adani
Ports and Logistics

APSEZL/EnvCell/2025-26/093 **Date:** 22.11.2025

To,

The Inspector General of Forest / Scientist C,
Integrated Regional Office (IRO),
Ministry of Environment, Forest and Climate Change,
Karmayogi Bhawan,
Block-3, F-2 Wing, 5th Floor,
Near CH-3 Circle, Sector – 10A
Gandhinagar – 382010.
E-mail: eccompliance-guj@gov.in, iro.gandhingr-mefcc@gov.in

Sub : Half yearly Compliance report for Expansion of Waterfront Development Plan of Mundra Port in an area of 3335 ha for handling of additional 289 MMTPA of multi-purpose cargo in addition to the existing approved capacity of 225 MMTPA, located at Mundra, Kachchh, Gujarat.

Ref : Environment and CRZ clearance granted to M/s Adani Ports & SEZ Limited vide F. No 10-24/2019-1A-III dated 13/08/2024.

Dear Sir,

Please refer to the above cited reference for the said subject matter. In connection to the same, it is to state that copy of the compliance report for the Environmental and CRZ Clearance for the period of April 2025 to September 2025 is being duly uploaded on the Parivesh Portal.

Additionally, a soft copy of the same is being submitted through soft copy (e-mail communication).

Kindly consider the above submission and acknowledge.

Thank you,
Yours Faithfully,
For, **M/s Adani Ports and Special Economic Zone Limited**

Bhagwat Swaroop Sharma
Head – Environment
Mundra & Tuna Port

Encl: As above
Copy to:

1) The Director (IA Division), Ministry of Environment, Forests & Climate Change, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi-110003.
2) The Zonal Officer, Regional Office, CPCB – Western Region, Parivesh Bhawan, Opp. VMC Ward Office No. 10, Subhanpura, Vadodara – 390023.
3) The Member Secretary, GPCB – Head Office, Paryavaran Bhavan, Sector 10 A, Gandhi Nagar – 382010.
4) The Director, Forests & Environment Department, Block – 14, 8th floor, Sachivalaya, Gandhi Nagar – 382010.
5) The Regional Officer, Regional Office GPCB (Kutch-East), Gandhidham – 370201.

Adani Ports and Special Economic Zone Ltd
Adani House,
PO Box No. 1
Mundra, Kutch 370 421
Gujarat, India
CIN: L63090GJ1998PLC034182

Tel +91 2838 25 5000
Fax +91 2838 25 51110
info@adani.com
www.adani.com

Registered Office: Adani Corporate House, Shantigram, Nr. Vaishno Devi Circle, S.G. Highway, Khodiyar, Ahmedabad – 382421, Gujarat, India

adani
Ports and Logistics

Environmental Clearance Compliance Report

Expansion of Waterfront Development Plan,
Mundra, Dist. Kutch, Gujarat

Adani Ports and SEZ Limited
Mundra, Kutch

For the period of

April-2025 to September-2025

Index

adani Ports and Logistics	Adani Ports and Special Economic Zone Limited, Mundra.	From :Apr'25 To : Sep'25

Status of the conditions stipulated in Environment and CRZ Clearance

APSEZ has been granted EC & CRZ Clearance for Expansion of Waterfront Development Plan of Mundra Port in an area of 3335 ha for handling of additional 289 MMTPA of multi-purpose cargo in addition to the existing approved capacity of 225 MMTPA from MOEF&CC, located at Mundra, Kachchh District, Gujarat by Adani Ports & SEZ Ltd vide F. No 10-24/2019-1A-III dated 13/08/2024.

Note: APSEZ has been accorded Consent to Establish (ToR to CtE) from GPCB vide dated 19th May, 2020 and the same become valid after getting EC & CRZ clearance from MoEF&CC vide its order dated 13th August, 2024. Therefore, compliance status of ongoing work undertaken after getting EC & CRZ clearance is being submitted in this half yearly compliance report.

Activities/facilities approved, major components completed and proposed future activities as per Environment and CRZ Clearance are as below:

Sl. No.	Description	Approved as per EC & CRZ Clearance	Already Developed till 30.09.2025	Balance to be developed	Remarks
1	Quay Length (m)	16760	8485	8275	Developed additional quay length in South port @ 615 meter (400 meter Jetty for Liquid / Gas / Cryogenic cargo handling + 215 meter Multi-purpose T2 Jetty extension) along with its related infrastructure facilities / back-up area has been developed for increase in Cargo Handling Capacity i.e. Liquid Cargo & Container Cargo by developing new berths along with its supporting infrastructure facilities/ utilities and regularizing General / Dry Cargo handling capacity in line with existing port capacity.
2	Dredging (MCuM)	120	3.07	116.93	Capital dredging activity for development additional quay length and basin area is in process.
3	Effluent Treatment Plant (KLD)	1065	265	800	ETP of 265 KLD already developed as part of earlier clearances granted till 2009. Based on the future requirement, ~800 KLD is proposed to be developed on Modular basis.
4	Sewage Treatment Plant (KLD)	50055	55	50000	STP of 55 KLD already developed as part of earlier clearances granted till 2009. Based on the future requirement, 50 MLD is proposed to be developed on Modular basis.
5	Desalination Plant (MLD)	447	80	367	Desalination plant of 47 MLD capacities already developed as part of earlier clearances granted in 2009. Additional development of 33 MLD capacity Desalination plant

Sl. No.	Description	Approved as per EC & CRZ Clearance	Already Developed till 30.09.2025	Balance to be developed	Remarks
					has been developed. However, as a part of WFDP-Expansion project, development of an additional 400 MLD capacity Desalination plant is approved. Out of this APSEZ has developed Desalination plant of 33 MLD capacities At present total 80 MLD (47 MLD – Existing + 33 MLD – New) desalination plant developed under WFDP west port (GPCB ID – 35427) with utilization of existing intake and outfall channel (up to 300 MLD capacities) and CC&A Amendment for the same granted by GPCB board Additional development of 80 MLD desalination plant is under progress through Mundra Petrochemical Ltd. (Subsidiary company of Adani Group). Separate Consent to Establish from GPCB has been obtained by them vide Order no. CTE-77914 dated 09.12.2024. Balance 287 MLD capacity desalination plant will be developed on a modular basis as per business requirement.
6	Sea Island Jetty	1	Nil	1	Not developed so far
7	Single Point Mooring (SPM)/ Single buoy Mooring (SBM)	3	2	1	02 SPMs / SBMs already developed as part of earlier clearances granted till 2009.

- ✓ The proposed expansion of west port and south port along with supporting utilities/infrastructure facilities will be undertaken over an area of 3335 ha. For handling of additional 289 MMTPA of multi-purpose/Liquid/gas/cryogenic cargo will be handled in addition to the existing approved capacity of 225 MMTPA.
- ✓ The entire existing and proposed quay length will be used for handling Multipurpose/Liquid /Gas/Cryogenic cargo.

adani Ports and Logistics	**Adani Ports and Special Economic Zone Limited, Mundra.**	**From :Apr'25** **To : Sep'25**
Status of the conditions stipulated in Environment and CRZ Clearance		

Note:

EC & CRZ Clearance has been granted for Expansion of WFDP @ Mundra port. Compliance of relevant conditions has been given as per current practices those are being followed as per existing operational activities in line with permission granted earlier from competent authorities. The same practice will also be continued during proposed expansion activities also.

Cargo Mix and its handling capacity for Proposed Expansion of Waterfront Development Plan is approved as below.

S. No	Cargo type	Cargo Mix	Cargo Handling Capacity (MMTPA)
1	Dry Bulk & Break Bulk Cargo	Multipurpose Cargoes including Coal / Iron ore / limestone / Mines & Minerals & other dry bulk/Fertilizers and raw materials for manufacture of fertilizer / food grains / sugar / clinker / cement / Project cargo / timber & wood / machines/ Iron steel products / Bulk/Break Bulk etc.	140
2	Containers	Container, Ro – Ro & Automobiles and any other non-hazardous cargo	250
3	Liquid Cargo	All Class A, B, C petroleum products, excluded petroleum products Including Petrochemical products, Hazardous, Toxic and Non-Hazardous chemicals/Liquids and other Liquid cargos. Tentative list of hazardous liquid cargo but not limited to are as follows: Ethylene, Propylene (Propene), Butadiene, Pentane, Ethyl Mercaptan Motor Spirit, Propylene Oxide, Hexane, Naphtha, Acetone, Methyl Chloride / Chloro Methane, Cyclohexane, Benzene, Ethyl Acetate, Acrylonitrile Acetonitrile, Methyl Methacrylate, Meth acrylonitrile, Methanol (Methyl Alcohol),Isopropyl Alcohol, Ethyl Alcohol (Ethanol), Ethylene di chloride, Methyl Isobutyl Ketone, Ethyl Benzene, N-Butyl Acetate, Isobutyl Alcohol (Iso Butanol), N-Butyl Alcohol (N-Butanol), Epichlorohydrine, Styrene, O-Xylene, Acetic Acid, Acetic Anhydride, Nonedible/ Mentha Oil Low Sulphur Heavy Stock/ Furnace oil, Aniline, Methyl Ethyl Ketone Peroxide, Ethyl Hexanol-2, Vinyl Chloride, Phenol, Naphthalene, Ethylene Glycol, Mono Ethylene Glycol, Toluene 2.4 -di isocyanate, Diphenyl Methane Di-Isocynate, Edible oil/Palm Oil, Paraffin, Bitumen, Sulphur, Coal, CNG, NG, Ammonia (NH_3), Diammonium Phosphate, Muriate of Potash (MOP), Soda Ash (Sodium Carbonate), Urea, Limestone, Caustic Soda, Sulphuric acid, Phosphoric acid, Piperine/ Piperdine, Chloroform, Hydrochloric Acid (HCL), Ethylene diamine (EDA), CMDI etc. PoL such as Motor Spirit, Naptha, HSD, Crude Oil, Aviation Fuel, Kerosene, Low Sulphur Heavy stock/Furnace Oil, Carbon Black Feedstock, Paraffin, Bitumen, Lube Oil, Asphalt etc.	84
4	Gas /Cryogenics/ Liquid	LNG, Propane, Butane, n-Butane, Ethane, LPG, CNG, NG and All Class A, B, C petroleum products, excluded petroleum products Including Petrochemical products, Hazardous, Toxic and Non-Hazardous chemicals/Liquids and other Liquid cargos.	40
		TOTAL	**514**

Compliance Report of Environmental and CRZ Clearance

Half yearly Compliance report for Expansion of Waterfront Development Plan of Mundra Port in an area of 3335 ha for handling of additional 289 MMTPA of multi-purpose cargo in addition to the existing approved capacity of 225 MMTPA, located at Mundra, Kachchh District, Gujarat by Adani Ports & SEZ Ltd."

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
1. Specific Conditions		
1.1	Construction activity shall be carried out strictly according to the provisions of the CRZ Notification, 2011. No construction work/activity other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Being Complied. Construction work for the project is partially completed & construction activity is in progress for proposed development in accordance with existing rules & regulations of CRZ Notification, 2011 and as amended from time to time. All the specific conditions provided for construction phase is being considered upon recommencement of construction activity.
1.2	All the recommendations and conditions specified by the Gujarat Coastal Zone Management Authority vide letter no. ENV/10/2024/37/T dated 20th April, 2024 shall be implemented.	Complied. Point wise compliance report of CRZ recommendations issued by GCZMA (Gujarat Coastal Zone Management Authority), Gandhinagar vide letter ENV/10/2024/37/T dated 20th April 2024 attached as **Annexure A**.
1.3	All the storage proposed in the CRZ area shall be in line with the CRZ notification, 2011. No storage is allowed other than the products mentioned in the CRZ notification, 2011 in the CRZ area.	Complied. Storage of all the cargo proposed in CRZ area will be carried out in line with CRZ Notification, 2011 and its amendments thereafter as well as permissions granted by regulatory authorities.
1.4	Multipurpose Backup Area of 252.3 ha proposed in the CRZ-IA area only permissible activities shall be taken up. And in no case mangroves falling in proposed backup area shall be disturbed and 50-meter buffer should be kept around mangroves.	Complied. Multipurpose Backup Area of 252.3 ha proposed in the CRZ-IA area is part of 1840 Ha reserved forest area, which had been diverted vide 30th September 2009 for development of port based SEZ. Copy of Forest clearance submitted during compliance period Apr'24 to Sep'24. There are no mangroves, or any other eco-sensitive area falls within this proposed Multipurpose Backup Area in line with CRZ notification, 2011 and its amendments thereafter.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
1.5	In no case mangrove area falling within proposed Multipurpose Backup Area shall be disturbed and a buffer of 50 meters shall be provided all around the mangroves area.	Activities permitted as per CRZ Notification, 2011 and as amended from time to time would be carried out in the proposed Multipurpose backup area only. NCSCM (MoEF&CC promoted Government Agency) study on comprehensive and integrated plan for preservation and conservation of mangroves and associated creeks in and around APSEZ. As a part of mangrove conservation plan, APSEZ has done following activities. a. To comply with the GCZMA recommendations regarding mangrove monitoring at every 2 years, presently APSEZ has entrusted NCSCM, Chennai to carry out the Monitoring of mangrove distribution in creeks in and around APSEZ with cost 45.87 Lacs from year 2021 to 2023. b. Recently, NCSCM has conducted ground truthing during 5th to 7th Mar'25 & 22nd to 27th Apr'25 in and around our APSEZ area for mangrove mapping using High resolution Multispectral satellite images with scenes of the years 2021-2023. The mangrove mapping study work has been completed. The overall assessment of mangrove mapping is as per below. • The distribution of mangroves in Kotdi, Baradimata, Navinal, Bocha, and Khari Creeks, as well as on Bocha Island, was assessed using WorldView-3 satellite images from **February 2021 and September 2023**. • Regarding the overall health of mangroves in the creeks in and around APSEZ, it was observed that there was a stable growth in mangrove cover approximately **2 hectares**, accounting for about a **0.08%** increase. • Hence, overall increase in mangrove cover area in creek system in and around APSEZ from 2011 (2094 Ha) to September 2023 (2501 Ha) is **407 Ha (19.43%)**. The NCSCM Mangrove mapping report is attached as **Annexure – 1**. c. Tidal observation in creeks in and around APSEZ – The cost of the said activity was INR 1.0 Lacs incurred by APSEZ. d. Algal & Prosopis removal from Mangrove area - The

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>
cost of the said activity was Rs. 1,50,000 during FY 2024-25. The algal removal report was submitted during the compliance period Oct'24 to Mar'25.
e. Awareness of mangroves importance in surrounding communities & Fodder support - The expenditure for fodder supporting activities was approx. 236.66 Lacs during FY 2025-26 till Sep'25 which was incurred by APSEZ. This activity is being done on continuous basis as a part of CSR activity.

As a part of GCZMA recommendations and NCSCM mangrove conservation action plan, APSEZ has undertaken the following activities.
<table>
<tr><th>Sr. No.</th><th>Recommendations</th><th>Compliance</th></tr>
<tr><td>1.</td><td>Mangrove mapping and monitoring in and around APSEZ</td><td>
• APSEZ entrusted NCSCM, Chennai to carry out Monitoring of mangrove distribution in creeks in and around APSEZ and shoreline changes in Bocha island.
• Recently, NCSCM has conducted ground truthing during 5th to 7th Mar'25 & 22nd to 27th Apr'25 in and around our APSEZ area for mangrove mapping using High resolution Multispectral satellite images with scenes of the years 2021-2023. The mangrove mapping study work has been completed. The overall assessment of mangrove mapping is as per below.
• The distribution of mangroves in Kotdi, Baradimata, Navinal, Bocha, and Khari Creeks, as well as on Bocha Island, was assessed using WorldView-3 satellite images from February 2021 and September 2023.
• Regarding the overall health of mangroves in the creeks in and around APSEZ, it was observed that there was a stable growth in mangrove cover approximately 2 hectares, accounting for about a 0.08% increase.
Hence, overall increase in mangrove cover area in creek system in and around APSEZ from 2011 (2094 Ha) to September 2023 (2501 Ha) is 407 Ha (19.43%). The NCSCM Mangrove mapping report is attached as
</td></tr>
</table>
</td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025		
				Annexure – 1. The cost of the said study was INR 45.87 Lacs incurred by APSEZ.
		2.	Tidal observation in creeks in and around APSEZ	• APSEZ carried out the tidal observations at locations similar to 2017 in Kotdi, Baradimata, Navinal, Bocha and Khari creeks under the guidance of NCSCM. • The observed tidal ranges indicate that the creeks experience normal tidal ranges, adequate for the growth of mangroves. • The cost of the said activity was INR 1.0 Lacs.
		3.	Removal of Algal and Prosopis growth from mangrove areas	• Algal and Prosopis growth monitoring was done in and around mangrove area and algal encrustation was found in some of the mangrove areas, which has been removed manually. • The cost of the said activity was Rs. 150000 during FY 2024-25. The algal removal report was submitted during compliance period Oct'24 to Mar'25.
		4.	Awareness of mangroves importance in surrounding communities	• Adani Foundation – CSR Arm of Adani group has done awareness camps/activities created in the community regarding importance of mangroves. Adani Foundation provides Good Quality dry and green fodder to 36 Villages. Dry Fodder 865965 Kg Green – 3075945 Kg. • Awareness of mangroves importance in surrounding communities & Fodder support - The expenditure for fodder supporting activities was approx. 236.66 Lacs during FY 2025-26 till Sep'25, which was incurred by APSEZ. • **Grass Land development:** 213 acres of gauchar land has been cleaned and allocated for Grass land development with strong Community Contribution and Mobilization. • Other than this dedicated security guard with gate system deployed by APSEZ across the coastal area and no unauthorized persons allowed within coastal as well as mangrove areas. • APSEZ has celebrated the International Day for the

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		<table><tr><td></td><td></td><td>Conservation of the Mangrove Ecosystem with coordination of Adani Foundation from 24th to 26th July 2024 to raise awareness of the importance of mangrove ecosystems as "a unique, special and vulnerable ecosystem". The report for the same was submitted during the EC compliance report submission for the period Apr'24 to Sep'24. • Refer CSR report attached as **Annexure 2.**</td></tr></table> A Regional Impact Assessment study through Chola MS, Chennai (NABET accredited consultant) to identify impacts of all the existing as well as proposed project activities in Mundra region inline to ToR issued by GCZMA. The cost of said study was 1.3 Cr, which was incurred by APSEZ.
1.6	Compensatory Mangrove Afforestation over 100 ha, as also stipulated in GCZMA conditions and agreed by the PP, shall be carried out at the Project cost. Accordingly, plan shall be prepared in consultation with state Forest Department or any other agency authorized by the government. The plan shall be submitted to the IRO of MoEFCC within 3 months of the issue of EC/CRZ clearance and implementation of the plan shall be submitted in 6 monthly monitoring report.	Will be complied. The said Compensatory Mangrove Afforestation over an area of 100 Ha required to be carried out through Green Credit Programme in line with GCZMA recommendation issued to this project. APSEZ is following-up with Green Credit Cell, ICFRE to undertake the said work, however we are in receipt of the response below from Green Credit Cell, ICFRE. *"The Green Credit Programme is currently in its pilot stage, hence at this stage only the PSUs are allowed to participate as entity and State Forest Departments as Implementing Agency. Private entities may be allowed later. We will keep you informed as we progress and expand the program to private entities participation. Your user ID, if created, will be activated accordingly."* Latest corresponds with concern authority is attached as **Annexure - 3**. Once Green Credit Programme is available for participation by private entities, we will initiate the same and submit our action plan to undertake the Compensatory Mangrove Afforestation over an area of 100 ha to the IRO of MoEF&CC.
1.7	No mangrove shall be cut or affected due to port construction.	Complied.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		No Mangrove would be cut or affected due to port construction and development of its related infrastructures other than utility corridors proposed in mangrove / mangrove buffer area which will have an overall impact on 0.92 Ha area. For which APSEZ will carry out Compensatory Mangrove afforestation over an area of 100 Ha through Green Credit Programme as mentioned in Point No. 1.6. To enhance the marine biodiversity, till date APSEZ has carried out mangrove afforestation in 4140 ha. area across the coast of Gujarat. Total expenditure for the same till Sep'25 is INR 1592.8 lakh. Please refer compliance of Condition No. 1.5 for mangrove conservation in detail.
1.8	Brine reject from desalination plant and cooling water reject from re-gasification unit of LNG will be discharged at the offshore location as identified through scientific study. No Objection Certificate from the concern Gujarat State Pollution Control Board need to be obtained.	Complied. Existing LNG Jetty and terminal has been developed and is being operated by GSPC LNG Limited as per separate permissions obtained and NOC given by APSEZ. Discharge of cooling water reject from re-gasification unit of LNG is being taken care by GSPC only. Development of LNG Jetty and terminal approved as a part of this clearance has not been carried out so far. However, cooling water reject from re-gasification unit of LNG will be discharged at the offshore location as per EIA, once it is developed. At present 47 MLD capacity Desalination plant along with associated Intake and Outfall facility have been developed out of earlier approved 300 MLD capacities in line with permissions granted by competent authorities. However, as a part of WFDP-Expansion project, development of an additional 400 MLD capacity Desalination plant is approved. Out of this APSEZ has developed Desalination plant of 33 MLD capacities for which CtE (ToR to CtE) already been granted by GPCB vide dated 19.05.2020. Copy submitted during compliance period Apr'24 to Sep'24.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		At present total 80 MLD (47 MLD – Existing + 33 MLD – New) desalination plant developed under WFDP west port (GPCB ID – 35427) with utilization of existing intake and outfall channel (up to 300 MLD capacities) and CC&A Amendment for the same granted by GPCB board CC&A Amendment order copy for the same was submitted during compliance period Oct'24 to Mar'25. Additional development of 80 MLD desalination plant is under progress through Mundra Petrochemical Ltd. (Subsidiary company of Adani Group). Separate Consent to Establish from GPCB has been obtained by them vide order no. CTE-77914 dated 09.12.2024 Copy of the same was submitted during compliance period Oct'24 to Mar'25. Balance 287 MLD capacity desalination plant will be developed on a modular basis as per business requirement. The existing Intake and Outfall channel is suitable for 300 MLD Desalination capacity. For additional desalination plant capacity will have intake & outfall with pipeline system. The desal reject is being discharged into deep sea at identified location through existing outfall channel approved in EC granted in 2009.
1.9	Construction of Utility corridor on stilts is proposed through Gantry Girder Launching technology which does not require construction of road for transporting heavy machineries and therefore ensure minimal/zero footprint on land /mangrove areas. As per CRZ mapping by NCSCM actual damage to mangroves will be limited to only 0.92 ha. PP will carry out 100 ha Compensatory Mangrove afforestation.	Complied. APSEZ ensures minimal/zero footprint on land /mangrove areas by implementing following method during construction: ➢ Use of advanced construction techniques, i.e. elevated gantry girder will eliminate the requirement of creation of temporary approach road in the mangrove/creek areas which will impact less or very negligible footprint on the ground. ➢ Use of construction safety nets will be deployed on the working platform of the gantry girder, which will prevent impact due to dropping of construction materials & tools in the creek and mangrove areas. ➢ The temporary stress on the avifauna and mangroves dependent species are limited to short period of time.

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>➢ Turbidity due to piling in water column is contained since piling activity is carried out within the steel casings.

Development of Utility corridor (Conveyor corridor) from West port to SEZ area for transportation of liquid cargo is in progress, which is being passed through CRZ area. For which advance Elevated Gantry Girder Launching construction technology is being used, which has negligible impact on ground.

APSEZ is ensuring above mentioned aspects during construction activity of utility corridor in CRZ area.

Please Refer Compliance status of Condition no 1.6 for compensatory mangrove afforestation.</td></tr>
<tr><td>1.10</td><td>The Environmental Clearance to the project is primarily under provisions of EIA Notification, 2006. It does not tantamount to approvals/consent/ permissions etc required to be obtained under any other Act/Rule/regulation The Project Proponent is under obligation to obtain approvals /clearances under any other Acts/ Regulations or Statutes as applicable to the project.</td><td>Point Noted and Complied.

All requisite permission from concerned authorities will be obtained under relevant act/rules/regulation.

Requisite permissions from Gujarat Maritime Board (GMB), for carrying out construction activities will be taken from time to time.

The project is being developed as per Consent to Establish (CtE) and Consent to Operate (CtO) granted by SPCB. The present in-force CtE & CtO are mentioned below.

<table>
<tr><th>S. No.</th><th>Permission</th><th>Project</th><th>Ref. No. / Order No.</th><th>Valid till</th></tr>
<tr><td>1</td><td>CtE – Amendment</td><td>LPG Terminal</td><td>PC/CCA-KUTCH-1437/GPCB ID-53331/587015</td><td>01.03.26</td></tr>
<tr><td>2</td><td>CtE – Amendment</td><td>WFDP</td><td>17739 / 15618</td><td>18.05.27</td></tr>
<tr><td>3</td><td>CC&A - Renewal</td><td>West Port – WFDP</td><td>AWH-113458</td><td>01.02.27</td></tr>
<tr><td>4</td><td>CC&A – Renewal</td><td>Mundra Port Terminal</td><td>AWH-117045</td><td>20.11.26</td></tr>
<tr><td>5</td><td>CC&A - Correction</td><td>Mundra Port Terminal</td><td>PC/CCA-KUTCH-39(8)/GPCB ID 17739/592900</td><td>20.11.26</td></tr>
<tr><td>6</td><td>CC&A - Renewal</td><td>LPG Terminal</td><td>PC/CCA-KUTCH-1437/PCB ID-53331/816485</td><td>27.06.29</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>7</td><td>CC&A – Amendment</td><td>Mundra Port Terminal</td><td>WH-141598</td><td>20.11.2026</td></tr>
<tr><td>8</td><td>CC&A – Amendment</td><td>West Port – WFDP</td><td>WH-139724</td><td>01.02.27</td></tr>
</table>

Above mention permission copy from Sr 1 to 6 submitted during compliance period Apr'24 to Sep'24.

The permission copies (Sr. No. 7 & 8) was submitted during compliance period Oct'24 to Mar'25.</td></tr>
<tr><td>1.11</td><td>All the recommendations mentioned in the Marine Biology study conducted and validation process by the Gujarat Institute of Desert Ecology (GUIDE) shall be implemented. The compliance to the recommendations shall be submitted along with 6 monthly compliance report to the regional office of MoEFCC.</td><td>Point noted and agreed.

Compliance to the recommendations mentioned in the Marine Biology study conducted by NABET accredited consultant i.e. M/s Cholamandalam MS Risk Services Ltd. and the same has been validated by M/s Gujarat Institute of Desert Ecology (GUIDE) is attached as Annexure - 4.</td></tr>
<tr><td>1.12</td><td>Continuous monitoring of the ecological characteristics of the habitat during and after the construction, to assess the changes in the water quality, coastal hydrology, bottom contamination and diversity & abundance of marine organisms. The report of the monitoring report shall be submitted to the concern IRO, MoEF&CC along with six monthly report.</td><td>Complied.

To ensure no damage to marine ecology, marine water & sediment monitoring is being carried out once a month by NABL and MoEF&CC accredited agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi as part of regular environment monitoring plan.

Summary of the same for duration from Apr'25 to Sep'25 is mentioned below.

