flue gas emission through stack shall confirm to the following standards.

Stack No	Stack attached to	Stack height in meter	APCM	Parameter	Permissible Limit
1	Boiler (01 TPD)	12	Water Scrubber	PM	150 mg/Nm3

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	2	Vessel (12 TPD)	11	with Cyclone Separator	SO2 NOx	100 PPM 50 PPM
	3	Furnace	30	Alkali Scrubber		
	4	DG Set (80 kVA) Stand by	11	--		

4.3 There shall be no process gas emission from manufacturing activities and other ancillary operations.

4.4 The concentration of the following 11parameters in the ambient air within the premises of the industry shall not exceed the limits specified hereunder as per National Ambient Air Quality Standards issued by MoEF & CC dated 16th November-2009.

Sr. No.	Pollutant	Time Weighted Average	Concentration in Ambient air in microgram/cum
1	Sulphur Dioxide (SO2)	Annual 24 Hours	50 80
2	Nitrogen Dioxide (NO2)	Annual 24 Hours	40 80
3	Particulate Matter (PM10)	Annual 24 Hours	60 100
4	Particulate Matter (PM2.5)	Annual 24 Hours	40 60

4.5 The applicant shall provide portholes, ladder, platform etc at chimney(s) for monitoring the air emissions and the same shall be open for inspection to/and tor use of Board's 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.

4.6 The industry shall make adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75dB(a) during day time and70 dB(A)during night time. Daytime is reckoned in between 6 AM to 10 PM and nighttime is reckoned between 10 PM to 6 AM.

4.7 **DG Sets Conditions:**

The D.G. Set shall have acoustic enclosure and shall comply with the standards specified at Sr. no. 95 of Schedule-I of the rule-3 of E.P. Rules -1986 and Noise pollution level as per the Air Act, 1981.

D.G. Sets standards:

The flue gas emission through stack attached to D.G. Sets shall conform to the following standards.

a) The minimum height of stack to be provided with each of the generator set shall be H=h +0.2(KVA) 112, where H=Total stack height in meter, h=height of the building in meters where or by the side of which the generator set is installed.
b) Noise from DG set shall be controlled by providing an acoustic enclosure or by treating the room acoustically, at the user's end
c) The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/ acoustic treatment. Such circumstances the performance may be checked for noise reduction up to actual ambient noise level.

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	preferably, in the night time). The measurement for insertion loss may be done at different points at 0.5 m from the acoustic enclosure/room, and the averaged. d) The D.G. Set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A). e) All efforts shall be made to bring down the noise level due to the D.G. Set, outside the premises, within the ambient noise requirements by proper siting and control measures. f) Installation of a D.G. Sets must be strictly in compliance with the recommendations of the D.G. Set manufacturer. g) A proper routine and preventive maintenance procedure for the D G. Set should be set and followed in consultation with the DG Set manufacture which would help prevent noise levels of the DG Set from deteriorating with use.
5	**Authorization under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 & amended.**
5.1	**Authorization Number: AWH -43501 Date of Issue: 21/10/2020 and shall valid up to 27/06/2025.**
5.2	**M/s. Aviation Corporation (PCB ID -63724),** is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated PLOT NO. S. No. 67/2/P1, Shikarpur– 370150, TAL: Bhachau, DIST: Kutch.

Sr. No	Waste	Quantity	Schedule-I	Facility
1	Used or spent Oil	1800 MT/yr.	5.1	Receipt, Collection, Storage, Transportation & reused in process.
2	Oily waste	1800 MT/yr.	5.2	Receipt, Collection, Storage, Transportation & reused in process.
2	Sludge from Wet Scrubber	05.0 MT/yr.	37.1	Collection, Storage, Transportation & Disposed to TSDF site.
3	Sludge and filter contaminated with Oil	20.0 MT/yr.	3.3	Collection, Storage, Transportation & Disposed to TSDF site.
4	Empty barrels/ containers/ liners contaminated with hazardous chemicals / wastes	04.00 M/yr.	33.1	Collection, Storage, Transportation & disposed by selling it to registered recycler.

5.3	The authorization is granted to operate a facility for collection, storage within factory premises, transportation and ultimate disposal of Hazardous waste by selling it to registered recyclers.
5.4	Unit shall apply for authorization for other types of hazardous waste referring to the amended Rules.
5.5	The authorization is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.
5.6	**Terms and conditions of authorization:-**
1.	The authorized person shall comply with the provisions of the Environment (Protection) Act, 1986, and the rules made there under.

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2.	The authorization or its renewal shall be produced for inspection at the request of an officer authorized by the State Pollution Control Board.
3.	The person authorized shall not rent, lend, sell, transfer or otherwise transport the hazardous and other wastes except what is permitted through this authorization.
4.	Any unauthorized change in personnel, equipment or working conditions as mentioned in the application by the person authorized shall constitute a breach of his authorization.
5.	The person authorized shall implement Emergency Response Procedure (ERP) for which this authorization is being granted considering all site specific possible scenarios such as spillages, leakages, fire etc. and their possible impacts and also carry out mock drill in this regard at regular interval of time.
6.	The person authorized shall comply with the provisions outlined in the Central Pollution Control Board guidelines on "Implementing Liabilities for Environmental Damages due to Handling and Disposal of Hazardous Waste and Penalty".
7.	It is the duty of the authorized person to take prior permission of the State Pollution Control Board to close down the facility.
8.	The imported hazardous and other wastes shall be fully insured for transit as well as for any accidental occurrence and its clean-up operation.
9.	The record of consumption and fate of the imported hazardous and other wastes shall be maintained.
10.	The hazardous and other waste which gets generated during recycling or reuse or recovery or pre-processing or utilization of imported hazardous or other wastes shall be treated and disposed of as per specific conditions of authorization.
11.	The importer or exporter shall bear the cost of import or export and mitigation of damages if any.
12.	An application for the renewal of an authorization shall be made as laid down under these Rules.
13.	Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board from time to time.
14.	Annual return shall be filed by June 30th for the period ensuring 31st March of the year.
5.7	**General Conditions**
1	Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.
2	Applicant shall also comply with the general conditions given in annexure I.
3	The waste generator shall be totally responsible for (I.E. Collection, storage, transportation and ultimate disposal) of the wastes generated.
4	Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form - 4 by 31s1 January of every year.
5	In case of any accident, details of the same shall be submitted in Form - 5 to Gujarat Pollution Control Board.
6	As per "Public liability Insurance Act - 91" company shall get Insurance policy, if applicable
7	Empty drums and containers of toxic and hazards material shall be treated as per guideline published for management & handling of discarded containers". Records of the same shall be maintained and forwarded to Gujarat Pollution Control Board regularly.
8	In no case any kind of hazardous waste shall be imported without prior approval of appropriate authority.
9	In case of transport of hazardous waste to a facility for (I.E. Treatment, Storage and disposal) existing in a state other than the state where hazardous waste are generated, the occupier shall obtain "No Objection certificate" from the state pollution Control Board, the Committee of the

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	concerned state or Union territory Administration where the facility exists.
10	Unit shall take a)) concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within 03 months and also along with Form 4.
11	Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Hon Supreme Court's order in W.P. NO.65 of 1995 dated 14th October 2003.
12	Industry shall have to display online data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant, including wastewater and air emissions and solid hazardous waste generated within the factory premises.

For and behalf of
Gujarat Pollution Control Board

Regional Officer, Kutch(East)

01 JUN 2022

REGIONAL OFFICE

GUJARAT POLLUTION CONTROL BOARD

PLOT NO: 1616-1617, 1st FLOOR, SWASTIC COMPLEX,
NEAR VEER MOKHADAJI CIRCLE, GHOGHA ROAD
BHAVNAGAR- 364001 PHONE: 2566108

No. GPCB/RO-BHV/BHV-1001/ID-15970/ 17394 **Dt:** 15 OCT 2022

To,
M/s. Fine Rifiners Pvt. Ltd. (ID: 15970)
Plot No: 40,
Village-Vartej, GIDC, Vartej
Vartej-364001
Tal: Bhavnagar, Dist: Bhavnagar.

Sub: Extension of validity of Consolidated Consent & Authorization under the Water Act-1974, the Air Act-1981 & the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

Ref: 1. Issued Consent order no. AWH-52604, Dated: **05/03/2022.**
2. Consent issued vide letter No. **GPCB/RO-BHV/BHV-1001/ID- 15970/ 17255,** Dated: 31/03/2022.

Sir,

In exercise of power conferred under section-27 of the Water (Prevention and Control of Pollution) Act-1974, under Section-21 of the Air (Prevention and Control of Pollution)-1981 & and authorization under Rule 3(3) & 6(2) of The Hazardous and other Wastes (Management and Transboundary Movement) Rules, 2016 and as amended from time to time, framed under The Environmental (Protection) Act-1986, Consent is granted with respect of following condition as under.

- The Validity period of the above referred CCA order is extended up to **30/09/2026,** with following specific condition:
  - Unit shall obtain CTE & CCA Amendment for additional plot.

- All other condition of CCA issued vide letter No. **GPCB/RO-BHV/BHV-1001/ID-15970/**17255, Dated: 31/03/2022. **shall remain unchanged.**

FOR AND BEHALF OF
GUJARAT POLLUTION CONTROL BOARD

(A.J. Rathod)
Regional Officer

FOR, FINE REFINERS PVT. LTD.

DIRECTOR

Dt. 05/05/2023

GUJARAT POLLUTION CONTROL BOARD
REGIONAL OFFICE
Swastik Complex, First Floor, Plot No. 1616/1617,
Near Vir Mokhdaji Circle, Ghogha Road, Bhavnagar - 364 001.
Phone (0278) 2566108 E-mail : ro-gpcb-bhav@gujarat.gov.in XGN site : www.gpcb.gujarat.gov.in

In exercise of the power conferred under section-25 of The Water (Prevention and Control of Pollution) Act-1974, Section-21 of The Air (Prevention and Control of Pollution) Act-1981, and authorization under Rule 3(3) & 6(2) of The Hazardous and Other Solid Wastes (Management & Transboundary Movement) Rules, 2016 and as amended from time to time, framed under The Environmental (Protection) Act-1986.

And whereas Board has received application vide **Inward ID No: 200555 & Inward Dt: 02/09/2021**, for The Consolidated Consent and Authorization (CC&A) of this Board under the provisions/rules of the aforesaid act. Consents & Authorization are hereby grant as under:

CONSENTS & AUTHORISATION
(Under the provisions/rules of aforesaid environmental acts)

TO,

M/s Fine Refiners Pvt. Ltd. (ID: 15970)
Plot No. 40,
GIDC-Vartej,
TAL: Bhavnagar, DIST: Bhavnagar

1 Consolidated Consent and Authorization Order **No: AWH-52604, Date of Issue 05/03/2022.**
2 The validity period of the order shall be up to **30/09/2022**
3 The list of the proposed product to manufacture is as below:

Sr. No	PRODUCT	QUANTITY
1.	Re refined of Used oil	200KL/Month
2.	Re refined of Waste oil	1000KL/Month

Special Condition:

- Unit shall submit the revised presentation including the material mass balance including quantity of raw material including activated clay requirement, product and waste generated, separate corrected flow diagram for used oil and waste oil.
- Unit shall improve the housekeeping and shall carry out plant retrofitting along with painting wherever required and shall submit the photograph.
- Unit shall submit the MOU as per hazardous waste generation of distillation residue and membership certificate for other waste disposal as per material balance quantity.
- Unit shall submit hazardous waste annual returns regularly.
- Unit shall adopt and regularly use the online manifest system for procurement & disposal of hazardous waste.

4 **CONDITIONS UNDER THE WATER ACT:**

4.1 The quantity of trade effluent from the manufacturing process and other ancillary operations shall not exceed **0.3 KL/Day.**

4.2 The applicant shall provide adequate effluent treatment system in order to achieve the quality of the treated effluent as per GPCB norms mentioned below:

Parameter	Permissible Limit
pH	6.5-8.5
Temperature	40 °C

FOR, FINE REFINERS PVT. LTD.

DIRECTOR

Dt. 05/05/2023

Color (Pt. Co Scale)	100 units
Suspended Solids	100 mg/l
Oil & Grease	10 mg/L
Ammonical Nitrogen	50 mg/L
BOD (5 days at 20 deg C)	30 mg/L
COD	100 mg/L
Chlorides	600 mg/L
Sulphates	1000 mg/L
TDS	2100 mg/L
% Na	60%.
Sodium Absorption Ratio	26

(All efforts shall be made to remove color and Unpleasant odor as far as practicable)

4.3 The Final treated effluent confirming to above shall be utilized on land within the factory premises and on land of farmer with whom agreement is made, for gardening & plantation purpose.

4.4 The quantity of sewage effluent from the factory shall not exceed **0.8 KL/Day**.

4.5 Domestic effluent shall be disposed off through septic tank/soak pit system.

5 CONDITIONS UNDER THE AIR ACT:

5.1 The following shall be used as fuel in the Boiler (Hot Water Generation):

Sr No.	Fuel	Quantity
1	Wood	50 Kg/Hr
2	LDO	15 Lit/Hr

5.2 The flue gas emission through stack shall conform to the following standards:

Sr.	Stack attached to	Stack height in meters	APCM	Parameters	Permissible Limit
1	Dehydration Furnace	Common Stack 33	Water Scrubber	Particulate Matter SO_2 NOx	150 mg/NM^3 100 ppm 50 ppm
2	Distillation Furnace				
3	Bleaching Furnace				
4	Incinerator				

5.3 There shall be no any process emission from the manufacturing process and other ancillary industrial operations.

5.4 The concentration of the following parameters in the ambient air within the premises of the industry and a distance of 10 meters from the source other than the stack/vent shall not exceed the following levels:

Sr. No.	Pollution Parameters	Time weighted Average	Concentration Ambient Air
1.	Sulphur dioxide (SO2), µg/M^3	Annual 24 Hours	50 80
2.	Nitrogen dioxide (NO2), µg/M^3	Annual 24 Hours	40 80
3.	Particulate Matter (Size less than 10µm)OR PM 10 µg/M^3	Annual 24 Hours	60 100
4.	Particulate Matter (Size less than 2.5m) OR PM2.5 µg/M^3	Annual 24 Hours	40 60

FOR, FINE REFINERS PVT. LTD.

DIRECTOR

Dt. 05/05/2023

5.5 Stack monitoring facilities like port hole, platform/ladder etc shall be provided with stack/vents chimney in order to facilitate sampling of gases being emitted in to the atmosphere.

5.6 The applicant shall provide proper ventilation and exhaust facilities to maintain healthy working atmosphere within the factory premises.

6 CONDITIONS UNDER HAZARDOUS WASTE:

6.1 Number of Authorization: AWH- -52604, Date of issue: 05/03/2022

6.2 **M/s Fine Refiners Pvt. Ltd.** is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated at **Plot No. 40,GIDC-Vartej, TAL: Bhavnagar, DIST: Bhavnagar.**

Sr. No.	Waste	Quantity	Category	Facility
1	Wastes or residues containing oil	9000 (MT/Year)	1-5.2	Collection, Storage, Recycle, Transport
2	Chemical sludge from waste water treatment	0.600 (MT/Year)	1-35.3	Collection, Storage, Reuse as lubricant within plant
3	Used or Spent Oil	1800 (MT/Year)	1-5.1	Collection, Storage, Recycle, Transport
4	Ash from incineration and flue gas cleaning residue	294.00 (MT/Year)	1-37.2	Collection, Storage, Reuse as lubricant within plant
5	Spend Clay Containing Oil	300.0 (MT/Year)	1-4.5	Collection, Storage, Transportation Disposal at TSDF site
6	Empty barrels/ containers/liners contaminated with hazardous chemicals/wastes	12.00 (MT/Year)	1-33.1	Collection, Storage, Reuse
7	Organic Residues From Process	130.600 (MT/Year)	1-4.4	Collection, Storage, Disposal at Incinerator.
8	Contaminated cotton rags or other cleaning materials	0.600 (MT/Year)	1-33.2	Collection, Storage, Disposal at Incinerator.

6.3 The authorization shall be valid up to **30/09/2022.**

6.4 The applicant shall obtain membership of common Hazardous Waste incinerator for disposal of incinerable waste, whenever applicable.

6.5 The applicant shall provide temporary storage facilities for each type of Hazardous Waste as per Hazardous and other solid waste (Management & Transboundary Movement) Rules-2016 as amended from time to time.

7 GENERAL CONDITION:

7.1 Unit shall develop green belt within premise as per the CPCB guidelines. However, if the adequate land is not available within premises, the unit shall tie up with local agencies like gram panchayat, school, and social forestry office etc. for the plantation at suitable open land in nearby locality and submit an action plan of plantation for next three years to GPCB.

7.2 Adequate plantation shall be carried out all along the periphery of premises in such a way that the density of plantation is at least 1000 tree per acre of land and a green belt of 10 meters width is developed.

7.3 The applicant shall have to submit the returns in prescribe form regarding water consumption and shall have to make payment of water cess to the Board under The Water Act-1977.

7.4 In case of change of ownership/management, the name and address of the new Owners/partners/directors/proprietor shall immediately intimate to the Board.

FOR, FINE REFINERS PVT. LTD.

DIRECTOR

Dt. 05/05/2022

7.5 The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emission or swage waste from the proposed industrial plant. The applicant is required to make application to this Board for this purpose in the prescribed forms under the provisions of the Water Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986.

7.6 The overall noise level in and around the plant area shall be kept well within the standard by providing noise control measure including engineering control like accoustic insulation hood, silencers, enclosures etc on all source of noise generation. The ambient noise level shall conform to the standards prescribed under the Environment (Protection) Act-1986& Rules.

7.7 The concentration of noise in ambient air within the premises of industrial unit shall not exceed following levels:

Between 6A.M. and 10P.M.: 75dB (A)
Between 10P.M. and 6A.M.: 70dB (A)

7.8 Applicant is required to comply with the manufacturing, Storage and Import of Hazardous Chemicals Rules-1989 Framed under the Environment (Protection) Act-1986.

7.9 If it is, establish by any competent authority that the damage is caused due to their industrial activities to any Person or his property; in that case they are obliged to pay the compensation as determined by the competent authority.

7.10 Applicant shall have to comply with the guidelines/directive issued/being issued by MoEF & CC/CPCB/DoEF from Time to time.

7.11 Applicant shall not use/withdraw ground water either during construction and/or operation phase.

7.12 Environmental cell shall be step and shall be responsible for the total Environmental management.

7.13 Monitoring in respect to Air, Water, and Noise level shall carry out regularly and results shall submit to this Board.

FOR AND BEHALF OF
GUJARAT POLLUTION CONTROL BOARD

31-3-2022
(A.G. Oza)
Regional Officer, Bhavnagar

No. GPCB/RO/BHV-1001/ID-15970/17255

Dt: 31 MAR 2022

M/s Fine Refiners Pvt. Ltd. (ID: 15970)
Plot No. 40,
GIDC-Vartej,
TAL: Bhavnagar, DIST: Bhavnagar

submit to this Board.

FOR, FINE REFINERS PVT. LTD.
DIRECTOR

Dt 05/05/2023

GPCB

GUJARAT POLLUTION CONTROL BOARD

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

"Consent to Establish"

(CTE-110273)

NO: GPCB/CCA-KUTCH-1742/ ID-78079 /573422 Date: 05-12-2020

To,

M/s. Mahalaxmi Asphalt Pvt. Ltd.,
Survey no.: 343,
Village: Bandhadi ,
Tal: Bhachau
Dist: Kutch – 370 140,

Sub Consent to Establish (NOC)-Amendment under Section 25 of Water Act 1974 and Section 21 of Air Act 1981

Ref: Your application for CTE no. **179791** received dated **22/09/2020.**

Without prejudice to the powers of this Board under the Water (Prevention and Control of Pollution) Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board grants Consent to Establish to set up an industrial plant located at Survey 343, Village. Bandhadi Tal Bhachau, Dist: Kutch

1. The validity of this order will be up to 21/09/2027.
2. The list of the products to be manufacture is as below:

Sr. No.	Product	Quantity
1.	Re-refined waste oil	500 KL/Month
2	Bitumen Melting	200 MT/Month

SUBJECT TO THE FOLLOWING CONDITIONS:

1. Industry shall not carry out any activity which attracts provision of EIA notification 2016 & its amendment.
2. Industry shall not withdrawal ground water without prior NOC of CGWA as per order of Hon National Green Tribunal.
3. Unit shall obtain Rule 9 permission as per Hazardous & Other Waste Management Rule-2016 for refining of waste oil.
4. Industry shall use environmentally sound technologies for refining of used oil/ waste oil as per Hazardous Rules.
5. Industry shall carry out only melting of solid bitumen in bitumen melting plant.
6. Unit shall obtain fresh water from valid source have permission of the complete authority
7. Industry shall take adequate measures to control fugitive emission due to storage, handling and transportation of raw materials and products.

3. **CONDITIONS UNDER WATER ACT 1974:**

3.1 Water Source: - Tankers

3.2 The quantity of fresh water consumption for Industrial purpose shall not exceed 4 KL/Day.

3.3 The quantity of fresh water consumption for Domestic purpose shall not exceed 2 KL/Day.

3.4 There shall be no generation of effluent asphalt mixer plant industrial waste water from waste oil refine plant after necessary treatment, shall be reused in cooling tower. In order to achieve ZLD.

3.5 Industry shall provide fixed pipeline with flow meter for reuse of treated industrial waste water & maintain its record.

3.6 The quantity of Domestic waste water generation shall not exceed 1.6 KL/Day.

3.7 The sewage shall be disposed through septic tank / soak pit system.

3.8 Disposal system for storm water shall be provided separately. In no circumstances storm water shall be mixed with the industrial effluent.

4. CONDITIONS UNDER AIR ACT 1981:

4.1 The following shall be used as fuel in the Furnaces, TFH & D.G Set respectively.

Sr. No.	Utility	Fuel	Quantity
1.	Furnaces (2 nos.)	Diesel	40 liter/hr
2.	TFH	Diesel	45 liter/hr
3	D.G set	Diesel	05 liter/hr

4.2 The applicant shall install & operate comprehensive air pollution control system in order to achieve flue gas emission norms as prescribed below.

4.3 The flue gases emission from stack attached to Furnaces, THF & D.G Set respectively:

Sr. No	Stack attached to	Stack height In Meters	APCM	Parameter	Permissible limit
1.	Furnaces (2 nos.) (waste oil plant)	33	Heat Quencher	PM SO_2 NO_x	150 mg/NM^3 100 ppm 50 ppm
2.	TFH (6 lakh K cal) (Bitumen melting plant)	11	–	PM SO_2 NO_x	150 mg/NM^3 100 ppm 50 ppm
3.	D.G. set (cap –165 KVA) Standby facility	–	–	PM SO_2 NO_x	150 mg/NM^3 100 ppm 50 ppm

4.4 There shall be no process gas emission from manufacturing process and other ancillary operations

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MAHALAXMI ASPHALT PVT. LTD.

For, MAHALAXMIASPHALT PVT. LTD.

AUTHORISED SIGNATORY

GPCB

GUJARAT POLLUTION CONTROL BOARD

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

4.5 The concentration of the following parameters in the ambient air within the premises of the industry and a distance of 10 meters from the sources (other than the stack/vent) shall not exceed the following levels.

Sr. NO.	Pollutant	Time Weighted Average	Concentration in Ambient air in $\mu g/m^3$
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

4.6 The level of Noise in ambient air within the premises of industrial unit shall not exceed following levels:

Between 6 am to 10 pm : 75 dB(A)
Between 10 pm to 6 am : 70 dB(A)

4.7 <u>D.G. Sets Conditions</u>

The D.G. Set shall have acoustic enclosure and shall comply sith the standards specified at Sr. no. 95 of Schedule-I of the rule-3 of E.P. Rules -1986 and Noise pollution level as per the Air Act-1981.

D.G. Sets standards: -

The flue gas emission through stack attached to D.G. Sets shall conform to the following standards.

a) The minimum height of stack to be provided with each of the generator set shall be H=h + 0.2 (KVA) 1/2, where H= Total stack height in meter, h= height of the building in meters where or by the side of which the generator set is installed.

b) Noise from DG set shall be controlled by providing an acoustic enclosure or by reating the room acoustically, at the users end.

c) The acoustic enclosure or acoustic treatment of the room shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/ acoustic treatment. Such circumstances the performance may be checked for noise reduction up to actual ambient noise level, preferably, in the night time). The measurement for insertion loss may be done at different points at 0.5 m from the acoustic enclosure/room, and the averaged.

d) The D.G. Set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A).

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Area- Dist. Kutch
Reg. No. 5848
Gujarat State
(INDIA)

Clean Gujarat Green Gujarat

ISO - 9001 - 2008 & ISO - 14001 - 2004 Certified Organisation

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e) All efforts shall be made to bring down the noise level due to the D.G. Set, outside the premises, within the ambient noise requirements by proper siting and control measures Installation of a D.G. Sets must be strictly in compliance with the recommendations of the D.G. Set manufacturer.

f) A proper routine and preventive maintenance procedure for the D.G. Set should be set and followed in consultation with the DG Set manufacture which would help prevent noise levels of the DG Set from deteriorating with use

5. **CONDITIONS UNDER HAZARDOUS & OTHER WASTE RULES 2016:**

5.1 The applicant shall have to comply with provisions of Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.

5.2 The applicant shall obtain membership of common TSDF site for disposal of Hazardous waste as categorized in Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.

5.3 The applicant shall obtain membership of common Hazardous Waste Incinerator for disposal of incinerable waste.

5.4 The applicant shall provide temporary storage facilities for each type of Hazardous Waste as per Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.

5.5 The applicant shall obtain registration/authorization for recycling/reprocessing any hazardous waste before procuring material/starting production as per HW Rules 2016.

5.6 The applicant shall obtain authorization for recovery/reuses of any hazardous waste material as per HW Rules 2016.

6. **GENERAL CONDITION:**

6.1 Adequate plantation shall be carried out all along the periphery of the Industrial premises in such a way that the density of plantation is atleast 1000 trees per acre of land and a green belt of 03 meters' width is developed.

6.2 In case of change of ownership/management the name and address of the new owners /partners/ directors/ proprietor should immediately be intimated to the Board.

6.3 The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emission or sewage waste from the proposed industrial plant. The applicant is required to make applications to this Board for this purpose in the prescribed forms under the provisions of the Water Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986.

6.4 The concentration of Noise in ambient air within the premises of Industrial unit shall not exceed following levels:

Between 6 A.M. and 10 P M : 75 dB(A)
Between 10 P M and 6 A.M. : 70 dB(A)

NOTARY GOVT. OF INDIA UMED K. JOSHI Area: Dist. Kutch Reg. No. 5483 Gujarat State (INDIA)

MAHALAXMIASPHALT PVT. LTD.

For, MAHALAXMIASPHALT PVT. LTD.

AUTHORISED SIGNATORY

GPCB

GUJARAT POLLUTION CONTROL BOARD

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

6.5 Applicant is required to comply with the manufacturing, Storage and Import of Hazardous Chemicals Rules-1989 framed under the Environment (Protection) Act-1986.

6.6 If it is established by any competent authority that the damage is caused due to their industrial activities to any person or his property .in that case, they are obliged to pay the compensation as determined by the competent authority.

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(Smt U.K. Upadhyay)
Environment Engineer

NOTARY
UMED K. JOSHI
Area- Dist. Kutch
Reg. No.5848
Gujarat State
(INDIA)
GOVT. OF INDIA

TRUE COPY
(U. K. JOSHI)
NOTARY
DIST. KUTCH- (GUJARAT)
Reg. No.5848

MAHALAXMIASPHALT PVT. LTD.

For, MAHALAXMIASPHALT PVT. LTD

AUTHORISED SIGNATORY

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GUJARAT POLLUTION CONTROL BOARD

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

BY RPAD

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 6(2) of the Hazardous & other Waste (Management, Handling and Tran boundary Movement) Rules, 2016 framed under the E (P) Act-1986.

And whereas Board has received consolidated application Inward **ID No.154661, dated 01/04/2019** for the consolidated consent and authorization (CC&A) of this Board under the provisions / rules of the aforesaid acts, Consent & Authorization is hereby granted as under.

CONSENTS AND AUTHORISATION:
(Under the provisions /rules of the aforesaid environmental acts)

NOTARY SAPNA D. DADLANI Area Gandhidham-Kutch Regd. No. 7916/2018 GUJARAT-INDIA Expiry Date 12-03-2023 GOVT. OF INDIA

TO,
M/S. PRIYANSI CORPORATION,
SHED NO.,CI-804 TO 808,
GIDC,BAMANBORE-363520,
TA:CHOTILA, DIST: SURENDRANAGAR

1. **Consent Order No.: AWH – 101211 date of issue: 22/04/2019.**
2. The consents shall be valid up to <u>21/04/2024</u> for operation of industrial plant for manufacture of the following items/products:

Sr. No.	Product	Quantity
1	Recycle Waste Oil	150 KL/Month
2	Re Refine Used Oil	200 Kl/Month

Specific Condition: Unit shall have to comply with all the conditions stipulated in registration certificate for re-refining /recycling of Hazardous waste.

3. CONDITIONS UNDER THE WATER ACT:

3.1. There shall be no generation of industrial effluent from the manufacturing process and other ancillary industrial operations. But waste water generated from Dehydration process , unit has provided collection cum Neutralization Tank for the same.

3.2. The quantity of sewage wastewater from the factory shall not exceed **1000 Lit/day.**

3.3 Unit shall provide flow meter on water intake line of raw water and maintain record of use of water & made available for inspection.

3.4. Sewage wastewater shall be disposed off through septic tank / soak pit system.

4. CONDITIONS UNDER THE AIR ACT:

4.1 The following shall be used as fuel.

Sr. No.	Fuel	Quantity
1	Wood	1.5 MT/Day
2	Light out Oil	10 Lit/Hrs

4.2 The applicant shall install & operate air pollution control system in order to achieve norms prescribed below.

4.2.1 The flue gas emission through stack attached shall conform to the following standards:

Stack No.	Stack attached to	Stack height in Meter	Air Pollution Control Measures	Parameter	Permissible Limit
1.	Furnace-3 Nos (Heating vessel)	33	---	Particulate Matter SO_2 NO_x	150 mg/NM^3 100 ppm 50 Ppm

4.2.2 The process emission through various stack/vent of reactors, process, vessel shall conform to the following standards.

Outward No:508421/20/06/2019

4.2.3 The concentration of the following parameters in the ambient air within the premises of the industry shall not exceed the limits specified hereunder.

PARAMETER	PERMISSIBLE LIMIT ANNUAL	PERMISSIBLE LIMIT 24 HRS. AVERAGE
Particulate matter$_{10}$[PM10]	60 Microgram /NM^3	100 Microgram /NM^3
Particulate matter$_{2.5}$[PM2.5]	40 Microgram /NM^3	60 Microgram /NM^3
Oxides of Sulphur	50 Microgram /NM^3	80 Microgram /NM^3
Oxides of Nitrogen	40 Microgram /NM^3	80 Microgram /NM^3

4.3. The applicant shall provide portholes, ladder, platform etc at chimney(s) for monitoring the air emissions and the same shall be open for inspection to/and for use of Board's 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.

4.4. The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75 dB(A) during day time and 70 dB (A) during night time. Daytime is reckoned in between 6 a.m. and10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

Authorization for the Management & Handling of Hazardous Wastes Form-2 (See rule 6(2) Form for grant of authorization for occupier or operator handling hazardous waste.

M/s PRIYANSI CORPORATION, is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated at **SHED NO.,CI-804 TO 808,GIDC,BAMANBORE-363520,TA:CHOTILA, DIST: SURENDRANAGAR.**

No.	Waste	Quantity	Schedule / I	Facility
1.	Used oil	2880 Kl/Year	IV-20	Reception, Storage,Transportation& disposal by used as raw material.
2	Waste Oil	2400 KL/Year	IV-20	Reception, Storage,Transportation& disposal by used as raw material.
3	Organic Residue from process	300 Kl/year	4.4	Collection,Storage,Transportation & disposal by incineration at CHWIF of SEPPL, Kutch.
4	Spent Clay containing Oil	78 MT/Year	4.5	Collection,Storage,Transportation & disposal by incineration at CHWIF of SEPPL, Kutch.
5	ETP Waste	600 KG/Year	35.3	Collection,Storage,Transportation & disposal by incineration at CHWIF of SEPPL, Kutch.
6	Discarded drums /Barrels	12,000 Nos/Year	33.1	Collection,Storage,Transportation & disposal by sale to registered recyclers.

5.2 The authorization shall be in force up to **21/04/2024**.

5.3 The authorization is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.

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

5.4 TERMS AND CONDITIONS OF AUTHORISATION:

a) The applicant shall comply with the provisions of the Environment (Protection) Act - 1986 and the rules made there under.
b) The authorisation shall be produced for inspection at the request of an officer authorized by the Gujarat Pollution Control Board.
c) The persons authorized shall not rent, lend, sell, and transfer of otherwise transport the hazardous wastes without obtaining prior permission of the Gujarat Pollution Control Board.
d) Any unauthorized change in personnel, equipment or working conditions as mentioned in the authorisation order by the persons authorized shall constitute a breach of this authorisation.
e) It is the duty of the authorised person to take prior permission of the Gujarat Pollution Control Board to close down the facility.
f) An application for the renewal of an authorisation shall be made as laid down in rule 5 (6) (ii).
g) Industry shall submit annual report within 15 days and subsequently by 30th June of every year.

6. GENERAL CONDITIONS: -

6.1 Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.
6.2 Applicant shall also comply with the general conditions given in annexure I.
6.3 The waste generator shall be totally responsible for (I.E. Collection, storage, transportation and ultimate disposal) of the wastes generated.
6.4 Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form – 4 by 30th June of every year.
6.5 In case of any accident, details of the same shall be submitted in Form – 5 to Gujarat Pollution Control Board.
6.6 As per "Public liability Insurance Act – 91" company shall get insurance policy, if applicable.
6.7 Empty drums and containers of toxic and hazards material shall be treated as per guideline published for "management & handling of discarded containers". Records of the same shall be maintained and forwarded to Gujarat Pollution Control Board regularly.
6.8 In no case any kind of hazardous waste shall be imported without prior approval of appropriate authority.
6.9 In case of transport of hazardous waste to a facility for (I.E. Treatment, Storage and disposal) existing in a state other than the state where hazardous waste are generated, the occupier shall obtain "No Objection certificate" from the state pollution Control Board, the Committee of the concerned state or Union territory Administration where the facility exists.
6.10 Unit shall take all concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within three months and also along with Form – 4.
6.11 Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Hon Supreme Court's order in W.P. No.657 of 1995 dated 14th October 2003.
6.12 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 emissions and solid hazardous waste generated within the factory premises.

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6.13 The applicant shall provide proper collection system for storage of solid waste generated from plant and Effluent treatment plant & disposed of the same in environmentally mentally sound manner.

For and on behalf of
Gujarat Pollution Control Board

D.M. Thaker 21/5/19
(D.M.THAKER)
Environmental Engineer

NO: GPCB/ CCA/SN-199/ ID- 34506/

ISSUED TO:
M/S. PRIYANSI CORPORATION,
SHED NO.,CI-804 TO 808,
GIDC, BAMANBORE-363520,
TA: CHOTILA, DIST: SURENDRANAGAR

-3 DEC 2022
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(SAPNA D. DADLANI)
ADVOCATE & NOTARY
Gandhidham-Kutch

NOTARY
SAPNA
D. DADLANI
Area Gandhidham-Kutch
Regd. No. 7916/2010
GUJARAT-INDIA
Expiry Date
12-05-2025
GOVT. OF INDIA

Outward No:508942, 03/06/2019

Regional Office – Kutch (East)
Gujarat Pollution Control Board
Room No. 215-216-217, 2nd Floor,
Kandla Port Trust Administrative Building,
Gandhidham – 370201, Kutch.
Email:- rogpcb.eastkutch@gmail.com

In exercise of the power conferred under section-25 of the Waster (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 6(2) of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 framed under the E (P) Act-1986.

And whereas Board has received consolidated application no: **168422**, dated 17/12/2019 for the fresh consolidated consent and authorization (CC & A) of this Board under the provision / rules of the aforesaid acts-rules. Consent & Authorization is hereby granted as under.

CONSOLIDATED CONSENT AND AUTHORISATION:
(Under the provision / rules of the aforesaid environmental acts)

To,
Revolution Petrochem LLP. (PCB ID -59793),
PLOT NO: 187, Mithi Rohar (GGDC) Industrial Estate,
Mithi Rohar-370201
TAL: Gandhidham, DIST: Kutch.

1. Consent Order No,: AWH -40354; Date of Issue: 24/01/2020

2. The consent shall be valid up to 16/12/2024 for the use of outlet for the discharge of trade effluent and emission due to operation of industrial plant for manufacture of following items/products at an above-mentioned address.

Sr No	Product	Quantity
1	Recycled Waste Oil (Industrial Fuel)	1200 KL/Month
2	Re-Refined Used Oil	300 KL/Month

Specific Condition	
1. No ground water shall be withdrawn without prior approval from competent authority. 2. You shall not carry out any activity which may attract the applicability of EIA notification-2006 and its amendments. 3. Management of Solid Waste generated from industrial activities shall be as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46). 4. As per provision of Rule-18 of Solid Waste Management Rules-2016 all industrial units using fuel and located within 100 km from the refused derived fuel (ROF) plant shall made an arrangement to replace at least five percent of their fuel requirement by refused derived fuel so produced.	
3	**Condition under the Water Act**
3.1	The quantity of industrial effluent shall not exceed 5.4 KL/Day.
3.2	The quantity the Domestic waste water (sewage) shall not exceed 1.0 KL/Day.
3.3	The quality of industrial effluent shall confirm to following standards.

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PARAMETER	PERMISSIBLE LIMIT
pH	6.5 to 8.5
Temperature	40°C
Color	100 Units
Suspended Solids	100 mg/l
Oil & Grease	10 mg/l
Phenolic Compound	01 mg/l
Ammoniacal Nitrogen	50 mg/l
BOD (03 days At 27° C)	30 mg/l
COD	100 mg/l
Chloride	600 mg/l
Sulphates	1000 mg/l
Total Dissolved Solids	2100 mg/l
Sulphides	02 mg/l

All efforts shall be made to remove color & unpleasant odor as far as practicable.

3.4 The treated waste water confirming to the above standards, where 4.2 KL/Day treated waste water shall be recirculated in cooling tower & remaining 1.2 KL/Day shall be evaporated in heat quencher & evaporation.

3.5 Sewage shall be disposed of through septic tank / soak pit system.

4 **Conditions under the Air Act**

4.1 The following shall be used as fuel.

Sr No	Fuel	Quantity
1	Diesel	125 L/Hr.

4.2 The flue gas emission through stack shall confirm to the following standards.

Stack No	Stack attached to	Stack height in meter	Parameter	Permissible Limit
1	Boiler + TFH (06 L K Cal/Hr.)	11	PM SO2 NOx	150 mg/Nm3 100 PPM 50 PPM
2	Furnace	33		
3	Furnace	33		
4	DG Set (165 kVA)	11	NO_x+ HC CO PM Smoke Limit (Light Absorption Co-efficient)	≤ 7.5 g/kW-hr ≤ 3.5 g/kW-hr ≤ 0.3 g/kW-hr ≤ 0.7 m^{-1}

4.3 There shall be no process gas emission from manufacturing activities and other ancillary operations.

4.4 The concentration of the following 11parameters in the ambient air within the premises of the industry shall not exceed the limits specified hereunder as per National Ambient Air Quality Standards issued by MoEF & CC dated 16th November-2009.

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Gandhidham – 370201, Kutch.
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Sr. No.	Pollutant	Time Weighted Average	Concentration in Ambient air in microgram/cum
1	Sulphur Dioxide (SO2)	Annual 24 Hours	50 80
2	Nitrogen Dioxide (N02)	Annual 24 Hours	40 80
3	Particulate Matter (PM10)	Annual 24 Hours	60 100
4	Particulate Matter (PM2.5)	Annual 24 Hours	40 60

4.5 The applicant shall provide portholes, ladder, platform etc at chimney(s) for monitoring the air emissions and the same shall be open for inspection to/and tor use of Board's 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.

4.6 The industry shall make adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75dB(a) during day time and70 dB(A)during night time. Daytime is reckoned in between 6 AM to 10 PM and nighttime is reckoned between 10 PM to 6 AM.

5 **Authorization under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 & amended.**

5.1 **Authorization Number: AWH -40354 Date of Issue: 21/01/2020 and shall valid up to 16/12/2024.**

5.2 **Revolution Petrochem LLP. (PCB ID -59793),** is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated PLOT NO: 187, Mithi Rohar (GGDC) Industrial Estate, Mithi Rohar- 370201, TAL: Gandhidham, DIST: Kutch.

Sr. No	Waste	Quantity	Schedule-I	Facility
1	Used or spent Oil	4321.0 MT/yr.	5.1	Receipt, Collection, Storage, Transportation & reused in process.
2	Distillation Residues	170.0 MT/yr.	20.3	Collection, Storage, Transportation & Disposed to TSDF site.
3	Chemical sludge from waste water treatment	2.40 MT/yr.	35.3	Collection, Storage, Transportation & Disposed to TSDF site.
4	Empty barrels/containers/liners contaminated with hazardous chemicals /wastes	5.00 M/yr.	33.1	Collection, Storage, Transportation & disposed by selling it to registered recycler.
5	Spent clay containing oil	105.0 MT/yr.	4.5	Collection, Storage, Transportation & Disposed to TSDF site.

Outward No:15[illegible]/2020

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NOTARY
DIST. KUTCH- (GUJARAT)
Reg. No.5848

NOTARY GOVT. OF INDIA

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Gandhidham – 370201, Kutch.
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	6	Wastes as residues containing oil	17280.0 MT/yr.	5.2	Collection, Storage, Transportation & disposed by selling it to registered recycler.

5.3	The authorization is granted to operate a facility for collection, storage within factory premises, transportation and ultimate disposal of Hazardous waste by selling it to registered recyclers.
5.4	Unit shall apply for authorization for other types of hazardous waste referring to the amended Rules.
5.5	The authorization is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.
5.6	**Terms and conditions of authorization:-**
1.	The authorized person shall comply with the provisions of the Environment (Protection) Act, 1986, and the rules made there under.
2.	The authorization or its renewal shall be produced for inspection at the request of an officer authorized by the State Pollution Control Board.
3.	The person authorized shall not rent, lend, sell, transfer or otherwise transport the hazardous and other wastes except what is permitted through this authorization.
4.	Any unauthorized change in personnel, equipment or working conditions as mentioned in the application by the person authorized shall constitute a breach of his authorization.
5.	The person authorized shall implement Emergency Response Procedure (ERP) for which this authorization is being granted considering all site specific possible scenarios such as spillages, leakages, fire etc. and their possible impacts and also carry out mock drill in this regard at regular interval of time.
6.	The person authorized shall comply with the provisions outlined in the Central Pollution Control Board guidelines on "Implementing Liabilities for Environmental Damages due to Handling and Disposal of Hazardous Waste and Penalty".
7.	It is the duty of the authorized person to take prior permission of the State Pollution Control Board to close down the facility.
8.	The imported hazardous and other wastes shall be fully insured for transit as well as for any accidental occurrence and its clean-up operation.
9.	The record of consumption and fate of the imported hazardous and other wastes shall be maintained.
10.	The hazardous and other waste which gets generated during recycling or reuse or recovery or pre-processing or utilization of imported hazardous or other wastes shall be treated and disposed of as per specific conditions of authorization.
11.	The importer or exporter shall bear the cost of import or export and mitigation of damages if any.
12.	An application for the renewal of an authorization shall be made as laid down under these Rules.
13.	Any other conditions for compliance as per the Guidelines issued by the Ministry of Environment, Forest and Climate Change or Central Pollution Control Board from time to time.
14.	Annual return shall be filed by June 30th for the period ensuring 31st March of the year.
5.7	**General Conditions**
1	Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.
2	Applicant shall also comply with the general conditions given in annexure I.
3	The waste generator shall be totally responsible for (i.e. Collection, storage, transportation and ultimate disposal) of the wastes generated.

