DEENDAYAL PORT AUTHORITY
(Erstwhile: DEENDAYAL PORT TRUST)

Tel(O) : (02836) 220038,
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E Mail : kptdesignsection@gmail.com
kptemc@gmail.com
Website : www.deendayalport.gov.in

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
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EG/WK/4751/Part (Ro-Pax)/ 181 Dated: 02/12/2024

To,
The Director (Environment) & Member Secretary,
Gujarat Coastal Zone Management Authority,
Forest & Environment Department,
Govt. of Gujarat,
Block No. 14, 8th floor,
Sachivalaya,
Gandhinagar – 382 010

Sub: Bifurcation (600 mt waterfront out of total 4800 mt) of Environmental and CRZ clearance issued to M/s Essar Bulk Terminal Limited for Expansion of Port Facility at Hazira, Surat, Gujarat – **Submission of Compliance Report of Stipulated Conditions in CRZ recommendation reg.**

Ref.:
1. Bifurcation (600 mt water front out of total 4800 mt) of Environmental and CRZ Clearance issued to M/s Essar Bulk Terminal Limited for expansion of port facility at Hazira, Surat, Gujarat by the MoEF&CC, GoI vide letter F.No. 11-46/2011 - IA III dated 4/4/2022
2. Environmental and CRZ Clearance for the expansion of port facility at Hazira, Surat, Gujarat by M/s Essar Bulk Terminal Ltd by the MoEF&CC, GoI vide letter F.No. 11-46/2011 - IA III dated 06/05/2014
3. CRZ Recommendation issued by GCZMA, GoG vide letter dated 01/06/2013 to M/s Essar Bulk Terminal
4. DPA letter no. EG/WK/4751/Part (Ro-Pax)/346 dated 07/08/2023
5. DPA letter no. EG/WK/4751/Part (Ro-Pax)/36 dated 18/03/2024

Sir,

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

In this regard, it is to state that, the MoEF&CC, GoI, New Delhi vide above mentioned letter dated 4/4/2022 cited at Reference 1 had issued Bifurcation of Environmental and CRZ Clearance accorded to M/s Essar Bulk Terminal Limited vide letter of even number dated 6th May, 2014 in the name of Deendayal Port Trust (Now Deendayal Port Authority) for ***"Development of 600 m Waterfront and 24 ha. Back up Area at Hazira, Surat by Deendayal Port Trust (Now: Deendayal Port Authority)".***

In the said letter dated 4/4/2022, the MoEF&CC, GoI under Para 8 has mentioned that, Deendayal Port Authority shall comply with all the specific & general conditions stipulated in the EC & CRZ Clearance of even no. dated 6th May, 2014 cited at Reference 2.

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Accordingly, as directed under Specific Condition no. (xv) stipulated in the EC & CRZ Clearance dated 6th May, 2014 i.e. All the conditions/ recommendations stipulated by Gujarat Coastal Zone Management Authority (GCZMA) No. ENV 10-2011-877-E dated 01.06.2013 shall be complied with, kindly find enclosed herewith compliance report of stipulated conditions in the CRZ recommendation for the period upto May, 2024 **(Annexure I)** along with necessary annexures, for kind information and record please.

Further, as per the MoEF&CC, Notification S.O.5845 (E) dated 26.11.2018, which 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 gczma.crz@gmail.com & direnv@gujarat.gov.in

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

Yours faithfully,

Encl.: As above

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

Copy to:

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

Annexure I

Compliance report (upto May, 2024)

Project: Development of Ro-Ro/Ro-Pax Facility at Hazira by Deendayal Port Authority (600 m water front – 170 m berthing jetty and other allied structure viz. approach jetty, pontoons, link span etc. and 5 Ha. area (onshore facility).

Status of Project: Under Operation Stage (RoRo/RoPax facility: 170 m berthing jetty and other allied structure viz. approach jetty, pontoons, link span etc. and 5 Ha. area (onshore facility)). As per bifurcated EC & CRZ Clearance dated 4/4/2022 issued by the MoEF&CC, GoI, DPA has obtained CCA (PCB Id: 88242) from GPCB vide Order dated 10/07/2023 with validity upto 26/07/2027.

Reference:

- MoEF&CC, GoI, vide letter dated 4/4/2022 issued Bifurcation of EC&CRZ Clearance accorded to M/s Essar Bulk Terminal Limited vide letter dated 6th May, 2014 by MoEF&CC, GoI in the name of Deendayal Port Trust (Now Deendayal Port Authority).
- Condition no. (xv) under Specific Conditions "*All the conditions/recommendations stipulated by Gujarat Coastal Zone Management Authority (GZCMA) No. ENV 10-2011-877-E dated 01/06/2013*" of Environmental and CRZ Clearance accorded to M/s Essar Bulk Terminal Limited vide letter dated 6th May, 2014 by MoEF&CC, GoI.

Status of compliance of conditions stipulated in the CRZ Recommendation dated 01/06/2013:

Sl. No.	EC Condition	Compliance
1.	The provisions of the CRZ Notification of 2011 shall be strictly adhered to by M/s EBTL. No activity in contradiction to the provisions of the CRZ Notification shall be carried out by M/s EBTL.	With regard to Ro-Ro/Ro-Pax Facility developed by DPA, the provisions of the CRZ Notification of 2011 are being strictly adhered to by DPA and no activity in contradiction to the provisions of the CRZ Notification is being carried out.
2.	Natural drainage system shall be designed in such a way that there shall be no damage to the existing mangrove patches nearby site.	The GMB had allotted land of 24 Hectares to Deendayal Port Authority devoid of Mangroves. However, due care is being taken so that Natural Drainage System will be maintained.
3.	The Essar Bulk Terminal Limited shall take up mangrove plantation in 500 ha of land in consultation with GEC/Forest department.	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.

		Further DPA has assigned work to to M/s GUIDE, Bhuj vide work order dated 10/06/2024 for "Mangrove Plantation in an area of 50 Ha for Deendayal Port Authority" for the period of 10/06/2024 to 09/03/2025. The work order is attached here with as **Annexure 1** For regular monitoring of mangroves, DPA engaged M/s GUIDE, Bhuj during the year 2017 & subsequently, vide work order dated 3/5/2021. The final report submitted by M/s GUIDE has already been communicated with the compliance report dated 05/08/2022. 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 2**
4.	Coal, ore and other material handling shall be done through totally closed system.	N/A. DPA developed Ro-Ro/Ro-Pax facility which is being used for public conveyance and also for trailer, trucks, cars etc.
5.	All necessary permissions from different Government Departments/ agencies, including GMB, shall be obtained by M/s EBTL, before commencing the activities.	The Ministry of Ports, Shipping & Waterways, Government of India appointed Deendayal Port Authority (Erstwhile: DPT) as its nominee to take over the Project assets under the Concession Agreement (at Ghogha and Dahej terminals and the maintenance dredging at Dahej terminal) and also the assets at Hazira for the Ro-Pax ferry service. For the purpose, the 600m waterfront along with 24 ha backup land is allotted to Deendayal Port Authority by the Gujarat Maritime Board, GoG at Hazira for developing Ro-Ro/Ro-Pax Facility at Hazira Copy of GMB has already been communicated along with last compliance report. As directed in the Bifurcated EC & CRZ Clearance issued to DPA by the MoEF&CC,

		GoI dated 4/4/2022 , DPA has obtained the CCA from the Gujarat Pollution Control Board (under Water Act 1974 and Air Act 1981) in the name of DPA for development of 600 m waterfront and 24 ha back up area vide GPCB letter no. GPCB/CCA-SRT-2458/ID-88242/74790 dated 13/07/2023 (**Copy – Annexure 3**).
6.	All the recommendations and suggestions given by WAPCOS in their Environmental Impact Assessment reports for conservation/ protection and betterment of environment shall be implemented strictly by M/s EBTL.	Point noted.
7.	The construction and operational activities shall be carried out in such a way that there is no negative impact on mangroves, if any, and other important coastal / marine habitats. Construction activity shall be carried out only under the guidance/ supervision of the reputed institute / organization.	The GMB had allotted land of 24 Hectares to Deendayal Port Authority devoid of Mangroves. However, due care is being taken so that there is no negative impact on mangroves, if any, and other important coastal/ marine habitat. The Ro-Ro/Ro-pax facility is under operation.
8.	M/s EBTL shall strictly ensure that no rivers are blocked due to any activity at the proposed site.	It is assured that; due care is being taken by DPA so that no rivers are blocked due to any activity at the project site.
9.	The construction debris and / or any other type of waste shall not be disposed of in to the sea, creek or in the CRZ area. The debris shall be removed from the construction site immediately after construction is over.	Currently, the Ro-Ro/Ro-pax facility is under operation.
10.	The construction camps shall be located outside the CRZ area and the construction labour shall be provided with the necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by the construction labours.	Currently, the Ro-Ro/Ro-pax facility is under operation.
11.	M/s EBTL shall bear the cost of the external agency that may be appointed by this department for	Currently, the Ro-Ro/Ro-pax facility is under operation.

	supervision / monitoring of proposed activities and the environmental impacts of the proposed activities.	
12.	The groundwater shall not be tapped within the CRZ areas by the EBTL to meet with the water requirements in any case.	Water requirements are met through private tankers.
13.	M/s EBTL shall take up massive greenbelt developmental activities in consultation with Forest Department / GEER Foundation / Gujarat Ecology Commission. A comprehensive plan for this purpose has to be submitted to the Forest and Environment Department.	DPA had already developed required plantation **(area of about 7000 m^2)** within the Ro-Ro/Ro-Pax Terminal area .
14.	The EBTL shall have to take up bio-shielding development programme as part of CSR in consultation with Forest Department / PCCF and an action plan in this regard shall have to be submitted to the MoEF, GoI and this department.	Not Applicable. DPA developed Ro-Ro/Ro-Pax facility which is being used for public conveyance and also for trailer, trucks, cars etc.
15.	The EBTL shall have to contribute financially for taking up the socio-economic upliftment activities in this region in consultation with the Forest and Environment Department and the District Collector / District Development Officer.	As per the CSR Guidelines issued from time to time by the MoPSW,GoI, DPA since the year 2011-12 had carried out various CSR activities **(Annexure 4).**
16.	A separate budget shall be earmarked for environmental management and socio-economic activities including the greenbelt/ mangrove plantation and details thereof shall be furnished to this Department as well as the MoEF, GoI. The details with respect to the expenditure from this budget head shall also be furnished along with the compliance report.	The allocation made under the scheme of "Environmental Services & Clearance thereof other related Expenditure" during BE 2023-2024 is Rs. 274 Lakhs. The expenditure made under the scheme of "Environmental Services & Clearance thereof other related Expenditure" is Rs. Approx. Rs. 657 Lakhs from Dec, 2023 to May 2024.
17.	A separate Environmental Management Cell with qualified personnel shall be created for environmental monitoring and	DPA is already having dedicated EMC. In this regard, DPA has also appointed expert agency for providing Environmental Experts from time to time. Currently, DPA

	management during construction and operational phases of the project.	appointed M/s Precitech Laboratories Pvt. Ltd., Vapi for three years vide work order dated 5/2/2021 **(Copy of work order has already been communicated with the compliance report dated 05/08/2022).** In addition, DPA has also appointed Manager (Environment) on contractual basis for a period of 3 years & further extendable for 2 years **(Copy of offer of appointment has already been communicated with the compliance report dated 05/08/2022.)** Further, DPA had assigned the work of monthly environmental monitoring to M/s A 2 Z Envirotech vide Work Order dated 15/09/2022. The copy of the monitoring report has already been communicated with the last compliance report. Recently, DPA has assigned the work of monthly environmental monitoring to GEMI, Gandhinagar for a period of 3 years vide letter dated 18/04/2023. The work is in progress and the latest quarterly report submitted by GEMI is attached herewith as **Annexure 5**.
18.	Environmental Audit report indicating the changes, if any, with respect to the baseline environmental quality in the coastal and marine environment shall be submitted every year by M/s EBTL to this department as well as to the MoEF, GoI.	Point noted for compliance.
19.	A six monthly report on compliance of the conditions mentioned in this letter shall have to be furnished by M/s EBTL on a regular basis to this Department as well as to the Ministry of Environment and Forest, Government of India.	It is assured that w.r.t. subject project, six monthly report on compliance of the conditions mentioned in this letter will be furnished by DPA on a regular basis to GCZMA as well as to the Regional Office, MoEF&CC, GoI.
20.	Any other condition that may be stipulated by this Department /	Point noted.

	Ministry of Environment and Forest, Government of India from time to time for Environmental Protection / management purpose shall also have to be complied with by M/s EBTL.	

ANNEXURE- 1

DEENDAYAL PORT AUTHORITY

दीनदयाल पत्तन प्राधिकरण
DEENDAYAL PORT AUTHORITY

Website : www.deendayalport.gov.in

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

NO. EG/WK/4751/Part (Revamping – EC onwards)/69 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: Mangrove Plantation in an area of 50 Hectares for Deendayal Port Authority reg.

Ref.: 1) DPA request vide letter no. EG/WK/4751/Part (Revamping - EC onwards)/55 dated 15/4/2024.
2) Offer submitted by GUIDE, Bhuj vide letter no. GUIDE/DPA/MP/72/2024 dated 08/05/2024.

Sir,

Your offer for the subject work submitted vide above referred letter dated 8/5/2024 **(Copy attached- Annexure A)** amounting to Rs. 25,00,000.00 + applicable GST (Rupees Twenty-Five Lakhs plus applicable GST) including all terms & conditions mentioned in the offer letter, has been accepted by the competent authority in DPA.

2. Scope of Work:

In order to comply with the stipulated condition of the EC & CRZ Clearance dated 1/1/2024 read with CRZ Recommendation dated 25/8/2022 – Condition no.7, Mangrove Plantation [50 HaJ to be carried out for DPA with the objective to find out potential and suitable sites for Mangrove plantation in consultation with the District Forest Department office and Gujarat Ecology Commission. The Mangrove plantation activities under this project will cover two mangrove species, i.e. Avicennia marina and Rhizophora mucronata.

3. The terms of payment:

(i) 50% of project budget to be paid within 15 days after submission of Inception report.
(ii) 30% of project budget to be paid within 15 days on completion of Nursery preparation.
(iii) 10% of project budget to be paid within 15 days on completion of 50 Ha. plantation.
(iv) 10% of budget to be paid within 15 days on submission of Final report.

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Obligation of DPA:

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

5. Time Period: 9 months from the date of issue of the work order i.e. from 10/06/2024 to 09/03/2025.

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

Thanking you.

Yours faithfully,

10/6/24

Deputy Chief Engineer & EMC (i/c)
Deendayal Port Authority

ANNEXURE- 2

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.

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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

ANNEXURE- 3

GPCB

GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN, SECTOR 10-A,
GANDHINAGAR - 382010,
(T) 079-23232152

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)-1981 and Authorization under rule 3(3) & 6 of the Hazardous Waste (Management and Handling & Trans boundary Movement) Rules,2016 framed under the Environmental (Protection) Act-1986. This Board is empowered to Grant CC&A.

And whereas Board has received consolidated consent application Inward no. **261148 dated 27/07/2022** 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:

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

To,
M/s. Deendayal Port Authority
Essar Bulk Terminal Ltd, Adani Hazira Port Road,
Hazira Gam, Suvali - 394270,
Tal: Chorasi, Dist: Surat.

1. **Consent Order No. AWH-127510 Date of issue: 10/07/2023.**

2. The consents shall be **valid upto 26/07/2027** for the use of outlet for the discharge of treated effluent and emission due to operation facility of the following activity:

Sr. No.	Facility
1	"600 Meter water front including berthing Jetty of 170 meter and 5 Ha back up area for Ro-Ro/Ro-Pax Facility"

SUBJECT TO SPECIFIC CONDITION:

I. **Industry shall strictly comply with EC issued by Central Authority vide their letter No: F. No. 11-46/2011-IA.III dated: 04/04/2022.**
II. **Industry shall manage Solid Wastes generated from industrial activities as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46)).**
III. **As per Provisions of Rule 18 of Solid Waste Management Rules-2016 you are directed to make an arrangement in Utilities to replace at least five percent (5%) of your solid fuel requirement by 'refused derived fuel'.**
IV. **To do retrofitting at D.G. Sets for emission control and unit shall submit compliance with respect to Board circular No. GPCB/Air Action – 03 (1)(E)/599145, dated 27/08/2021 in the matter of NGT O.A. No. 681/2018.**
V. **Unit shall abide by any decision/order in the NGT matter OA No: 59/2022 (WZ)**

3. **CONDITIONS UNDER THE WATER ACT:**

3.1. Source of Water: Gujarat Water Supply & Sewerage Board (GWSSB).

3.2. The quantity of the fresh water consumption for industrial purpose shall be NIL.
3.3. The quantity of the fresh water consumption for domestic purpose shall not exceed 12 KL/Day.
3.4. There shall be no industrial waste water generation from the manufacturing process and other ancillary industrial operations.
3.5. The quantity of domestic waste water shall not exceed 8 KL/Day.
3.6. Domestic waste water shall be disposed through septic tank/soak pit system.

4. CONDITIONS UNDER THE AIR ACT:

4.1. The following shall be used as a fuel in D.G. Set.

Sr. No.	Fuel	Quantity
1	Diesel	50 Liter/Hr.

4.2. The applicant shall install & operate comprehensive adequate air pollution control system in order to achieve prescribed norms.
4.3. The flue gas emission through stack attached to D.G. Set shall conform to the following standards:

Stack No.	Stack Attached to	Stack Height in Meter	Air Pollution Control System	Parameters	Permissible Limit
1	D.G. Set (300 KVA) Stand by	11	Acoustic Enclosure	Particulate Matter SO_2 NO_x	150 mg /Nm^3 100 ppm 50 ppm

4.4. There shall be no process emission from the manufacturing process as well as any other ancillary process.
4.5. Applicant shall comply with National Ambient Air Quality Standards notified by Central Pollution Control Board, New Delhi time to time under the provision of the Environment (Protection) Act-1986 for all the parameters. The concentration of all 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 than the permissible limit.

Parameters	Permissible Limit ($\mu g/m^3$)	
	Annual	24 Hrs Average
Particulate Matter-10 (PM_{10})	60	100
Particulate Matter-2.5 ($PM_{2.5}$)	40	60
SO_2	50	80
NO_x	40	80

4.6. 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.
4.7. 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. and 10 p.m. and nighttime is reckoned between 10 p.m. and 6 a.m.

5. **D. G. 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. Set Standards:

a. The flue gas emission through stack attached to D. G. Sets shall conform to the following standards.
b. 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.
c. Noise from DG set shall be controlled by providing an acoustic enclosure or by treating the room acoustically, at the users end.
d. 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 be possible to check the performance of the acoustic enclosure / acoustic treatment, under 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.
e. The D.G set shall be provided with proper exhaust muffler with insertion loss of minimum 25 dB (A).
f. 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 sitting and control measures.
g. Installation of a D. G. Sets must be strictly in compliance with the recommendations of the D. G. Set manufacturer.
h. A proper routine and preventive maintenance procedure for the D. G. Set should be set and followed in consultation with the DG Sets manufacture which would help prevent noise levels of the DG Set from deteriorating with use.

6. **AUTHORIZATION as per HAZARDOUS AND OTHER WASTE (MANAGEMENT AND TRANSBOUNDARY) RULES, 2016 Form-2 [See rule 6 (2)]**

Form for grant of authorization for occupier or operator handling Hazardous waste

6.1. Authorization order No: **AWH-127510** of Issue: **10/07/2023**.

6.2. **M/s. Deendayal Port Authority** is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated at **Essar Bulk Terminal Ltd., Adani Hazira Port Road, Hazira Gam, Suvali - 394270, Tal: Chorasi, Dist: Surat**.