Total Sampling Locations: 09 Nos.
<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit</th><th colspan="3">Surface</th><th colspan="3">Bottom</th></tr>
<tr><th>Min</th><th>Max</th><th>Avg.</th><th>Min</th><th>Max</th><th>Avg.</th></tr>
<tr><td>pH</td><td>--</td><td>7.96</td><td>8.28</td><td>8.17</td><td>7.81</td><td>8.4</td><td>8.01</td></tr>
<tr><td>BOD (3 Days @ 27 °C)</td><td>mg/L</td><td>2.4</td><td>3.5</td><td>2.96</td><td>BDL(MDL: 1.0)</td><td>BDL(MDL: 1.0)</td><td>BDL(MDL:1.0)</td></tr>
<tr><td>TSS</td><td>mg/L</td><td>112</td><td>164</td><td>138.15</td><td>86</td><td>132</td><td>113.59</td></tr>
<tr><td>DO</td><td>mg/L</td><td>6.37</td><td>7.04</td><td>6.69</td><td>6.27</td><td>6.83</td><td>6.56</td></tr>
<tr><td>Salinity</td><td>ppt</td><td>35.71</td><td>36.71</td><td>36.16</td><td>36.62</td><td>37.45</td><td>37.05</td></tr>
</table></td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025

TDS	mg/L	35140	36640	35726	35996	37250	36517

*BDL – Below Detection Limit
*MDL – Minimum Detection Limit

Please refer to **Annexure – 5** for detailed analysis reports. Approx. INR 8.73 Lakh is spent for all environmental monitoring activities during the FY 2025-26 till Sep'25 for overall APSEZ, Mundra. Marine monitoring for west port area including location near existing intake and outfall location is being carried out by M/s. Adani Power (Mundra) Limited (Pre-monsoon & Post-monsoon) through NABL accredited and MoEF&CC authorized agency namely M/s. UniStar Environment & Research Labs Pvt. Ltd. Monitoring reports are also enclosed as **Annexure – 5**.

Summary of ecological parameters of M/s. Adani Power (Mundra) Limited is given below:

PHYTOPLANKTON DIVERSITY: Phytoplankton sampling was carried out at 5 stations. At each station, water samples were collected from surface and bottom waters. During the sampling period the phytoplankton population in the coastal waters of APL-Mundra was more diverse (Table 5). The detailed species percentage composition reported during the sampling period is given in Annexure I. The phytoplankton community was represented with a total of 36 phytoplankton genera belonging to diatoms (32 genera) and dinoflagellate (4 genera). Diatoms assemblage was dominated by species belonged to Amphora sp., Amphiprora sp., Asterionella sp., Bacillaria sp., Odontella sp., Chaetoceros spp., Corethron sp., Coscinodiscus spp., Cyclotella sp., Cylindrotheca sp., Cymbella sp., Diploneis sp., Ditylum sp., Guinardia sp., Gyrosigma sp., Lauderia spp., Leptocylindrus sp., Lithodesmium sp., Navicula spp. Nitzschia spp. Melosira sp., Odontella sp., Pinnularia sp., Pleurosigma spp., Rhizosolenia sp., Streptotheca sp., Synedra spp., Surirella sp., Stauroneis sp., Thalassionema sp., Thalassiosira spp. and Thalassiothrix sp.

The phytoplankton abundance in the study region was higher during 192 to 336 cells x 10^2 L^{-1}. Phytoplankton abundance was higher at St-1 in surface water (336 cells x 10^2 L^{-1}). The lowest phytoplankton abundance (192 cells x 10^2 L^{-1}) was observed at St-4 in bottom

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		water. The diatom genera, Navicula sp. (up to 58 cells x 10^2 L^{-1}) dominated the species assemblage followed by Coscinodiscus (up to 44 cells x 10^2 L^{-1}) and Thalassiosira spp. (up to 39 cells x 10^2 L^{-1}) (Annexure I). The study shows that the marine water around APL, Mundra was enriched with the diverse phytoplankton population during the sampling period. **BENTHIC DIVERSITY:** **Subtidal region:** The macrobenthic population study revealed large spatiotemporal variation with the benthic population during the study period. Overall, more macrobenthos abundance and biomass were reported at subtidal stations than at intertidal stations. During the sampling period, the macrobenthos density ranged from 800 no./m^2 to 1200 nos./m^2 (Table 6). The biomass of the macrobenthic community was ranged from 2.0 g/ m^2 to 3.3 g/ m^2 in the study region. The maximum abundance and biomass of benthic microorganisms was reported at St-4 (1200 nos./m^2 and 3.3 g/m^2). In species composition (Annexure III), Polychaete species (Phylum Annelida) belonging to the family Paraonidae, Pilargidae, Capitillidae, Cossuridae, Glyceridae, Ciratullidae, Nephthyida, Nereidae, Lumbriconeridae, Spionidae were abundant contributing ~69.9% to macrobenthic population. Molluscs contributed ~14% to macrobenthic population (Annexure III). Overall, the presence of Polychaete, Amphipods, and Nemerteans suggest the availability of food organisms for benthic predators in the area. The macrobenthic population reported during both studies reveals that the large spatial-temporal variation with the benthic population could be due to the change in bottom substratum. **Intertidal region:** The sandy substratum with low organic matter affects the occurrence of the macrobenthic community in the intertidal region. The highest biomass was measured (0.32 g/m^2 to 0.45 g/m^2) in the intertidal region. The highest density of macrobenthic organisms was reported at station IT-2 (LW) (272 nos./m^2), whereas

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		the lowest density was reported at Station IT-2 (HW) (144 nos./m^2). No macrobenthic community was observed at St-3 (HW and LW) may be due to sandy sediment during both sampling periods. In species composition (Annexure IV), Polychaete species dominated the macrobenthic population in the intertidal region. APSEZ will increase the no. of marine water monitoring locations if required.
1.13	The Project Proponent shall ensure that no creeks or rivers are blocked due to any activities at the project site and free flow of water is maintained.	Complied. APSEZ has taken following measures for conservation of creeks which is detailed below: ➢ The prominent creek system (main creeks and small branches of creeks) in and around APSEZ are: (1) Kotdi (2) Baradimata (3) Navinal (4) Bocha (5) Mundra (Oldest port (Juna Bandar) leading to Bhukhi river). ➢ All above creek mouths are open allowing free flow of water into the creeks and surrounding areas and there is no filling or reclamation of any creek area. ➢ This aspect is also confirmed from the earlier studies of NCSCM in 2017-18, which highlights the bathymetry data of the entire coast around APSEZ. ➢ From the bathymetry data it can be concluded that there are sufficient depths at the creek mouths and all creek mouths are open allowing flushing of water. APSEZ has so far constructed 19 culverts having total length of approx. 1100 m with total cost of INR 20 Crores. Three RCC Bridges have also been constructed over Kotdi creek with total length of 230 m and cost of INR 10 Crores. As per the bathymetry study carried out by NCSCM in 2017-18, it can be concluded that there are sufficient depths at the creek mouths and all creek mouths are open allowing flushing of water. As a part of mangrove conservation plan, APSEZ has done following activities. a. To comply with the GCZMA recommendations

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		regarding mangrove monitoring at every 2 years, presently APSEZ has entrusted NCSCM, Chennai to carry out the Monitoring of mangrove distribution in creeks in and around APSEZ with cost 45.87 Lacs from year 2021 to 2023. b. Recently, NCSCM has conducted ground truthing during 5th to 7th Mar'25 & 22nd to 27th Apr'25 in and around our APSEZ area for mangrove mapping using High resolution Multispectral satellite images with scenes of the years 2021-2023. The mangrove mapping study work has been completed. The overall assessment of mangrove mapping is as per below. • The distribution of mangroves in Kotdi, Baradimata, Navinal, Bocha, and Khari Creeks, as well as on Bocha Island, was assessed using WorldView-3 satellite images from **February 2021 and September 2023**. • Regarding the overall health of mangroves in the creeks in and around APSEZ, it was observed that there was a stable growth in mangrove cover approximately **2 hectares**, accounting for about a **0.08%** increase. • Hence, overall increase in mangrove cover area in creek system in and around APSEZ from 2011 (2094 Ha) to September 2023 (2501 Ha) is **407 Ha (19.43%)**. The NCSCM Mangrove mapping report is attached as **Annexure – 1**. Photographs of culvert and bridges submitted during compliance period Apr'24 to Sep'24. However, increase in mangrove cover around the creeks of APSEZ over the period of years also confirms, there is no blockage of any creek or river. APSEZ will also ensure that no creeks or rivers should be blocked due to any port expansion activities and free flow of water should be maintained.
1.14	No underwater blasting is permitted.	Complied. No underwater blasting activity is being carried out or will be carried out as a part of proposed port expansion activities.
1.15	The closed conveyor gallery along with the	Complied.

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td>junction/transfer towers shall be provided with dust suppression systems (DSS). Dust suppression systems with water sprinklers/fogging system shall be provided to prevent the fugitive dust emissions during handling, transfer and storage. Further, the Greenbelts prevent/arrest/controls the fugitive emissions.</td><td>
The following safeguard measures are being taken for abatement of dust / fugitive emissions.

➢ Regular water sprinkling on road and other open area.
➢ Regular cleaning of roads through mechanized equipment
➢ Dry fog Dust Suppression System (DSS) in hopper, transfer towers and conveyor belts
➢ Use of water mist canon
➢ Closed type conveyor belts
➢ Regular sprinkling on coal heaps with mechanized system
➢ Covering other types of dry bulk cargo heaps
➢ Installation of wind breaking wall
➢ Development of greenbelt along the periphery of the storage yards/back up area
➢ Mechanized handling system for coal and other dry bulk cargo
➢ Wagon loading and truck loading through closed silo
➢ Greenbelt development within plant premises

Photographs of safeguard measures implemented for abatement of dust / fugitive emissions at site submitted during compliance period Apr'24 to Sep'24.

The same practice will also be continued as a part of proposed expansion activities.

Ambient Air Quality (twice in a week) monitoring is being carried out by NABL and MoEF&CC accredited agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi. Summary of the same for duration from Apr'25 to Sep'25 is mentioned below.

Total Ambient Air Sampling Locations: 13 Nos.
<table>
<tr><th>Parameter</th><th>Unit</th><th>Min</th><th>Max</th><th>Average</th><th>Perm. Limit $</th></tr>
<tr><td colspan="6">AAQM</td></tr>
<tr><td>PM_{10}</td><td>$\mu g/m_3$</td><td>41.28</td><td>86.73</td><td>63.63</td><td>100</td></tr>
<tr><td>$PM_{2.5}$</td><td>$\mu g/m_3$</td><td>10.35</td><td>40.51</td><td>26.16</td><td>60</td></tr>
</table>
</td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		<table><tr><td>SO_2</td><td>µg/m^3</td><td>7.98</td><td>35.89</td><td>22.28</td><td>80</td></tr><tr><td>NO_2</td><td>µg/m^3</td><td>10.11</td><td>39.84</td><td>26.42</td><td>80</td></tr></table> $ as per NAAQ standards, 2009 * as per CC&A granted by GPCB Values recorded confirms to the stipulated standards. The environmental management budget (including horticulture) for FY 2025-26 is to tune INR 1173.79 lakh. Out of which approximately INR 463.43 lakh has been spent till Sep'25, including INR 8.73 lakh till Sep'25 for environmental monitoring.
1.16	Construction spoils, including bituminous material and other hazardous materials, must not be allowed to contaminate watercourses and the dump sites for such material must be secured so that they should not leach into the ground water.	Complied. All the waste materials are being handled in line with applicable rules and regulations. APSEZ also ensures no kind of waste materials are being dumped into water bodies or in any open land.
1.17	Spillage of fuel/engine oil and lubricants from the construction site are a source of organic pollution which impacts marine life, particularly benthos. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.	Complied. Utmost care as well as provision of appropriate secondary contamination control is being taken to avoid Spillage of fuel/engine oil and lubricants from the construction site. As well as proper environment awareness training for handling of fuel/engine is being imparted to workers to avoid any spillage and same practice will also be continued as a part of proposed expansion activities.
1.18	Oil spillage prevention and mitigation scheme shall be prepared. In case of oil spillage/contamination, action plan shall be prepared to clean the site by adopting proven technology. The recyclable waste (oily sludge) and spent oil shall be disposed of to the authorized recyclers.	Complied. Oil spill contingency plan is in place to handle Tier 1 level oil spills considering different accident scenarios, and the vulnerable areas are identified, and mitigation plan is prepared. Based on the oil spill modeling study, it has been observed that crude oil spill of 700 tons (Tier-I) will spread over an area having radius of around 400 m within 4hr. APSEZ already has facilities for combating a Tier-1 spill.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		Recommendations of Marine EIA by NIO with respect to pollution emergency contingency plan for Multipurpose Terminal, Container, Dry & Break Bulk Terminal as well as associated facilities are addressed in Oil Spill Response Plan. This action plan prepared by APSEZ to combat the oil spill (LOS-DCP) is in accordance with the NOS DCP, International Petroleum Industry Environmental Conservation Association (IPIECA). Waste/Spent Oil/Oily sludge generated would be disposed of through authorized recycler.
1.19	Emergency response system for oil spillage and oil spill contingency plan, any other hazardous material spillages shall be in place at the site level. The mock drill in this regard shall be conducted regularly and the same shall be documented and made available during inspections of local pollution control board, port authorities and MoEF&CC.	Complied. Oil spill contingency response plan is being updated on regular basis and the same was last updated on July 2025 is in place and implemented. The updated Oil spill contingency response plan attached as **Annexure 6.** For responding to oil spill, the Indian Coast Guard has developed the National Oil Spill Disaster Contingency Plan NOSDCP which has the approval of the Committee of Secretaries and has been in operation since 1996. Oil Spill Contingency Response Plan (OSCRP) prepared by APSEZ is in accordance with the NOSDCP. Latest Regional Level Pollution Response exercise "SWACHCHH SAMUDRA-NW 2025" was carried out by Indian Coast Guard on 11th - 12th Sep'25 at Off Vadinar, Gujarat. All participants from various Oil Handling Agencies and Stakeholders (M/S Adani Port & SEZ, Mundra, Indian Oil Corporation LTD, Jamnagar, M/S Nayara Energy LTD VOTL, Vadinar, M/S Reliance Industries LTD, Sikka Jamnagar, M/S Essar Bulk Terminal, Salaya) were participated in this exercise. Mock drills are conducted regularly by APSEZ. Last Oil Spill Mock drill was conducted on 21.04.2025. The updated Oil Spill Mock Drill report is enclosed as **Annexure – 7**. On Site Emergency Response Plan and Crisis Management Plan is in place and implemented. The

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>
updated (Aug'23) Onsite emergency plan submitted during compliance period Apr'24 to Sep'24.

Regular TBT and fire & safety training is being imparted by the fire & safety department.

Regular drills are being conducted for the effectiveness of the system. There were 11 drills conducted for various scenarios during compliance period (Apr'25 to Sep'25) as mentioned below.
<table>
<tr><th>Sr. No.</th><th>Month</th><th>Location</th><th>Scenario</th></tr>
<tr><td>1.</td><td>Apr-25</td><td>ACMTPL Building</td><td>Drill and exercises are planned and implemented in an effort to educate everyone at Adani Ports And Special Economic Zone Ltd on the appropriate response in the event of a real emergency. In addition, lessons learned from these activities enhance the PUB 5A2 Building emergency prevention and response capabilities.</td></tr>
<tr><td>2.</td><td>Apr-25</td><td>AICTPL Building</td><td>Evacuation Drill and exercises are planned and implemented to educate at person at Adani Ports and Special Economic Zone Ltd., Mundra on the appropriate response in the event of a real emergency. In addition, lessons learnt from these activities enhance the Port's emergency prevention and response capabilities.</td></tr>
<tr><td>3.</td><td>Apr-25</td><td>T3 Berth No 10, Dry Cargo</td><td>To conduct a mock drill to test the emergency response plan and preparedness of the team in the event of an accident. Scenario: person Injury in vessel hatch. V.T-Ram (DUMMY). Wharf Supervisor immediately informed about this to superintendent. Simultaneously informed to ISCR, OHC, and Safety & Security (Security Control), Safety, POC and to all concern people.</td></tr>
<tr><td>4.</td><td>May-25</td><td>Enclosure no -09 -Tank no -119</td><td>During the cargo receipt from the vessel, a flange gasket rupture occurred at the center valve of the pipeline at the tank side. This resulted in spilled cargo, leading to a fire outbreak in the tank dyke area, caused by unidentified sources.</td></tr>
<tr><td>5.</td><td>Jun-25</td><td>ACMTPL/Yard 7J/Slot No:82ACMTP</td><td>Mock drill was decided, and advance information given Operation team, Fire team, OHC,</td></tr>
</table>
</td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		<table><tr><td></td><td></td><td>L/Yard 7J/Slot No:82</td><td>Safety, Security, ERT, Terminal head, POC, admin team regarding emergency. Scenario and execution plan was decided as per scenario.</td></tr><tr><td>6.</td><td>Jun-25</td><td>Steel Yard in gate</td><td>Mass marine surveyor trailer checking activity at in gate area that time trailer hit the person.</td></tr><tr><td>7.</td><td>Jul-25</td><td>AICTPL/2F-3F Cross Road</td><td>Mock drill was decided, and advance information given Operation team, Fire team, OHC, Safety, Security, ERT, Terminal head, POC, admin team regarding emergency. Scenario and execution plan was decided as per scenario.</td></tr><tr><td>8.</td><td>Jul-25</td><td>FCC-BU 5&6</td><td>Nabil enterprise housekeeping person Chando Paswan housekeeping activities at BU 5&6 that time slipped from ladder.</td></tr><tr><td>9.</td><td>Aug-25</td><td>West Basin Berth No 02, Dry Cargo</td><td>Conduct a mock drill to test the emergency response plan and preparedness of the team in the event of an accident. Scenario: Person got injured in side vessel hatch. V.T- shyam (DUMMY). On board Supervisor immediately informed about this to Control Room. Simultaneously informed to Site main controller, OHC, Safety, Fire, Marine & Security (Security Control), to all concern people.</td></tr><tr><td>10.</td><td>Sep-25</td><td>Tank -11 (Encloser-01)</td><td>Fall from height during tank maintenance activity due to dizziness. (No major Injury)</td></tr><tr><td>~~11.~~</td><td>~~Apr-25~~</td><td>~~ACMTPL Building~~</td><td>~~Drill and exercises are planned and implemented in an effort to educate everyone at Adani Ports And Special Economic Zone Ltd on the appropriate response in the event of a real emergency. In addition, lessons learned from these activities enhance the PUB 5A2 Building emergency prevention and response capabilities.~~</td></tr></table> Safety Mock drill report (latest report) conducted during the compliance period is enclosed as **Annexure – 8.**
1.20	Since liquid/gaseous product handling is involved, complete risk safety assessment including 'BLEVE' study and mitigation measures and safety precautions shall be drawn and implemented along with the Robust	Complied. Quantitative Risk Assessment for existing facilities i.e; Tank farms, Jetty Area & Pipelines was conducted in Nov'2016 by M/s TECHNIP INDIA LIMITED to assess the risk levels associated with the facilities to handle liquid/gaseous product; evaluate risks based on the HSE UK Risk Acceptance Criteria, and risks if found are outside the tolerable region, then risk reduction

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td>safety standards and latest fire detection and prevention techniques. The report shall be submitted along with the 6 monthly compliance report.</td><td>measures shall be proposed to bring the risks into tolerable or As Low As Reasonably Practicable (ALARP) Levels and lower levels and recommendations of the study is being complied with. Copy of QRA report submitted during compliance period Apr'24 to Sep'24.

Quantitative Risk Assessment (QRA) study has been conducted for the development of the VLCC Jetty at Mundra, which is intended for handling crude oil imports. The objective of the study is to evaluate the potential consequences of hydrocarbon releases from process piping and equipment, determine the frequency of such releases, and quantify both individual and societal risks. These risk levels are then assessed against established risk tolerability criteria to evaluate their acceptability. Additionally, the study identifies appropriate risk reduction measures suitable for the current phase of development and demonstrates that all risks are being managed to a level that is As Low As Reasonably Practicable (ALARP). Copy of the same attached as Annexure 9.</td></tr>
<tr><td>1.21</td><td>The risk assessment and management plan being drawn up with regards to the environmental impacts of natural disasters, oil spills and other waste, dredging and dumping on marine ecology shall scrupulously implemented. It shall be ensured that the marine ecology in the area of influence shall not affect. The monitoring and compliance status of the marine ecology management plan shall be submitted along with the six monthly EC compliance reports.</td><td>Complied.

Disaster Management Plan is updated regularly and the updated DMP submitted during compliance period Apr'24 to Sep'24.

APSEZ would stringently implement risk assessment and management plan, and few recommendations implemented in past is mentioned below:

Few Marine EIA recommendations:
<table>
<tr><td>Shore based power supply shall be provided to the ships that are berthed to reduce the air emissions.</td><td>Complied.

Power supply from Grid/Solar is being supplied to the vessels berthed to reduce emissions.</td></tr>
<tr><td>The ballast water or any discharge from the ships shall be prevented by insisting the ships/vessels to follow the MARPOL Convention guidelines.</td><td>Complied

Ships berthing at Mundra Port comply with MARPOL regulations.

No discharge such as ballast/bilge wastes, sewage or any other liquid</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th colspan="2">Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td colspan="2">
<table>
<tr><td>The discharge from the ships, if required, shall be disposed only after proper treatment.</td><td>wastewater is allowed into marine environment inside port limits.

APSEZ has adequate Waste Reception facility as per MARPOL and DG Shipping regulations. The port has reception facility for all MARPOL waste streams (Annex-I, Annex-II, Annex-IV & Annex-V) except Annex-VI that is generated from vessels.

As a general practice APSEZ provide facility for receiving slop / waste oil from vessels through hose connection with oil tankers. These tankers divert slop / waste oil to Oil water separator system where water and oil particles are separated. Separated oil is being sold to authorized recycler /re-processor. However, no slope / waste oil was received during the compliance period.

Regular Marine water and sediments monitoring is being carried out by NABL and MoEF&CC accredited agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi. Monitoring reports for the period from Apr'25 to Sep'25 is enclosed as Annexure – 5.</td></tr>
<tr><td>A risk assessment of the ships and other vessels entering the port shall be carried out to avoid introduction of alien species or pests.</td><td>Complied

No discharge such as ballast/bilge wastes, sewage or any other liquid wastewater is allowed into marine environment inside port limits to avoid introduction of alien species or pests.</td></tr>
</table>

Marine water monitoring for west port area is being carried out by M/s. Adani Power (Mundra) Limited (Pre-monsoon & Post-monsoon) through NABL accredited and MoEF&CC authorized agency namely M/s. UniStar Environment & Research Labs Pvt. Ltd. Monitoring reports are also enclosed as Annexure – 5.

Please Refer Compliance status of specific Condition no 1.12 of EC & CRZ clearance for Continuous monitoring of the ecological characteristics
</td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td>1.22</td><td>All the recommendations mentioned in the risk assessment report, disaster management plan and safety guidelines shall be implemented.</td><td>Complied.

We have commenced port expansion activity after getting EC & CRZ clearance and Consent to Establish from concern regulatory authorities. Hence, all the recommendations suggested in risk assessment report, disaster management plan and safety guidelines are being complied as applicable.</td></tr>
<tr><td>1.23</td><td>The project proponent shall install a system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM10 and PM2.5 in reference to PM emission, and SO2 and NOx in reference to SO2 and NOx emissions) within and outside the port area at least at four locations (one within and three outside the port area at an angle of 120°each), covering upwind and downwind directions.</td><td>Complied.

Ambient Air Quality is being carried out by NABL accredited and MoEF&CC authorized agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi.

Total number of ambient air monitoring station is 13. Out of which 09 Nos. is within Port & 04 Nos. Outside Port.

Locations have been selected considering an angle of 120°each), covering upwind and downwind directions of port operational activities.

Summary of the same for duration from Apr'25 to Sep'25 is mentioned below:

Air sampling locations & frequency: 13 nos. (twice a week including surrounding villages)
<table>
<tr><th>Parameter</th><th>Unit</th><th>Min</th><th>Max</th><th>Average</th><th>Perm. Limit$</th></tr>
<tr><td></td><td colspan="5">AAQM</td></tr>
<tr><td>PM10</td><td>µg/m3</td><td>41.28</td><td>86.73</td><td>63.63</td><td>100</td></tr>
<tr><td>PM2.5</td><td>µg/m3</td><td>10.35</td><td>40.51</td><td>26.16</td><td>60</td></tr>
<tr><td>SO2</td><td>µg/m3</td><td>7.98</td><td>35.89</td><td>22.28</td><td>80</td></tr>
<tr><td>NO2</td><td>µg/m3</td><td>10.11</td><td>39.84</td><td>26.42</td><td>80</td></tr>
</table>
$ as per NAAQ standards, 2009
* as per CC&A granted by GPCB
Values recorded confirms to the stipulated standards.

Please refer Annexure – 5 for detailed analysis reports. Approx. INR 8.73 Lakh is spent for all environmental monitoring activities during the FY 2025-26 till Sep'25 for overall APSEZ, Mundra.