Outward No.:-

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NOTARY
DIST. KUTCH- (GUJARAT)
Reg. No.5848

NOTARY GOVT. OF INDIA

Regional Office – Kutch (East)
Gujarat Pollution Control Board
Room No. 215-216-217, 2nd Floor,
Kandla Port Trust Administrative Building,
Gandhidham – 370201, Kutch.
Email:- rogpcb.eastkutch@gmail.com

4	Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form - 4 by 31s1 January of every year.
5	In case of any accident, details of the same shall be submitted in Form - 5 to Gujarat Pollution Control Board.
6	As per "Public liability Insurance Act - 91" company shall get insurance policy, if applicable.
7	Empty drums and containers of toxic and hazards material shall be treated as per guideline published for management & handling of discarded containers". Records of the same shall be maintained and forwarded to Gujarat Pollution Control Board regularly.
8	In no case any kind of hazardous waste shall be imported without prior approval of appropriate authority.
9	In case of transport of hazardous waste to a facility for (I.E. Treatment, Storage and disposal) existing in a state other than the state where hazardous waste are generated, the occupier shall obtain "No Objection certificate" from the state pollution Control Board, the Committee of the concerned state or Union territory Administration where the facility exists.
10	Unit shall take a)} concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within 03 months and also along with Form 4.
11	Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Hon Supreme Court's order in W.P. NO.65 of 1995 dated 14th October 2003.
12	Industry shall have to display online data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant, including wastewater and air emissions and solid hazardous waste generated within the factory premises.

NO. GPCB/RO- Kutch (East)/CCA-Fresh/Kutch-/PCB ID: 59793/ Date: -

For and behalf of
Gujarat Pollution Control Board

Regional Officer, Kutch(East)

Outward No:15594, 22/04/2020

TRUE COPY
(U. K. JOSHI)
NOTARY
DIST. KUTCH-(GUJARAT)
Reg. No.5848

NOTARY GOVT. OF INDIA

TRUE COPY

GUJARAT POLLUTION CONTROL BOARD
REGIONAL OFFICE-AHMEDABAD (CITY)

2nd floor, Gujarat Pollution Control Board (Old Building), Paryavaran Bhavan, Sector-10-A, Gandhinagar-382010. Phone: 079-23222096 E-Mail – ID: ro-gpcb-ahmc@gujarat.gov.in

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 5(4) of the Hazardous and Other Wastes (Management and Transboundry Movement) Rules, 2016, framed under the Environment (Protection) Act-1986.

And whereas Board has received consolidated consent application **NO. 164983** dated **16/10/2019** for the Consolidated Consent and Authorization (CC & A) of this Board under the provisions/rules of the aforesaid acts. Consents & Authorization are hereby granted as under:

NOTARY SHWETA N. RAMNANI Area-Gadhidham Kutch Regd. No. 21871/20 GUJARAT-INDIA Expiry Date 04/03/2025 GOVT. OF INDIA

CONSENTS AND AUTHORISATION:
(Under the provisions /rules of the aforesaid environmental acts)

To,
M/s. Shana Oil Process
Nr Good Luck Market,
Chandola Lake,
Ahmedabad-380028

1. **Consent Order No.: AWH–39520, Date of issue: 27/11/2019.**
2. The consents shall be valid up to **30/09/2024** for use of outlet for the discharge of trade effluent & emission due to operation of industrial plant for following products.

Sr. No	Product	Quantity
1	Re-Refining of Used Oil	24.25 KL/Month
2	Recycled Waste Oil (Industrial Fuel)	40 KL/Month

SPECIFIC CONDITIONS

- **Unit shall obtain CTE/CCA Amendment on receipt of CCA Renewal.**
- **Unit shall not to procure waste oil or used oil more than consented quantity and comply with undertaking dated 10/10/2019.**
- **Unit shall not operate plant in night hours during winter season and comply with the winter action plan and air action plan of Ahmedabad city.**
- **The applicant shall receive/transport/sell any hazardous waste in global Positioning system enabled (GPS ensbled) dedicated tankers/trucks only and shall have to adopt online manifest system of GPCB-Xtended green node (XGN) invariably.**

3. CONDITIONS UNDER WATER ACT 1974

3.1 Domestic water consumption shall not exceed **1.0 KLPD** and the quantity of the domestic waste water (sewage) shall not exceed **0.8 KLPD**. Sewage shall be discharge in to AMC drain.

3.2 Industrial water consumption shall not exceed **3.25 KLPD** which shall be treated in ETP and partly reuse in cooling tower make up & partly evaporated in evaporator, so there shall be no discharge of any kind of industrial effluent from the manufacturing process and other ancillary operations.

3.3 The directives issued by the board from time to time in view of direction issued by the Honorable High Court of Gujarat in the matter of S.C.A. 770/95 and any other shall have to be complies with.

4. CONDITIONS UNDER THE AIR ACT :

4.1 The following shall be used as fuel in furnaces.

Sr. No.	Fuel	Quantity
1	LDO	0.03 KL/Hr

4.2 The applicant shall install & operate the Air pollution control system in order to achieve norms prescribed below.

Stack No.	Stack attached to	Stack height in Meter	Parameter	Permissible Limit
1	Furnaces (2 nos)	11	Particulate Matter SO_2 NO_x	150 mg/NM^3 100 PPM 50 PPM

4.3 Stack monitoring facility like port hole, platform / ladder, etc. shall be provided with stack/vents chimney in order to facilitate sampling of gases being emitted into the atmosphere.

4.4 There shall be no process gas emission.

4.4 Ambient air quality within the premises of the industry shall conform to the following standards:

Pollutant	PERMISSIBLE LIMIT Annual	PERMISSIBLE LIMIT 24 Hrs Average
Particulate Matter 10 (PM10)	60 Microgram/M^3	100 Microgram/M^3
PM 2.5 (PM 2.5)	40 Microgram/M^3	60 Microgram/M^3
SO_2	50 Microgram/M^3	80 Microgram/M^3
NO_x	40 Microgram/M^3	80 Microgram/M^3

The industry shall take adequate measures for control of noise levels from its own sources within the permission so as to maintain ambient air quality standards in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Daytime is reckoned in between 6 a.m. and 10 a.m. and nighttime is reckoned between 10 p.m. and 6 a.m.

4.6 The applicant shall provide proper ventilation and exhaust facilities so as to maintain healthy working atmosphere within the factory premises.

5. Authorization for the Management & Handling of Hazardous Wastes Form-2 (See rule 3 (c) & 5 (4) Form for grant of authorization for occupier or operator handling hazardous waste.

5.1 Number of authorization: AWH-39520, Date of issue: 27/11/2019.

Shana Oil Process is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated at **Nr Good Luck Market, Chandola Lake, Ahmedabad-380028.**

Sr. No	Waste	Quantity per year	Schedule / category	Facility
1	Used or Spent Oil	300 MT	5.1	Collection, Storage, Reception, Reprocess within premises

2	Waste or Residues containing Oil	610 MT	5.2	Collection, Storage, Reception, Reprocess within premises
3	Distillation Residues	56 MT	20.3	Collection, Storage, Transportation to common hazardous waste incineration facility for final disposal by incineration at approved CHWIF
4	Spent Clay Containing Oil	98 MT	4.5	Collection, Storage, Transportation to common hazardous waste incineration facility for final disposal by incineration at approved CHWIF
5	Chemical Sludge from Waste Water Treatment	0.72 MT	35.3	Collection, Storage, Transportation to common hazardous waste treatment facility for final disposal by land filling at approved CHWTF
	Empty Barrels/Containers/Liners Contaminated with Haz Chemicals/ Wastes	100 MT	33.1	Collection, Storage, Decontamination, Transportation, Sell to Registered Recyclers

5.2 The authorization is granted to operate a facility for collection, storage, Reuse within factory premises and ultimate disposal of generated hazardous waste at CHWTF site of M/s. SEPPL, Bhachau.

5.3 The authorization shall be in force for a period up to **30/09/2024.**

5.4 The authorization is subject to the conditions stated below and such other conditions as may be specified in the rules from time to time under the Environment (Protection) Act-1986.

5.5 Terms and conditions of Authorization:

a) The Applicant shall comply with the provisions of the environment (protection) Act – 1986 and the rules made there under.

b) The Authorization shall be produced for inspection at the request of an officer authorized by the Gujarat Pollution Control Board.

c) The persons authorized shall not rent, land, sell, transfer of otherwise transport the hazardous waste without obtaining prior permission of the Gujarat Pollution Control Board.

d) Any authorized change in personnel, equipment or working conditions as mentioned in the Authorization order by the persons authorized shall constitute a breach of this authorization.

e) It is the duty of the authorized person to take prior permission of the Gujarat Pollution Control Board to close down the facility.

f) An Application for the renewal of an Authorization shall be made as laid down in rule 5 (6) (ii).

g) Industry shall manage waste as per amended rules 2016 and shall applied authorization for all applicable waste as per amended rules 2016 within 15 days.
h) Industry shall submit annual report within 15 days and subsequently by 30 June every year.

6. **GENERAL CONDITIONS**: -

6.1 Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.

6.2 In case of any accident, details of the same shall be submitted in Form – 14 to Gujarat Pollution Control Board.

6.3 In no case any kind of hazardous waste shall be imported without prior approval of appropriate authority.

6.4 Unit shall take all concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within three months and also along with Form – 4.

6.5 In case of transport of hazardous waste to a facility for (i.e. Treatment, Storage and disposal) existing in a state other than the state where hazardous waste are generated, the occupier shall obtain "No Objection certificate" from the state pollution Control Board, the Committee of the concerned state or Union territory Administration where the facility exists.

6.6 Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Hon Supreme Court's order in W.P. No.657 of 1995 dated 14th October 2003.

6.7 As per "Public liability Insurance Act – 91" company shall get Insurance policy, if applicable.

6.8 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 emissions and solid hazardous waste generated within the factory premises.

NOTARY SHWETA N. RAMNANI Area-Gandhidham Kutch Regd. No. 21071/20 GUJARAT-INDIA Expiry Date 05/03/2025 GOVT. OF INDIA

For and on behalf of
Gujarat Pollution Control Board

N.D. Ajmera
I/C Regional Officer

NO: GPCB/RO-ABD/AMC-[illegible]/ID-13711/ 19670

5 DEC 2019

30 MAY 2022
TRUE COPY
(SHWETA N. RAMNANI)
ADVOCATE & NOTARY
Gandhidham - Kachchh

ISSUED TO:
M/s. Shana Oil Process
Nr Good Luck Market,
Chandola Lake,
Ahmedabad-380028

COPY TO:
1. THE MEMBER SECRETARY, G.P.C.BOARD. GANDHINAGAR.
2. OFFICE COPY CONCERNED INDUSTRIES FILE.

/

/

Annexure L

Oil Spill contingency plan

ANNEXURE-XIV

(Oil Spill Contingency Plan)

Annexure-H

MEMORANDUM OF UNDERSTANDING

BETWEEN

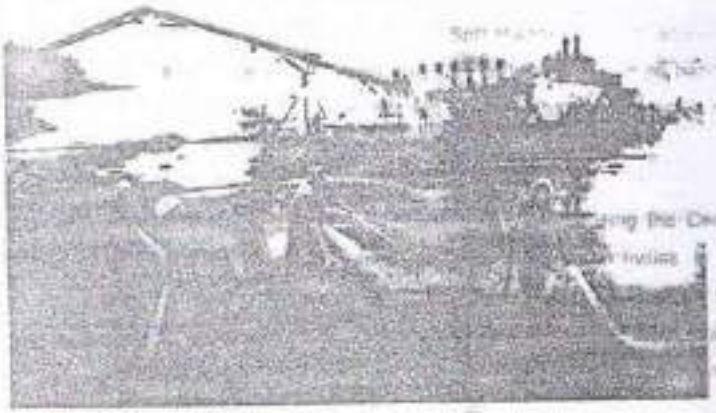
KANDLA PORT TRUST

AND

OIL COMPANIES

ON

SETTING UP OF TIER-I FACILITY FOR COMBATING OIL SPILL AT KANDLA



THE MEMORANDUM OF UNDERSTANDING AMONGST KPT, BPCL, IOCL, HPCL ON SETTING UP OF TIER-I FACILITY FOR COMBATING OIL SPILL AT KANDLA

This Memorandum of Understanding made on this 14th day of June 2011 amongst -

1. Kandla Port Trust having its administrative office at Gandhidham, Kutch District, Gujarat State (hereinafter referred to as KPT).
2. Bharat Petroleum Corporation Limited having its registered office at Bharat Bhavan, 4&6 Currimbhoy Road, Ballard Estate, Mumbai – 400 001 (hereinafter referred to as BPCL),
3. Indian Oil Corporation Limited having its registered office at G-9, Allyavar Jung Marg, Bandra (East), Mumbai (hereinafter referred to as IOCL),
4. Hindustan Petroleum Corporation Limited having its registered office at 17-Jamshedji Tata Road, Mumbai – 400 020 (hereinafter referred to as HPCL).

BPCL, IOCL and HPCL are hereinafter collectively referred to as Oil Companies wherever the context so requires. KPT and Oil Companies are hereafter collectively referred as parties whenever the context so requires.

WHEREAS in recent times the risk of Oil Spill at various Port locations has gone up rapidly due to increased quantum and frequency in oil handling and recognizing the importance, it is felt essential that oil companies shall participate in the efforts to combat oil spill.

AND WHEREAS the Director General, Coast Guard being the Central Coordinating Authority for marine oil spill response activities in the maritime zones in India has prepared and published the National Oil Spill Disaster Contingency Plan (NOSDCP) to combat oil spill, which delineates the duties and responsibilities of each participating agency. To meet the

requirement of providing a Tier-I facility to combat oil spill at Kandla, based on the discussions held at various levels amongst KPT and Oil companies operating at Kandla, the parties herein agree to deduce the same into writing by this Memorandum of Understanding (MOU).

NOW, THEREFORE, THE PARTIES HEREIN MUTUALLY AGREE AND WITNESSETH AS FOLLOWS:

1.0 Objective

The objective of this MOU is to strengthen the Oil spill combating Tier-I facilities available at Kandla so as to meet the requirements as mentioned above.

2.0 Scheme for setting up of Tier-I facility for combating oil spill

2.1 KPT and Oil Companies hereto have mutually agreed to and shall participate in this scheme for combating the oil spill as mentioned herein.

2.2 Oil Companies jointly agree to make an one time payment of Rs. 500 lakhs (Rupees Five Hundred Lakhs) to KPT and KPT agrees for setting up of Tier-I facilities at Oil Spill Response Centre (OSRC) at Kandla by December 2011. Thereafter, KPT shall develop, operate and maintain these facilities to combat oil spill as required in 1.0 above.

KPT further agrees that the above mentioned payment of Rs. 500 lakhs will only be used for setting up of Tier-I facilities for combating oil spill. Further, Oil Companies shall not be asked for any payments towards purchase of equipments under Tier-II/III facilities. The Oil Companies shall not be responsible for the maintenance of these

facilities and day to day operating and maintenance costs shall be borne by KPT only.

The payment by Oil Companies to KPT will be proportionate to the throughput of each Oil Company as mentioned in 2.3. The amount of Rs. 500 lakhs is based on the estimates as per the enclosed list of equipment. However, the overall payment shall be made based on actual progressive expenditure.

2.3 Oil Companies agree that the payment to be made by individual oil company to KPT shall be shared amongst them, on the basis of the volume of the oil handled by the Oil Companies during 2009-10, in the following manner:

Oil Co	Volume Handled (In MTs) during 2009-10	% Share
IOCL	2017761	77.33
HPCL	291796	11.18
BPCL	299704	11.49
TOTAL	2609261	100.00

The payments by the Oil Companies to KPT shall be made as per the advice of the KPT which will be based on actual expenditure with details of accounts as certified by KPT and Oil Companies shall have access to such documents.

2.4 KPT will provide the necessary dedicated sea worthy vessel for installing all the OSRC equipment and it will be kept ready for efficient OSRC activities.

KPT shall be responsible for taking necessary statutory and other approvals for operation, maintenance and purchase of equipments/facilities and for other obligations as per this MOU. All approvals (tendering process etc.) shall be carried out by KPT.

2.5 A separate fund (sinking fund) for expenses for operations, maintenance and replacement of equipments (oil spill combat equipments) including insurance cover of the same, would be created by KPT. The co-ordination/monitoring committee shall monitor the fund management.

In order to implement the model and make it self-sustainable for timely maintenance and replacement of equipments as and when required, KPT to approach TAMP for levying some kind of fee/surcharge on all vessels berthed at Kandla Port, other than participating Oil Companies.

All the ships coming to Kandla Port carry POL as bunker fuel and hence tariff for each vessel to be finalized by KPT and the fund to be put in the sinking fund. The tariff will be 'nil' for participating companies.

2.6 Some other private companies may be rare users of Port facilities in handling and their volumes of hydro carbons are less . However, if they cause any pollution, they will be charged by KPT for recovery of the oil spill, apart from the other statutory fines. Further, if participating Oil Companies cause any leak/ pollution, no recoveries of any expenses or penalties shall be levied against them.

As regards recovery from non participating port users identified as the polluter, KPT shall issue a public notice to bring to their knowledge about the recovery of expenditure @ 300 % of actual plus

supervision and overhead charges (@7 %) towards combating oil spill from non-participating port users identified by KPT as the polluter. KPT shall co-ordinate for such recovery from the polluter who are non-participating port users. The amount so recovered shall be ploughed back to meet the normal operation & maintenance and manning & crewing of OSRC set up.

For any new entrant, proportionate sharing of costs shall be recovered by KPT. This amount will be part of the sinking fund and available to the Co-ordination committee for appropriate use.

2.7 KPT shall make use of the expertise of the Coast Guard while preparing the specifications of the oil spill combating facilities.

2.8 KPT shall be obliged to provide accounts of expenditures and allow access to such documents as may be asked by Oil Companies and also shall provide necessary documents to Oil Companies to claim rebate on income tax/service tax, as applicable.

3.0 Oil Spill Contingency Plan

KPT has prepared its action plan for setting up the oil spill combating facilities along with target dates, in consultation with Oil Companies.

This plan shall be updated every year. The Action Plan, attached hereto, shall form a part of the MoU. As per the action plan, the oil spill combating facilities shall be fully functional by December 2011. KPT shall maintain and operate these facilities as per the norms prescribed by Original Equipment Manufacturers (OEMs), the Coast Guard, statutory bodies, and Government agencies. KPT shall also

keep proper record and Oil Companies shall in no way be held responsible for the same.

4.0 Geographical coverage

KPT shall normally operate the oil spill combating facilities within the limits of the Kandla Port. However, KPT will extend the said facilities beyond the limits of Kandla Port, on specific requests from Oil Companies and other Government agencies, on mutually agreeable terms.

5.0 Mock Drill

KPT shall organize at least one mock drill every six months. The date of the mock drill will be communicated to the Coast Guard and Oil Companies well in advance. The Oil Spill Contingency Plan will be modified and updated, if required , to take care of the observations made during the mock drill.

6.0 Co-ordination Committee

For effective coordination and smooth working of the Plan, a Committee with representative of KPT as Chairman, and representative of the Coast Guard and Oil Companies as Members will be formed to monitor the functioning of the oil spill combating facilities. The decision may be considered to be taken by majority of member committee. The committee shall meet as and when required, but at least four meetings shall be held in a year (one in each quarter).

The committee shall oversee the following :

a. Cash flow requirement : This will be based on the actual expenses towards procurement of equipment (inclusive of all taxes). This will be based on the PO placed by KPT.

b. Progress Review : Every quarter the progress shall be reviewed and the Committee shall advise on the adequate funds required for next quarter or six months, so as to ensure smooth execution of all activities.

7.0 Notices

All notices, requests, demands and other communications required or provided for under this MoU shall be forwarded to the following respective addresses of the parties hereto :

1. The Deputy Conservator,
   Kandla Port Trust Admin Office
   Gandhidham – (Dist-Kutchh)

2. Senior Manager Operations (Retail),
   Bharat Petroleum Corporation Ltd.,
   Khan Rohar Road
   Kandla (Dist. Kutchh)

3. Senior Installation Manager,
   Hindustan Petroleum Corporation Ltd.,
   Khan Rohar Road,
   Kandla (Dist. Kutchh)

4. Sr Terminal Manager,
   Indian Oil Corporation Ltd.,
   Fore Shore Terminal, K K Road,
   Kandla (Dist. Kutchh)

5. Sr Terminal Manager,
Indian Oil Corporation Ltd.,
Main Terminal,
Kharirohar Road,
Kandla (Dist. Kutchh)

8.0 General

8.1 This MoU supersedes all provisions or undertakings arrived at between all the parties herein regarding the subject of these presents, whether in writings or otherwise prior to the date of execution of these presents.

8.2 This MoU shall not be amended, varied or modified in any manner except by an instrument in writing and signed by all the parties herein.

8.3 Any dispute or difference of any nature whatsoever between any of the parties hereto arising out of or in relation to this MOU shall be referred to the sole Arbitration as detailed in the Arbitration Clause in the Annexure attached hereto.

8.4 This MoU shall be made in five copies and each party to the MoU shall have one copy each.

8.5 To ensure the compliance by the non-participating Port users, KPT shall issue a Public Notice, which shall be binding on the non-participating users at the time of the incidence.

14/6/11

14/6/11

IN WITNESS WHEREOF THE PARTIES HERETO HAVE SET THEIR HANDS SIGNED AND DELIVERED THIS M.O.U ON THE DATE ABOVE WRITTEN.

14/6/11

KPT
CAPT H K SIBAL

14.6.11

BPCL
Sr Manager Operations (R) Kandla
D.G. DHAKATE

14/6/11

IOCL
Sr Terminal Manager, FST, Kandla (G. ROUT)

IOCL
Sr Terminal Manager, Main, Kandla
D.V. SARANGIA

14/6/11

(T.M. MEHTA) BPCL
Sr Installation Manager, Kandla

ARBITRATION CLAUSE

(a) Any dispute or difference of any nature whatsoever any claim counter-claim or set off of the _____ against the _____ or regarding any right, liability, act , omission or account of any of the parties hereto arising out of or in relation to this MOU shall be referred to the sole Arbitration of the Director(Marketing) of [redacted] Oil Company or of some officer of the Oil Company who may be nominated by the Director (Marketing). The _____ will not be entitled to raise any objection to any such arbitrator on the ground that the arbitrator is an officer of the Oil Company or that he has dealt with the matters to which the contract relates or that in the course of his duties as an officer of the Oil Company he had expressed views on and or any other matters in dispute or difference. In the event of the arbitrator to whom the matter is originally referred being transferred or vacating his office or being unable to act for any reason, the Director(Marketing) as aforesaid at the time of such transfer, vacation of office or inability to act may in the discretion of the Director(Marketing) designate another person to act as arbitrator in accordance with the terms of the MOU to the end and intent that the original arbitrator shall be entitled to continue the arbitration proceedings notwithstanding his transfer or vacation of office as an officer of Oil Company if the director (Marketing) does not designate another person to act as arbitrator on such transfer, vacation of office or inability of original arbitrator . Such persons shall be entitled to proceed with the reference from the point at which it was left by his predecessor . It is also a term of this contract that no person other than the director (Marketing) or a person nominated by such Director (marketing) of Oil Company as aforesaid shall act as arbitrator hereunder. The award of the arbitrator so appointed shall be final conclusive and binding on all parties to the MOU subject to the provisions of the Arbitration Act, 1996 or any statutory modification or re-enactment thereof and the rules made thereunder for the time being in force shall apply to the arbitration proceedings under this clause .

(b) The award shall be made in writing and published by the arbitrator within two years after entering upon the reference or within such extended time not exceeding further twelve months as the sole arbitrator shall by a writing under his own hands appoint. The parties hereto shall be deemed to have irrevocably given their consent to the arbitrator to make and publish the award within the period referred to hereinabove and shall not be entitled to raise any objection or protest thereto under any circumstances whatsoever.

(c) The arbitrator shall have power to order and direct either of the parties to abide by , observe and perform all such directions as the arbitrator may think fit having regard to the matters in difference i.e dispute before him. The arbitrator shall have all summary powers and may take such evidence oral and/or documentary, as the arbitrator in his absolute discretion thinks fit and shall be entitled to exercise all powers under the Indian Arbitration Act, 1996 including admission of any affidavit as evidence concerning the matter in difference i.e dispute before him.

1/2

are the parties against whom the arbitration proceedings have been initiated. That is to say, the respondents in the proceeding, shall be entitled to prefer a counter-claim or set off before the arbitrator in respect of any matter in issue arising out of or in relation to MOU without seeking a formal reference of arbitration to the Director (Marketing). In such counter-claim, cross-claim, or set off and the arbitrator shall be entitled to consider and deal with the same as if the matters arising therefrom has been referred to him originally and deemed to form part of the reference made by the Director(Marketing).

(e) The arbitrator shall be at liberty to appoint, if necessary any accountant or engineering or other technical person to assist him, and to act by the opinion so taken.

(f) The arbitrator shall have power to make on or more awards whether interim or otherwise in respect of the dispute and difference and in particular will be entitled to make separate awards in respect of claims or cross-claims of the parties.

(g) The arbitrator shall be entitled to direct any one of the parties to pay the costs of the other party in such manner and to such extent as the arbitrator may in his discretion determine and shall also be entitled to require one or both the parties to deposit funds in such proportion to meet the arbitrators expenses whenever called upon to do so.

The parties hereby agree that the courts in the city of Gandhidham alone shall have jurisdiction to entertain any application or other proceedings in respect of anything arising under this MOU and any award or awards made by the sole arbitrator hereunder shall be filed in the concerned courts in the city of Gandhidham only.

2/2

14/6/11
KPT
Dy. Conservator
CAPT. M.K. SIBAL

14.06.11
BPCL
Sr Manager Operations (R) Kandla
(R. K. DUKARE)

14/6/11
IOCL
Sr Terminal Manager, PSL, Kandla
(B - ROUT)

14/6/11
IOCL
Sr Terminal Manager, Main, Kandla
D.V. SARANGLA

14/6/11
BPCL
Sr Installation Manager, Kandla

Annexure - H

KANDLA PORT TRUST

LOCAL OIL SPILL - DISASTER CONTINGENCY PLAN.

(KPT - LOS - DCP)

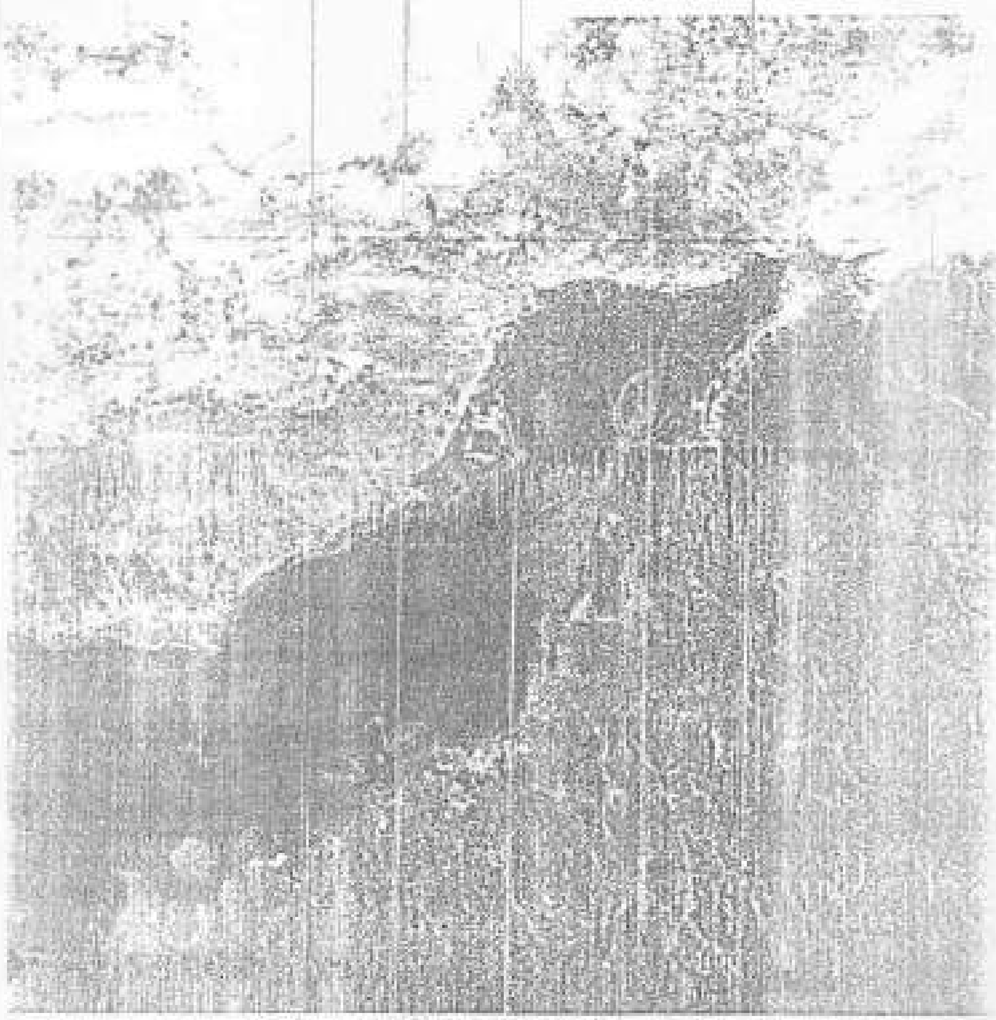
AUGUST 2000

MARINE DEPARTMENT, KANDLA PORT TRUST, P O BOX - 50, GANDHIDHAM, KUTCH, GUJARAT - 370 [illegible].
Tel 02836-[illegible], FAX: 02836-[illegible], SATELLITE PHONE: 00 873 762045 777.

©KANDLA PORT TRUST

LOCAL OIL SPILL - DISASTER CONTINGENCY PLAN.

(KPT - LOS - DCP)



AUGUST 2000

MARINE DEPARTMENT, KANDLA PORT TRUST, P O BOX - [illegible], GANDHIDHAM, KUTCH, GUJARAT - [illegible]
Tel: [illegible], FAX: [illegible], SATELLITE PHONE: [illegible]

CONTENTS

List of Annexures:

KANDLA PORT TRUST

LOCAL OIL SPILL – DISASTER CONTINGENCY PLAN

(LOS-DCP)

INTRODUCTION

The Indian Coast Guard (ICG) has been designated as the nodal agency to deal with all contingencies associated with OIL SPILL DISASTERS in the coastal and marine environs of the Nation. The ICG in this regard had prepared a NATIONAL OIL SPILL – DISASTER CONTINGENCY PLAN popularly known as the NOS-DCP. The NOS-DCP identifies the Major Ports as among the RESOURCE AGENCIES of ICG. Further the plan details co-ordination procedures for the resource agencies to interact with the nodal agency.

Under the guidelines of the NOS-DCP it is obligatory for the resource agencies to develop a local oil spill disaster contingency plan and link it up with the NOS-DCP. This plan is an effort of KANDLA PORT TRUST to link up its updated LOS-DCP with the NOS-DCP.

Kandla Port is located towards the extreme eastern margin of the GULF OF KUTCH (GOK). Ships calling at Kandla port therefore have to traverse across the GOK, which had been identified as a highly sensitive coastal zone of the maritime state of GUJARAT, owing to the rich bio-diversity persisting along its southern coast line. The GOK is also significant in maritime culture with the existence of three port complexes viz. KANDLA – VADINAR Major port complex, RELAINCE PETRO-CHEMICALS Ltd.- Marine Terminal complex and the up coming GUJARAT ADANI PORT Ltd. complex. In view of the above ships plying in the GOK and the maritime community associated with them are required to exercise utmost caution particularly with regard to prevention of oil pollution by ships.

KPT - LOS - DCP, Jurisdiction and description of the plan area

The plan jurisdiction encompasses the Port limits in general. Fig 1 illustrates the Port limits as defined by the Govt. of India Notification no. 254(E), published in the gazette of India, part II section 3, subsection (i) dated 1st May 1974.

2.1 Oil Spill threat Perception

Oil spill can be broadly categorized into three categories depending upon the volume and area of oil spill, which has taken place. These three categories of oil spill are generally classified as Tier 1, 2 & 3 and each tier will require response strategies suitable to magnitude and manifestations as mentioned below:

Tier – 1: This would be a spill of a magnitude the local resources can respond to successfully without assistance from other agencies.

Tier – 2: This would be a spill of a magnitude that would outstrip the local resources & would require assistance on a regional basis. This would either come from local/central Government or local Industries Mutual Aid arrangement.

Tier – 3: This would be a spill of a magnitude that would surpass the capabilities of tier one and tier- 2. Additional resources would be required on a national and international level.

Tier level	Volume
One	$<10\ m^3$
Two	$10m^3 - 100m^3$
Three	$>100m^3$

The Oil spill threat perception in Kandla Port has taken into consideration various Port facilities, type of port operations in conjunction with local conditions and record of recurrences of oil spill events. A review of the above aspects reveals the following points :-

- SBM operations at Vadinar are susceptible for probable oil spills.
- In the entire history of Kandla port, there had been no record of Tier 2 & 3 level oil spills. However, minor occurrence of tier level-1, oil spills are on record. Oil spill on 31st May 1998, which occurred due to failure of sub-marine hose which, resulted in oil spill of 2000 litres of Bombay High Crude while the second event of oil spill was noticed during the aftermath period of Cyclone of June 1998. The spill was of minor nature and the source of spill was from a badly damaged and grounded ship, which was subsequently salvaged and was berthed, in a cold move. The third occurrence of the oil spill of an uncertain source was established during November 1999. The quantity of oil spilled was also undetermined. This oil spill was established based on the evidences observed on the shoreline in the vicinity of Vadinar.
- The mitigative action taken in the above accidents was deployment of dispercent chemicals.
- Owing to the local conditions, any occurrence of the oil spill in the plan area are likely to spread and travel faster, thereby bringing down the available response time to very short duration.
- Owing to the short duration of the response time available, the danger of oil spill striking the coastline at Vadinar is highly probable.
- The existence of Coral reeves in the vicinity of Vadinar Port area sensitizes port operations at Vadinar.
- Use of chemical dispercents, deployment of offshore oil spill containment booms and complimentary skimmers are strongly recommended for SBM operations at Vadinar.
- The above mentioned oil spill response equipment needs to be kept in readiness at all times.
- The threat perception in the Kandla scenario is not as much as at Vadinar owing to the decline in POL traffic at Kandla.

In view of above the plan area is classified in to the following zones in the order of importance based on oil spill threat perception:

OIL SPILL THREAT PERCEPTION ZONE	APPROPRIATE OIL SPILL RESPONSE SYSTEM SUGGESTED IN ORDER OF PERFERENCE
Vadinar SBM operational area	Immediate deployment of containment boom system, followed by skimming by MV saganka and, in the event of inclement weather attempt use of chemical dispercents.
Vadinar Anchorage	Immediate deployment of containment boom system, followed by skimming by MV saganka and in the event of inclement weather attempt use of chemical dispercents.
Old Kandla Oil Jetty complex	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispercents.
Vadinar port craft jetty	Press in MV Saganka for skimming, secondly attempt spraying chemical dispercents to disperse the oil slick.
New Kandla general cargo berths and harbor area	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispercents.
Kandla creek including inner anchorage and moorings	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispercents.
Kandla outer anchorage (OTB area)	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispercents.
Kandla creek system and area within Port limits other than the above.	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispercents.

2.2 Port facilities

Within the Plan area, the following operational port facilities exist:

KANDLA

- Five 'T' shaped Oil Jetties for handling liquid cargo inclusive of one jetty, which is equipped with LPG handling facilities.

- One Steel Floating Dry Dock for dry docking Port crafts.

- A Rectangular shape basin for handling barges
- A 80 m. long "L" shaped Berthing Jetty for the use of Port crafts.
- 2280 m. long wharf to accommodate 10 to 12 ships in a straight line for handling general cargoes.
- Three pre-designated Inner Anchorage points and three mid stream anchorage points.
- Shipping tugs, Harbor tugs, Mooring Crafts, General Service Launches, Fire Boat, Pilot launches, Buoy laying dumb barge and one Survey Launch equipped with modern automated hydrographic equipment.
- One Buoy laying dumb barge equipped with 20 tonne winch
- Two units of land based Fire Brigade System (One located at Oil Jetties Complex and another within the General Cargo Berths complex).
- One Multi-purpose anti pollution vessel.
- One Tank lorry to receive oily waste from ships along side berths.

VADINAR

- Two Single Buoy Moorings (SBM) installed at a depth of 33 mtrs. Off Salaya Creek at Vadinar. The two SBMs are inter-connected with sub-marine pipeline, which ultimately leads to the tank farms located on the Nirara bet.
- Two Nos. Pull Back / Shipping Tugs.
- Two Nos. Mooring tenders and a harbor tug.
- One Multi-purpose Anti pollution vessel.

In addition to the above mentioned Port facilities, well developed infrastructural facilities such as adequate power supply units, adequate water supply units, residential complexes, sewage & drainage system and rail and road net work also exist. While at Vadinar, the Crude Oil discharge facilities is directly connected by inter state across the country pipeline from the IOC tank terminal at Naraira bet to Koyali, Mathura and Panipat Refineries with branching at Viramgam and Mathura.

2.3 Port activities

The significant Port activities with particular reference to vulnerability to probable oil spills are as follows:-

Vadinar –

- Waiting of ships at Outer Anchorage at Vadinar
- Crude Oil discharge operations from SBM No.1 & 2 at Vadinar.
- Port craft maintenance operations at Vadinar Port Craft Jetty.
- Ships running aground due to loss of engine control or Weather
- Ship to ship collision due to engine control failure or poor visibility associated with malfunctioning of navigational aids like Rader/ARPA system.

Kandla –

- Waiting of ships at outer anchorage at Kandla.
- Discharge of liquid chemicals and POL through pipelines from Old Kandla Oil Jetty complex to various tank farm complexes belonging to PSU Oil Companies and private sector liquid chemical storage complexes.

- Loading and discharge of dry bulk/break bulk cargoes at the General Cargo Berths.
- Maintenance operations of Port crafts at Steel Floating Dry Dock and at the Port craft Berthing Jetty.
- Ships running aground due to loss of engine control or inclement weather.
- Ship to ship collision due to engine control failure or poor visibility associated with malfunctioning of navigational aids like Radar/ARPA system.

2.4 Local environmental conditions

The local environmental conditions at Kandla Port attract significant consideration with respect to Oil spill prevention, response and mitigation activities owing to the mega tidal domain and the meteorological parameters. In the event of any oil spill, the slick dimensions and the direction of its progradation are dependent on sea surface winds and surface currents. In order to make onsite assessment, the meteorological data recorded at Kandla Observatory is placed at Annexure-I.

Tides and currents – Consequent to the large tidal range, the Port experiences high magnitude tide currents both during ebb and flow (of the order of 3.0 to 3.6 meters per second). Annexure-II illustrates detailed information of tide levels and tidal streams observed at Kandla and Vadinar.

Waves – Kandla Port area being located on the West Bank of Kandla creek which, emerges from the extreme eastern margin of the Gulf of Kutch is well protected from wave action. The significant wave height measures 2.20 mtrs. However, occasionally due to prevailing winds, wind generated waves and associated swells can reach maximum height of 3.5 mtrs.

Wind – The plan area experiences predominantly WSW winds for over
months in the year and NE winds are experienced during October t
December. The WSW winds tend to push the berthed vessels away from th
berths whereas the NE winds tend to push the vessels on to the berth thereb
causing probable damages to the ship's side or the port structure.

Turbidity – Due to very high background value of SPM, the waters
Kandla are turbid round the year. Presence of SPM in the creek wate
enables any event of oil spill to coagulate faster and act as a natural disperse
This aspect protects the Kandla creek system from ecological perturbanc
naturally.

Rainfall – Precipitation in the region of plan area is generally categoriz
under "Scanty rain fall". The major source of rainfall for this region is from t
residual southwesterly monsoon clouds. The average rain fall in the regi
measures 400 mm. Per annum.

3. Existing Oil Spill Contingency System at Kandla Port

3.1 Communication system and Reporting procedures :-

Communication System

Kandla Port Trust has established 3 Emergency Response Centres (ERC) which are equipped with a state of art Communication systems. These are located at Administrative Office Building at Gandhidham, Port & Customs Building at Kandla and at Vadinar Port Office. The three ERCs are provided with uninterrupted power supply and are designed for round the clock and round the year operations. The communication system installed in these units include the following:-

- VHF communication system
- P & T Telephones
- Fax facility
- Intercom connection
- Planet – 1 satellite telephone system
- Multimedia P.C. with Internet
- UHF communication system
- Mobile phone (to the officers In-charge of the ERC units & above.)

In addition to the above mentioned communication systems, the Kandla ERC is equipped with Cyclone Warning Dissemination System (CWDS) of IMD. Xerox, transistor Radio and television sets are also provided at all the three ERCs. Details of the above mentioned communication system together with the contact numbers of the resource personnel of the OSRT is placed at Annexure-III & IV.

Reporting procedures

The port operational areas are extensively traversed by Port cra henceforth, the field staff and officers particularly Pilots, Tug Masters Marine Engineers are instructed to report any occurrence of oil spill to nearest ERC in the format shown at Annexure-V. The ERC in turn, convey particulars of oil spill event to the Oil Spill Response Team (OSRT), which immediately attempt to reach the site of spill occurrence and commen response and mitigative action. The response activities basically include :-

- Detecting the spill and establishment of its current location
- Estimation of the extent and assessment of the oil spill in terms of quantity
- Assessment of the probable direction of slick's progradation
- Selection of appropriate interception mechanism/ mitigative measures
- Mobilization of resources and execution of actual cleanup operation
- Investigation and report generation.

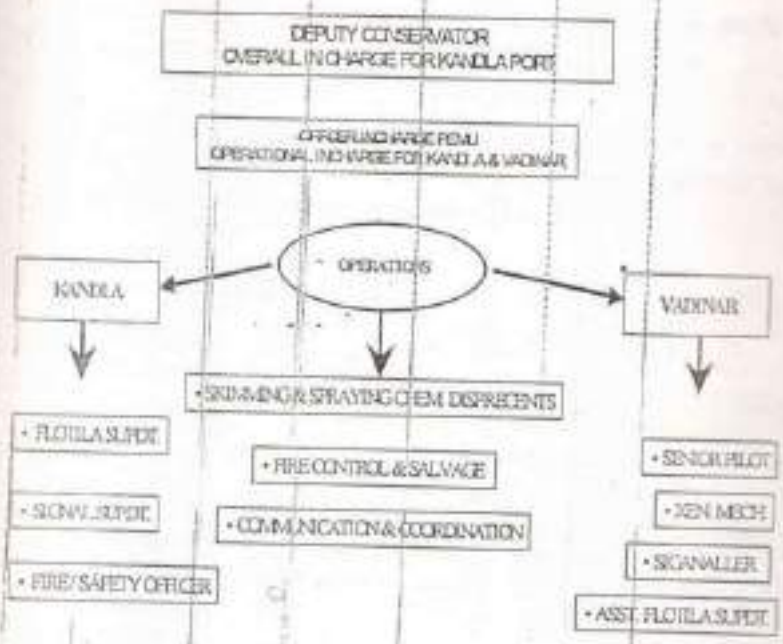
The OSRT, on reaching the site, shall commence their response activities w the preparation of standard POLREP message in the format placed Annexure-VI.

3.2 Oil Spill Response Team set up

The overall in-charge of the Oil Spill Response Team is Dy. Conservato and the operational in-charge of Response Team is lead by the Director of Po Environmental Management Unit. The Oil Spill Response Team is an inter divisional unit of Marine Department, drawn from trained personnel of Fisher Section, Fire Brigade and Environmental Management Unit, coordinated by the Director, Port Environment Management Unit. The organogram is as under :-

ORGANOGRAM

OIL SPILL RESPONSE ORGAINSATION STRUCTURE



3.3 Oil Spill Response Equipment & Accomplishments

- Standing stock of 5000 liters of chemical dispercents approved by the NIO/ZSI (separate inventories for Vadinar and Kandla are maintained). Adequate inventories are also maintained on Board Agni Shanti, Anti Pollution Vessels – Karishma at Kandla and Sagarika at Vadinar.

- MV SAGARIKA and MV KARISHMA are Oil & floating debris recovery vessels fitted with skimmer and dispercent spraying booms.