Sr. No.	Waste (Schedule-I/ Category)	Quantity MT/Year	Facility
1	Used Oil (I/5.1)	0.010	Collection, storage, & sale out to MOEF registered recyclers through online xgn generated manifest system and vehicle registered with VLTS system only.

6.3. The authorization shall be valid up to **26/07/2027**.

6.4. 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.

6.5. The authorization is granted to operate a facility for collection, storage within factory premises transportation and ultimate disposal of Hazardous wastes as per condition no.6.2 to the industry having valid CCA of this Board.

7. TERMS AND CONDITIONS OF AUTHORISATION

7.1 The applicant shall comply with the provisions of the Environment (Protection) Act-1986 and the rules made there under.

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

7.3 The persons authorized shall not rent, lend, sell, and transfer or otherwise transport the hazardous wastes without obtaining prior permission of the Gujarat Pollution Control Board.

7.4 Any unauthorized change in personnel, equipment or working conditions as mentioned in the authorization order by the persons authorized shall constitute a beach of this authorization.

7.5 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;

7.6 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 Wastes and Penalty''

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

7.8 An application for the renewal of an authorization shall be made as laid down in rules 6(2) under Hazardous Waste and Other Waste Rules, 2016.

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

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

7.11 The hazardous and other wastes 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.

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

7.13 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.

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

7.15 Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form-4 by 30th day of June of every year for the preceding period April to March.

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

7.17 As per "Public Liability Insurance Act-91" company shall get Insurance Policy, if applicable.

7.18 Empty drums and containers of toxic and hazard 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.

7.19 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 of Union Territory Administration where the facility exists.

7.20 Unit shall take all concrete measures to show tangible results in waste generation, reduction, avoidance, reuse and recycle. Actions taken in this regard shall be submitted within three months and also along with Form-4.

7.21 Industry shall have to display the relevant information with regards to hazardous waste as indicated in the Hon. Supreme Court's Order in W.P. No.657 of 1995 dated 14th October, 2003.

7.22 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 wastes generated within the factory premises.

8. GENERAL CONDITIONS:

8.1 Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.

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

8.3 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.

8.4 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.

8.5 The Environmental Management Unit/Cell shall be setup to ensure implementation on 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 also coordinate the exercise of environmental audit and preparation of environmental statements.

8.6 The Environmental audit shall be carried out yearly and the environmental statements pertaining to the previous year shall be submitting to this State Board latest by 30th September every year.

8.7 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.

8.8 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.

8.9 Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Hon. Supreme order in w.p. no. 657 of 1995 dated 14th October 2003.

9. SPECIFIC CONDITIONS:

9.1 The authorized actual user of hazardous and other wastes shall maintain records of hazardous and other wastes purchased in a passbook issued by the State Pollution Control Board along with the authorization.

9.2 Handling over of the hazardous and other wastes to the authorized actual user shall be only after making the entry in the passbook of the actual user.

9.3 In case of renewal of authorization, a self-certified compliance report in respect of effluent, emission standards and the conditions specified in the authorization for hazardous and other wastes shall be submitted to SPCB.

9.4 The occupier of the facility shall comply Standard operating procedure/guidelines published by MOEF&CC or CPCB or GPCB from time to time.

9.5 Unit shall comply provisions of E-Waste Management Rules-2016.

9.6 The disposal of Hazardous Waste shall be carried out as per the waste Management hierarchy.

9.7 The occupiers of facilities shall not store the hazardous and other wastes for a period not exceeding ninety days. Prior permission of the Board shall be obtained for extension of the storage period.

9.8 The occupier shall maintain the records of generation, sale, storage, transport, recycling, co processing and disposal of hazardous waste and make available during the inspection.

9.9 The transportation of the hazardous waste shall be carried out in GPS mounted dedicated vehicles.

For and on behalf of
Gujarat Pollution Control Board

(M. R. Macwana)
Unit Head, Surat

NO: GPCB/CCA-SRT-2458/ID-88242/ **Date:**

Issued to:
M/s. Deendayal Port Authority
Essar Bulk Terminal Ltd, Adani Hazira Port Road,
Hazira Gam, Suvali - 394270,
Tal: Chorasi, Dist: Surat.

ANNEXURE- 4

CSR Works for the year 2018-19

Sr. No	Activity/Work	Approved Cost (In lakhs)
1.	CSR work to Donate 100 Nos of Computers to Daughters of Martyred Soldiers in the country under the "BETI BACHAO BETI PADHAO" program by Atharva Foundation, Mumbai	24.00
2.	CSR work to Donate ONE (40 Seater) School Bus for Deaf Children Students for the Institute of Mata Lachmi Rotary Society, Adipur	18.00
3.	CSR work to Providing One R.O Plant with Cooler at Panchyat Prathmik Sala, Galpadar Village for the ANARDE Foundation, Kandla & Gandhidham Center.	1.50
4.	CSR work for Providing Drainage Line at Meghpar Borichi village, Anjar Taluka.	25.00
5.	CSR work for Construction of Health Centre at Kidana Village	13.00
6.	CSR work to provide 4 Nos. of Big Dust Bin for Mithi Rohar Juth Gram Panchayat.	3.40
7.	CSR work for Renovation & construction of shed at Charan Samaj, Gandhidham –Adipur.	10.00
8.	CSR Work for Renovation/Repairing of Ceiling of School Building at A. P Vidhyalay, Kandla.	10.00
9.	CSR work for Construction of Over Head Tank & Providing 10 Nos of Computers (for students) of Navjivan Viklang Sevashray, Bhachau, Kutch	9.50
10.	CSR work to Provide Books & Tuition fees for Educational facilities to weaker section children of Valmiki Samaj, Kutch.	2.00
11.	CSR work to provide Water Purifier & Cooler for the ST. Joseph's Hospital, Gandhidham	1.50
12.	CSR work for Construction of Second Floor (Phase – I) for Training Centre of "Garbh Sanskran Kendra" "Samarth Bharat Abhiyan" of Kutch KalyanSangh, Gandhidham	37.00
	Total Approved Work Amount:	154.90 Lakh

CSR Works for the year 2019-20

Sr. No	Name of Scheme	Approved Cost (Rs. In Lakhs)
1.	CSR activities for Providing Drainage line at Nani Nagalpar village.	3.00
2.	CSR activities for Development of ANGANWADI Building at School no- 12 at Ward no 3 & 6 at Anjar.	7.00
3.	CSR activities for Improving the facilities of Garden at Sapna Nagar(NU-4) & (NU-10 B), Gandhidham.	18.00
4.	CSR activities for development of School premises of Shri Guru Nanak Edu. Society, Gim.	30.00
5.	CSR activities for the improvement of the facilities at St JOSEPH Hospital & Shantisadan at Gandhidham	20.00
6.	Consideration of Expenditure for running of St Ann's High School at Vadinar of last five years 2014 to 2019 under CSR.	825.00
7.	CSR activities for development of school premises of Shri Adipur Group Kanya Sala no-1 at Adipur	6.50
8.	CSR activities for development of school premises of Shri Jagjivan Nagar Panchyat Prathmiksala, Gandhidham.	16.50
9.	CSR activities for development of school premises of Ganeshnagar Government high school, Gandhidham.	9.00
10.	CSR activities for improving greenery, increase carbon sequestration and beat Pollution at Kandla, DPT reg.	352.32
11.	CSR activities for providing infrastructures facilities at "Bhiratna Sarmas Kanya Chhatralaya" under the Trust of SamajNav- Nirman at Mirjapur highway, Ta Bhuj.	46.50
	Total Approved Work Amount:	1333.82 Lakh

CSR Works for the year 2020-21

Sr. No	Name of Scheme	Approved Cost (Rs. In Lakhs)
1.	CSR Proposal for earmarking of 15% Funds for National Maritime Heritage Complex, Lothal, Gujarat (NMHC) from allocated CSR Fund of Rs 3.46 Cr	51.90
2.	PM Care Fund	800.00
3.	Other COVID related exp.	188.00
	Total Approved Work Amount:	1039.90 Lakh

CSR Works for the year 2021-22

Sr. No	Name of Scheme	Approved Cost (Rs. In Lakhs)
1.	CSR Activities for providing Water supply pipe line for drinking water facilities for poor people & Fishermen at VANDI Village.	20
2.	CSR activities for providing facilities in Girls Hostel of Kasturba Gandhi Balika Vidhyalay, Gandhidham.	30
3.	CSR works for Construction of Auditorium Hall at RSETI (Rural Self Employment Training Institute) at Bhujodi-Bhuj.	16
4.	CSR works for the providing of SOLAR POWER SYSTEM and other facilities for 0the JEEV SEVA SAMITI at Gandhidham.	9.3
5.	CSR Activities for providing HD projector for KANYA MAHA VIDYALAYA, Adipur	1.5
6.	CSR works for Construction of New Building for Setting up of skill development centre at Rajkot (Sewa Gujarat).	250
7.	CSR Works for Ladies Environment Action Foundation (LEAF) Trust for providing infrastructure to the primary school at Gandhinagar District	46.5
8.	CSR works lor Providing of Furniture for the School "Shri Galpadar Panchayat Prathmic Kumar group Sala" at Galpadar village, Taluka: Gim	5
	Total Approved Work Amount:	378.30 Lakh

CSR Works for the year 2022-23

Sr. No	Name of Scheme	Approved Cost (Rs. In Lakhs)
1.	CSR work for providing One Bore hole with construction one room along with Motor pump at Village MOTI NAGALPAR, Anjar.	18.00
2.	CSR work for Construction of Shamashan bhoomi (Crematorium) at Gandhidham.	49.50
3.	CSR work for providing metallic sheet DOME in Community Hall at Old Sunderpuri for Shri Juni Sundarpuri Maheshwari Samaj at Gandhidham.	15.00
4.	CSR Activities for construction of Samajwadi at village: Rampar, Taluka: Anjar.	15.00
5.	Financial assistance under CSR for providing basic facilities at Gandhidham GSRTC bus station.	25.00
6.	CSR Activities for construction of School Building for physically disabled, deaf & mute children, Shri & Shrimati Chhaganlal Shyamjibhai Virani Behera Munga Shala Trust, Virani Deaf School at Rajkot.	5.00

7.	CSR work for construction of new Administrative staff block for the Maitri Maha Vidhyalaya, Adipur.	80.10
8.	Financial support under CSR for providing 60 seater school bus for "Aadhaar Sankul", Manav Seva Trust, Gandhidham.	25.00
9.	Financial assistance under CSR for Rooftop Solar System & Afforestation under clean energy & sustainable development in 10 villages around DPA	63.72
10.	CSR works for Shree Kachchh Mahila Kalyan Kendra, Bhuj-Kutch	55.00
11.	CSR works for Installation of 125 no. Sanitary Pad Vending Machines at Women Hostels, NGOs etc, in Kutch District.	15.00
12.	CSR Fund for Vadinar Village & surrounding	128.54
13.	CSR Activities for Girls Hostel at Kasturba Gandhi Balika Vidhyalaya At Shinay, Taluka:Gim	33.25
14.	CSR request for Allotment of fund for construction of Community hall at Adipur.	25.00
15.	CSR Request for requirement of funds for renovation work in Sector-7, Gandhidham (Aryasamaj Gandhidham)	30.00
16.	CSR Request for providing"Antim Yatra Bus" & Mortuary Cabinet Morgue" for Adipur-Gandhidham from CSR Funds,	25.00
17.	CSR Request for creation of a Children park at Gandhidham Military Station, Gandhidham	15.00
18.	CSR Request for construction of Toilet block units for Girls & Boys NAV JIVAN VIKLANG SEVA SHREY Bhachau	3.04
19.	CSR Request for laying Synthetic Athletic track in Galpadar and to Provide One E-Kart facility for Conveyance of youths at BSF Campus, Gandhidham	75.00
20.	CSR request for submitted by AAS, Indore for solid waste Management at Gandhidham & Kandla.	60.00
21.	CSR request from Trikamsaheb Manav Seva Trust at Madhapar Near Bhuj for grant for Construction of Community Hall, Compound Wall etc.	40.00
22.	CSR Request for construction of Dome shaped shed at Rampar Village Prathmik Shala, Rampar	24.00
23.	CSR Fund for development of School premises of Shri Guru Nanak Education Society, Gandhidham	4.50
24.	CSR Request for conducting Awareness campaigns on T.B. Prevention & treatment, Mumbai	60.00

25.	CSR Request for fund Under CSR for Railway institute, Gandhidham, Western Railway	5.00
26.	CSR proposal project for Sanitary Pad Making Machine For School Girls.	12.39
27.	CSR funds for requirement of Mentally disabled childrens in Adipur, Kutch	70.83
28.	CSR Funds for support for Procurement of kitchen Equipment & machineries to Serve Mid-day meals to Govt. School children in Bhuj-Kutch	55.31
29.	CSR support for the Junagadh Hospital Project under the CSR Initiatives	30.24
30.	CSR Request for financial Assistance on menstrual Hygiene for girls, Assam-TIPKAI	20.00
31.	CSR Request received from Anjar Education Society to the Extent of Rs 35 Lakhs for Installation of 75 KVA Capacity Solar power system.	35.00
	Total Approved Work Amount:	1118.42 Lakh

ANNEXURE- 5

सत्यमेव जयते

Forests & Environment Department
Government of Gujarat

Quartely Environmental Monitoring Plan Report (EMP report)

For

"Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Dahej-Hazira-Ghogha for a period of 3 years"

(January to April 2024)

Final Report

Submitted to:
Deendayal Port Authority (DPA), Kandla

GEMI/835(6)/2024/110

Gujarat Environment Management Institute (GEMI)
(An Autonomous Institute of Government of Gujarat)

GEMI Bhavan, 246-247,GIDC Electronic Estate,Sector-25, Gandhinagar 382024

"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 project **"Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Dahej-Hazira-Ghogha for a period of 3 years" by Deendayal Port Authority, Kandla.** Under the said project the report titled "Final Quarterly Environmental Monitoring Plan Report (13th Jan 2024 to 12th Apr 2024)" has been prepared.

Name of the Report:	Final Quarterly Environmental Monitoring Plan report for "Preparing and Monitoring of Environmental Monitoring and Management Plan for Deendayal Port Authority at Dahej-Hazira-Ghogha for a period of 3 years" (13th Jan 2024 to 12th Apr 2024)"
Version:	1.0
Report Ref. No.:	GEMI/835(6)/2024/110
Report Issue Date:	05/08/2024

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Chapter 1
Introduction

1.1 Introduction

Deendayal Port Authority (DPA), Erstwhile Kandla Port Trust, is one of the 13th 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 the state of Gujarat in India. DPA has commissioned Ro-Ro/Ro-Pax facilities at Hazira and Ghogha, Gujarat. This waterfront is proposed to be operated for berthing and unberthing of ROPAX Ferry vessels to load and unload vehicles along with embarking and disembarking passengers. The travel time between Ghogha and Hazira has reduced from 10 hours to 3.15 hours with the start of the Ro-Ro ferry service. The road distance from Surat to Bhavnagar is 360 kilometers. Whereas the sea route distance is 67 nautical miles only. So, Ro-Ro/Ro-Pax vessels are deployed to reduce travel time and thereby, reduce carbon emission. In compliance with the conditions stipulated in statutory clearances viz. Environmental/CRZ Clearance from the Ministry of Environment & Forest, CRZ recommendations from the state Forest & Environment Department, and NOC from the State Pollution Control Board (SPCB), and to ensure implementation of the project in an environmentally sustainable manner in & around the project site, it is important to monitor the environmental status and prepare an effective environmental monitoring and management plan of the port facility for sustainable development.

In this regard, DPA proposes to formulate a detailed and effective environmental monitoring and management plan by conducting monthly environmental monitoring for its onward submission to the statutory bodies.

Under the said study, monitoring of the various aspects of the environment such as Ambient air, DG stack emissions, meteorology, drinking water, soil, noise, and marine environment- Water, Sediment & Ecological characteristics for the locations at Hazira, Dahej & Ghogha for 3 years needs to be carried out.

This report includes the Quarterly Environmental Monitoring Plan (EMP) report for monitoring carried out for the month of "13th January 2024 to 12th April 2024".

1.2 Locations for environmental monitoring

Finalized monitoring locations as per the preliminary site visit report are shown in **Table 1** and **Figure 1 to 3**. The monitoring photographs are shown in **Figure 4**.

Table 1: Monitoring locations of environmental components

Locations	Sample code	Latitude	Longitude
Ambient Air Monitoring			
Admin building at Ghogha Ro-Ro ferry	AM-G	21.673483	72.284497
Terminal building at Hazira Ro-Ro ferry	AM-H1	21.077458	72.657147
Staff accommodation at Ro-Ro ferry at Hazira	AM-H2	21.0775717	72.6551994
Admin building at Ro-Ro ferry service at Dahej	AM-D	21.666383	72.561889
Drinking Water Monitoring			
Canteen building at Ghogha Ro-Ro ferry	DW-G	21.677216	72.283060
Terminal building at Hazira Ro-Ro ferry	DW-H	21.077399	72.657189
Canteen building at Ro-Ro ferry service at Dahej	DW-D	21.66435	72.563489
Noise Monitoring			
Admin building at Ghogha Ro-Ro ferry	N-G	21.673481	72.284464
Terminal building at Hazira Ro-Ro ferry	N-H1	21.077458	72.657147
Staff accommodation at Ro-Ro ferry at Hazira	N-H2	21.0775717	72.6551994
Admin building at Ro-Ro Ferry Service at Dahej	N-D	21.666383	72.5561889
Meteorological Data Monitoring			
Admin building at Ghogha Ro-Ro ferry	M-G	21.673483	72.284497
Terminal building at Hazira Ro-Ro ferry	M-H	21.077458	72.657147
Admin building at Ro-Ro Ferry Service at Dahej	M-D	21.666383	72.561889
Soil Quality Monitoring			
Terminal building at Ghogha Ro-Ro ferry	S-G	21.67496	72.284388
Near Terminal building at Hazira Ro-Ro ferry	S-H	21.076353	72.657294
Ro-Ro ferry service at Dahej	S-D	21.666037	72.563489
Marine Water, Ecology and Sediment Monitoring			
Near Ro-Ro ferry terminal at Ghogha	MA-G1	21.67954	72.29433
Away from Ro-Ro ferry terminal at Ghogha and along the ferry route from Ghogha to Hazira	MA-G2	21.665054	72.336313
Near Ro-Ro ferry terminal at Hazira	MA-H1	21.07577	72.65839
Away from Ro-Ro ferry terminal at Hazira and along the ferry route from Hazira to Ghogha	MA-H2	21.072114	72.657794
Near Ro-Ro ferry Service at Dahej	MA-D	21.65988	72.56365
DG stack emission Monitoring			
Near substation-3 at Ghogha Ro-Ro ferry	DG-G	21.6739638	72.2835000
Generator Room near Terminal building at Hazira Ro-Ro ferry	DG-H	21.0775041	72.6563279
Near Substation-1 at Dahej Ro-Ro ferry	DG-D	21.665902	72.562056

Figure 1. Sampling locations at Ghogha

Figure 2. Sampling locations at Hazira

Figure 3. Sampling locations at Dahej

Figure 4. Photographs of Environmental Monitoring

1.3 Details of environmental monitoring components

Detailed plan of environmental monitoring components and its parameters is shown in **Table 2.**