Ambient air quality monitoring in surrounding villages is being carried out by M/s. Adani Power (Mundra) Limited, Mundra through NABL accredited and MoEF&CC authorized agency namely M/s. UniStar</td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		Environment & Research Labs Pvt. Ltd. and monitoring reports of the same are also enclosed in **Annexure – 5**. If required, nos. of Ambient Air Monitoring Locations will also be increased.
1.24	Appropriate Air Pollution Control (APC) system shall be provided for all the dust generating points including fugitive dust from all vulnerable sources, so as to comply prescribed fugitive emission standards.	Complied. For further details regarding the control measures for fugitive emissions, please refer to specific condition no 1.15 of the EC and CRZ clearance.
1.25	Emission and air quality monitoring and results of manual stack monitoring and manual monitoring of air quality /fugitive emissions to Regional Office of MoEF&CC, Zonal office of CPCB and Regional Office of SPCB along with six monthly monitoring report.	Complied. For further details regarding ambient air quality monitoring & results, please refer to specific condition no 1.15 of the EC and CRZ clearance. Stack monitoring (once in six month) is being carried out by NABL and MoEF&CC accredited agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi. Monitoring reports for the period from Apr'25 to Sep'25 is enclosed as **Annexure – 5.**
1.26	Rain water harvesting for roof run-off and surface run-off, should be implemented. Before recharging the surface run off, pre-treatment must be done to remove suspended matter, oil and grease.	Complied Groundwater recharge cannot be done at the project site since the entire project is in the intertidal / sub tidal areas. Rainwater within project area is managed through storm water drainage. We have installed Rainwater recharge bore well (4 Nos.) within our township to recharge ground water. During FY 2025-26 till Sep'25 approx. 3.62 ML of rainwater has been recharged to increase the ground water table. We have also connected roof top rainwater duct of operational building (Tug berth building within MPT) with u/g water tank for utilization of collected rainwater for gardening / horticulture purpose. Details of the same submitted during compliance period Apr'24 to Sep'24.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		However, Adani Foundation – CSR arm of Adani Group has carried out rainwater harvesting activities in the nearby villages for benefit of the locals. Water conservation Projects i.e. Roof Top Rainwater Harvesting, Desilting of Check dams, Bore Well Recharge and Pond deepening were taken up in past years, review and monitoring of all water harvesting structures had been taken up. To make connections between human actions and the level of biological diversity found within a habitat and/or ecosystem, this year Adani Foundation launch project "Sanrakshan" in coordination with GUIDE and Sahjeevan. Since, 10 years considerable Water Conservation Work carried out in Mundra Taluka. Due to satisfactory rain in current year 1.11 mtr ground water table increased as per increased in coastal belt of Mundra as per Government Figures. **Our water conservation work is as below.** The Water Conservation Projects completed during the current Compliance period: ❖ **Water conservation project (till date water conservation work):** In recent years, the villages near our operational area have experienced significant enhancements in both the availability and quality of water. These improvements stem from our focused efforts in managing and conserving groundwater and surface water resources. • **Key interventions—** ○ pond deepening, ○ strengthening of check dams, ○ installation of rainwater harvesting systems, borewell drilling, and clearing of river inlets—have together increased water storage capacity. • **Till the date (Sep'25)** ○ 145 Pond Deepening ○ 209 Bore & Wells

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		○ 355 Rainwater Harvesting ○ 30 Check Dams ○ 25 Percolation Wells ○ Farmers Benefitted - 1760 Storage ○ capacity Increase – 2171435Cum. • **<u>Current year (Apr'25 to Sep'25)</u>** ○ Pond Deepening - 05 Village Pond ○ Check dam Re- strenghtining-01 ○ Farmer - 300 famer Land irrigated - 1800 Acre ○ **8.0%** Increase in Revenue ○ **9.00 %** TDS Reduction ○ Rs **1200** Reduce in health expenses Monthly • **<u>ROOF TOP RAINWATER HARVESTING:</u>** ○ 355 RRWHS units built across 355 homes, positively impacting more than 1,760 people. ○ TDS level below 100 meeting WHO standards for safe drinking water. ○ First-time rainwater harvesting enabled for the community, ensuring quality drinking water and reducing financial burdens ○ **1760+** Residents benefited ○ **97.73%** Less TDS than local municipality water Gundiyali – 4410 TDS ○ **Rs. 1125** monthly Saved on drinking water ○ **Rs. 3000** yearly saved on health expense **The Water Conservation Projects completed during the FY 2024-25.** ➢ **WATER CONSERVATION "SWAJAL PROJECT" ENHANCING RURAL WATER RESOURCES** ❖ Adani Foundation has undertaken significant water conservation initiatives to address water scarcity and improve water availability in rural areas. ❖ Through the creation of 737 various water structures, the project has increased water capacity by 5,400,735 cubic meters (CUM) and benefited 64,515 people. ➢ **Check Dam New/Renovation:** ○ Structures: 29 ○ Water Capacity Increase: 1,072,332 CUM ○ Beneficiaries: 30,870

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		○ Impact: Enhances water storage and irrigation. ➢ **Rainwater Harvesting Structures (RRWHS):** ○ Structures: 330 ○ Water Capacity Increase: 3,300,000 CUM ○ Beneficiaries: 1,650 ○ Impact: Maximizes rainwater capture and usage. Rs. 10950 yearly saved/house ➢ **Pond Deepening:** ○ Structures: 135 ○ Water Capacity Increase: 1,028,403 CUM ○ Beneficiaries: 18,350 ○ Impact: Improves water retention and availability. ➢ **Construction of Percolation Wells:** ○ Structures: 26 ○ Ground Water Recharge: Significant ○ Beneficiaries: 3,000 ○ Impact: Boosts groundwater levels and availability. ➢ **Bore/Well Recharge:** ○ Structures: 209 ○ Ground Water Recharge: Significant ○ Beneficiaries: 1,045 ○ Impact: Enhances groundwater recharge and sustainability. ➢ **Construction of New Wells:** ○ Structures: 8 ○ Purpose: Drinking Water ○ Beneficiaries: 9,600 ○ Impact: Provides reliable drinking water sources ➢ **WATER MANAGEMENT PROJECTS:** ○ Percolation Well, Mota Bhadiya: 80 farmers benefited. ○ Percolation Bore Cleaning, GPVC Villages: 3150 farmers benefited. ○ Pond Deepening & Road Cleaning, GPVC Villages: 6KM cleaned. ➢ **DRIP IRRIGATION - ENHANCING LIVELIHOODS IN KUTCH:** ○ The Drip Irrigation Initiative by Adani Foundation promotes efficient water use in farming by providing financial support to farmers for installing drip systems. It helps

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		conserve water, improve crop yield, and encourage sustainable agriculture in Kutch. • In 2024-25, Adani Foundation supported sustainable water management in Kutch by Promoting drip irrigation across 490 villages in Abdasa, Lakhpat, Mandvi, Mundra, and Nakhtrana talukas. Covering a total area of 2,074.53 hectares, the initiative benefited 1,041 farmers. This effort enhanced irrigation efficiency, boosted agricultural productivity, and contributed to water conservation and eco-friendly farming practices in the region. With the objective of to preserve the rainwater to reduce the impact of salinity and recharge the ground water (the main source of water) to facilitate the Agricultural activities as well as for drinking water. Please refer **Annexure - 2** for full details of CSR activities carried out by Adani Foundation in the Kutch region. The budget allocated for CSR activities for the financial year 2025-26 was INR 1131.67 lakh. Out of which Approx INR 448.96 lakh has been spent during the FY 2025-26 till Sep'25. APSEZ will also explore the possibility of Rainwater harvesting within port premises during port expansion activities through proper collection of rainwater, if feasible.
1.27	Ensure minimum 5% of total electricity requirement be met through installation of solar energy/ green/ non-conventional in the proposed activity area.	Complied. APSEZ has implemented the following for reduction of renewal source of energy consumption. ➢ Installed 8.8 MW roof top solar generating plant at various locations and 22.4 MW wind generating plant in SEZ in Mundra. ➢ Development of 1000 MW of solar park at Khavda (under process). ➢ 217 nos. of Electrical truck Vehicle for internal movement of material (E-ITV's). ➢ 10 nos. of Electrical Car for movement of employees and all are working.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		➢ Replacement of diesel loco by Electrified railway line of approx. 91 km from West port to Adipur Railway station.
1.28	All the commitments made as part of EMP with the budget provisions shall be implemented. The compliance to the recommendations shall be submitted along with 6 monthly compliance report to the regional office of MoEFCC.	Complied. All the commitments made as part of EMP with the budget provisions is being implemented gradually and budget allocated for the EMP will be used for the implementation of EMP only and the said will not be diverted to any other specific purpose. Budget for environmental management measures (including horticulture) for the FY 2025-26 is to the tune of INR 1173.79 lakh. Out of which approx. INR 463.43 lakh has been spent during FY 2025-26 till Sep'25. Detailed breakup of the expenditures for the past 3 years is attached as **Annexure – 10**.
1.29	As per the Ministry's Office Memorandum F.No.22-65/2017-IA.III dated 30th September 2020, the project proponent shall abide by all the commitments made by them to address the concerns raised during the public consultation. The project proponent shall initiate the activities proposed by them, based on the commitment made in the public hearing, and incorporate in the Environmental Management Plan and submit to the Ministry. All other activities including pollution control, environmental protection and conservation, R&R, wildlife and forest conservation/protection measures including the	Point Noted and Agreed. A public hearing for the said project was exempted by MoEF&CC vide Amendment in ToR dated 10th April, 2024. APSEZ is already working in Mundra Since 1995 and people are well aware about the associated environment impacts of the development activities, and how best APSEZ is implementing its Environment Management Plan, through best practices. APSEZ is implementing CSR activity through its CSR arm - Adani Foundation in the following areas ✓ Education ✓ Community Health ✓ Sustainable Livelihood Development ✓ Community Infrastructure Development ✓ Skill Development The budget allocated for CSR activities for the financial year 2025-26 was INR 1131.67 lakh. Out of which approx. INR 448.96 lakh has been spent during the FY 2025-26 till Sep'25.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	NPV, Compensatory Afforestation etc, either proposed by the project proponent based on the social impact assessment and R&R action plan carried out during the preparation of EIA report or prescribed by EAC, shall also be implemented and become part of EMP.	Till Sep'25, Adani Foundation has done total expenditure of INR 192.9 Cr. for CSR activities in Kutch region since its inception. APSEZ will continue to do the CSR activities. As per O&M dated 30th September 2020 and 20th October 2020, CER is not applicable. However, APSEZ has carried out many works inline to Sustainable Environment in the areas surrounding the project, with focus on Resource conservation, Waste Minimization, Biodiversity enhancement and conservation, Water conservation, Wastewater Management etc. Same will also be taken up further, based on the need-based assessment and in consultation with local administration.
1.30	Environmental Clearance is granted subject to final outcome of Hon'ble Supreme Court of India, Hon'ble High Court of Gujarat, and any other court of law, if any, as May be applicable to this project.	Point Noted and Agreed.
1. Statutory Compliance		
1.1	Construction activity shall be carried out strictly according to the provisions of CRZ Notification, 2011 and the State Coastal Zone Management Plan as drawn up by the State Government. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	Being Complied. Construction work for the project is partially completed & construction activity is in progress for proposed development in accordance with existing rules & regulations of CRZ Notification, 2011 and as amended from time to time. All the specific conditions provided for construction phase is being considered upon recommencement of construction activity.
1.2	A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained.	Complied. APSEZ's subsidiary unit MUL is supplying power during construction & operation phase, emergency DG sets will only be used for Emergency power shutdown. Emergency DG sets used will confirm CPCB standards.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
1.3	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Coast Guard, Civil Aviation Department shall be obtained, as applicable by project proponents from the respective competent authorities.	Complied. All statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Coast Guard, Civil Aviation Department have been obtained from concern authorities and same will be continued for proposed expansion also.
2. Air Quality Monitoring and Preservation		
2.1	The project proponent shall install system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM10 and PM2.5 in reference to PM emission, and SO2 and NOx in reference to SO2 and NOx emissions) within and outside the project area at least at four locations, covering upwind and downwind directions.	Complied For further details regarding ambient air quality monitoring & results, please refer to specific condition no 1.23 of the EC and CRZ clearance.
2.2	Appropriate Air Pollution Control (APC) system shall be provided for all the dust generating points including fugitive dust from all vulnerable sources, so as to comply prescribed emission standards	Complied. For further details regarding the control measures for fugitive emissions, please refer specific condition no 1.15 of the EC and CRZ clearance.
2.3	Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or	Complied. Proposed Facilities would be covered on all sides to avoid dust discharge from site. APSEZ had provided provision of hydraulic operated spill plate & wind screen to retain any accidental spill of dry cargo into the sea.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.	Also, administrative control is taken by providing regular training to crane operators to drop the coal from less height to reduce fugitive dust emission. APSEZ also has a dedicated housekeeping staff doing rigorous dry housekeeping with mechanized sweeping machine round the corner. Also rest shelter would be provided at the workplace.
2.4	Dust collectors shall be deployed in all areas where blasting (surface cleaning) and painting operations are to be carried out, supplemented by stacks for effective dispersion.	Point Noted and Will be complied.
2.5	The Vessels shall comply the emission norms prescribed from time to time.	Complied. Ships berthing at Mundra Port complies with MARPOL regulations. No discharge such as bilge wastes, sewage or any other liquid wastewater is allowed into marine environment inside port limits. APSEZ has adequate Waste Reception facility as per MARPOL and DG Shipping regulations. The port has reception facility for all MARPOL waste streams (Annex-I, Annex-II, Annex-IV & Annex-V) except Annex-VI that is generated from vessels. APSEZL has not received any sewage/liquid waste from ships / vessels till date. As a general practice APSEZ provide facility for receiving slop / waste oil from vessels through hose connection with oil tankers. These tankers divert slop / waste oil to Oil water separator system where water and oil particles are separated. Separated oil is being sold to authorized recycler /re-processor. However, no slope / waste oil was received during the compliance period.
2.6	Diesel power generating sets proposed as source of backup power should be of	Complied.

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td>enclosed type and conform to rules made under the Environment (Protection) Act, 1986. The height of stack of DG sets should be equal to the height needed for the combined capacity of all proposed DG sets. Use of low sulphur diesel. The location of the DG sets may be decided with in consultation with State Pollution Control Board.</td><td>MUL is supplying uninterrupted power throughout the year. However, DG sets have been kept as stand-by for Emergency power shutdown. DG sets used is confirming to CPCB standards.

Nos. of D.G. Sets: 19
Frequency of Monitoring: Six Monthly

Summary of DG stack monitoring is mentioned below: -

<u>Results of DG Stack Monitoring</u>
Monitoring Period: –April-2025 to –September-2025
<table><tr><th>Sr. No.</th><th>Parameter</th><th>Unit</th><th>MIN</th><th>MAX</th><th>AVERAGE</th><th>Permissible Limit</th></tr><tr><td>1</td><td>Particulate Matter</td><td>mg/Nm^3</td><td>16.95</td><td>29.94</td><td>21.07</td><td>150</td></tr><tr><td>2</td><td>Sulphur Dioxide</td><td>ppm</td><td>6.04</td><td>16.77</td><td>8.85</td><td>100</td></tr><tr><td>3</td><td>Oxide of Nitrogen</td><td>ppm</td><td>15.38</td><td>31.27</td><td>21.84</td><td>50</td></tr></table>
Six monthly DG stack monitoring reports for duration Apr'25 to Sep'25 attached as Annexure – 5.</td></tr>
<tr><td>2.7</td><td>A detailed traffic management and traffic decongestion plan shall be drawn up to ensure that the current level of service of the roads within a 05 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 05 Kms radius of the site in different scenarios of space and time and the traffic management plan</td><td>Complied.

APSEZ is well connected with a National Highway (NH-8A) and State Highway (SH-6). The National and State highways have connections to other major roads, cities and parts of the country such as the Delhi Mumbai Industrial Corridor, NH-14, SH-48, etc. In addition to them the port has 7 approach roads connecting to state and national highways for easy cargo movement. The port also has a good rail connectivity, and it is the first port in India connected by double stack container rail facility.

As part of the traffic assessment, expansion of 8 nos. of roads and laying 9 nos. of internal road connectivity to handle the traffic due to proposed development based on future requirement with obtaining requisite permission from concerned authorities.

For the traffic management, the government and APSEZ have already collaborated on an investment of approx. Rs. 321 crores. A bridge is being constructed</td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	shall be duly validated and certified by the State Urban Development department and the P.W.D./ competent authority for road augmentation and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.	from Pragpar to our T-junction, and the entire road is being expanded to six lanes. The traffic coming from Gandhidham is being redirected. North corridor road connectivity from North gate parking to Luni State Highway is in progress. Work execution is in three part. One is North gate parking to existing North corridor road length is 350 rmt and 7.00 mtr wide bitumen road , second is Airport to LC 22 connecting road length is 1500 rmt and 7.00 mtr wide bitumen road .Third part is Concor yard to Luni State Highway connectivity road length is 920 Rmt and 7.00 mtr wide bitumen road.All roads are two lane and cost is 19.00 Cr.
3. Water Quality Monitoring And Preservation		
3.1	The Project proponent shall ensure that no creeks or rivers are blocked due to any activities at the project site and free flow of water is maintained.	Complied For further details please refer compliance to specific condition no 1.13 of the EC and CRZ clearance.
3.2	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality. Silt curtains shall be used to contain the spreading of suspended sediment during dredging within the dredging area.	Complied. During dredging activities all the recommendations such as use of silt curtains, disposing of dredged material at a specific point into offshore location, etc. would be implemented. Entire quantity of dredged material is being used for reclamation activities only; no disposal is carried out in the sea. Total 3.07 MCuM Capital dredging or reclamation is carried out in CRZ area (except CRZ-IA area) since Oct'24 to Sep'25 for Expansion of Waterfront Development Plan in line with approved EC & CRZ Clearance. Out of which 1.52 MCuM is carried out during the compliance period Apr'25 to Sep'25.
3.3	No ships docking at the proposed project site will discharge its on-board waste water untreated in to the estuary/ channel. All such wastewater load will	Point Noted and Agreed Ships berthing at Mundra Port comply with MARPOL regulations. No discharge such as bilge wastes, sewage or any

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	be diverted to the proposed Effluent Treatment Plant of the project site.	other liquid wastewater is allowed into marine environment inside port limits. APSEZ has adequate Waste Reception facility as per MARPOL and DG Shipping regulations. The port has reception facility for all MARPOL waste streams (Annex-I, Annex-II, Annex-IV & Annex-V) except Annex-VI that is generated from vessels. APSEZL has not received any sewage/liquid waste from ships / vessels till date. As a general practice APSEZ provide facility for receiving slop / waste oil from vessels through hose connection with oil tankers. These tankers divert slop / waste oil to Oil water separator system where water and oil particles are separated. Separated oil is being sold to authorized recycler /re-processor. However, no slope / waste oil was received during the compliance period.
3.4.	Measures should be taken to contain, control and recover the accidental spills of fuel and cargo handle.	Complied. For further details regarding oil spill contingency plan, please refer specific condition no 1.17 of the EC and CRZ clearance.
3.5	The project proponents will draw up and implement a plan for the management of temperature differences between intake waters and discharge waters.	Complied. Marine monitoring is being carried out by the M/s Adani Power Limited, Mundra at the marine outfall locations and reports is being submitted to the concerned authorities on regular basis. Monitoring Report attached as **Annexure - 5.**
3.6	Spillage of fuel / engine oil and lubricants from the construction site are a source of organic pollution which impacts marine life. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.	Complied. For further details regarding oil spill contingency plan, please refer specific condition no 1.18 of the EC and CRZ clearance.
3.7	Total freshwater use shall not exceed the proposed requirement as provided in	Complied.

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td>the project details. Prior permission from competent authority shall be obtained for use of fresh water.</td><td>APSEZ sources its water for various project activities from the desalination plant of APSEZ and/or water through Gujarat Water Infrastructure Limited (GWIL). Average water consumption for entire APSEZ area is 5.21 MLD during compliance period i.e. Apr'25 to Sep'25.

Additional capacity of desalination plant will be developed to fulfill the freshwater requirement of APSEZ in line with expansion activity as well as future business requirement.</td></tr>
<tr><td>3.8</td><td>Sewage Treatment Plant shall be provided to treat the wastewater generated from the project. Treated water shall be reused for horticulture, flushing, backwash, HVAC purposes and dust suppression.</td><td rowspan="2">Point Noted and Agreed

Entire quantity of sewage generated is being treated in designated ETP / STP and treated sewage conforming with GPCB standard is fully utilized for Horticulture purposes.

<table>
<tr><th>Location</th><th>Capacity</th><th>Quantity of Treated Water (Avg. from Apr'25 to Sep'25)</th><th>Type of ETP / STP</th></tr>
<tr><td>LT</td><td>265 KLD</td><td>159.74 KLD</td><td>Activated Sludge</td></tr>
<tr><td>West Port</td><td>55 KLD</td><td>14.31 KLD</td><td>FAB</td></tr>
</table>

Third party analysis of the treated water is being carried out once in a month at ETP & twice in a month at West Port by NABL and MoEF&CC accredited agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi. Summary of the same for duration from Apr'25 to Sep'25 is mentioned below.

<table>
<tr><th colspan="6">Industrial Effluent / Sewage (For ETP)</th></tr>
<tr><th>Parameter</th><th>Unit</th><th>Min</th><th>Max</th><th>Average</th><th>Perm. Limit$</th></tr>
<tr><td>pH</td><td>--</td><td>6.91</td><td>7.74</td><td>7.43</td><td>6.5 – 8.5</td></tr>
<tr><td>TSS</td><td>mg/L</td><td>22</td><td>74</td><td>33.67</td><td>100</td></tr>
<tr><td>Ammonical Nitrogen as NH_3-N</td><td>mg/L</td><td>22.6</td><td>35.4</td><td>28.08</td><td>50</td></tr>
<tr><td>BOD (3 Days @ 27°C)</td><td>mg/L</td><td>21</td><td>26</td><td>23.58</td><td>30</td></tr>
<tr><td>COD</td><td>mg/L</td><td>72.4</td><td>88.4</td><td>82.73</td><td>100</td></tr>
<tr><td>TDS</td><td>mg/L</td><td>710</td><td>1120</td><td>890.67</td><td>2100</td></tr>
</table>
</td></tr>
<tr><td>3.9</td><td>A certificate from the competent authority for discharging treated effluent/ untreated effluents into the public sewer/ disposal/drainage systems along with the final disposal point should be obtained.</td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>
Domestic Sewage (for STP)
<table>
<tr><th>Parameter</th><th>Unit</th><th>Min</th><th>Max</th><th>Average</th><th>Perm. Limit$</th></tr>
<tr><td>pH @ 25 ° C</td><td>--</td><td>6.86</td><td>7.58</td><td>7.32</td><td>6.5 to 9</td></tr>
<tr><td>Total Suspended Solids</td><td>mg/L</td><td>10.00</td><td>18.00</td><td>14.83</td><td>20</td></tr>
<tr><td>COD</td><td>mg/L</td><td>17.50</td><td>48.20</td><td>32.43</td><td>50</td></tr>
<tr><td>Biochemical Oxygen Demand (BOD) (5 days at 20 ° C)</td><td>mg/L</td><td>5.00</td><td>9.40</td><td>7.40</td><td>10</td></tr>
<tr><td>Total Nitrogen</td><td>mg/L</td><td>4.10</td><td>9.80</td><td>6.98</td><td>10</td></tr>
<tr><td>Total Phosphorus</td><td>mg/L</td><td>0.30</td><td>0.87</td><td>0.70</td><td>1.0</td></tr>
<tr><td>Fecal Coliform</td><td>MPN Index /100 ml</td><td>42.00</td><td>90.00</td><td>66.83</td><td>Desirable 100 MPN/100 ml Permissible 230/100 ml</td></tr>
</table>
$ as per CC&A granted by GPCB
Values recorded confirms to the stipulated standards.

Monitoring and analysis of ETP and STP treated waste is also carried out regularly through in-house laboratory for the parameters such as pH, TDS, TSS, COD, Chlorides, and residual chlorine.
</td></tr>
<tr><td>3.10</td><td>No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.</td><td>Complied.

For further details please refer specific condition no 1.13 of the EC and CRZ clearance.</td></tr>
<tr><td>3.11</td><td>All the erosion control measures shall be taken at water front facilities. Earth protection work shall be carried out to avoid erosion of soil from the shoreline/boundary line from the land area into the marine water body.</td><td>Being Complied

Shoreline change study was carried out by M/s. Gujarat Institute of Desert Ecology, Bhuj in 2022 as a part of the Environmental Management Plan (EMP) compliance with the CIA study. The cost of said study was INR 17.39 Lacs.

In the present study, the rate of shoreline changes</td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>statistics on a time series of multiple shoreline positions of a totally 43 km coastline stretches (16 km on the west side and 27 km on the east side of Adani main port) on either side of Adani Ports and Special Economic Zone Ltd (APSEZL) has been taken into account for the calculation by using satellite images.

As a part of the NGT direction, the shoreline change analysis has been carried out for the years 2015-2022 to study the immediate changes after the commissioning of the port and initiation of the activities (September 2015) for short-term variation for the year 2015-2022 using EPR method has been carried out.

The details of the rate of shoreline changes (Short interval time) recorded from 2015 to 2022 are summarized in below table.

<table>
<tr><th rowspan="2">Period</th><th rowspan="2">Name of the block</th><th rowspan="2">Average Shoreline Change (M/Year)</th><th colspan="2">Shoreline Change(M)</th></tr>
<tr><th>Maximum Accretion</th><th>Maximum Erosion</th></tr>
<tr><td rowspan="2">2015-2022</td><td>West Port</td><td>-11.43</td><td>39.86</td><td>-78.68</td></tr>
<tr><td>Eastern side</td><td>-26.60</td><td>191.32</td><td>-165.19</td></tr>
</table>

The Shoreline Change Assessment Study report of GUIDE was submitted during compliance period Apr'24 to Sep'24.</td></tr>
<tr><td colspan="3">4. Noise Monitoring And Prevention</td></tr>
<tr><td>4.1</td><td>Noise level survey shall be carried as per the prescribed guidelines and report in this regard shall be submitted to Regional Officer of the Ministry as a part of six-monthly compliance report.</td><td>Complied.

Ambient Noise monitoring is being carried out by NABL accredited and MoEF&CC authorized agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd.,

Summary of the same for duration from Apr'25 to Sep'25 is mentioned below:

<table>
<tr><th colspan="6">Noise sampling locations & frequency: 10 nos. (once in a month)</th></tr>
<tr><th>Noise</th><th>Unit</th><th>Leq Min</th><th>Leq Max</th><th>Leq Ave.</th><th>Leq Perm. Limit*</th></tr>
<tr><td>Day Time</td><td>dB(A)</td><td>57.00</td><td>69.90</td><td>65.13</td><td>75</td></tr>
<tr><td>Night Time</td><td>dB(A)</td><td>51.30</td><td>64.90</td><td>61.01</td><td>70</td></tr>
</table>
</td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		$ as per NAAQ standards, 2009 * as per CC&A granted by GPCB Values recorded confirms to the stipulated standards. Please refer **Annexure – 5** for detailed analysis reports. Approx. INR 8.73 Lakh is spent for all environmental monitoring activities during the FY 2025-26 till Sep'25 for overall APSEZ, Mundra. Ambient noise quality monitoring in surrounding villages is being carried out by M/s. Adani Power (Mundra) Limited, Mundra through NABL accredited and MoEF&CC authorized agency namely M/s. UniStar Environment & Research Labs Pvt. Ltd. and monitoring reports of the same are also enclosed in **Annexure – 5**.
4.2	Noise from vehicles, power machinery and equipment on-site should not exceed the prescribed limit. Equipment should be regularly serviced. Attention should also be given to muffler maintenance and enclosure of noisy equipment's.	Complied. This reply covers condition no 4.2 and 4.3. For operation phase, following noise control measures are taken: • All Emergency DG sets were installed with acoustic enclosures confirming EPA norms. • Proper maintenance of equipment's / plant machineries is being done on regular basis. • Green Belt has been developed at roadsides and operational areas. Traffic control measures such as signage, speed regulation, traffic guides etc. are in place to reduce the unnecessary honking by cargo vehicles.
4.3	Acoustic enclosures for DG sets, noise barriers for ground-run bays, ear plugs for operating personnel shall be implemented as mitigation measures for noise impact due to ground sources.	
4.4	The ambient noise levels should conform to the standards prescribed under E(P)A Rules, 1986 viz. 75 dB(A) during day time and 70 dB(A) during night time.	Complied. Ambient noise quality monitoring is being carried out through NABL accredited and MoEF&CC authorized agency namely M/s. UniStar Environment & Research Labs Pvt. Ltd. Please refer to Noise Monitoring And Prevention condition no 4.1 of EC & CRZ Clearance for detailed information. Existing emergency D.G. Sets provided conforming to the standards prescribed under E(P)A Rules, 1986 only

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		and the same will be continued during proposed expansion activity also.
5. Energy Conservation Measures		
5.1	Provide solar power generation on roof tops of buildings, for solar light system for all common areas, streetlights, parking around project area and maintain the same regularly;	Complied. For further details regarding renewable energy installation and usage, please refer specific condition no 1.27 of the EC and CRZ clearance.
5.2	Provide LED lights in offices and project areas.	Complied. The conventional lights have been Switched over from (HPSV) to Energy Efficient LED lighting with automation motion sensor in APSEZ area which has reduced the energy consumption.
6. Waste Management		
6.1	Dredged material shall be disposed safely in the designated areas.	Complied. For further details regarding disposal of dredged material, please refer compliance of Water Quality Monitoring and Preservation condition no 3.2 of the EC and CRZ clearance.
6.2	Shoreline should not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary. The details shall be submitted along with the six monthly monitoring reports.	Being Complied. For further details regarding shoreline change, please refer Water Quality Monitoring and Preservation condition no 3.11 of the EC and CRZ clearance.
6.3	Necessary arrangements for the treatment of the effluents and solid wastes must be made and it must be ensured that they conform to the standards laid down by the	Complied For further details regarding treatment of effluents, please refer Water Quality Monitoring and Preservation condition no 3.8 & 3.9 of the EC and CRZ clearance.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986.	
6.4	The solid wastes shall be managed and disposed as per the norms of the Solid Waste Management Rules, 2016.	Complied. This reply covers condition no 6.4, 6.5, 6.6 & 6.7. **Waste Management** – APSEZ has adopted 5R concept for environmentally sound management of different types of solid & liquid wastes. Please refer below details about management of each type of waste. **Non-Hazardous Solid Waste**: A well-established system for segregation of dry & wet waste is in place. All wet waste (Organic waste) is being segregated & utilized for compost manufacturing and/or biogas generation for cooking purpose. The compost is further used by in house horticulture team for greenbelt development. Whereas dry recyclable waste is being sorted in various categories. Presently manual sorting is being done for sorting of different types of solid waste. Segregated recyclable materials such as Paper, Plastic, Cardboard, PET Bottles, and Glasses, etc. are then sent to respective recycling units, whereas remaining non-recyclable waste is bailed and sent to cement plant (M/s. Ambuja Cement Ltd., Kodinar) for Co-processing as RDF (Refused Derived Fuel). APSEZ, Mundra is certified for Zero Waste to Landfill management system (Certificate No.: CII/ZWL/2025/001) by Confederation of Indian Industry (CII). (valid up to 22.12.2027). The copy of certified for Zero Waste to Landfill management system was submitted during Compliance period Oct'24 to Mar'25. **Hazardous & Other Waste**: • Bio medical waste generated from OHCs and Adani Hospital is being disposed at Common Bio Medical Waste Treatment Facility namely M/s. Distromed Kutch Services Pvt. Ltd., Bhuj. • E – Waste is being sold to GPCB registered recyclers
6.5	Any wastes from construction and demolition activities related thereto shall be managed so as to strictly conform to the Construction and Demolition Waste Management Rules, 2016.	
6.6	A certificate from the competent authority handling municipal solid wastes should be obtained, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project.	
6.7	Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules	

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	of the regulatory authority to avoid mercury contamination.	namely M/s. Galaxy Recycling, Rajkot. • Used Batteries are being sold to GPCB registered recyclers namely Sabnam Enterprise, Kutch and S K Metal Industries, Rajkot. • Solid Hazardous Waste is being disposed through co-processing / incineration through common facility i.e. M/s. Saurashtra Enviro Projects Pvt. Ltd., Bhachau and/or cement industries of Ambuja Cement Ltd., Kodinar. • Used/Waste Oil is being sold to GPCB authorized recyclers / re-processors namely M/s. Western India Petro Chem Ind – Bhavnagar, K Kasha Enterprises - Ahmedabad, Shana Oil Process - Ahmedabad. It is also being reused within organization for lubrication purpose. • ETP Sludge, Oily Cotton Waste, Pig Waste are being disposed through co-processing in cement industries of Ambuja Cement Ltd., Kodinar. • Discarded drums / barrels was being sold to authorized decontamination facility i.e. M/s. Jawrawala Petroleum, Ahmedabad. It is also being reused within organization for filling hazardous waste. • Solid hazardous waste i.e. Tank bottom sludge was being sold to authorized recycler namely M/s. Mundra Oil Pvt. Ltd., Mundra for recycling. • Expired paint materials was being disposed by incineration through common facility i.e. M/s. Saurashtra Enviro Projects Pvt. Ltd., Bhachau. • Downgrade chemicals generated from cleaning of storage tanks / pipelines were being sold to authorized solvent recovery facilities namely M/s. Acquire Chemicals, Ankleshwar. • Slop Oil received from vessels is treated to separate water and oil particles in Oil Water Separator system. Separated oil from the same was being sold to authorized recycler / reprocessor namely M/s. Western India Petro Chem Ind - Bhavnagar, Aviation Corporation - Kutch & Aroma Petrochem - Bhavnagar and water is sent to ETP for further treatment. However, during the compliance period, there was no received or disposal of Slope Oil. • However, during the compliance period i.e. Apr'25 to Sep'25 there was no generation and disposal of Sludge & Filters contaminated with oil, Tank Bottom

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>
sludge, Asbestoses Waste, Glass wool Waste (Thermal Insulation Material), Downgrade Chemicals, Waste Oil and Expired Paint Material.
• Horticulture waste is collected from various green belt areas and it is using for making of manure and manure is being utilizing in horticulture purpose within plant premises.