- Two Oil-cum-Debris recovery vessels namely MV Sagarika (Vadinar) and MV Karishma (Kandla) with the following systems/capabilities for oil spill recovery operations and floating garbage collection:

• Speed in picking up oil spill	- 0 – 2 knots
• Slope tank	- 25 m3
• Dispercent tank	- 1.0 m3
• Oil skimmer	- 30 m3
• Capacity of Oil Recovery	- 30 t/hrs.
• Capacity of garbage recovery	- 1.0m3/hrs
• Garbage tank capacity.	- 4 cu.mtrs.
• Recovered Oil/Slop/Transfer pump	- 30 Cu.M./hrs. with a standby pump of same capacity.

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• Capacity of garbage recovery	- 1.0m3/hrs
• Garbage tank capacity.	- 4 cu.mtrs.
• Recovered Oil/Slop/Transfer pump	- 30 Cu.M./hrs. with a standby pump of same capacity.

3.4 Oil Spill Response Fleet of Kandla Port

VADINAR

Sr. No.	NAME OF THE PORT CRAFT	BULLADR PULL IN TONNES	TYPE OF VESSEL
1	❖ MV SAGARIKA	—	MULTI PURPOSE ANTI POLLUTION VASSEL
2	❖ MT GAJ RAJ	35.0	MARINE TUG
3	❖ MT BANNI	7.5	MARINE TUG
4	❖ MT SURAJBARI	5.0	MARINE TUG
5	MT KUTCH KESARI	40.0	MARINE TUG
6	MT VADINAR	5.0	MOORING TENDER

KANDLA

1	❖ MV KARISHMA	—	MULTI PURPOSE ANTI POLLUTION VASSEL
2	❖ FF AGNI SAMTHI	—	FIRE FLOAT
3	❖ MV KARISHMA	—	MULTI PURPOSE ANTI POLLUTION VASSEL
4	❖ MT KALINGA	35.0	MARINE TUG
5	❖ MT HEERA	35.0	MARINE TUG
6	❖ MT MEHUL	35.0	MARINE TUG
7	❖ MT CHEETAH	35.0	MARINE TUG
8	MT MEKAN	19.0	MARINE TUG
9	MT JUMBO	19.0	MARINE TUG
10	❖ MT SIKANDAR	19.0	MARINE TUG
11	❖ MT GALPADAR	7.5	HARBOR TUG
12	ML NIRISHAK	—	SURVEY LAUNCH
13	ML SURVESHAK	—	PILOT CUM SURVEY LAUNCH
14	ML LIZA	—	PILOT LAUNCH
15	ML TAPKESHWARI	—	PILOT LAUNCH
16	ML SHAKTI	—	G S LAUNCH
17	ML ROSE	—	G S LAUNCH
18	ML RAGINI	—	G S LAUNCH
19	ML MRINAL	—	G S LAUNCH
20	ML UNNATI	—	MOORING LAUNCH
21	ML VAISHALI	—	MOORING LAUNCH
22	ML MEGHA	—	MOORING LAUNCH
23	ML PRIYADRASHNI	—	MOORING LAUNCH
24	ML MRIGNAYANI	—	MOORING LAUNCH
25	ML VIJAY	—	MOORING LAUNCH

❖ INDICATES THAT THE VESSEL IS FITTED WITH CHEMICAL DISPERCENT SPRAYING BOOMS

4. Oil Spill Response System Upgradation Plan (near future)

4.1 Procurement of equipment (Oil spill containment boom system)

In view of the fragile echo system along the coastline of southern Gu Kutch it is essential to upgrade the Oil Spill Response system of Kandla Po State level Review Committee headed by the Chief Secretary to Government of Gujarat with regard to Oil Spill Prevention Preparedn measures in the Gulf of Kutch has emphasized this aspect in January, 20 Further, the NOS-DCP prepared by the Indian Coast Guard stro recommended that the Port Establishments in the region should eq themselves with adequate Oil spill containment boom systems.

Appropriate skimmers should also compliment these systems w adequate tank space for recovery of the spilled oil to tackle accidental oil spi the Tier level 1 & 2.

The Indian Coast Guard through its NOS-DCP also made its emphas on inter-institutional cooperation. In view of the above, Kandla Port proposes procure 500 meters of inflatable Oil spill containment boom system.

Details of proposed Oil spill containment boom system:

- Two sets of Diesel powered hydraulically operated Reel mounted Inflatab boom systems are proposed to be installed on a suitable vessel wit adequate tank space for collection the recovered oil. The vessel shall be o a long-term charter preferably 3 to 5 years and shall be manned by the trained personnel on contract terms. In the vicinity of SBM operations, this vessel shall be kept in readiness at all times.

- The above mentioned system is contemplated as the same is compatible to the Oil spill containment system of RPL marine Terminal at Sikka. This aspect also satisfies the vision of inter-organizational cooperation if need arises (in the event of a Tier 3 level disaster).

- Within the purview of threat perception, logically evaluated scenario inclusive of worst disastrous situation which can result in oil spill in the context of Kandla Port operations are listed below:

  - ✓ Ship accidents resulting in containment failure of ships' cargo/ships' own fuel oils due to :
    - ⇒ grounding and listing of ships
    - ⇒ ship to ship coalition
    - ⇒ ship colliding with SBM/Port structures
  - ✓ Hose burst due to
    - ⇒ Failure of floating hose connection (ship to SBM.)
    - ⇒ Failure of under buoy hose
    - ⇒ Failure of valve systems
    - ⇒ Major structural failure of ships during severe sea conditions.
    - ⇒ Hose burst during transshipment/lighterage operations.

4.2 Oily waste reception facilities

The Government of India, is a signatory to MARPOL 73/78. The various annexes of the Convention having been ratified, particularly Regulation 12 of Annexure-I, it is required to create Oily waste reception facilities at Ports where the crude oil is loaded into Oil Tankers or all Ports having ship repair yards and tank cleaning facilities. In view of the above and various other Clauses under Regulation 12 of Annexure-I, Kandla Port had installed a 450 ton capacity tank near Old Kandla complimented with tank lorry. Despite the facility having been provided in Kandla Port, except for one instance, the system was not utilized

optimally to its capacity. The probable reasons for the under utilization of the system may be due to the following reasons:

- Very high berth occupancy.
- Non-availability of Oily based reception barges with the Port.
- Ambiguity which persists with regard to treatment of oily waste and ultimate disposal.
- Conflicting use of Custom Department with regard to duties on oily waste.

In view of the above probable reasons, the shipping industry perhaps was not motivated to optimally utilize the facility provided by Kandla Port.

Status quo remaining thus and with a futuristic overview, the Port Authorities have reviewed and discussed the issue with other Ports namely, Mumbai, JNPT and Chennai Ports and arrived at the following conclusions:

- That it will be opt for Kandla Port to declare the oily waste reception facility as open to private operators with valid license from the State/Central Pollution Control Board.

- These operators should essentially possess oily waste reception barges, tank lorries and a terminal point from where they can receive/discharge oily waste into a transit storege tank.

- Kandla Port may also contemplate providing infrastructural facilities to the parties who are interested in setting up oily waste treatment plants for the ultimate disposal of oily waste. In connection with the above, a press release is being issued in the leading newspepers.

Note:

At present, for the purpose of emergency, there are two private companies operating tanker barges with valid Port Craft License issued by Kandla Port Trust. These barges are available on hire. The particulars of the said companies are as follows:

Name of the company	Address	Contact person	Tel. No.
M/s. Jaisu Shipping Co.	Kewalramani House, Behind Seva Sadan-II, New Kandla	Mr. Suresh Kewalramani	(02836) 70828
M/s. A.V.Joshi & Co.	Maitri Bhavan, Plot No.18, Sector-8, Gandhidham	Mr. Ramesh Singhvi	(02836) 31388 31899

4.3 System to monitor sea surface currents on a regional scale

Surface current monitoring on a regional scale attains a great deal of importance in tracking oil slicks and in mitigating the adverse effects of oil spills. In view of the above it is proposed to acquire a system which operates on RADAR frequencies. The system is capable of logging data into a PC and covers an area of 30 Km radius from the location of the sensor with resolution cells of 100 m^2. Data thus obtained will be useful for analyzing complex circulation pattern off the creek mouths, which emerge from the Gulf of Kutch. This kind of analysis also enables successful investigations leading to identification of point sources of oil spill.

METEOROLOGICAL INFORMATION - KANDLA PORT

MAXIMUM TEMPERATURE	44.4 C	SEASONAL WIND DIRECTION	
MINIMUM TEMPERATURE	7.20 C		
MAXIMUM WIND VELOCITY	180 KmPH NNW (09-	JAN TO FEB	N/NNW/ENE
MAXIMUM GUST	200 KmPH NNW (09-	MAR TO SEP	SW/WSW
AVERAGE RAINFALL	400 mm	OCT TO DEC	N/NWE
MINIMUM ANNUAL RAINFALL	75.60 mm		
MAXIMUM ANNUAL RAINFALL	1393 mm (1979)	WAVE DATA OBSERVED AT GTS	
MAXIMUM RELATIVE HUMIDITY	100%	SIGNIFICANT WAVE Ht.	2.20 m
MINIMUM RELATIVE HUMIDITY	01%	HIGHEST WAVE Ht.	3.70 m
MINIMUM DEW POINT	-33.30 C	AVERAGE WAVE PERIOD	3 TO 15 Sec
RANGE OF SEA WATER TEMPERATURE	16.8 C to 31.8 C		
RANGE OF SEA WATER SPECIFIC GRAVITY	1.002 to 1.034		
RANGE OF S P M IN SEA WATER	94 TO 863 mg/L		
RANGE OF SALINITY a)	8.50 TO 39.20 ppt (Aug 86)		
b)	41.40 TO 47.80 ppt (Nov 86)		
c)	42.20 TO 50.50 ppt (Feb 87)		

PARTICULARS OF WIND GENERATED ANAMALOUS SEA WAVE:

DATE: 09-06-1990

DURATION: 0915 hrs. TO 1715 hrs

FETCH: >65 Km.

AVERAGE WIND VELOCITY: 180 TO 200 kmph (ESTIMATED)

WIND DIRECTION: 0915 TO 1315 hrs. WSW - LULL PERIOD 15 Minutes - 1230 TO 1715 hrs. NE

MAX. RAISE IN SEA LEVEL: 9.50 m. ABOVE C.D. AT 1440 hrs.

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW KANDLA OBSERVATORY

AVERAGED FOR THE YEARS [illegible]

LATITUDE = 23.01 N

LONGITUDE = 70.13 E

INDIA NO. [illegible]

FIRST RAINY DAY

LAST RAINY DAY

KPT	TEMPERATURE						WIND SPEED				AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN FALL	
MONTH	AVG. MAX. °C	DAY OF MONTH	MAX. °C	AVG. MIN. °C	DAY OF MONTH	MIN. °C	AVERAGE Km.P.H	DAY OF MONTH	MAX. Km.P.H	WIND DIR.	0830 Hrs mb	1730 Hrs mb	0830 Hrs (%)	1730 Hrs (%)	TOTAL (mm)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11.0	12.0	13	14	15	16
JAN	26.36	---	31.70	14.06	---	9.70	11.70	---	43.00	---	1017.2	1014.3	60.00	39.30	0.19	---
FEB	27.54	---	34.56	15.90	---	9.00	11.10	---	65.00	---	1015.3	1012.1	59.60	37.50	0.76	---
MAR	31.20	---	37.80	20.15	---	13.00	13.50	---	55.00	---	1013.3	1010.0	69.63	41.13	0.04	---
APR	34.62	---	42.60	23.63	---	18.50	17.22	---	55.00	---	1009.8	1006.8	73.78	45.11	0.89	---
MAY	35.23	---	42.10	33.03	---	19.80	21.44	---	60.00	---	1007.1	1004.1	77.00	55.11	4.60	---
JUN	35.14	---	41.10	27.96	---	24.30	21.69	---	71.00	---	1002.3	999.6	77.22	61.67	65.69	---
JUL	32.66	---	37.60	27.20	---	23.00	20.80	---	56.00	---	1001.8	999.6	81.70	67.90	158.25	---
AUG	31.33	---	37.60	26.02	---	23.00	20.60	---	80.00	---	1003.2	1000.7	84.70	71.20	191.15	---
SEP	33.10	---	40.20	25.76	---	22.00	15.80	---	50.00	---	1008.0	1005.1	79.70	56.10	50.51	---
OCT	34.25	---	40.10	24.30	---	18.00	10.89	---	55.00	---	1012.2	1009.1	69.40	45.70	0.68	---
NOV	30.51	---	37.60	19.93	---	13.80	9.22	---	100.00	---	1014.7	1011.7	63.33	44.67	34.34	---
DEC	24.54	---	33.60	15.35	---	7.80	10.50	---	29.00	---	1017.2	1014.3	56.00	40.30	2.01	---
AVERAGE	31.36		38.08	23.76		16.80	15.39		69.75		1010.0	1007.3	71.00	50.47		
MAX.			42.60						100.00		1017.2	1014.3				
MIN.						7.80										
TOTAL															[illegible]	

MONTH WISE AUTOMATED METEOROLOGICAL DATA OF NEW KANDLA OBSERVATORY

LATITUDE = 23.03 N
LONGITUDE = 70.13 E
YEAR : 2008

WMO NO 42838
FIRST RAINY DAY : 03-06-08
LAST RAINY DAY : 23-09-08

MONTH	TEMPERATURE						WIND SPEED			WIND DIR.	AVERAGE PRESSURE		AVERAGE HUMIDITY		DAILY RAIN FALL	
	AVG.MAX. °C	DAY OF MONTH	MAX. °C	AVG.MIN. °C	DAY OF MONTH	MIN. °C	AVERAGE Km.P.H	DAY OF MONTH	MAX. Km.P.H		0830 Hrs mb	1730 Hrs. mb	0818 Hrs (%)	1718 Hrs (%)	TOTAL (mm.)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11.0	12.0	13	14	15	16
JAN	24.8	30	29.2	11.9	23	10.5	10.0	20	18.0	N	1015.2	1013.3	71.0	51.0	0.0	0.0
FEB	27.6	23	31.8	16.2	9	11.7	9.0	14	21.0	SW	1016.5	1013.6	64.0	40.0	0.0	0.0
MAR	31.5	30	35.9	20.3	1	15.3	11.0	23	17.0	SSW	1013.0	1009.7	35.0	42.0	0.0	0.0
APR	34.2	30	37.1	21.6	3	18.7	14.0	28	29.0	WSW	1011.1	1007.2	65.0	45.0	0.0	0.0
MAY	35.9	20	41.6	25.7	4	21.0	20.0	28	30.0	SW	1006.9	1003.1	72.0	53.0	0.0	0.0
JUN	34.8	8	40.3	27.7	9	24.9	20.0	11	33.0	E	1001.5	1000.3	77.0	58.0	43.4	4.0
JUL	32.2	18	34.9	26.7	24	23.7	21.0	31	40.0	SW	1002.6	1000.4	82.0	69.0	226.4	17.0
AUG	31.9	22	33.9	26.0	22	24.4	19.0	1	38.0	SW	1004.5	1001.9	84.0	70.0	67.0	8.0
SEP	33.6	21	35.6	26.0	28	24.3	14.0	5	30.0	SW	1008.4	1005.2	78.0	56.0	7.4	3.0
OCT	34.6	8	37.9	24.0	28	22.0	9.0	11	21.0	SSW	1012.4	1008.8	69.0	40.0	0.0	0.0
NOV	31.7	1	36.1	20.9	28	17.8	8.0	30	16.0	NNE	1016.5	1013.0	58.0	38.0	0.0	0.0
DEC	26.6	7	30.4	15.8	27	7.2	9.0	26	20.0	NNE	1018.1	1014.8	59.0	44.0	0.0	0.0
AVERAGE	31.6		34.4	22.0		18.6	13.7		26.1		1010.7	1007.6	67.8	50.5		
MAX.			41.60						40.00		1018.1	1014.8				
MIN.						1.30										
TOTAL															344.2	52.0

MONTH WISE AVERAGED METEOROLOGICAL DATA OF [illegible] KANDLA OBSERVATORY

LATITUDE = 23.01 N

LONGITUDE = 70.13 E

YEAR : 1990

INDEX NO. 42639

FIRST RAINY DAY : [illegible]

LAST RAINY DAY : [illegible]

MONTH	TEMPERATURE AVG MAX. °C	DAY OF MONTH	MAX. °C	AVG MIN. °C	DAY OF MONTH	MIN. °C	WIND SPEED AVERAGE Km P.H	DAY OF MONTH	MAX. Km P.H	WIND DIR.	AVERAGE PRESSURE 0830 Hrs mb	1730 Hrs mb	AVERAGE HUMIDITY 0830 Hrs (%)	1730 Hrs (%)	RAIN FALL TOTAL (mm)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11.0	12.0	13	14	15	16
					2	12.0	9.0	27	32.0	SSW	1017.5	1014.5	65.0	37.0	0.0	0.0
JAN	27.9	24	32.7	15.3	2	13.0	10.0	17	46.0	SSW	1014.7	1011.6	66.0	41.0	29.8	1.0
FEB	28.0	7	32.9	17.7	1	14.6	11.0	22	40.0	SSW	1013.9	1010.8	67.0	34.0	10.4	1.0
MAR	30.6	19	37.5	19.3	5	21.1	16.0	20	46.0	SSW	1009.3	1005.8	72.0	51.0	0.0	0.0
APR	34.0	30	35.9	23.4	7&8	25.4	20.0	14	47.0	SSW	1005.6	1001.8	75.0	55.0	0.0	0.0
MAY	35.2	23	38.1	27.4	25	27.7	22.0	14	48.0	SSW	1002.8	999.7	76.0	58.0	3.3	3.0
JUN	36.2	1	38.3	28.4	28	26.2	26.0	10	64.0	SW	1001.7	999.8	78.0	67.0	15.8	11.0
JUL	32.0	18	33.5	27.3	25	24.2	18.0	12	46.0	SW	1004.3	1001.9	85.0	73.0	200.6	16.0
AUG	31.2	15	34.5	26.1	16	24.6	13.0	12	44.0	SW	1007.9	1004.8	83.0	69.0	28.7	6.0
SEP	32.7	21	36.9	26.0	20	20.8	7.0	2	35.0	SE	1012.6	1009.2	67.0	44.0	0.0	0.0
OCT	34.6	11	37.5	24.3	25	17.0	6.0	2	41.0	SE	1015.6	1012.5	65.0	38.0	1.0	1.0
NOV	31.1	2	33.4	20.6	31	7.0	7.0	29	35.0	W	1017.6	1014.5	65.0	45.0	0.0	0.0
DEC	26.9	2	29.6	16.3												39.0
AVERAGE	31.6		34.3	22.2		19.5	13.8		42.9		1010.3	1007.2	72.4	50.6		
MAX.		***	38.30		***			***	54.00		1017.5	1014.5				
MIN.						7.50										
TOTAL															289.6	39.0

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW KANELA OBSERVATORY

LATITUDE = [illegible] N | YEAR : 1991

LONGITUDE = [illegible] E

INDEX NO. [illegible]
FIRST RAINY DAY : [illegible]
LAST RAINY DAY : [illegible]

KPT	TEMPERATURE						WIND SPEED				AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN FALL	
MONTH	AVG.MAX. °C	DAY OF MONTH	MAX. °C	AVG.MIN. °C	DAY OF MONTH	MIN. °C	AVERAGE Km.P.H	DAY OF MONTH	MAX. Km.P.H	WIND DIR.	0830 Hrs mb	1730 Hrs. mb	0830 Hrs.(%)	1730 Hrs.(%)	TOTAL (mm)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11	12	13	14	15	16
JAN	25.5	27	35.6	15.1	1.0	8.9	12.0	7	36.0	NNW	1015.7	1013.6	63.0	35.0	0.0	0.0
FEB	28.1	08	31.9	17.1	17.0	10.7	9.0	15	31.0	N	1014.4	1012.3	77.0	34.0	0.0	0.0
MAR	33.9	29	42.7	21.4	1.0	17.5	10.0	22	37.0	SSW	1010.3	1007.7	60.0	36.0	0.0	0.0
APR	34.0	19	38.4	24.9	3.0	21.6	11.0	8	34.0	SW	1008.0	1005.1	68.0	45.0	0.0	0.0
MAY	34.5	31	40.2	27.0	1.0	26.2	10.0	2	36.0	SSW	1006.0	1003.4	78.0	55.0	0.0	0.0
JUN	34.6	01	42.6	28.8	1.0	26.8	15.0	19	47.0	SW	1000.0	997.8	78.0	66.0	0.0	0.0
JUL	32.8	15	38.0	27.9	27.0	25.6	15.0	4	38.0	SW	999.6	997.5	75.0	68.0	0.2*	1.0
AUG	31.6	24	34.0	27.1	15.0	26.1	14.0	10	30.0	SW	1002.7	1000.5	75.0	66.0	129.4	15.0
SEP	32.3	22	35.1	26.4	25.0	26.0	11.0	3	28.0	SW	1009.6	1006.3	69.0	51.0	28.5	14.0
OCT	35.0	10	38.1	24.1	19.0	22.2	9.0	14	27.0	SW	1009.8	1007.1	66.0	32.0	0.0	0.0
NOV	31.0	01	35.4	20.8	30.0	17.4	9.0	14	16.0	N	1014.7	1011.7	65.0	42.0	0.0	0.0
DEC	27.5	07	31.2	16.7	30.0	12.7	8.0	16	15.0	NNW	1017.6	1014.3	68.0	40.0	0.0	0.0
AVERAGE	19.5		37.1	27.1		20.1	11.1		31.3		1009.0	1006.4	66.0	47.5		30.0
MAX.		***	42.70		***			***	47.00		1017.6	1014.3				
MIN.						8.90										
TOTAL															158.1	30.0

MONTH WISE AVERAGE METEOROLOGICAL DATA OF NEW [illegible] OBSERVATORY

YEAR: [illegible]

LATITUDE = [illegible] N

LONGITUDE = [illegible] E

INDEX NO. [illegible]

FIRST RAINY DAY: [illegible]

LAST RAINY DAY: [illegible]

MONTH	TEMPERATURE AVG. MAX. °C	DAY OF MONTH	MAX. °C	AVG. MIN. °C	DAY OF MONTH	MIN. °C	WIND SPEED AVERAGE Km.P.H.	DAY OF MONTH	MAX. Km.P.H.	WIND DIR.	AVERAGE PRESSURE 0830 hrs. mb	1730 hrs. mb	AVERAGE HUMIDITY 0830 hrs. (%)	1730 hrs. (%)	RAIN TOTAL (mm)	FALL RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11	12	13	14	15	16
JAN	25.0	11	31.8	14.4	18	10.3	10.0	12	17.0		1018.8	1016.0	65.0	46.0	0.0	0.0
FEB	26.6	25	31.7	17.4	19	10.6	10.0	27	21.0		1015.2	1013.2	69.0	51.0	0.0	0.0
MAR	30.6	22	34.3	19.8	09	17.1	12.0	06	36.0		1014.2	1011.8	75.0	63.0	0.0	0.0
APR	33.4	25	39.7	23.0	17	20.1	14.0	22	23.0		1011.1	1008.3	80.0	68.0	0.0	0.0
MAY	34.8	07	38.2	26.0	01	22.1	20.0	26	32.0		1007.5	1005.5	80.0	66.0	0.0	0.0
JUN	36.2	04	43.0	30.2	01	25.7	24.0	25	46.0		1001.9	998.0	83.0	68.0	28.0	1.0
JUL	34.0	15	38.5	30.3	28	26.5	21.0	31	34.0		1000.1	998.1	86.0	73.0	275.0	11.0
AUG	32.2	10	35.0	28.7	12	26.0	17.0	21	26.0		1002.1	999.7	86.0	72.0	44.0	10.0
SEP	30.8	30	34.5	26.4	20	24.6	16.0	24	20.0		1007.9	1005.1	82.0	59.0	71.7	2.0
OCT	31.4	08	35.4	26.2	31	22.0	9.0	10	22.0		1012.1	1008.9	80.0	59.0	0.0	0.0
NOV	31.0	08	35.0	22.0	27	18.5	8.0	21	16.0		1016.5	1013.3	81.0	56.0	0.0	0.0
DEC	27.7	06	31.8	19.0	14	15.8	7.0	13	14.0		1018.2	1015.3	78.0	46.0	0.0	0.0
AVERAGE	31.2		34.9	33.0		20.3	14.0		25.6		1010.3	1007.9	78.8	60.6		
[illegible]		***	43.00		***	10.30		***	46.00		1018.8	1016.0				
MIN.																
TOTAL															438.7	24.0

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW KANDLA OBSERVATORY

LATITUDE = [illegible]

LONGITUDE = [illegible]

YEAR : [illegible]

INDEX NO [illegible]

FIRST RAINY DAY [illegible]

LAST RAINY DAY : [illegible]

KPT	TEMPERATURE						WIND SPEED				AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN FALL	
MONTH	AVG.MAX. °C	DAY OF MONTH	MAX. °C	AVG.MIN. °C	DAY OF MONTH	MIN. °C	AVERAGE Km.P.H	DAY OF MONTH	MAX. Km.P.H	WIND DIR.	0830 Hrs mb	1730 Hrs. mb	0830 Hrs.(%)	1730 Hrs.(%)	TOTAL in(mm)	RAINY DAYS
JAN	26.5	25	32.2	15.4	16	12.7	09	21	10.0	NNE	1016.5	1013.7	59.0	35.0	0.0	0.0
FEB	27.9	19	31.2	16.9	25	12.1	10	20	36.0	VAR	1014.9	1011.9	60.0	35.0	0.0	0.0
MAR	33.7	18	40.2	21.9	01	18.5	10	26	21.0	SSW	1013.9	1009.9	62.0	35.0	0.0	0.0
APR	33.7	09	37.8	23.8	08	19.1	16	6	37.0	NNE	1010.2	1006.6	73.0	53.0	0.0	0.0
MAY	34.7	15	37.7	25.6	06	22.1	20	25	31.0	WSW	1007.6	1004.3	78.0	60.0	0.0	0.0
JUN	36.0	06	42.7	28.4	16	25.1	18	2	47.0	WSW	1000.6	997.6	78.0	59.0	107.0	9.0
JUL	30.6	04	33.6	26.6	13*	23.0	20	6	39.0	NSW	999.9	997.9	83.0	72.0	440.6	22.0
AUG	29.9	31	31.4	25.8	09,	24.7	17	9	36.0	NSW	1002.9	1000.1	86.0	74.0	290.7	19.0
SEP	31.0	26	34.6	24.3	10	21.8	13	9	36.0	WSW	1008.2	1005.5	79.0	63.0	191.7	9.0
OCT	34.3	07	36.2	23.7	21	21.3	08	6	18.0	NNW	1013.1	1010.0	76.0	37.0	0.0	0.0
NOV	30.7	01	33.9	19.4	26	10.5	08	22	14.0	N	1016.5	1013.2	78.0	46.0	0.0	0.9
DEC	27.2	05	30.8	14.8	30	11.2	09	15	14.0	N	1018.5	1015.7	80.0	54.0	0.0	0.0
AVERAGE	31.3		35.2	22.2		19.0	8.0		20.9		1010.2	1007.2	74.3	57.6	***	***
MAX.		***	42.70		***			***	47.00		1018.5	1015.7				
MIN.						11.20										
TOTAL															2030.0	59.0

MONTHWISE AVERAGED METEOROLOGICAL DATA OF NEW KAMELA OBSERVATORY

LATITUDE = 23.01 N YEAR : 1995

LONGITUDE = 78.11 E

INDEX NO.42019

FIRST RAINY DAY : 05-03-95

LAST RAINY DAY : 30-12-95

SITE	TEMPERATURE						WIND SPEED				AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN FALL	
MONTH	AVG.MAX. °C	DAY OF MONTH	M.E. °C	AVG.MIN °C	DAY OF MONTH	M.E. °C	AVERAGE (Km.P.H)	DAY OF MONTH	MAX. (Km.P.H)	WIND DIR.	0830 hrs m/s	1730 hrs. m/s	0818 hrs.(%)	1718 hrs.(%)	TOTAL (in mm)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11.E	12.E	13	14	15	16
JAN	25.3	6	30.9	14.4	19	11.1	9.0	17	21.0	NNE	1016.4	1015.7	61.0	43.0	0.0	0.0
FEB	28.3	9	31.9	16.9	16	15.1	9.0	21	21.0	SSW	1015.2	1013.2	73.0	38.0	0.0	0.0
MAR	30.3	22	36.4	19.6	11	15.5	13.0	9	26.0	NNW	1013.7	1010.6	70.0	39.0	0.2	1.0
APR	34.5	12	37.8	23.6	2	20.1	13.0	15	29.0	WSW	1011.1	1007.6	71.0	38.0	0.0	0.0
MAY	36.8	29	44.0	20.8	2	25.1	19.0	18	32.0	SW	1006.1	1003.5	75.0	59.0	0.0	0.0
JUN	35.7	15	39.0	28.6	3	27.2	22.0	30	34.0	SSW	1002.9	999.8	88.0	65.0	0.0	0.0
JUL	33.1	10	36.7	27.6	17	25.2	19.0	2	38.0	SW	999.9	997.6	88.0	71.0	190.6	19.0
AUG	32.5	31	34.4	26.9	7	24.5	21.0	13	40.0	WSW	1003.7	1001.1	82.0	67.0	11.3	14.0
SEP	34.3	2	38.4	26.2	19	24.7	16.0	4	32.0	WSW	1007.8	1004.7	76.0	56.0	1.4	1.0
OCT	34.4	10	38.6	25.9	31	21.7	9.0	10	10.0	NNW	1011.1	1007.7	70.0	51.0	78.3	3.0
NOV	34.1	12	33.8	20.0	30	14.7	7.0	30	16.0	NNE	1014.6	1011.3	59.0	37.0	0.0	0.0
DEC	27.9	14	30.8	16.6	1	13.1	9.0	8	17.0	NNE	1018.7	1015.7	69.0	51.0	0.2	1.0
AVERAGE	32.3		36.1	22.8		19.8	11.8		26.3		1010.3	1007.3	75.0	51.3		
MAX.		***	44.00		***			***	40.00		1018.7	1015.7			***	***
MIN.						11.1										
TOTAL															292.0	39.0

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW MANGALORE OBSERVATORY

INDEX NO 43839
FIRST RAINY DAY : 15-05-98
LAST RAINY DAY : 11-09-98

LATITUDE = 13.01 N
LONGITUDE = 74.11 E

MONTH	TEMPERATURE						WIND SPEED				AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN FALL	
	AVG.MAX. °C	DAY OF MONTH	MAX. °C	AVG.MIN. °C	DAY OF MONTH	MIN. °C	AVERAGE Km.P.H	DAY OF MONTH	MAX. Km.P.H	WIND DIR.	0830 Hrs mb	1730 Hrs. mb	0830 Hrs.(%)	1730 Hrs.(%)	TOTAL M.M(ins.)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11.0	12.0	13	14	15	16
JAN	29.90	13	35.9	14.8	18	9.2	9.8	21	18	SSW	1016.4	1013.6	66.0	41.0	1.1	1.0
FEB	29.20	28	35.3	17.4	1	13.4	9.8	25	32	SW	1014.8	1011.5	64.0	36.0	0.0	0.0
MAR	33.80	20	40.0	22.1	7	18.1	11.9	25	32	WSW	1011.9	1008.3	62.0	35.0	0.0	0.0
APR	35.10	15	41.8	24.3	10	21.0	14.8	21	30	SW	1009.3	1005.9	77.0	48.0	1.8	1.0
MAY	34.90	8	41.2	26.4	6	24.1	20.9	10	48	WSW	1008.1	1005.6	84.0	69.0	8.0	0.0
JUN	34.50	16	39.4	28.2	21	24.3	28.8	14	38	SSW	1002.1	999.2	80.0	64.0	256.0	7.0
JUL	33.50	15	36.8	28.0	8	25.1	18.0	3	30	WSW	1001.6	999.0	87.0	74.0	68.0	10.0
AUG	31.70	24	33.9	25.9	28	24.3	21.3	8	40	WSW	1004.9	1002.5	86.0	75.0	38.5	5.0
SEP	32.90	23	35.5	27.5	21	24.7	16.0	8	40	SSW	1007.3	1004.1	84.0	68.0	8.5	1.0
OCT	34.80	16	39.4	25.1	31	21.6	10.0	24	26	NE	1011.6	1008.5	87.0	48.0	0.0	0.0
NOV	31.20	7	34.6	18.2	21	13.1	7.0	2	20	SW	1015.5	1012.2	82.0	36.0	0.0	0.0
DEC	28.00	1	30.7	15.0	8	11.1	8.0	7	20	NNE	1017.8	1014.6	86.0	39.0	0.0	0.0
				22.79			13.59		31.7		1010.1	1007.1	79.0	57.0		
AVERAGE	31.83								46.00		1017.8	1014.6				
MAX. :			41.80			9.20									3519	26.0
MIN. :																
TOTAL:																

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW MANGALA OBSERVATORY

LATITUDE = 21.01 N (YEAR : 1998)

LONGITUDE = 78.15 E

INDEX NO.42639

FIRST RAINY DAY : 98-06-08

LAST RAINY DAY : 12-10-98

KPT	TEMPERATURE						WIND SPEED				AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN FALL	
MONTH	AVG.MAX. °C	DAY OF MONTH	MAX. °C	AVG.MIN. °C	DAY OF CNTH	MIN. °C	AVERAGE Km.P.H	DAY OF MONTH	MAX. Km.P.H	WIND DIR.	0830 hrs mb	1730 hrs mb	0830 hrs (%)	1730 hrs (%)	TOTAL (mm.)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11.0	12.0	13	14	15	16
JAN	29.70	6	29.30	14.10	19	10.80	9.00	17	15.00	NNE	1017.3	1014.6	65.0	36.0	0.00	0.0
FEB	33.40	12	33.90	16.50	20	10.00	10.00	21	20.00	SSW	1015.8	1013.8	73.0	35.0	0.00	0.0
MAR	37.80	22	40.60	21.20	2	16.00	10.00	9	15.00	NNW	1013.8	1010.5	70.0	43.0	0.00	0.0
APR	34.60	5	39.90	25.00	29	21.40	16.00	15	23.00	WSW	1010.8	1007.3	78.0	56.0	0.00	0.0
MAY	36.60	11	46.70	27.60	4	20.00	18.00	18	30.00	SW	1006.8	1003.1	78.0	42.0	0.00	0.0
JUN	34.60	16	42.50	28.00	16	22.00	21.00	30	60.00	SSW	1002.5	999.7	83.0	68.0	50.90	4.0
JUL	32.50	29	35.50	27.40	31	25.50	21.00	2	44.00	SW	1001.2	998.5	86.0	71.0	123.60	16.0
AUG	33.00	24	36.10	25.80	10	25.00	21.00	13	40.00	WSW	1004.3	1002.0	85.0	65.0	37.30	8.0
SEP	34.10	15	36.30	25.50	23	25.00	17.00	4	42.00	WSW	1006.9	1003.5	86.0	61.0	28.20	5.0
OCT	33.70	9	37.70	25.50	27	25.30	8.00	16	34.00	NNW	1010.2	1007.6	83.0	57.0	104.50	3.0
NOV	31.00	3	34.40	20.60	29	15.00	6.00	30	14.00	NNE	1014.6	1011.4	73.0	44.0	0.00	0.0
DEC	27.80	1	30.30	17.10	28	14.10	4.00	8	22.00	NNE	1017.4	1014.5	78.0	46.0	0.00	0.0
AVERAGE	32.19			23.67			13.50				1010.2	1007.3	78.17	51.42		
MAX.			42.50						60.00		1017.4	1014.6				
MIN.						10.80										
TOTAL															349.50	36.0

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW KANDLA OBSERVATORY

YEAR : [illegible]

LATITUDE = 23.01 N

LONGITUDE = 70.13 E

INDEX NO. [illegible]

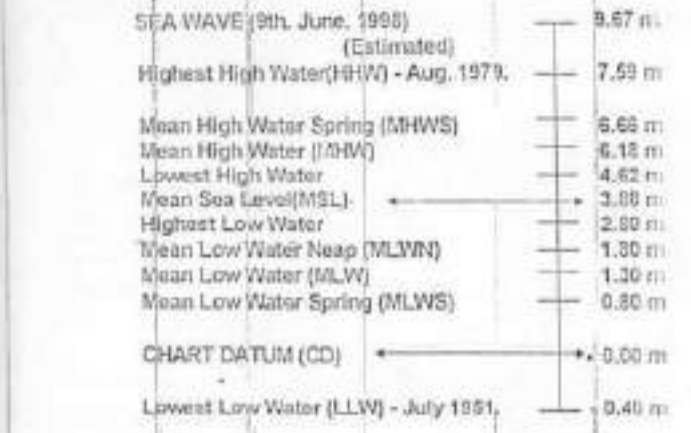
FIRST RAINY DAY : 15-02-19

LAST RAINY DAY : 07-10-19

MONTH	TEMPERATURE: AVG. MAX. °C	DAY OF MONTH	MAX. °C	AVG. MIN. °C	DAY OF MONTH	MIN. °C	WIND SPEED: AVERAGE Km.P.H	DAY OF MONTH	MAX. Km.P.H	WIND DIR.	AVERAGE PRESSURE: 0830 hrs mb	1730 hrs mb	AVERAGE HUMIDITY: 0830 hrs (%)	1730 hrs (%)	RAIN FALL: TOTAL in (mm)	RAINY DAYS
1	2	3	4	5	6	7	8	9	10		11.0	12.0	13	14	15	16
JAN	24.5	16	27.9	15.5	29	11.4	4.5	29	30.00	SW	1015.8	1013.3	83.0	54.0	0.0	0.0
FEB	28.8	18	33.8	18.1	1	14.8	8.0	15	48.00	W	1015.0	1010.8	70.0	50.0	27.5	2.0
MAR	32.6	29	37.7	20.9	11	19.3	7.0	18	34.00	SSW	1011.0	1007.3	67.0	42.0	0.0	0.0
APR	36.3	5	41.1	23.7	13	21.8	13.0	27	40.00	SW	1009.1	1005.6	78.0	35.0	0.0	0.0
MAY	34.6	4	38.8	28.4	30	24.3	22.0	20	60.00	S	1005.2	1002.2	70.0	62.0	25.8	3.0
JUN	34.1	14	35.8	26.6	2	23.3	23.0	2	43.00	WSW	1003.5	1001.3	84.0	57.0	24.2	2.0
JUL	33.1	7	28.8	27.6	2	24.8	23.0	28	48.00	SW	1001.2	999.1	87.8	66.0	8.6	6.0
AUG	33.7	15	34.2	26.8	4	25.6	21.0	1	40.00	WW	1008.9	1004.8	78.0	61.0	16.9	6.0
SEP	34.7	28	36.5	26.6	10	30.2	12.0	4	33.00	SW	1005.7	1004.5	74.0	53.0	3.4	3.0
OCT	34.1	9	38.7	25.2	30	22.6	8.0	10	28.00	SSE	1011.0	1005.8	78.0	56.0	132.0	7.0
NOV	33.2	3	35.5	21.8	20	16.7	7.0	10	30.00	SW	1016.7	1012.8	75.0	40.0	0.0	0.0
DEC	27.8	5	33.8	16.3	23	13.8	7.0	11	18.00	NE	1017.2	1013.1	66.0	41.0	0.0	0.0
AVERAGE	31.87			23.87			12.08				1010.2	1000.1	76.58	53.00		
MAX.			41.10						60.00		1023.2	1023.7				
MIN.						11.40										
TOTAL															238.30	29.0

Details of Tide levels and tidal stream

KANDLA PORT TIDE LEVEL REFFERED TO CHART DATUM



PLACE	Lat. N	Long. E	HEIGHT IN METRES ABOVE DATUM				
			MHWS	MHWN	MLWN	MLWS	MSL
KANDLA	23° 01'	70° 13'	6.7	5.7	1.8	0.8	3.8

Tidal stream information of Kandla creek

KANDLA		50 m off Berth No. 5	
Hours		Direction	Rate (Kn) Sp
BEFORE HW	6	100°	0.80
	5	040°	0.50
	4	300°	1.50
	3	295°	1.70
	2	270°	1.61
	1	340°	1.10
HW		068°	0.20
AFTER HW	1	160°	0.70
	2	250°	1.00
	3	225°	1.30
	4	210°	1.20
	5	175°	0.60
	6	140°	0.45

Tidal stream information at SBM – I

VADINAR		Lat. : 22° 31' 00" N Long.: 69° 41' 30" E		
Hours		Direction	Rate (Kn) Sp	Np
BEFORE HW	6	354°	0.2	0.1
	5	038°	1.2	0.8
	4	042°	1.5	1.0
	3	049°	1.5	1.0
	2	047°	1.2	0.8
	1	036°	0.5	0.3
HW		198°	0.4	0.2
AFTER HW	1	202°	1.0	0.7
	2	232°	1.3	1.0
	3	222°	1.4	1.0
	4	226°	1.3	0.9
	5	232°	0.7	0.5
	6	310°	0.1	0.1

...s of Emergency Response Centers

FACILITY	A.O.BUILDING, GANDHIDHAM	P & C BUILDING, NEW KANDLA	VADINAR SIGNAL STATION
...LEPHONE	02836 32990	02836 70277 02836 70549	02833 56555
...	02836 33708	02836 70338	02833 56540
...MAIL	kpt@guj1.guj.nic.in	—	—
...NDS OF IMD	—	INSTALLED	—
PLANET-1 SATELLITE PHONE VOICE FAX DATA	762092 777 762092 778 762092 779	762092 789 762092 790 762092 791	762092 786 762092 787 762092 788

ANNEXURE -IV

Contact numbers of resource personnel of the OSRT.:

	Name	Designation	Tel (O)	Tel (R)	Fax
1	KANDLA Capt. P.C.Chaturvedi	Dy.Conservator	33585 20235	34374	35982
	G.Mallikarjun Rao	Coordinator, PEMU	70277	27327	32040
	C.U.Singh	Flotilla Supdt.	70280	30870	
	M.D.Samuel	Fire-cum-Safety Officer	70176 70178	70297	
	Badrinarayan	Signal Supdt.	70194 70549		
	Name	Designation	Tel(O)	Tel(R)	Fax
2	VADINAR S.K.Kotak	Suptd. Engineer	(02833) 56749	(02833) 56522	(02833) 56540
		Senior Pilot	----	----	(02833) 56540
		Asstt.Flotilla Suptd.	(02833) 56574	----	(02833) 56540

Spill Report Form and POLREP Message Format

Particulars of person / organisation reporting incident :

a. Title :

b. Company :

c. Telephone / FAX / Telex No. :

d. Date / Time :

e. Spill location :

f. Type and Quality of oil spill :

g. Cause of spill :

h. Response to spillage, if any :

i. Any other information :

POLREP MESSAGE FORMAT

(See amplification in succeeding table)

Reference : IMO - 560 (1990)

Address
Date
Identification
Serial Number

From ..... To .....
Time Group

1.	Date and time
2.	Position
3.	Incident
4.	Outflow
5.	Acknowledge
40.	Date and Time
41.	Position
42.	Characteristics of pollution
43.	Source and cause of pollution
44.	Wind direction and speed
45.	Current or tide
46.	Sea state and pollution
47.	Drift of pollution
48.	Forecast
49.	Identity of observer and ships on scene
50.	Action taken
51.	Photographs or samples
52.	Names of other agencies informed
53-59.	Spare
60.	Acknowledge
80.	Date and time
81.	Request for assistance
82.	Coast
83.	Pre-arrangements for the delivery
84.	Assistance to where and how
85.	Other agencies requested
86.	Change of command
87.	Exchange of information
88.	Names and number of
89.	Description of equipment
90.	ETA and arrival information
91.	Place of embarkation
92.	Place of disembarkation
93-98.	Spare
99.	Acknowledge

PART III (POLFAC)

CONTENTS	REMARKS
51 REQUEST FOR ASSISTANCE	Type and amount of assistance required in the form of: - specified equipment - specified equipment with trained personnel - complete strike teams - personnel with special expertise with indication of country requested
52 COST	Requirements for cost information to requesting country of delivered assistance
53 PRE-ARRANGEMENTS FOR THE DELIVERY OF ASSISTANCE	Information concerning customs clearance, access to territorial waters, etc. in the requesting country.
54 TO WHERE ASSISTANCE SHOULD BE RENDERED AND HOW	Information concerning the delivery of the assistance, e.g. rendezvous at sea with information on frequencies to be used, call sign and name of Supreme On-Scene Commander of requesting country, or land-based authorities with telephone number, telex number [illegible]
55 NAMES OF OTHER STATES AND ORGANIZATION	Only to be filled in if not covered by figure 51, e.g. if further assistance [illegible] States.
56 CHANGE OF COMMAND	When a substantial part of an oil pollution or serious threat of oil pollution [illegible] into the zone of another Contracting Party, the country which has exercised the supreme command of the operation may request the other country to take over the [illegible]
57 EXCHANGE OF INFORMATION	When a mutual agreement has been reached between two parties on a change [illegible] the country transferring the supreme command should give a report on all [illegible] to the operation to the country taking over the command.
58-98	SPARE FOR ANY OTHER RELEVANT REQUIREMENTS OR INSTRUCTIONS
99 ACKNOWLEDGE	When this figure is used the telex should be acknowledged as soon as possible by the competent national authority.