Table 2: Detailed plan of environmental monitoring components

Sr. No	Parameter	No. of locations	Frequency	Parameters
1.	Ambient air quality monitoring (4 locations)	1 at Ghogha, 2 at Hazira and 1 at Dahej	Twice a week	PM_{10}, $PM_{2.5}$, Sulphur dioxide, Oxides of nitrogen, Carbon monoxide
			Once in a month	Hydrocarbons, Benzene, Volatile Organic Compound, Non-methane VOC
2.	Drinking water monitoring (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Once in a month	Odor, Color, pH, Turbidity, TDS, TSS, Conductivity, Chloride, Calcium as Ca, Magnesium, Total hardness, Sulphate as SO_4, Nitrate as NO_3, Nitrite as NO_2, Fluoride as F, Sodium as Na, Iron as Fe, Potassium as K, Manganese, Total chromium, Hexavalent chromium, Copper, Cadmium, Arsenic, Lead, Zinc, Mercury, Salinity, Free residual chlorine, Microbiological (MPN)
3.	Noise level monitoring (4 locations)	1 at Ghogha, 2 at Hazira and 1 at Dahej	24 hrs period once in a month	Leq (Day) & (Night)
4.	Soil quality monitoring (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Once in a month	Total Organic Matter, Organic Carbon, Inorganic Phosphate, Texture, pH, Conductivity, Particle size distribution & Silt content, SAR, Water holding capacity, Aluminum, Chromium, Nickel, Copper, Zinc, Cadmium, Lead, Arsenic, Mercury
5.	Meteorological data monitoring (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Daily	Wind speed, Wind direction, Rainfall, Humidity, Temperature, Solar radiation
6.	DG emissions (3 locations)	1 at Ghogha, 1 at Hazira and 1 at Dahej	Once in a month	Particulate Matter, Sulphur dioxide, Oxides of nitrogen, Carbon monoxide, Carbon dioxide
7.	Marine water quality (5 locations)	2 at Ghogha, 2 at Hazira	Once in a month	Odor, Color, pH, Turbidity, TDS, TSS, Conductivity, DO, Particulate organic carbon, COD, BOD, Silica,

Sr. No	Parameter	No. of locations	Frequency	Parameters
		and 1 at Dahej		Phosphate, Sulphate as SO_4^-, Nitrate as NO_3, Nitrite as NO_2, Sodium as Na, Potassium as K, Manganese, Iron as Fe, Total chromium, Hexavalent chromium, Copper, Cadmium, Arsenic, Lead, Zinc, Mercury, Oil & grease, Floating material (scum), Microbiological (MPN), Density
8.	Marine water quality for biological monitoring (5 locations)	2 at Ghogha, 2 at Hazira and 1 at Dahej	Once in a month	Chlorophyll-a, Pheophytin, Productivity (Net & Gross), Biomass; Relative abundance, species composition and diversity of phytoplankton; Relative abundance, species composition and diversity of zooplankton; Relative abundance, species composition and diversity of benthic invertebrates; (Meio, Micro and Macro benthos), Particulate oxidizable organic carbon, Secchi disk depth
9.	Sediments quality (5 locations)	2 at Ghogha, 2 at Hazira and 1 at Dahej	Once in a month	Texture, Organic Matter, Inorganic Phosphate, Silica, Phosphate, Sulphate, Nitrite, Nitrate, Calcium, Magnesium, Sodium, Potassium, Aluminum, Copper, Chromium, Nickel, Zinc, Cadmium, Lead, Arsenic, Mercury

1.4 Sample collection, preservation, storage and transportation to GEMI's Laboratory

Sampling of water and wastewater samples was carried out by 'GEMI's sampling protocol for water and wastewater' approved by the Government of Gujarat vide letter no. ENV-102013-299-E dated 24-04-2014 under the provision of the Water (Preservation and control of pollution) Act 1974. Soil sampling was conducted as per the 'Soil sampling manual by GEMI' published in November 2016. Whereas, for the other components of the environment such as ambient air, noise, & marine ecology, the guidelines/manuals brought out by CPCB were followed. The sampling was carried out by GEMI's trained manpower. The details of the environmental samples and their respective standards are summarized in **Table 3.**

Table 3: Details of sample collection and analysis method for each environmental component

Sr. No.	Type of sample		Manual/ Standards and Protocols	Instruments
1.	Ambient air	IS 5182 (Part 23): 2006	PM_{10}	Respirable Dust Sampler (RDS) conforming to IS:5182 (Part-23): 2006
		IS:5182 (Part:24):2019	$PM_{2.5}$	Fine Particulate Sampler (FPS) conforming to IS:5182 (Part-24): 2019
		IS:5182 (Part-2):2001	SO_x	Gaseous attachment conforming to IS:5182 (Part-2):2001
		IS:5182 (Part-6):2006	NO_x	Gaseous attachment conforming to IS:5182 (Part-6): 2006
		GEMI/SOP/AAQM/11; Issue no 01, Issue date 17.01.2019: 2019	Carbon monoxide	Sensor based Instrument
		IS 5182 (Part 11): 2006	Benzene	Low flow air sampler conforming to IS:5182 (Part-11): 2006
		IS 5182 (Part 11): 2006	VOC	Low flow air sampler conforming to IS:5182 (Part-11): 2006
		IS: 5182 (Part 17): 1979	Hydrocarbon	Aluminized plastic bags with on/off valve conforming to IS 5182 (Part 17):1979
		IS: 5182 (Part 17): 1979	Non-methane VOC	Aluminized plastic bags with on/off valve conforming to IS 5182 (Part 17):1979
2.	DG emissions		IS: 11255 and USEPA Method	Sensor based flue gas analyzer (Make: TESTO, Model 350) Stack Monitoring Kit
3.	Meteorological data		Installation of automatic weather stations to get periodic meteorological data as per the requirement	Automatic Weather Stations (AWS)

Sr. No.	Type of sample	Manual/ Standards and Protocols	Instruments
4.	Water (Drinking water, Surface water)	Sampling protocol for water & wastewater 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.	For drinking water- Titration apparatus, pH meter and conductivity meter Sample collection method: Grab sampling For marine water - Niskin sampler
5.	Soil and Marine sediments	Soil sampling manual by GEMI published in November 2016	For sediment sample collection –Van veen grab sampler
6.	Noise	IS 9989:2014	Noise meter
7.	Marine ecology	Technical guidance book – An introduction to aquatic biomonitoring using macro-invertebrates,2021 by CPCB	The sampling of the benthic invertebrates will be carried out with the help of D-frame nets, whereas the sampling of zooplankton and phytoplankton shall be carried out with the help of plankton nets (60 micron and 20 micron).

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Chapter 2
Results and observations of Environmental monitoring at Dahej, Hazira & Ghogha

2.0 Monitoring of various environmental components

Monitoring of various environment components was carried out at the locations listed in **Table 1** above. Details of each monitoring components have been mentioned below.

2.1 Ambient air monitoring

Air monitoring was carried out at four locations, 1 at Dahej, 2 at Hazira, and 1 at Ghogha. The monitoring cycle was twice a week for 24-hour sampling. Sampling for Benzene, Hydrocarbon, Non-methane VOC, and VOC has been executed for once in a month.

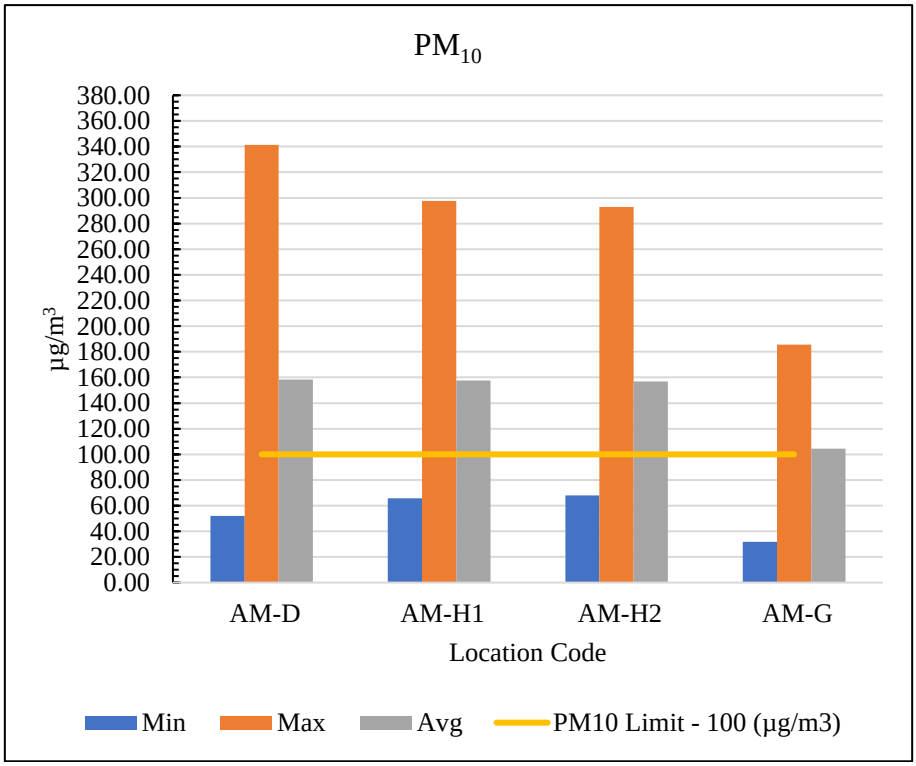
2.1.1 Statistical Data and Graphs

The station-wise summarized results of ambient air quality monitoring are given in **Table 4**, and Graphs are represented as **Graph 1 to 5**.

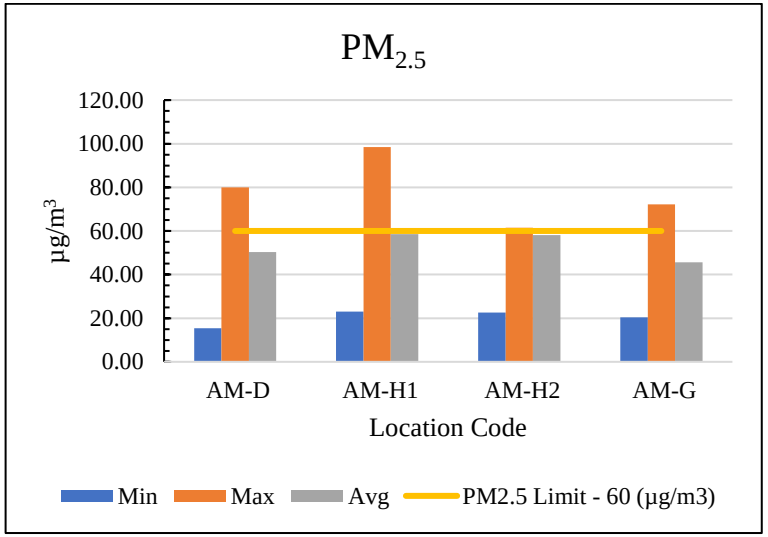
Table 4: Summarized results of Ambient air quality monitoring

Sr. No.	Parameters	NAAQ Standards, 2009 (Industrial, Residential, Rural & Other Areas) for 24 hours	Statistical data	Location code			
				AM-D	AM-H1	AM-H2	AM-G
1	PM_{10} ($\mu g/m^3$)	100	Min	52.01	65.68	67.92	31.90
			Max	341.21	297.62	292.86	185.67
			Avg.	158.30	157.72	156.94	104.37
2	$PM_{2.5}$ ($\mu g/m^3$)	60	Min	15.34	23.10	22.63	20.44
			Max	80.01	98.42	61.45	72.16
			Avg.	50.32	58.57	58.09	45.59
3	SO_2 ($\mu g/m^3$)	80	Min	<5	<5	<5	<5
			Max	141.85	64.52	61.45	43.20
			Avg.	39.94	26.40	26.18	6.93
4	NOx ($\mu g/m^3$)	80	Min	<6	7.00	6.84	<6
			Max	40.18	44.42	44.86	20.28
			Avg.	19.40	22.66	22.40	6.93
5	CO ($\mu g/m^3$)	2000	Min	960.00	470.00	470.00	450.00
			Max	1180.00	520.00	530.00	510.00
			Avg.	1077.92	505.42	502.08	478.33

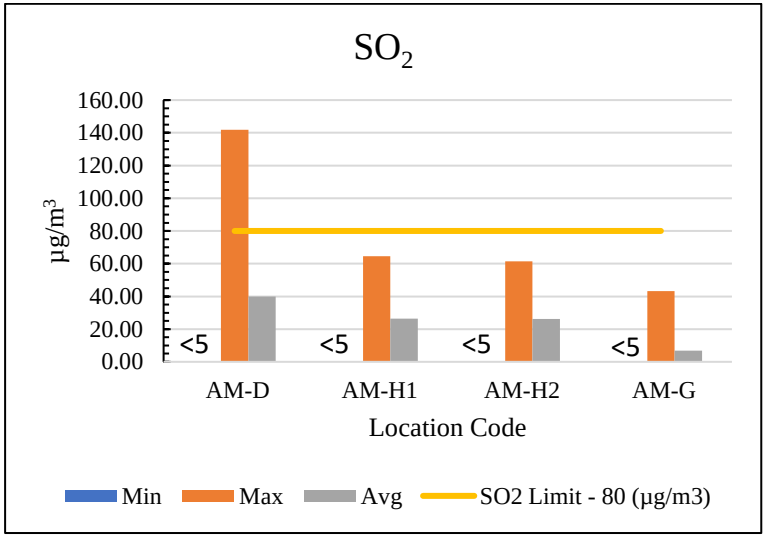
Sr. No.	Parameters	NAAQ Standards, 2009 (Industrial, Residential, Rural & Other Areas) for 24 hours	Location Code			
			AM-D	AM-H1	AM-H2	AM-G
1	Benzene (µg/m³)	5	<4.0	<4.0	<4.0	<4.0
2	Hydrocarbons (µg/m³)	-	<4.0	<4.0	<4.0	<4.0
3	Non-methane VOC (µg/m³)	-	<4.0	<4.0	<4.0	<4.0
4	VOC (µg/m³)	-	<4.0	<4.0	<4.0	<4.0



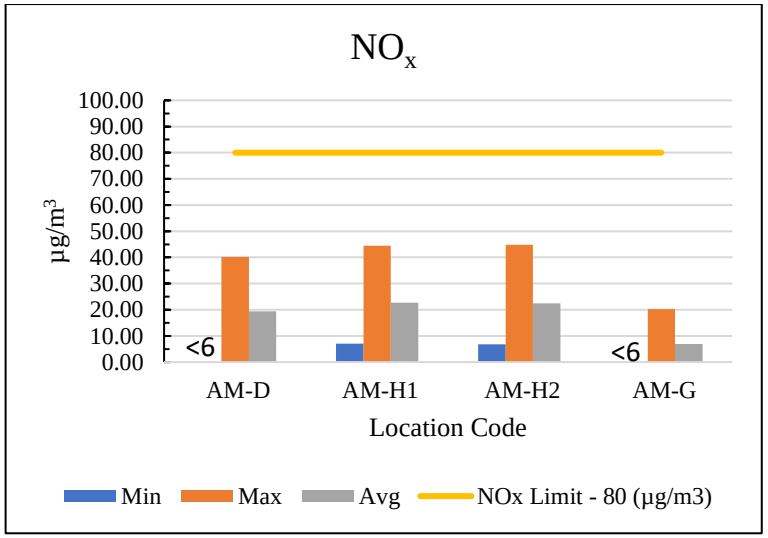
Graph 1: PM_{10} Concentration



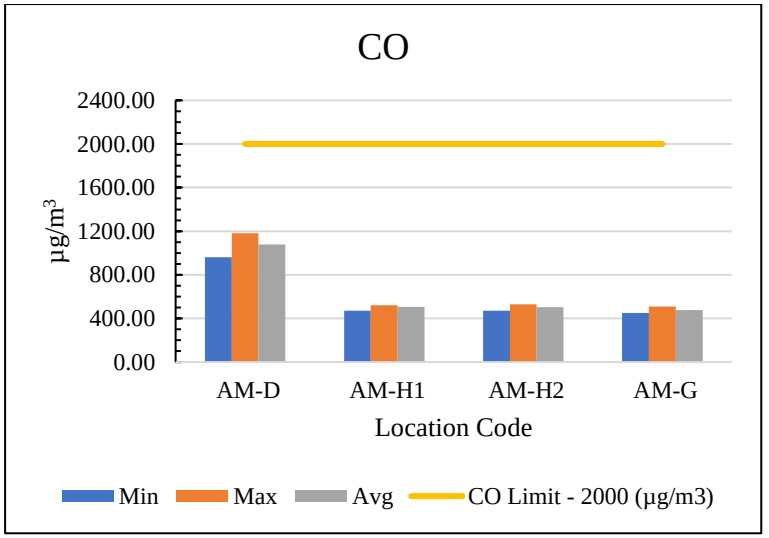
Graph 2: $PM_{2.5}$ Concentration



Graph 3: SO_2 Concentration



Graph 4: NOx Concentration



Graph 5: CO Concentration

2.1.2 Observations:

The concentration of ambient air quality monitoring results was compared with the National Ambient Air Quality Standards (NAAQS), 2009 specified by the Central Pollution Control Board (CPCB).

- **Dahej:**
  - The average concentration of $PM_{2.5}$, SO_2, NOx, CO, Benzene, Hydrocarbons, Non-methane VOCs, and VOCs were found within the standard limit.
  - PM_{10} concentration was found in the range of 52.01 – 341.21 µg/m^3 with an average concentration of 158.30 µg/m^3 against the standard concentration of 100 µg/m^3.
- **Hazira:**
  - The average concentration of $PM_{2.5}$, SO_2, NO_x, CO, Benzene, Hydrocarbons, Non-methane VOCs, and VOCs were within the standard limit.
  - PM_{10} was found in the range of 65.68 – 297.62 µg/m^3 with an average concentration of 157.72 µg/m^3 at AM-H1 location and 156.94 µg/m^{3}at AM-H2 location against the standard concentration of 100 µg/m^3.
- **Ghogha:**
  - The average concentration of $PM_{2.5}$, SO_2, NO_x, CO, Benzene, Hydrocarbons, Non-methane VOCs, and VOCs were observed within the standard limit.
  - PM_{10} was found in the range of 31.90 – 185.67 µg/m^3 with an average concentration of 104.37 µg/m^3 against the standard concentration of 100 µg/m^3.
- The high concentration of PM_{10} could be attributed to vehicular movement in the port area and surrounding road dust, causing the dispersion of emitted particulate matter in the ambient air.

2.1.3 Preventive measures:

- Water sprinkling on roads should be practiced to reduce dust suspension and its emission during vehicular movement.
- The primary port-related particulate matter sources are from the exhaust of engines of the power landside equipment, Seagoing marine vehicles, Ro-pax facilities operated at Hazira and Ghogha for loading and unloading vehicles, and other industrial and commercial sources that burn fuel. This can be controlled by regular maintenance of the engines of the power landside equipment, Seagoing marine vehicles, and Ro-pax facilities. Further, verification of the Pollution Under Control (PUC) Certificate of vehicles loading into the Ro-pax ferry and within the port area can also help in reducing

emissions.

- Practice should be initiated by using masks as a preventative measure, to avoid the health risk associated with the inhalation of dust particles to the person working in the port area.

2.2 Drinking water monitoring

Drinking water sampling was carried out once a month at three locations i.e., 1 at Dahej, 1 at Hazira and 1 at Ghogha.

2.2.1 Statistical Data and Graphs

The station-wise summarized results are compared with the stipulated standards as per IS 10500:2012 and mentioned in **Table 5** and the **Graphs 6 and 7** show the graphical representation of the data with mean values of the parameters.