Details of permissions / agreements of hazardous waste authorized vendors was submitted during compliance period Apr'24 to Sep'24 and there is no further change.

The following table summarizes the waste management practice (from Apr'25 to Sep'25) for different types of wastes at APSEZ:

<table>
<tr><th>Type of Waste</th><th>Waste Description</th><th>Quantity (MT)</th><th>Disposal Method</th></tr>
<tr><td rowspan="5">Hazardous Waste</td><td>ETP/CETP Sludge</td><td>6.04</td><td>Co-processing at cement industries</td></tr>
<tr><td>Oily Cotton Waste</td><td>37.75</td><td>Co-processing at cement industries</td></tr>
<tr><td>Pig Waste</td><td>5.19</td><td>Co-processing at cement industries</td></tr>
<tr><td>Used / Spent / Waste Oil</td><td>75.49</td><td>Sell to registered recycler</td></tr>
<tr><td>Total</td><td>124.47</td><td></td></tr>
<tr><td rowspan="7">Non-Hazardous Waste</td><td>Glass Waste</td><td>12.3</td><td>After recovery sent for recycling / Reuse within premises</td></tr>
<tr><td>Horticulture Waste</td><td>847.1</td><td>Used for making of manure and utilize for horticulture purpose</td></tr>
<tr><td>Metal Scrap</td><td>571.77</td><td>After recovery sent for recycling / Reuse within premises</td></tr>
<tr><td>Organic / Food Waste</td><td>565.9</td><td>Converted to Manure for Horticulture use / Biogas for cooking purpose</td></tr>
<tr><td>Paper Waste</td><td>19.07</td><td>After recovery sent for recycling / Reuse within premises</td></tr>
<tr><td>Plastic Waste</td><td>87.98</td><td>After recovery sent for recycling / Reuse within premises</td></tr>
<tr><td>RDF (Non Recyclable Waste)</td><td>161.52</td><td>Co-processing at cement industries</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Conditions as per clearance letter</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td></td><td>Rubber Waste</td><td>127.88</td><td>After recovery sent for recycling / Reuse within premises</td></tr>
<tr><td></td><td>Wooden waste</td><td>168.11</td><td>After recovery sent for recycling / Reuse within premises</td></tr>
<tr><td></td><td>STP Sludge</td><td>Nill</td><td>Used as manure in Horticulture purpose.</td></tr>
<tr><td></td><td>Total</td><td>2561.63</td><td></td></tr>
<tr><td>Other Waste</td><td>Bio Medical Waste</td><td>4.163</td><td>To approved CBWTF Site and registered recyclers</td></tr>
<tr><td></td><td>Battery Waste</td><td>14.91</td><td>Sell to registered recycler</td></tr>
<tr><td></td><td>E-Waste</td><td>4.21</td><td>Sell to registered recycler</td></tr>
<tr><td></td><td>Total</td><td>23.28</td><td></td></tr>
<tr><td colspan="2">Grand Total</td><td colspan="2">2709.38</td></tr>
</table>
</td></tr>
<tr><td>6.8</td><td>Oil spill contingency plan shall be prepared and part of DMP to tackle emergencies. The equipment and recovery of oil from a spill would be assessed. Guidelines given in MARPOL and Shipping Acts for oil spill management would be followed. Mechanism for integration of terminals oil contingency plan with the overall area contingency plan under the co-ordination of Coast should be covered.</td><td>Complied.

For further details regarding oil spill contingency plan, please refer specific condition no 1.18 of the EC and CRZ clearance & regarding MARPOL guideline details please refer to Air Quality Monitoring and Preservation condition 2.5.</td></tr>
<tr><td colspan="3">7. Green Belt</td></tr>
<tr><td>7.1</td><td>Green belt shall be developed in area as provided in project details with a native tree species in accordance with CPCB guidelines.</td><td rowspan="2">Being Complied

This reply covers condition no 7.1 and 7.2.

APSEZ has developed its own "Dept. of Horticulture" which is taking measures/ steps for terrestrial greening as well as mangrove plantation.

The species such as Ficus Infectoria, Ficus religiosa, Terminalia arjuna, Cocos nucifera, Washingtonia</td></tr>
<tr><td>7.2</td><td>Topsoil shall be separately stored and used in the development of green belt.</td></tr>
</table>

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		fillifera, Casurina spp., Azadirachta Indica, Eucalyptus spp., Jatropha curacus, Ficus bengalensis, Subabool spp., Casia fistula, Date Palm and *Delonix regia* are grown within APSEZ area. Within the port areas approx. 189.41 hectare of greenbelt having 461349 trees with the density of 2435 trees per hectare is developed till date within port premises. So, far APSEZ has developed 457.99 ha. area as greenbelt with plantation of more than 9.06 Lacs saplings within the APSEZ area. Please refer **Annexure – 11** for further details regarding greenbelt development, mangrove afforestation and updated green belt development plan. Budget for Horticulture Department for the FY 2025-26 is to the tune of INR 655 lakh. Out of which, Approx. INR 175 lakh has been spent during the year FY 2025-26 till Sep'25. An additional greenbelt will be developed during proposed expansion activity as per feasibility and approved under EC & CRZ Clearance.
8. Marine Ecology		
8.1	Dredging shall not be carried out during the fish breeding and spawning seasons.	Complied. Dredging activity is being done in non-fish breeding and spawning seasons and dredged material is being disposed-off in line permission granted in EC & CRZ Clearance.
8.2	Dredging, etc shall be carried out in the confined manner to reduce the impacts on marine environment.	Complied. For further details regarding dredging activity control measures, please refer Water Quality Monitoring And Preservation condition no 3.2 of the EC and CRZ clearance.
8.3	The dredging schedule shall be so planned that the turbidity developed is dispersed soon enough to prevent any stress on the fish population.	Point Noted and Agreed

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
8.4	While carrying out dredging, an independent monitoring shall be carried out through a Government Agency/Institute to assess the impact, and necessary measures shall be taken on priority basis if any adverse impact is observed.	Being Complied All construction and operation activities as well as dredging and reclamation activities would be carried out as per approved permission. Further all the recommendations made in the EIA report would be implemented while carrying out dredging activity. For further details regarding marine ecology monitoring, please refer specific condition no 1.12 of the EC and CRZ clearance.
8.5	A detailed marine biodiversity management plan shall be prepared through the NIO or any other institute of repute on marine, brackish water and fresh water ecology and biodiversity and submitted to and implemented to the satisfaction of the State Biodiversity Board and the CRZ authority. The report shall be based on a study of the impact of the project activities on the intertidal biotopes, corals and coral communities, molluscs, sea grasses, sea weeds, sub-tidal habitats, fishes, other marine and aquatic micro, macro and mega flora and fauna including benthos, plankton, turtles, birds etc. as also the productivity. The data collection and impact assessment shall be as per standards survey methods and include underwater photography.	Point Noted and Agreed We will comply with all the recommendations suggested in EIA study report prepared by NABET accredited agency and validated by reputed agency i.e. GUIDE, Bhuj. However, A reputed organization will be engaged to prepare marine biodiversity management plan. The same will be submitted to State Biodiversity Board and the CRZ authority for their examination and approval also.
8.6	Marine ecology shall be monitored regularly also in terms of sea weeds, sea grasses, mudflats, sand dunes, fisheries,	Complied. For further details regarding marine ecology monitoring, please refer specific condition no 1.12 of the EC and CRZ clearance.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	echinoderms, shrimps, turtles, corals, coastal vegetation, mangroves and other marine biodiversity components including all micro, macro and mega floral and faunal components of marine biodiversity.	
8.7	The project proponent shall ensure that water traffic does not impact the aquatic wildlife sanctuaries that fall along the stretch of the river.	Being Complied. A VTMS service for Gulf of Kutch is operated by Directorate General of Lighthouses and Lightships (DGLL), Govt. of India. APSEZ is practicing well defined traffic control procedure. Marine Control of APSEZ provides traffic update to vessels in Mundra Port Limit on VHF Channel- 77. Arrival and departure information in Gulf of Kutch is provided to VTMS information cell through an agent or directly by sending an e-mail to vtsmanagergulfofkutch @ yahoo.com and vtsgok@yahoo.com. Mundra port has subscribed and taking VTMS feed from Kandla from link www.vts.gov.in.
9. Public Hearing And Human Health Issues		
9.1	The workspace shall be maintained as per international standards for occupational health and safety with provision of fresh air respirators, blowers, and fans to prevent any accumulation and inhalation of undesirable levels of pollutants including VOCs.	Complied. APSEZ has obtained ISO 45001:2018 certification for Occupational health and safety management systems to systematically manage health and safety risks and is fully implemented. Updated copy of the same attached as **Annexure 12.** APSEZ has established Occupational Health Center & First Aid facility at different locations within SEZ, which will be utilized during entire construction as well as operation phase of SEZ project. In case of emergency situation requiring higher level of treatment, the facilities at Adani hospital (multi-Specialty) having 100 bedded facilities located with SEZ area can be utilized.

Status of the conditions stipulated in Environment and CRZ Clearance

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
9.2	Workers shall be strictly enforced to wear personal protective equipments like dust mask, earmuffs or ear plugs, whenever and wherever necessary/ required. Special visco-elastic gloves will be used by labour exposed to hazards from vibration.	Complied APSEZ has provided job specific safety PPE's to all workers and wearing of safety PPE's is strictly implemented within port premises Further, Safety awareness training is also provided to workers about work related PPE's.
9.3	In case of repair of any old vessels, excessive care shall be taken while handling Asbestos & Freon gas. Besides, fully enclosed covering should be provided for the temporary storage of asbestos materials at site before disposal to CTSDF.	Being Complied. No repair activity of any old vessel is being permitted within APSEZ's Port premises.
9.4	Safety training shall be given to all workers specific to their work area and every worker and employee will be engaged in fire hazard awareness training and mock drills which will be conducted regularly. All standard safety and occupational hazard measures shall be implemented and monitored by the concerned officials to prevent the occurrence of untoward incidents/ accidents.	Complied Regular Toolbox Talk (TBT) and fire & safety training is being imparted by the fire & safety department. Please refer to compliance of specific condition 1.19 of EC & CRZ clearance for detailed information. Safety Mock drill report (latest report) conducted during the compliance period is enclosed as **Annexure – 8.**
9.5	Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.	Complied An emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan is being implemented. On site Emergency plan submitted during compliance period Apr'24 to Sep'24.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
9.6	Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	Complied Workers engaged in construction activities would be mainly from nearby villages hence there would be no requirement of infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP. Existing facilities for drinking water, toilet & rest shelter would be utilized by workers.
9.7	Occupational health surveillance of the workers shall be done on a regular basis.	Complied. Annual health checkup is being carried out on regular basis and submit as a part of Half yearly EC & CRZ compliance. Latest health checkup report was submitted during the compliance period Oct'24 to Mar'25.
10. Environment Responsibility		
10.1	The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest /wildlife norms/ conditions. The company shall have defined system of reporting infringements / deviation / violation of the environmental / forest / wildlife norms / conditions and / or shareholders /	Complied Environment Policy duly approved by the Board of Directors is in place and updated copy of Environment Policy submitted during compliance period Apr'24 to Sep'24.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report.	
10.2	A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly report to the head of the organization.	Complied APSEZL has a well-structured Environment Management Cell, staffed with qualified manpower for implementation of the Environment Management Plan at site. Site environment head reports to site Chief Executive Officer (CEO) and the CEO directly reports to the top management. The updated Environment Management Cell Organogram submitted during compliance period Apr'24 to Sep'24. And there is no further change.
10.3	Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six-Monthly Compliance Report.	Complied Responsibility Matrix for implementation of EMP and Environment conditions has been mentioned in approved EMP and the same would be implemented. Separate budget for the Environment protection measures is earmarked every year. All environment and horticulture activities are considered at corporate level and budget allocation is done accordingly. All the expenses are recorded in advanced accounting system of the organization. Budget for environmental management measures (including horticulture) for the FY 2025-26 is to the tune of INR 1173.79 lakh. Out of which, Approx. INR 463.43 lakh has been spent during FY 2025-26 till Sep'25. Detailed breakup of the expenditures for the past 3 years is attached as **Annexure – 10.**
10.4	Self-environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.	Point Noted and will be complied.
11. Miscellaneous		

adani Ports and Logistics	Adani Ports and Special Economic Zone Limited, Mundra.	From :Apr'25 To : Sep'25

Status of the conditions stipulated in Environment and CRZ Clearance

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
11.1	The project proponent shall make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days and in addition this shall also be displayed in the project proponent's website permanently.	Complied. The original copy of the CRZ clearance was obtained on 13.08.2024 and advertisement (containing informing that the EC & CRZ clearance is accorded to the proposed project and a copy of clearance letter is available with the SPCB and may also be seen at the website of MoEF&CC) was given in local Newspaper Kutch Mitra in Gujarati (local) language dated 20.08.2024 & 22.08.2024 and in The Indian Express (English) newspaper dated 20.08.2024. Copy of the newspaper advertisement submitted during compliance period Apr'24 to Sep'24.
11.2	The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.	Complied The copy of CRZ clearance letter has been submitted to the respective concerned authorities the District Collector Office, Bhuj, District Industries Centre office, Bhuj, GPCB Reginal Office, Gandhidham, GPCB Head Office, Gandhinagar, Sub District Magistrate office, Mundra, Mamlatdar Office, Mundra, and Taluka Vikas Adhikari office, Mundra. with the request for display at least for 30 days. The acknowledgements copy submitted during compliance period Apr'24 to Sep'24. A copy of the EC & CRZ Clearance letter is uploaded on APSEZ web site https://www.adaniports.com /ports-downloads.
11.3	The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.	Point noted and being complied. Compliance report of EC & CRZ conditions is uploaded regularly. A soft copy of last compliance report including results of monitoring data for the period of Oct'24 to Mar'25 was submitted through e-mail to Integrated Regional Office (IRO), MoEF&CC @ Gandhinagar, Zonal Office of CPCB @ Baroda, GPCB @ Gandhinagar & Gandhidham and Dept. of Forests & Env., Gandhinagar vide our letter dated 24.05.2025. The copy of the same is also available on our web site https://www.adaniports.com /ports-downloads as well as also uploaded on MoEF&CC Parivesh Portal dated 30.05.2025.
11.4	The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental	

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal.	
11.5	The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.	Complied. Environmental statement for each financial year is submitted to GPCB. The same for the FY ending 31.03.2025 in Form-V for existing permission is submitted to GPCB vide our letter dated 08th September 2025. The acknowledgement copy of the Environmental Statement (Form V) of FY 2024-25 attached as **Annexure 13**. Copy of the submitted Environmental Statement FY 2024-25 is also available on our web site https://www.adaniports.com/ports-downloads.
11.6	The criteria pollutant levels namely; PM2.5, PM10, SO2, NOx (ambient levels) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.	Complied For further details regarding the ambient air monitoring & results, please refer to specific condition no 1.15 of the EC and CRZ clearance. Pollutants levels is being displayed at Main gate of Main Port & West Port on regular basis.
11.7	The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.	Point Noted and Agreed
11.8	The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that during their presentation to the Expert Appraisal Committee.	Point Noted and Agreed.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
11.9	No further expansion or modifications in the project shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).	Point Noted and Agreed.
11.10	Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.	Point Noted and Agreed.
11.11	The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory under the provisions of the Environmental (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner.	Point Noted and Agreed.
11.12	The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.	Point Noted and Agreed.
11.13	The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data /	Point Noted and Agreed.

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
	information/monitoring reports.	
11.14	The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts and any other Court of Law relating to the subject matter.	Point Noted and Agreed.
11.15	Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.	Point Noted and Agreed.
12. Specific Conditions		
12.1	The unit shall make the arrangement for protection of possible fire hazards during manufacturing process in material handling. Firefighting system shall be as per the norms.	Complied With respect to onshore facilities tug (Dolphin-11) has a firefighting system of 1200 m^3/hr. along with 20-ton lifting "A" frame and diving support facility for support at offshore. With respect to onshore facilities valve station, pumping station and transportation pipeline, foam base fire tender, fire water network is available. Fire-fighting system has been installed and maintained to meet emergency situations. Additionally for emergencies, emergency DG Set is provided for fire

Sr. No.	Conditions as per clearance letter	Compliance Status as on 30-09-2025
		water pumps to ensure continuous water supply for firefighting purpose. Detailed information on firefighting facility available at APSEZ submitted during compliance period Apr'24 to Sep'24.

ANNEXURE – A

CRZ Recommendation Compliance Report of WFDP Expansion

Half yearly Compliance report of CRZ recommendation for "Proposed expansion of Waterfront Development Plan of Mundra Port" by M/s. Adani Ports and SEZ Limited, Mundra, Kachchh District, Gujarat" vide Letter No. ENV/10/2024/37/T dated 20th April, 2024.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
Specific Conditions		
1	APSEZ shall ensure that all the proposed activities as part of expansion are carried out within the ambit of the earlier approved Waterfront Development Plan and no new additional reclamation will be carried out outside.	Complied. All the proposed activities as part of expansion are being / will be carried out within the ambit of the earlier approved Waterfront Development Plan and no new additional reclamation will be carried out outside the approved area of WFDP granted EC & CRZ clearance in Jan-2009. Please refer to compliance of EC & CRZ clearance specific condition no 1.1 for further details.
2	APSEZ shall have to comply with all the directions issued by the Ministry of Environment, Forest and Climate Change, Government of India from time to time for APSEZ.	Point Noted and agreed.
3	APSEZ shall carry out 100-Hectare mangroves plantation in consultation with Forest Department.	Point noted & Will be Complied. This reply covers condition no 3 & 4. For further details compensatory plantation, please refer to compliance of specific condition no 1.6 of the EC and CRZ clearance.
4	APSEZ shall participate in Green Credit Programme administrated by the Indian Council of Forestry Research and Education (ICFRE) for carrying out Tree Plantation in 100 Hectare area under this	

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
	programme. PP shall fund necessary amount for this purpose to Forest Department, GoG.	
5	APSEZ shall ensure that no natural free flow of water or natural drainage of storm water or creek be disturbed.	Being Complied For further details regarding status of natural free flow of water, please refer to compliance of specific condition no 1.13 of the EC and CRZ clearance.
6	APSEZ shall ensure that no activities are undertaken in violations of any order, if any issued by the Hon'ble NGT/Hon'ble High Court/Hon'ble Supreme Court of India, or any court of laws.	Point Noted and agreed.
7	APSEZ shall comply with the conditions stipulated in the recommendation letter GCZMA dated. 13.10.2008 and subsequent environment clearance & CRZ clearance for Waterfront Development Project.	Complied Compliance status of the recommendations letter GCZMA dated. 13.10.2008 and subsequent EC & CRZ clearance granted for WFDP on 12th & 19th Jan, 2009 is being submitted to all the concern authorities on half yearly basis separately. Details regarding the past six compliance report submissions are mentioned below: **Sr. no. / Compliance period / Date of submission** 1. / Apr'22 to Sep'22 / 30.11.2022 2. / Oct'22 to Mar'23 / 30.05.2023 3. / Apr'23 to Sep'23 / 29.11.2023 4. / Oct'23 to Mar'24 / 29.05.2024 5. / Apr'24 to Sep'24 / 30.11.2024 6. / Oct'24 to Mar'25 / 30.05.2025 The copy of the same is also available on our web site https://www.adaniports.com /ports-downloads as well as also uploaded on MoEF&CC Parivesh Portal dated 30.05.2025.

Status of the conditions stipulated in Environment and CRZ Clearance

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
8	The provisions of the CRZ notification, 2011 and as amended from time to time shall be strictly adhered to by the PP.	Complied. APSEZ ensures to strictly follow existing rules & regulation of CRZ notification, 2011 and as amended from time to time.
9	PP shall obtain all necessary clearances/NOC from concerned competent authorities/ departments before construction and commissioning of the activities.	Complied. For further details regarding clearances/permissions, please refer to the compliance of specific condition no 1.10 of the EC and CRZ clearance.
10	All the recommendations and suggestions given in the Environment Impact Assessment Study as well as studies undertaken for the project shall be implemented strictly by PP.	Complied. All recommendations/suggestions given in the Environment Impact Assessment Study as well other technical studies is being complied / will be complied strictly.
11	PP shall obtain consents/ authorization/ permission of the Gujarat Pollution Control Board under applicable Water {Prevention and Control of Pollution) Act, 1974, Air {Prevention and Control of Pollution) Act'1981 and Rules made under Environment (Protection) Act' 1986. Discharge of pollutants shall not exceed the limits prescribed under the environmental Acts/	Complied. For further details regarding permissions/consents/ authorization from Gujarat Pollution Control Board; please refer to compliance of specific condition no.1.10 of the EC & CRZ Clearance. For further details regarding quality monitoring of pollutants, please refer Water Quality Monitoring and Preservation compliance of condition no 3.8 & 3.9 of the EC and CRZ clearance.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
	Rules.	
12	There shall no discharge of any kind of wastewater/ sewage / effluent/ wastes into the creek or sea or in CRZ areas except allowed by this permission.	Complied. No treated/untreated effluent is being discharged into creek or sea or in CRZ area. Entire quantity of effluent generated is being treated in designated ETP / STP and treated sewage is being fully utilized for Horticulture purposes. Please refer to compliance of specific condition no 1.12 of EC & CRZ clearance for detailed information.
13	The groundwater shall not be tapped to meet with the water requirements in any case.	Complied No groundwater is being tapped to meet water requirements. APSEZ sources its water for various project activities from the desalination plant of APSEZ and/or water through Gujarat Water Infrastructure Limited (GWIL). Average water consumption for entire APSEZ area is 5.21 MLD during compliance period i.e. Apr'25 to Sep'25.
14	PP shall ensure that there will not disturbance to nearby Ecologically Sensitive area due to their proposed project activities.	Complied. For further details regarding conservations of nearby Ecologically Sensitive area, please refer to compliance of specific condition no 1.12 of the EC and CRZ clearance.
15	PP shall ensure that the labour construction camps are kept outside the CRZ areas and the construction labour are provided with adequate amenities like drinking water, fuel, sanitation, etc. to ensure that the existing environmental condition is not deteriorated by them.	Complied Workers engaged in construction activities would be mainly from nearby villages hence there would be no requirement of infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP. Existing facilities for drinking water, toilet & rest shelter would be utilized by workers.
16	PP shall adopt the necessary soil conservation measures	Being Complied This reply covers condition no 16 & 17.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
	to prevent any exposed soil from being eroded or blown over.	For further details regarding soil conservations & greenbelt development please refer to compliance of Greenbelt condition no 7.1 & 7.2 of the EC and CRZ clearance.
17	PP shall develop 33% greenbelt within premises and shall maintain greenbelt.	
18	Project proponent (PP) shall have to carry out marine water quality environment monitoring regularly on quarterly basis and submit the report to GCZMA, GPCB, IRO & MOEF & CC, GoI.	Complied For further details regarding marine ecology monitoring, please refer to compliance of specific condition no 1.12 of the EC and CRZ clearance.
19	PP shall bear the cost of the external agency that may be appointed by this Department for supervision/ monitoring of proposed activities.	Point noted and agreed
20	PP shall contribute through its CER fund for environmental infrastructure up-gradation, awareness programs etc.	Complied. CER is not applicable for this project. However APSEZ CSR team is actively working with local community around the project area and provides required support for their livelihood and other concerns through the CSR arm – Adani Foundation. Adani Foundation (AF) is the CSR arm of the Adani Group actively working for upliftment of the communities in the surroundings of various project sites of Adani Group. AF has prepared a specific action plan to protect livelihood of fishermen at Mundra. Various initiatives, as stated below are discussed in detail in the report namely "Silent Transformation of Fisher folk at Mundra". Said report also includes the information related to the planned expenses to the tune of approx. 13.5 Cr. INR for various initiatives for the next five years (2016 – 2021) (Budget details provided in Page No. 68 of report). Copy of the same is already submitted to MoEF&CC vide our letter dated 10.09.2016.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
		Till, Sep'25 approx. 16.43 Cr. INR, has already been invested fisherfolk livelihood. Further, details regarding the expenditure incurred against the commitment are attached as **Annexure - 14**. APSEZ is carrying out various initiatives specific to the Fisherfolk community which includes: • Distributed education kits to HSC and graduation-level students, including notebooks, guides, stationery, and study bags. • Facilitated job opportunities and skill development for youth through community engagement and support programs. • Provided daily transportation for 86 school-going children to ensure consistent access to education. • Awarded scholarships totaling ₹3,58,765 to 34 students for higher secondary and technical education. **Previous Support to Fisherfolk Community:** • Educational Kit Support: 686 nos. • Fisherman Shelter Support: 273 nos. • Vehicle transportation Support: 1368 nos. • Cycle Support to high school students: 111 nos. • Scholarship Support: 648 nos. • Youth Employment: 494 nos. • Linkage with Fisheries Scheme: 195 nos. • Ramatotasav Community Engagement: 3534 nos. • Man-Days mangrove plantation: 56523 days • **Vidya Deep Yojana** Developing school preparedness programme and empowering balwadis at fisherfolk settlement. Under this scheme, 4 balwadis at different settlements have been constructed. This programme includes nutrition food, hygiene, awareness of health, cleanliness, discipline, regularity and development of basic age-appropriate conception. • **Youth employment:** Our main objective is to offer sustainable employment opportunities to the local fishing community in APSEZ Mundra. We bridge the gap between industries and Fisherfolk youth by facilitating job placements. Acting as a bridge between industries and fisherfolk youth, the Adani Foundation facilitated job placements for 30 fisherfolk as RTG operators, in the HR department, and as supervisors in APSEZ companies.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
		In the APSEZ area and colony, 45 fisherfolk youth have been offered professional painting roles. To ensure they are skilled for the role, they underwent comprehensive training in partnership with Asian Paints. • **Vidya Sahay Yojana –** • **Scholarship Support:** All basic education supportive facilities have been created to promote education in the fisherfolk community. We are deeply committed to empowering the future of fisherfolk communities through education. To uplift financially challenged communities, we extended scholarships support of Rs. 3,58,765 to 35 students, enabling them to pursue higher secondary and technical education. • **Education Kits Support:** Equipping 88 fisherfolk students in HSC and Graduation with essential tools for academic success, including notebooks, guides, stationery and study bags, we empower them to pursue their education with no financial barriers. • **Vehicle Transportation Facilities:** Ensure seamless access to education for 121 school-going children from Modhva, Tragadi, and Zarpara Bandar Fisherfolk Students in reaching the nearest School, eliminating barriers to regular attendance. Additionally, personal cycle support to 5 fisherfolk students. • **Adani Vidya Mandir** Children of the family with an income of salary less than 1.5 lac/annum are admitted. School focusses on nutrition food, uniform and other services to the children for free. • **Fisherman Approach in SEZ** After due consultative process, APSEZ has provided 7 fishermen access roads for to approach to the sea for fishing activity. • **Machhimar Arogya Yojana** The Fisher folk communities are disposed to several water and air abided diseased due to exposure to unhygienic working conditions. Frequently Special Healthcare Camps are organized at Vasahat. Our Mobile health care unit van regularly visit fisherfolk settlements. **Awareness camp on Menstrual health:** A menstrual health awareness camp was organized for 200+ women from the fishing communities of Modhva and Tragadi villages. • **Machhimar Kaushalya Vardhan Yojana** Based on need assessment a number of trades were introduced through the Adani Skill Development Centre in Mundra, where in fisher folk youth could join and get a number of technical and non-technical training. • **Machhimar Sadhan Sahay Yojana** Fishing material support was provided by AF at Mundra as per the requests of Pagadiya fishermen. According to their needs, fishing nets,