/

/

Annexure M

Form IV

DEENDAYAL PORT AUTHORITY
(Erstwhile: DEENDAYAL PORT TRUST)

ISO 9001-2015 &
ISO 14001-2015 Certified Port

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

www.deendayalport.gov.in

EG/WK/EMC/CCA/ Part(III)/ 91

Date: 19/07/2024

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 2023-24 reg.
(Detailed Consent Order issued by GPCB vide letter no. GPCB/CCA-Kutch-812/(5)/ID - 28494/581914 dated 22/01/2021 – Consent no. AWH – 110594 & CCA amendment Order – WH-130995).

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.
12) DPA letter no. EG/WK/EMC/CCA/Part III/325 dated 19/06/2023.

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 had obtained Renewal of Consolidated Consent & Authorization from the GPCB vide order no. AWH – 110594 dated 22/01/2021 valid up to 21/07/2025 for Port Area of Deendayal Port Authority and subsequently, the GPCB had issued correction in consent vide order dated 09/04/2021. Afterward, DPA has also obtained amendment in Consent Order from the GPCB vide order dated 11/01/2024 (CCA Amendment – WH-130995) **(Copy attached as Annexure I).**

In this regard, as per statutory requirement, the DPA has regularly submitted Annual Returns (as mentioned in references 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 2023-24, as **Annexure II**.

This is for kind information and record please.

Encl: As above

Yours faithfully,

19/7/24

Dy. Chief Engineer & EMC (I/C)
Deendayal Port Authority

Annexure I

GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN, SECTOR 10-A,
GANDHINAGAR - 382010,
(T) 079-23232152

GPCB

CCA-Amendment
(WH-130995)

No. PC/CCA-KUTCH- 812(6)/ GPCB ID-28494/ **Date: /01/2024**

To,
M/s. Kandla Port Trust,
At Kandla, A.O Building Gandhidham,
Tal: Gandhidham,
Dist: Kutch – 370 201.

SUB: Amendment in the consolidated consent & Authorization of the Board.

REF: 1) CCA issued by this office vide order no- **AWH- 110594** dated 22/01/2021 valid up to 21/07/2025.
2) Your CCA Amendment Application Inward ID No.**277270** dated **23/05/2023.**

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 6(2) of the Hazardous And Other Waste (Management and Transboundary) Rules, 2016 & framed under the Environment (Protection) Act-1986, The Board has granted CCA vide order No. **AWH- 110594** issued vide order dated 22/01/2021 valid up to 21/07/2025.

The Board has right to review and amend the conditions of the said CCA and its amendment orders. Now, considering your application for CCA amendment inward ID No.**277270** dated 23/05/2023, **the said CCA order is amended as below:**

1. **The order shall be read as CCA amendment Order No.: WH- 130995 Date of Issue: 14/12/2023, valid up to 21/07/2025.**

SUBJECT TO THE FOLLOWING SPECIFIC CONDITIONS:

1. There shall be no change in existing production and its capacity, raw materials consumption, fuel consumption, flue gas emission & process gas emission, due to CCA Amendment.
2. Industry shall not carry out any activity which may attract the applicability of EIA notification-2006 & its amendment.
3. No ground water shall be withdrawal without prior permission from CGWA as per Hon'ble NGT order.
4. Unit shall obtain fresh water from valid source have permission of the competent authority.
5. Industry shall manage Solid Wastes generated from industrial activities as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46)).
6. Industry shall renew Public Liability Insurance Policy time to time & submit a copy of the same to this office.
7. Industry shall comply with circular of the Board dated 27/08/2021 regarding retrofitting of emission control/ equipment in D.G. Set of capacity 125 KVA and above as per system & procedure for emission compliance testing of Retrofit Emission Control Devices (RECD) for D.G. Set issued by CPCB dated 01/02/2022 at the earliest and submit compliance.

2. **The condition no. 3 of the said CCA is amended as below:**

3. CONDITION UNDER THE WATER ACT:

3.1 Water Source: - GWIL.

3.2 There shall be no industrial water consumption & waste water generation from manufacturing process & other ancillary operation.

3.3 The quantity of domestic water consumption shall be decreased from 1300 KL/Day to 3000 KL/Day, due to CCA-Amendment.

3.4 The quantity of domestic waste water shall not exceed 800 KL/Day.

3.5 Sewage shall be treated separately to conform to the following standards as per Hon.ble NGT order in the matter of OA No.1069/2018 dated 30/04/2019

PARAMETERS	GPCB NORMS
pH	5.5-9.0
Biochemical Oxygen Demand (BOD)	10 mg/L
Total suspended solids (TSS)	20 mg/L
Chemical Oxygen Demand (COD)	50 mg/L
Nitrogen –Total	10 mg/L
Phosphorous-Total (for discharge into Ponds, Lakes)	1.0 mg/L
Fecal Coliform	Desirable-100 MPN/100ml Permissible -230 MPN/100 ml

3.6 Treated domestic effluent conforming to above standard shall be discharged on land for gardening and plantation purpose within premises.

3.7 Industry shall provide fixed pipeline network with flow meter for even distribution of treated domestic effluent and maintain its record.

3.8 Disposal system for storm water shall be provided separately. In no circumstances storm water shall be mixed with the industrial effluent.

3. **The condition no. 5.1 & 5.2 of the said CCA is amended as below:**

5.1 Authorization order no. **WH-130995** Date of issue: 14/12/2023.

5.2 **M/s. Kandla Port Trust** is hereby granted an authorization based on the enclosed signed inspection report for generation, collection, treatment, storage, transport of hazardous waste on the premises situated at Kandla, A.O Building Gandhidham, Tal: Gandhidham, Dist: Kutch;

Sr. No.	Waste	Quantity per Annum		Schedule &Category	Facility
		Existing	After CCA-Amendment		
1.	Used or Spent Oil	1125 MT	4250 MT	I-5.1	Collection, storage, transportation and disposal by selling out to registered recycler.

2.	Residue Containing Oil	3444.43 MT	8500 MT	I-5.2	Collection, storage, transportation and disposal by selling out to registered recycler.

4. Rest of conditions of Consolidated Consent & Authorization (CC&A) order No: AWH-110594 issued vide this office letter no. GPCB/CCA-KUTCH-812(5)/ID: 28494/581914 dated 22/01/2021 shall remain unchanged and industry shall comply with the same judicially.

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(T. C. Patel)
Unit Head

Annexure II

"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 23 to March 24)

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, correction in consent order issued by the GPCB dated 09/04/2021 and CCA amendment issued by the GPCB dated 11/01/2024.
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 2023-24 Total Cargo Handled is **132.37 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:** 2431.39 MT 2. **Waste residue containing oil:** 7294.16 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-A)**
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	

Date: 19/7/2024

Place: Gandhidham

Dy. Chief Engineer & EMC (I/C)
Deendayal Port Authority

MARINE DEPARTMENT
(ACCOUT SECTION)

Annexure A

Sub :- Annual return statement showing the collection and disposal of Hazardous and Non Hazardous Wastes carried out by various parties for the year 04/2023 to 03/2024.

With reference to the above subject, the annual return showing the collection and Disposal of Hazardous and Non Hazardous Wastes carried out by various parties for the period 01.04.2023 to 31.03.2024 of Marine department is enclosed herewith.

Encl : AS above

Dy. Conservator
Deendayal Port Authority

EMC (I/C)
NO: MR/WK/1316/282

Dt. 21.06.2024

Deendayal Port Authority
Marine Department

Statement of Hazardous and Non hazardous Waste disposal from the Vessels at Kandla Port for the Period April 2023 to March 2024 – For the Whole Port Area

(PCB ID 28494)

Sr.No.	Month	Year	Hazardous Waste Generation in MT			Solid Waste Generated in MT
			Total Quantity	Used Oil	Waste Residue Containing Oil	
1.	April	2023	484.45	121.11	363.34	169.57
2.	May	2023	1065.92	266.48	799.44	307.83
3.	June	2023	671.82	167.96	503.87	155.03
4.	July	2023	743.45	185.86	557.59	207.71
5.	August	2023	814.63	203.66	610.97	221.78
6.	September	2023	758.07	189.52	568.55	318.76
7.	October	2023	1002.51	250.63	751.89	144.20
8.	November	2023	982.88	245.72	737.16	198.54
9.	December	2023	802.58	200.65	601.94	254.75
10.	January	2024	825.89	206.47	619.41	207.61
11.	February	2024	549.50	137.38	412.13	200.38
12.	March	2024	1023.87	255.97	767.90	186.79
Total			**9725.56**	**2431.39**	**7294.17**	**2572.94**

Deputy Conservator
Deendayal Port Authorit

Marine Department

Statement showing the Collection and disposal of Hazardous and Non-Harardous Wastes carried out by

	Name of Party	Type of Licence	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Total
1	Alicid Organic Industries Limited	Hazardous	-	-	-	-	-	-	-	-	36.76	-	-	-	36.76
2	Amar Hydrocarbon Pvt. Ltd	Hazardous	-	-	-	-	-	-	-	18.42	-	-	-	41.48	59.90
3	Atlas Organics Pvt. Ltd	Hazardous	-	-	-	19.24	7.00	-	-	-	-	-	-	-	26.24
4	Aviation Corporation	Hazardous	9.60	18.45	23.97	-	-	-	-	-	-	-	-	-	52.02
5	Mahalaxmi Asphalt Pvt Ltd	Hazardous	102.96	-	-	138.88	-	25.23	67.34	-	73.93	50.49	14.85	43.97	517.65
6	Priyansi Corporation	Hazardous	16.25	91.36	87.35	-	-	29.89	-	35.57	67.03	-	-	-	327.45
7	Revolution Petrochem LLP	Hazardous	379.86	591.26	594.09	622.50	534.20	453.78	589.26	681.93	423.16	383.95	442.62	648.60	6,345.21
8	Shana Oil Process	Hazardous	-	-	-	-	-	-	-	-	-	-	-	-	-
9	United Shipping Company	Hazardous	-	418.14	-	-	314.16	287.07	396.04	296.10	241.83	432.74	119.51	341.01	2,846.60
10	Chitrakut Trading & Industries	Non-Hazardous	7.24	28.39	14.70	14.98	10.70	6.35	4.78	-	-	0.83	-	-	87.97
11	Golden Shipping Services	Non-Hazardous	1.03	61.82	-	56.87	43.26	77.20	36.10	23.64	75.26	42.55	37.33	49.00	504.06
12	Green Earth Marine Solutions	Non-Hazardous	18.50	37.68	4.42	18.50	27.60	5.00	-	20.34	-	3.71	6.71	-	142.46
13	Harish A. Pandya	Non-Hazardous	12.00	7.18	1.95	-	5.02	-	6.42	-	12.59	7.29	-	-	52.45
14	K M Enterprise	Non-Hazardous	62.00	99.18	74.30	64.40	64.00	48.37	36.34	56.74	70.28	64.52	67.04	113.62	820.79
15	Naaz Shipping Services Ent	Non-Hazardous	-	-	-	7.56	-	12.40	6.35	5.47	6.35	6.36	-	-	44.49
16	New India Marine Works	Non-Hazardous	4.00	-	-	10.50	23.70	45.15	7.00	11.00	17.80	9.00	-	-	128.15
17	Omega Marine Services	Non-Hazardous	23.81	31.42	30.66	-	-	68.44	19.51	47.35	46.10	30.31	58.85	-	356.45
18	V K Enterprise	Non-Hazardous	24.00	30.00	-	15.00	18.00	18.00	18.00	15.00	15.00	15.00	9.00	-	177.00
19	Vishwa Trade-link Inc.	Non-Hazardous	16.99	12.16	29.00	19.90	29.50	37.85	9.70	19.00	11.37	28.04	21.45	24.17	259.13
		Hazardous - Total	**508.67**	**1,119.21**	**705.41**	**780.62**	**855.36**	**795.97**	**1,052.64**	**1,032.02**	**842.71**	**867.18**	**576.98**	**1,075.06**	**10,211.83**
		Non-Hazardous - Total	**169.57**	**307.83**	**155.03**	**207.71**	**221.78**	**318.76**	**144.20**	**198.54**	**254.75**	**207.61**	**200.38**	**186.79**	**2,572.94**

Copy to : GPCB, Gandhidham / Harbour Master

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Annexure N

Form IV

DEENDAYAL PORT AUTHORITY
(Erstwhile: DEENDAYAL PORT TRUST)

दीनदयाल पत्तन प्राधिकरण
DEENDAYAL PORT AUTHORITY

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)/ 92

Date: 19/07/2024

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. (Detailed Consent Order issued by GPCB vide letter no. GPCB/CCA-Kutch-812/(5)/ID - 28494/581914 dated 22/01/2021 – Consent no. AWH – 110594 & CCA amendment Order – WH-130995).

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
12) DPA letter no. EG/WK/4751 (CCA Renewal)/326 dated 19/06/2023

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 had obtained Renewal of Consolidated Consent & Authorization from the GPCB vide order no. AWH – 110594 dated 22/01/2021 valid up to 21/07/2025 for Port Area of Deendayal Port Authority and subsequently, the GPCB had issued correction in consent vide order dated 09/04/2021. Afterward, DPA has also obtained amendment in Consent Order from the GPCB vide order dated 11/01/2024 (CCA Amendment – WH-130995) **(Copy attached as Annexure I).**

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 2023-24 as **Annexure II**.

This is for kind information and record please.

Encl : As above

Yours faithfully

19/7/24

Dy. Chief Engineer & EMC (I/C)
Deendayal Port Authority

Annexure I

GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN, SECTOR 10-A,
GANDHINAGAR - 382010,
(T) 079-23232152

GPCB

CCA-Amendment
(WH-130995)

No. PC/CCA-KUTCH- 812(6)/ GPCB ID-28494/ **Date: /01/2024**

To,
M/s. Kandla Port Trust,
At Kandla, A.O Building Gandhidham,
Tal: Gandhidham,
Dist: Kutch – 370 201.

SUB: Amendment in the consolidated consent & Authorization of the Board.

REF: 1) CCA issued by this office vide order no- **AWH- 110594** dated 22/01/2021 valid up to 21/07/2025.
2) Your CCA Amendment Application Inward ID No.**277270** dated **23/05/2023.**

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 6(2) of the Hazardous And Other Waste (Management and Transboundary) Rules, 2016 & framed under the Environment (Protection) Act-1986, The Board has granted CCA vide order No. **AWH- 110594** issued vide order dated 22/01/2021 valid up to 21/07/2025.

The Board has right to review and amend the conditions of the said CCA and its amendment orders. Now, considering your application for CCA amendment inward ID No.**277270** dated 23/05/2023, **the said CCA order is amended as below:**

1. **The order shall be read as CCA amendment Order No.: WH- 130995 Date of Issue: 14/12/2023, valid up to 21/07/2025.**

SUBJECT TO THE FOLLOWING SPECIFIC CONDITIONS:

1. There shall be no change in existing production and its capacity, raw materials consumption, fuel consumption, flue gas emission & process gas emission, due to CCA Amendment.
2. Industry shall not carry out any activity which may attract the applicability of EIA notification-2006 & its amendment.
3. No ground water shall be withdrawal without prior permission from CGWA as per Hon'ble NGT order.
4. Unit shall obtain fresh water from valid source have permission of the competent authority.
5. Industry shall manage Solid Wastes generated from industrial activities as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46)).
6. Industry shall renew Public Liability Insurance Policy time to time & submit a copy of the same to this office.
7. Industry shall comply with circular of the Board dated 27/08/2021 regarding retrofitting of emission control/ equipment in D.G. Set of capacity 125 KVA and above as per system & procedure for emission compliance testing of Retrofit Emission Control Devices (RECD) for D.G. Set issued by CPCB dated 01/02/2022 at the earliest and submit compliance.

2. **The condition no. 3 of the said CCA is amended as below:**

3. CONDITION UNDER THE WATER ACT:

3.1 Water Source: - GWIL.

3.2 There shall be no industrial water consumption & waste water generation from manufacturing process & other ancillary operation.

3.3 The quantity of domestic water consumption shall be decreased from 1300 KL/Day to 3000 KL/Day, due to CCA-Amendment.

3.4 The quantity of domestic waste water shall not exceed 800 KL/Day.

3.5 Sewage shall be treated separately to conform to the following standards as per Hon.ble NGT order in the matter of OA No.1069/2018 dated 30/04/2019

PARAMETERS	GPCB NORMS
pH	5.5-9.0
Biochemical Oxygen Demand (BOD)	10 mg/L
Total suspended solids (TSS)	20 mg/L
Chemical Oxygen Demand (COD)	50 mg/L
Nitrogen –Total	10 mg/L
Phosphorous-Total (for discharge into Ponds, Lakes)	1.0 mg/L
Fecal Coliform	Desirable-100 MPN/100ml Permissible -230 MPN/100 ml

3.6 Treated domestic effluent conforming to above standard shall be discharged on land for gardening and plantation purpose within premises.

3.7 Industry shall provide fixed pipeline network with flow meter for even distribution of treated domestic effluent and maintain its record.

3.8 Disposal system for storm water shall be provided separately. In no circumstances storm water shall be mixed with the industrial effluent.

3. **The condition no. 5.1 & 5.2 of the said CCA is amended as below:**

5.1 Authorization order no. **WH-130995** Date of issue: 14/12/2023.

5.2 **M/s. Kandla Port Trust** is hereby granted an authorization based on the enclosed signed inspection report for generation, collection, treatment, storage, transport of hazardous waste on the premises situated at Kandla, A.O Building Gandhidham, Tal: Gandhidham, Dist: Kutch;

Sr. No.	Waste	Quantity per Annum		Schedule &Category	Facility
		Existing	After CCA-Amendment		
1.	Used or Spent Oil	1125 MT	4250 MT	I-5.1	Collection, storage, transportation and disposal by selling out to registered recycler.

2.	Residue Containing Oil	3444.43 MT	8500 MT	I-5.2	Collection, storage, transportation and disposal by selling out to registered recycler.

4. Rest of conditions of Consolidated Consent & Authorization (CC&A) order No: AWH-110594 issued vide this office letter no. GPCB/CCA-KUTCH-812(5)/ID: 28494/581914 dated 22/01/2021 shall remain unchanged and industry shall comply with the same judicially.

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(T. C. Patel)
Unit Head

Annexure II

Environmental Statement (Form V)
For Deendayal Port Authority, Kandla
For the FY @ 2023-2024

"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, 2024

"PART-A"

1) Name and Address of the owner/occupier of the industry or process		
➢ NAME	:	Shree V 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	:	27th June, 2016

"PART-B"

WATER AND RAW MATERIAL CONSUMPTION

Sr.No.	WATER CONSUMPTION	KLD
1.	Process	**1573**
2.	Cooling	
3.	Domestic Purpose	
Total water consumption for the period from April 2023 to March 2024 was **574086 KL** hence, average water consumption for per day – **1573 KLD**		

I. Water Consumption

Sr. No.	Name of Products	Process Water Consumption per unit of products output	
		During the current financial year 2022-23	**During the current financial year 2023-24**
01.	Dry Cargo Handling	**137.5 MT**	**132.37 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 2023-24 Total Cargo Handled is **132.37** MMTPA However, Details of the Domestic water consumption for the financial year 2023-24 please refer **Annexure-A**			

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 2022-23	**During the current financial year 2023-24**
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 -B** 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 (MANAGEMNET AND HANDLING) RULES -1989 & AMENDMENT RULES -2008]

Sr.No.	Hazardous Waste	Total Quantity in MT/Year	
		During the current financial year 2022-23	During the current financial year 2023-24
1.	5.1- Used Spent Oil	4578.79	2431.39
2.	5.2- Waste Residue Containing Oil	9157.58	7294.17
• Details of Hazardous Waste generated during the financial year 2022-23 please refer **Annexure-C**			
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 2022-23	**During the current financial year 2023-24**
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	**2473.19 MT**	**2572.94**
Details of Solid Waste (Non-Hazardous Waste) generated during the financial year 2023-24 please refer **Annexure-C**			

"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 2024-2025 is Rs. 657 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 D**)
13. Deendayal Port Authority had carried out mangrove plantation in an area of 1600 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 CO_2 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.

Annexure A

Statement Showing the quantity of water consumed from GWSSB from April 2023 to March 2024

Sr.No.	Month	Total Quantity Consumed in KL
1.	April 2023	47342.47
2.	May 2023	48920.55
3.	June 2023	47342.00
4.	July 2023	48920.55
5.	August 2023	48920.55
6.	September 2023	59980.00
7.	October 2023	48680.00
8.	November 2023	57820.00
9.	December 2023	52100.00
10.	January 2024	45566.00
11.	February 2024	30884.00
12.	March 2024	37610.00
Total		**574086.12**

XEN (PL)

Annexure B

Environmental Monitoring Annual Report

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: April 2023 - March 2024

Document Ref No.: GEMI/DPA/782(2)(3)/2024-25/103

Submitted to:

Deendayal Port Authority (DPA), Kandla

Gujarat Environment Management Institute (GEMI)

(An Autonomous Institute of Government of Gujarat)

GEMI Bhavan, 246-247, GIDC Electronic Estate, Sector-25, Gandhinagar-382025

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

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 Annual Report (Monitoring Period: April 2023 - March 2024)"* is prepared.

- **Name of the Report:** *Environment Monitoring Report (Monitoring Period April 2023-March 2024)*
- **Date of Issue:** 26/06/2024
- **Version:** 1.0
- **Report Ref.:** GEMI/DPA/782(2)(3)/2024-25/103

Table of Contents

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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
MMTPA	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 Environmental monitoring and management plan (EMMP)

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 environmental monitoring done during the period from April 2023-March 2024.

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 monthly monitoring and 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, sulphate, NH_4, PO_4, 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.

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 transhipment), 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 **Map 1 & 2** as follows:

SS

Map 1: Locations of Kandla and Vadinar Port

Map 2: Locations of Kandla Port

Map 3: Locations 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 1** as given below:

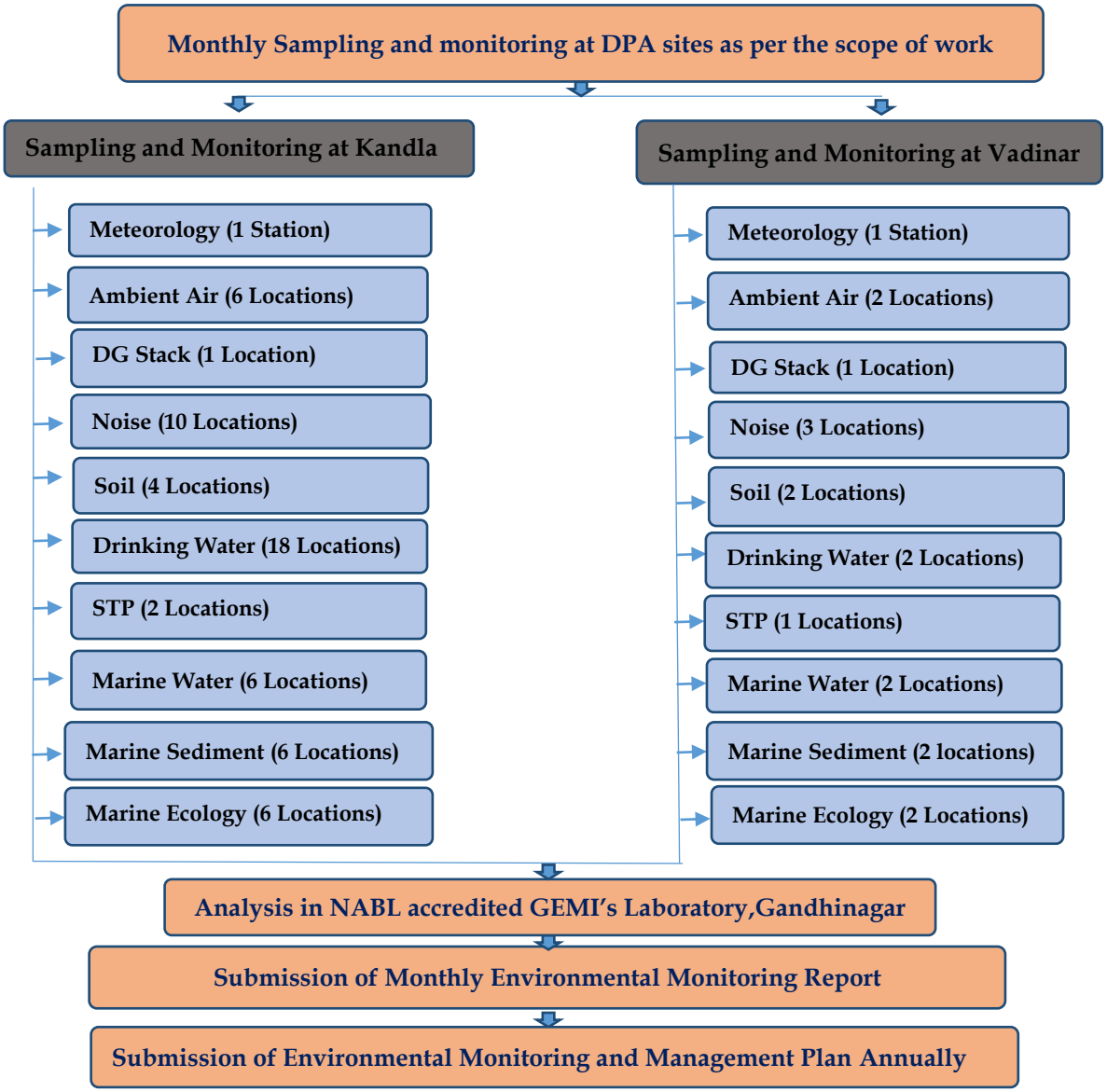


Figure 1: Methodology flow chart

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

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	^{o}C		
6.	Solar Radiation	W/m^2		

Monitoring Frequency:

The Meteorological parameters were recorded at an interval of 1 hour in a day for the period of April 2023 to March 2024 and the average value for all the Meteorological parameters were summarized for the sampling period of at both the observatory site.

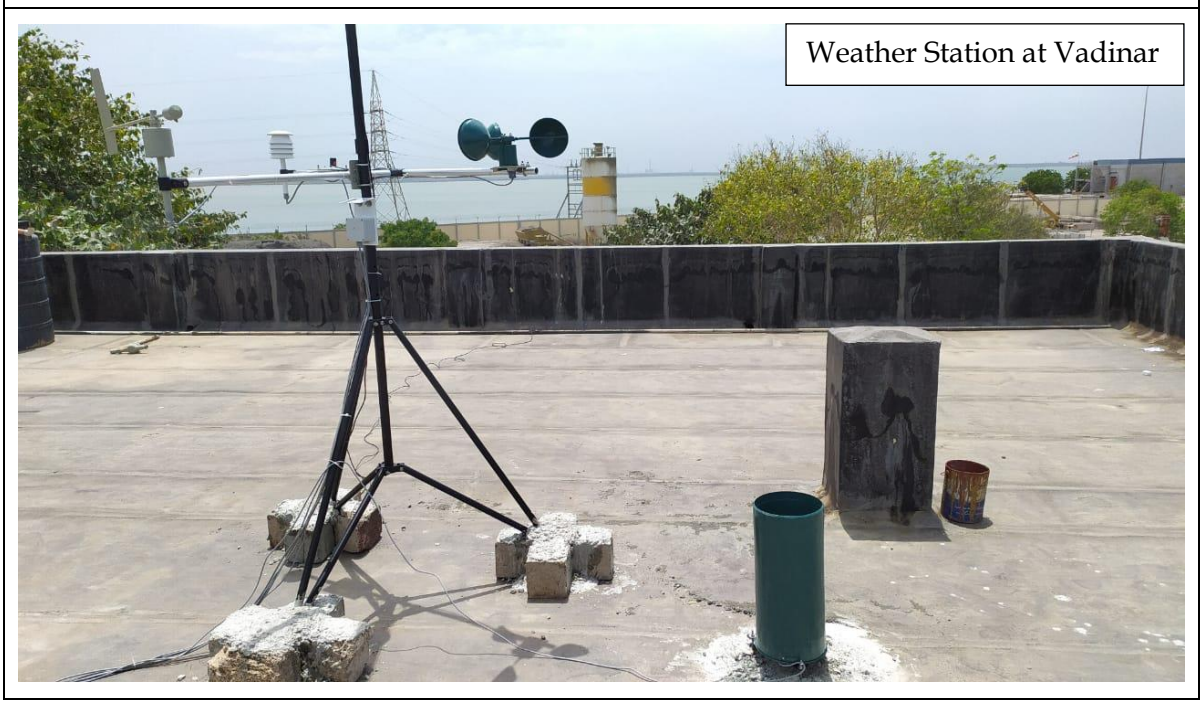


Figure 2: Photographs of Automatic Weather Monitoring Station at Kandla and Vadinar

3.2 Results and discussion

The summary of hourly climatological observations recorded at Kandla and Vadinar during the monitoring period of **April 2023 to March 2024,** 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/m²)**	**Wind Direction (°)**	**Rainfall (mm)**
	Max.	**Min**	**Avg.**	**Max.**	**Min**	**Avg.**	**Max.**	**Min**	**Avg.**			
April-May 23	27.02	1.54	8.78	32.21	30.4	31.31	64.12	61.07	57.76	105.42	S.S.E	0.05
May-June 23	48.85	3.07	12.94	32.64	31.23	31.93	70.33	65.93	68.17	90.14	N & N.N.W	0.37
June- July 23	38.99	1.23	9.71	31.54	30.27	30.89	76.32	72.43	74.47	67.76	E.W.E & W.S.W	3.56
July-Aug 23	35.4	1.47	7.67	30.51	29.32	29.91	77.72	73.87	75.78	57.4	W.S.W	14.94
Aug-Sep 23	37.52	0.63	6.55	48.44	30.33	38.43	84.57	69.18	75.59	73.28	W.S.W	21.89
Sep- Oct 23	20.36	0.16	4.75	31.01	29.66	30.32	71.62	66.85	69.32	74.08	W.S.W	2.87
Oct- Nov 23	9.85	0.025	1.15	31.24	29.63	30.41	55.4	49.02	52.18	65.11	North	0.012
Nov- Dec 23	14.72	0	2.09	25.76	24.32	25.03	59.69	54.6	57.1	54.28	N.E	0.96
Dec- Jan 24	15.75	0	1.87	23.22	21.68	22.44	56.5	51.11	53.78	60.66	North	0
Jan- Feb 24	15.29	0.131	3.147	24.83	23.18	24	56	50.51	53.19	65.32	North	0
Feb- Mar 24	22.41	0.44	5.12	26.7	25.06	25.86	51.55	45.91	48.64	78.46	North	0.04
Mar- Apr 24	33.09	0.025	5.43	48.44	26.87	30.08	73.25	30.59	55.06	89.43	W.S.W	0

Details of Micro-meteorological data at Vadinar Observatory												
Monitoring Period	**Wind Speed (Km/h)**			**Temperature (°C)**			**Relative humidity (%)**			**Solar Radiation (W/m²)**	**Wind Direction (°)**	**Rainfall (mm)**
	Max.	**Min**	**Avg.**	**Max.**	**Min**	**Avg.**	**Mean**	**Max.**	**Min**			
April-May 23	26.33	7.78	13.24	28.74	28.04	28.17	73.47	70	71.08	110.76	W & South	0.02
May-June 23	34.08	7.63	16.76	29.96	29.22	29.34	71.77	69.03	69.83	102.95	S.S.E	0.19
June- July 23	12.31	1.62	5.19	29.51	28.86	28.94	77.68	75.42	75.95	78.26	South	0.27
July-Aug 23	31.69	5.39	13.12	28.62	27.99	28.06	79.51	77.31	77.77	60.86	South	0.22
Aug-Sep 23	28.07	5.2	12.96	27.75	27.18	27.22	75.13	72.87	73.42	88.14	South & S.W	0
Sep- Oct 23	21.82	4.64	9.59	28.12	27.5	27.56	77.12	74.66	75.32	87.51	South	0.06
Oct- Nov 23	13.8	1.77	4.17	27.89	27.1	27.28	63.61	59.58	61.15	81.61	N.E	0.18
Nov- Dec 23	19.37	3	4.84	24.79	24.11	24.24	64.12	60.47	61.79	70.68	S.S.E	0.03
Dec- Jan 24	16.76	1	4.18	22.94	22.14	22.34	63.13	59.25	60.71	73.37	South	0
Jan- Feb 24	10.62	1.99	3.94	23.24	22.92	22.7	65.66	64.19	64.9	87.29	South	0
Feb- Mar 24	16.92	5.36	8.55	24.16	23.6	23.82	62.34	60.91	61.51	101.99	N.N.W	0
Mar- Apr 24	29.61	0.31	11.63	29.8	24.96	26.5	82.36	57.41	71.08	114.77	N.N.W	0

3.3 Data Interpretation and Conclusion

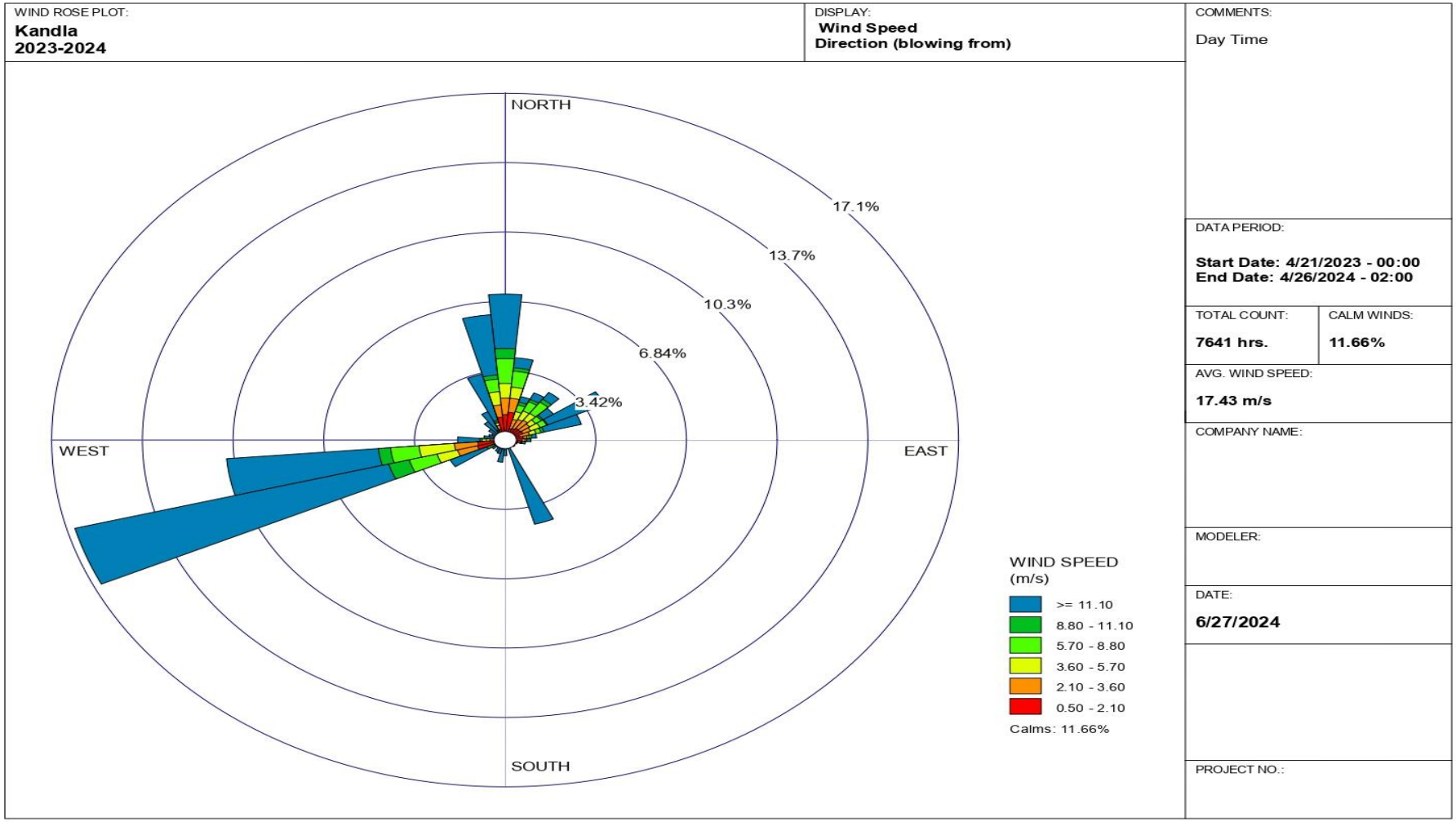
1) Kandla:

a. The ambient temperature for the summer season varies in the range of **21.68** to **48.44** °C; in the monsoon season, the temperature varies between **29.32** and **33.38** °C; and in the winter season, the temperature varies between **21.68** and **31.24** °C. The yearly average temperature at Kandla is observed to be around **29.217** °C, with a standard deviation of 4.31.
b. The relative humidity for the summer season was recorded in the range of **30.59%** to **76.32%**; in the monsoon season, relative humidity was recorded in the range of **66.85%** to **84.57%**; and in the winter season, relative humidity was recorded in the range of **49.02** to **59.69%**; the yearly average humidity at Kandla was **61.75%** with a standard deviation of **10.635**.
c. The maximum rainfall at Kandla was observed at **21.89** mm for the monitoring period of August to September 2023; the yearly average rainfall was found to be **3.72** mm.
d. Wind speed and direction play a significant role in transporting pollutants and thus determining the air quality. In the summer season, wind blew from the North and North North West directions; in the monsoon season, wind blew from the West South West; and in the winter season, wind blew from the North direction.
e. The wind speed recorded ranges from **0.025** to **48.85** km/h in the summer season; in the monsoon season, the wind speed recorded ranges from **0.16** to **37.52** km/h; and in the winter season, the wind speed recorded ranges from **0** to **15.75** km/h. The yearly average wind speed at Kandla is **5.77** km/h, with a standard deviation of 3.55.
f. The **maximum** solar radiation at Kandla was observed at **105.42** W/m^2 during the monitoring period **April to May 2023**; the **minimum** solar radiation at Kandla was observed at 54.**28** W/m^2 for the monitoring period **November to December 2023; and** the yearly **average** solar radiation was found to be **73.445** W/m2 with a standard deviation of 15.19.

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 monitoring period, the prevailing winds predominantly blow from the West South West direction at Kandla, whereas, high speed winds were also observed to blow from North direction.


WIND ROSE PLOT:
Kandla
2023-2024
DISPLAY:
Wind Speed
Direction (blowing from)
COMMENTS:
Day Time
NORTH
EAST
SOUTH
WEST
17.1%
13.7%
10.3%
6.84%
3.42%
WIND SPEED
(m/s)
>= 11.10
8.80 - 11.10
5.70 - 8.80
3.60 - 5.70
2.10 - 3.60
0.50 - 2.10
Calms: 11.66%
DATA PERIOD:
Start Date: 4/21/2023 - 00:00
End Date: 4/26/2024 - 02:00
TOTAL COUNT:
7641 hrs.
CALM WINDS:
11.66%
AVG. WIND SPEED:
17.43 m/s
COMPANY NAME:
MODELER:
DATE:
6/27/2024
PROJECT NO.:
WRPLOT View - Lakes Environmental Software

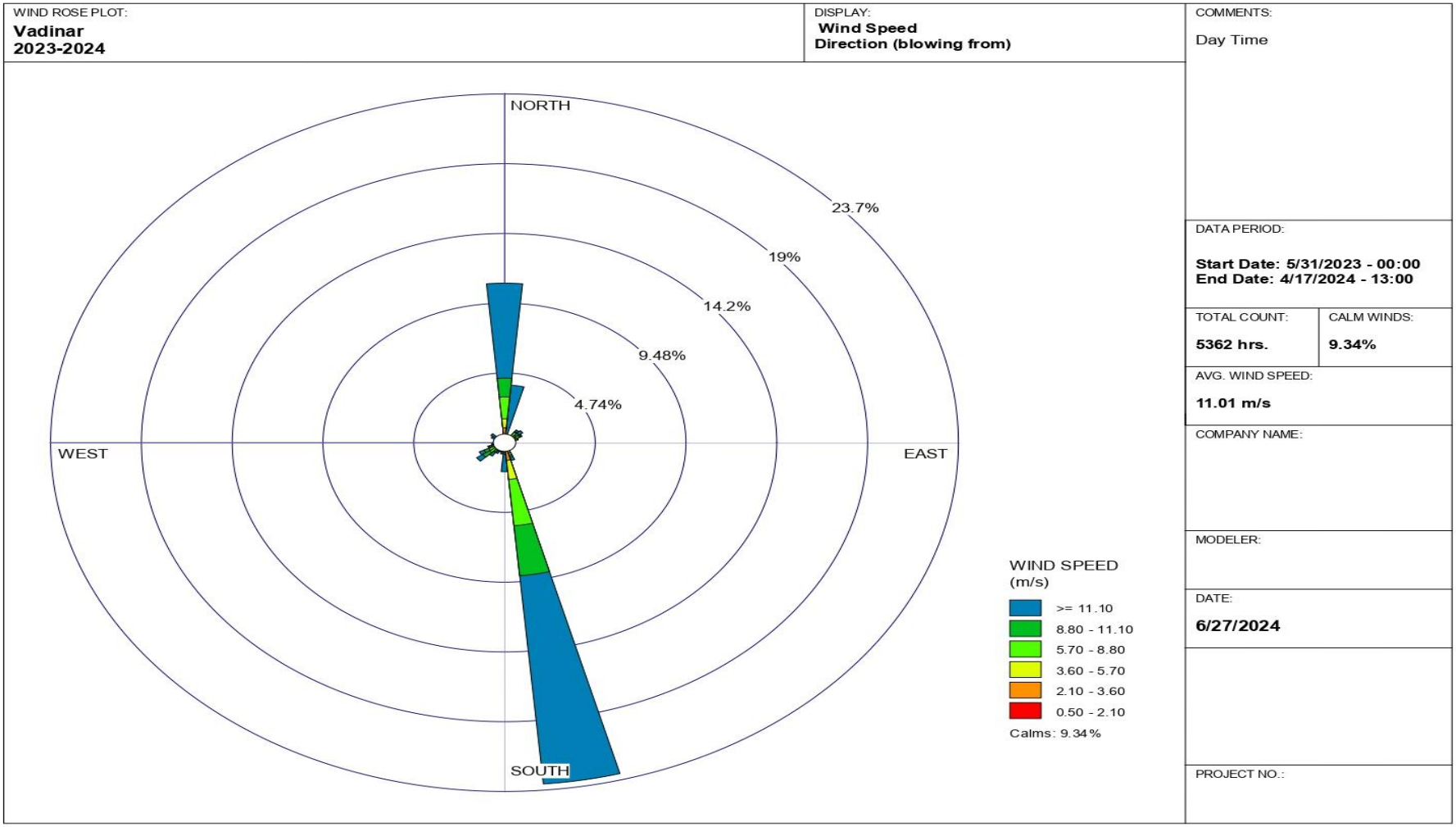
2) Vadinar:

a. The ambient temperature for the summer season varies between **23.6** and **29.96** °C; in the monsoon season, it varies between **27.18** and **28.62** °C; and in the winter season, it varies between **22.14** and **27.89** °C. The yearly average temperature at Vadinar is **2.347** °C with standard deviation of **2.4**.
b. The relative humidity for the summer season was recorded in the range of **57.41**% to **82.36**%; in the monsoon season, relative humidity was recorded in the range of **72.87**% to **79.51**%; and in the winter season, relative humidity was recorded in the range of **59.25**% to **65.66**%; the yearly average humidity at Vadinar was **68.7**% with a standard deviation of 6.38.
c. The **maximum** rainfall at Vadinar was observed at **0.27** mm for the monitoring period from **June to July 2023**; the yearly **average** rainfall was found to be **0.08** mm.
d. In Summer Season wind blew from South Direction, in Monsoon season wind blew from South and in Winter Season wind blew from South and South West direction. The recorded wind speed ranges from **0.31** to **34.08** km/hr in the summer season, **4.64** to **31.69** km/hr, and in the monsoon season, the recorded wind speed ranges from **1** to **19.37** km/hr. The yearly average wind speed at Vadinar is 9.014 km/h with a standard deviation of **4.49**.
e. The maximum solar radiation at Vadinar was observed at **114.77** W/m2 for the monitoring period April to May 2024; the minimum solar radiation at Vadinar was observed at **60.86** W/m2 for the monitoring period July to August 2023; and the yearly average solar radiation was found to be **88.182** 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.