Table 5: Summarized results of Drinking water quality monitoring

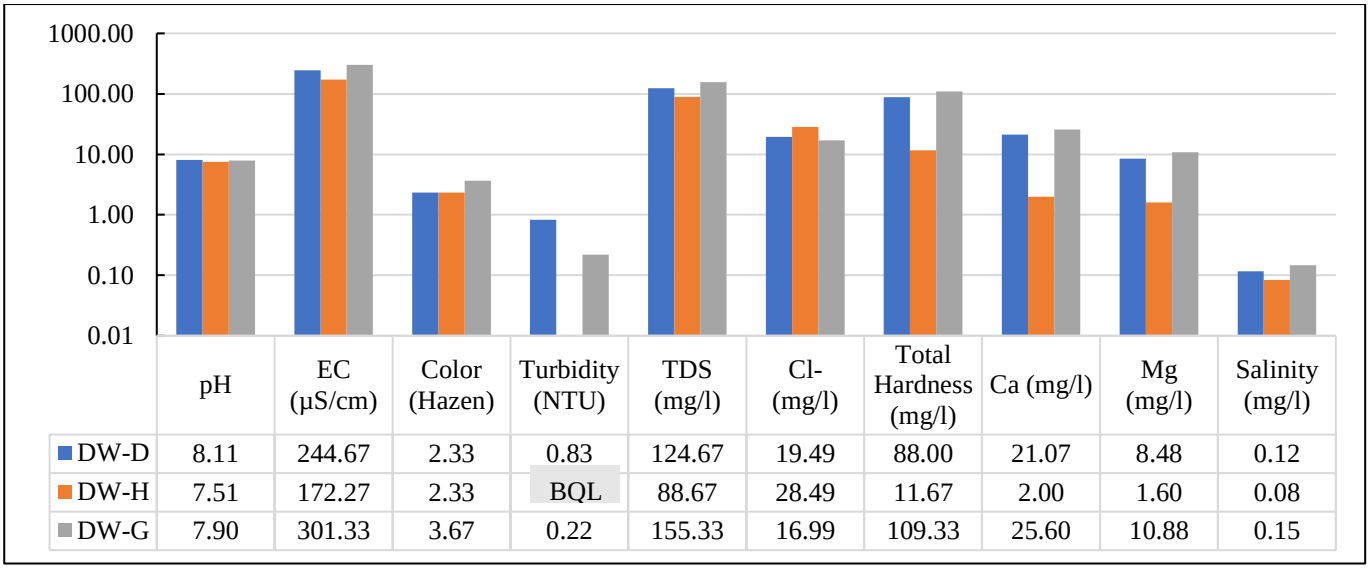
Sr. No.	Parameters	Unit	Acceptable limit	Permissible limit	Location Code & Sampling Date			
			Standards IS 10500:2012			DW-D	DW-H	DW-G
1	pH	-	6.5-8.5	No Relaxation	Min	7.99	7.27	7.78
					Max	8.31	7.63	7.96
					Avg.	8.11	7.51	7.90
2	EC	µS/cm	-	-	Min	237.00	163.00	292.00
					Max	250.00	181.20	309.00
					Avg.	244.67	172.27	301.33
3	TDS	mg/L	500	2000	Min	120.00	82.00	154.00
					Max	128.00	96.00	156.00
					Avg.	124.67	88.67	155.33
4	Chloride	mg/L	250	1000	Min	17.49	25.99	15.00
					Max	20.99	29.99	18.99
					Avg.	19.49	28.49	16.99
5	Total Hardness	mg/L	200	600	Min	82.00	11.00	90.00
					Max	96.00	12.00	120.00
					Avg.	88.00	11.67	109.33
6	Calcium as Ca	mg/L	75	200	Min	20.00	1.20	20.00
					Max	22.40	3.20	28.80
					Avg.	21.07	2.00	25.60
7	Magnesium as Mg	mg/L	30	100	Min	6.24	0.96	9.60
					Max	10.56	1.92	12.00
					Avg.	8.48	1.60	10.88
8	Turbidity	NTU	1	5	Min	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)
					Max	2.48	BQL (QL=0.5)	0.66
					Avg.	0.83	BQL (QL=0.5)	0.22

Sr. No.	Parameters	Unit	Acceptable limit	Permissible limit	Location Code & Sampling Date			
			Standards IS 10500:2012			DW-D	DW-H	DW-G
9	Fluoride as F	mg/L	1	1.5	Min	BQL (QL=0.3)	BQL (QL=0.3)	BQL (QL=0.3)
					Max	BQL (QL=0.3)	BQL (QL=0.3)	0.36
					Avg.	BQL (QL=0.3)	BQL (QL=0.3)	0.23
10	SO_4	mg/L	200	400	Min	BQL (QL=10)	BQL (QL=10)	BQL (QL=10)
					Max	BQL (QL=10)	BQL (QL=10)	BQL (QL=10)
					Avg.	BQL (QL=10)	BQL (QL=10)	BQL (QL=10)
11	Na	mg/L	-	-	Min	12.68	25.12	14.60
					Max	16.57	28.41	17.49
					Avg.	14.43	27.03	16.03
12	K	mg/L	-	-	Min	BQL (QL=5)	BQL (QL=5)	BQL (QL=5)
					Max	BQL (QL=5)	BQL (QL=5)	BQL (QL=5)
					Avg.	BQL (QL=5)	BQL (QL=5)	BQL (QL=5)
13	NO_3	mg/L	45	No relaxation	Min	3.16	BQL (QL=1)	5.79
					Max	4.72	9.18	8.91
					Avg.	4.04	5.39	7.07
14	NO_2	mg/L	-	-	Min	BQL (QL=0.1)	BQL (QL=0.1)	BQL (QL=0.1)
					Max	BQL (QL=0.1)	BQL (QL=0.1)	BQL (QL=0.1)
					Avg.	BQL (QL=0.1)	BQL (QL=0.1)	BQL (QL=0.1)
15	Odour	TON	Agreeable	Agreeable	Min	1.00	1.00	1.00
					Max	1.00	1.00	1.00
					Avg.	1.00	1.00	1.00
16	Hg	mg/L	0.001	No relaxation	Min	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)
					Max	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)
					Avg.	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)
17	Salinity	mg/L	-	-	Min	0.11	0.08	0.14
					Max	0.12	0.09	0.15
					Avg.	0.12	0.08	0.15
18		mg/L	0.2	1	Min	BQL	BQL	BQL

Sr. No.	Parameters	Unit	Acceptable limit	Permissible limit	Location Code & Sampling Date			
			Standards IS 10500:2012			DW-D	DW-H	DW-G
	Free Residual Cl					(QL=2)	(QL=2)	(QL=2)
					Max	BQL (QL=2)	BQL (QL=2)	BQL (QL=2)
					Avg.	BQL (QL=2)	BQL (QL=2)	BQL (QL=2)
19	Pb	mg/L	0.01	No relaxation	Min	BQL (QL=0.002)	BQL (QL=0.002)	BQL (QL=0.002)
					Max	BQL (QL=0.002)	BQL (QL=0.002)	BQL (QL=0.002)
					Avg.	BQL (QL=0.002)	BQL (QL=0.002)	BQL (QL=0.002)
20	Cd	mg/L	0.003	No relaxation	Min	BQL (QL=0.002)	BQL (QL=0.002)	BQL (QL=0.002)
					Max	BQL (QL=0.002)	BQL (QL=0.002)	BQL (QL=0.002)
					Avg.	BQL (QL=0.002)	BQL (QL=0.002)	BQL (QL=0.002)
21	Fe	mg/L	0.3	No relaxation	Min	BQL (QL=0.1)	BQL (QL=0.1)	BQL (QL=0.1)
					Max	0.119	BQL (QL=0.1)	BQL (QL=0.1)
					Avg.	0.04	BQL (QL=0.1)	BQL (QL=0.1)
22	Total Cr	mg/L	0.05	No relaxation	Min	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
					Max	BQL (QL=0.005)	BQL (QL=0.005)	0.018
					Avg.	BQL (QL=0.005)	BQL (QL=0.005)	0.006
23	Hexavalent Cr	mg/L	-	-	Min	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)
					Max	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)
					Avg.	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)
24	Cu	mg/L	0.05	1.5	Min	BQL (QL=0.005)	BQL QL=0.005)	BQL (QL=0.005)
					Max	0.007	BQL (QL=0.005)	0.006
					Avg.	0.004	BQL QL=0.005)	0.002
25	Zn	mg/L	5	15	Min	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)
					Max	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)

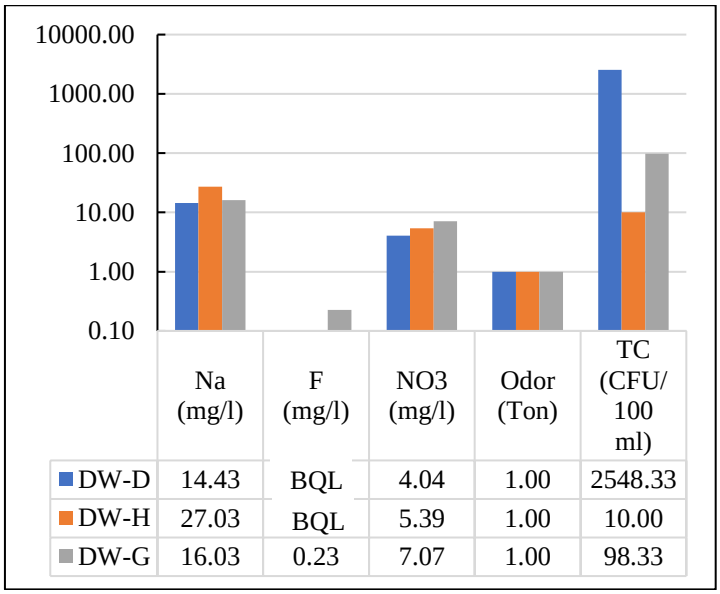
Sr. No.	Parameters	Unit	Acceptable limit	Permissible limit	Location Code & Sampling Date			
			Standards IS 10500:2012			DW-D	DW-H	DW-G
					Avg.	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)
26	As	mg/L	0.01	0.05	Min	BQL (QL=0.005)	BQL QL=0.005)	BQL (QL=0.005)
					Max	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
					Avg.	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
27	Colour	Hazen	5	15	Min	1.00	1.00	1.00
					Max	5.00	5.00	5.00
					Avg.	2.33	2.33	3.67
28	TSS	mg/L	-	-	Min	BQL (QL=2)	BQL (QL=2)	BQL (QL=2)
					Max	BQL (QL=2)	BQL (QL=2)	BQL (QL=2)
					Avg.	BQL (QL=2)	BQL (QL=2)	BQL (QL=2)
29	Microbiologi-cal (MPN) Total Coliform (TC)	CFU/ 100ml	Absent/100ml Shall not be detected		Min	1360	BQL (QL =1)	40
					Max	4100	30.00	205
					Avg.	2548.33	10.00	98.33
30	Mn	mg/L	0.1	0.3	Min	BQL (QL=0.04)	BQL (QL=0.04)	BQL (QL=0.04)
					Max	BQL (QL=0.04)	BQL (QL=0.04)	BQL (QL=0.04)
					Avg.	BQL (QL=0.04)	BQL (QL=0.04)	BQL (QL=0.04)

BQL- Below Quantification Limit



	pH	EC (µS/cm)	Color (Hazen)	Turbidity (NTU)	TDS (mg/l)	Cl- (mg/l)	Total Hardness (mg/l)	Ca (mg/l)	Mg (mg/l)	Salinity (mg/l)
DW-D	8.11	244.67	2.33	0.83	124.67	19.49	88.00	21.07	8.48	0.12
DW-H	7.51	172.27	2.33	BQL	88.67	28.49	11.67	2.00	1.60	0.08
DW-G	7.90	301.33	3.67	0.22	155.33	16.99	109.33	25.60	10.88	0.15

Graph 6: Average results of Physico-Chemical parameters of Drinking water



	Na (mg/l)	F (mg/l)	NO3 (mg/l)	Odor (Ton)	TC (CFU/ 100 ml)
DW-D	14.43	BQL	4.04	1.00	2548.33
DW-H	27.03	BQL	5.39	1.00	10.00
DW-G	16.03	0.23	7.07	1.00	98.33

Graph 7: Average results of Physico-Chemical and Biological parameters of Drinking water

2.2.2 Observations:

The samples were collected from the respective RO system at the monitored locations. The following were observed from the results of drinking water samples.

- At all three locations, Dahej, Hazira, and Ghogha, the concentration of all the physicochemical, minerals and heavy metals was found to be within the standard acceptable limit.
- The total coliform content was detected in the samples, 1360-4100 CFU/100 ml at Dahej, BQL-30 CFU/100 ml at Hazira and 40-205 CFU/100 ml at Ghogha.

2.2.3 Preventive measures:

- The presence of Total Coliforms in samples of all the three locations indicates the microbiological contamination. Therefore, regular cleaning and maintenance of the RO system is recommended. The disinfection system should be replaced to prevent the contamination of water from coliform.

2.3 Noise level monitoring

Noise monitoring was conducted at all four locations, i.e., 1 at Dahej, 2 at Hazira and 1 at Ghogha. The Noise has been monitored once a month at all the locations for 24 hours.

2.3.1 Statistical Data and Graphs

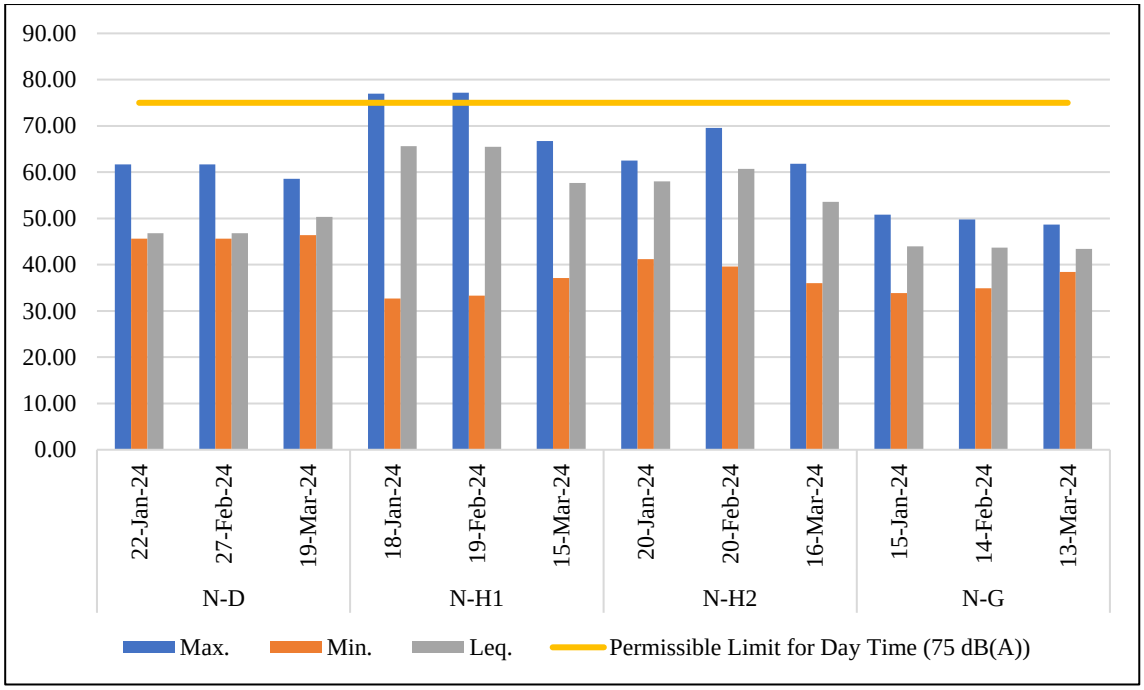
The station-wise summarized results of the Noise monitoring are mentioned in **Table 6** and **Graph 8 to 9** below and are compared with the prescribed limit of noise level as per the Noise 2000 Standards of Environment Protection Rules and shown in **Table 7**.

Table 6: Summarized results of Noise Monitoring

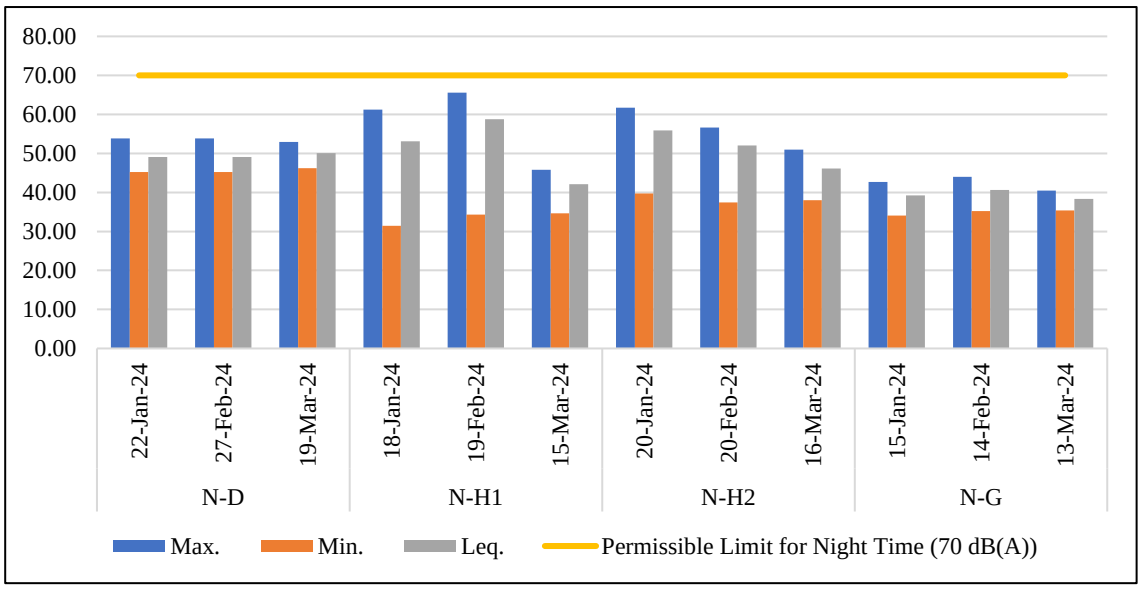
Quarterly Result for Noise monitoring		Location Code N-D			Location Code N-H1			Location Code N-H2			Location Code N-G		
		Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
Day Time	Leq.	46.8	50.3	48.0	57.7	65.6	62.9	53.6	60.7	60.7	43.4	44.0	43.7
Night Time	Leq.	49.1	50.1	49.4	42.1	58.8	51.3	46.1	55.9	55.9	38.3	40.6	39.4

Table 7: Ambient air quality norms in respect of Noise

Area Code	Type of area	Noise dB(A) Leq	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silent zone	50	40



Graph 8: Average Leq results of day time Ambient noise



Graph 9: Average Leq results of night time Ambient noise

2.3.2 Observations:

Average Leq noise levels for Day and Night time at all locations were found below the respective maximum permissible limits defined for “Industrial area”.

2.4 Soil quality monitoring

Soil quality monitoring was carried out at all three locations, 1 at Dahej, 1 at Hazira and 1 at Ghogha once a month.

2.4.1 Statistical Data and Graphs

The station-wise summarized results of the soil quality monitoring are shown in

Table 8 and **Graphs 10 & 11**. To classify the soil quality, the soil quality standards- "Soil fertility class by Soil Health card 2015" & "Standard limit EU 2002" have been adopted and shown in **Table 9**.