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
		ropes, buoys, ice boxes, crates, weighing scales, anchors, solar lights etc., were provided. • **Machhimar Awas Yojana** Shelters, equipped with basic facilities of a toilet. and pure drinking water has been constructed for living while fishing and to provide a healthy and hygienic residence. • **Machhimar Shudhh Jal Yojana** This scheme of providing potable water has helped in reducing the drudgery of women and contributed largely towards general wellbeing. **Potable water Distribution:** Providing access of potable Drinking water Facilities to Nine fisherfolk vasahat on Daily bases, either By Water tanker or Linkage with Nearest Gram panchayat with daily water tanker support. ❖ **Sughad Yojana** Toilets for men and women are constructed at all three Vasahats.Infrastructure was accompanied with continuous awareness campaign on hygiene sanitation and use of toilets in particular. ❖ **Machhimar Akshay kiran Yojana** Solar street lights at each settlement have been installed. For fish landing shed and school extension room have been fitted with solar invertor allowing late evening video shows for awareness and fish sorting work at ease. ❖ **Machhimar Suraksha Yojana** Distance Alarm Transmission System – DATS' project was introduced in order to promote safety of the fishermen. Forced to be at sea to earn their livelihood puts the lives of many fishermen at risk. ❖ **Machhimar Ajivika Uparjan Yojana** Mangrove plantation in the area as means of alternate income generating activity for the fisher folk community during the non-fishing months. During the non-fishing months, the fishermen under usual circumstances were benefited by other alternate economic activity to sustain them. ❖ **Bandar Svachhata Yojana** Waste bins have been provided for proper collection and segregation of waste. Adani Foundation is working in main five persuasions as below. ❖ Education ❖ Community Health ❖ Rural Infrastructure ❖ Sustainability Livelihood ❖ Skill Development

<table>
<tr><th>Sr. No.</th><th>Specific Conditions</th><th>Compliance Status as on 30-09-2025</th></tr>
<tr><td></td><td></td><td>Brief information about activities in the main five persuasions is mentioned below. Activities carried out for the same are summarized as below.

<table>
<tr><th>Area</th><th>Activity</th></tr>
<tr><td>Community Health</td><td>❖ Mobile Heath Care Units and Rural Clinics
• Rural Clinics: 7 Nos.
• MHCU Stoppages: 31 Nos.
• Villages Covered: 29 Nos.
• Total individuals benefited from MHCU and Rural clinic services: 9867 Nos.33% average savings on healthcare-related costs.
• 42% People are aware and become health Conscious
• Adani Foundation's medical support program has provided critical care to 1,071 underprivileged patients, addressing serious health issues like kidney and heart conditions at Adani Hospital Mundra.
• In life-threatening cases, patients are stabilized and referred to GKGH, Bhuj, with full coordination for advanced treatment—ensuring no one is left behind in their journey to recovery.
• Students Health Screening Camp Beneficiary: 1093 Nos.Cataract Camp Beneficiary: 67 Nos.
• MHCU - Labour Colony v: 591 Nos.
• Health Awareness Session Beneficiary: 711 Nos.
• Specialty Health Camp Beneficiary: 1882 Nos.
• General Health Camp Beneficiary: 958 Nos.
• Rural Clinic Beneficiary: 6123 Nos.
• Mobile Van Beneficiary: 6719 Nos.
• Medical & Dialysis Supports Beneficiary: 995 Nos.
❖ Awareness and Screening Drive in Mundra Schools:</td></tr>
</table>
</td></tr>
</table>

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025	
			• Adani Foundation conducted health and hygiene awareness sessions across primary schools in Mundra Block, fostering lifelong wellness habits among children and educators. • Over 584 students and teachers participated in interactive sessions focused on hygiene practices and healthy living. • Comprehensive health screenings were carried out for 1,093 students, enabling early detection of health issues and timely intervention. • Core topics included handwashing, dental care, nutrition, personal cleanliness, and environmental health. • Adani Foundation organized a focused TB awareness initiative in Mundra Block, enhancing health literacy among affected individuals through expert-led sessions. • Patients received vital education on symptoms, medication, hygiene, diet, and lifestyle from healthcare professionals including the District TB Health Officer. ❖ **Animal Husbandry:** • Awareness meetings on modern dairy farming in villages, engaging local cattle owners. • Organized vaccination camps across villages, covering 1,647 animals (1,410 camels + 237 cattle). • Improved livestock health and productivity by reducing disease risk and promoting sustainable care practices.
		Sustainable Livelihood – Fisher folk, Agriculture & Women	❖ **<u>WOMEN EMPOWERMENT:</u>** ❖ **Self Help Groups:** Women were mobilized into 82 SHGs through formal registration, laying the foundation for collective growth and financial inclusion. ❖ **Skill Building:** Tailored workshops and hands-on training empowered members with

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025	
			entrepreneurial, financial, and operational skills. Conducted 12 workshops for 1000 women's. ❖ **Exposure & Learning:** 60 nos. exposure visits to successful enterprises inspired SHG members, boosting confidence and sparking innovative ideas. ❖ **Need-Based Support:** Adani Foundation provided timely support— equipment, funding, and guidance—based on each group's evolving needs and goals 52 times. ❖ **Community Impact:** SHGs now uplift entire communities— enhancing household income, promoting leadership, and driving social change and 1450 people are benefited. **CHETNA" - initiative with gender diversity:** ❖ **Women Mobilization & Employment Facilitation:** Adani Foundation, in partnership with Unnati Portal and Adani Solar, mobilized and counseled women and their families, enabling them to confidently enroll, attend interviews, and secure jobs. ❖ **Empowerment Through Opportunity:** Women from Kutch began working in formal roles, gaining financial independence, self-confidence, and inspiring broader community acceptance of female workforce participation. Till Now 600+ Female Joined Adani Solar @Pan India and 459 are from Kutch. ❖ 12th passed student benefited with 1.8 lac/annum and graduate students benefied with 2.16 Lac/Annum. **Empowering Fisherfolk Community:** • Distributed education kits to HSC and graduation-level students, including notebooks, guides, stationery, and study bags.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025	
			• Facilitated job opportunities and skill development for youth through community engagement and support programs. • Provided daily transportation for 86 school-going children to ensure consistent access to education. • Awarded scholarships totaling ₹3,58,765 to 34 students for higher secondary and technical education. ❖ **Job initiatives:** • Acting as a bridge between industries and fisherfolk youth, the Adani Foundation facilitated job placements for 30 fisherfolk as RTG operators, in the HR department, and as supervisors in APSEZ companies. • In the APSEZ area and colony, 45 fisherfolk youth have been offered professional painting roles. To ensure they are skilled for the role, they underwent comprehensive training in partnership with Asian Paints. ❖ **Potable water Distribution:** • Providing access of potable Drinking water Facilities to Nine fisherfolk vasahat on Daily bases, either By Water tanker or Linkage with Nearest Gram panchayat. • More than 5000 Fisherfolk Population are getting benefit which impact on their health and well-being.
		Education	**Strengthening Government Primary Schools:** Adopting and upgrading government 81 nos. of primary schools & High school to model schools. **Main streaming Progressive learners:** • 2776 students of classes 4 & 5 were assessed. • 1151 students emerged as progressive learners • Personalized learning through different activities and TLM • 220 students mainstreamed.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025	
			Library Activity: • Library books issues & Activities planned every Saturday. • 45000+ Books issued. • 300+ Oasis workshop arranged to increase reading habits of students. **IT on wheels:** • 1187 primary & 1448 high school students are learning basic computer skills. • Students gain essential computer skills, enhancing their digital literacy and preparing them for future academic and career opportunities. **Mothers Meet:** • Mothers' meetings conducted every second Saturday in Utthan schools. • Over 95,00 mothers have joined. • Guidance on exams, scholarships, and healthy eating. • Home visits and discussions on academic performance. **Competitive Exam:** • 1050 passed and 21 students made it to the merit list. • 2726 students are preparing for exams like JNV, NMMS, PSE, and CET. • Meetings with 560 high school parents to encourage their support. **Gunotsav Primary School Performance:** • Gunotsav Results: Gunotsav grades are assessment by GoG as part of its statewide initiative to assess and enhance the quality of education in government schools. • 4 High Schools Achieved 100% Pass Rate in Results. • All Utthan-supported schools showed a marked rise in Gunotsav grades, with many moving up to A & B categories—reflecting

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025	
			the positive impact of targeted academic and co-curricular interventions. **Abacus & Vedic Maths:** • Utthan initiative has introduced Abacus and Vedic Mathematics in 54 primary and 08 high schools. Abacus is a tool used for performing arithmetic calculations, while Vedic Mathematics is an ancient system of Indian mathematics that simplifies complex calculations. Total 1800 nos. of Abacus and 1302 nos. of Vedic math's Students are benefited. **Project Udaan:** • Adani Foundation's Project Udaan empowers youth through immersive educational tours to key Adani Group facilities, offering real-world exposure beyond the classroom. • Students gain firsthand insights into industries like ports, power, and refineries, sparking curiosity and ambition for future careers. • The initiative nurtures entrepreneurial thinking, leadership qualities, and a vision for innovation among school and college students. • Faculty participation strengthens academic-industry linkages, enriching the learning ecosystem. • Project Udaan has become a catalyst for inspiring young minds to dream big and pursue meaningful, future-ready paths. • Total 229 institute visit & 05 corporate visit done with 16380 student.
		Rural Infrastructure & Environmental Sustainability	**COMMUNITY INFRASTRUCTURE DEVELOPMENT PROJECTS & ITS BENEFICIARIES FY 2025-26 Till SEP'25:** • Pond Deepening: 03 Nos. • Digital Library: 04 Nos. • Common Gathering Shed: 09 Nos. • Gaushala Development: 02 Nos.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025	
			• RRWHS Construction: 25 Nos. • Community Center: 02 Nos. • Check dam strengthening: 02 Nos. • Restrengthening of Approach Road: 24 Km **Water Conservation Work Done during Compliance Period Apr'25 to Sep'25:** ❖ **Water conservation project (till date water conservation work):** In recent years, the villages near our operational area have experienced significant enhancements in both the availability and quality of water. These improvements stem from our focused efforts in managing and conserving groundwater and surface water resources. • **Key interventions—** ○ pond deepening, ○ strengthening of check dams, ○ installation of rainwater harvesting systems, borewell drilling, and clearing of river inlets—have together increased water storage capacity. • **Till the date (Sep'25)** ○ 145 Pond Deepening ○ 209 Bore & Wells ○ 355 Rainwater Harvesting ○ 30 Check Dams ○ 25 Percolation Wells ○ Farmers Benefitted - 1760 Storage ○ capacity Increase – 2171435Cum. • **Current year (Apr'25 to Sep'25)** ○ Pond Deepening - 05 Village Pond ○ Check dam Re- strenghtining-01 ○ Farmer - 300 famer Land irrigated - 1800 Acre ○ **8.0%** Increase in Revenue ○ **9.00 %** TDS Reduction ○ Rs **1200** Reduce in health expenses Monthly ❖ **ROOF TOP RAINWATER HARVESTING:**

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025	
			○ 355 RRWHS units built across 355 homes, positively impacting more than 1,760 people. ○ TDS level below 100 meeting WHO standards for safe drinking water. ○ First-time rainwater harvesting enabled for the community, ensuring quality drinking water and reducing financial burdens ○ **1760+** Residents benefited ○ **97.73%** Less TDS than local municipality water Gundiyali – 4410 TDS ○ **Rs. 1125** monthly Saved on drinking water ○ **Rs. 3000** yearly saved on health expense
		Skill Development	**Student Benefitted Under Utthan Project during the FY 2025-26 till Sep'25:** **Strengthening Government Primary Schools:** Adopting and upgrading government 81 nos. of primary schools & High school to model schools. **Main streaming Progressive learners:** • 2776 students of classes 4 & 5 were assessed. • 1151 students emerged as progressive learners. • Personalized learning through different activities and TLM • 220 students mainstreamed. **Library Activity:** • Library books issues & Activities planned every Saturday. • 45000+ Books issued. • 300+ Oasis workshop arranged to increase reading habits of students. **IT on wheels:** • 1187 primary & 1448 high school students are learning basic computer skills. • Students gain essential computer skills, enhancing their digital literacy and preparing them for future academic and career opportunities.

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
		Mothers Meet: • Mothers' meetings conducted every second Saturday in Utthan schools. • Over 95,00 mothers have joined. • Guidance on exams, scholarships, and healthy eating. • Home visits and discussions on academic performance. **Competitive Exam:** • 1050 passed and 21 students made it to the merit list. • 2726 students are preparing for exams like JNV, NMMS, PSE, and CET. Please refer **Annexure - 2** for full details of CSR activities carried out by Adani Foundation in the Mundra region. The budget allocated for CSR activities for the financial year 2025-26 is INR 1131.67 lakh. Out of which Approx. INR 448.96 lakh has been spent during the FY 2025-26 till Sep'25. Till Sep'25, Adani Foundation has done total expenditure of INR 192.9 Cr. for CSR activities in Kutch region since its inception.
21	A Disaster Management Plan to meet with any eventualities that may arise during construction and/or operation phase shall be prepared through an expert agency and shall execute the Plan in co-ordination with concerned district offices including the District Authorities.	Complied. For further details regarding Disaster Management Plan; please refer to specific condition no 1.21 of the EC and CRZ clearance.
22	A separate Environmental Cell with qualified personnel shall be created to implement	Complied For further details regarding Environmental Cell, please refer

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
	the Environmental Management Plan and a separate budget shall be provided for this purpose.	to compliance of Environment Responsibility condition no 10.2 of the EC and CRZ clearance.
23	PP shall implement programs in line with the commitments made in the Environment Management Plan submitted and shall submit the reports to GCZMA periodically.	Complied Compliances to the commitments made in EMP will be submitted as a part of Half yearly EC compliance on regular basis. EMP Compliance attached as **Annexure B**
24	A separate budget shall be earmarked for environmental management and socio-economic activities and details thereof shall be furnished to this Department. The details with respect to the expenditure from this budget head shall also be furnished.	Complied. For further details regarding expenditure budget, please refer to compliance of Environment Responsibility condition no 10.3 of the EC and CRZ clearance
25	PP shall take up socio-economic upliftment activities in consultation with the District Collector/ DDO. A separate budget shall be provided for this purpose.	Complied. For further details regarding CSR activities, please refer to compliance of specific condition no 1.29 of the EC and CRZ clearance
26	PP shall regularly submit the half-yearly compliance report on the conditions stipulated by this Department/GCZMA/ MoEFCC.	Being complied. Compliance report of EC & CRZ conditions is uploaded regularly. A soft copy of last compliance report including results of monitoring data for the period of Oct'24 to Mar'25 was submitted through e-mail to Regional Office of Integrated Regional Office (IRO) @ Gandhinagar, Zonal Office of CPCB @ Baroda, GPCB @ Gandhinagar & Gandhidham and

Sr. No.	Specific Conditions	Compliance Status as on 30-09-2025
		Dept. of Forests & Env., Gandhinagar vide letter dated 24.05.2025. The copy of the same is also available on our web site https://www.adaniports.com /ports-downloads as well as also uploaded on MoEF&CC Parivesh Portal dated 30.05.2025.
27	Any additional condition that may be imposed by this department/ GCZMA authority/ Ministry of Environment Forest and Climate Change from time to time shall have to be complied with by PP.	Point Noted and Agreed.

Annexure – B

adani
Ports and Logistics

Compliance Report of EMP & Mitigation Measures

Sr. No.	Suggested Measures	Compliance Status
✍ **Construction Phase:**		
1	Developments at East Port will be taken up as a future development after obtaining necessary approvals.	Point Noted and agreed
2	The site clearance activities will generate dusts, and this shall be confined within the site by isolating the construction site with fences.	Complied The following control measures for fugitive dust emissions is being adopted/ implemented. ➢ Isolated storage areas with wind shield is provided for storage of construction materials. ➢ Sprinkling of water in the construction sites and stored raw materials as well as vehicle movement accesses. ➢ Excavated material/loose material is kept covered with tarpaulin cover. ➢ Accidental spillage is immediately removed from workplace. ➢ Aggregates & raw material is sourced by nearby places & is transported in vehicle covered with tarpaulin. ➢ Dust generating source like batching place is enclosed by all side. ➢ Closed conveyor is being used in batching plant ➢ Air pollution control mechanism (dust collector) is provided in batching plant ➢ Cement is transferred into bulker through closed hopper & from low height. ➢ Periodic maintenance of batching plant & cleaning of dust collector on regular basis. ➢ The speed limit is implemented within port. ➢ Provision of dedicated storm water is there to avoid sludgy formation so that vehicle tyre does not get dusty. ➢ Proper housekeeping is ensured to reduce dust emissions.
3	The vehicles used to carry men and material for transportation during the construction period shall be restricted to certain timings for entry and exit of the port. Since these vehicles are addition to the cargo traffic of the existing infrastructure, the timings	Complied Shift timing is implemented for construction worker to avoid traffic rush. All vehicles used for construction activity conform to Bharat Stage-VI norms laid down by CPCB and are less than 5-year-old in good condition PUC certified. Regular maintenance of vehicles carrying men

Sr. No.	Suggested Measures	Compliance Status
	for vehicle movements will help in reducing the increments of SOx and NOx in the air environment. All the vehicles entering the port shall be checked for the Pollution Under Control (PUC) Certificate. The contractors shall be advised to use the vehicles that comply with the Bharat Stage-VI norms laid down by CPCB that are effective from April 2020. The vehicles shall be well maintained and any vehicle which is older than 15 years or those which were found to emit more pollution shall be brought to the notice of the contractor and may be removed from site. The materials for construction shall be sourced from nearby quarries after obtaining necessary approvals from the competent authorities. The construction materials such as sand, cement bags etc which are transported by trucks shall be covered by tarpaulin so as to avoid any air-borne emissions. The non-paved roads used for transportation of vehicles shall be sprinkled with water often to reduce dust emissions.	and materials is being done on regular interval. Please refer compliance of point no 2 for detailed information on control measures for fugitive dust emissions.
3	The construction materials if stored in open storage shall be covered with tarpaulin and at a minimum height of 3 m so that the wind-borne emissions shall be reduced.	Complied. Construction materials are being stored in covered shed with wind shield having minimum 3-meter height. Required quantity is only taken at site.
4	As per the latest notification of MoEF&CC for the Diesel engine exhaust69, the emissions of the DG sets which have the capacity of more than 75	Complied MUL co-developer entity of Adani group is supplying uninterrupted power during construction activity. DG set is provided as stand-by and used for emergency backup only.

Sr. No.	Suggested Measures	Compliance Status
	kW and upto 800 kW shall have the emission limits of PM:<0.2 g/kW-hr, CO:<3.5 g/kW-hr and NOx+HC: <4.0 g/kW-hr. The CPCB guidelines70 states that the old DG sets which doesn't have manufacturer's warranty shall not be used and DG sets manufactured on or after 17th May 2002 shall be discarded after 15 years of operation or 50,000 hours of operation whichever is earlier. DG sets shall be serviced and maintained regularly in such a manner that dust accumulation shall be inspected and cleaned once a week. The contractor shall be advised to use good quality fuel and lubricants for the DG sets.	DG set used conforms with standard laid under EPA Act 1986. Low sulphur content diesel is being used and adequate stack height is also provided for proper dispersion of pollutant.
5	The construction activities shall be carried out at daytime and it shall be suspended at the night time.	Complied Construction activity was carried out during daytime only.
6	The dredging activity and frequency shall be scheduled to avoid accumulation of high noise levels.	Point noted and agreed. The dredging activity and its frequency has been scheduled to avoid accumulation of high noise levels.
7	The construction materials shall be stored in paved surfaces so that the runoff from storage yards will not affect the underlying soil and groundwater. Any spillage of concrete or any other construction materials on soil shall be cleaned immediately. Bunds shall be provided around the Excavation and reclamation areas so as to delineate the areas and also to drain the excess water which will reduce the impacts on the surrounding	Complied. All construction materials are being stored in covered shed with paved area only. Accidental spillage is immediately cleared from construction site. Bund will be provided around the excavation and reclamation areas so as to delineate the areas and also to drain the excess water which will reduce the impacts on the surrounding soil environment.

Sr. No.	Suggested Measures	Compliance Status
	soil environment.	
8	The dredged soil to be used for reclamation shall be checked for its quality and any contaminated soil shall be removed as it will alter the quality of the underlying soil.	Point noted and agreed. Entire quantity of capital dredging material will be used for reclamation / level raising purpose within approved area only while maintenance dredged material will be disposed off into deep sea at identified locations.
9	The vehicle movements in reclamation sites shall be restricted during the process of compaction of soil. Any spillage of construction materials from the vehicles shall be avoided or cleaned immediately.	Compiled The vehicle movements in reclamation sites is being restricted during the process of compaction of soil. Construction Material is transported in vehicle covered with tarpaulin & accidental spillage is immediately cleaned.
10	Water requirement during the construction phase is less, the existing water source is adequate to meet the water demand during the construction phase of the project. Hence no new water source will be explored.	Compiled The present source of fresh water for APSEZ is sufficient to meet water demand during construction phase. Hence no new water source is required to be explored.
11	The foundations shall be provided with sheet piles so that there is no flooding of water from the surrounding environment. The runoff from the construction activities, domestic use water by labours and storage yards of construction raw materials will be routed to the STP in the existing facility, if any. The washing of construction equipment and vehicles shall be prevented inside the port during the construction period. Any stagnation of water in any place of the port shall be removed or pumped to ETP/STP for treatment if available in large quantity.	Compiled The following measures are being taken. ✓ Pucca flooring with sheet piles has been provided for construction raw material storage so that there is no flooding of water from the surrounding environment. ✓ Workers engaged in construction activities would be mainly from nearby villages hence there would be no requirement of infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP. ✓ Existing facilities for drinking water, toilets & rest shelter would be utilized by workers. ✓ The washing of construction equipment and vehicles is strictly prevented inside the port during the construction period.
12	The dredging and the reclamation activities in the intertidal region shall be	Point noted and being complied Reclamation / level raising activity proposed as

Sr. No.	Suggested Measures	Compliance Status
	carried out with precautions so that the groundwater table shall not be intersected and salinity intrusion can be avoided.	part of the expansion plan will occur in the intertidal, offshore area and approved APSEZ area only. Hence, the possibility of salinity ingress in the groundwater aquifer due to reclamation is low. The vehicle movements over the reclaimed soil are avoided during the initial period so that compaction of soil is not affected which in turn will have an effect on the underlying groundwater table.
13	Clear demarcation of construction area to avoid any unintended material storage or waste dumping in the area.	Complied Dedicated area with demarcation is provided for construction area.
14	Proper and responsible handling of construction machinery, materials, waste, etc.	Complied
15	HDD technology will be used for installing underground pipeline/cables for the sections crossing the creek/ mangrove/ mangrove buffer area, with adequate casing and risk mitigation measure causing no impact on the area.	Point noted and agreed. HDD technology or advance gantry girder technology will be used for laying underground pipeline/cables for the sections crossing the creek/ mangrove/ mangrove buffer area, which will have negligible impact on ground.
16	Survival mangrove patches along the bank of the creek at the upstream of the bridge shall be monitored periodically during the operation phase.	Complied Please refer compliance to specific condition no 1.4 of EC & CRZ clearance for detailed information regarding mangrove conservation and monitoring.
17	As an additional measure the possibility of providing fencing for the utility corridor along the creek crossing shall be explored. This will restrict the people's access to the mangrove and creek area and also to avoid the unattended dumping of wastes.	Complied The construction site will be enclosed with barricade/boundary. Provision of security guards is also there for monitoring of unauthorized access to mangroves and CRZ area.
19	The construction wastes and debris from the construction activities will have to be removed	Point noted and agreed Construction debris and waste materials is being handled in line with C&D Waste Rules – 2016.