At Vadinar, the winds were observed to blow from Souths direction.


WIND ROSE PLOT:
Vadinar
2023-2024
DISPLAY:
Wind Speed
Direction (blowing from)
COMMENTS:
Day Time
NORTH
EAST
SOUTH
WEST
23.7%
19%
14.2%
9.48%
4.74%
WIND SPEED
(m/s)
>= 11.10
8.80 - 11.10
5.70 - 8.80
3.60 - 5.70
2.10 - 3.60
0.50 - 2.10
Calms: 9.34%
DATA PERIOD:
Start Date: 5/31/2023 - 00:00
End Date: 4/17/2024 - 13:00
TOTAL COUNT:
5362 hrs.
CALM WINDS:
9.34%
AVG. WIND SPEED:
11.01 m/s
COMPANY NAME:
MODELER:
DATE:
6/27/2024
PROJECT NO.:
WRPLOT View - Lakes Environmental Software

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(1).

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 air quality 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	23.043538N 70.218617E	
3.		A-3	Kandla Port Colony	23.019797N 70.213536E	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 **Map 4 and 5** respectively.

Ambient Air monitoring photos

Kandla

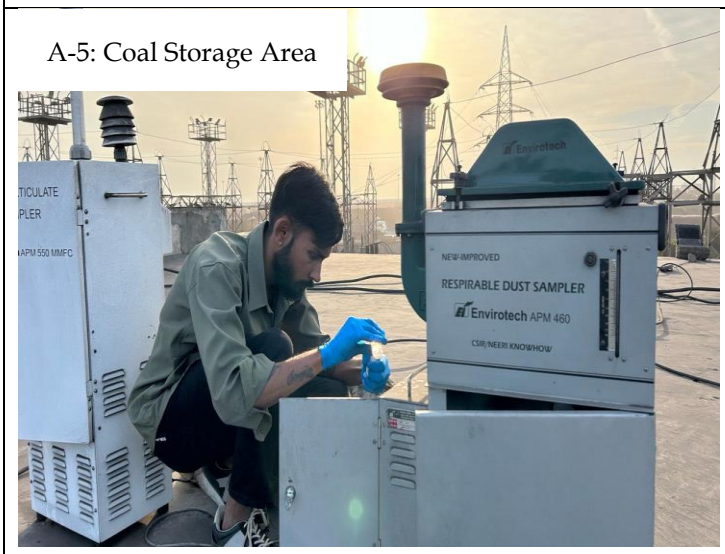
A-1: Oil Jetty No. 1

A-2: Oil Jetty No. 7

A-3: Kandla Port Colony

A-4: Marine Bhavan

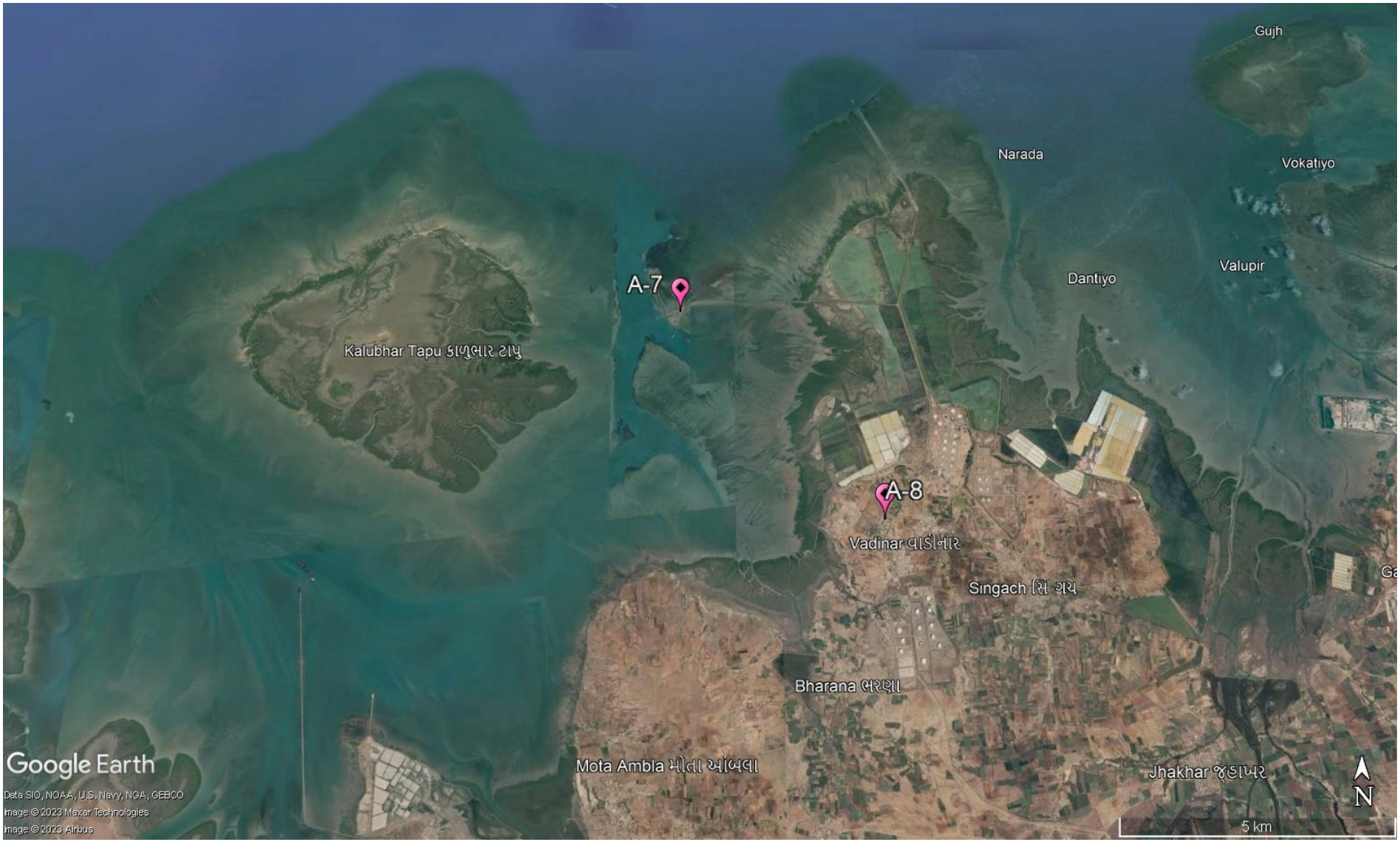
A-5: Coal Storage Area



A-6: Gopalpuri Hospital

Vadinar	
A-7: Admin Building 	A-8: Vadinar Colony 

Map 4: Ambient Air Monitoring locations at Kandla



Map 5: Ambient Air Monitoring locations at Vadinar

Monitoring Frequency

The sampling for Particulate matter, i.e., PM_{10} and $PM_{2.5}$, and gaseous components like SO_x, NO_x, and CO, as well as the total VOCs, was monitored twice 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 a monthly basis. The monitoring period for this study is from April 15, 2023, to April 15, 2024. During this period, 95 air samples were taken from six locations in Kandla, and 97 samples were taken from two locations in Vadinar.

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 PM_{10}, 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 SO_2 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 PM_{10}, $PM_{2.5}$, 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/m³	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/m³	IS:5182 (Part:24):2019	Fine Particulate Sampler (FPS) conforming to IS:5182 (Part-24): 2019	
3.	Sulphur Dioxide (SO_x)	µg/m³	IS 5182 (Part:2): 2001	Gaseous Attachment conforming to IS:5182 Part-2	
4.	Oxides of Nitrogen (NO_x)	µg/m³	IS:5182 (Part-6): 2006	Gaseous Attachment conforming to IS:5182 Part-6	
5.	Carbon Monoxide (CO)	mg/m³	GEMI/SOP/AAQM/11; Issue no 01, Date 17.01.2019: 2019	Sensor based Instrument	
6.	VOC	µg/m³	IS 5182 (Part 17): 2004	Low Flow Air Sampler	
8.	PAH	µg/m³	IS: 5182 (Part 12): 2004	Respirable Dust Sampler (RDS) conforming to IS:5182 (Part-12): 2004	Monthly
7.	Benzene	µg/m³	IS 5182 (Part 11): 2006 RA: 2017	Low Flow Air Sampler	
9.	Non-methane VOC	µg/m³	IS 5182 (Part 11): 2006	Low Volume Sampler	

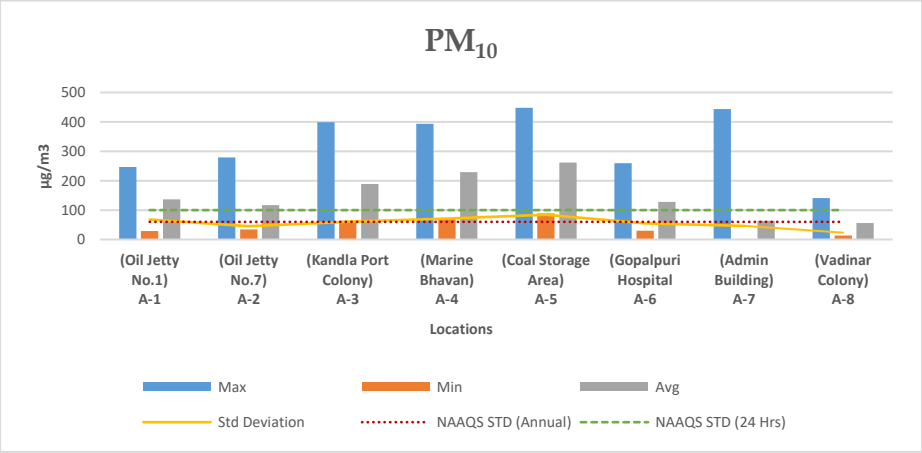
4.2 Result and Discussion

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**.**

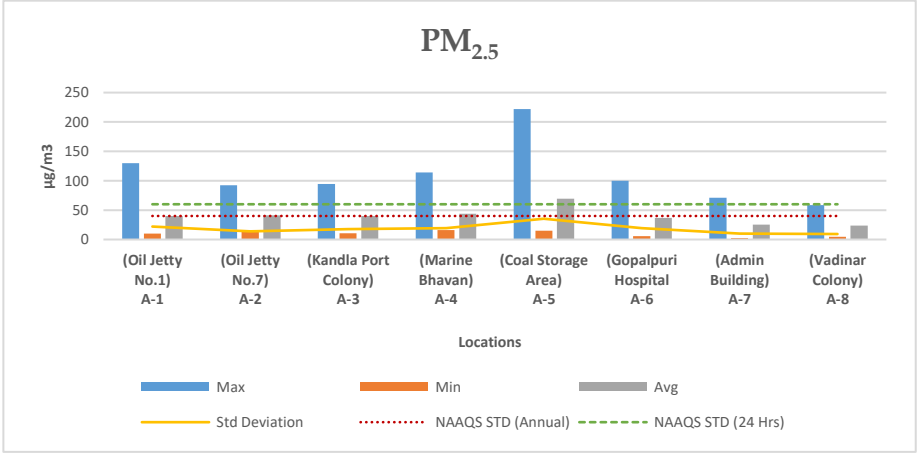
Table 6: Summarized results of PM_{10}, $PM_{2.5}$, SO_2, NO_x, VOC and CO for Ambient Air quality monitoring

Parameters / Locations	NAAQS by CPCB		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
PM_{10} (µg/m3)	24 Hours -100 Annual -60	Max	247.03	279.33	399.25	393.74	448.12	259.88	443.2	140.7
		Min	28.68	34.39	63.28	71.77	89.21	30.3	1.45	13.89
		Avg	136.50	116.67	188.36	229.41	262.04	127.95	63.49	56.54
		Std Deviation	68.203	44.97	60.56	71.74	84.18	55.43	46.36	23.15
$PM_{2.5}$ (µg/m3)	24 Hours -60 Annual -40	Max	129.77	92.24	94.51	114.34	221.9	99.82	71.18	58.73
		Min	10.03	12.85	10.84	15.97	14.85	5.51	2.36	4.7
		Avg	40.27	41.2	40.26	43.70	69.70	36.95	25.11	23.73
		Std Deviation	22.049	13.87	17.52	19.15	35.36	19.04	10.06	9.33
SO_2 (µg/m3)	24 Hours -80 Annual -50	Max	51.87	151.58	79.24	55.04	283	49.89	59.69	69.81
		Min	0.65	1.18	1.1	1.19	1.1	1.12	0.52	1.4
		Avg	11.076	20.01	14.63	11.82	16.82	11.56	12.59	13.69
		Std Deviation	12.142	28.41	17.15	12.25	30.85	12.08	13.35	14.90
NO_X (µg/m3)	24 Hours -80 Annual -40	Max	54.33	52.54	80.67	55.39	80.94	79.88	52.76	33.79
		Min	2.29	1.11	2.36	1.29	1.97	1.01	2.89	0.9
		Avg	14.75	14.58	22.91	20.52	28.12	15.24	12.84	9.70
		Std Deviation	11.68	9.85	14.98	10.53	17.98	13.59	8.62	5.73
VOC (µg/m3)	-	Max	4.85	5.67	17.43	4.41	3.97	4.12	4.52	6.62
		Min	0.01	0.01	0.01	0.02	0.04	0.01	0.01	0.01
		Avg	1.20	1.226	1.52	0.98	0.94	0.96	0.96	0.95
		Std Deviation	1.155	1.298	2.275	0.99	0.94	0.99	0.93	1.12
CO (mg/m3)	8 Hours -2 1 Hour -4	Max	0.98	4.21	2.91	3.16	3.21	2.18	3.14	2.74
		Min	0.08	0.09	0.14	0.39	0.36	0.32	0.03	0.45
		Avg	0.73	0.848	0.89	0.95	1.13	0.74	0.78	0.94
		Std Deviation	0.194	0.557	0.41	0.39	0.53	0.32	0.46	0.36

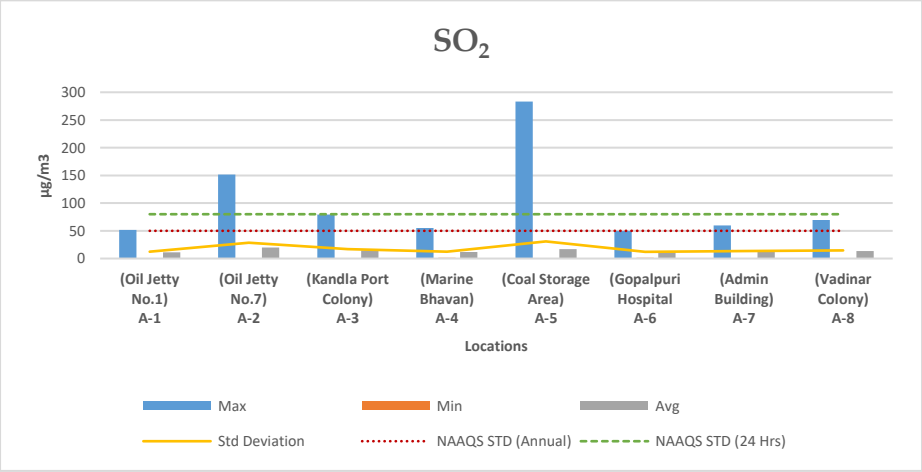
Graphs 1-6 shows spatial trend of ambient air parameter at all the eight-monitoring location (six at Kandla and 2 at Vadinar)



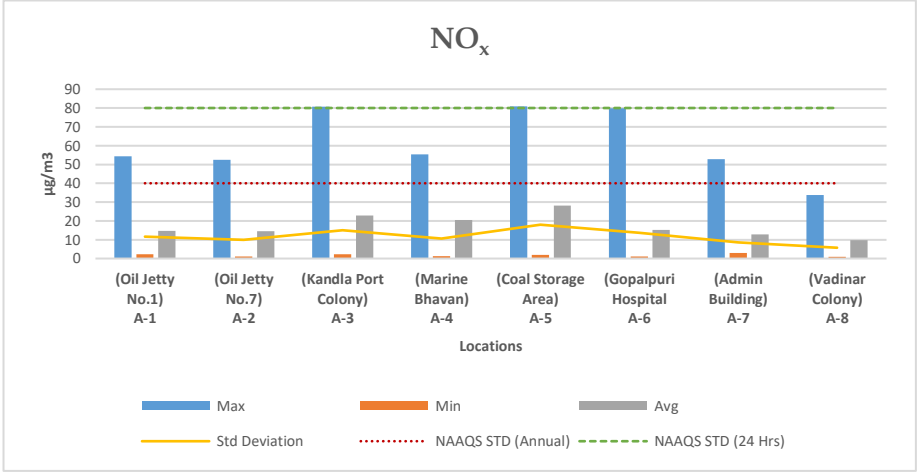
Graph 1 Spatial trend in Ambient PM_{10} Concentration



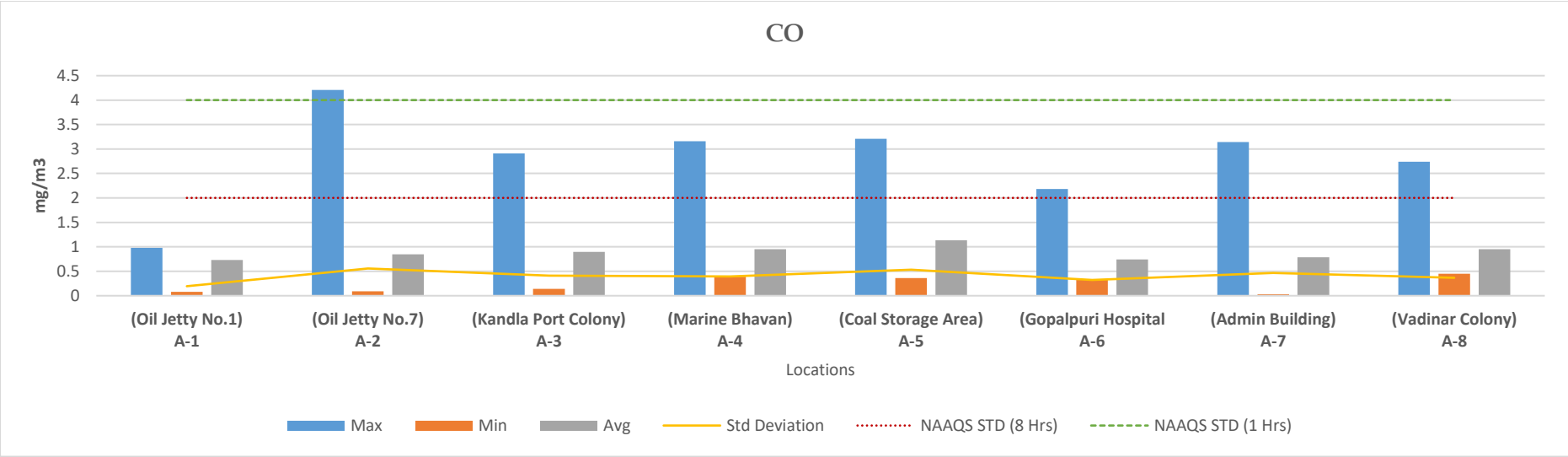
Graph 2 Spatial trend in Ambient $PM_{2.5}$ Concentration



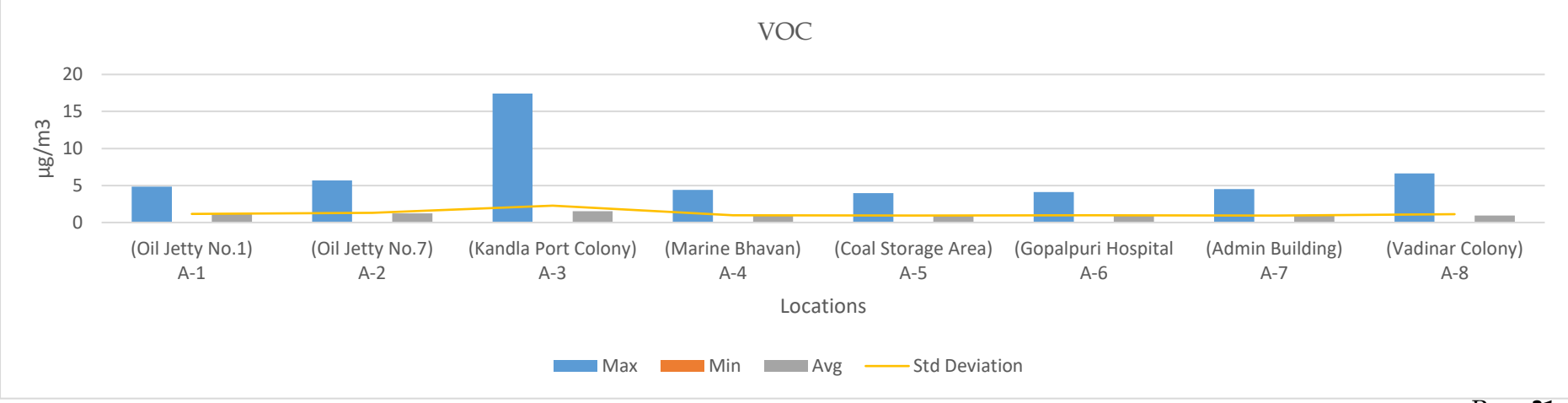
Graph 3 Spatial trend in Ambient SOx Concentration



Graph 4 Spatial trend in Ambient NOx 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

Parameters / Locations	NAAQS by CPCB		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
Benzene (µg/m3)	Annual - 5	Max	3.8	1.84	1.43	1.95	1.11	1.97	1.03	0.95
		Min	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.01
		Avg	0.83	0.46	0.42	0.32	0.41	0.49	0.33	0.229

Table 8: Summarized results of Polycyclic Aromatic Hydrocarbons

Parameters / Locations		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
Napthalene (µg/m3)	Max	1.57	17.31	5.24	5.55	7.8	39.82	1.98	1.84
	Min	0.02	0.21	0.04	0.14	0.37	0.02	0.1	0.13
	Avg	0.40	3.29	0.58	1.05	2.01	4.96	0.45	0.42
Acenaphthylene (µg/m3)	Max	0.8	0.67	0.54	0.95	0.53	0.86	0.84	0.65
	Min	0.01	0.01	0.01	0.02	0.007	0.02	0.005	0.005
	Avg	0.15	0.20	0.17	0.31	0.15	0.18	0.19	0.17
Fluorene (µg/m3)	Max	0.39	0.39	22.99	178.72	10.88	27.22	7.57	11.64
	Min	0.01	0.05	0.04	0.11	0.01	0.06	0.01	0.01
	Avg	0.14	0.19	3.435	19.99	1.25	3.52	0.82	1.18
Anthracene (µg/m3)	Max	0.87	0.91	1.25	5.05	2.02	3.78	0.85	0.57
	Min	0.09	0.09	0.07	0.09	0.03	0.01	0.02	0.02
	Avg	0.3	0.42	0.40	0.94	0.94	0.69	0.23	0.19
Phenanthrene (µg/m3)	Max	0.9	0.82	0.84	0.91	1	0.99	0.82	0.74
	Min	0.01	0.009	0.01	0.01	0.01	0.01	0.07	0.06
	Avg	0.23	0.20	0.15	0.22	0.33	0.20	0.25	0.22
Fluoranthene (µg/m3)	Max	2.65	0.84	1.59	19.54	4.16	20.36	0.68	1.71
	Min	0.06	0.15	0.2	0.24	0.2	0.01	0.01	0.01
	Avg	0.43	0.36	0.74	3.61	1	2.12	0.24	0.30
Pyrene (µg/m3)	Max	3.52	1.13	2.4	42.23	40.25	51.22	0.87	0.74
	Min	0.01	0.14	0.23	0.15	0.02	0.01	0.01	0.01
	Avg	0.54	0.48	0.90	7.46	4.37	7.98	0.16	0.14
Chrycene (µg/m3)	Max	4.59	1.03	3.01	6.27	5.51	5.82	0.61	0.79

	Min	0.08	0.15	0.44	0.42	0.08	0.06	0.05	0.05
	Avg	0.78	0.51	1.01	1.50	1.47	1.22	0.19	0.22
Banz(a)anthracene (µg/m3)	Max	5.64	2.84	3.7	15.42	6.57	16.73	1.01	0.97
	Min	0.17	0.17	0.04	0.14	0.05	0.06	0.01	0.01
	Avg	0.89	0.65	0.88	2.66	1.44	2.93	0.25	0.31
Benzo[k]fluoranthene (µg/m3)	Max	7.67	1.99	5.98	4.81	4.06	6.89	0.84	0.69
	Min	0.15	0.38	0.14	0.48	0.05	0.06	0.03	0.03
	Avg	1.32	0.99	1.34	1.21	0.89	1.76	0.35	0.21
Benzo[b]fluoranthene (µg/m3)	Max	7.89	1.93	6.15	5.12	4.73	7.29	0.59	0.71
	Min	0.12	0.04	0.21	0.17	0.07	0.01	0.06	0.01
	Avg	1.09	0.62	1.053	1.43	1.06	1.65	0.17	0.20
Benzopyrene (µg/m3)	Max	10.9	2.79	8.42	7.25	8.91	9.19	0.96	0.69
	Min	0.24	0.08	0.39	0.39	0.01	0.04	0.01	0.01
	Avg	1.64	0.87	1.66	1.75	1.58	1.31	0.30	0.27
Indeno [1,2,3-cd] fluoranthene (µg/m3)	Max	2.39	6.67	0.95	2.46	1.68	4.61	0.52	0.98
	Min	0.13	0.07	0.42	0.26	0.11	0.09	0.07	0.06
	Avg	0.71	1.02	0.57	0.72	0.70	1.25	0.22	0.42
Dibenz(ah)anthracene (µg/m3)	Max	1.82	1.2	0.91	1.25	2.24	0.99	1.34	2.48
	Min	0.11	0.08	0.16	0.1	0.07	0.04	0.08	0.05
	Avg	0.47	0.32	0.35	0.46	0.54	0.24	0.31	0.4
Benzo[ghi]perylene (µg/m3)	Max	16.3	9.7	27.2	13.6	9.4	12.2	8	2.3
	Min	0.1	0.07	0.04	0.06	0.06	0.17	0.07	0.13
	Avg	2.049	2.63	2.95	2.55	1.61	2.13	0.83	0.47
Acenaphthene (µg/m3)	Max	0.69	0.45	15.1	119.08	2.54	11.8	0.67	2
	Min	0.01	0.05	0.04	0.11	0.01	0.06	0.01	0.01
	Avg	0.14	0.22	2.63	11.34	0.369	1.55	0.14	0.33

Table 9: Summarized results of Non-methane VOC

Parameters \ Locations		(Oil Jetty No.1) A-1	(Oil Jetty No.7) A-2	(Kandla Port Colony) A-3	(Marine Bhavan) A-4	(Coal Storage Area) A-5	(Gopalpuri Hospital A-6	(Admin Building) A-7	(Vadinar Colony) A-8
Non- Methane VOC (µg/m3)	Max	2.11	2.67	3.54	1.35	1.8	2.01	2.15	1.67
	Min	0.12	0.09	0.1	0.08	0.13	0.11	0.07	0.1
	Avg	0.73	0.79	0.87	0.79	1.09	0.93	0.91	0.74s

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).

1) Kandla:

Particulate matter:

- The concentration of PM_{10} varies very widely and is reported in the range of **28.68** to **448.12** µg/m3, with a yearly average value of **176.83** with standard deviation **64.185** µg/m^3. As shown in Graph 1, the highest concentration (value) of PM_{10} is reported at location A-5 (coal storage area) during the winter. It can be seen that PM_{10} exceeds the NAAQS annual limit, i.e., 60 µg/m^3, in all locations. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-1 (oil jetty No. 1) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 100 µg/m^3.
- The concentration of PM2.5 varies in the range of 5.51 to 221.9 µg/m^3, with a yearly average value of 45.35 with standard deviation 21.16 µg/m^3. As shown in Graph 2, the highest concentration of $PM_{2.5}$ is at location A-5 (the coal storage area) in winter. It can be seen that $PM_{2.5}$ exceeds the NAAQS annual limit, i.e., 40 µg/m3, on five locations, and location A-6, i.e., Gopalpuri hospital, falls within the NAAQS annual limit. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-6 (Gopalpuri hospital) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 60 µg/m^3.
- The highest concentration of Particulate matter at locations **A–5, (the coal storage area)**, could be attributed to the presence of heavy vehicular traffic in upwind areas, which have a higher impact, causing the dispersion of emitted particulate matter in the ambient air. Ther activities observed in the surrounding such as The unloading of coal directly into the truck using grabs, construction in the vicinity causes the dust 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 or dumpers during their transit from vessel to yard or storage site. This might increase the PM in and around the coal storage area and Marine Bhavan.

Gaseous Pollutants:

- The concentration of SOx varies from **0.52** to **283** µg/m^3, with a yearly average concentration of **14.029** with standard deviation **18.85** µg/m^3. As shown in Graph 3, the highest concentration of SOx is at location **A-5 (the coal storage area)** in winter. It can be seen that at all locations, SOx are within the NAAQS annual limit, i.e., 50 µg/m^3. It can be seen that location A-2 **(Oil Jetty No. 7)** had the maximum percentage exceedance, i.e., **7.36**%, which is about 7 days out of 95 days of monitoring, and the other five locations comply with the standards (compliance more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m^3. The concentration of NOx varies from **1.01** to **80.94** µg/m3, with a yearly average concentration of **19.35** with standard deviation **13.10**

µg/m3. As shown in Graph 4, the highest concentration of NOx is at location A-5 (the coal storage area) in winter. It can be seen that on all locations's NOx within the NAAQS annual limit, i.e., 40 µg/m^3, it can be seen that all locations comply with the standards (complied more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m^3.

- The concentration of CO varies from **0.08** to **4.21** mg/m^3, with a yearly average concentration of **0.884** with standard deviation **0.40** mg/m^3. As shown in Graph 5, the highest concentration of CO is at location A-2 (Oil Jetty No. 7) in winter. It can be seen that at all locations, they're complying (more than 98% of the time) with the NAAQS 1 hour limit, i.e., 4 mg/m^3. Location A-5 (the coal storage area) had the maximum percentage exceedance, i.e., **7.36**%, which is about 7 days out of 95 days of monitoring, and other locations such as Location A-2 (Oil Jetty No. 7), Location A-3 (Kandla Port Colony), Location A-4 (Marine Bhavan), and Location A-6 (Gopalpuri Hospital) had percentage exceedances of **5.26, 5.26, 2.85**, and **2.85**, respectively. And location A-1 (oil jetty no. 1) comply with the standards (compliance more than 98% times) while comparing with the NAAQS 8-hour limit, i.e., 2 mg/m3.
- The concentration of total VOC levels was recorded in the range of **0.01** to **17.43** µg/m3, with a yearly average value of **1.14** with standard deviation 1.21 µg/m3 at Kandla. As shown in graph 6, the highest concentration of VOCs is at location **A-3, (Kandla port colony)**; this is the only spike observed in the whole monitoring period for VOCs at this location. The main source of VOCs in the ambient air may be attributed to the burning of gasoline and natural gas in vehicle exhaust, burning fossil fuels, and garbage that releases VOCs into the atmosphere. During the monitoring period, the wind flows in the south 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.

  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. These locations are commercial areas where Vehicular activity and dust emission is common. PAHs are a class of chemicals that occur naturally in coal, crude oil, and gasoline. The higher concentration which results from burning coal, oil, gas, road dust, etc. Other outdoor sources of PAHs may be the industrial plants in-and-around the DPA premises.
- The concentration of Benzene levels was recorded in the range of **0.02** to **3.8** µg/m^3, with a yearly average value of **0.84** with standard deviation **0.64** µg/m^3. The highest concentration of Benzene is at location **A-1, (Oil Jetty No. 1)** in summer. It can be seen that at all locations, Benzene within the NAAQS annual limit, i.e., 5 µg/m3.
- The ambient air monitoring location of Kandla recorded the non-methane VOC (NM-VOC) concentration in the range of **0.08** to **3.54** µg/m3, with a yearly average value of **0.86** µg/m3 at Kandla. The highest concentration is at location **A-3, (Kandla Port Colony** in Winter.

2) Vadinar:

Particulate matter: The concentration of PM10 at Vadinar varies in the range of **1.45 to 443.2** µg/m³, with a yearly average value of **63.49** with a standard deviation of **34.76** µg/m3. As shown in Graph 1, the highest concentration of PM_{10} is at location A-7 (Admin Building Vadinar) in the winter. It can be seen that at location A-7 (Admin Building Vadinar), PM_{10} exceeds the NAAQS annual limit, i.e., 60 µg/m³, and at location A-8 (Vadinar Colony), it falls within the annual standards. It can be seen that locations A-7 (Admin Building Vadinar) and A-8 (Vadinar Colony) had a 5.15% percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 100 µg/m³.

- The concentration of $PM_{2.5}$ varies in the range of **2.36** to **71.18** µg/m³, with a yearly average value of **24.42** with a standard deviation **of 9.69** µg/m³. As shown in Graph 2, the highest concentration of $PM_{2.5}$ is at location **A-7 (Admin Building Vadinar)** in winter. It can be seen that in all two locations, $PM_{2.5}$ is within the NAAQS annual limit, i.e., 40 µg/m³. it can be seen that on both locations, **A-7 (building Vadinar)** and **A-8 (Vadinar Colony)** comply with the standards (complimented more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 60 µg/m³.

Gaseous Pollutants:

- The concentration of SOx varies from **0.52** to **69.91** µg/m3, with a yearly average concentration of 13.146 with a standard deviation of 14.14 µg/m3. As shown in Graph 3, the highest concentration of SOx is at location A-8 (Vadinar Colony) in the winter. It can be seen that in all locations, SOx are within the NAAQS annual limit, i.e., 50 µg/m³. It can be seen that both locations comply with the standards (compliance more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m³.
- The concentration of NOx varies from **0.9** to **52.76** µg/m³, with a yearly average concentration of **11.28** with a standard deviation of **7.17** µg/m³. As shown in Graph 4, the highest concentration of NOx is at location A-7 (Admin Building Vadinar) in the winter. It can be seen that in all locations, NOx is within the NAAQS annual limit, i.e., 40 µg/m³. It can be seen that all locations comply with the standards (compliance more than 98% of the time) while comparing with the NAAQS 24-hour limit, i.e., 80 µg/m³.
- The concentration of CO varies from **0.03** to **3.14** mg/m3, with a yearly average concentration of **0.87** with a standard deviation **0.41** mg/m³. As shown in Graph 5, the highest concentration of CO is at location **A-7, (Admin Building Vadinar)** in winter. it can be seen that at all locations they are complying (Complied more than 98% times) with the NAAQS 1 hour limit, i.e., 4 mg/m³. Both **locations A-7, (Admin building Vadinar)** and **A-8,(Vadinar Colony)** had **5.16**% exceedance, which is about 5 days out of 97 days of monitoring, while comparing with the NAAQS 8-hour limit, i.e., 2 mg/m3.
- The concentration of **Total VOCs** levels was recorded in a range of **0 to 6.62** µg/m³ with a yearly average value of **0.96** with a standard deviation of **1.051** µg/m³ at Vadinar. As shown in graph 6, the **highest** concentration of **VOCs** is at

location A-8, (Vadinar Colony), this is the only spike observed in the whole monitoring period for VOCs at this location.

Polycyclic Aromatic Hydrocarbons (PAHs):

- The concentration of **Benzene** levels was recorded in a range of **0.01 to 1.03** µg/m^3, with a yearly average value of **0.28** with a standard deviation of 0.36 µg/m^3. the **highest** concentration of Benzene is at **location A-7, (Admin building Vadinar)** in Winter. It can be seen that in all locations **Benzene** within the NAAQS annual limit, i.e., 5 µg/m^3.
- **Non-methane VOC** (NM-VOC) concentration at Vadinar was observed in the range of **0.07 to 2.15** µg/m^3 with a yearly average value of **0.82** with a standard deviation **0.085** µg/m^3. the **highest** concentration is at **A-7, (Admin building Vadinar)** in Winter.

With reference to the Ambient Air Quality monitoring conducted under the study, it may be concluded that the particulate matter PM_{10}, were reported in higher concentration and apparently exceeds the NAAQS particularly at locations of Kandla., whereas $PM_{2.5}$ complies with the NAAQS at majority of the locations. For both the ambient air monitoring parameters (PM_{10} and $PM_{2.5}$), the major exceedance was observed at location A-5 i.e. Coal Storage Area. The gaseous pollutants (NO_x, SO_x, CO, VOCs etc.) falls within the permissible limit. The probable reasons 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.
3. **Coal Handling:** Resuspension of dust occurs due to the transportation of coal and the handling of coal.
4. **Construction Activities:** Another reason for the high particulate matter content in this area is due to high construction activities in the surrounding area.

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.
- End to End 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.
- Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.
- Dust collectors shall be deployed in all areas where blasting (surface cleaning) and painting operations are to be carried out, supplemented by stacks for effective dispersion.
- Periodic vacuum-sweeping mechanisms shall be adopted.

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, SO_2, 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 6 and 7** as follows:

Map 6: DG Stack monitoring Locations at Kandla

Map 7: DG Stack monitoring Locations 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: DG stack parameters

Sr. No.	Parameter	Unit	Instrument
1.	Suspended Particulate Matter	**mg/Nm³**	**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.

Monitoring Frequency

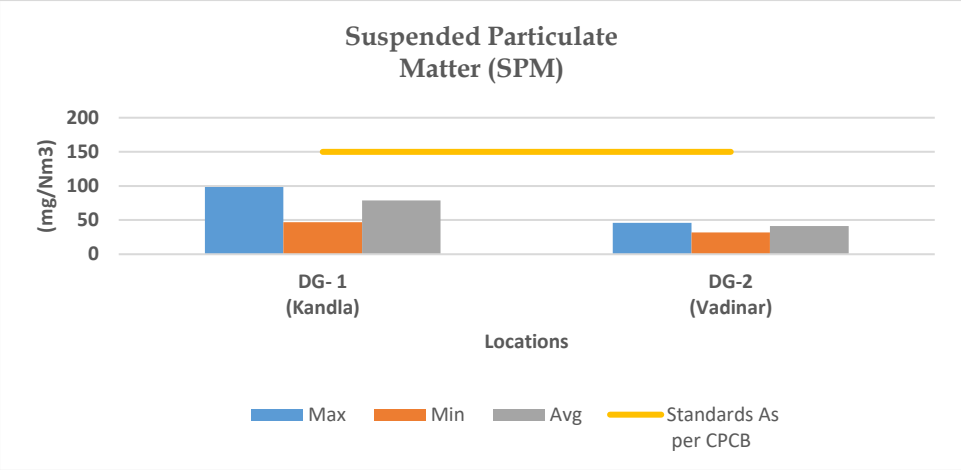
Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar for a period of April 2023 to March 2024.

5.2 Result and Discussion

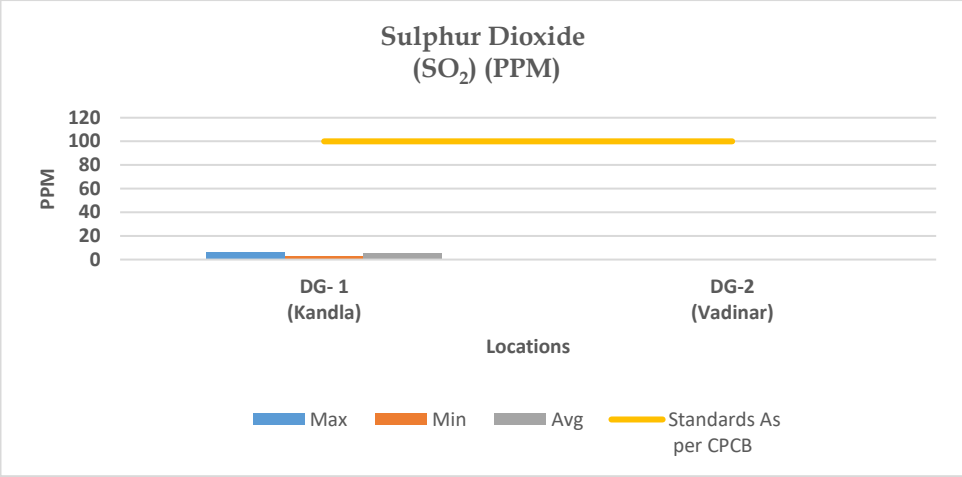
The sampling and monitoring of DG stack emission was carried out for monitoring period at Kandla and Vadinar and its comparison with CPCB or Indian standards for Industrial Stack Monitoring the flue gas emission from DG set has given in **Table 12.**

Table 12: DG monitoring data

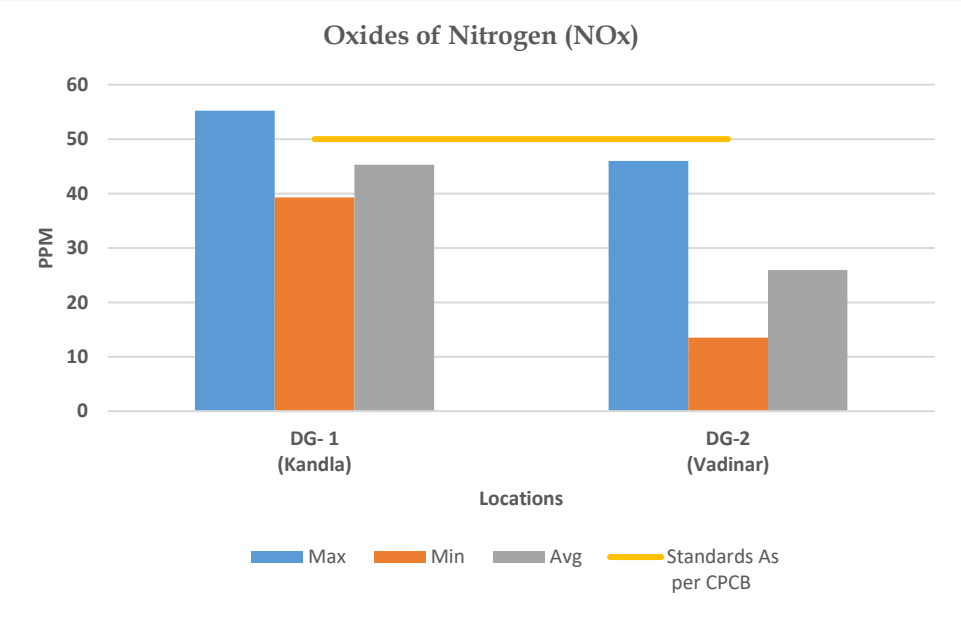
Sr. No.	Stack Monitoring Parameters for DG Sets		DG- 1 (Kandla)	DG-2 (Vadinar)	Stack Monitoring Limits /Standards As per CPCB
1.	**Suspended Particulate Matter (SPM) (mg/Nm³)**	**Max**	98.47	45.32	**150**
		Min	46.82	31.85	
		Avg.	78.96	41.33	
2.	**Sulphur Dioxide (SO2) (PPM)**	**Max**	6.45	N.D.	**100**
		Min	3.25	N.D.	
		Avg.	4.95	N.D.	
3.	**Oxides of Nitrogen (NO_x) (PPM)**	**Max**	55.2	46	**50**
		Min	39.27	13.52	
		Avg.	45.31	25.92	
4.	**Carbon Monoxide (CO) (%)**	**Max**	0.34	0.016	**1**
		Min	0.007	0.002	
		Avg.	0.16	0.01	
5.	**Carbon Dioxide (CO_2) (%)**	**Max**	3.09	1.42	**-**
		Min	1.21	1.03	
		Avg.	1.92	1.19	



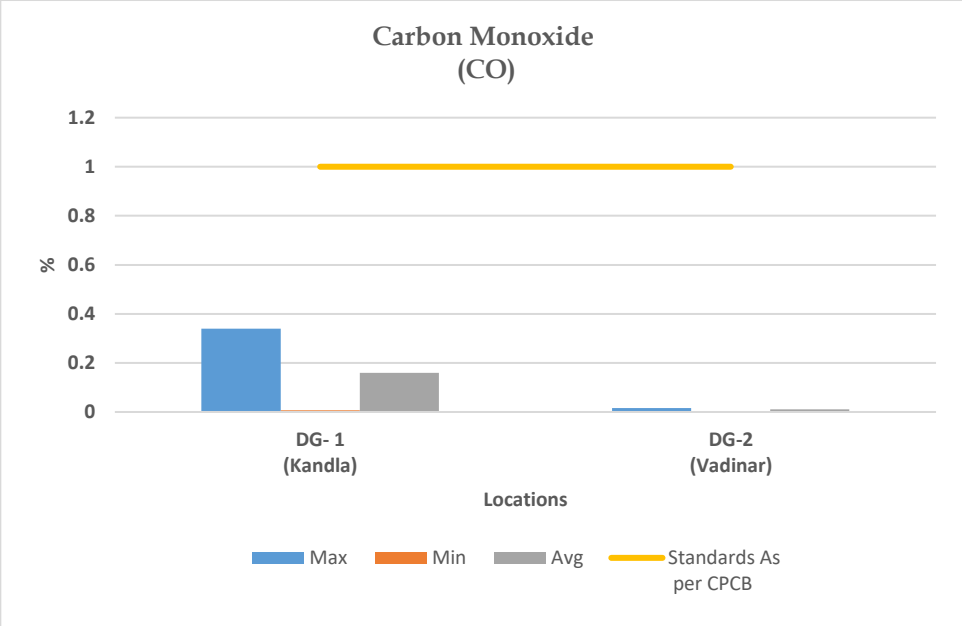
Graph 7 Spatial trend in SPM Concentration



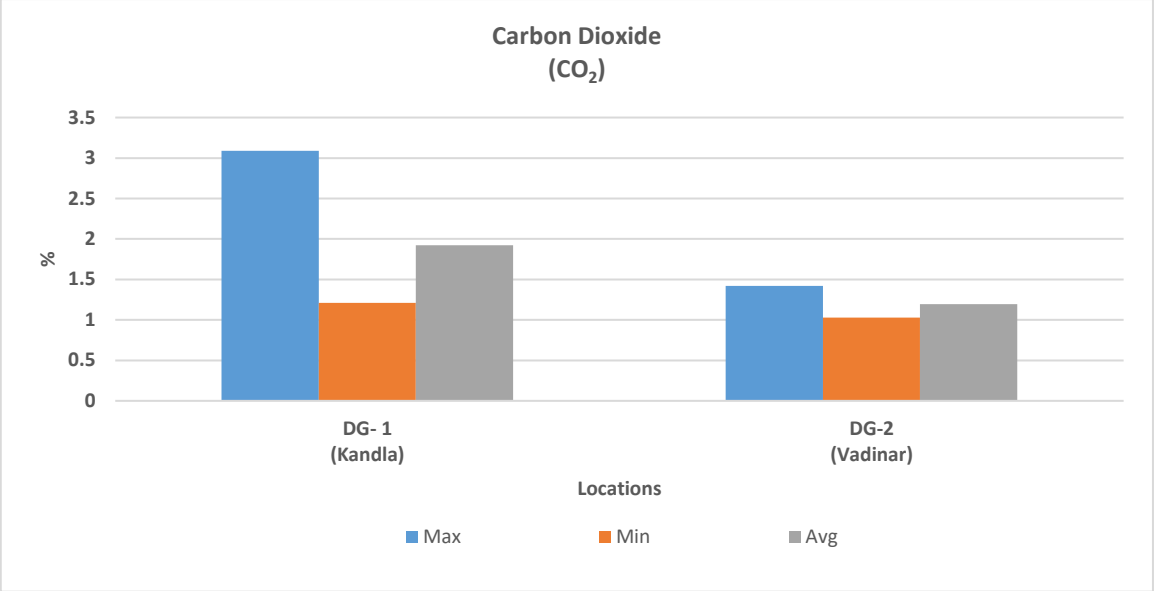
Graph 8 Spatial trend in SO_x Concentration



Graph 9 Spatial trend in NOx Concentration



Graph 10 Spatial trend in CO Concentration



Graph 11 Spatial trend in CO_2 Concentration

5.3 Data Interpretation and Conclusion

1) Kandla:

The Suspended Particulate Matter (SPM) varies in the range of **46.82** to **98.47** mg/m^3. The yearly average SPM of D.G stack-1 is **78.96** mg/m^3. The maximum concentration for SPM was observed in the monitoring period of October to November 2023. The Sulphur dioxide (SO_x) varies in the range of **3.25** to **6.45** PPM. The yearly average SO_x of D.G stack-1 is **4.95** PPM. The maximum concentration of SO_x observed in the monitoring period of October to November 2023.