Table 8: Summarized results of Soil quality monitoring

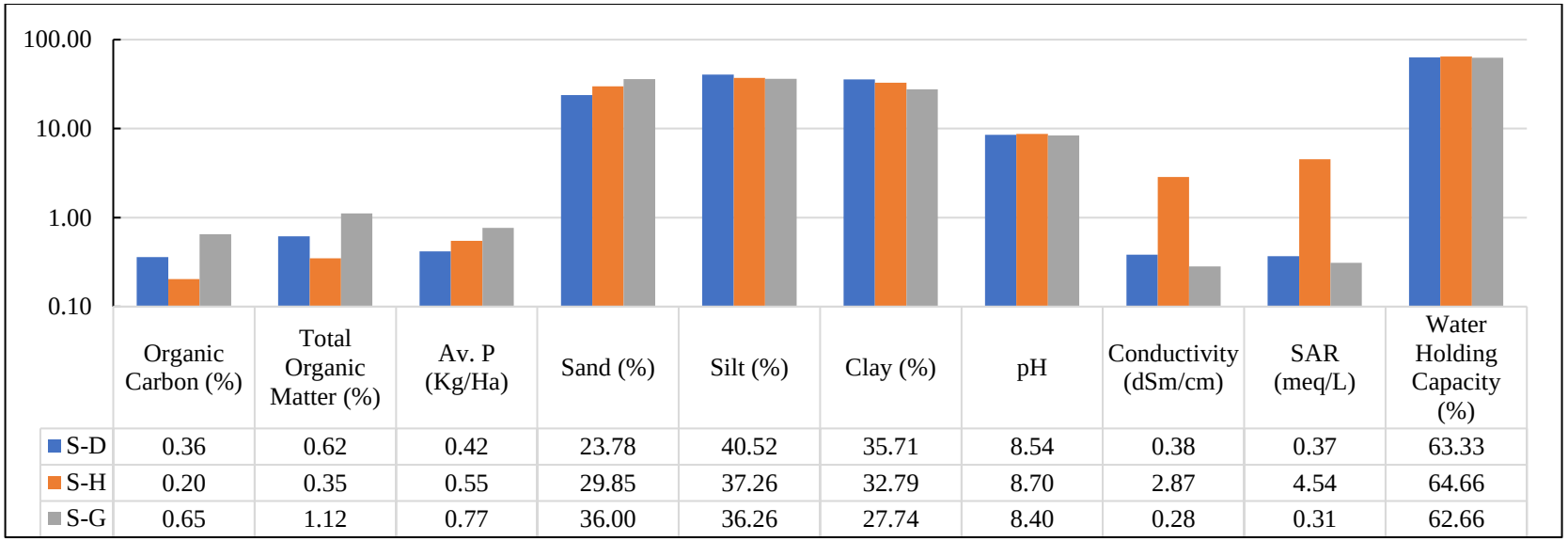
Sr. No.	Parameters		Unit		Sampling Locations code		
					S-D	S-H	S-G
1	Organic Carbon		%	Min	0.21	0.18	0.57
				Max	0.56	0.25	0.72
				Avg.	0.36	0.20	0.65
2	Total Organic Matter		%	Min	0.36	0.31	0.98
				Max	0.97	0.43	1.24
				Avg.	0.62	0.35	1.12
3	Inorganic Phosphate (Av. Phosphorous)		kg/Ha	Min	0.22	0.36	0.16
				Max	0.55	0.66	1.15
				Avg.	0.42	0.55	0.77
4	Particle size distribution & silt content	Sand	%	Min	14.64	26.42	28.64
				Max	39.00	32.33	49.01
				Avg.	23.78	29.85	36.00
5		Silt	%	Min	35.56	33.27	29.56
				Max	43.99	41.23	41.21
				Avg.	40.52	37.26	36.26
6		Clay	%	Min	25.44	26.45	21.44
				Max	43.36	40.01	33.36
				Avg.	35.71	32.79	27.74
7	pH		-	Min	8.39	8.62	8.23
				Max	8.69	8.75	8.54
				Avg.	8.54	8.70	8.40
8	Conductivity		dSm/cm	Min	0.37	2.51	0.27
				Max	0.39	3.40	0.30
				Avg.	0.38	2.87	0.28
9	SAR		meq/L	Min	0.28	3.38	0.07
				Max	0.44	5.75	0.76
				Avg.	0.37	4.54	0.31
10	Water Holding Capacity		%	Min	61.99	60	59.99
				Max	64.00	67.99	64.00
				Avg.	63.33	64.66	62.66
11	Al		mg/kg	Min	877.26	1286.373	654.10
				Max	15883.77	13666.43	10536.88
				Avg.	6028.24	5559.05	4064.32
12	Cr		mg/kg	Min	84.27	84.16	63.15
				Max	89.87	91.62	78.78
				Avg.	87.22	87.00	73.28
13	Ni		mg/kg	Min	41.06	38.287	34.10
				Max	45.03	42.96	41.77
				Avg.	42.71	39.98	37.72
14	Cu		mg/kg	Min	77.51	59.88	49.47

Sr. No.	Parameters	Unit	Sampling Locations code			
				S-D	S-H	S-G
			Max	79.62	77.37	67.27
			Avg.	78.72	65.84	57.48
15	Zn	mg/kg	Min	55.24	52.817	60.61
			Max	57.86	65.18	70.65
			Avg.	56.90	57.70	64.67
16	Cd	mg/kg	Min	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
			Max	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
			Avg.	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
17	Pb	mg/kg	Min	3.30	2.65	6.04
			Max	4.12	3.48	7.84
			Avg.	3.82	3.12	6.69
18	As	mg/kg	Min	3.43	3.08	6.20
			Max	3.95	3.44	8.63
			Avg.	3.66	3.25	7.12
19	Hg	mg/kg	Min	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
			Max	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
			Avg.	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)

BQL – Below Quantification Limit, QL- Quantification Limit

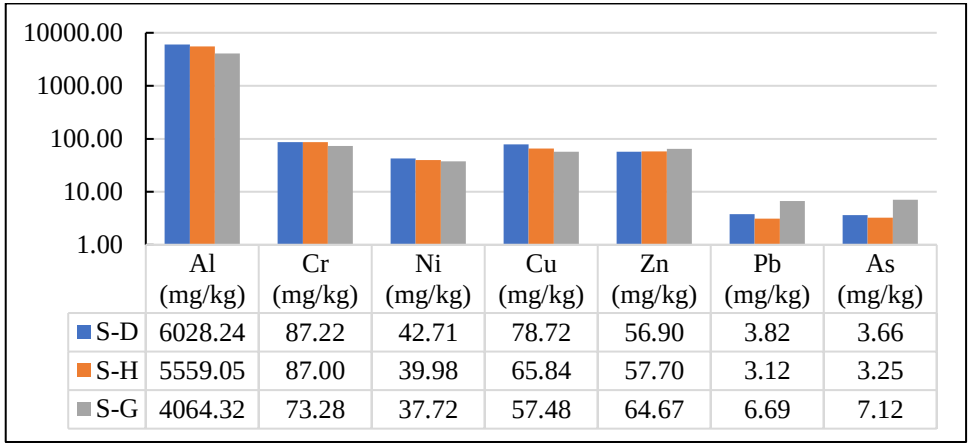
Table 9: Soil quality standard

Soil fertility class by Soil Health Card (SHC 2015)				
Sr. No.	Parameter	Range & Interpretation of Result		
1	pH	Acidic <6.5	Normal 6.5-8.2	Alkaline >8.2
2	Electrical Conductivity (dSm/m)	Normal <1	Medium 1-3	Harmful >3
3	Available Phosphorus (kg/Ha)	Low < 28	Medium 28-56	High >56
4	Organic Carbon (%)	Low < 0.5	Medium 0.5-0.75	High > 0.75
5	Zinc (mg/kg)	Low < 0.5	Medium 0.5-1.0	High >1.0
6	Copper (mg/kg)	Low < 0.2	Medium 0.2-0.4	High >0.4
Standard limit EU 2002				
7	Chromium (mg/kg)	150		
8	Lead (mg/kg)	300		
9	Cadmium (mg/kg)	3.0		
10	Nickel (mg/kg)	75		



	Organic Carbon (%)	Total Organic Matter (%)	Av. P (Kg/Ha)	Sand (%)	Silt (%)	Clay (%)	pH	Conductivity (dSm/cm)	SAR (meq/L)	Water Holding Capacity (%)
S-D	0.36	0.62	0.42	23.78	40.52	35.71	8.54	0.38	0.37	63.33
S-H	0.20	0.35	0.55	29.85	37.26	32.79	8.70	2.87	4.54	64.66
S-G	0.65	1.12	0.77	36.00	36.26	27.74	8.40	0.28	0.31	62.66

Graph 10: Average results of soil quality parameters



	Al (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Pb (mg/kg)	As (mg/kg)
S-D	6028.24	87.22	42.71	78.72	56.90	3.82	3.66
S-H	5559.05	87.00	39.98	65.84	57.70	3.12	3.25
S-G	4064.32	73.28	37.72	57.48	64.67	6.69	7.12

Graph 11: Average results of metals of soil

2.4.2 Observations:

- The pH value in Hazira, Dahej, and Ghogha was found alkaline in nature.
- The Electrical Conductivity was found in the 'Normal' class at Dahej and Ghogha; whereas, at Hazira, it was found in the range of 2.51 – 3.40 dSm/cm respectively, and the average concentrations 2.87 fall into the 'Medium' class.
- The texture of the Soil was found to vary during Jan-Feb'24, Feb-Mar'24 and Mar-Apr'24 months. It was found to be between Loam to Silty Clay Loam at Dahej, Loam to Clay at Hazira and Loam to Clay loam class at Ghogha.
- The Organic Carbon falls under the 'Low fertility' quality class at Dahej and Hazira. Whereas, it was found in the range of 0.57 – 0.72 % with an average concentration of 0.65% at Ghogha and falls into the 'Medium' quality class.
- The concentration of copper falls under the 'High quality' class at all locations.
- The concentration of available Phosphorus falls under the 'Low fertility' quality class at all three locations.
- The concentration of zinc was observed in the 'High' fertility class at all three locations.
- Metals such as Cr, Pb, Cd, and Ni were detected within permissible limits at all locations.
- The soil monitoring locations are coastal soils and exhibit saline soil characteristics. The overall soils were found to have low essential nutrients, hence less suitable for plant growth.

2.5 Marine Water, Sediment & Ecology Monitoring

Marine water, sediment, and ecology monitoring was carried out at five locations, 1 at Dahej, 2 at Hazira, and 2 at Ghogha once a month.

2.5.1 Marine water quality monitoring

The Marine water samples collected once a month from the locations of Dahej, Hazira & Ghogha.

2.5.1.1 Statistical Data and Graphs

The station-wise summarized results of the marine water monitoring are mentioned in **Table 10** and compared with the water quality criteria for the designated best use for the coastal water stipulated as per "The Environment (Protection) Act, 1986 as listed in **Table 11**, and **Graph 12 to 14** below.

Table 10: Summarized results of Marine water quality monitoring

Sr. No	Parameters	Unit		Location Code				
				MA-D	MA-H1	MA-H2	MA-G1	MA-G2
1	EC	µS/cm	Min	44000.00	46200.00	46600.00	46700.00	46800.00
			Max	46300.00	48000.00	49000.00	47900.00	47400.00
			Avg.	45366.67	47200.00	47700.00	47266.67	47100.00
2	DO	mg/L	Min	6.80	5.60	5.90	6.80	7.10
			Max	7.60	7.10	6.20	7.30	7.30
			Avg.	7.27	6.10	6.03	7.00	7.17
3	pH	-	Min	7.91	7.66	7.73	7.94	7.92
			Max	8.03	7.85	7.81	8.11	8.12
			Avg.	7.97	7.77	7.77	8.02	8.02
4	Colour	Hazen	Min	1.00	5.00	5.00	5.00	5.00
			Max	5.00	15.00	10.00	5.00	5.00
			Avg.	3.67	11.67	8.33	5.00	5.00
5	Odour	TON	Min	1.00	1.00	1.00	1.00	1.00
			Max	1.00	1.00	1.00	1.00	1.00
			Avg.	1.00	1.00	1.00	1.00	1.00
6	Turbidity	NTU	Min	>500 (QL=500)	>500 (QL=500)	>500 (QL=500)	>500 (QL=500)	>500 (QL=500)
			Max	421.00	544.00	298.00	>500 (QL=500)	398.00
			Avg.	140.33	372.33	127.13	>500 (QL=500)	159.67
7	TDS	mg/L	Min	30388.00	32456.00	28576.00	32620.00	32254.00
			Max	32654.00	33964.00	33878.00	34480.00	34380.00
			Avg.	30776.67	33204.00	33052.00	33588.00	33447.33
8	TSS	mg/L	Min	504.00	186.00	174.00	626.00	318.00
			Max	956.00	718.00	778.00	860.00	870.00
			Avg.	680.00	435.33	463.33	746.67	510.00
9	Particulate Organic Carbon	mg/L	Min	3.18	0.77	0.78	2.93	0.63
			Max	5.91	5.47	3.21	4.16	4.92
			Avg.	4.70	2.71	1.95	3.41	3.15
10	COD	mg/L	Min	33.80	20.40	40.00	51.46	62.14
			Max	69.80	49.52	72.90	68.10	87.60
			Avg.	56.42	36.64	52.43	62.12	77.25
11	BOD	mg/L	Min	BQL (QL=3)	3.83	4.40	3.40	4.38
			Max	8.73	6.19	9.11	8.35	10.25
			Avg.	5.65	4.67	6.17	6.06	7.47
12	Silica	mg/L	Min	>5(DL=5)	>5(DL=5)	>5(DL=5)	>5(DL=5)	>5(DL=5)
			Max	>5(DL=5)	4.73	4.39	>5(DL=5)	4.31
			Avg.	>5(DL=5)	3.15	0.19	>5(DL=5)	0.60
13	PO_4	mg/L	Min	0.53	BQL (QL=0.005)	BQL (QL=0.005)	0.54	BQL (QL=0.005)
			Max	0.85	0.53	0.56	0.67	1.22
			Avg.	1.33	0.18	0.19	0.59	0.60
14	SO_4	mg/L	Min	1620.50	1920.40	1924.80	1698.50	1807.40
			Max	2041.70	2161.00	2243.20	2070.00	1896.95

Sr. No	Parameters	Unit		Location Code				
				MA-D	MA-H1	MA-H2	MA-G1	MA-G2
			Avg.	1877.77	2027.10	2100.33	1890.27	1854.02
15	NO_3	mg/L	Min	4.57	BQL (QL=1)	BQL (QL=1)	5.25	5.10
			Max	5.42	7.45	7.41	5.47	5.50
			Avg.	4.97	4.60	4.33	5.38	5.34
16	NO_2	mg/L	Min	BQL (QL=0.1)	BQL (QL=0.1)	BQL (QL=0.1)	BQL (QL=0.1)	BQL (QL=0.1)
			Max	BQL (QL=0.1)	0.54	0.33	BQL (QL=0.1)	BQL (QL=0.1)
			Avg.	BQL (QL=0.1)	0.28	0.19	BQL (QL=0.1)	BQL (QL=0.1)
17	Na	mg/L	Min	7315.00	8461.00	8272.00	8317.00	8444.00
			Max	7926.00	>10,000 (QL=10,000)	>10,000 (QL=10,000)	11565.00	9501.00
			Avg.	7618.00	5799.33	8940.00	9431.00	8985.33
18	K	mg/L	Min	215.00	231.84	232.00	278.00	246.00
			Max	274.70	388.00	434.00	340.00	330.00
			Avg.	248.23	307.28	320.33	303.67	289.00
19	Mn	mg/L	Min	0.19	0.04	BQL (QL=0.04)	0.18	0.05
			Max	0.82	0.22	0.85	0.79	0.97
			Avg.	0.42	0.11	0.30	0.41	0.65
20	Fe	mg/L	Min	2.35	0.87	1.14	2.51	0.93
			Max	9.34	2.99	11.97	11.62	13.79
			Avg.	5.62	1.71	4.75	6.16	6.80
21	Total Cr	mg/L	Min	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	0.007	BQL (QL=0.005)
			Max	0.020	0.007	0.030	0.031	0.035
			Avg.	0.013	0.002	0.010	0.017	0.017
22	Hexavalent Cr	mg/L	Min	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)
			Max	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)
			Avg.	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)	BQL (QL=0.01)
23	Cu	mg/L	Min	0.014	BQL (QL=0.005)	BQL (QL=0.005)	0.011	0.007
			Max	0.038	0.014	0.048	0.049	0.058
			Avg.	0.023	0.005	0.016	0.026	0.032
24	Cd	mg/L	Min	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
			Max	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
			Avg.	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
25	As	mg/L	Min	BQL	BQL	BQL	BQL	BQL

Sr. No	Parameters	Unit		Location Code				
				MA-D	MA-H1	MA-H2	MA-G1	MA-G2
				(QL=0.005)	(QL=0.005)	(QL=0.005)	(QL=0.005)	(QL=0.005)
			Max	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	0.015	0.021
			Avg.	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	0.005	0.007
26	Pb	mg/L	Min	BQL (QL=0.002)	BQL (QL=0.002)	BQL (QL=0.002)	0.002	0.002
			Max	0.015	BQL (QL=0.002)	0.006	0.007	0.009
			Avg.	0.006	BQL (QL=0.002)	0.002	0.005	0.005
27	Zn	mg/L	Min	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)
			Max	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)
			Avg.	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)	BQL (QL=0.5)
28	Hg	mg/L	Min	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)
			Max	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)
			Avg.	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)	BQL (QL=0.0005)
29	Oil & grease	mg/L	Min	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
			Max	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
			Avg.	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
30	Micro-biological TC (MPN)	100 ml/ MPN	Min	2.00	BQL (QL =2)	9.00	BQL (QL =2)	BQL (QL =2)
			Max	8.00	130.00	130.00	240.00	9.00
			Avg.	4.67	50.67	53.33	110.00	3.00
31	Micro-biological FC (MPN)	100 ml/ MPN	Min	2.00	BQL (QL =2)	2.00	BQL (QL =2)	BQL (QL =2)
			Max	8.00	130.00	17.00	240.00	9.00
			Avg.	4.67	46.33	7.67	82.00	3.00
32	Density	kg/ m^3	Min	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)
			Max	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)
			Avg.	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)	>1000 (QL=1000)