Sr. No.	Suggested Measures	Compliance Status
	periodically. The wastes that get accumulated to over 20 million tons per day or 300 tons per project in a month have to be disposed as per the Construction and Demolition Rules, 2016.	
20	The solid wastes shall be segregated into biodegradable and non-biodegradable wastes. The biodegradable wastes shall be sent to the existing compost and it can be used as manure for greenbelt. The non-biodegradable wastes shall be managed as per the Hazardous & Other Waste Management rules, 2016, amended till date.	Complied Provision of color code bins is there at site for proper waste segregation. Organic waste is used in biogas for fuel generation & Organic waste converter for manure generation.
21	The hazardous wastes such as used or spent oil, wastes or residues containing oil, process wastes, residues and sludges, empty containers contaminated with hazardous chemicals/wastes, etc as specified in section 2.2.14.4 during the construction period will have to be dealt in accordance to the Hazardous & Other Waste Management rules, 2016, amended till date.	Complied Hazardous waste generated is being handled in line with H&OW Rules - 2016. Please refer compliance to Waste Management condition no 6.4, 6.5, 6.6 & 6.7 of EC&CRZ clearance for detailed information
22	The site of operation shall be marked with buoys/signboards and the nearby fishing communities shall be intimated before commencement of the construction activities for breakwaters and berths.	Point noted and complied
23	The construction equipment and pile driving equipment shall be maintained regularly and old machines shall be replaced. The equipment shall be inspected by qualified professionals to check for any leaks from the	Complied Periodic maintenance is being done of all equipment. Regular inspection of tools & equipment is being carried out by safety team in coordination with project team

Sr. No.	Suggested Measures	Compliance Status
	equipment. The washing of equipment shall not be carried out near the site as the runoff from these will contaminate the water quality. The fueling of the equipment will have to be done onshore at a distance away from the marine waters and there should not be any discharge into the marine environment from this equipment at any point of time. The fuel storage shall not be done at operational site and any required storage of these fuels shall be carried out at a distance away from the site with the lowest possible volumes.	Washing of vehicles/bulkers/equipment is allowed at designated place only. Fuel is being stored in storage areas far away from marine. Proper care is being taken while refueling and is done at offshore only to avoid accidental spill into marine environment
24	The storage of construction materials should be kept at a distance so that runoff from the storage areas will not affect the marine environment. In case of any spillage of construction materials or concrete, the operation maybe temporarily suspended and restarted only after rectification of the same. In case, concrete is pumped through hoses, the same shall be checked for leaks and spills. During rains and on event of natural/man-made disasters, the construction activities shall be suspended. The raw materials shall be covered during the rainy season to avoid runoff and in summer season to avoid wind-borne emissions.	Complied Construction material is stored in covered sheds away from marine environment. Accidental spill is immediately cleared off. Construction activity is restricted during monsoon & raw material at site is covered with tarpaulin.
25	The usage of toxic or hazardous materials in construction shall be avoided. Spill response kits shall be made available near the construction sites to	Complied. The usage of toxic or hazardous materials in construction is avoided. Spill kit & secondary containment is made available at construction site where fuel is used.

Sr. No.	Suggested Measures	Compliance Status
	contain any spills. The sediment screens shall be deployed in the operational site to limit the spread of plumes by the construction of berths and pile driving activities. Weather forecast shall be checked and construction activities during flood tidal conditions may be avoided or shall be carried out with necessary preventive measures.	All the major construction activities is being undertaken after confirming the weather forecast only. Disaster management plan & onsite emergency plan is in place to rescue with emergency situations occurred due to manmade or natural calamities.
26	The marine water quality in the site of operation as well as in the surrounding environment shall be checked regularly and the important parameters that should be tested are Turbidity and Dissolved Oxygen along with other physic-chemical and biological parameters. Any alarming rate of change in the water quality shall be addressed immediately and the operations may be temporarily suspended.	Point noted and agreed Please refer compliance to specific condition no 1.12 of EC&CRZ clearance for detailed information. Till now such situation has not arisen when marine water quality parameter is disturbed, however if it happens APSEZ ensures that it will temporarily stop its activity until the marine water quality parameter becomes normal.
27	Appropriate noise mitigation measures such as bubble barriers/curtains 71, double pile, filled double pile72 , double walled air filled sleeve around the pile73, can be explored to reduce noise generated from piling.	Point noted and agreed
28	The area of dredging shall be marked and no dredging shall be carried out in areas outside the designated sites. The record of oceanographic information and meteorological information for the operational days of dredging shall be maintained.	Point noted and being complied. Dredging area has already been identified as per location approved in EC&CRZ clearance. Meteorological parameter is being recorded by marine department.
29	The sediment screens shall be provided in the	Complied

Sr. No.	Suggested Measures	Compliance Status
	operational sites to contain the sediment suspension due to the dredging activities.	Please refer compliance to Water Quality Monitoring and Preservation condition no 3.2 of EC&CRZ clearance for detailed information
30	The marine water quality, sediment and ecology shall be tested prior to dredging, during the operation and post-dredging.	Complied Please refer compliance to specific condition no 1.12 of EC&CRZ clearance for detailed information.
31	The excavated materials from dredging shall be stored with a minimum height of 5m in order to avoid dust emissions. Before commencement of reclamation, the dredged materials shall be tested for quality and contaminated soils shall be treated properly.	Point noted and will be Complied Please refer compliance to Water Quality Monitoring and Preservation condition no 3.2 of EC&CRZ clearance for detailed information
32	The laying of pipeline and the pile driving activities for SBM/Sea island Jetty shall be carried out in a confined manner by installing sediment screens around the working site.	Point noted and agreed once laying of pipeline and the pile driving activities for SBM/Sea island Jetty undertaken.
33	The subsea pipelines shall be subjected to regular maintenance because any leakages will cause heavy damage to marine environment.	
34	The liquid discharges/waste discharges from the barges shall not be permitted as they will alter the marine water quality.	Complied Please refer compliance to Water Quality Monitoring and Preservation condition no 3.3 of EC&CRZ clearance for detailed information.
35	The concrete filling/maintenance works/grouting for leakages shall be carried out with containment measures to avoid impacts on the surrounding environment.	Complied Secondary containment is being placed near construction site to reduce impact on the surrounding in case of accidental spillage.
36	Environmental friendly/water based drilling shall be adopted for pile driving activities.	Point Noted and Complied The dredging is being carried out using Trailing Suction Hopper Dredger (TSHD).
37	Care should be taken not to overfill piles with concrete and in case of precast piles,	Point noted and agreed

Sr. No.	Suggested Measures	Compliance Status
	the angles of insertion in the seabed shall be checked so that it will not be misplaced or become unstable over time.	
38	There should not be any runoff, discharge or waste dumping in to the marine environment during the construction period.	Complied No waste is being dumped into marine environment. Waste generated is being disposed as per APSEZ waste management policy
39	The intake and outfall structures along with pumping stations shall be installed by taking precautions in not to disturb the surrounding environment by providing sediment screens and confining the areas.	Point noted and complied The existing intake and outfall system is adequate for discharge of reject from 300 MLD capacities Desalination Plant. The requisite measures will be adopted for pipeline system will be provided for additional capacities of desalination plant.
40	The route of the subsea pipelines of the intake and outfall points shall be furnished to Naval Hydrographic Office to include in the Naval Hydrographic Chart as a warning for navigation.	
41	The intake structure shall be provided with fishnets/grits and the velocity at intake point shall be maintained as low as possible to avoid entrapment of the marine organisms into the intake pipeline. The effectiveness of the screens shall be checked regularly and shall be replaced immediately in case of any damage noticed.	Complied Fishnet/grit is tied at the inlet intake point to avoid any possibility of marine organism getting trapped into intake pipeline
42	The intake and outfall locations shall be marked with buoys so that fishing boats or vessels will not collapse the structures.	Point noted and agreed
43	The intake and outfall structures shall be cleaned regularly to avoid anaerobic decomposition in the pipelines and to remove the waste loads.	Complied Regular cleaning is being carried out to avoid decomposition in the pipelines and any blockages

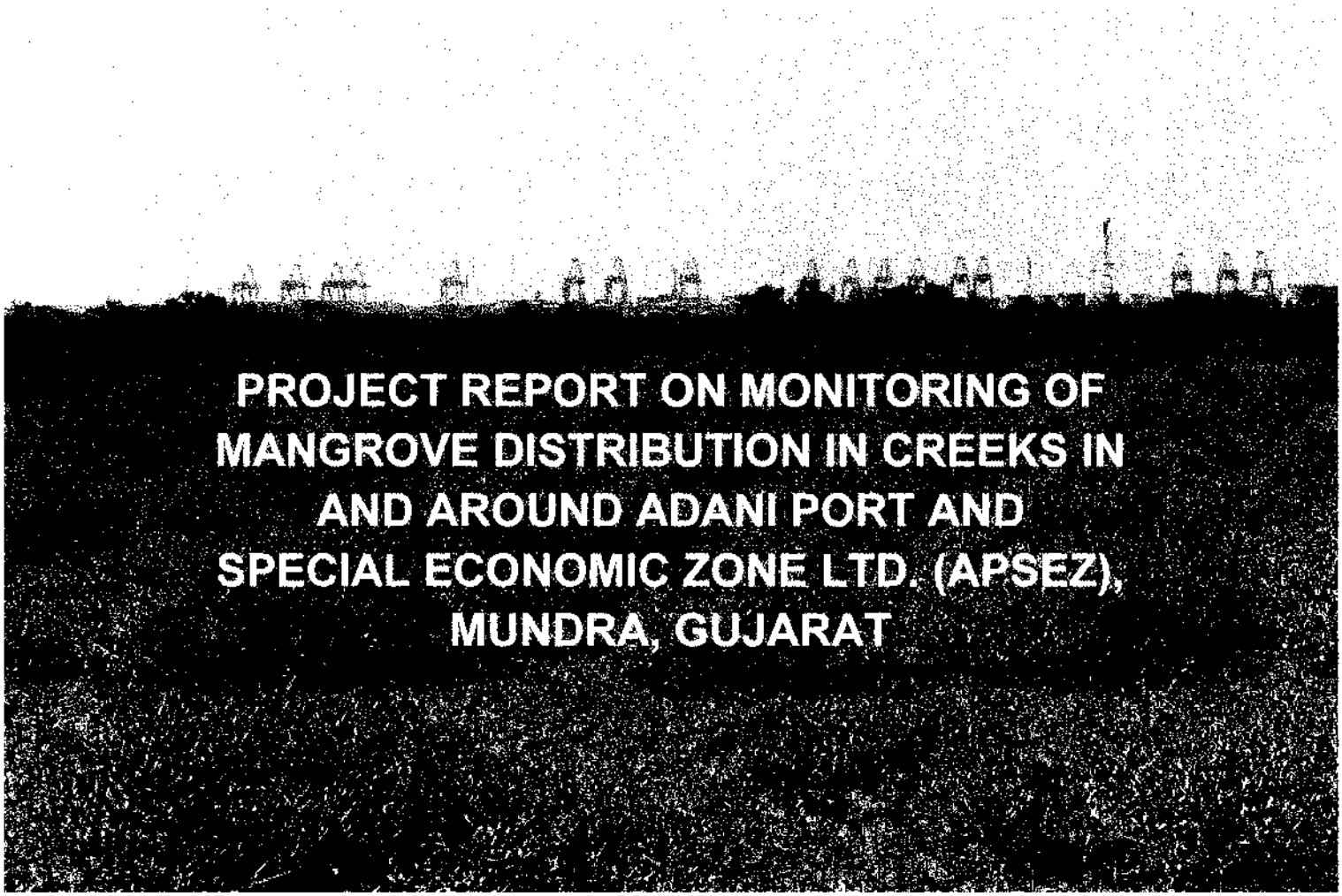
Sr. No.	Suggested Measures	Compliance Status
✍ **Operation Phase:**		
1	Dust suppression measures as committed (such as at Ship unloader discharging into hoppers, Stockyards, Discharge and feeding points of conveyors, Rapid loading system etc.) shall be implemented.	Complied This reply cover condition no 1, 2 & 3. Please refer compliance to specific condition 1.15 of EC & CRZ clearance for detailed information
2	The vehicles that carry the dry bulk cargo shall be covered with tarpaulin sheets in order to protect the air environment from air-borne emissions during transportation. The vehicles entering and leaving the coal storage facilities shall undergo wheel-washing in order to avoid dust particles being carried by trucks and getting deposited on the way.	
3	The vehicles that enter and exit the port shall be checked for the valid Pollution Under Control (PUC) Certificate.	
4	The ships entering the port shall be checked for the "International Air Pollution Prevention Certificate".	Complied Please refer compliance to Water Quality Monitoring and Preservation condition no 3.3 of EC&CRZ clearance for detailed information
5	The vehicles and machinery shall be maintained under regular maintenance program to ensure that the noise reducing requirements are met.	Complied Periodic maintenance is being carried out to reduce noise emission. Also, acoustic enclosure, barricading is used for reduction in noise level. Earmuff is provided to worker working in high noise area
6	APSEZ and tenant industries/facilities within the APSEZ are required to required to undertake noise monitoring at their facility demonstrating their compliance to the noise level standards.	Complied This reply covers condition no 6 & 7. Ambient Air Quality (twice in a week) and Noise (once in a month) monitoring are being carried out by NABL and MoEF&CC accredited agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi. Please refer specific condition no. xi of the EC & CRZ clearance or further details.
7	Continuous noise recording systems can be installed by APSEZ at facility boundary to address the community	

Sr. No.	Suggested Measures	Compliance Status
	grievances, when required.	
8	The vibration dampers shall be provided around the source of generation.	Complied
9	The storage yards shall be paved.	Complied
10	The dumping of solid and hazardous wastes on soil will also lead to contamination	Complied
11	The rainwater will be collected separately in stormwater drains.	Complied APSEZ has implemented storm water drains in the existing facility taking into account the natural gradient to meet the peak rainfall in the area and avoid flooding in neighboring areas
12	The process water drains shall be maintained separately to collect the wastewater from the port activities. The oil and grease from the wastewater of truck parking, workshop area, cargo storage and cargo handling areas shall be collected separately and treated or disposed under hazardous waste.	Complied Effluent generation from operation is being treated in existing ETP of capacity 265 KLD. An additional 800 KLD ETP proposed for proposed expansion activities. Oil and grease from the wastewater of truck parking, workshop area, cargo storage and cargo handling areas is being collected separately and disposed under hazardous waste through selling to registered recyclers.
13	The solid wastes from the port operations shall be segregated into bio-degradable and non-biodegradable	Complied APSEZ has existing facility conforming to the CPCB standard for storage of hazardous waste. Please refer compliance to Waste Management condition no 6.4, 6.5, 6.6 & 6.7 of EC&CRZ clearance for detailed information
14	The hazardous chemicals and cargo shall be stored in designated storage areas with concrete paved surfaces. These shall be as per the prescribed/ approved safety norms.	
15	The battery wastes used for the equipment and other port operations shall be separately collected and disposed through authorized vendors as per Battery Waste (Management and Handling) Rules, 2010 and subsequent amendments.	

Sr. No.	Suggested Measures	Compliance Status
16	The existing port is utilizing the mechanical handling of cargo and the same shall be followed for the proposed development as well with necessary additional equipment so that there is no spillage in the marine environment.	Point noted and agreed
17	The Ships visiting the port will have to comply with MARPOL convention and avoid any discharges as per the International law. The ballast water discharge is prohibited within the harbor limits.	Complied This reply covers condition no 17 & 18. Please refer compliance to Water Quality Monitoring and Preservation condition no 3.3 of EC&CRZ clearance for detailed information
18	During emergency, provision of reception facilities will be explored to receive the residues and oily mixtures generated from ship operations. These wastes will be collected separately and disposed as per applicable waste management rules and guidelines.	
19	Any cargo that is spilled shall be retreived and deposited at the respective storage areas to the maximum extent possible.	Complied. Provision of leak bund is already implemented.
20	Environmental Monitoring Programme comprising of monitoring of marine water quality, marine sediment quality and marine ecology will be initiated 1 week prior to commencement of maintenance dredging and will be carried out during the dredging period.	Point Noted and Agreed Please refer to specific condition no 1.12 of EC & CRZ clearance for detailed information on marine water quality monitoring
21	The wastewater from the port activities will be treated in the ETP and the treated water will be utilized as much as possible within the facility for green belt, dust suppression and excess water from ETP will be disposed as a combined	Complied Please refer compliance to Water Quality Monitoring And Preservation condition no 3.8 & 3.9 of EC & CRZ clearance for detailed information.

Sr. No.	Suggested Measures	Compliance Status
	discharge along with desalination plant reject in to the offshore after meeting discharge standards.	
22	Screens/bunds shall be provided around the mangrove area if there is any construction activities to be carried out near the region.	Point noted and agreed
23	The health of the mangroves and benthic habitat shall be monitored for detrimental damage. The remediation measures shall be implemented if the rates are alarming.	Complied Please refer to specific condition no 1.12 of EC & CRZ clearance for detailed information on marine water quality monitoring

Annexure – 1



PROJECT REPORT ON MONITORING OF MANGROVE DISTRIBUTION IN CREEKS IN AND AROUND ADANI PORT AND SPECIAL ECONOMIC ZONE LTD. (APSEZ), MUNDRA, GUJARAT

Submitted to

M/s Adani Ports and Special Economic Zone Ltd
Mundra, Gujarat

Prepared by

National Centre for Sustainable Coastal Management
Ministry of Environment, Forest and Climate Change
Chennai

July 2025

EXECUTIVE SUMMARY

The Adani Ports and Special Economic Zone Ltd (APSEZ) was directed by the Ministry of Environment, Forest and Climate Change (MoEF&CC) to develop a Comprehensive Integrated Conservation Plan for the preservation and protection of mangroves and creeks in the Mundra region as part of the conditions for Environmental Clearance (EC) issued in July 2014 and September 2015. To fulfil this requirement, APSEZ entrusted the National Centre for Sustainable Coastal Management (NCSCM) with the task of preparing the conservation plan and carrying out periodic monitoring. The present study reports the findings of the mangrove monitoring undertaken between 2021 and 2023, utilizing high-resolution WorldView-3 satellite imagery and detailed ground validation, covering Kotdi, Baradimata, Navinal, Bocha, and Khari Creeks, including Bocha Island.

The monitoring results indicate a marginal overall increase in mangrove cover by approximately 2 hectares (around 0.08%), from 2499 ha in 2021 to 2501 ha in 2023. However, the area under dense mangroves increased by 56 hectares during this period, suggesting positive ecological succession and improving vegetation density. Among the individual creeks, Kotdi Creek recorded 6 hectares decrease in mangrove extent, mainly in the scattered category, which may be attributed to human-induced pressures, although increases in dense and sparse mangrove categories reflect good tidal connectivity. Baradimata Creek showed a net gain of 16 hectares, driven by the formation of new dense mangroves, while minor losses in sparse zones were likely caused by tidal erosion. In the Navinal–Bocha Creek system, a slight reduction of 6 hectares was noted, primarily due to erosion at the tip of Bocha Island. However, sparse mangrove cover showed localized increases, indicating ongoing regrowth in some areas. Khari Creek remained largely stable, with only a minor decline of 1 hectares offset by the expansion of scattered mangroves on adjacent mudflats.

Despite the overall stable condition of mangroves in the APSEZ region, several localized issues require attention. Ongoing erosion at Bocha Island is leading to loss of dense mangrove patches, while the formation of sand spits in Navinal Creek may potentially hinder tidal water flow, affecting mangrove health in the future. Additionally, small areas of mangrove clearing were observed near the downstream section of Navinal Creek and in the upper Baradimata Creek due to road expansion activities. In view of these observations, the report recommends that mangrove monitoring continue on a biennial basis using high-resolution satellite data and field surveys. Where necessary, dredging should be undertaken in a phased manner to enhance tidal water inflow, especially in Navinal and Bocha Creeks. Dumping of dredged material must be strictly avoided near creek mouths and interiors to prevent siltation and bank erosion. Control measures to mitigate erosion at Bocha Island, such as dredging shallow areas and constructing sand bunds, should be implemented if erosion persists.

Furthermore, the practice of restricting entry to mangrove areas should be continued to prevent cutting of vegetation, and awareness campaigns must be strengthened to highlight the ecological value of mangroves. In order to reduce pressure on mangrove resources for fodder, local communities should be encouraged to adopt sustainable fodder cultivation with support from the Adani Foundation and local authorities. The study underscores that tidal flow, elevation, and substrate conditions are critical in maintaining mangrove health. While the mangrove ecosystems in and around APSEZ appear to be functioning well, ongoing management and timely interventions will be essential to ensure their long-term sustainability in the face of developmental pressures.

List of Contributors from NCSCM

Task	Name
Project Co-ordination, formulation, guidance, Critical review of project activities and review of report	Dr. Purvaja Ramachandran, Director
Project facilitation and review of report	Dr. Deepak Samuel, Scientist E
Reconnaissance survey	Dr. Deepak Samuel V, Scientist E Dr. Viswanathan C, Scientist B
Preparation of mangrove maps and report	Dr. Mary Divya Suganya, Scientist C
Field work on mangroves and mangrove report preparation	Dr. Viswanathan C, Scientist B Mr. Joyson Joe Jeevamani, Project Scientist II

Table of Contents

List of Tables

List of Figures

1. INTRODUCTION

The northern Gulf of Kachchh in the western coast of India has extensive formation of mangrove. Ministry of Environment, Forest and Climate Change have accorded Environmental Clearance (EC) vide Letter No. F.No.10-138/2008-IA.III dt. 15th July, 2014 & 12th February, 2020 to M/s Adani Ports and Special Economic Zone Ltd (APSEZ), to set up a multi-product SEZ at Mundra, Kachchh, Gujarat. The project involves development of SEZ in a notified SEZ area of 8481.2784 ha.

While according Environmental Clearance (EC) to the project, the MoEF&CC have stipulated General and Special conditions in their Environment Clearance. Further inline to the MoEF&CC final order, vide F.No.10-47/2008-IA.III dtd 18th September 2015 which also contained special conditions, two of which (sr. no iv and v of the order) are as follows:

(iv) A Comprehensive and integrated conservation plan including detailed bathymetry study and protection of creeks/mangrove area including buffer zone, mapping of co-ordinates, running length, HTL, CRZ boundary will be put in place. The plan will take note of all the conditions of approvals granted to all the project proponents in this area, e.g., the reported case of disappearance of mangroves near Navinal Creek. The preservation of entire area to maintain the fragile ecological condition will be a part of the plan in relation to the creeks, mangrove conservation and conservation of Bocha Island up to Baradimata and others.

(v) NCSCM will prepare the plan in consultation with relevant stakeholders, PP and GCZMA. In recognition of the fact that the existing legal provisions under the E(P) Act 1986 do not provide for any authority to impose ERF by the Government, the plan will be financed by the PP. The implementation will be carried out by GCZMA. The monitoring of the implementation will be carried by NCSCM.

In line with the above conditions, APSEZ entrusted NCSCM for the preparation of a Comprehensive and Integrated plan for the conservation of mangroves and associated creeks. The Conservation plan was prepared and submitted to the Gujarat Coastal Zone Management Authority and in its meeting held in October 2019, then plan was approved as per their email dt. 22nd September 2020.

2. COMPLIANCE TO THE EC CONDITIONS

M/s Adani Ports and Special Economic Zone Ltd (APSEZ) has submitted the conservation plan and submitted it to the Gujarat Coastal Zone Management Authority in its meeting held in October 2019, and then plan was approved as per their email on 22nd Sept 2020. The major recommendations relating to mangroves that were specified in the conservation plan are as follows:

"The APSEZL shall carry out mangrove monitoring every two years and submit the data to Forest Department/GCZMA and MOEF&CC, GOI".

In order to comply with the above recommendations relating to the assessment of the health of mangroves, APSEZ again entrusted NCSCM, Chennai to carry out Monitoring of mangrove distribution in creeks in and around APSEZ. NCSCM carried out mangrove monitoring in the year 2020-21 comparing Google Earth images of 2017 and 2019. A report of the same was submitted to APSEZ in April – 2021. Accordingly, APSEZ has requested NCSCM to monitor the mangrove coverage using the satellite images of 2021 and 2023 to comply with the recommendations of GCZMA.

3. SCOPE OF WORK

The scope of the present consultancy is to prepare a mangrove distribution map between March 2021 and March 2023 for all the creeks of the APSEZ area including extent, and vegetative features. Besides, the current map will be compared with the previous map to understand the changes in mangrove cover, if any.

4. STUDY AREA

The study area includes a creek and mangrove areas within and around the boundary of APSEZ as indicated in Fig. 1. The creeks present in and around APSEZ are two parts of Kotdi, two parts of Baradimata, Navinal, Bocha, and Khari Creeks. The land adjoining the creeks has mangrove formations, which vary from creek to creek. Dense mangrove formations are common in Bocha Island along Bocha and Navinal Creeks, and along Baradimata Creek.

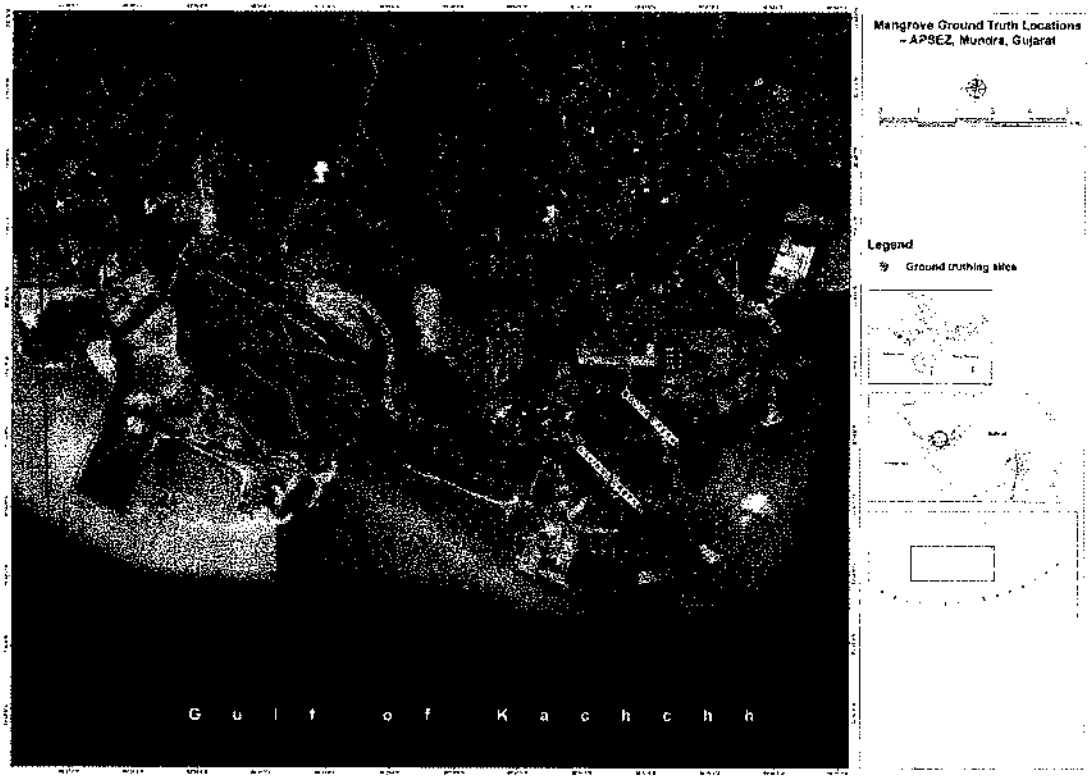


Fig. 1. Study Area – Adani Ports and Special Economic Zone (APSEZ), Mundra

5. TASKS PROPOSED TO BE CARRIED OUT

Details of tasks proposed to be carried out are:

1. Mapping of mangrove distribution in the APSEZ area
2. Mangrove coverage in creeks in and around APSEZ, Mundra using the latest satellite images for the duration of year March 2021 to March 2023

6. TASKS PERFORMED

6.1 MAPPING OF MAGROVES

6.1.1 Satellite Data used

Mapping of mangroves carried out using High resolution Multispectral satellite images with scenes of the years 2021-2023. The mangrove maps were prepared using ArcGIS. Further, ground truth was performed along the creeks in the APSEZ area such as Bocha (including the island), Navinal, Kotdi, Baradimata (including land mass) and Khari by the team of Scientists from NCSCM to verify the distribution of mangroves. In 2019 and 2021, the Gujarat Institute of Desert Ecology mapped the mangroves using IRS P6 LISS-IV satellite imagery with a spatial resolution of 5.8 m, recording mangrove areas of 2,670.08 ha and 2,722.87 ha, respectively. In the present study, high-resolution WorldView-3 (pan-sharpened) imagery with a spatial resolution of 0.5 m was employed for more accurate mapping for the years 2021 and 2023. The ability to map mangroves from satellite imagery mainly depends on the sensor's spatial resolution (pixel size).