The NO_x varies in the range of **39.27** to **55.2** PPM. The yearly average of NO_x of D.G stack-1 at Kandla is **45.31** PPM. The maximum concentration of NO_x observed in the monitoring period of July to August 2023.

The CO at Kandla varies in the range of **0.007** to **0.34** %. The yearly average of CO of D.G stack-1 at Kandla is **0.16** % The maximum concentration of CO observed in the monitoring period of March to April 2024.

The CO_2 at Kandla varies in the range of **1.21** to **3.09** %. The yearly average of CO_2 of D.G stack-1 at Kandla is **1.92** % The maximum concentration of CO_2 observed in the monitoring period of March to April 2024.

The results of all the above parameters of DG stack-1 at Kandla emission are compared with the permissible limits mentioned in the consent issued by GPCB, and have been found within the prescribed limit for all the monitored parameters.

2) Vadinar:

The Suspended Particulate Matter (SPM) in the range of **31.85** to **45.32** mg/m^3. The yearly average SPM of D.G stack-2 at Vadinar is **41.33** mg/m^3. The maximum concentration of SPM was observed in the monitoring period of March to April 2024. There is no Sulphur dioxide (SO_x) concentration detected at Vadinar.

The NO_x at Vadinar varies in the range of **13.52** to **46** PPM. The yearly average of NO_x of D.G stack-2 at Vadinar is **25.928** PPM. The maximum concentration of NO_x observed in the monitoring period of June to July 2023.

The CO at Vadinar varies in the range of **0.002** to **0.016** %. The yearly average of CO of D.G stack-2 at Vadinar is **0.0106** % The maximum concentration of CO observed in the monitoring period of October to November 2023.

The CO_2 at Vadinar varies in the range of **1.03 to 1.42** %. The yearly average in CO_2 of D.G stack-2 at Vadinar is **1.92** % The maximum concentration of CO_2 observed in the monitoring period of June to July 2024.

The results of all the above parameters of DG stack-2 at Vadinar emission are compared with the permissible limits mentioned in the consent issued by GPCB, and have been found within the prescribed limit for all the monitored parameters.

CHAPTER 6: NOISE MONITORING

6.1 Noise Monitoring

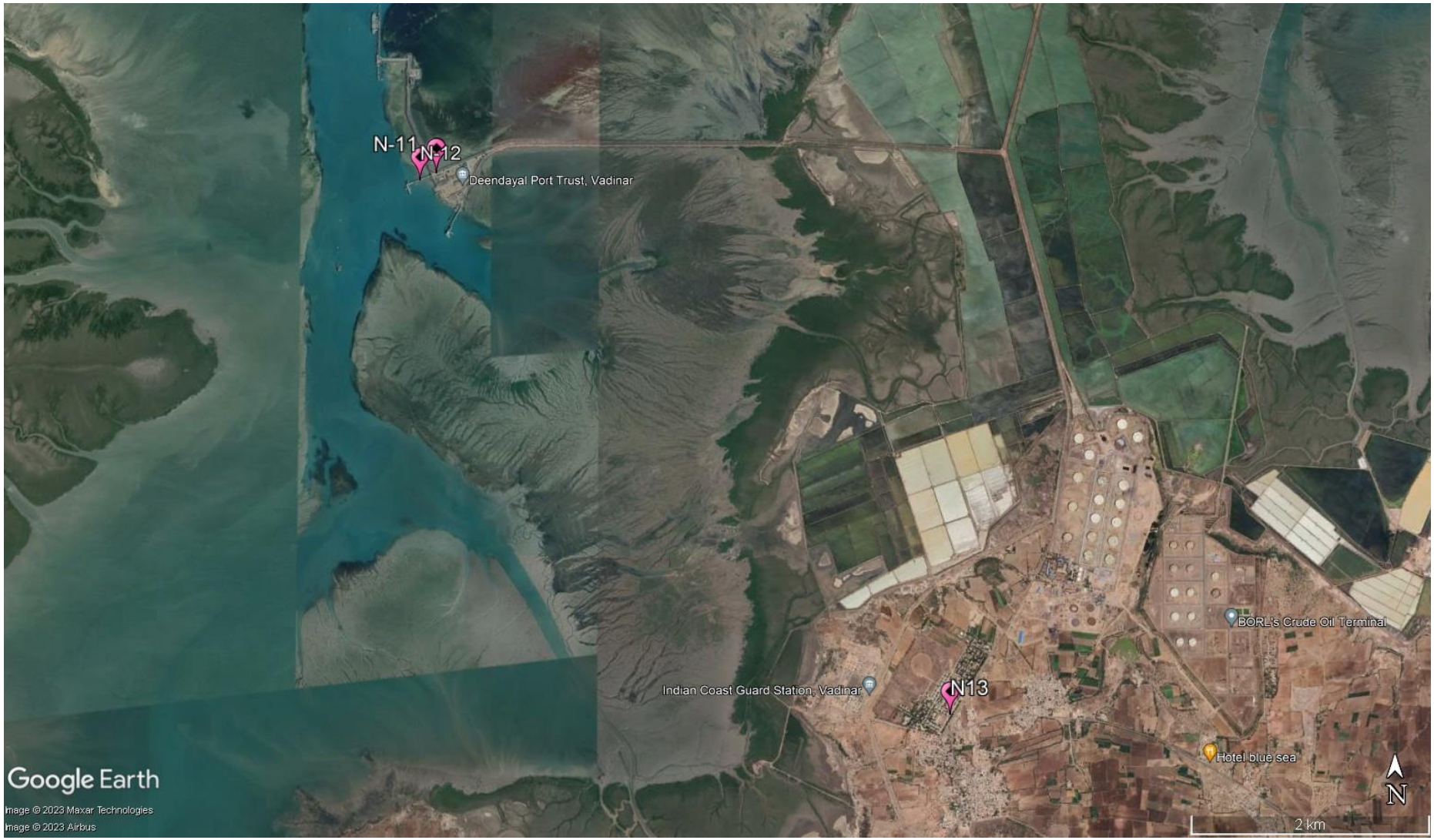
Noise can be defined as an unwanted sound, and it is therefore, necessary to measure both the quality as well as the quantity of environmental noise in and around the study area. Noise produced during operation stage and the subsequent activities may affect surrounding environment impacting the fauna 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 **Map 8 and 9** as follow:

Table 13: Details of noise monitoring locations

Sr. No.	Location Code		Location Name	Latitude/ Longitude
1.	Kandla	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.	Vadinar	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

Map 8: Locations for Noise Monitoring at Kandla



Map 9: Locations 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.

Monitoring 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

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[2]

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 April 2023 to March 2024 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 in dB(A)			Standard	Night Time in dB(A)		
					Max.	Min.	Avg.		Max.	Min.	Avg.
1	N-1	Oil Jetty 7	A	75	65.7	36.5	47.75	70	57.5	33	41.801
2	N-2	West Gate No.1	A	75	68.4	36.5	54.35	70	54.2	36.1	47.02
3	N-3	Canteen Area	B	65	66.2	38	52.61	55	52.1	33	43.46
4	N-4	Main Gate	A	75	61.4	35.3	50.69	70	50.8	36.1	43.33
5	N-5	Main Road	A	75	66.1	33.5	51.67	70	55.5	33.6	43.7
6	N-6	Marin Bhavan	B	65	62.3	38.9	52.52	55	52.3	31.9	43.23
7	N-7	Port & Custom Building	B	65	66.3	37.6	50.89	55	54.3	33.9	38.91
8	N-8	Nirman Building	B	65	60.8	40.9	51	55	58.9	35.2	43.02
9	N-9	ATM Building	B	65	65.1	35.1	49.7	55	53.4	34.1	39.25
10	N-10	Wharf Area/ Jetty	A	75	74.5	36.9	52.9	70	52.7	36	42.3
11	N-11	Near Main Gate	A	75	72.3	34	62.51	70	71.2	34.3	55.71
12	N-12	Near Vadinar Jetty	A	75	76.3	39.2	64.98	70	68.5	34.7	56.38
13	N-13	Port Colony Vadinar	C	55	77.5	37.7	50.05	45	65.9	36.2	49.5

6.3 Data Interpretation and Conclusion

1) **Kandla:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 10 locations at Kandla ranged from **33.5** dB(A) to **74.5** dB(A) while, during Night Time the average Noise Level ranged from **31.9** dB(A) to **58.9** dB(A), of which six locations out of ten locations, noise level were within the permissible limits for the industrial, commercial area and residential zone for Day time and night time.
   Other Four locations such as i.e., **N-3 (Canteen Area)**, **N-7 (Port & Custom Building), N-8 (Nirman Building)** and **N-9 (ATM building)** which are Commercial areas, slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period of **April to May 2023 and May to June 2023**.

2) **Vadinar:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 3 locations at Vadinar ranged from **34** dB(A) to **77.5** dB(A) while, during Night Time the average Noise Level ranged from **34.3** dB(A) to **71.2** dB(A) at Vadinar, on location **N-11 (Near main gate)** noise level was within the permissible limits for the industrial zone for Day time and night time.
   On locations of Vadinar such as i.e., **N-12 (Near Vadinar jetty)**, which are considered as industrial area slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period **of June to July 2023**. And on location **N-13 (Port Colony Vadinar)**, most frequently exceed the permissible limit during the day time as well as night time.

6.4 Remedial Measures

The noise levels detected at the locations of Kandla and Vadinar, are found within the prescribed norms. The noise can further 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

Sr. No.	Location Code		Location Name	Latitude Longitude
1.	Kandla	S-1	Oil Jetty 7	23.043527N 70.218456E
2.		S-2	IFFCO Plant	23.040962N 70.216570E
3.		S-3	Khori Creek	22.970382N 70.223057E
4.		S-4	Nakti Creek	23.033476N 70.158461E
5.	Vadinar	S-5	Near SPM	22.400026N 69.714308E
6.		S-6	Near Vadinar Jetty	22.440759N 69.675210E

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:

Monitoring Frequency

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar. The monitoring was done from April 2023, to March, 2024.

Table 18: Soil parameters

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, 6th 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 10 and 11** as follows:

Map 10: Soil Quality Monitoring Locations at Kandla

Map 11: Soil Quality Monitoring Locations at Vadinar

7.2 Result and Discussion

The analysis results of physical analysis of the soil samples collected during environmental monitoring period during April 2023 to March 2024 mentioned in **Table 19** are shown below:

Table 19: Soil Quality for the Monitoring period

Sr. No	Parameters / Location		Kandla				Vadinar	
			S-1 (Oil Jetty 7)	S-2 IFFCO Plant)	S-3 (Khori Creek)	S-4 (Nakti Creek)	S-5 (Near SPM)	S-6 (Near Vadinar Jetty)
1	pH	Max	9.53	8.8	8.88	9.48	8.69	9.36
		Min	7.3	6.48	6.52	7.86	7.19	8.16
		Avg.	8.24	8.20	7.96	8.52	8.14	8.55
2	Conductivity (µS/cm)	Max	71500	36500	75700	17850	501	625
		Min	587	526	586	204	63	127
		Avg	26881.17	11442	20646.33	5470	177.13	281.54
3	Inorganic Phosphate (Kg/ha)	Max	13.32	619.89	20.31	15.87	5.64	8.67
		Min	0.39	0.43	1.24	0.32	0.35	0.26
		Avg	4.21	57.15	5.64	4.71	2.39	2.25
4	Organic Carbon (%)	Max	2.83	2.54	3.83	3.35	0.85	2.48
		Min	0.03	0.08	0.14	0.27	0.06	0.14
		Avg	0.91	0.79	1.06	0.92	0.33	0.59
5	Organic Matter (%)	Max	4.88	4.38	6.6	5.78	1.47	4.28
		Min	0.06	0.14	0.24	0.32	0.09	0.241
		Avg	1.57	1.36	1.82	1.48	0.57	1.01
6	SAR (meq/L)	Max	41.45	22.91	31.51	10.01	0.25	0.45
		Min	0.81	0.36	0.5	0.36	0.05	0.09
		Avg	13.24	6.56	11.71	2.57	0.10	0.17
7	Aluminium (mg/Kg)	Max	8643.04	9065.97	10298.7	9286.91	15921.7	14806.19
		Min	812.75	830.95	840.71	916.4	735.77	754.58
		Avg	2223.8	2322.3	2517.4	2470.4	2848.2	2762.2
8	Chromium (mg/Kg)	Max	92.23	90.7	86.18	87.07	106	91.88
		Min	28.213	28.91	31.57	24.7	71.68	60.93
		Avg	52.28	58.79	59.005	53.30	82.46	70.91
9	Nickel (mg/Kg)	Max	33.32	36.66	38.1	45.41	41.425	42.68
		Min	13.17	11.82	11.91	10.43	27.14	25.52
		Avg	19.17	19.22	22.72	21.72	33.29	32.353
10	Copper (mg/Kg)	Max	92.51	88.31	150.7	192.72	123.18	104.64
		Min	12.42	14.71	14.74	12.8	81.14	60.57
		Avg	49.94	61.10	84.93	56.708	103.06	82.37
11	Zinc (mg/Kg)	Max	210.35	1755.44	188.29	142.71	88.14	97.36
		Min	16.46	42.93	29.9	23.57	37.03	15.33
		Avg	73.75	283.57	99.49	81.77	62.53	49.70
12	Cadmium (mg/Kg)	Max	0.397	23.47	0.59	0	3	0
		Min	0.397	0.5	0.59	0	3	0
		Avg	0.397	6.608	0.59	0	3	0
13	Lead (mg/Kg)	Max	50.28	277.82	47.87	26.48	1.58	21.07
		Min	3.79	2.58	1.29	2.26	0.59	0.89
		Avg	12.09	32.75	15.59	8.88	1.08	6.66

Sr. No	Parameters / Location		Kandla				Vadinar	
			S-1 (Oil Jetty 7)	S-2 IFFCO Plant)	S-3 (Khori Creek)	S-4 (Nakti Creek)	S-5 (Near SPM)	S-6 (Near Vadinar Jetty)
14	Arsenic (mg/Kg)	Max	4.87	8.4	5.28	6.62	0.4	5.05
		Min	0.1	0.29	0.88	0.3	0.099	0.59
		Avg	2.38	3.04	2.97	2.26	0.22	2.82
15	Mercury (mg/Kg)	Max	0	0	0	0	0	0
		Min	0	0	0	0	0	0
		Avg	0	0	0	0	0	0
16	Water Holding Capacity (%)	Max	54	77.92	61.99	75.84	60	66
		Min	35.8	34	23.74	15.9	39.85	44
		Avg	42.66	46.48	43.95	48.34	47.70	60.01
17	Sand (%)	Max	77.61	77.7	85.46	82.36	62.4	78.46
		Min	44.4	46.57	48.27	13.39	42.26	42.25
		Avg	59.26	65.74	62.96	65.03	51.61	60.59
18	Silt (%)	Max	53.28	47.28	41.25	57.98	49.27	53.27
		Min	9.77	9.28	9.93	9.28	12.24	12
		Avg	30.41	26.40	28.84	24.13	34.72	29.17
19	Clay (%)	Max	19.53	14.32	22.35	28.63	35.92	21.02
		Min	2.32	0.63	0.64	0.48	1.75	1.74
		Avg	10.29	7.86	8.19	10.83	13.66	10.23
20	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	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 parameters have been given an interpretation based on the observations as follows:

1) Kandla:

- The value of **pH** ranges from **6.48** to **9.53**, with the highest at location **S-1 (Oil Jetty 7)** and the lowest at **location S-2 (IFFCO plant),** while the average pH for Kandla was observed to be **8.23**. The pH in Kandla varies from **Slightly alkaline to strongly alkaline**

- At all monitoring locations, the value of **Electrical Conductivity** ranges from **204 to 75,700** µs/cm, with the highest at **location S-3 (Khori Creek**) and the lowest at **S-4 (Nakti Creek).** The average Electrical Conductivity is **16,109.87** µs/cm.

- The concentration of inorganic phosphate varied from **0.32** to **619.89** kg/ha, with an average of **17.93** kg/ha. The highest concentration of inorganic phosphate was found at **S-2 (IFFCO plant)** and the lowest concentration was found at **S-4 (Nakti Creek)**. The availability of phosphorus in the soil solution is influenced by several factors, such as organic matter, clay content, pH, temperature, and more.

- The concentration of **Total Organic Carbon** ranges from **0.03% to 3.86%,** with an average TOC of **0.92%** detected. The highest concentration was found at **location S-3 (Khori Creek),** and the minimum concentration was found **at S-1 (Oil Jetty 7).**
- The **Sodium Adsorption Ratio** ranges from **0.36** to **41.45** meq/L, with an average value of **8.25** meq/L at Kandla. The highest concentration of SAR is found at **S-1 (Oil Jetty 7)** and the lowest concentration at **S-4 (Nakti Creek)**.
- The **Water Holding Capacity (WHC)** in the soil samples of Kandla varies from **15.9% to 77.92%**, with an average of **45.36%**. The highest concentration of WHC was observed at **S-2 (IFFCO plant)** and the lowest concentration at **S-4 (Nakti Creek)**.
- The Soil Texture was observed as "**Sandy loam**" to "**loamy sand**" at all the monitoring locations in Kandla.

Heavy Metals

- During the sampling period, the concentration of **Aluminium** varied from **812.75** to **10,298.7** mg/kg. The average **Aluminium** concentration was observed to be **2,383.475** mg/kg at the Kandla monitoring station. The **highest concentration** was observed at **S-3 (Khori Creek)**, and the **lowest concentration** was observed at **S-1 (Oil Jetty 7)**.
- The concentration of **Chromium** varied from **24.7 to 92.23** mg/kg, with an average value of **55.848** mg/kg observed at the Kandla monitoring station. The highest concentration was observed at **S-1 (Oil Jetty 7)**, and the lowest concentration was observed at **S-4 (Nakti Creek)**.
- The concentration of **Nickel** varied from **10.43** to **45.41** mg/kg at Kandla, with an average value of **20.71** mg/kg at the Kandla monitoring station. The highest concentration was observed at **S-4 (Nakti Creek)**, while the lowest concentration was also observed at **S-4 (Nakti Creek)**.
- The concentration of **Zinc** varied from **16.46** to **1755.4** mg/kg at Kandla, with an average value of **134.64** mg/kg at the Kandla monitoring station. The highest concentration was observed at **S-2 (IFFCO plant)**, which was the only spike observed during the entire monitoring period at Kandla. The lowest concentration was observed at **S-1 (Oil Jetty 7)**.
- The concentration of **Copper** varied from **12.42** to **192.72** mg/kg, with an average value of **13.667** mg/kg observed at the Kandla monitoring station. The highest concentration was observed at **S-4 (Nakti Creek)** and the lowest concentration was observed at **S-1 (Oil Jetty 7)**.
- The concentration of Lead varied from **1.29 to 277.82** mg/kg, with an average value of **17.33** mg/kg. The highest concentration was observed at **S-2 (IFFCO plant)**; this was the only spike observed during the entire monitoring period, while the lowest concentration was observed at **S-3 (Khori creek)**.
- The concentration of A**rsenic** varied from **0.1 to 8.4** mg/kg, with an average value of **2.67** mg/kg. The highest concentration was observed at **S-1 (Oil Jetty 7)**, and the lowest concentration was observed at **S-3 (Khori Creek)**.
- The concentration of **Cadmium** varied from **0** to **23.47** mg/kg, with an average value of **1.89** mg/kg. The highest concentration was observed at **S-2 (IFFCO plant)**. During the monitoring period, it was observed that cadmium was mostly found **Below**

Quantification Limit (BQL) at all locations, with only one spike observed at **S-2 (IFFCO plant)** throughout the entire monitoring period.

- During the monitoring period, it was observed that the concentration of **Mercury** was mostly found **below the quantification limit (BQL)** at all locations.

2) Vadinar:

- The value of **pH** ranges from **7.675** to **9.36**, with the highest at location **S-6 (Near Vadinar jetty)** and the lowest at **location S-5 (Near SPM),** while the average pH for Vadinar was observed to be **8.34**. pH of Soil at Vadinar was found to be **moderately alkaline**.
- At all monitoring locations in Vadinar, the value of **Electrical Conductivity** ranges from **63 to 625** µs/cm, with the highest at **S-6 (Near Vadinar jetty)** and the lowest at **location S-5 (Near SPM).** The average Electrical Conductivity is **229.33** µs/cm.
- The concentration of **inorganic phosphate** varied from **0.26** to **8.67** kg/ha, with an average of **2.32** kg/ha. The highest concentration of inorganic phosphate was found at **S-6 (Near Vadinar jetty)** and the lowest concentration was found at **location S-5 (Near SPM)**.
- The concentration of **Total Organic Carbon** ranges from **0.06% to 2.48%,** with an average TOC of **0.46%** detected at Vadinar. The highest concentration was found at **S-6 (Near Vadinar jetty),** and the minimum concentration was found **at S-5 (Near SPM).**
- The **Sodium Adsorption Ratio** ranges from **0.05** to **0.45** meq/L, with an average value of **0.143** meq/L at Vadinar. The highest concentration of SAR is found at **6 (Near Vadinar jetty)** and the lowest concentration at **S-5 (Near SPM)**.
- The **Water Holding Capacity (WHC)** in the soil samples of Vadinar varies from **39.85% to 66%**, with an average of **53.85%**. The highest concentration of WHC was observed at **S-6 (Near Vadinar jetty)** and the lowest concentration at **S-5 (Near SPM)**.
- The soil texture of Vadinar varies from "loam" to "slit loam".

Heavy Metals

- During the sampling period, the concentration of **Aluminium** varied from **735.77** to **15921.72** mg/kg. The average **Aluminium** concentration was observed to be **2,805.2** mg/kg at the Vadinar monitoring station. The **highest concentration** was observed at **S-5 (Near SPM)**, and the **lowest concentration** was observed at **S-5 (Near SPM) but during different months**.
- The concentration of **Chromium** varied from **60.93 to 106** mg/kg, with an average value of **76.69** mg/kg observed at the Vadinar monitoring station. The highest concentration was observed at **S-5 (Near SPM)**, and the lowest concentration was observed at **S-6 (Near Vadinar jetty)**.
- The concentration of **Nickel** varied from **25.62** to **42.68** mg/kg, with an average value of **32.825** mg/kg at the Vadinar monitoring station. The highest concentration was observed at **S-6 (Near Vadinar jetty)**, and the lowest concentration was also observed at **S-6 (Near Vadinar jetty)** but during different months.

- The concentration of **Zinc** varied from **15.33** to **97.36** mg/kg, with an average value of **56.118** mg/kg at the Vadinar monitoring station. The highest concentration was observed at **S-6 (Near Vadinar jetty)**, and the lowest concentration was also observed at **S-6 (Near Vadinar jetty)** but during different months.
- The concentration of **Copper** varied from **60.57** to **123.18** mg/kg, with an average value of **92.71** mg/kg observed at the Vadinar monitoring station. The highest concentration was observed at **S-5 (Near SPM)** and the lowest concentration was observed at **S-6 (Near Vadinar jetty)**.
- The concentration of **Lead** varied from **0.59 to 21.07** mg/kg, with an average value of **3.875** mg/kg. The highest concentration was observed at **S-6 (Near Vadinar jetty)**; this was the only spike observed during the entire monitoring period at Kandla, while the lowest concentration was observed at **S-5 (Near SPM)**.
- The concentration of A**rsenic** varied from **0.099 to 0.59** mg/kg, with an average value of **5.05** mg/kg. The highest concentration was observed at **S-6 (Near Vadinar jetty)**, and the lowest concentration was observed at **S-5 (Near SPM)**.
- The concentration of **Cadmium** varied from **0** to **3** mg/kg, with an average value of **3** mg/kg. The highest concentration was observed at **S-5 (Near SPM)**. During the monitoring period, it was observed that cadmium was mostly found **Below Quantification Limit (BQL)** at all locations.
- During the monitoring period, it was observed that the concentration of **Mercury** was mostly found **below the quantification limit (BQL)** at all locations.

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 **Map 12 and 13.**

Table 20: Details of Drinking Water Sampling Locations

Sr. No.	Location Code		Location Name	Latitude/ Longitude
1.	Kandla	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.	Vadinar	DW-19	Near Vadinar Jetty	22.440759N 69.675210E
20.		DW-20	Near Port Colony	22.401619N 69.716822E

Map 12: Drinking Water Monitoring Locations at Kandla

Map 13: Drinking Water Monitoring Locations 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[3]

Sr. No.	Parameters	Units	Reference method	Instrument
1.	pH	-	APHA, 23rd Edition (Section-4500-H^+B):2017	pH Meter
2.	Colour	Hazen	APHA, 23rd Edition, 2120 B:2017	Color Comparator
3.	EC	µS/cm	APHA, 23rd Edition (Section-2510 B):2017	Conductivity Meter
4.	Turbidity	NTU	APHA, 23rd Edition (Section -2130 B):2017	Nephlo Turbidity Meter
5.	TDS	mg/L	APHA, 23rd Edition (Section-2540 C):2017	Vaccum Pump with filtration assembly and Oven
6.	TSS	mg/L	APHA, 23rd Edition, 2540 D: 2017	
7.	Chloride	mg/L	APHA, 23rd Edition (Section-4500-Cl-B):2017	Titration Apparatus
8.	Total Hardness	mg/L	APHA, 23rd Edition (Section-2340 C):2017	
9.	Ca Hardness	mg/L	APHA, 23rd Edition (Section-3500-Ca B):2017	
10.	Mg Hardness	mg/L	APHA, 23rd Edition (Section-3500-Mg B):2017	
11.	Free Residual Chlorine	mg/L	APHA 23rd Edition, 4500	
12.	Fluoride	mg/L	APHA, 23rd Edition (Section-4500-F-D):2017	UV- Visible Spectrophotometer
13.	Sulphate	mg/L	APHA, 23rd Edition (Section 4500-SO4-2-E):2017	
14.	Sodium	mg/L	APHA, 23rd Edition (Section-3500-Na-B):2017	Flame Photometer
15.	Potassium	mg/L	APHA,23rd Edition, 3500 K-B: 2017	
16.	Salinity	mg/L	APHA, 23rd Edition (section 2520 B, E.C. Method)	Salinity /TDS Meter
17.	Nitrate	mg/L	APHA, 23rd Edition, 4500 NO3- B: 2017	UV- Visible Spectrophotometer
18.	Nitrite	mg/L	APHA, 23rd Edition, 4500 NO2-B: 2017	
19.	Hexavalent Chromium	mg/L	APHA, 23rd Edition, 3500 Cr B: 2017	
20.	Manganese	mg/L	APHA,23rd Edition, ICP Method 3120 B: 2017	ICP-OES

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

Monitoring Frequency

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar. Sample Collected from this location during the monitoring period April/2023 to March/2024.

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) [4] have been summarized in **Table 22A, 22B, 22C** as follows:

Table 22A: Drinking Water Quality for the Monitoring period

Parameters	Standard values as per IS-		DW-1 (Oil Jetty 7)			DW-2 (Port & Custom Building)			DW-3 (North Gate)			DW-4 (Workshop)			DW-5 (Canteen Area)			DW-6 (West Gate 1)			DW-7 (Sewa Sadan -3)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
pH	6.5-8.5		7.9	6.6	7.4	8.4	6.8	7.3	8.0	6.8	7.3	8.1	7.1	7.4	8.2	7.3	7.7	8.4	7.2	7.7	8.2	7.2	7.5
Colour (Hazen)	5	15	5.0	1.0	1.7	5.0	1.0	1.3	5.0	1.0	1.3	5.0	1.0	1.3	5.0	1.0	3.3	5.0	1.0	1.7	5.0	1.0	1.3
EC (µS/ cm)			370	19.4	195.6	600.	36.0	153.8	1653	27.0	259.7	401	12.8	85.6	2200	42.0	1056	1470	28.0	336.3	150	22	57.8
Salinity (PSU)			1.0	0.0	0.2	0.3	0.0	0.1	0.8	0.0	0.1	0.2	0.0	0.0	1.1	0.0	0.5	0.7	0.0	0.2	0.1	0	0.0
Turbidity (NTU)	1	5	1.2	1.1	1.1	2.0	1.5	1.8	1.9	0.7	1.2	3.7	0.9	2.3	3.1	0.9	1.9	1.5	1.0	1.2	5.9	1.1	3.5
Chloride (mg/L)	250	1000	81	5.8	41.6	92	7.5	34.1	354.9	8.0	56.9	110	3	22.9	437.4	10.3	192.0	329.9	9.0	78	42.5	6.5	15.7
Total Hardness (mg/L)	200	600	42	3	13.3	148	3	24.8	320	2.0	33.4	20.0	2	7.5	310	10	181	230	5.0	53.2	10	2	4.1
Ca Hardness (mg/L)			27	2	6.3	92	2	13.9	200	1.0	20.3	8.0	1	3.3	210.0	5	103.9	120.0	2.5	28.9	5.0	1	2.2
Mg Hardness (mg/L)			15	1	6.8	56	1	10.1	120	1.0	13.1	12	1	3.9	120.0	5	76.6	110.0	2.0	24.4	5.0	1	2
Free Residual Chlorine (mg/L)	0.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDS (mg/L)	500	2000	184	10	101.7	306	20	81.8	840	14	132.7	204	8.0	44.7	928	22	452.4	752	20.0	171.6	78	14	30.8
TSS (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0
Fluoride (mg/L)	1	1.5	0.4	0.4	0.4	0.5	0.4	0.5	0.7	0.3	0.4	0.0	0.0	0.0	0.9	0.3	0.5	0.9	0.7	0.8	0.4	0.4	0.4
Sulphate (mg/L)	200	400	15.7	15.7	15.7	35.7	35.7	35.7	73.9	73.9	73.9	0.0	0.0	0.0	113.3	2.2	64.0	97.3	2	55.3	0	0	0

Parameters	Standard values as per IS-		DW-1 (Oil Jetty 7)			DW-2 (Port & Custom Building)			DW-3 (North Gate)			DW-4 (Workshop)			DW-5 (Canteen Area)			DW-6 (West Gate 1)			DW-7 (Sewa Sadan -3)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Nitrate (mg/L)	45		26	3.7	12.5	4.2	0.5	1.8	7.5	1.3	4.6	2.4	2.4	2.4	8.8	3.4	5.8	5.7	1.3	2.8	2.1	2.1	2.1
Nitrite (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.2	0.2	0.2	0	0	0
Sodium (mg/L)			86	5	34.5	38.5	7	21.2	178.6	9.7	38.0	42.6	5.7	18.0	319.6	12.0	118.4	197.5	8.8	44.1	15.1	5.5	9.6
Potassium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	5.8	5.8	5.8	0	0	0	0	0	0
Hexavalent Chromium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odour (TON)	Agreeable			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	0.01	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium (mg/L)	0.003		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper (mg/L)	0.05	1.5	17.3	0	5.8	8.4	0.0	2.8	6.2	0.0	3.1	11.1	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iron (mg/L)	0.3		0.6	0	0.3	0.2	0.2	0.2	0.2	0.0	0.1	0.2	0.2	0.2	0.2	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1
Lead (mg/L)	0.01		3.1	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Manganese (mg/L)	0.1	0.3	0.1	0	0.1	0	0	0	0.5	0.5	0.5	0.1	0.1	0.1	0	0	0	0.5	0	0.2	0	0	0
Mercury (mg/L)	0.001		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chromium (mg/L)	0.05		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zinc (mg/L)	5	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Coliform* (MPN/ 100ml)	Shall not be detected		630.0	5.0	118.0	12500.0	5.0	1629.3	250.0	10.0	100.7	50.0	5.0	24.0	144500	5.0	17137	4350	5.0	1407	23500	2.0	3963.3

Table 22B: Drinking Water Quality for the Monitoring period

Parameters	Standard values as per IS		DW-8 (Nirman Building)			DW-9 (Custom Building)			DW-10 (Port Colony Kandla)			DW-11 (Wharf Area/ Jetty)			DW-12 (Hospital Kandla)			DW-13 (A.O. Building)			DW-14 (School Gopalpuri)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
pH	6.5-8.5		8	7	7.5	8	6.2	7.3	7.9	6.82	7.31	8.3	6.85	7.71	7.75	6.62	7.224	8.5	7.2	7.61	8.2	7.08	7.56
Colour (Hazen)	5	15	5.0	1.0	2.3	5.0	1.0	2.0	5.0	1	2	10	1	3.083	5	1	1.67	5	1	1.33	10	1	3.28
EC (µS/ cm)			2000	40.0	403.8	2900.0	48.0	492.9	3100	105.4	554.9	2460	55	980.1	269	47	141.2	1412	23.2	187.2	1467	43.3	412.15
Salinity (PSU)			1.0	0.0	0.2	1.5	0.0	0.2	1.6	0.05	0.283	1.2	0.02	0.42	0.13	0.03	0.072	0.71	0.02	0.151	0.73	0.03	0.22
Turbidity (NTU)	1	5	3.6	1.1	1.8	4.7	1.0	2.8	2.2	0.95	1.575	3.79	1	2.09	2	1.02	1.57	9.9	0.9	3.67	13.9	0.5	5.48
Chloride (mg/L)	250	1000	499.9	10.0	93.1	689.8	12.5	108.7	504.8	21.99	75.52	404.8	13.54	173.9	67.98	12.5	31.79	307.4	7.5	44.28	332.4	11.5	93.83
Total Hardness (mg/L)	200	600	280.0	4.0	61.8	480	6.0	80.2	340.0	3	62.83	320	15	176.4	30	3	17.84	240	1.5	70.3	270	2	82.64
Ca Hardness (mg/L)			140.0	2.0	31.8	240	3.0	38.7	190.0	2	33.5	170	5	91.30	17	2	9.67	120	1	31.12	140	1.5	42.96
Mg Hardness (mg/L)			140.0	2.0	30.1	190	3.0	37.5	150.0	1	29.32	150	10	84.76	14	1	8.167	120	0.5	33.15	130	2	43.6
Free Residual Chlorine (mg/L)	0.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDS (mg/L)	500	2000	1012	22.0	205.2	1522	24.0	255.8	1064	54	165.4	872	29	403.8	138	24	73.17	718	14	101.9	742	22	218
TSS (mg/L)			2.0	2.0	2.0	12.0	2.0	7.0	2.0	2	2	2	2	2	0	0	0	0	0	0	12	8	10
Fluoride (mg/L)	1	1.5	0.0	0.0	0.0	1.5	0.6	1.1	0.5	0.416	0.433	1.06	0.367	0.57	1.108	1.108	1.108	0	0	0	0.35	0.15	0.25
Sulphate (mg/L)	200	400	100.8	45.5	73.2	142.0	41.5	80.0	115.6	3.17	59.39	134.7	1.97	59.51	0	0	0	108.7	108.77	108.7	113.4	11.55	56.304
Nitrate (mg/L)	45		4.5	1.1	2.6	5.6	2.4	3.8	7.5	1.04	3.68	8.49	3.78	5.929	2.023	1.42	1.752	3.392	1.524	2.585	4.48	1.382	2.38

Parameters	Standard values as per IS		DW-8 (Nirman Building)			DW-9 (Custom Building)			DW-10 (Port Colony Kandla)			DW-11 (Wharf Area/ Jetty)			DW-12 (Hospital Kandla)			DW-13 (A.O. Building)			DW-14 (School Gopalpuri)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Nitrite (mg/L)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.201	0.11	0.147	0	0	0	0	0	0	0	0	0
Sodium (mg/L)			109.5	9.2	39.4	396.2	8.0	75.4	105.8	11.98	37.65	356.5	12.8	106.5	31.35	11.59	20.22	83.91	8.66	21.44	173.5	6.24	46.666
Potassium (mg/L)			0	0	0	13.6	13.6	13.6	7.0	2.6	4.8	0	0	0	0	0	0	0	0	0	0	0	0
Hexavalent Chromium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Odour (TON)	Agreeable			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	0.01	0.05	0	0	0	0	0	0	0	0.007	0.007	0.005	0.0039	0.004	0	0	0	0	0	0	0.015	0.015	0.015
Cadmium (mg/L)	0.003		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0.005	0.005	0.006	0.006	0.006
Copper (mg/L)	0.05	1.5	6.8	0	3.4	0	0	0	10.2	0.005	2.049	0	0	0	9.257	0.005	3.57	0.008	0.0079	0.008	0	0	0
Iron (mg/L)	0.3		0.1	0.1	0.1	0	0	0	0.3	0.0001	0.16	0.17	0.0001	0.092	0	0	0	0.13	0.13	0.13	0.0001	0.0001	0.0001
Lead (mg/L)	0.01		0.2	0	0.1	0	0	0	0	0.0033	0.003	0.004	0.0038	0.004	0.0028	0.003	0.003	0.002	0.002	0.002	4.27	4.27	4.27
Manganese (mg/L)	0.1	0.3	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0.05	0.05	0	0	0
Mercury (mg/L)	0.001		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chromium (mg/L)	0.05		0	0	0	0	0	0	0	0	0	0	0	0	0.0122	0.012	0.012	0.006	0.006	0.006	0	0	0
Zinc (mg/L)	5	15	0	0	0	0.6	0.6	0.6	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Coliform* (MPN/ 100ml)	Shall not be detected		240.0	2.0	114.7	12050	4.0	1826	37080	35	5374	25550	5	3329	140	4	47.2	685	20	166.7	4900	15	636.4

Table 22C: Drinking Water Quality for the Monitoring period

Parameters	Standard values as per IS		DW-15 (Guest House)			DW-16 (E- Type Quarter)			DW-17 (F- Type Quarter)			DW-18 (Hospital Gopalpuri)			DW-19 (Near Vadinar Jetty)			DW-20 (Near Port Colony)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
pH	6.5-8.5		7.99	6.87	7.35	7.68	6.93	7.28	8.19	6.78	7.46	8.27	7.12	7.6	8.38	7.21	7.685	8.07	7.05	7.435
Colour (Hazen)	5	15	5	1	1.67	5	1	1.67	5	1	1.67	10	1	3.5	5	1	2.333	20	1	6
EC (µS/ cm)			264	34.3	120.22	746	17.79	116.84	1337	15.93	298.6	7930	30.2	1037	537	30	199.7	1736	88.4	427.7
Salinity (PSU)			0.7	0.02	0.113	0.38	0.02	0.06	0.67	0.02	0.16	4.39	0.02	0.55	0.26	0.02	0.100	0.87	0.05	0.235
Turbidity (NTU)	1	5	2.29	0.63	1.27	2.8	0.52	1.50	1.97	1.1	1.66	3.98	0.7	2.03	1.5	1.2	1.35	5.3	0.7	3.25
Chloride (mg/L)	250	1000	60.98	10.5	26.98	124.96	4	24.58	287.41	4	61.99	163.9	9	75.28	66.98	9	27.20	407.37	13	73.15
Total Hardness (mg/L)	200	600	20	2	11.97	180	1.5	22.86	230	2	52.6	195	4	96.25	160	2	44.58	240	20	88.5
Ca Hardness (mg/L)			10	1.5	6.25	80	1	10.77	120	1	28.5	102	2	49.43	80	1.5	21.54	140	10	44.08
Mg Hardness (mg/L)			12.5	1	6.136	100	0.5	13.25	110	1	24.1	100	1	46.79	80	1	25.09	100	8	44.41
Free Residual Chlorine (mg/L)	0.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TDS (mg/L)	500	2000	138	18	62.75	382	10	60.5	682	8	157.5	448	16	198.8	272	15	100.9	882	46	218.5
TSS (mg/L)			0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	12	4	8
Fluoride (mg/L)	1	1.5	0.34	0.34	0.34	0	0	0	0.5	0.37	0.43	0.51	0.38	0.44	0.35	0.35	0.35	1.06	1.06	1.06
Sulphate (mg/L)	200	400	10.62	10.3	10.46	34.35	34.35	34.35	104.64	8.37	41.20	59.94	1.81	40.82	42.2	13.07	31.87	102.92	25.4	48.22
Nitrate (mg/L)	45		5.63	1.12	2.53	1.97	1.97	1.97	6.06	1.19	3.20	16.51	1.17	5.1	15.79	1.82	5.55	18.54	1.06	6.45
Nitrite (mg/L)			0	0	0	0	0	0	0	0	0	0.20	0.11	0.16	0	0	0	1.89	1.89	1.89

Parameters	Standard values as per IS		DW-15 (Guest House)			DW-16 (E- Type Quarter)			DW-17 (F- Type Quarter)			DW-18 (Hospital Gopalpuri)			DW-19 (Near Vadinar Jetty)			DW-20 (Near Port Colony)		
	A	P	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Sodium (mg/L)			40.46	14.3	19.38	74.46	7.06	24.85	82.61	5.75	35.30	185.2	7.08	55.81	58.37	6.08	20.49	204.04	7.18	46.23
Potassium (mg/L)			0	0	0	0	0	0	0	0	0	3.2	3.2	3.2	0	0	0	5.85	5.85	5.85
Hexavalent Chromium (mg/L)			0	0	0	0	0	0	0	0	0	0	0	0	0.041	0.041	0.041	0.01	0.01	0.01
Odour (TON)	Agreeable			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	0.01	0.05	0.007	0.007	0.007	0	0	0	0.008	0.008	0.008	0.015	0.01	0.012	0.08	0.08	0.08	0	0	0
Cadmium (mg/L)	0.003		0.007	0.007	0.007	0.006	0.006	0.006	0.007	0.007	0.007	0.008	0.008	0.008	0	0	0	0	0	0
Copper (mg/L)	0.05	1.5	7.24	0.006	2.42	0	0	0	0.012	0.012	0.012	7.3	0.006	3.65	16.25	0.006	7.99	15.403	0.01	3.09
Iron (mg/L)	0.3		0.25	0.0002	0.13	0	0	0	0.52	0.0001	0.213	0.11	0.0003	0.055	1.47	1.47	1.47	0	0	0
Lead (mg/L)	0.01		2.21	0.002	1.10	0	0	0	0	0	0	0	0	0	10.53	0.003	5.26	0.002	0.002	0.002
Manganese (mg/L)	0.1	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.	0.13	0	0.08
Mercury (mg/L)	0.001		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chromium (mg/L)	0.05		0	0	0	0	0	0	0	0	0	0.006	0.006	0.006	0	0	0	0	0	0
Zinc (mg/L)	5	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Coliform* (MPN/ 100ml)	Shall not be detected		200	5	57.75	7650	5	1669	57000	9	6635	310	5	131	2850	120	1485	130000	10	16647

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 NO_3 (QL=1 mg/L), Nitrite as NO_2 (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 from 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.