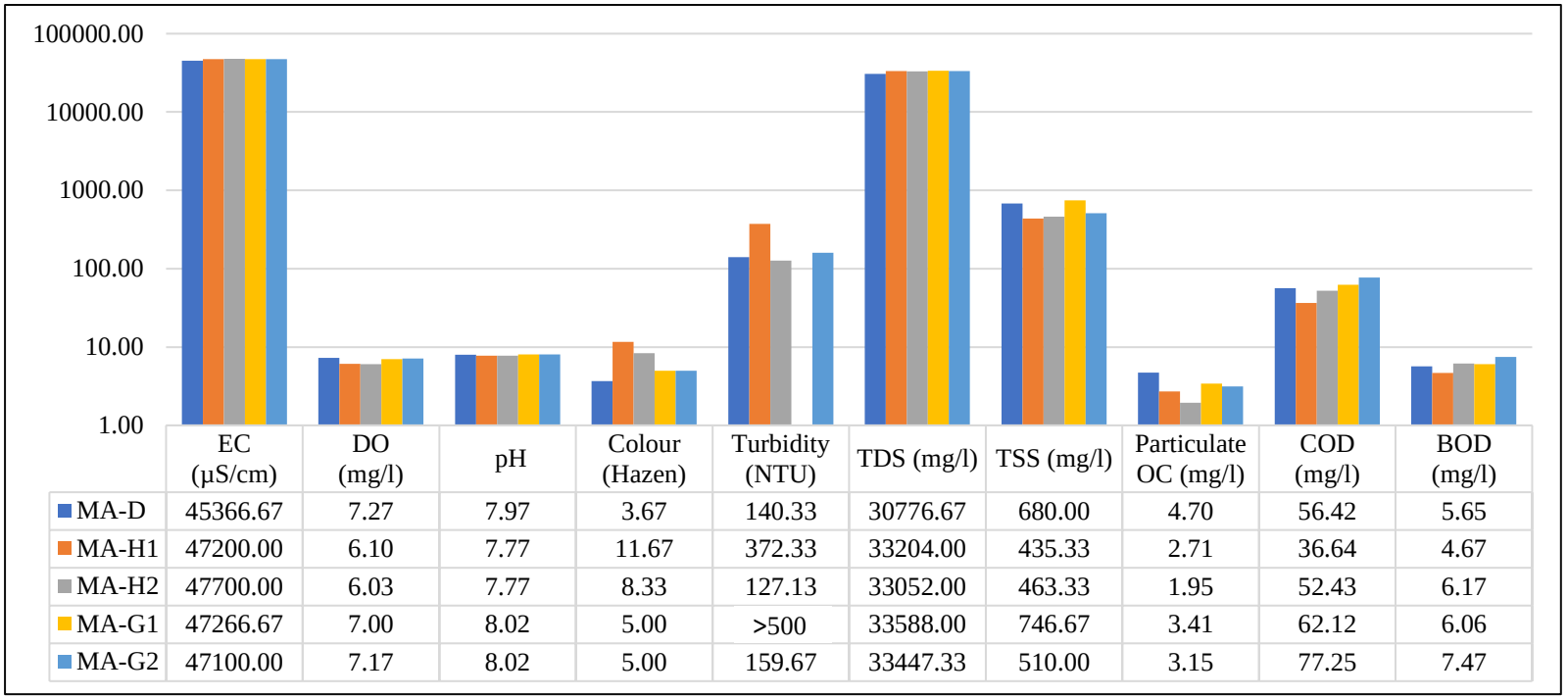
Sr. No	Parameters	Unit	Location Code					
				MA-D	MA-H1	MA-H2	MA-G1	MA-G2
33	Floating material (Scum, Petroleum products)		Min	ND	ND	ND	ND	ND
			Max	ND	ND	ND	ND	ND
			Avg	ND	ND	ND	ND	ND

BQL-Below Quantification Limit, QL- Quantification Limit

Table 11: Water quality criteria: primary water quality criteria for designated best uses for coastal waters [as per "the Environment (Protection) act, 1986]

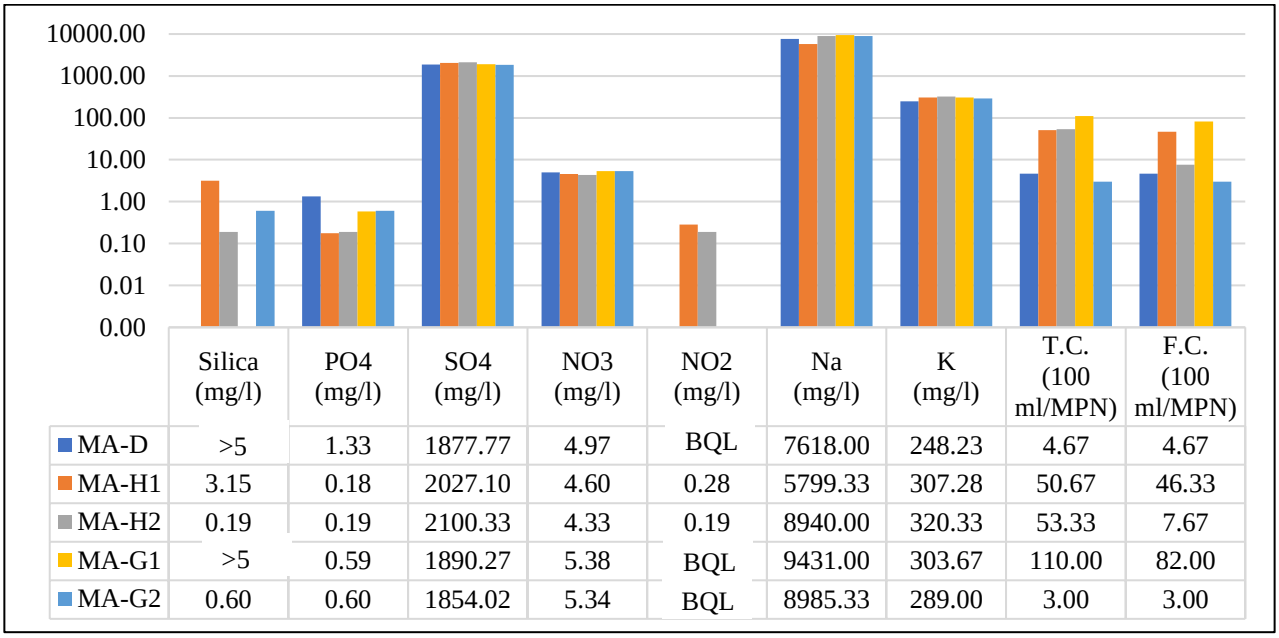
Parameters	SW-I	SW-II	SW-III	SW-IV	SW-V
pH	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.0 – 9.0	6.0 – 9.0
Dissolved oxygen (as O_2), mg/L, min	5 or 60% of saturation value, whichever is higher	4 or 50% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher	3 or 40% of saturation value, whichever is higher
Color & Odour	No noticeable color or offensive odour	No noticeable color or offensive odour	No noticeable color or offensive odour	No noticeable color or offensive odour	None in such concentrations that would impair any usages specifically assigned to this class
Floating matters	No visible, obnoxious floating debris, oil slick, scum	Nothing obnoxious or detrimental for use purpose	No visible, obnoxious floating debris, oil slick, scum	10 mg/L max. (including Oil & grease & scum / petroleum products)	-
Oil & grease, mg/L max. (including petroleum products)	0.1	-	-		-
Suspended solids	None from sewage & industrial origin	-	-	-	-
Heavy metals • Mercury, mg/L (as Hg) • Lead, mg/L (as Pb) • Cadmium, mg/L (as Cd)	• 0.001 • 0.001 • 0.01	-	-	-	-
Turbidity, NTU max.	-	30	30	-	-

Parameters	SW-I	SW-II	SW-III	SW-IV	SW-V
Fecal coliforms, MPN/100ml, max	-	100	500	500	500
BOD, mg/L, 3 days at27°C, max	-	3	-	5	-
Dissolved iron, mg/L max (as Fe)	-	-	0.5	-	-
Dissolved manganese, mg/L max (as Mn)	-	-	0.5	-	-
Sludge deposits, solid refuse, floating solids, oil & grease, scum	-	-	-	-	None except for such a small amount that may result from discharge of appropriately treated sewage & or industrial waste
SW-I: Salt pans, shell fishing, mariculture, and ecologically sensitive zone SW-II: Bathing, contact water sports, and commercial fishing SW-III: Industrial cooling, recreation (non-contact), and aesthetics SW-IV: Harbor waters SW-V: Navigation and controlled waste disposal					



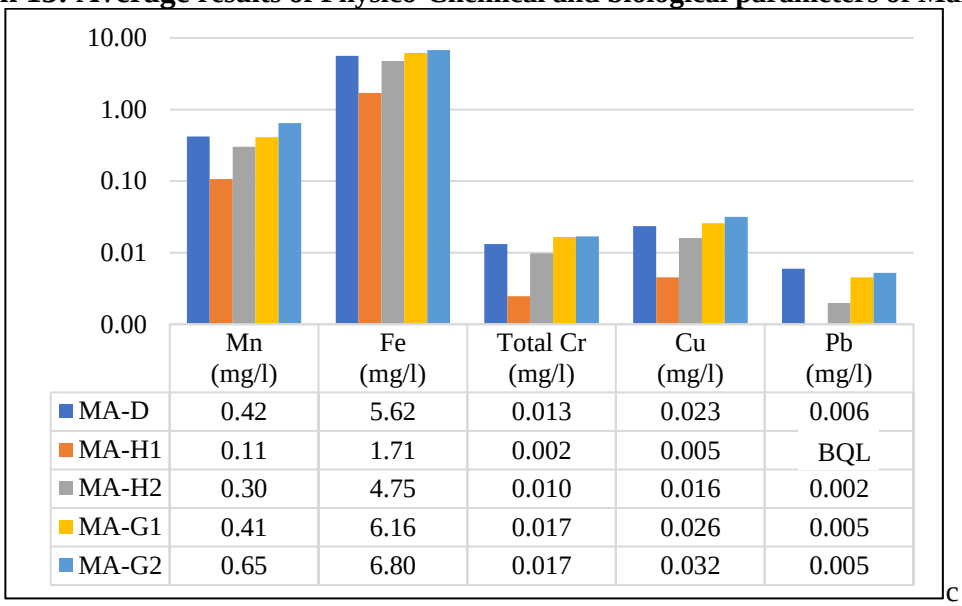
	EC (µS/cm)	DO (mg/l)	pH	Colour (Hazen)	Turbidity (NTU)	TDS (mg/l)	TSS (mg/l)	Particulate OC (mg/l)	COD (mg/l)	BOD (mg/l)
MA-D	45366.67	7.27	7.97	3.67	140.33	30776.67	680.00	4.70	56.42	5.65
MA-H1	47200.00	6.10	7.77	11.67	372.33	33204.00	435.33	2.71	36.64	4.67
MA-H2	47700.00	6.03	7.77	8.33	127.13	33052.00	463.33	1.95	52.43	6.17
MA-G1	47266.67	7.00	8.02	5.00	>500	33588.00	746.67	3.41	62.12	6.06
MA-G2	47100.00	7.17	8.02	5.00	159.67	33447.33	510.00	3.15	77.25	7.47

Graph 12: Average results of Physico-Chemical parameters of Marine water



	Silica (mg/l)	PO4 (mg/l)	SO4 (mg/l)	NO3 (mg/l)	NO2 (mg/l)	Na (mg/l)	K (mg/l)	T.C. (100 ml/MPN)	F.C. (100 ml/MPN)
MA-D	>5	1.33	1877.77	4.97	BQL	7618.00	248.23	4.67	4.67
MA-H1	3.15	0.18	2027.10	4.60	0.28	5799.33	307.28	50.67	46.33
MA-H2	0.19	0.19	2100.33	4.33	0.19	8940.00	320.33	53.33	7.67
MA-G1	>5	0.59	1890.27	5.38	BQL	9431.00	303.67	110.00	82.00
MA-G2	0.60	0.60	1854.02	5.34	BQL	8985.33	289.00	3.00	3.00

Graph 13: Average results of Physico-Chemical and biological parameters of Marine water



	Mn (mg/l)	Fe (mg/l)	Total Cr (mg/l)	Cu (mg/l)	Pb (mg/l)
MA-D	0.42	5.62	0.013	0.023	0.006
MA-H1	0.11	1.71	0.002	0.005	BQL
MA-H2	0.30	4.75	0.010	0.016	0.002
MA-G1	0.41	6.16	0.017	0.026	0.005
MA-G2	0.65	6.80	0.017	0.032	0.005

Graph 14: Average results of metals of Marine water

2.5.1.2 Observations:

- From the analysis results of the marine water samples collected from the various locations, the following points were observed.
- Surface water was found highly turbid due to the accumulation of high amounts of suspended solids and water currents.
- There were no oil slicks or floating trash at the sampling locations.
- Average BOD was found slightly higher in the range of BQL-8.73 mg/L at Dahej (MA-D), 4.40-9.11 mg/L at Hazira (MA-H2), 3.40-8.35 mg/L at Ghogha (MA-G1) and 4.38-10.25 mg/L at Ghogha (MA-G2) which may be due to human activities.

2.5.2 Marine sediment quality monitoring

The Marine sediment samples collected once a month from the locations of Dahej, Hazira & Ghogha.

2.5.2.1 Statistical Data and Graphs

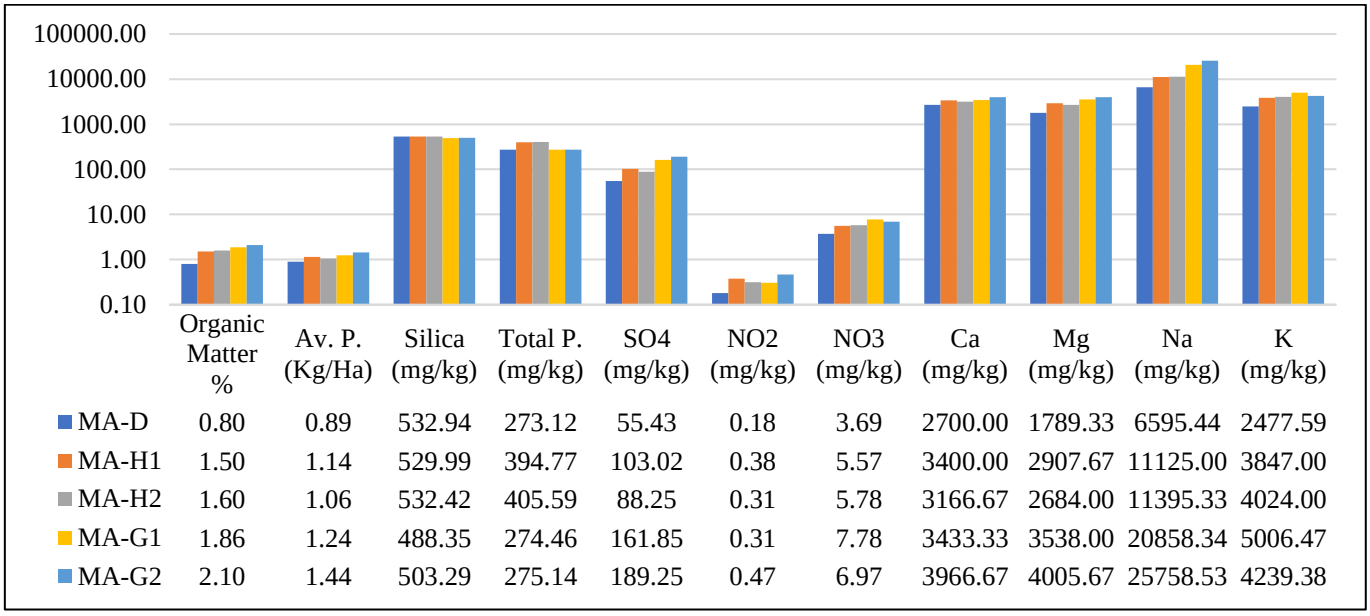
The station-wise summarized results of the marine sediment monitoring are mentioned in **Table 12** and **Graph 15 to 16** below.

Table 12: Summarized results of Marine Sediment Monitoring

Sr. No.	Parameters	Unit		Sampling Locations				
				MA-D	MA-H1	MA-H2	MA-G1	MA-G2
1	Organic Matter	%	Min	0.56	1.34	1.37	1.69	1.69
			Max	1.14	1.70	1.77	2.18	2.53
			Avg.	0.80	1.50	1.60	1.86	2.10
2	Inorganic phosphate (Av. phosphorus)	kg/Ha	Min	0.15	0.80	0.90	1.07	1.25
			Max	1.35	1.36	1.21	1.47	1.63
			Avg.	0.89	1.14	1.06	1.24	1.44
3	Silica	mg/kg	Min	521.01	524.62	526.12	462.54	476.38
			Max	543.78	538.76	539.06	529.72	540.34
			Avg.	532.94	529.99	532.42	488.35	503.29
4	Phosphate (Total Phosphorous)	mg/kg	Min	188.80	297.77	270.91	209.00	186.76
			Max	356.00	501.28	537.84	403.71	399.68
			Avg.	273.12	394.77	405.59	274.46	275.14
5	SO_4	mg/kg	Min	40.50	53.92	72.15	122.39	164.47
			Max	69.50	129.57	119.03	238.28	216.13
			Avg.	55.43	103.02	88.25	161.85	189.25
6	NO_2	mg/kg	Min	BQL (QL=0.1)	0.33	0.02	0.10	0.17
			Max	0.37	0.41	0.59	0.60	0.93
			Avg.	0.18	0.38	0.31	0.31	0.47
7	NO_3	mg/kg	Min	3.31	4.92	4.85	7.19	5.42
			Max	4.06	6.33	6.80	8.24	8.16
			Avg.	3.69	5.57	5.78	7.78	6.97
8	Ca	mg/kg	Min	2200.00	3200.00	3000.00	3000.00	2800.00
			Max	3400.00	3700.00	3300.00	4200.00	4800.00
			Avg.	2700.00	3400.00	3166.67	3433.33	3966.67
9	Mg	mg/kg	Min	915.00	2318.00	2257.00	2623.00	3477.00
			Max	2745.00	3355.00	3050.00	5246.00	4453.00
			Avg.	1789.33	2907.67	2684.00	3538.00	4005.67
10	Na	mg/kg	Min	3589.00	6903.00	7786.00	14130.00	18370.58
			Max	9058.00	14704.00	15440.00	32525.03	36285.00
			Avg.	6595.44	11125.00	11395.33	20858.34	25758.53
11	K	mg/kg	Min	1369.00	3278.00	3449.00	4383.00	3322.13
			Max	3854.00	4411.00	5025.00	6106.42	4716.00
			Avg.	2477.59	3847.00	4024.00	5006.47	4239.38
12	Al	mg/kg	Min	920.12	1272.65	1284.19	722.07	785.25
			Max	8634.23	18708.92	18096.01	1524.61	1538.85

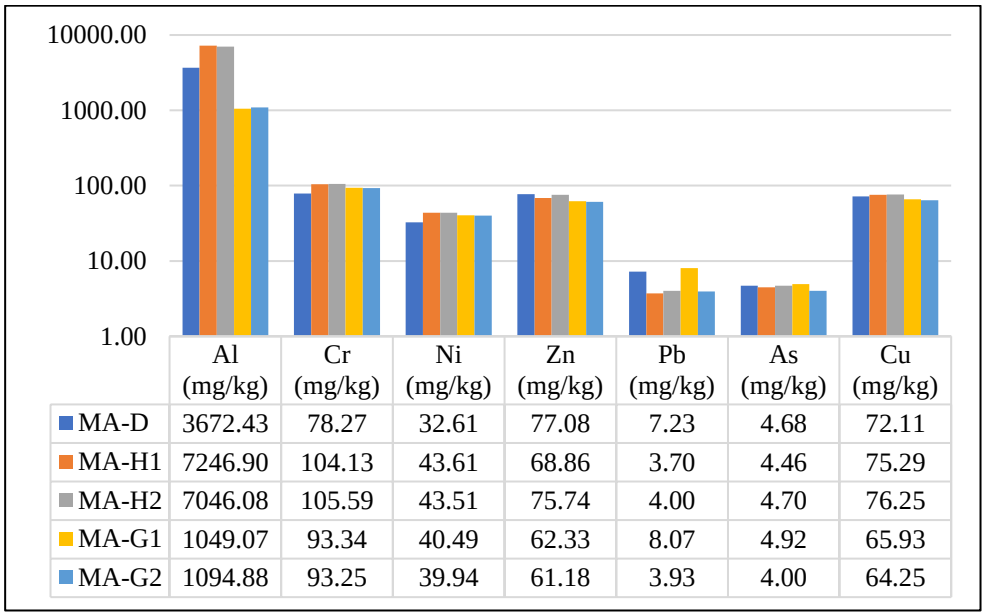
Sr. No.	Parameters	Unit		Sampling Locations				
				MA-D	MA-H1	MA-H2	MA-G1	MA-G2
			Avg.	3672.43	7246.90	7046.08	1049.07	1094.88
13	Cr	mg/kg	Min	61.27	102.76	101.89	86.57	91.23
			Max	90.28	106.01	108.77	100.14	95.09
			Avg.	78.27	104.13	105.59	93.34	93.25
14	Ni	mg/kg	Min	24.75	43.11	40.49	36.44	37.87
			Max	37.66	44.01	46.73	44.86	41.82
			Avg.	32.61	43.61	43.51	40.49	39.94
15	Zn	mg/kg	Min	71.64	64.87	66.20	61.36	60.31
			Max	80.33	75.98	80.52	64.20	62.10
			Avg.	77.08	68.86	75.74	62.33	61.18
16	Cd	mg/kg	Min	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
			Max	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
			Avg.	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)	BQL (QL=1)
17	Pb	mg/kg	Min	6.35	3.36	3.56	3.74	3.67
			Max	7.77	4.18	4.77	16.64	4.15
			Avg.	7.23	3.70	4.00	8.07	3.93
18	As	mg/kg	Min	4.07	3.85	3.68	3.94	3.68
			Max	5.78	5.04	5.83	6.59	4.47
			Avg.	4.68	4.46	4.70	4.92	4.00
19	Hg	mg/kg	Min	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
			Max	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
			Avg.	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)	BQL (QL=0.005)
20	Cu	mg/kg	Min	69.45	69.70	69.75	61.82	61.80
			Max	74.45	84.76	87.83	70.98	65.99
			Avg.	72.11	75.29	76.25	65.93	64.25