Each pixel indicates a particular ground area, defining the smallest object that can be accurately detected and outlined. LISS-IV imagery (5.8 m spatial resolution) covers an area of approximately 33.6 m^2 per pixel, making it suitable for regional-scale mangrove mapping at cartographic scales of 1:25,000 to 1:50,000. In contrast, WorldView-3 imagery (0.5 m pan-merged) offers significantly finer spatial detail, with each pixel representing 0.25 m^2. This high-resolution data supports mapping at scales of 1:1,500 to 1:2,000, enabling the detection of small mangrove patches, seedling zones, canopy gaps, and edge degradation. For such site-level mapping, WV3 ha can be considered for delineating fine-scale mangrove features. Therefore, LISS-IV is suitable for assessing broad-scale mangrove distributions, whereas WorldView-3 enables high-precision mapping for localized conservation, restoration, and monitoring studies (https://doi.org/10.3390/rs14102317).

The specifications of the satellite images used in the study is listed below:

Table 1. Data source for mangrove mapping

Year	Satellite Data	Spatial Resolution
2021	Worldview3	50 cm
2023	Worldview3	50 cm

6.1.2 Methodology

The various steps involved in mapping of APSEZ mangroves is outlined in Fig. 2.

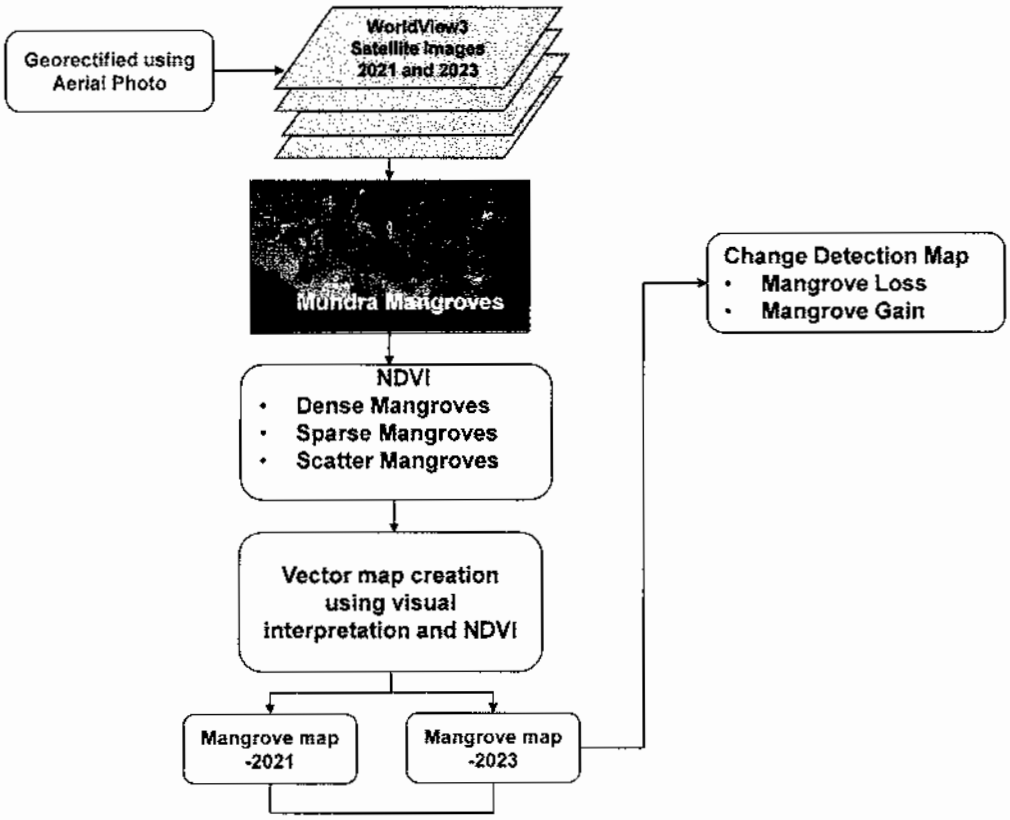


Fig. 2. Mangrove mapping workflow

a. Pre-processing of Satellite Images

The extraction of mangrove areas from satellite data involves the geo-referencing of satellite images using aerial photographs, followed by digital image classification to identify mangrove extents. Rigorous geometric correction was performed to minimize both systematic and non-systematic errors in the satellite imagery. In this study, image-to-image registration was applied to rectify the satellite images using orthophotos as the reference in

ERDAS Imagine software. Geo-referencing all satellite images to a common coordinate system using orthophotos is essential to enable accurate comparison of historical imagery and to analyse mangrove change detetction across the entire study region.

b. Mangrove Extraction

The study area involves in and around Mundra region, Kachchh district for mapping mangroves using remote sensing satellite data. Previously, mangrove delineation have been completed for the study for the year 2019. Monitoring of mangrove extent for the year 2021 and 2023 was delineated through visual interpretation of WorldView3 satellite imagery with a spatial resolution of 0.5 meters. Level III classification scheme adopted by Space Application Centre (SAC), Ahmedabad. Visually, these mangrove categories were mapped using key interpretation elements adopted by Space Application Centre (SAC), Ahmedabad. The high spatial detail provided by the WorldView3 sensor is particularly effective for mapping narrow and fragmented mangrove patches along complex shorelines. Delineation was performed in a GIS environment using digitization techniques, allowing precise manual tracing of mangrove boundaries. Interpretation classified as dense, sparse and scatter mangroves guided by key visual indicators such as:

- **Tone and color**: mangroves typically appear as dark red or dense textured patches in false color composites for dense mangroves, slight red with segregated for sparse and very light red with isolated patches for scatter mangroves
- **Canopy texture and pattern**: the uniform texture and crown clumping differ from surrounding vegetation types.
- **Contextual information**: proximity to tidal zones, estuarine areas, and wetland environments was used to refine delineation.
  The approach follows accepted visual interpretation standards for coastal vegetation mapping and has been widely used in similar high-resolution mangrove studies (e.g. Giri et al., 2011).

c. Normalized Difference Vegetation Index (NDVI)

The Normalized Difference Vegetation Index (NDVI) was utilized to classify mangrove density into dense, sparse, and scattered categories using ERDAS Imagine software. NDVI was computed from Near-Infrared (NIR) and Red (R) spectral bands based on the standard formula (Eq. 1):

$$NDVI = \frac{NIR - R}{NIR + R} \qquad (Eq.1)$$

This spectral index effectively highlights vegetation health and density by exploiting the contrast between high reflectance in the NIR band and absorption in the Red band.

Post-calculation, the NDVI raster was reclassified using the following thresholds:

Dense Mangroves: NDVI values greater than 0.45
Sparse Mangroves: NDVI values ranging from 0.30 to 0.45
Scattered Mangroves: NDVI values between 0.00 and 0.30

Boundary polygons were delineated by overlaying the classified NDVI outputs onto base vector datasets. Manual editing and correction were performed in areas where clarification was required, ensuring accurate extraction of mangrove boundaries.

6.2 MONITORING ON DISTRIBUTION OF MANGROVES IN CREEKS IN AND AROUND APSEZ

6.2.1 Overall assessment

The Kotdi, Baradimata, Navinal, Bocha and Khari Creeks experience high tidal ranges, reaching up to 6 m, with an average tidal range of 2 to 4.5 m that varies annually. These creeks support mangrove formation due to muddy substratum. The mangroves are tide fed, with tidal flow into the mangrove areas occurring only during high tide. This characterize them as inter-tidal mangroves, making their growth and distribution highly sensitive to changes in tidal conditions within the creeks.

The distribution of mangroves in Kotdi, Baradimata, Navinal, Bocha, and Khari Creeks, as well as on Bocha Island, was assessed using WorldView-3 satellite images from February 2021 and September 2023. Regarding the overall health of mangroves in the creeks in and around APSEZ, it was observed that there was a stable growth in mangrove cover approximately 2 hectares, accounting for about a 0.08% increase. Further analysis of mangrove categories revealed an increase in dense mangroves, suggesting that mangrove growth is progressing in a positive direction (Table 2; Figs. 3 to 5).

Table 2. Distribution of various categories of mangroves in the creeks in and around APSEZ in 2021 and 2023

Category	Area (Hectares)	
	2021	**2023**
Dense	1003	1059
Sparse	476	462
Scatter	1021	980
Total	**2499**	**2501**

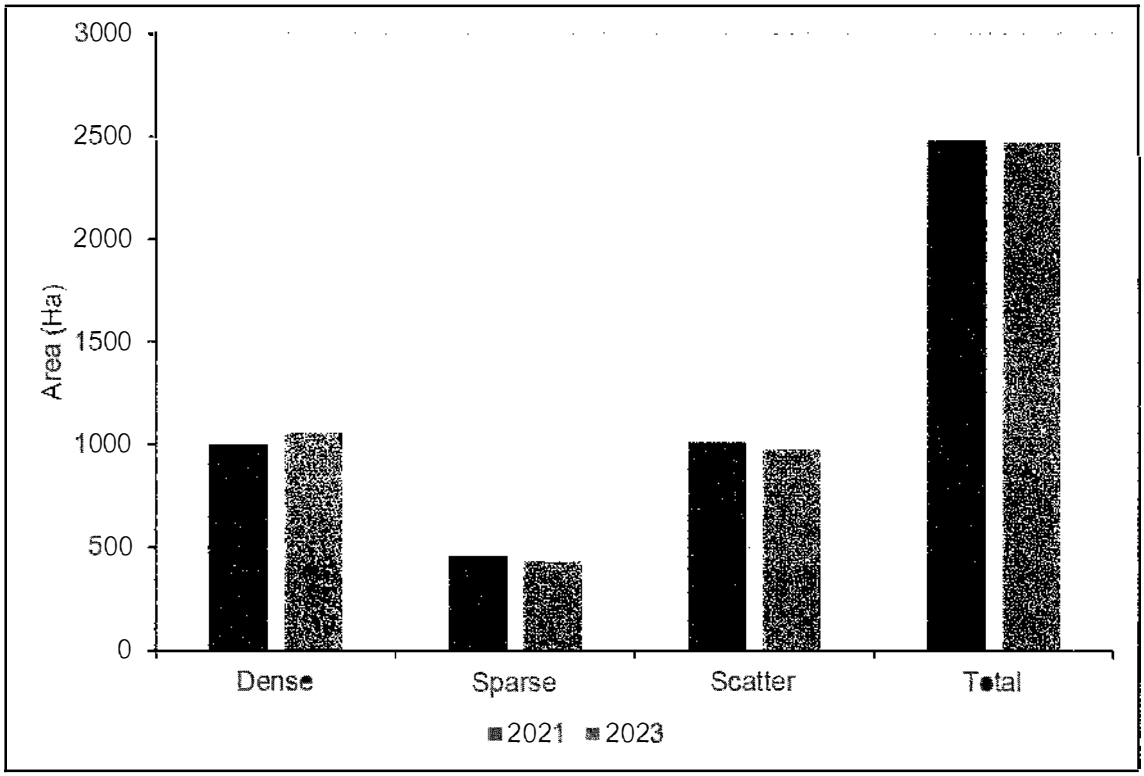


Fig. 3. Comparison of various categories of mangroves in creeks of APSEZ between 2021 and 2023

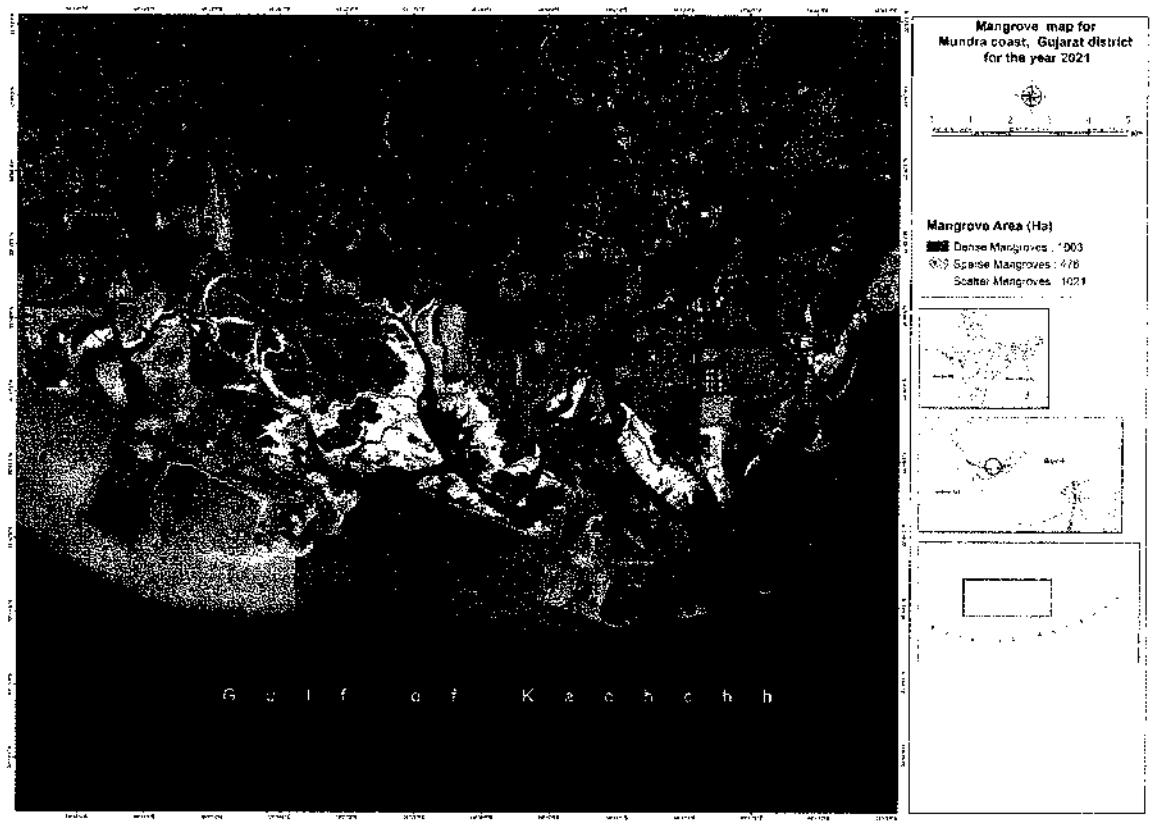


Fig. 4. Distribution of various categories of mangroves in 2021

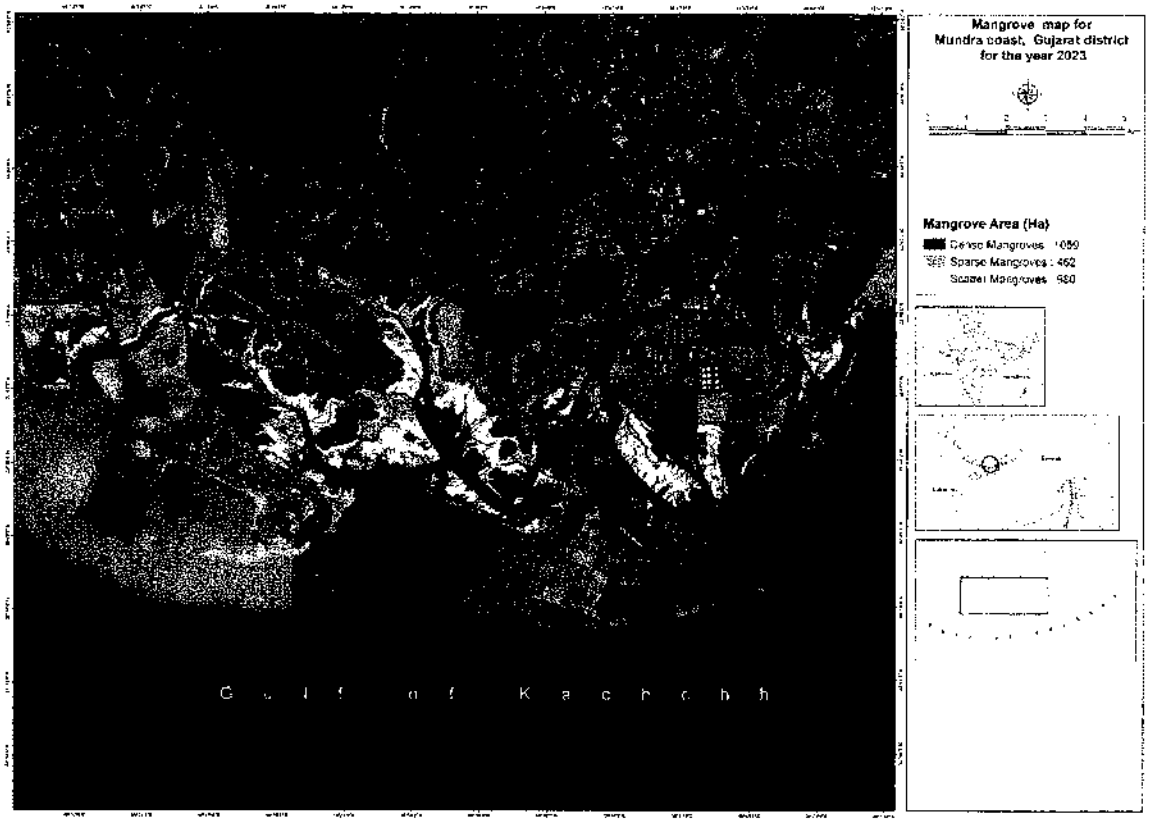


Fig. 5. Distribution of various categories of mangroves in 2023

Vegetation Structure Assessment

Field surveys were carried out in April 2025 across four creek systems (Fig. 1), with sampling points spaced at a minimum interval of 50 meters along the creeks to evaluate the mangrove vegetation structure. In each creek, 10 m × 10 m quadrats were randomly established to capture variability in vegetation characteristics, resulting in 77 sampling plots (Table 3). Within each plot, all mangrove trees with a girth at breast height (GBH) greater than 8 cm were identified to the species level, counted, and their heights measured. The corresponding diameter at breast height (DBH) is greater than 2.5 cm. To assess regeneration, seedlings (individuals less than 1 meter in height) were counted within randomly placed 1 m × 1 m sub-quadrats inside the larger plots. From these measurements, tree basal area ($m^2\ ha^{-1}$) and stand density (trees ha^{-1} or seedlings ha^{-1}) were calculated to quantify the mangrove structure. The Importance Value Index (IVI), which integrates relative density, relative frequency, and relative dominance, was computed to assess the ecological significance of each species. All sampling followed non-destructive protocols, ensuring that no trees were felled during the survey.

$$\textit{Relative density}\ (\%) = \frac{\textit{Number of individuals of a species}}{\textit{total number of individuals of all species}} * 100 \qquad (Eq.2)$$

$$\textit{Relative frequency}\ (\%) = \frac{\textit{Frequency of a species}}{\textit{Sum of frequency of all species}} * 100 \qquad (Eq.3)$$

$$\textit{Relative dominance}\ (\%) = \frac{\textit{Basal area of a species}}{\textit{Sum of basal area of all species}} * 100 \qquad (Eq.4)$$

$$\textit{IVI}\ (\%) = \textit{Relative density} + \textit{Relative frequency} + \textit{Relative dominance} \qquad (Eq.5)$$

Table 3. Summary of sampling details

Zones	No. of tree species observed	No. of quadrats laid
Baradimata Creek	1	30
Khari Creek	1	11
Kotdi Creek	1	12
Navinal-Bocha Creek	3	24
Overall	**3**	**77**

6.2.2 Creek wise assessment

a. Kotdi Creek

The Kotdi Creek, with two mouths—Kotdi I, located on the western end of the South Port of Adani, and Kotdi II, situated east of Kotdi I—experiences tidal inflow extending up to 4.5 km in Kotdi I and 7.4 km in Kotdi II during high tide. The tidal range observed in 2020 varied between 2.9 and 4.7 meters. During the study period, the creek exhibited significant growth across all categories of mangroves, though a slight overall decrease of 26.43 hectares (approximately 5%) was recorded in 2023 compared to 2021. Notably, dense and sparse mangrove cover increased by 0.1 and 3.4 hectares, respectively, while the scatter category decreased marginally by 29.8 hectares (Table 4; Figs. 6 to 8). These findings indicate good tidal connectivity and suggest that the mangrove ecosystem in Kotdi Creek remains in generally healthy condition.

Table 4. Distribution of mangroves in Kotdi Creek system in 2021 and 2023

Category	Area in Hectares	
	2021	**2023**
Dense	182.33	182.43
Sparse	98.64	101.99
Scatter	278.06	268.18
Total	**559.03**	**552.60**

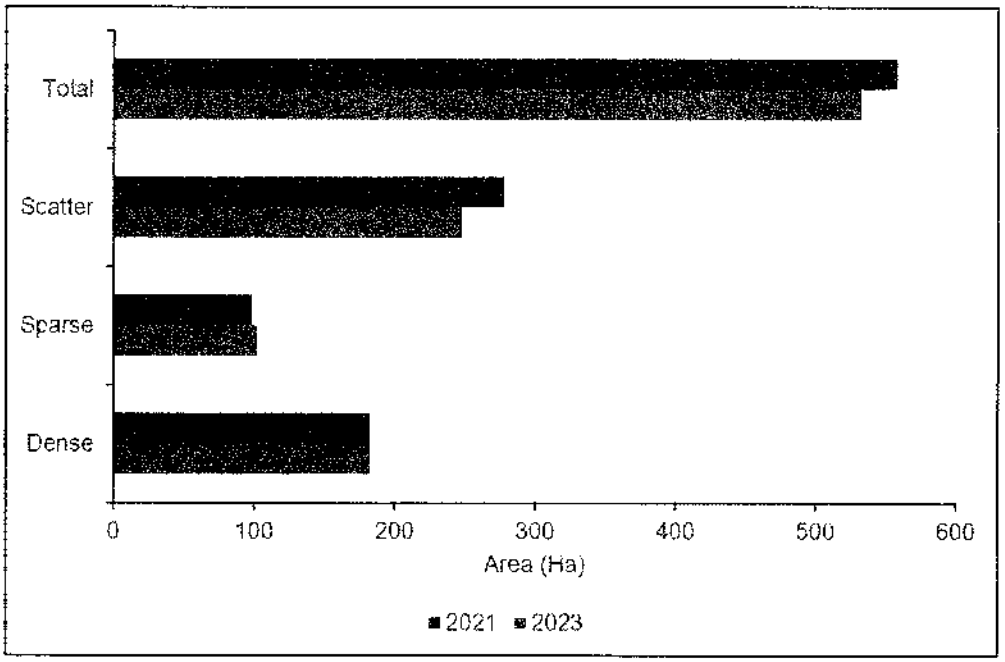


Fig. 6. Comparison of mangrove distribution between 2021 and 2023 in Kotdi Creek

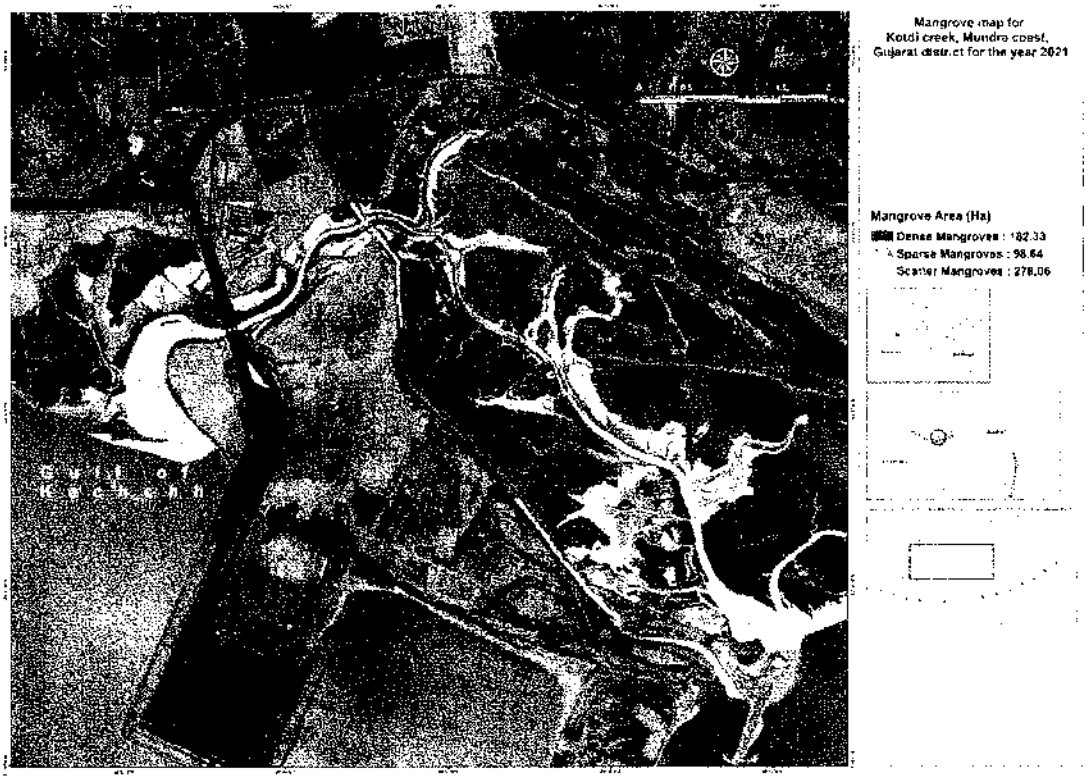


Fig. 7. Distribution of mangroves in 2021 in Kotdi Creek system

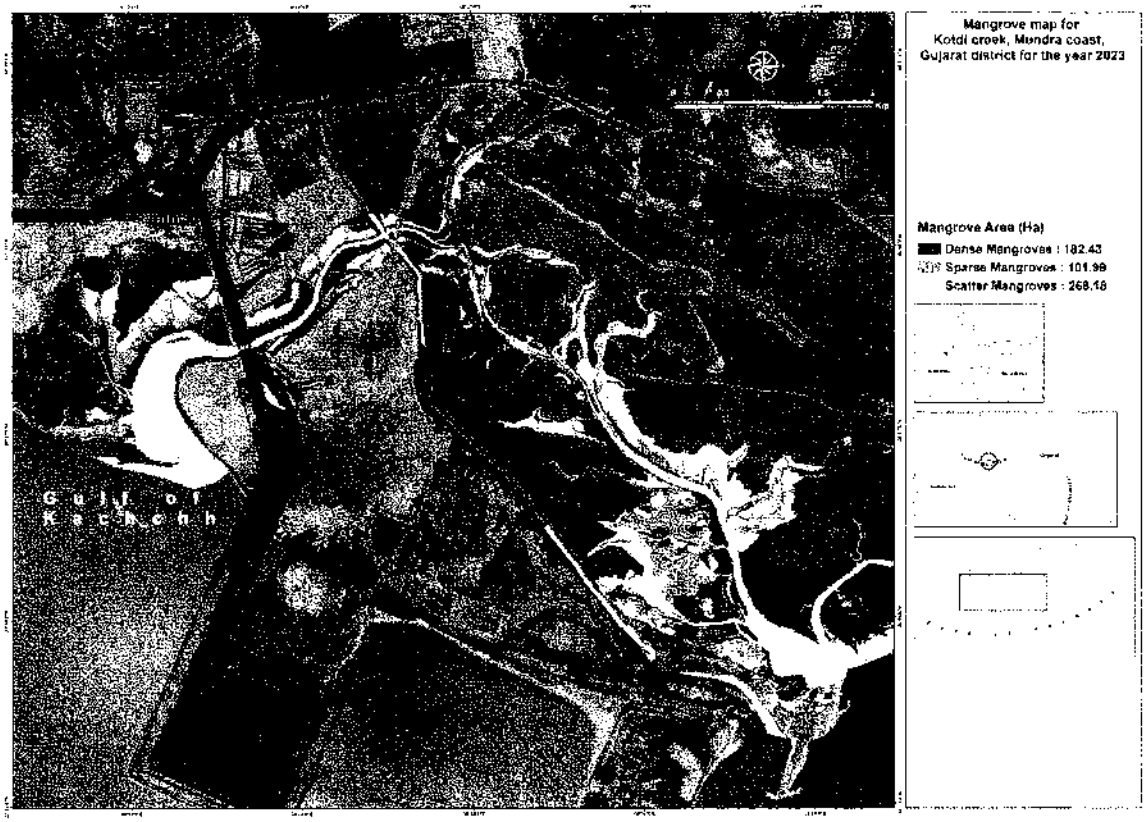


Fig. 8. Distribution of mangroves in 2023 in Kotdi Creek system

Change analysis in Kotdi Creek

A reduction of approximately 12 hectares in mangrove cover was observed in Kotdi Creek between 2021 and 2023, with the most significant losses occurring along the western and south-western tip of the creek (Fig. 9). This decline is primarily in the scattered mangrove category, which is more vulnerable to environmental stress and human-induced pressures. The likely causes include anthropogenic disturbances such as mangrove clearing, land conversion, and infrastructural development near the creek.