Physico-Chemical Parameters:

- **pH:** The pH values of drinking water samples in Kandla were reported to be in the range of **6.24 to 8.5**, with an average pH of **7.5**. In Vadinar, its values ranged from **7.05 to 8.38**, with an average pH of **7.36**. 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.
- **Colour:** The colour varies from 1 to 10 at the monitoring locations in Kandla. Locations DW-11, DW-14 and DW-10 showed the value of 10 Hazen at Kandla. At Vadinar, the color was observed within the range of 1 to 20 Hazen. the Colour levels at both project sites fall within the acceptable range of 1 to 15, as specified under IS:10500:2012, except of one location DW-20 within the monitoring period of April to May 2023
- **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 **12.83 to 7930 µS/cm**, with an average value of **708.65** µS/cm. In Vadinar, the EC values showed variation from **30 to 1736 µS/cm**, with an average value of **503.14** µS/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.
- **Salinity:** Salinity at Kandla varies from **0.02 to 4.39 PSU** with an average of **0.396** PSU, while at Vadinar, salinity was observed within the range of **0.02** to **0.87 PSU**.
- **Turbidity**: The Turbidity values of drinking water samples in Kandla were reported to be in the range of **0.5 to 13.9 NTU**, with an average of **2.32**. In Vadinar, its values ranged from **0 to 5.3**, with an average **2.21**. Notably, the Turbidity levels at both project sites fall within the acceptable range of 1 to 5 NTU, as specified under IS:10500:2012, except DW-7, in the monitoring period of July to August 2023, DW-13 in the monitoring period of May to June 2023 and DW-14 in the monitoring period of September to October and October to November 2023. On all this location most of the time Turbidity observed Below Quantification Limit
- **Chlorides:** The chloride concentrations in Kandla varied from **3 to 689.78 mg/L**, with an average value of **116.85** mg/L. At Vadinar the chloride concentration was observed within the range of **9** mg/L to **407.37** mg/L, with an average value of **99.45** mg/L. Thus, the chloride levels at both project sites fall within the Permissible limit of 1000 mg/L, as specified under IS:10500:2012.
- **Total Hardness (TH):** The concentration of Total Hardness varies from **1.5 to 480 mg/L**, with an average concentration of **88.68** mg/L. While at Vadinar, the observed values were within range of **2 to 240** mg/L. at both study areas Total Hardness found

to be within the Permissible limit norm of 600 mg/L as specified by IS:10500:2012 and is not harmful for local inhabitants.

- **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 **8** to **1522** mg/L, with an average concentration of **264.4** mg/L. which is within the permissible limit. while in Vadinar, it ranged from **6** to **882** mg/L, with an average of **255.75** mg/L. It is important to note that the TDS concentrations in both Kandla and Vadinar fall well within the Permissible limit of 2000 mg/L.
- **Fluoride:** The concentration Fluoride varies from **0** to **1.477** mg/L, with an average concentration of **0.44** mg/L. While at Vadinar Fluoride concentration was varies within range of **0** to **1.06** mg/L**,** with an average concentration of **0.708** mg/L**.** The Fluoride concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Fluoride found to be within the Permissible limit norm of 1.5 mg/L as specified by IS:10500:2012
- **Sulphate:** The concentration Sulphate varies from **0** to **141.99** mg/L, with an average concentration of **45.67** mg/L. While at Vadinar Sulphate concentration was varies within range of **13.07** to **102.92** mg/L**,** with an average concentration of **43.94** mg/L**.** 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.
- **Nitrate:** The concentration Nitrate varies from **0** to **25.96** mg/L, with an average concentration of **4.08** mg/L. While at Vadinar Nitrate concentration was varies within range of **0** to **18.54** mg/L**,** with an average concentration of **8.20** mg/L**.** The Nitrate concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Nitrate found to be within the Acceptable limit norm of 45 mg/L as specified by IS: 10500:2012.
- **Nitrite:** The concentration Nitrite varies from **0** to **0.2** mg/L. While at Vadinar Nitrite concentration was varies within range of **0** to **1.89** mg/L**,** with an average concentration of **0.945** mg/L**.** The Nitrite concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar.
- **Sodium:** During the monitoring period, at Kandla variation in the concentration of Sodium was observed to be in the range of **5.01 to 396.2 mg/L**, with the average concentration of **63.71** mg/L. While at Vadinar, the concentration recorded between **6.08** to **204.4** mg/L, with the average concentration of **57.067** mg/L.
- **Odour:** Odour values recorded 1 TON at all monitoring locations of Kandla and Vadinar.

Metals:

- **Arsenic:** The Arsenic concentrations in Kandla varied from **0 to 0.042 mg/L**. At Vadinar the Arsenic concentration was observed within the range of **0** mg/L to **0.08** mg/L. Thus, the Arsenic levels at both project sites fall within the Permissible limit of 0.05 mg/L, as specified under IS:10500:2012, except on one location at Vadinar DW-19 where Arsenic Concentration found 0.08 mg/L in the monitoring period of November to December 2023. In Kandla and Vadinar, the Arsenic concentrations were recorded

BQL for majority of the locations except the locations DW-2, DW-12, and DW-18 in Kandla and DW-20 In Vadinar.

- **Copper:** The Copper concentrations in Kandla varied from **0 to 17.3 mg/L**. At Vadinar the Copper concentration was observed within the range of **0** mg/L to **16.25** mg/L. Thus, the Copper levels at both project sites fall within the Permissible limit of 1.5 mg/L, as specified under IS:10500:2012, except for locations DW-1, DW-2, DW-4, DW-8, DW-10, DW-12, DW-15, DW-18 in Kandla and on both Locations DW-19 and DW-20 of Vadinar for some samples taken during whole monitoring period. The Copper concentrations were recorded BQL for majority of the locations in Kandla and Vadinar.
- **Iron:** The Iron concentrations in Kandla varied from **0 to 0.64 mg/L**, with an average concentration of **0.10** mg/L. At Vadinar the Iron concentration was observed within the range of **0** mg/L to **1.478** mg/L. Thus, the Iron levels at both project sites fall within the Acceptable limit of 0.3 mg/L, as specified under IS:10500:2012, except for locations DW-1, DW-10, and DW-17 in Kandla and on Location DW-19 of Vadinar for some samples taken during the whole monitoring period. The Iron concentrations were recorded by BQL for the majority of the locations in Kandla and Vadinar.
- **Lead:** The Lead concentrations in Kandla varied from **0 to 4.279 mg/L**, with an average concentration of **0.37** mg/L. While at Vadinar the Lead concentration was observed within the range of **0** mg/L to **10.53** mg/L, with an average concentration of **2.6344**. Thus, the Lead levels at both project sites fall within the Acceptable limit of 0.01 mg/L, as specified under IS:10500:2012, except for locations DW-1, DW-8, DW-14 and DW-15 in Kandla and on Location DW-19 of Vadinar for some samples taken during the whole monitoring period. The Lead concentrations were recorded in BQL for the majority of the locations in Kandla and Vadinar.
- **Manganese:** The Manganese concentrations in Kandla varied from **0 to 0.51 mg/L**, with an average concentration of **0.1** mg/L. While at Vadinar, the Manganese concentration was observed within the range of **0** mg/L to **0.13** mg/L. Thus, the Manganese levels at both project sites fall within the Acceptable limit of 0.3 mg/L, as specified under IS:10500:2012, except for locations DW-3, and DW-6 in Kandla and on Location DW-20 of Vadinar for some samples taken during the whole monitoring period. The Manganese concentrations were recorded BQL for the majority of the locations in Kandla and Vadinar.
- The concentrations of parameters such as **Free Residual Chlorine, Total Suspended Solid, Potassium Hexavalent Chromium** and **the metals (Cadmium, Mercury, Total Chromium and Zinc)** were observed to fall within the Permissible limit at both project sites. Observed "Below the Quantification Limit (BQL)" at majority of the locations during the monitoring period.
- Bacteriological Analysis of the drinking water reveals that **Total Coliforms (TC)** were detected in the range of **0** to **144500** MPN/100ml, with the average of **6964.8** MPN/100ml. While at Vadinar the observed within the range of **0** MPN/100ml to **1,30,000** MPN/100ml, with the average concentration of **25,185** MPN/100ml. And for the rest of the monitoring locations of Kandla and Vadinar were detected "Below the Quantification Limit (BQL)". Reporting such concentration of Coliforms indicates

certain external influx may contaminate the source. Hence, it should be checked at every distribution point. The higher concentration of total coliforms were observed on locations DW-2, DW-5, DW-7, DW-10, DW-11, and DW-17 in Kandla and DW-20 location in Vadinar.

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.

The following steps can be implemented to ensure that the water being supplied is safe for consumption:

- Regular monitoring should be carried out 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.
- It is necessary to carry out a system assessment to determine whether the drinking-water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets identified targets. This also includes the assessment of design criteria of the treatment systems employed.
- Identifying control measures in a drinking-water system that will collectively control identified risks and ensure that the health-based targets are met. For each control measure identified, an appropriate means of operational monitoring should be defined that will ensure that any deviation from required performance (water quality) is rapidly detected in a timely manner.
- Management and communication plan should be formulated describing actions to be taken during normal operation as well as during incident conditions (such as drinking water contamination) and documenting the same.

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 23A** as follows:

Frequency of monitoring: weekly

Table 23A: 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 23B**. 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 22B: Discharge norms (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 3 and 4** as follows:

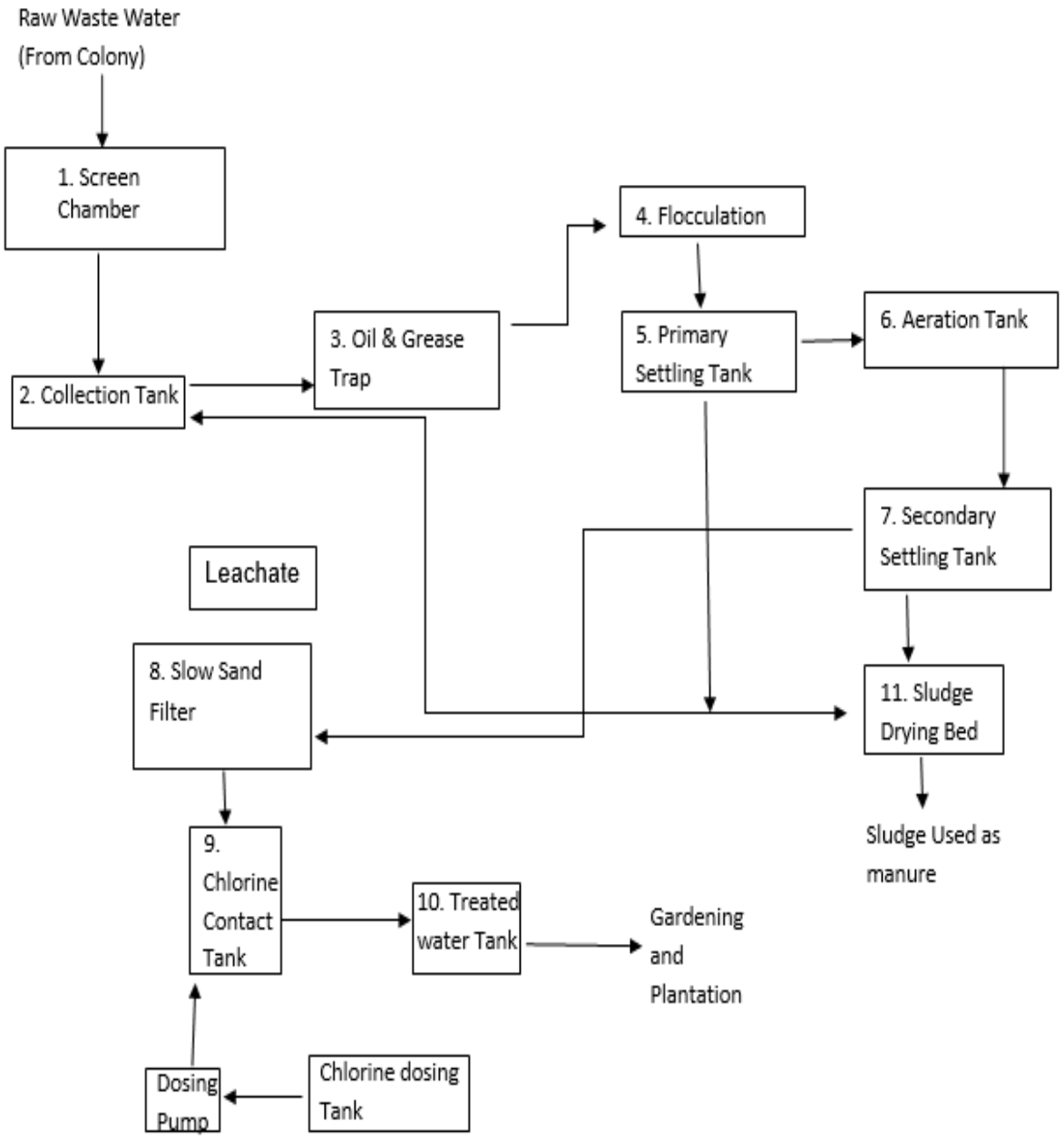


Figure 3: Process flow diagram of STP at Kandla

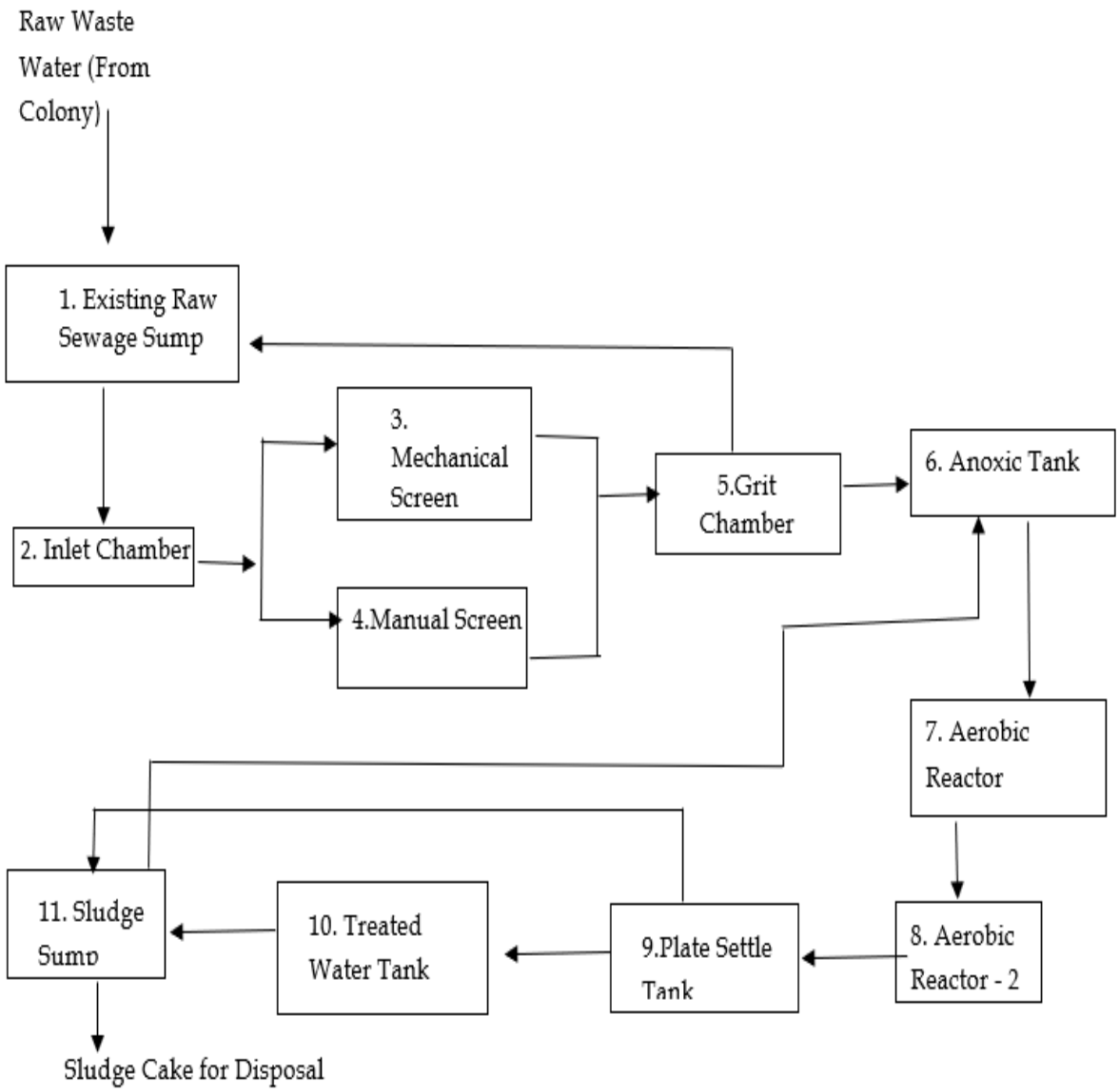


Figure 4: Process flow diagram of STP at Gopalpuri, Kandla

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 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 23: 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

Sr. No.	Parameters	Prescribed limits
5.	COD	50 mg/L

The detailed process flow diagram of the Vadinar STP have been mentioned in **Figure 5** as follows:

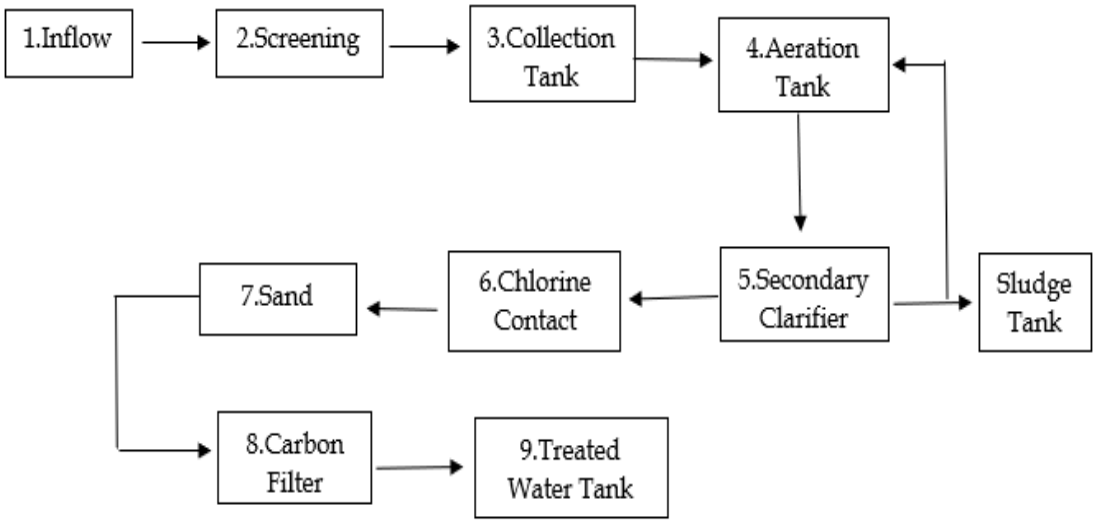
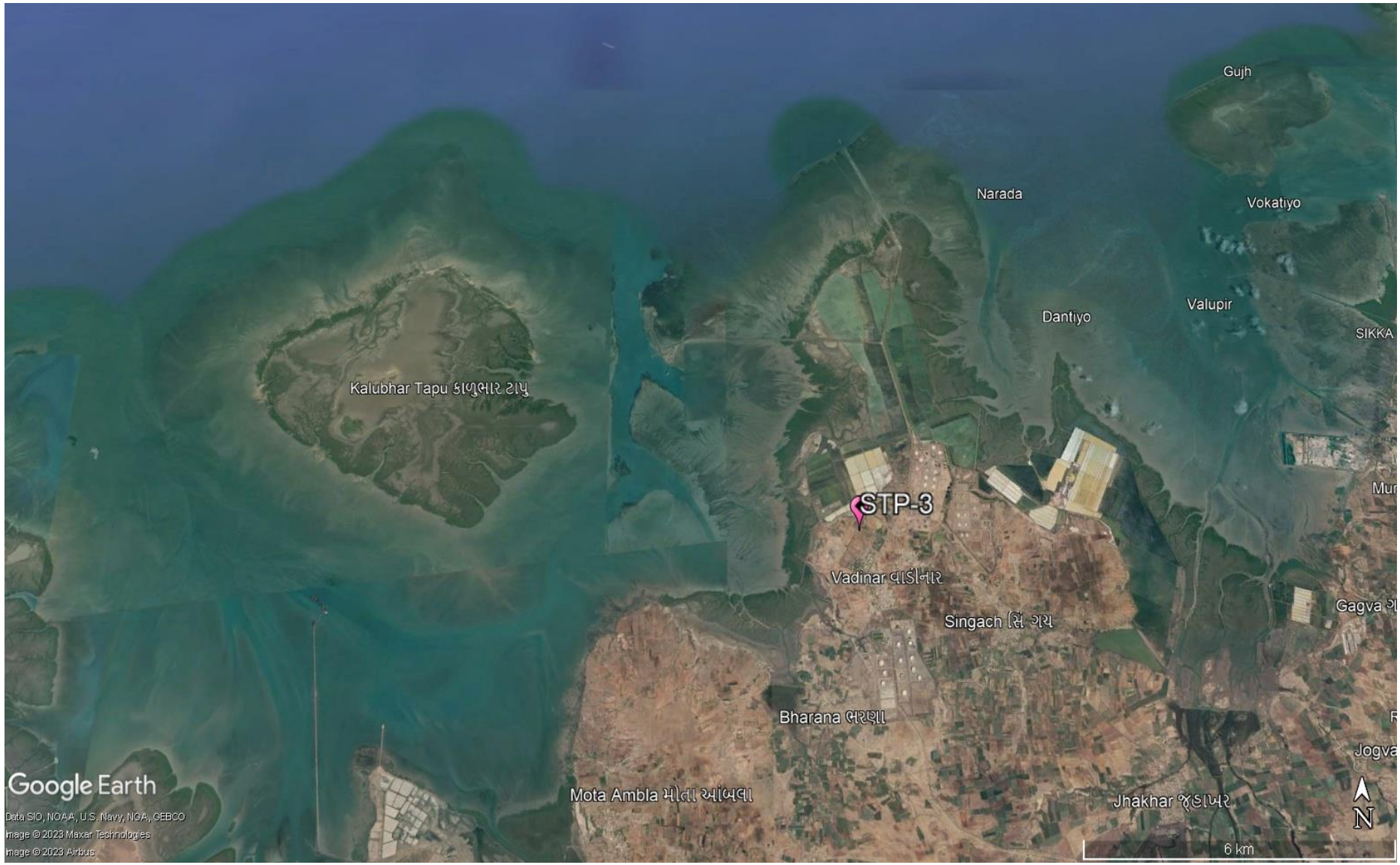


Figure 5: Process flowchart for the STP at Vadinar

The map depicting the locations of STP to be monitored in Kandla and Vadinar have been shown in **Map 14 and 15** as follows:

Map 14: STP Monitoring Locations at Kandla



Map 15: STP Monitoring Locations 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:

Monitoring 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. Sample Collected from this location during the monitoring period April 2023 to March 2024.

Table 24: List of parameters monitored for STP's at Kandla and Vadinar

Sr. No.	Parameters	Units	Reference method	Instruments
1.	pH	-	APHA, 23rd edition, 4500- H^+ B, 2017	pH Meter
2.	TDS	mg/L	APHA, 23rd Edition, 2540 C: 2017	Vacuum Pump with filtration assembly and Oven
3.	TSS	mg/L		
4.	DO	mg/L	APHA, 23rd Edition, 4500 C: 2017	Titration Apparatus
5.	COD	mg/L	APHA, 23rd 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

Analytical results of the STP samples collected from the inlet and the outlet of the STP's of Kandla and Vadinar have been summarized in **Table 26**. Further it was compared with the standard norms specified in the CC&A of the respective STPs.

Table 25: Water Quality of inlet and outlet of STP of Kandla

Sr No.	Parameter	Units	Kandla						Vadinar			
			GPCB Norms (Kandla)	STP-1			STP-2			GPCB Norms (Vadinar)	STP-3		
				Inlet	Outlet		Inlet	Outlet			Inlet	Outlet	
				Avg	Avg	Max	Avg	Avg	Max		Avg	Avg	Max
1.	pH	-	**6.5-8.5**	7.17	7.302	7.65	6.99	7.48	8.88	**5.5-9**	7.19	7.41	8.46
2.	TDS	mg/L	-	3065.7	2069.28	6228	1099.40	1003.3	1814	-	471.61	402.67	482
3.	TSS	mg/L	**100**	183.4	20.97	88	115.17	16.45	46	**20**	38.78	8.42	36
4.	COD	mg/L	-	184.7	32.57	133.1	213.54	25.98	88.4	**50**	138.27	16.18	40.2
5.	DO	mg/L	-	145.91	37.780	277.09	162.29	21.98	76.92	-	115.12	18.69	54.5
6.	BOD	mg/L	**30**	56.82	11.937	52.4	61.75	8.40	18.45	**10**	44.62	6.053	11
7.	SAR	meq/L	-	12.06	9.318	21.04	5.75	5.43	13.1	-	2.71	2.12	3.2
8.	Total Coliforms	MPN/ 100ml	**<1000**	1565.95	1530.66	1600	1537.02	1500.51	1600	**100-230**	1551	1492.3	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 average pH at the inlet of STP-1, STP-2, and STP-3 is, respectively, **7.17, 6.99, and 7.19**. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum pH of **7.65, 8.88, and 8.46** and an average pH of **7.302, 7.48, and 7.41**, respectively. Which conform to their respective stipulated norms of 6.5–8.5 at Kandla and 5.5–9 at Vadinar, respectively.
- The average TDS concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **3065.8, 1099.4, and 471.33** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TDS concentration of **6228, 1814, and 482** mg/L, and an average TDS concentration of **2069.3, 1003.3, and 402.67** mg/L, respectively.
- The average TSS at the inlet of STP-1, STP-2, and STP-3 is respectively **183.43, 115.17, and 38.78** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TSS of **88, 46**, and **36** mg/L, and an average TSS of **20.974, 16.452, and 8.41** mg/L, respectively. Which conform to their respective stipulated norms of 100 mg/L at Kandla and 20 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average COD at the inlet of STP-1, STP-2, and STP-3 is respectively **184.7, 213.54, and 138.27** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had maximum COD concentrations of **133.1, 88.4, and 40.2** mg/L, and average COD concentrations of **32.576, 25.97, and 16.18** mg/L, respectively. There are no discharge norms for the COD parameter in STP-1 and STP-2 at Kandla, and they conform to their respective stipulated norms of 50 mg/L at Vadinar as mentioned in their respective CCA.
- The average DO concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **145.91, 162.29, and 115.12** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum DO concentration of **277.09, 76.92, and 54.5** mg/L, and an average DO concentration of **37.78, 21.98, and 18.68,** mg/L respectively.
- The average BOD at the inlet of STP-1, STP-2, and STP-3 is respectively **56.82, 61.76, and 44.62** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum BOD of **52.4, 18.45, and 11** mg/L, and an average BOD of **11.93, 8.40, and 6.05** mg/L, respectively. Which conform to their respective stipulated norms of 30 mg/L at Kandla and 10 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average SAR concentrations at the inlet of STP-1, STP-2 and STP-3 are respectively **12.068**, **5.75** and **2.71** meq/L**.** After treatment, the treated effluent from

STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) having maximum SAR concentration **21.04**, **13.1** and **3.2** meq/L, and having Average SAR concentration **9.31**, **5.46** and **2.12** meq/L respectively.

- The **Total Coliforms** was observed to exceed the norms at the locations of the STP-1 & STP-2 for the treated effluent at Kandla and STP-3 at 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 as specified under the 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 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/H_2O_2 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.

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 27:**

Table 26: Details of the sampling locations for Marine water

Sr. No.	Location Code		Location Name	Latitude Longitude
1.	Kandla	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.	Vadinar	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 16 and 17** as follows:

Map 16: Marine Water Monitoring Locations at Kandla

Map 17: Marine Water Monitoring Locations 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 28** along with the analysis method and instrument.

Monitoring 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). For the period April 2023 to March 2024.

Table 27: List of parameters monitored for Marine Water

Sr. No	Parameters	Units	Reference method	Instrument
1.	Electrical Conductivity	µS/cm	APHA, 23rd Edition (Section-2510 B):2017	Conductivity Meter
2.	Dissolved Oxygen (DO)	mg/L	APHA, 23rd Edition, 4500 O C, 2017	Titration Apparatus
3.	pH	-	APHA, 23rd Edition (Section-4500-H+B):2017	pH meter
4.	Color	Hazen	APHA, 23rd 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, 23rd Edition (Section-2540 C):2017	Vaccum Pump with Filtration Assembly and Oven
8.	Total Suspended Solids (TSS)	mg/L	APHA, 23rd Edition, 2540 D: 2017	
9.	Particulate Organic Carbon	mg/L	APHA, 23rd 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, 23rd Edition, 4500 C, 2017	UV- Visible Spectrophotometer
13.	Phosphate	mg/L	APHA, 23rd Edition, 4500 P-D: 2017	
14.	Sulphate	mg/L	APHA, 23rd Edition, 4500 SO4-2 E: 2017	
15.	Nitrate	mg/L	APHA, 23rd Edition, 4500 NO3-B: 2017	
16.	Nitrite	mg/L	APHA, 23rd Edition, 4500 NO2- B: 2017	
17.	Sodium	mg/L	APHA, 23rd Edition, 3500 Na-B: 2017	Flame photometer

Sr. No	Parameters	Units	Reference method	Instrument
18.	Potassium	mg/L	APHA, 23rd Edition, 3500 K-B: 2017	
19.	Manganese	µg/L	APHA, 23rd Edition, ICP Method 3120 B: 2017	ICP-OES
20.	Iron	mg/L	APHA, 23rd Edition, ICP Method 3120 B: 2017	
21.	Total Chromium	µg/L	APHA, 23rd Edition, 3500 Cr B: 2017	
22.	Hexavalent Chromium	µg/L		UV- Visible Spectrophotometer
23.	Copper	µg/L	APHA, 23rd 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, 23rd 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 29**. The said water quality has been represented in comparison with the standard values as stipulated by CPCB for Class SW-IV Waters.

Table 28: Results of Analysis of Marine Water Sample for the sampling period

Parameters	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		
		Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Density (kg/m³)	-	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.021	1.02	1.02	1.02	1.02	1.02	1.02
pH	6.5-9.0	6.12	8.32	7.89	7.04	8.36	7.99	7.83	8.33	8.11	7.69	8.31	8.05	7.19	8.48	8.03	6.01	8.31	7.94	7.98	8.2	8.11	7.07	8.22	8.06
Colour (Hazen)	No Noticeable	1	10	5.41	1	20	7.83	1	15	7.16	5	20	9	5	15	7.41	5	20	8.27	1	10	5.66	1	10	5.08
EC (µS/ cm)	-	49700	63600	54282.5	49800	61700	54490.91	50200	60600	53767.75	50400	75300	55689.91	50100	65100	55115.58	15950	61528	50873.17	52200	56900	54239.2	52.119	57500	50312.6
Turbidity (NTU)	-	56.4	310	188.26	33.9	314	206.76	61.8	317	203.81	69	300	216.66	94.5	379	202.5	70.1	346	209.23	3.15	12.5	5.36	3.42	13.8	6.39
TDS (mg/L)	-	24800	44466	36356.3	24900	41922	36679.5	25100	41624	35690.92	25200	64721	38189.5	25000	47159	36938.58	9970	41436	32927.91	25784	38620	35400.16	26882	41790	35965.75
TSS (mg/L)	-	44	436	342.42	26	563	374.58	52	478	340.75	58	924	402.33	80	682	427.66	58	852	387.72	78	341	255.08	151	346	282.33
COD (mg/L)	-	29.2	79.37	49.62	11.98	79.37	47.81	25.41	81	47.68	22.65	81	52.12	31.56	79.37	53.76	22.97	88.8	49.34	21.28	75	50.98	17.92	75	47.63
DO (mg/L)	3.0 mg/L	4.7	6.4	5.76	5.3	6.4	6.07	4.5	6.7	5.87	3.4	6.5	5.85	5	6.6	6.07	5.6	8.4	6.49	4.3	7.6	6.25	4.4	7.9	6.48
BOD (mg/L)	5.0 mg/L	5.24	8.54	7.56	8.4	8.9	8.57	3.74	8.45	6.81	5	8.78	7.755	9.32	9.87	9.57	3.6	11.1	8.64	3.91	7.5	6.51	4.2	7.16	6.16
Oil & Grease (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphate (mg/L)	-	2056	2937.5	2529.7	2156.32	2897.7	2544.18	2083.7	2925.2	2530.85	2239	3704.9	2879.88	2334.9	2916.8	2652.42	632.62	3612.8	2561.07	1846.3	3225.8	2472.195	2039.9	3236.8	2664.27
Nitrate (mg/L)	-	1.89	5.40	4.28	1.12	5.16	3.75	3.21	5.68	4.17	3.41	5.85	4.64	3.17	6.92	4.21	3.06	6.84	4.06	2.225	5.17	3.56	1.759	5.1	3.39
Nitrite (mg/L)	-	0.12	0.12	0.12	0	0	0	0	0	0	0	0	0	0.11	0.11	0.11	0.13	0.16	0.14	0	0	0	0	0	0!
Phosphate (mg/L)		0.25	1.59	0.82	0.09	1.34	0.69	0.57	1.46	0.96	0.61	2.01	0.92	0.29	1.34	0.76	0.54	1.61	0.81	0.64	0.94	0.79	1.43	1.43	1.43
Silica (mg/L)	-	0.29	3.24	2.12	0.22	4.04	2.24	0.2	3.73	2.19	1.12	3.69	2.54	1.26	4	2.64	0.33	3.74	1.92	0.11	0.96	0.56	0.09	1.86	0.76
Sodium (mg/L)	-	7686	10625	9475.57	7811	10341	9242.42	7763	10308	9347.33	9101	10323	9724.14	8789	10278	9403.67	2086	10722	8042.71	2149.6	9485	6743.97	2349.4	9542	7244.66
Potassium (mg/L)	-	68.35	451.9	318.57	69.27	446.5	303.94	68.57	421	290.60	71.73	543.96	342.71	69.63	423.34	324.92	68.34	442.63	272.9	10.86	421.7	259.6	76.31	518	327.43
Hexavalent Chromium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	321	321	321	333	333	333
Odour	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	-	5.13	5.13	5.13	5.25	5.25	5.25	5.4	5.4	5.4	0	0	0	0	0	0	9.44	12.94	11.19	0.11	1	0.41	0.08	1	0.38
Cadmium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper (mg/L)	-	5.1	6.99	5.8175	0.006	10.9	5.79	0.005	7.7	3.85	5.34	12.01	8.224	0.0067	7.6	5.13	8.07	10.2	9.49	3.4	3.4	3.4	0	0	0
Iron (mg/L)	-	0.69	4.11	1.38	0.21	4.07	1.76	0.37	3.92	1.79	1.02	7.93	2.49	0.98	5.45	2.09	0.43	5.3	2.005	0.01	0.25	0.145	0.08	0.66	0.21
Lead (mg/L)	-	0.002	3.44	2.067	0.0029	3.44	2.29	0.0026	3.06	1.98	0.002	9.68	4.32	0.002	4.65	2.39	0.0029	3.65	2.47	0.0023	2.26	1.035	0.002	2.75	0.96
Manganese (mg/L)	-	0.082	129.91	71.47	0.12	159.78	83.88	0.1085	125.66	74.0	0.096	294.91	93.56	0.074	213.14	74.7	0.11	156.41	80.27	2.39	113.93	39.62	1.97	98.8	34.64
Total Chromium (mg/L)	-	0	0	0	5.62	7.8	6.71	5.67	5.67	5.67	5.14	15.99	12.28	5.11	9.65	7.207	0	0	0	0	0	0	45.75	45.75	45.75
Zinc (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Particulate Organic	-	0.51	900	76.22	0.51	35	3.98	0.42	10	1.94	0.58	55	6.03	0.92	30	3.89	0.85	44	5.01	0.47	4.67	1.62	0.32	4.76	1.51

Parameters	Primary	Kandla																		Vadinar					
Carbon (mg/L)																									
Total Coliform* (MPN/ 100ml)	500/100 ml	0.32	1600	159.61	0.16	120	29.76	0.56	108	31.55	0.25	47	14.02	0.35	170	37.19	0.29	50	21.86	0.36	240	39.76	0.39	240	35.28
Floating Material (Oil grease scum, petroleum products) (mg/L)	10 mg/L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	23	23

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:

- **Density** at Kandla was observed in the range of **1.02 to 1.03 kg/m³**, with the average of **1.022 kg/m³.** Whereas for the location of Vadinar, it was observed in the range of **1.021 to 1.026 kg/m³**, with the average of **1.022 kg/m³**.
- **pH** at Kandla was observed in the range of **6.01 to 8.48**, with the average pH as **7.78**. Whereas for the locations of Vadinar, it was observed in the range of be **7.07** to **8.22**, with the average pH as **7.94**. For the monitoring location of both the study areas, pH was found to comply with the norms of 6.5-8.5.
- **Color** range varied from **1 to 20 Hazen** at all the monitoring locations in Kandla, and for Vadinar, it varied from **1 to 10 Hazen**.
- **Electrical conductivity (EC)** was observed in the range of **15,950 to 75,300 µS/cm**, with the average EC as **54,344.32** µS/cm for the locations of Kandla, whereas for the locations of Vadinar, it was observed in the range of **52,199 to 57,500 µS/cm**, with the average EC as **45,200.67** µS/cm.
- For all monitoring locations of Kandla the value of **Turbidity** was observed in the range of **33.9 to 379 NTU**, with average value of **198.83** NTU. For Vadinar it ranges from **3.15 to 13.8 NTU**, with average of **7.43** 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.
- For the monitoring locations at Kandla the value of **Total Dissolved Solids (TDS)** ranged from **9,970 to 64,721 mg/L**, with an average value of **35,171** mg/L. Similarly, at Vadinar, the TDS values ranged from **25,784 to 41,790 mg/L**, with an average value of **34,073** mg/L.

- **TSS** values in the studied area varied between **26 to 924 mg/L** at Kandla and **78 to 346 mg/L** at Vadinar, with the average value of **362.69** mg/L and **242.23** mg/L respectively for Kandla and Vadinar.
- **COD** varied between **11.98 to 88.8 mg/L** at Kandla and **17.92 to 75 mg/L** at Vadinar, with the average value as **51.83** mg/L and **47.86** mg/L respectively for Kandla and Vadinar.
- **DO** level in the studied area varied between **3.4 to 8.4 mg/L** at Kandla and **4.3 to 7.9 mg/L** at Vadinar, with the average value of **5.86** mg/L and **6.15** mg/L respectively for Kandla and Vadinar. Which represents that the marine water is suitable for marine life.
- **BOD** observed was observed in the range of **3.6 to 11.1 mg/L**, with average of **7.76** mg/L for the location of Kandla and for the locations of Vadinar, it was observed in the range of **3.91 to 7.5 mg/L**, with an average value of **5.9** mg/L.
- **Sulphate** concentration in the studied area varied between **632.92 to 3704.9 mg/L** at Kandla and **1846.3 to 3236.8 mg/L** at Vadinar. The average value observed at Kandla was **2566.45** mg/L, whereas **2580.87** mg/L was the average value of Vadinar. Sulphate is naturally formed in inland waters by mineral weathering or the decomposition and combustion of organic matter.
- **Nitrate** in the study area was observed in the range of **1.12 to 6.92 mg/L**, with the average of **4.26** mg/L. Whereas for the Vadinar the concentration of Nitrate was observed in the range of **1.759 to 5.17** mg/L, with the average **3.53** mg/L.
- **Nitrite** in the study area was observed in the range of **0 to 0.16 mg/L**, with the average of **0.625** mg/L. Whereas for the Vadinar the concentration of Nitrite was observed Below Quantification Limit During whole monitoring period.
- **Phosphate** in the study area was observed in the range of **0.09 to 2.01 mg/L**, with the average of **0.92** mg/L. Whereas for the Vadinar the concentration of Phosphate was observed in the range of **0.64 to 1.43** mg/L, with the average **1.11** mg/L.
- **Silica** in the study area was observed in the range of **0.2 to 4.04 mg/L**, with the average of **2.19** mg/L. Whereas for the Vadinar the concentration of silica was observed in the range of **0.09 to 1.86** mg/L, with the average **0.724** mg/L.
- In the study area of Kandla the concentration of **Potassium** varied between **68.34 to 543.68 mg/L** and **10.86 to 518 mg/L** at Vadinar, with the average value as **277.71** mg/L and **268.99** mg/L respectively for Kandla and Vadinar.
- **Sodium** in the study area varied between **2,086 to 10,722 mg/L**, with average of **8948.26** mg/L, at Kandla whereas at Vadinar its value recorded within range of **2149.6 to 9542 mg/L,** with the average of **6252.43** mg/L.
- **Odour** was observed 1 for all locations of Kandla and Vadinar.
- **Arsenic** concentration observed to be BQL for majority of location for Kandla and Vadinar except locations MW-1, MW-2, MW-3, MW-6, MA-7 and MW-8 for some instant of time during whole monitoring period.
- **Copper** in the study area varied between **0.005 to 12.01 mg/L**, with average of **6.23** mg/L, at Kandla whereas at Vadinar its value recorded within range of **0 to 3.4 mg/L,**

with the average of **2.04** mg/L, on both project sites during monitoring majority of time Copper found Below Quantification Limit.