BQL – Below Quantification Limit, QL- Quantification Limit



	Organic Matter %	Av. P. (Kg/Ha)	Silica (mg/kg)	Total P. (mg/kg)	SO4 (mg/kg)	NO2 (mg/kg)	NO3 (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	Na (mg/kg)	K (mg/kg)
MA-D	0.80	0.89	532.94	273.12	55.43	0.18	3.69	2700.00	1789.33	6595.44	2477.59
MA-H1	1.50	1.14	529.99	394.77	103.02	0.38	5.57	3400.00	2907.67	11125.00	3847.00
MA-H2	1.60	1.06	532.42	405.59	88.25	0.31	5.78	3166.67	2684.00	11395.33	4024.00
MA-G1	1.86	1.24	488.35	274.46	161.85	0.31	7.78	3433.33	3538.00	20858.34	5006.47
MA-G2	2.10	1.44	503.29	275.14	189.25	0.47	6.97	3966.67	4005.67	25758.53	4239.38

Graph 15: Average results of Marine sediment parameters



	Al (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Zn (mg/kg)	Pb (mg/kg)	As (mg/kg)	Cu (mg/kg)
MA-D	3672.43	78.27	32.61	77.08	7.23	4.68	72.11
MA-H1	7246.90	104.13	43.61	68.86	3.70	4.46	75.29
MA-H2	7046.08	105.59	43.51	75.74	4.00	4.70	76.25
MA-G1	1049.07	93.34	40.49	62.33	8.07	4.92	65.93
MA-G2	1094.88	93.25	39.94	61.18	3.93	4.00	64.25

Graph 16: Average results of metals of Marine sediment

2.5.2.2 Observations:

The average results of marine sediment of Dahej, Hazira, and Ghogha was compared and the following were observed.

- Organic matter in sediment consists of carbon and nutrients in the form of carbohydrates, proteins, fats, and nucleic acids. Sediment organic matter is derived from plant and animal detritus, bacteria, or plankton formed in situ, or derived from natural and anthropogenic sources in catchments. The concentration of organic matter was found in the range of 0.56-1.14 % at MA-D, 1.34-1.70 % at MA-H1, 1.37-1.77 % at MA-H2, 1.69-2.18 % at MA-G1 and 1.69-2.53 % at MA-G2 locations.
- The concentration of Inorganic phosphate was found in the range of 0.15-1.35 kg/Ha at

MA-D, 0.80-1.36 kg/Ha at MA-H1, 0.90-1.21 kg/Ha at MA-H2, 1.07-1.47 kg/Ha at MA-G1 and 1.25-1.63 kg/Ha at MA-G2 locations. The capacity of sediment to retain or release phosphorus is one of the important factors, that influence the concentration of inorganic/organic phosphorus in the overlying waters (Saravanakumar, Rajkumar, Serebiah, & Thivakaran, 2008).

- The texture of the sediments was found to vary during Jan-Feb'24, Feb-March'24 and March-April'24 month. It was found to be between Loam and Silt loam at MA-D, found to be between loam- sandy loam at MA-H1 & MA-H2, and between Silt loam to silty clay loam at MA-G1 & MA-G2.
- The concentration of Sulphate was found in the range of 40.50-69.50 mg/kg at MA-D, 53.92-129.57 mg/kg at MA-H1, 72.15-119.03 mg/kg at MA-H2, 122.39-238.28 mg/kg at MA-G1 and 164.47-216.13 mg/kg at MA-G2 locations. The sulphate concentrations in marine sediment can vary naturally based on geological and hydrological factors.
- The Nitrite concentration was found in the range of BQL-0.37 mg/kg at MA-D, 0.33-0.41 mg/kg at MA-H1, 0.02-0.59 mg/kg at MA-H2, 0.10-0.60 mg/kg at MA-G1 and 0.17-0.93 mg/kg at MA-G2 locations.
- The Nitrate concentration was found in the range of 3.31-4.06 mg/kg at MA-D, 4.92-6.33 mg/kg at MA-H1, 4.85-6.80 mg/kg at MA-H2, 7.19-8.24 mg/kg at MA-G1 and 5.42-8.16 mg/kg at MA-G2 locations.
- The Ca was found in the range of 2200-3400 mg/kg at MA-D, 3200-3700 mg/kg at MA-H1, 3000-3300 mg/kg at MA-H2, 3000-4200 mg/kg at MA-G1 and 2800-4800 mg/kg at MA-G2 locations. The source of Ca accumulation in marine sediment may be because of its naturally occurring element and its concentration can vary widely from local geological, hydrological conditions and environmental factors. It depends on various factors, including the composition of the underlying rocks, and the presence of calcareous organisms like coral reefs.
- The Mg was found in the range of 915-2745 mg/kg at MA-D, 2318-3355 mg/kg at MA-H1, 2257-3050 mg/kg at MA-H2, 2623-5246 mg/kg at MA-G1 and 3477-4453 mg/kg at MA-G2 locations. Magnesium is an essential component of marine sediments and plays a significant role in marine ecosystem dynamics. The concentration of magnesium in marine sediments can depend on various factors, including the composition of the underlying rocks, sediment type, and local hydrological conditions.
- The values for Sodium in marine sediment were found in the wide range of 3589-9058 mg/kg at MA-D, 6903-14704 mg/kg at MA-H1, 7786-15440 mg/kg at MA-H2, 14130-

32525.03 mg/kg at MA-G1 and 18370.58-36285 mg/kg at MA-G2 locations. Sodium concentrations in marine sediments are often correlated with salinity levels. It is an essential component of marine ecosystems.

- The values for Potassium were found in the range of 1369-3854 mg/kg at MA-D, 3278-4411 mg/kg at MA-H1, 3449-5025 mg/kg at MA-H2, 4383-6106.42 mg/kg at MA-G1 and 3322.13-4716 mg/kg at MA-G2 locations. Potassium is an essential nutrient for plants and the composition of parent materials, sediment types, weathering processes, and local hydrological conditions.
- The Silica in marine sediment was found in the range of 521.01-543.78 mg/kg at MA-D, 524.62-538.76 mg/kg at MA-H1, 526.12-539.06 mg/kg at MA-H2, 462.54-529.72 mg/kg at MA-G1 and 476.38-540.34 mg/kg at MA-G2 locations. Its presence in marine sediments can be attributed to both natural geological processes and biological contributions such as mineral weathering, biogenic silica, aquatic plants, and oceanographic processes.
- The Total phosphorus concentration was found in the range of 188.80-356 mg/kg at MA-D, 297.77-501.28 mg/kg at MA-H1, 270.91-537.84 mg/kg at MA-H2, 209-403.71 mg/kg at MA-G1 and 186.76-399.68 mg/kg at MA-G2 locations. Phosphorus is an essential nutrient for marine ecosystems, playing a crucial role in biological processes. Its presence in marine sediments can have significant implications for nutrient cycling and ecosystem health. It can accumulate on the seafloor due to land runoff, natural weathering, decomposition of organic matter, local geology, etc.
- The sediment quality for the trace metals concentration was compared to the sediment quality guidelines (US Environmental Protection Agency, 1977; Augustynowicz, et al., 2013; B., X., X., & S., 2018; Saravanakumar, Rajkumar, Serebiah, & Thivakaran, 2008; Sanyal, Anilava, & Subrata, 2017; Tokatli, 2017; Perin, Bonardi, & Scotto, 1997; Onjefu & Kwaambwa, 2020; Pazi, 2011), as shown in **Table 13**.

Table 13: Sediment Quality Guidelines (SQG) of the US Environmental Protection Agency (EPA) 1977

Metals	Sediment quality (mg/kg)		
	Not polluted	Moderately polluted	Heavily polluted
As	<3	3-8	>8
Cu	<25	25-50	>50
Cr	<25	25-75	>75
Ni	<20	20-50	>50
Pb	<40	40-60	>60
Zn	<90	90-200	>200
Al	ND	ND	ND
Cd	-	<6	>6

Metals	Sediment quality (mg/kg)		
	Not polluted	Moderately polluted	Heavily polluted
ND- Not detected			

- As per the comparison of the metals to this guideline, a variation in the concentration of the metals was found. The concentration of Zn, Cd and Pb was found in the 'Not polluted' quality classes. The concentration of As and Ni was found in the 'Moderately polluted' quality class. Whereas, concentration of Cr, Al and Cu were found in 'Heavily polluted' class. Sediments are highly dynamic, constantly being deposited and carried away by water currents (Labenua, et al., 2023). The possible reasons for the higher concentration of some heavy metals may be attributed to the high sedimentation rate and due to various natural and anthropogenic factor.

2.5.3 Marine Ecological Monitoring

The various parameters were monitored for Marine ecological monitoring monthly basis are mentioned in **Table 2** as above.

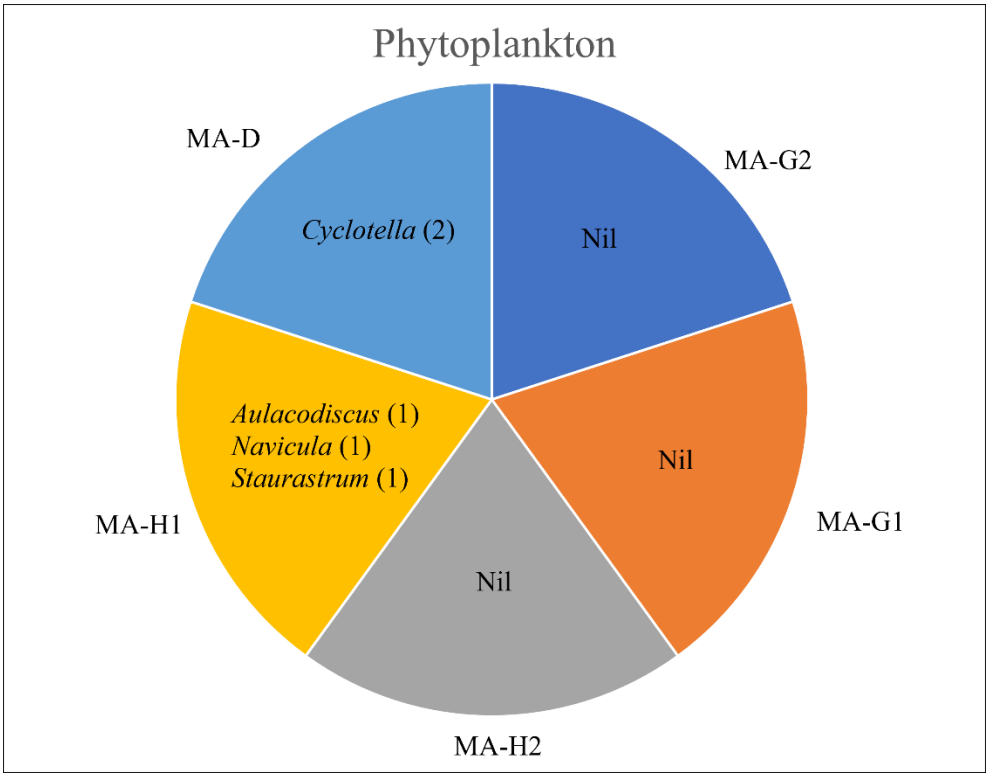
2.5.3.1 Statistical Data and Graphs

The station-wise summarized results of the marine ecological monitoring are mentioned in **Table 14** and **Graph 17 to 18** below:

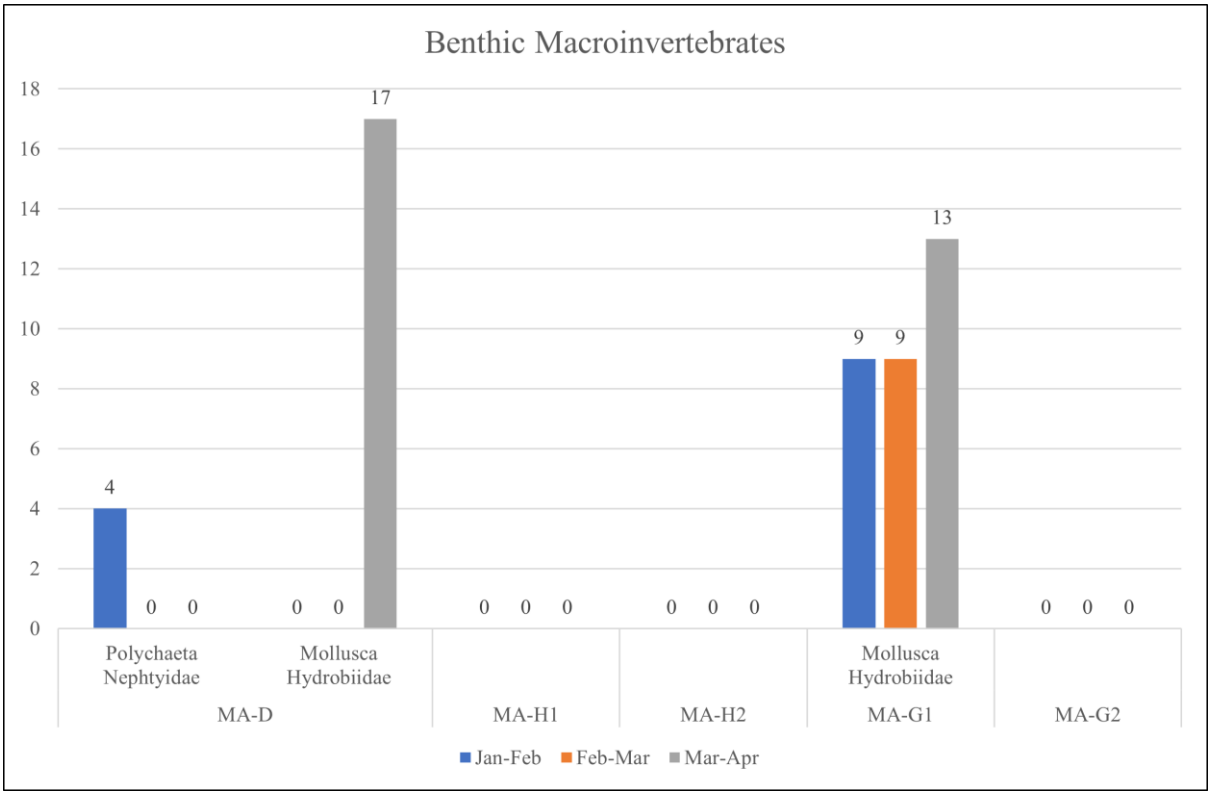
Table 14: Result of Marine ecological monitoring for Biomass, NPP, GPP, Pheophytin, Chlorophyll-a, Seechi depth & Particulate Oxidizable Organic Carbon

Location Code & Sampling Date	Biomass	Gross Primary Productivity (GPP)	Net Primary Productivity (NPP)	Pheophytin	Chlorophyll -a	Secchi Depth	Particulate Oxidizable Organic Carbon
	mg/L	mg/L/Hr	mg/L/Hr	mg/m^3	mg/m^3	meter	mg/L
MA-D 05-02-2024	166	BQL	BQL	3.5	37.60	0.10	5.01
MA-H1 07-02-2024	170	BQL	0.01	11	1.841	0.15	1.89
MA-H2 07-02-2024	196	BQL	BQL	7	1.620	0.06	1.86
MA-G1 02-02-2024	202	BQL	BQL	3	1.841	0.06	3.14
MA-G2 02-02-2024	148	BQL	BQL	2	0.527	0.06	0.63
MA-D 16-02-2024	190	BQL	BQL	BQL	1.055	0.06	3.18
MA-H1 28-02-2024	200	BQL	BQL	BQL	0.118	0.06	5.47
MA-H2 28-02-2024	204	BQL	BQL	BQL	0.648	0.09	3.21

Location Code & Sampling Date	Biomass	Gross Primary Productivity (GPP)	Net Primary Productivity (NPP)	Pheophytin	Chlorophyll -a	Secchi Depth	Particulate Oxidizable Organic Carbon
	mg/L	mg/L/Hr	mg/L/Hr	mg/m^3	mg/m^3	meter	mg/L
MA-G1 14-02-2024	232	BQL	BQL	BQL	0.789	0.06	4.16
MA-G2 14-02-2024	264	BQL	0.01	BQL	0.496	0.07	3.89
MA-D 26-03-2024	302	BQL	BQL	6	2.674	0.06	5.91
MA-H1 02-04-2024	114	BQL	BQL	BQL	1.127	0.20	0.77
MA-H2 02-04-2024	128	BQL	BQL	BQL	0.306	0.20	0.78
MA-G1 19-03-2024	162	-	-	BQL	5.359	0.06	2.93
MA-G2 19-03-2024	286	-	-	BQL	8.662	0.07	4.92



Graph 17: Sampling locations with their respective phytoplankton genera counts



Graph 18: Representation of benthic macrofauna obtained during monitoring period

2.5.3.2 Observations:

- The indication of Biomass content monitored in the study area ranging from 114 to 302 mg/L can be attributed to chlorophyll-containing along with chlorophyll-lacking primary producer organisms. For such values of biomass content, the waterbody under study is having nominal amount of planktonic algal chlorophyll. In the water bodies containing nominal amounts of phytoplankton, the Secchi depth is directly correlated to the levels of inorganic turbidity and color. (Lee, G. F., Jones-Lee, A., & Rast, W. (1995). Secchi depth as a water quality parameter. *Publication Pending*.)
- The phosphorus and nitrate concentrations of the study area have shown moderate to lower values even certain with below quantifiable limits. Such nutrient limiting conditions have resulted in negligible phytoplankton counts and ultimately absence of zooplankton organisms.
- Adequate light and favorable temperatures alone are insufficient to promote phytoplankton growth in the absence of above necessary nutrients.
- Rapid salinity fluctuations further are likely to inhibit the growth of stenohaline plankton and benthic macroinvertebrates, resulting in almost negligible productivity and low benthic macroinvertebrate counts.