- **Iron** in the studied area varied between **0.21 to 7.93 mg/L**, with the average of **2.55** mg/L, at Kandla, and for Vadinar value were recorded within range of **0.01** to **0.66** mg/L, with average value of **0.22** mg/L.
- **Lead** concentration varied **0.002 to 9.68 mg/L**, with an average of **2.41** mg/L at Kandla. At Vadinar location within range of **0.002** to **2.753** mg/L with an average **1.17** mg/L
- **Manganese** in the studied area varied between **0.0748 to 294.91 mg/L**, with the average of **86.57** mg/L, at Kandla and for Vadinar, recorded value were observed within the range of **1.97** to **113.93 mg/L**, with the average of **48.56** mg/L.
- **Total Chromium** in the study area varied between **0 to 15.99 mg/L**, with average of **5.13** mg/L, at Kandla whereas at Vadinar its value recorded **45.76** mg/L at MW-8 in the monitoring period of January to February 2024**,** While on both project sites during monitoring majority of time Total Chromium found Below Quantification Limit
- **Particulate Organic Carbon** in the study area was observed in the range of **0.42 to 900**, with the average value of **65.27**. the maximum spike of 900 is only observed once in the period of April to May 2023 during whole monitoring period. Whereas for the Vadinar, the value observed was Within the range of **0.32** to **4.76**, with the average of **2.22**.
- **Oil & Grease, Nitrite, Phosphate, Hexavalent Chromium, Arsenic, Cadmium, Total Chromium, Zinc, Mercury and Floating Material (Oil grease scum, petroleum products)** were observed to have concentrations **"Below the Quantification Limits (BQL)"** for most of the locations of Kandla and Vadinar, majority of time during whole monitoring period.
- **Total Coliforms** were detected complying with the specified norm of 500 MPN/100ml for all the locations of Kandla and Vadinar, except on location MW-1 in the month of May to June 2023.

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 30** as follows:

Table 29: 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 **Map 18 and 19** as follows:

Map 18: Marine Sediment Monitoring Location at Kandla

Map 19: Marine Sediment Monitoring Locations at Vadinar

The list of parameters to be monitored under the projects for the Marine Sediment sampling been mentioned in **Table 31** as follows:

Table 30: 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.	Titration Apparatus
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 of April 2023 to March 2024 has been summarized in the **Table 32.**

Table 31: Summarized result of Marine Sediment Quality

Parameters	Kandla																		Vadinar					
	MS-1			MS-2			MS-3			MS-4			MS-5			MS-6			MS-7			MS-8		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Inorganic Phosphate (kg/ ha)	16.85	0.86	6.6042	14.37	0.67	8.81	41.2	0.8	16.98	19.44	0.81	9.532	45.1	0.72	14.48	34.6	0.66	15.24	14.5	1.24	5.65	18.51	0.82	5.7325
Phosphate (mg/Kg)	3247.8	290.8	1280.63	2514.7	258.3	1304	3736	226.6	1515	3871	353.7	1287	3741	306.8	1442	14076	578.3	2793.9	3002	152.5	770.24	3477.29	167.93	940.70
Organic Matter (%)	1.42	0.21	0.7875	2.17	0.29	1.13	1.01	0.17	0.593	2.1	0.33	0.975	1.24	0.67	0.911	2.06	0.21	0.915	2.29	0.15	1.04	1.65	0.17	0.89
Sulphate as SO^{4-} (mg/Kg)	905.25	110.2	366.8	1022.25	98.2	370.03	571.64	95.33	275.09	650.25	97.45	268.51	768	87.28	294.27	732	96.38	249.1	296	74.07	126.31	213.4	80.06	132.03
Calcium as Ca (mg/Kg)	13800	1612	3464.3	5800	1259	2836	4200	962	2163	4200	1102	2669	10500	1089	3102	3800	1047	2274.6	3700	2200	2930.9	3974.2	2100	2805.45
Magnesium as Mg (mg/Kg)	1952	1225	1538.53	3050	826.46	1810.84	2136	764	1592.59	3172	866.94	1810.6	2440	1032	1622.80	2745	906.98	1581.95	1952	854	1385.18	14640	1167	2920.83
Silica (g/Kg)	671.25	261.3	479.11	612.51	289.4	481.7	571.5	329.1	444.8	555.2	245.7	392.1	597.1	179.2	418.6	580.4	245.3	436.12	529.8	220.9	377.71	546.08	264.92	426.66
Nitrite (mg/Kg)	0.75	0.12	0.41	0.92	0.13	0.50	0.81	0.08	0.41	0.91	0.01	0.43	0.71	0.11	0.375	0.89	0.07	0.489	0.22	0.07	0.159	0.37	0.04	0.23
Nitrate (mg/Kg)	22.34	5.86	16.58	37.12	7.59	18.29	36.47	4.51	15.50	25.94	4.31	13.99	10.34	5.24	13.17	20.38	6.34	14.52	25.33	9.54	15.36	25.21	4.75	10.52
Sodium (mg/Kg)	7860	3194	4512.43	14688	2453	5318	8612	2072	4550	18308	2612	6435	10520	2063	4665	14076	2072	5639.6	11944	3971	7904.6	13660	2719.42	9536.63
Potassium (mg/Kg)	2610.7	241	1525.98	11580	276	2320	3479	260.7	2126	4208	294	2424	3152	205	1790	3479	236.9	2233.4	3372	699	1876.1	4377	1028	2025.66
Aluminium (mg/Kg)	8371.7	2116	3827.74	10641	1237.1	4465.9	10363.1	1278.5	4370.2	12008.4	1971.2	5025.2	10361.1	1264.58	3891.23	12314.1	1273.22	4384.20	14179.7	358.3	4028.56	19356.55	479.16	4883.52
Mercury (mg/Kg)	4.71	4.71	4.71	10.74	10.74	10.74	41.29	41.29	41.29	6.44	6.44	6.44	15.21	15.21	15.21	34.69	34.69	34.69	0	0	0	0	0	0
Texture	Sandy loam	Sandy loam	Silt loam	Sandy loam	Silt loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Loam	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 April 2023 to March 2024. The detailed interpretation of the parameters is given below:

- **Inorganic Phosphate** for the sampling period was observed in range of **0.66 to 45.12** Kg/ha for Kandla. Whereas for Vadinar the value observed Within range of **0.82** to **18.51** Kg/ha. For Kandla and Vadinar the average value of Inorganic Phosphate was observed **13.77** and **7.74** Kg/ha respectively.
- The concentration of **Phosphate** was observed in range of **226.6 to 3871.15 mg/Kg** for Kandla and for Vadinar the value observed within the range of **152.53** to **3477.29** mg/Kg. For Kandla and Vadinar the average concentration of Phosphate was observed **1616.78** and **1418.5** mg/Kg respectively.
- The **Organic Matter** for the sampling period was observed in the range of **0.17 to 2.17** % for Kandla with the average value of **0.95**% and for Vadinar the value recorded Within range of **0.15 to 2.29**%, with average concentration as **1.03 %.**
- The concentration of **Sulphate** was observed in the range of **87.28 to 1022 mg/Kg** for Kandla and for Vadinar the value observed Within range of **74.07** to **296** mg/Kg. For Kandla and Vadinar the average value of Sulphate was observed **392.10** and **153.64** mg/Kg respectively.
- The value of **Calcium** was observed in the range of **962 to 13800 mg/Kg** for Kandla and for Vadinar the value observed within the range of **2100** to **3974.5** mg/Kg. The average value of Calcium for the monitoring period was observed **3660.21** mg/Kg and **2951.76** mg/Kg at Kandla and Vadinar, respectively.
- The value of **Magnesium** for the sampling period was observed in the range of **764 to 3172 mg/Kg** for Kandla and for Vadinar the value observed Within the range of **854** to **1952** mg/Kg. For Kandla and Vadinar the average value of Magnesium was observed **1726**.35 mg/Kg and **1440.69** mg/Kg respectively.
- For the sampling period **Silica** was observed in the range of **179.25 to 671.25 mg/Kg** for Kandla with average value **432.83** mg/Kg and for Vadinar the value observed within the range of **220.98** and **546.5** mg/Kg with average **394.35** mg/Kg.
- The value of **Nitrate** was observed in the range of **4.31 to 37.12 mg/Kg** for Kandla with average value **15.47** mg/Kg and for Vadinar the value observed within the range of **4.75** to **25.33** mg/Kg. with average **15.12** mg/Kg.
- The value of **Nitrite** was observed in the range of **0.01 to 0.92 mg/Kg** for Kandla with average value **0.45** mg/Kg and for Vadinar the value observed to be within the range of **0.04** to **0.37** mg/Kg, with average **0.1828** mg/Kg.
- The value of **Sodium** was observed in the range of **2063.3 to 18308 mg/Kg** for Kandla with average value **6647.43** mg/Kg and for Vadinar the value observed within the range of **2719.42** and **13660** mg/Kg, with average **8289** mg/Kg.
- The value of **Potassium** was observed in the range of **205.08 to 11580 mg/Kg** for Kandla with average value **2357.95** mg/Kg and for Vadinar the value observed within range of **699.09** to **4377** mg/Kg, with average **2229.65** mg/Kg.

- The value of **Aluminium**, was observed in the range of **1237.13 to 12314.13 mg/Kg** for Kandla with average value **5509.23** mg/Kg and for Vadinar the value observed within the range of **358.3** to **19356** mg/Kg, with average **7214.30** mg/Kg.
- The value of **Mercury**, was observed in the range of **4.71 to 41.29 mg/Kg** for Kandla with average value **18.84** mg/Kg and for Vadinar the value of **Mercury** was observed "Below the Quantification Limit" at both two locations. During monitoring period majority of time Mercury was observed Below Quantification limit.
- Texture was observed to be "**Sandy Loam**" at location MS-1, MS-2, MS-4 and MS-6 "**Silt loam"** at location MS-3 & MS-5 in Kandla. "**Sandy Loam**" at location MS-7 & "**Silt loam"** at location MS-8 in Vadinar during sampling period.

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 33.**

Table 32: 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 33: Comparison of Heavy metals with Standard value in Marine Sediment

Parameters	Kandla																		Vadinar					
	MS-1			MS-2			MS-3			MS-4			MS-5			MS-6			MS-7			MS-8		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Arsenic (mg/Kg)	5.13	1.09	3.527	4.43	2.11	3.264	6.17	2.06	3.92	5.86	1.28	3.75	5.2	1.75	3.458	5.78	1.98	3.67	5.36	2.04	2.84	5.17	2.5	3.69
Copper (mg/Kg)	5.6	2.13	3.282	11.4	2.14	5.013	8.1	2.08	4.49	9.8	3.48	5.71	12	2.14	5.97	8.9	2.98	4.97	6.13	2.19	4.567	412	2.1	39.05
Chromium (mg/Kg)	64.1	42.12	53.94	67.45	32.74	47.04	73.02	32.41	48.31	83.23	41.08	55.17	59.95	41.87	51.50	104.2	36.71	59.71	59.27	23.18	44.01	104.1	29.7	61.12
Nickel (mg/Kg)	51.4	16.8	31.76	38.9	10.21	23.87	36.41	4.54	22.77	40.87	7.61	27.45	31.86	21.72	25.881	50.78	4.54	25.058	36.21	12.23	22.84	43.66	12.47	29.282
Lead (mg/Kg)	7.05	1.25	5.3	7.45	4.21	5.76	28.73	2.36	6.683	8.25	3.46	5.9	14.22	1.21	6.055	5.01	2.81	7.88	7.94	2.85	4.90	10.58	2.97	5.65
Zinc (mg/Kg)	63.2	35.88	54.63	65.69	32.11	50.455	301.32	23.63	69.545	82.9	18.15	50.86	159.42	19.54	60.65	157.82	23.63	57.7	52.13	11.47	34.6	104.87	13.65	53.8595
Cadmium (mg/Kg)	1.08	0.88	0.98	0.6	0.6	0.6	1.25	0.87	1.1	1.12	0.78	1.022	1.08	0.91	0.995	7.53	0.15	2.302	0	0	0	0	0	0

- **Arsenic** was observed in the range of **1.09 to 6.17 mg/Kg** for Kandla with average value **3.58** mg/Kg and for Vadinar the value observed within range of **2.04** to **5.36** mg/Kg, with average of **3.6** mg/Kg. during monitoring period majority of time arsenic concentration found within moderately polluted class on both study area.
- **Copper** was observed in the range of **2.08 to 12 mg/Kg** for Kandla with average value **5.6** mg/Kg and for Vadinar the value observed within the range of be **2.1** to **8.33** mg/Kg, with average **4.72** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to copper falls in non-polluted class.
- **Chromium** was observed in the range of **32.41 to 104.24 mg/Kg** for Kandla with average value **55.25** mg/Kg and for Vadinar the value observed within the range of **23.18** to **104.16** mg/Kg, with average **53.57** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to chromium falls majority of time in moderately polluted and for some instance it location MS-4, MS-6, and MS-8 fall in Heavily polluted class.
- **Nickel** was observed in the range of **4.54 to 51.47 mg/Kg** for Kandla with average value **26.25** mg/Kg and for Vadinar the value observed within range of **12.23** to **43.66** mg/Kg, with average **26.115** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to nickel falls in moderately polluted class and for some instance it location MS-1, and MS-6 fall in heavily polluted class.

- **Lead** was observed in the range of **1.21 to 28.73 mg/Kg** for Kandla with average value **5.63** mg/Kg and for Vadinar the value observed within the range of **2.85** and **10.58** mg/Kg, with average **5.81** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to lead falls in not polluted class.
- **Zinc** was observed in the range of **18.15 to 301.32 mg/Kg** for Kandla with average value **73.73** mg/Kg and for Vadinar the value observed within the range of **11.47** to **104.87** mg/Kg, with average **46.997** mg/Kg. With reference to the guidelines mentioned in table 35, the sediment quality with respect to zinc falls in non-polluted class and for some instance its location MS-1, MS-3, MS-6 and MS-8 fall in Moderately polluted class.
- **Cadmium** was observed in the range of **0.15 to 7.53 mg/Kg** for Kandla with average value **1.325** mg/Kg**.** During the monitoring period majority of time **Cadmium** found BQL, which falls in non-polluted. While exception on one location MS-6 fall within moderately polluted for the duration of July to August 2023. **Cadmium** was observed BQL for all locations at Vadinar during sampling period. With reference to the guidelines mentioned in table 35, the sediment quality with respect to cadmium falls in non-polluted class.

Analysis of the sediments indicates moderate 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.

The presence of anthropic activity in the coastal areas has an effect upon the marine water and sediment. One of the primary risks associated with contaminated sediments is bioaccumulation in benthic organisms, which is a route of entry into the food chain. Generally adopted sediment remediation approaches include dredging, capping of contaminated areas, and monitored natural recovery (MNR). Dredging can remove contaminated sediments, but it requires large areas of land for sediment disposal. It is expensive and may cause secondary contamination of the water column during re-suspension. MNR relies on ongoing naturally occurring processes to decrease the bioavailability or toxicity of contaminants in sediment. These processes may include physical, biological, and chemical mechanisms that act together to reduce the environmental risks posed by contaminated sediments. MNR require longer monitoring time and can be even more expensive than for dredging and capping. Capping consists of in situ covering of clean or suitable isolating material over contaminated sediments layer to limit leaching of contaminants, and to minimize their re-suspension and transport. Hence appropriate remedial measures for the polluted sediment sites may be implemented, to reduce the concentration of the heavy metals.

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 35** as follows:

Table 34: Details of the sampling locations for Marine Ecological

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

The map depicting the locations of Marine Ecological monitoring in Kandla and Vadinar have been mentioned in **Map 20 and 21** as follows:

Map 20 Marine Ecological Monitoring: Locations at Kandla

Map 21: Marine Ecological Monitoring Locations at Vadinar

The various parameters to be monitored under the study for Marine Ecological Monitoring are mentioned in **Table 36** as follows:

Table 35: 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, ∑ = Summation symbol,

pi = 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:

$$D = 1 - \sum (p_i \hat{} 2)$$

Where, ∑ = Summation symbol, pi = 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:

$$D_{Mg} = \frac{S-1}{lnN}$$

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:

$$d = \frac{N_{max}}{\mathrm{N}_i}$$

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.

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

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.

Monitoring Frequency:

Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar. Sample Collected from this location during the monitoring period April 2023 to March 2024.

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 37.**

Table 36: Values of Biomass, Net Primary Productivity (NPP), Gross Primary Productivity (GPP), Pheophytin and Chlorophyll for Kandla and Vadinar

Sr. No.	Parameters	Kandla						Vadinar	
		ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
		Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
1.	Biomass	115	115	96	142	102	121	78	111
2.	Net Primary Productivity	2.91	3.77	3.08	2.99	5.47	2.49	4.16	2.64
3.	Gross Primary Productivity	2.95	3.04	3.73	3.26	2.44	2.85	3.67	3.09
4.	Pheophytin	1.10	1.28	0.80	1.35	0.82	5.81	2.66	2.43
5.	Chlorophyll-a	2.40	1.61	1.72	1.72	2.04	12.43	2.37	3.24
6.	Particulate Oxidisable Organic Carbon	1.34	1.12	1.18	1.51	1.45	1.40	1.26	1.20
7.	Secchi Depth	0.61	0.63	0.56	0.60	0.56	0.62	3.93	2.61

- **Biomass:**

  With reference to **Table 37**, the average concentration of biomass during the monitoring period, for locations ME-1 to ME-6 was reported within the range of **96–142** mg/L, with the lowest biomass present in **ME-3 (near coal berth)** and the highest biomass present in **ME-4 (Khori Creek)** during the sampling period. In Vadinar, the value of biomass was observed at **78** mg/L at ME-7 (near SPM) and **111** mg/L at 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. During the Monitoring Period, the monitoring location of Kandla reported GPP value in range between **2.44 to 3.73 mg/L/48 Hr** where the highest value recorded

for ME-3 (Near Coal Bearth) and lowest recorded at ME-5 (Nakti creek-near tuna port). In Vadinar, the value of **GPP** was observed **3.67** at ME-7 (Near SPM) and **3.09** mg/L/48 Hr at 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. During the monitoring period of 2023 to 2024 the Net primary productivity of the monitoring location at Kandla from (ME-1 to ME-6) has been estimated to be between **2.49 to 5.47 mg/L/48 Hr**. While in Vadinar, the value of **NPP** was observed **4.16** at ME-7 (Near SPM) and **2.64** mg/L/48 Hr at ME-8 (Near Vadinar Jetty) monitoring station.

- **Pheophytin**

  The level of Pheophytin was detected in the range from **0.8 to 5.81 mg/m^3** where the highest value observed at ME-6 (Nakti Creek (Near NH-8A)) and the lowest value observed at ME-3(Near Coral Breth), While in Vadinar, the value of Pheophytin was observed **2.66** mg/m^3 at ME-7 and **2.43** mg/m^3 at ME-8 monitoring station.

- **Chlorophyll-a**

  In the sub surface water, the value of Chlorophyll-a reported in range from **1.61 to 12.43 mg/m^3**. The highest value observed at ME-6 (Nakti Creek (Near NH-8A)), while the lowest value observed at ME-2 (Kandla Creek). In Vadinar, the value of chlorophyll-a was observed **2.37** mg/m^3 at ME-7 (Near SPM) and **3.24** mg/m^3 in ME-8 (Near Vadinar Jetty) monitoring station.

- **Particulate Oxidisable Organic Carbon**

  During the sampling period, the particulate oxidisable organic carbon falls within the range of **1.12 to 1.51 mg/L** from monitoring location ME-1 to ME-6 at Kandla, whereas for Vadinar, the value of POC observed **1.26** mg/L at ME-7 (Near SPM) and **1.20** mg/L in ME-8 (Near Vadinar Jetty) monitoring station.

- **Secchi Depth**

  In monitoring station of Kandla (ME-1 to ME-6) the level of Secchi Depth was observed between **0.56 to 0.63 ft** whereas at Vadinar, the value recorded at ME-7 i.e. Near SPM is **3.93** ft and in Near Vadinar Jetty is **2.61** 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.es. sampling locations (6 from Kandla and two from Vadinar).

The details of variation in abundance and diversity in phytoplankton communities is mentioned in **Table 38**.

Table 37: Phytoplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Bacillaria sp.	360	391	271	404	374	521	390	347
Biddulphia sp.	492	340	73	542	315	434	402	274
Chaetoceros sp.	279	379	316	258	627	322	462	394
Chlamydomonas sp.	286	312	147	329	478	456	325	503
Cyclotella sp.	367	443	284	418	454	609	303	378
Coscinodiscus sp.	455	412	290	206	330	376	370	244
Ditylum sp	342	322	124	241	225	205	227	294
Fragilaria sp.	395	381	336	300	355	0	350	360
Bacteriastrum sp.	178	96	52	166	111	252	162	252
Pleurosigma sp.	236	236	129	565	276	675	352	219
Navicula sp.	366	488	472	393	420	332	375	856
Nitzschia sp.	309	272	249	295	366	284	418	435
Synedra sp.	479	328	82	322	144	541	192	327
Skeletonema sp.	270	566	130	0	488	536	521	495
Oscillatoria sp.	341	351	176	251	493	423.5	144	306
Thallassiosira	147	134	64	132	170	224	235	161
Gomphonema sp.	550	495	128	360	600	310	564	500
Planktothrix sp.	140	302	123	411	393	495	272	353
Gyrosigma sp.	410	560	130	750	0	685	400	667
Actinestrum sp.	0	0	0	0	0	500	0	0
Cymbella	500	500	0	550	0	685	700	500
Limnothrix sp.	0	700	0	650	0	800	750	0
Scendesmus sp.	0	0	0	485	0	630	0	0
Mougeotia sp.	0	0	0	8	0	20	0	4
Chlorella sp.	0	0	0	0	0	850	0	0
Density-Units/L	3107.1	3525	3177.3	2918	3073	3704	3357	3576
No. of genera	**20**	**21**	**19**	**22**	**18**	**24**	**21**	**21**

The phytoplankton community of the sub surface water in the Kandla and Vadinar was represented by, Diatoms, green algae and filamentous Cynobacteria. Diatoms were

represented by 15 genera; green algae were represented by 1 genera and filamentous Cynobacteria were represented by 1 genera during the sampling period.

The density of phytoplankton of the sampling stations from ME-1 to ME-6 (Kandla) varying from **2918** to **3704** units/L, while for Vadinar its density of phytoplankton observed **3357** units/L at ME-7 and **3576** units/L at ME-8. During the sampling, all communities were contributing in phytoplankton on both location of Kandla & Vadinar except *Gyrosigma sp*, *Actinestrum sp*, *cymbella*, *Limnothrix sp*, *Scendesmus sp*, *Mougeotia sp* and *cholera sp*.

The details of Species richness Index and Diversity Index in Phytoplankton is mentioned in **Table 39**.

Table 38: Species richness Index and Diversity Index in Phytoplankton

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek- near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	13	14	13	14	13	15	14	13
Individuals	3099	3408	3202	2926	3094	3768	3357	3597
Shannon diversity	2.09	2.12	2.05	1.97	1.94	2.02	2.10	1.95
Simpson 1-D	0.86	0.86	0.85	0.83	0.83	0.84	0.86	0.80
Species Evenness	0.92	0.91	0.90	0.89	0.90	0.87	0.90	0.85
Margalef richness	1.03	1.09	1.02	1.00	0.93	1.01	1.07	1.01
Berger-Parker	0.20	0.21	0.22	0.24	0.25	0.24	0.22	0.28
Relative abundance	0.41	0.44	0.38	0.44	0.38	0.41	0.40	0.41

- **Shannon- Wiener's Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wierner's index of phytoplankton communities was in the range of **1.94 to 2.12** between selected sampling stations from ME-1 to ME-6. While for Vadinar, Average Shannon Wiener's index of phytoplankton communities recorded to be **2.10** at ME-7 and **1.95** at ME-8. 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):** During the monitoring period **2023 to 2024,** average Simpson diversity index (1-D) of phytoplankton communities was ranged between **0.83 to 0.86** at all sampling stations in the Kandla creek and nearby creeks. Similarly, for Vadinar average Simpson diversity index (1-D) of phytoplankton communities was **0.86** at ME-7 and **0.80** at ME-8.
- **Margalef's diversity index** (Species Richness): During the monitoring period **2023 to 2024,** average margalef's diversity index of phytoplankton communities in Kandla and nearby creeks sampling stations was varying from **0.93 to 1.09.** While for Vadinar, average Margalef's diversity index (Species Richness) of phytoplankton communities observed **1.07** at ME-7 and **1.01** at ME-8.

- **Berger-Parker Index (d):** During the monitoring period **2023 to 2024,** average Berger-Parker Index (d) of phytoplankton communities was in the range of **0.20 to 0.25** between selected sampling stations from ME-1 to ME-6. at Kandla creek and nearby creeks.

Average Berger-Parker Index (d) of phytoplankton communities in the sampling stations of Vadinar, was in the range of **0.22** to **0.28.** All the monitoring station signifies a low diversity with an even distribution among the different species.

- The Average **Species Evenness** is observed in the range of **0.87 to 0.92** for all the six-monitoring station of Kandla and for the Vadinar the average species evenness is observed in the range of **0.85** to **0.90**.

- During the sampling period, average **Relative Abundance** of phytoplankton communities was in range of **0.38 to 0.44** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative Abundance value **0.40** at ME-7 and **0.41** at ME-8. 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 40**.

Table 39: Zooplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Acartia sp.	2	2	2	2	2	2	3	2
Acrocalanus	2	2	2	2	2	2	2	4
Amoeba	3	2	3	3	4	2	3	2
Brachionus sp.	3	2	2	2	2	3	4	2
Calanus sp.	2	3	3	2	2	3	2	3
Cladocera sp.	2	3	5	2	3	2	3	3
Cyclopoid sp.	5	4	4	4	2	2	4	2
Copepod larvae	2	3	2	3	2	4	2	2
Diaptomus sp.	5	2	4	2	3	2	3	3
Eucalanus sp.	3	2	2	4	3	6	3	4
Mysis sp.	3	9	7	5	1	6	6	8
Oithona sp.	1	2	4	2	1	4	4	9
Paracalanus sp.	8	7	4	8	11	8	9	10
Density Unit/L	24.45	24.91	25.82	26.00	22.91	26.45	27.64	27.36
No. of genera	**13**	13	13	13	13	13	13	13

A total of 13 groups/taxa of zooplankton were recorded in Kandla and Vadinar during the study period which mainly constituted by *diaptomus*, *copepods*, *brachionus*, *cladocera*, fish and shrimp larval forms. *Amoeba* and *Cyclopoida* had the largest representation at all stations from (ME-1 to ME-8). The average density of Zooplankton of the sampling stations from ME-1 to ME-6 (Kandla) varying from **22.91** to **26.45** units/L, while for Vadinar its average density of zooplankton observed **27.64** units/L at ME-7 and **27.36** units/L at ME-8. During

the sampling, all communities were contributing in zooplankton except *Oithana sp.* in Kandla and Vadinar.

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

Table 40: Species richness Index and Diversity Index in Zooplankton

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	11	13	10	13	10	12	13	10
Individuals	24	57	26	26	23	26	28	27
Shannon diversity	1.77	1.74	1.76	1.79	1.67	1.76	1.79	1.72
Simpson (1-D)	0.79	0.75	0.79	0.79	0.76	0.77	0.79	0.77
Species Evenness	0.78	0.61	0.78	0.79	0.79	0.73	0.82	0.76
Margalef	2.15	2.21	2.07	2.21	2.06	2.34	2.22	2.16
Berger-Parker	0.34	0.42	0.32	0.34	0.35	0.37	0.31	0.35
Relative abundance	34.93	40.08	31.95	37.76	39.98	38.18	39.18	37.27

- **Shannon- Wiener's Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wierner's index of zooplankton communities was in the range of **1.67 to 1.79** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener's index of zooplankton communities recorded to be **1.79** at ME-7 and **1.72** at ME-8. 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):** During the monitoring period **2023 to 2024,** average Simpson diversity index (1-D) of zooplankton communities was ranged between **0.75 to 0.79** at all sampling stations in the Kandla creek and nearby creeks, for Vadinar average Simpson diversity index (1-D) of zooplankton communities was **0.79** at ME-7 and **0.77** at ME-8.
- **Margalef's diversity index** (Species Richness): During the monitoring period **2023 to 2024,** average margalef's diversity index of zooplankton communities in Kandla and nearby creeks sampling stations was varying from **2.06 to 2.34,** during the sampling period. While for Vadinar, average Margalef's diversity index (Species Richness) of zooplankton communities observed **2.2** at ME-7 and **2.16** at ME-8.

- **Berger-Parker Index (d):** During the monitoring period **2023 to 2024,** average Berger-Parker Index (d) of zooplankton communities was in the range of **0.32 to 0.42** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. Average Berger-Parker Index (d) of zooplankton communities in the sampling stations of Vadinar, was in the range of **0.31** to **0.35.** All the monitoring station signifies a low diversity with an even distribution among the different species.

- The average **Species Evenness** is observed in the range of **0.61 to 0.79** for all the six-monitoring station of Kandla whereas, for the Vadinar the average species evenness was observed in the range of **0.76** to **0.82**, during the monitoring period.

- During the sampling period, **average Relative Abundance** of zooplankton communities was in range of **31.95** to **40.08** between selected sampling stations from ME-1 to ME-6. at Kandla creek and nearby creeks. Whereas for Vadinar the average relative abundance value **39.18** at ME-7 and **37.27** at ME-8, 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 42.**

Table 41: Benthic Fauna variations in abundance and diversity in sub surface sampling

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Thiaridae	2	1	2	2	2	2	1	3
Mollusca sp.	2	1	2	2	3	2	2	3
Odonata sp.	2	1	2	3	2	2	2	3
Lymnidae	2	1	5	2	2	2	3	2
Planorbidae	1	1	2	1	2	2	2	1
Atydae	2	1	2	2	1	2	2	2
Gammaridae	2	1	1	2	1	2	2	3
Portunidae	1	1	1	1	0	1	1	1
Turbinidae	2	1	3	1	1	2	2	2
Palaemonidae	1	1	2	3	3	1	2	2
Diapatra sp.	2	1	3	4	2	4	2	3
Coleoptera sp.	2	1	3	3	0	1	3	2
Crustacea sp.	3	1	3	3	3	3	2	1
Hemiptera sp.	2	1	0	2	2	2	3	2
Tricoptera sp.	2	1	3	4	3	5	2	1
Hydrobidae	1	1	1	2	1	3	0	3
Viviparidae	3	1	0	1	2	2	3	3
Neridae	2	1	2	0	4	2	1	2
Density-m^3	10.18	8.82	9.64	10.09	8.5	9.73	9.73	9.55
No of genera	**18**	**18**	**16**	5.00	**16**	**18**	**17**	**18**

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 *Atyde, Palaemonidae, Mollusca sp.*, etc. The average density of benthic fauna was varying from **8.55** to **10.18** m^3.

The details of Species richness Index and Diversity Index in Benthic Organisms is mentioned in **Table 43.**

Table 42: Species richness Index and Diversity Index in Benthic Organisms

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek- near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg.	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	6	7	6	6	7	6	6	6
Individuals	10	9	10	10	9	10	9	10
Shannon diversity	1.55	1.42	1.47	1.50	1.43	1.48	1.43	1.43
Simpson 1-D	0.76	0.73	0.75	0.75	0.73	0.75	0.73	0.74
Species Evenness	0.89	0.89	0.92	0.92	0.90	0.91	0.90	0.89
Margalef	1.92	1.77	1.73	1.81	1.83	1.79	1.76	1.68
Berger-Parker	0.33	0.37	0.33	0.34	0.37	0.34	0.38	0.36
Relative abundance	55.92	57.66	53.67	56.55	60.63	56.18	57.46	51.58

- **Shannon- Wiener's Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wierner's index of benthic organism was in the range of **1.42 to 1.55** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener's index of benthic organism recorded to be **1.43** at ME-7 and ME-8. 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):** During the monitoring period **2023 to 2024,** average Simpson diversity index (1-D) of benthic organism was ranged between **0.73 to 0.76** at all sampling stations in the Kandla creek and nearby creeks, Similarly, for Vadinar average Simpson diversity index (1-D) of benthic organism was **0.73** at ME-7 and **0.74** at ME-8.

- **Margalef's diversity index** (Species Richness): During the monitoring period **2023 to 2024,** average margalef's diversity index of benthic organism in Kandla and nearby creeks sampling stations was varying from **1.73 to 1.92**. While for Vadinar, average Margalef's diversity index (Species Richness) of benthic organism observed to be **1.76** at ME-7 and **1.68** at ME-8.

- **Berger-Parker Index (d):** During the monitoring period **2023 to 2024,** average Berger-Parker Index (d) of benthic organism was in the range of **0.33 to 0.37** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. average Berger-Parker Index (d) of benthic organism in the sampling stations of Vadinar, was in the range of **0.36** to **0.38**. All the monitoring station signifies a low diversity with an even distribution among the different species.

- The average **Species Evenness** is observed in the range of **0.89 to 0.92** for all the six-monitoring station of Kandla and for the Vadinar the species evenness is observed in the range of **0.89** to **0.90.**

- During the sampling period, **average Relative Abundance** of Benthic organisms was in range of **53.67 to 60.63** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative abundance value **57.46** at ME-7 and **51.58** at ME-8, thus it is concluded that the studied species can be stated as neither highly dominant nor rare.

CHAPTER 13: SUMMARY AND CONCLUSION

13.1 Summary and Conclusion

The report, prepared by the Gujarat Environment Management Institute (GEMI), details the environmental monitoring and management plan for the Deendayal Port Authority (DPA) at Kandla and Vadinar. The monitoring covers the period from April 2023 to March 2024.

The primary objective is to systematically assess and monitor environmental parameters including ambient air, water (drinking and surface), soil, sediment, noise, and ecology to ensure compliance with environmental standards and statutory norms.

Methodology

Environmental monitoring was conducted using standard operating procedures, protocols, and guidelines to ensure accurate data collection. Various parameters were measured, including air quality, water quality, soil characteristics, noise levels, and meteorological data.

Based on the results obtained for both study areas, Kandla and Vadinar, during the monitoring period from April 2023 to March 2024, the following observations are concluded.

- **Ambient Air Quality Monitoring**
  Particulate matter (PM_{10} and $PM_{2.5}$) levels exceeded the national ambient air quality standards (NAAQS) at most monitoring locations, especially at the coal storage area. The high particulate matter levels were attributed to heavy vehicular traffic, loading/unloading of cargo, and dust from unpaved roads. For Gaseous monitoring, sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) were generally within the NAAQS limits.
  The noise level was within the permissible limits for the industrial, commercial, and residential zones for daytime and nighttime.

- **DG Stack Monitoring**
  Monitoring of the diesel generator (DG) stacks was conducted at one location each in Kandla and Vadinar. Parameters like suspended particulate matter, SO_2, NO_x, CO, and CO_2 were measured and found to be within the prescribed emission limits.

- **Soil Monitoring**
  The pH in Kandla varies from slightly alkaline to strongly alkaline, while the soil at Vadinar was found to be moderately alkaline. The soil texture was observed as “sandy loam” to “loamy sand” at all the monitoring locations in Kandla, and the soil texture of Vadinar varies from “loam” to “slit loam. Kandla displays higher salinity and nutrient levels, while Vadinar exhibits lower nutrient levels. Vadinar generally shows moderate conditions with higher water holding capacity and more consistent soil composition. The presence of heavy metals such as aluminium, chromium, nickel, copper, zinc, lead, arsenic, and cadmium vary considerably at both study area.

- **STP Monitoring**
  After the effluent treatment in both the study areas, the treated water followed the GPCB discharge norms except for total coliform.

- **Drinking Water Quality Monitoring**
  Drinking water samples were collected from 20 locations across Kandla and Vadinar. Most water quality parameters like pH, color, turbidity, chloride, and total hardness were within the drinking water standards (IS 10500:2012). A few locations showed slightly elevated levels of electrical conductivity, salinity, and total dissolved solids, likely due to the coastal location.

- **Marine Water and Sediment Quality Monitoring**
  Marine water and sediment samples were collected from 6 locations in Kandla and 2 locations in Vadinar. The water quality parameters like pH, salinity, dissolved oxygen, and nutrients were within the acceptable limits for coastal waters. The sediment quality in terms of heavy metals and organic contaminants was also found to be within the prescribed standards.

- **Marine Ecology Monitoring**
  Monitoring of marine ecology was conducted at 6 locations in Kandla and 2 locations in Vadinar. The analysis indicates that both regions exhibit low diversity with an even distribution among species, as evidenced by the Berger-Parker Index and Simpson Diversity Index values. These indices suggest a stable ecosystem where no single species overwhelmingly dominates, nor are any species exceedingly rare. The even distribution of species, coupled with moderate levels of biomass and primary productivity, highlights the resilience of these ecosystems.

Overall, the report concludes that the environmental monitoring conducted by the DPA during the period of April 2023 to March 2024 indicates compliance with the applicable environmental regulations, with some exceptions related to particulate matter levels in the ambient air.

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

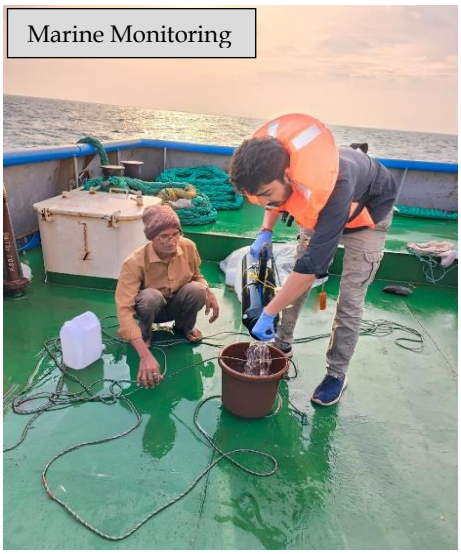
Air Monitoring

Noise Monitoring

STP Monitoring

Drinking water Monitoring

Marine Monitoring



Soil Monitoring

Source: GEMI

CHAPTER 14: REFERENCES

References:

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(2) Ambient Air Quality Standards in respect of Noise,2000.

(3) American Public Health Association 23rd Addition, Standard Methods for Water and Waste water analysis, 2017.s

(4) Indian Standard DRINKING WATER — SPECIFICATION (Second Revision), 2012.

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"We Provide Environmental Solutions"

MARINE DEPARTMENT
(ACCOUT SECTION)

Annexure C

Sub :- Annual return statement showing the collection and disposal of Hazardous and Non Hazardous Wastes carried out by various parties for the year 04/2023 to 03/2024.

With reference to the above subject, the annual return showing the collection and Disposal of Hazardous and Non Hazardous Wastes carried out by various parties for the period 01.04.2023 to 31.03.2024 of Marine department is enclosed herewith.

Encl : AS above

Dy. Conservator
Deendayal Port Authority

EMC (I/C)
NO: MR/WK/1316/282

Dt. 21.06.2024

Deendayal Port Authority
Marine Department

Statement of Hazardous and Non hazardous Waste disposal from the Vessels at Kandla Port for the Period April 2023 to March 2024 – For the Whole Port Area

(PCB ID 28494)

Sr.No.	Month	Year	Hazardous Waste Generation in MT			Solid Waste Generated in MT
			Total Quantity	Used Oil	Waste Residue Containing Oil	
1.	April	2023	484.45	121.11	363.34	169.57
2.	May	2023	1065.92	266.48	799.44	307.83
3.	June	2023	671.82	167.96	503.87	155.03
4.	July	2023	743.45	185.86	557.59	207.71
5.	August	2023	814.63	203.66	610.97	221.78
6.	September	2023	758.07	189.52	568.55	318.76
7.	October	2023	1002.51	250.63	751.89	144.20
8.	November	2023	982.88	245.72	737.16	198.54
9.	December	2023	802.58	200.65	601.94	254.75
10.	January	2024	825.89	206.47	619.41	207.61
11.	February	2024	549.50	137.38	412.13	200.38
12.	March	2024	1023.87	255.97	767.90	186.79
Total			**9725.56**	**2431.39**	**7294.17**	**2572.94**

Deputy Conservator
Deendayal Port Authorit

Marine Department

Statement showing the Collection and disposal of Hazardous and Non-Harardous Wastes carried out by

	Name of Party	Type of Licence	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Total
1	Alicid Organic Industries Limited	Hazardous	-	-	-	-	-	-	-	-	36.76	-	-	-	36.76
2	Amar Hydrocarbon Pvt. Ltd	Hazardous	-	-	-	-	-	-	-	18.42	-	-	-	41.48	59.90
3	Atlas Organics Pvt. Ltd	Hazardous	-	-	-	19.24	7.00	-	-	-	-	-	-	-	26.24
4	Aviation Corporation	Hazardous	9.60	18.45	23.97	-	-	-	-	-	-	-	-	-	52.02
5	Mahalaxmi Asphalt Pvt Ltd	Hazardous	102.96	-	-	138.88	-	25.23	67.34	-	73.93	50.49	14.85	43.97	517.65
6	Priyansi Corporation	Hazardous	16.25	91.36	87.35	-	-	29.89	-	35.57	67.03	-	-	-	327.45
7	Revolution Petrochem LLP	Hazardous	379.86	591.26	594.09	622.50	534.20	453.78	589.26	681.93	423.16	383.95	442.62	648.60	6,345.21
8	Shana Oil Process	Hazardous	-	-	-	-	-	-	-	-	-	-	-	-	-
9	United Shipping Company	Hazardous	-	418.14	-	-	314.16	287.07	396.04	296.10	241.83	432.74	119.51	341.01	2,846.60
10	Chitrakut Trading & Industries	Non-Hazardous	7.24	28.39	14.70	14.98	10.70	6.35	4.78	-	-	0.83	-	-	87.97
11	Golden Shipping Services	Non-Hazardous	1.03	61.82	-	56.87	43.26	77.20	36.10	23.64	75.26	42.55	37.33	49.00	504.06
12	Green Earth Marine Solutions	Non-Hazardous	18.50	37.68	4.42	18.50	27.60	5.00	-	20.34	-	3.71	6.71	-	142.46
13	Harish A. Pandya	Non-Hazardous	12.00	7.18	1.95	-	5.02	-	6.42	-	12.59	7.29	-	-	52.45
14	K M Enterprise	Non-Hazardous	62.00	99.18	74.30	64.40	64.00	48.37	36.34	56.74	70.28	64.52	67.04	113.62	820.79
15	Naaz Shipping Services Ent	Non-Hazardous	-	-	-	7.56	-	12.40	6.35	5.47	6.35	6.36	-	-	44.49
16	New India Marine Works	Non-Hazardous	4.00	-	-	10.50	23.70	45.15	7.00	11.00	17.80	9.00	-	-	128.15
17	Omega Marine Services	Non-Hazardous	23.81	31.42	30.66	-	-	68.44	19.51	47.35	46.10	30.31	58.85	-	356.45
18	V K Enterprise	Non-Hazardous	24.00	30.00	-	15.00	18.00	18.00	18.00	15.00	15.00	15.00	9.00	-	177.00
19	Vishwa Trade-link Inc.	Non-Hazardous	16.99	12.16	29.00	19.90	29.50	37.85	9.70	19.00	11.37	28.04	21.45	24.17	259.13
		Hazardous - Total	**508.67**	**1,119.21**	**705.41**	**780.62**	**855.36**	**795.97**	**1,052.64**	**1,032.02**	**842.71**	**867.18**	**576.98**	**1,075.06**	**10,211.83**
		Non-Hazardous - Total	**169.57**	**307.83**	**155.03**	**207.71**	**221.78**	**318.76**	**144.20**	**198.54**	**254.75**	**207.61**	**200.38**	**186.79**	**2,572.94**

Copy to : GPCB, Gandhidham / Harbour Master

Annexure D

Statement Showing the quantity of Domestic Waste Water Generation (STP – Kandla) for the period from April 2023 to March 2024

Sr. No.	Month	Average Quantity of Domestic Waste Water Generation (KLD)
1.	April 2023	225
2.	May 2023	200
3.	June 2023	210
4.	July 2023	220
5.	August 2023	230
6.	September 2023	225
7.	October 2023	230
8.	November 2023	210
9.	December 2023	235
10.	January 2024	255
11.	February 2024	230
12.	March 2024	220
Average	**224.16**	

XEN (Road)

19/06/24

DEENDAYAL PORT AUTHORITY