- The chlorophyll content monitored shows the values found between 0.118 to 37.6 mg/m^3. Higher chlorophyll content may relate to optimum Dissolved oxygen levels.
- The pheophytin content monitored at various locations mostly show below quantification limit values. Certain range from 2.0 to 11.0 mg/m^3 out of all 15 locations monitored. Consequently, minimal decomposition of chlorophyll has taken place. This typically signifies that the phytoplankton death or decomposition has not occurred in this water system (Wetzel, R.G. (2001). *Limnology: Lake and River Ecosystems*. Academic Press. This book explains the relationship between chlorophyll degradation products like pheophytin and environmental conditions) and the probability of phytoplankton population's stability might be fair and healthy with low turnover rates. This suggests a balanced aquatic environment and minimal impact from nutrient pollution.

2.6 Meteorological monitoring

- To determine the prevailing micro-meteorological conditions at the project site the Automatic Weather Monitoring Stations (AWS) have been installed at the sites the sites of Dahej, Hazira, and Ghogha at 10 m above the ground.

- The summary of hourly meteorological observations recorded at the observatory, Dahej, Hazira, and Ghogha for the significant parameters has been mentioned in **Table 15**.

Table 15: Result of Meteorological monitoring

Sr. No.	Location	Period	Wind Direction	Wind Speed (m/s)			Rain mm/hr (Avg)	Relative Humidity (%)			Temperature (°C)			Solar Radiation W/m^2 (Avg)
				Mean	Max	Min		Mean	Max	Min	Mean	Max	Min	
1	M-D	January'24 – April'24	From West-North-West	1.92	5.69	0.57	0.01	60.2	64.2	56.09	29.5	36.3	28.38	80.63
2	M-H		From North	5.97	10.2	2.55	0.01	73.18	76.78	64.6	33.48	35.78	29.2	47.9
3	M-G		From North-North-West	2.54	7.57	1.86	0.01	72.14	73.54	62.79	32.05	35.4	28.16	81.45

2.6.1 Observation:

The monthly average of maximum and minimum daily observed values summarized in **Table 15** have been discussed as follows.

- **Temperature**
  - Dahej: The ambient temperature varied from 28.38-36.3°C with an average temperature of 29.5°C.
  - Hazira: The ambient temperature varied from 29.2-35.78°C with an average temperature of 33.48°C.
  - Ghogha: The ambient temperature varied from 28.16-35.4°C with an average temperature of 32.05°C.
- **Relative Humidity**
  - Dahej: The relative humidity was recorded in the range of 56.09-64.2%, with an average Humidity of 60.2%.
  - Hazira: The relative humidity was recorded in the range of 64.6-76.78%, with an average humidity of 73.18%.
  - Ghogha: The relative humidity was recorded in the range of 62.79-73.54%, with an average humidity of 72.14%
- **Rainfall**
  - Dahej: The average rainfall was recorded 0.01 mm/hr.
  - Hazira: The average rainfall was recorded as 0.01 mm/hr.
  - Ghogha: The average rainfall was recorded as 0.01 mm/hr.
- **Wind Speed**
  - Wind speed and Direction play a significant role in transporting the pollutants and thus decide the air quality.
  - Dahej: The wind speed was recorded in the ranges of 0.57-5.69 m/s with an average of 1.92 m/s.
  - Hazira: The wind speed was recorded in the ranges of 2.55-10.2 m/s with an average of 5.97 m/s.
  - Ghogha: The wind speed was recorded in the ranges of 1.86-7.57 m/s with an average of 2.54 m/s.
- **Solar Radiation**
  - The average solar radiation at Dahej, Hazira, and Ghogha was 80.63 W/m2, 47.9 W/m2 and

81.45 W/m2 respectively.

- **Wind rose diagram**
  - The wind-rose diagram has been drawn based on hourly wind speed and direction data. This wind rose reveals that the prevailing winds in Dahej, Hazira, and Ghogha predominantly blow from a West-North-West (WNW), North (N), and North-North-West (NNW) direction respectively.

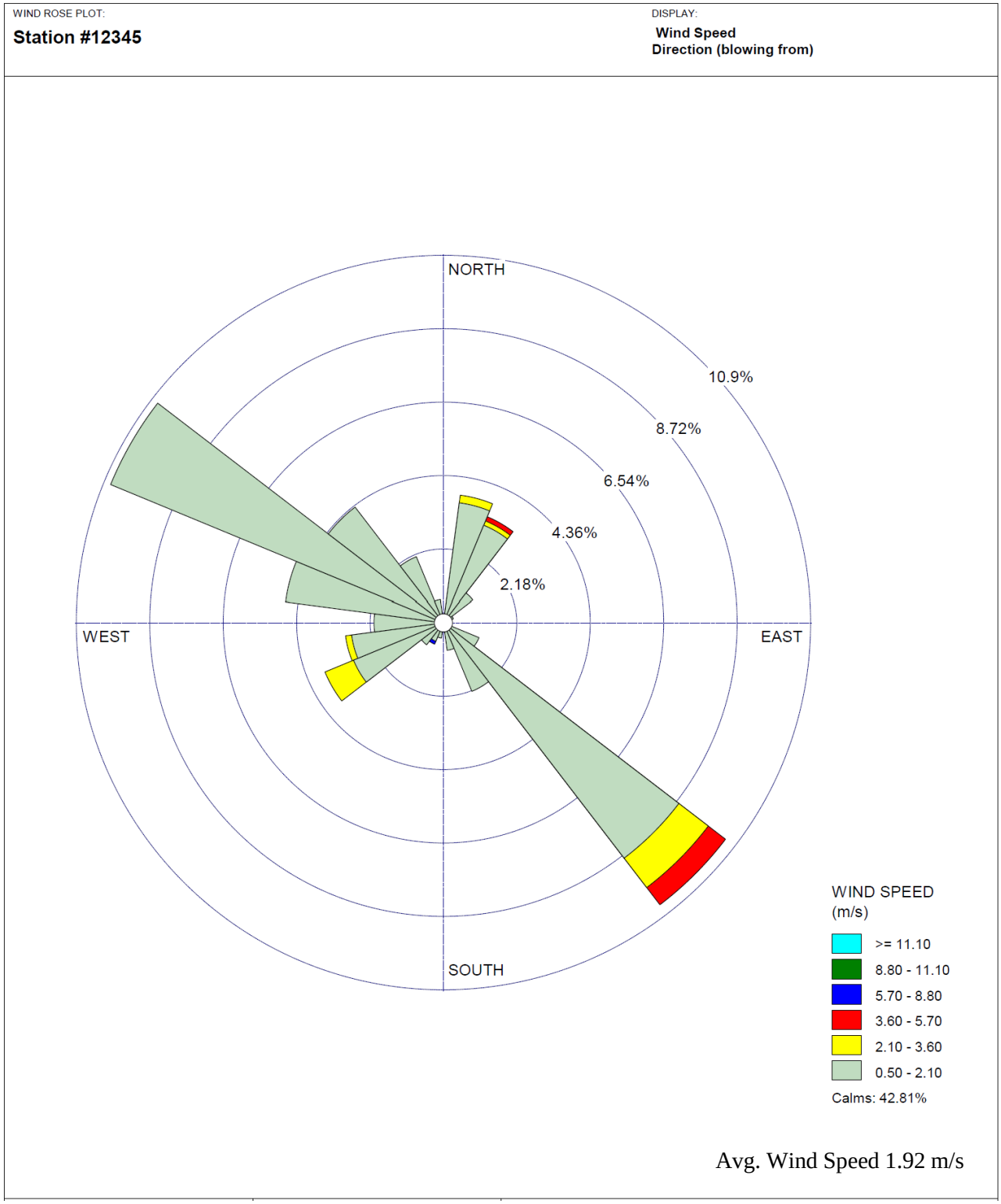


Figure 5: Windrose plot at Dahej

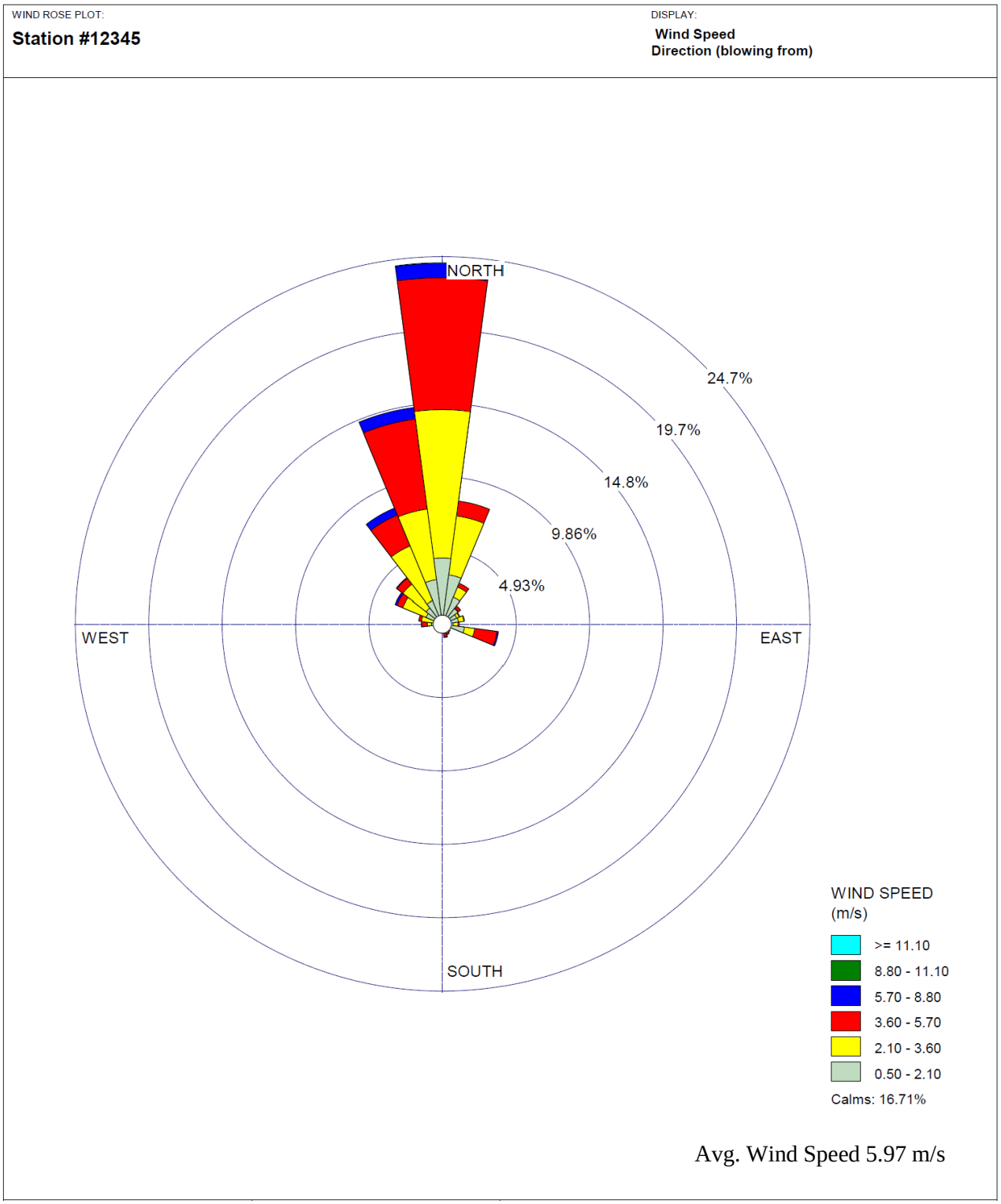


Figure 5. Windrose plot at Hazira

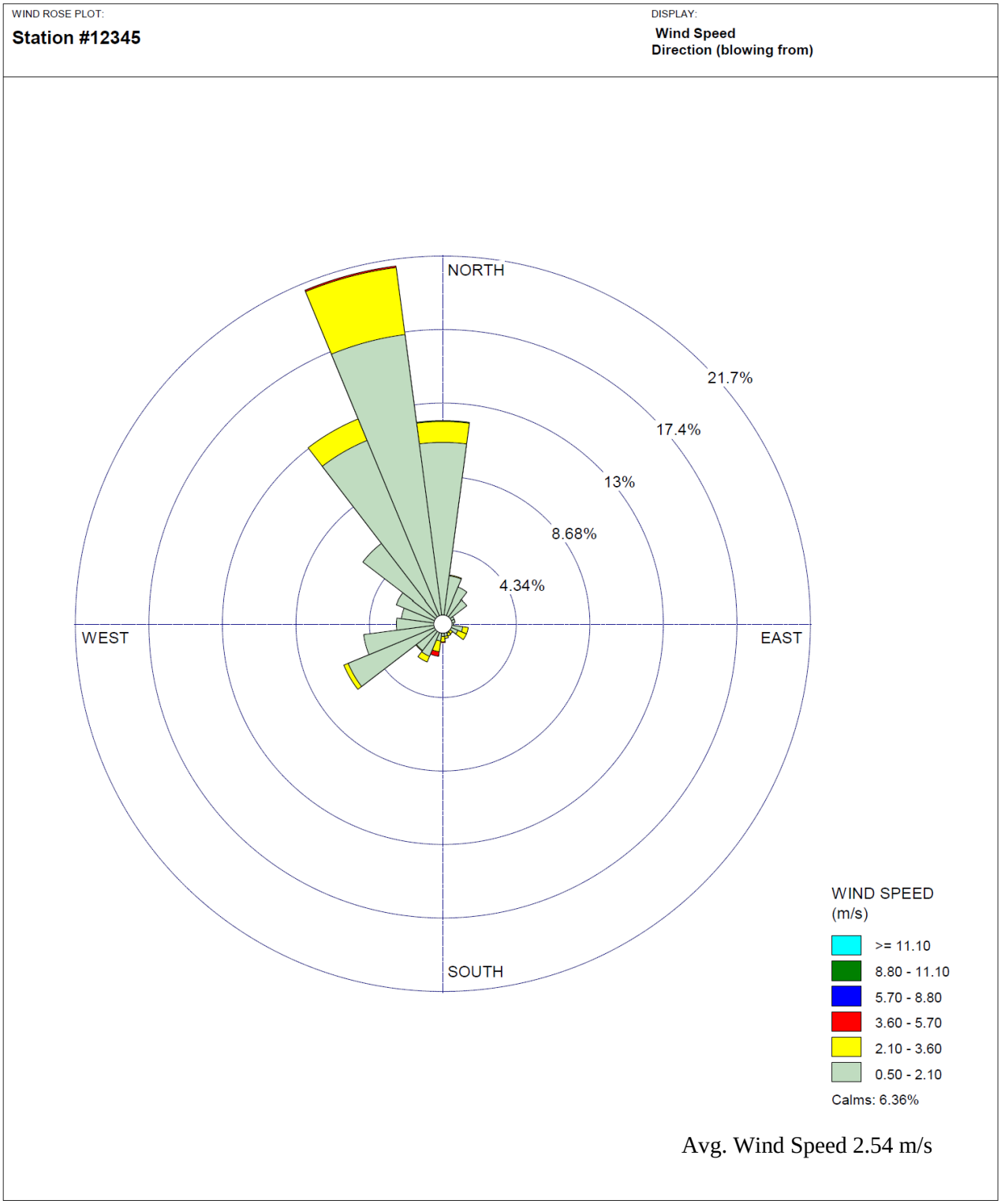


Figure 6. Windrose plot at Ghogha

2.7 DG stack emissions monitoring

DG sets at the Deendayal Port Authority (DPA) are generally utilized as a secondary power source. The sampling & monitoring of the DG stack emissions was carried out once a month at Dahej, Hazira and Ghogha**.**

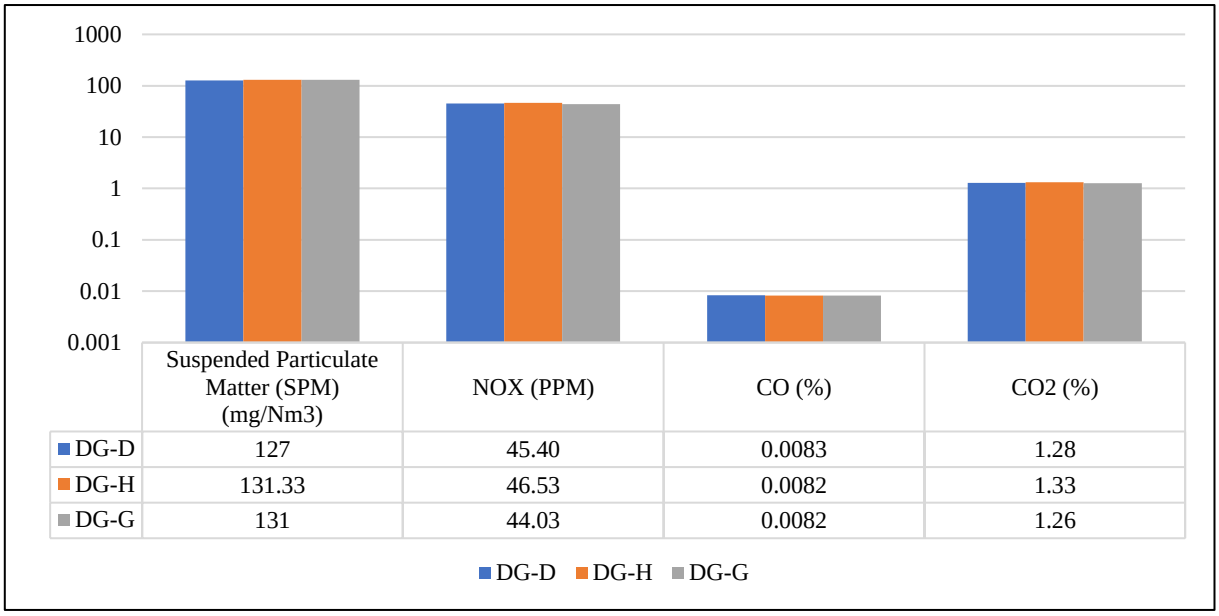
2.7.1 Statistical Data and Graphs

The station-wise summarized results of the DG stack emissions monitoring are mentioned in **Table 16** and **Graph 19** below.

Table 16: Summarized results of DG Stack emissions

Sr. No.	Parameters	Unit	DG Set standards		Location Code		
					DG-D	DG-H	DG-G
1	Suspended Particulate Matter (SPM)	mg/Nm^3	150	Min	126	130	128
				Max	128	132	136
				Avg	127	131.33	131
2	SO_2	PPM	100	Min	N.D.	N.D.	N.D.
				Max	N.D.	N.D.	N.D.
				Avg	N.D.	N.D.	N.D.
3	NO_X	PPM	50	Min	45.00	45.00	42.00
				Max	46.00	47.60	47.10
				Avg	45.40	46.53	44.03
4	CO	%	-	Min	0.0075	0.0074	0.0078
				Max	0.0092	0.0095	0.0089
				Avg	0.0083	0.0082	0.0082
5	CO_2	%	-	Min	1.16	1.25	1.22
				Max	1.49	1.41	1.32
				Avg	1.28	1.33	1.26

N.D. – Not Detected



	Suspended Particulate Matter (SPM) (mg/Nm3)	NOX (PPM)	CO (%)	CO2 (%)
DG-D	127	45.40	0.0083	1.28
DG-H	131.33	46.53	0.0082	1.33
DG-G	131	44.03	0.0082	1.26

Graph 19: Average results of DG Stack emission parameters

2.7.2 Observations:

The average results of DG stack emissions for Dahej, Hazira and Ghogha were compared with the permissible limits mentioned in the DG Sets standards and were found within the prescribed limit for SPM, SO_2 and NO_X.

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