In contrast, an increase in sparse mangrove cover was observed, suggesting natural transitional processes within the ecosystem. These changes are characteristic of intertidal mangrove environments, where tidal dynamics, sedimentation patterns, and ecological succession drive the gradual shift in mangrove density—from scattered to sparse, and eventually to dense formations.

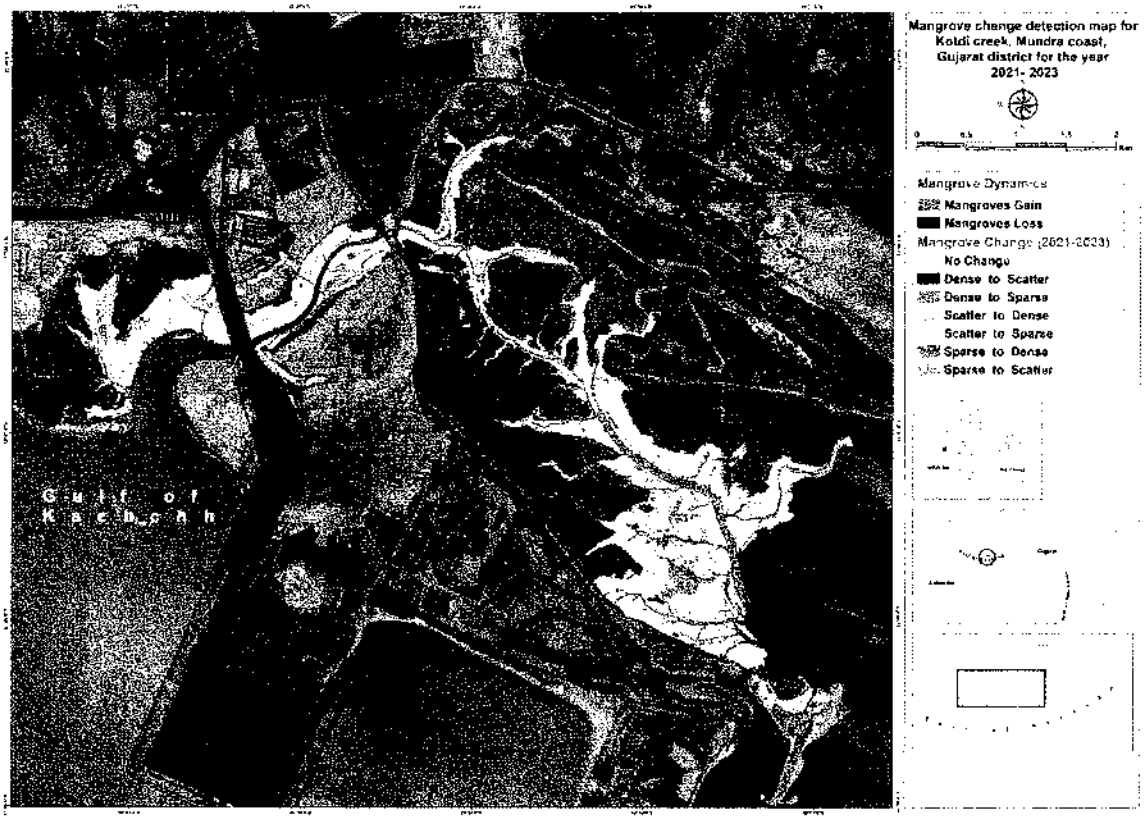


Fig. 9. Result of change analysis from 2021 to 2023 on categories of mangroves in Kotdi Creek system

Vegetation Structure in Kotdi Creek

The mangrove stand structure in Kotdi Creek was predominantly composed of *Avicennia marina*, which emerged as the dominant species (IVI = 300). *Ceriops tagal* species was also observed along with the creek. The density of *A. marina* was estimated at 5,100 trees ha^{-1}, with a corresponding basal area of 24.08 m^2 ha^{-1}. The average tree DBH was 6.51 cm, ranging from 2.70 cm to 26.79 cm. The average tree height was 2.71 m, ranging from 0.80 m to 5.50 m.

The distribution of trees across various diameter at breast height (DBH) classes is presented in Fig. 10, indicating a strong dominance of smaller-sized individuals and a complete absence of trees exceeding 27.5 cm DBH. This suggests a relatively young or regenerating mangrove population structure.

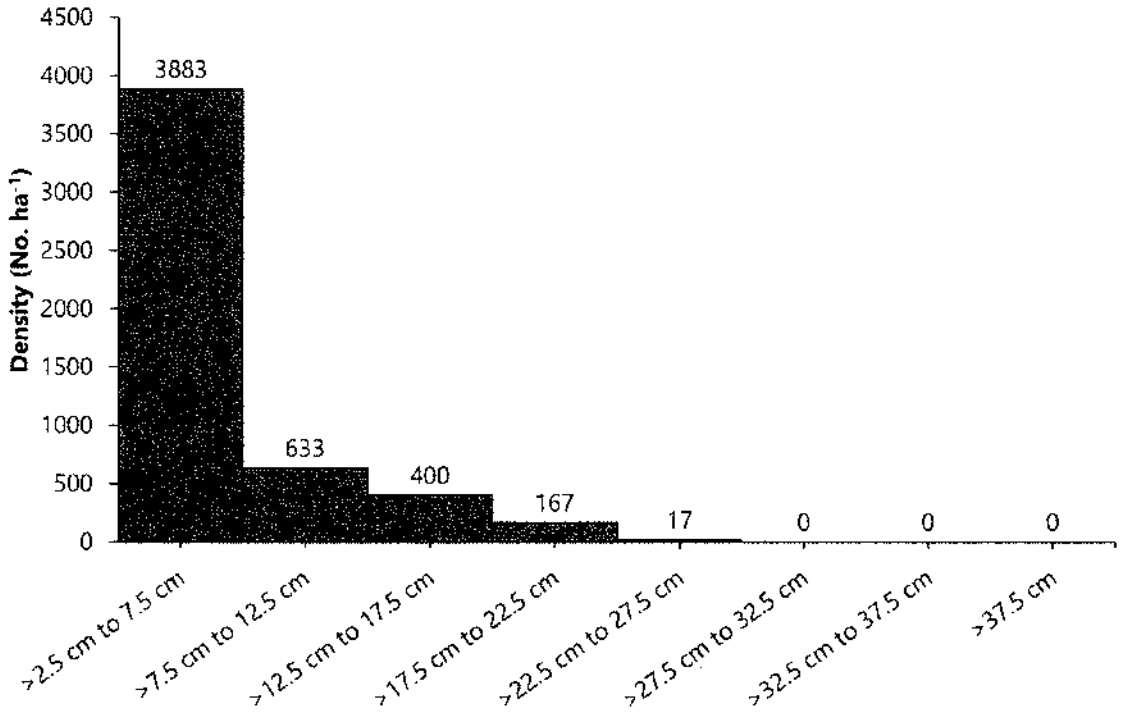


Fig. 10. Mangrove tree density by DBH (cm) size classes in Kotdi Creek

Tree height class distribution (Fig. 11) further supports this pattern, with the majority of individuals falling within the >1.5–2.2 m height range, followed by trees in the >2.2–2.9 m and >3.6–4.3 m height categories. This skewed distribution toward smaller size classes may reflect ongoing recruitment and limited presence of mature trees.

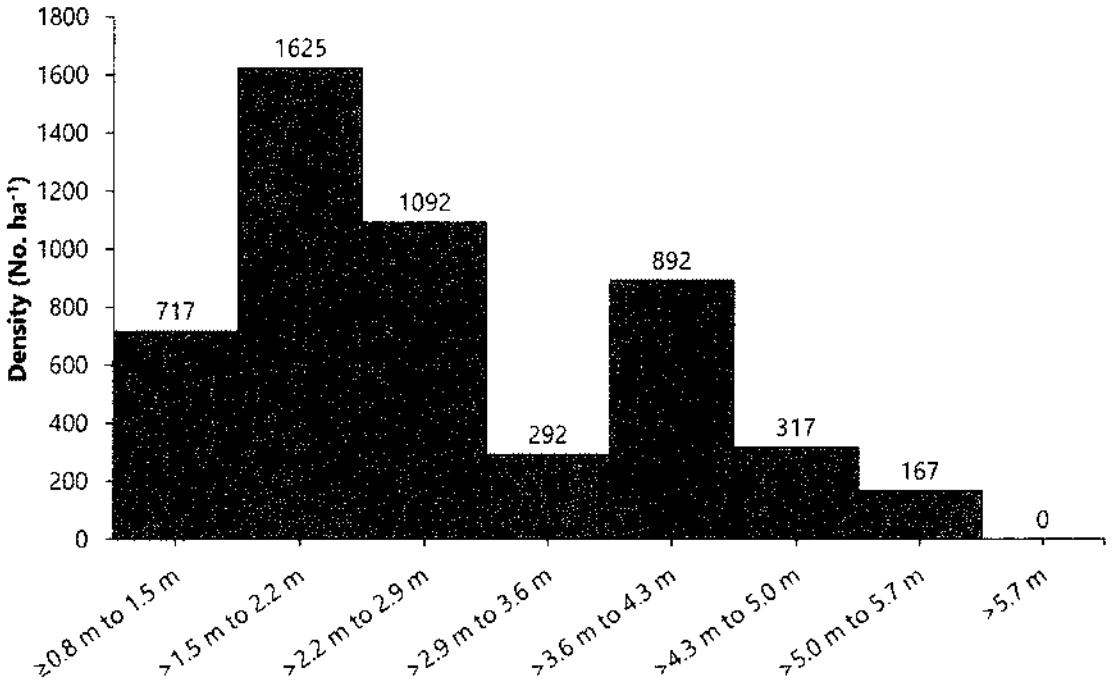


Fig. 11. Mangrove tree density by height (m) size classes in Kotdi Creek

The seedling (*A. marina*) density in Kotdi Creek was estimated at 62,500 seedlings ha^{-1}, indicating active natural regeneration within the mangrove stand.

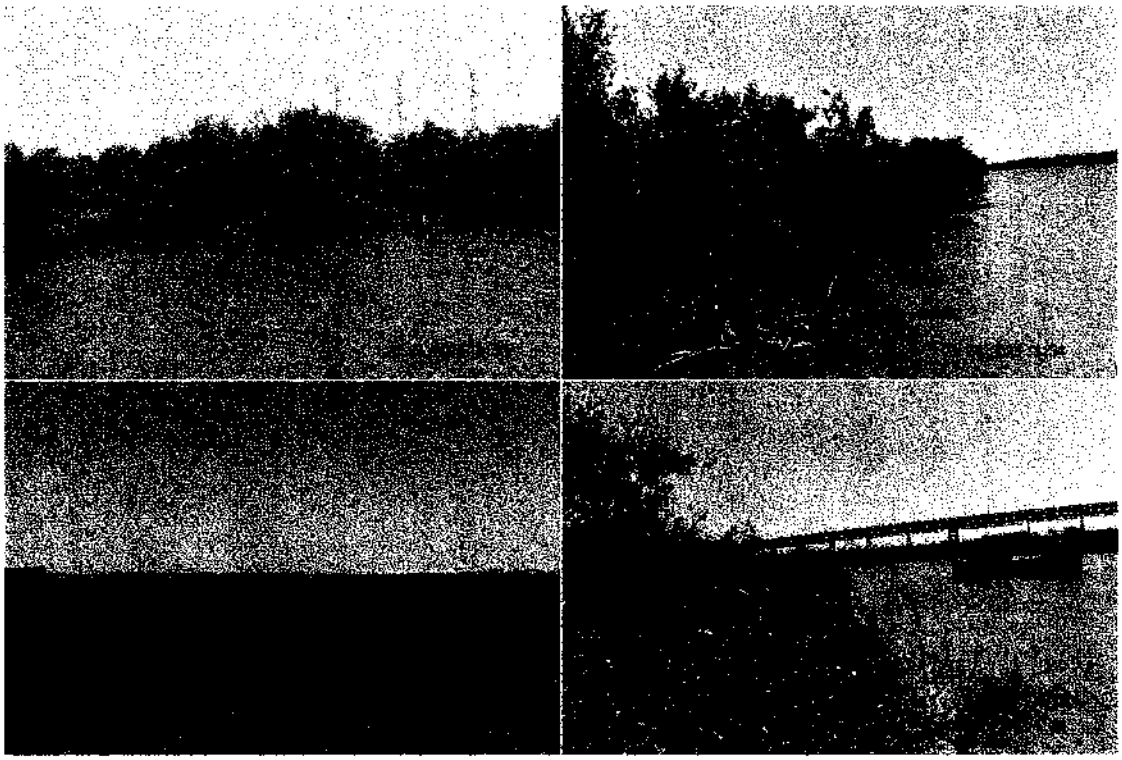


Fig. 12. Mangroves along the Kotdi Creek

b. Baradimata Creek

Baradimata Creek is one of the well tide-influenced creeks in the region. As of 2020, it exhibited a tidal range of 2.7 to 5 meters, with high tide penetration reaching up to 6.15 km from the creek mouth. The creek remains largely free from human interventions, aside from navigation by local fishing communities from nearby villages. The health of mangroves in the creek was assessed for the period 2021 to 2023, and the findings are presented in Table 5 and Figures 13 to 15. The analysis revealed increase in overall mangrove coverage, with major change of 16 hectares. Most of this variation is due to the formation of new mangroves, primarily in the dense category, along with minor inter-conversions, such as transitions from sparse to dense mangroves and new growth observed along smaller feeder creeks. A ~0.7% decrease in sparse mangroves, particularly in the south-western portion of the creek, is attributed to hydrodynamic activity that impacts edge vegetation, likely due to tidal scouring or erosion.

Table 5. Data on various categories of mangroves in the years 2021 and 2023 in Baradimata Creek

Category	Area in Hectares	
	2021	**2023**
Dense	324.27	382.41
Sparse	266.15	248.57
Scatter	513.76	489.26
Total	**1104.18**	**1120.24**

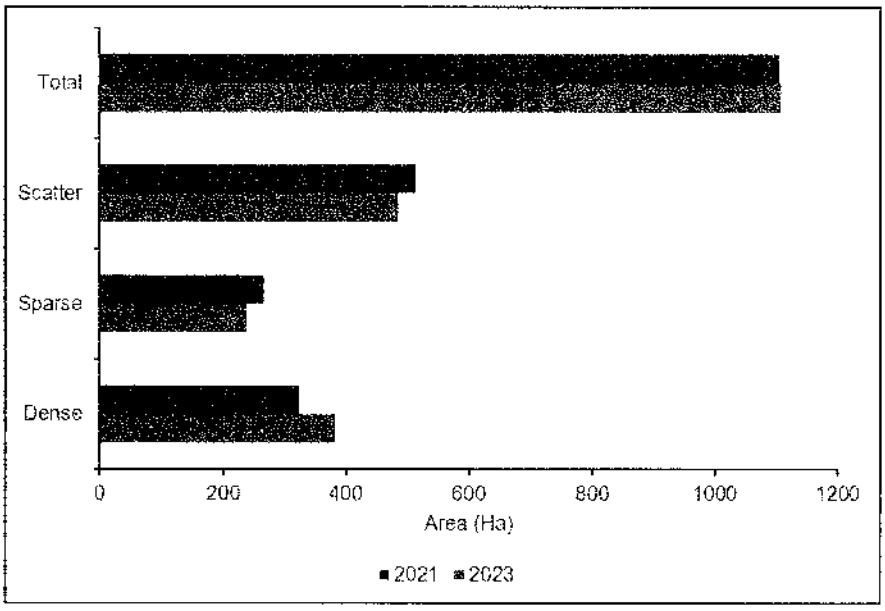


Fig. 13. Comparative analysis of various categories of mangroves in 2021 and 2023 in Baradimata Creek

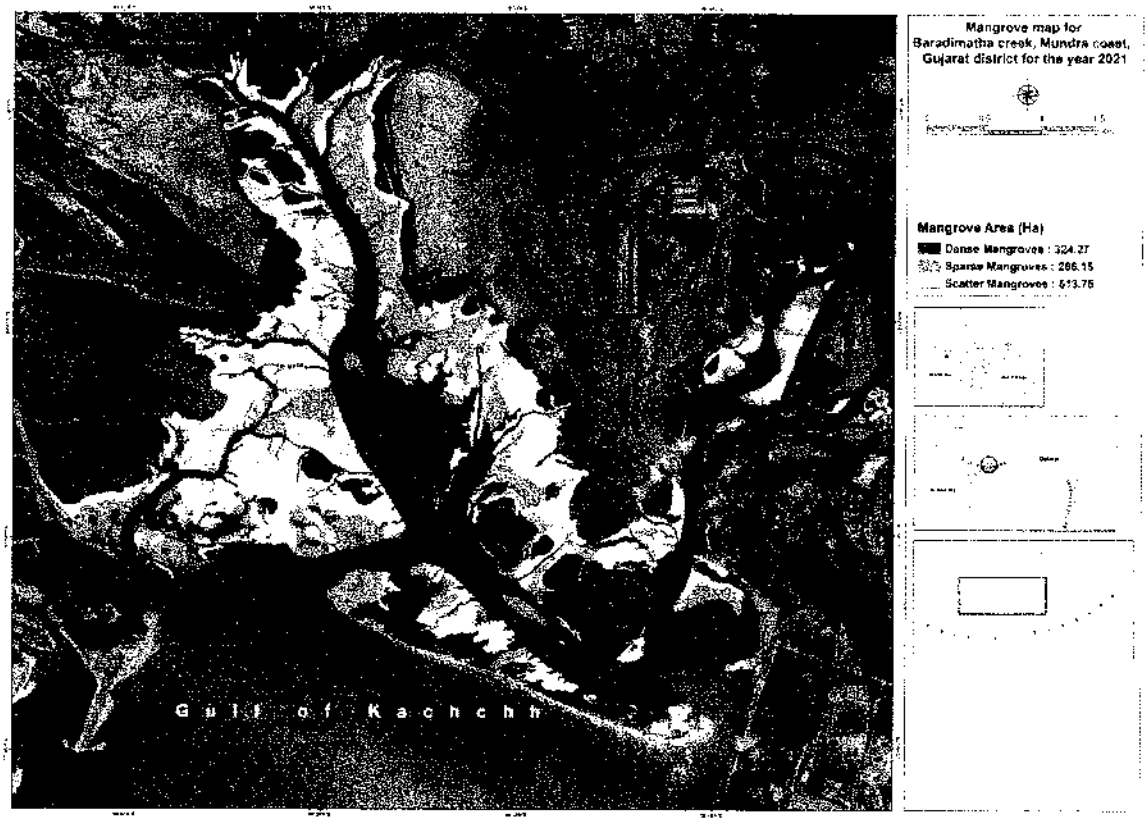


Fig. 14. Distribution of mangroves in Baradimata Creek during 2021

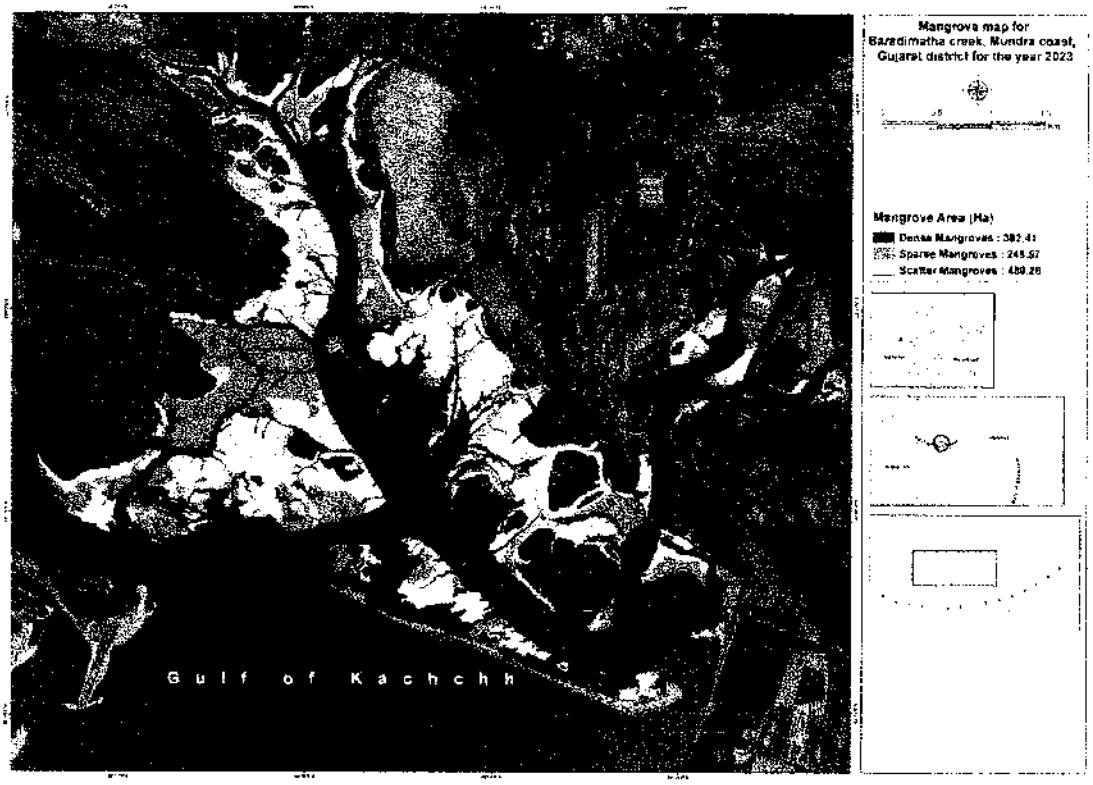


Fig. 15. Distribution of mangroves in Baradimata Creek during 2023

Change analysis in Baradimata Creek

A focused change analysis of the southern tip of Baradimata Creek reveals that this area has undergone notable transformation between 2021 and 2023. Approximately 5.4 hectares of mangrove cover was lost in this zone, marking it as one of the more dynamic and vulnerable sections of the creek system.

This mangrove loss is primarily attributed to natural tidal processes, which include strong tidal currents, sediment redistribution, erosion of the creek banks, and prolonged submergence of mangrove root zones. These natural forces often act more intensely at the southern fringe, where tidal energy is typically higher, leading to gradual degradation of loosely established or younger mangrove stands.

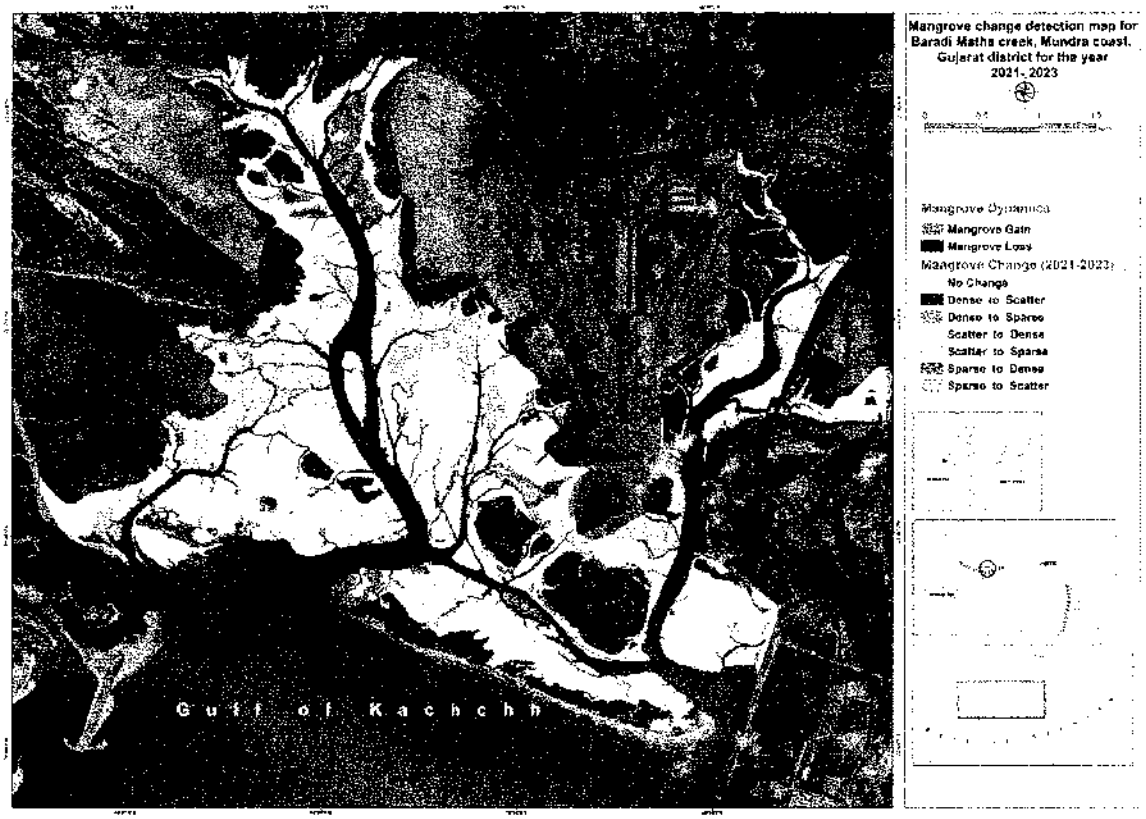


Fig. 16. Result of change analysis from 2021 to 2023 on categories of mangroves in Baradimata Creek system

Vegetation Structure in Baradimata Creek

The mangrove stand structure in Baradimata Creek was primarily dominated by *Avicennia marina*, which was identified as the most abundant species (IVI =

300). The density of *A. marina* was estimated at 5,220 trees per hectare, with a corresponding basal area of 25.18 m^2 ha^{-1}, indicating a well-established stand. The mean diameter at breast height (DBH) of the trees was 6.53 cm, with values ranging from 2.61 cm to 24.50 cm. The average tree height was recorded at 3.21 meters, ranging from 1.0 m to 6.0 m, reflecting a population structure dominated by small- to medium-sized individuals.

The diameter at breast height (DBH) distribution of mangrove trees in Baradimata Creek exhibits a highly skewed structure dominated by smaller-sized individuals (Fig. 17). The highest density was recorded in the >2.5 cm to 7.5 cm DBH class, with 3,793 trees ha^{-1}, followed by 840 trees ha^{-1} in the >7.5 cm to 12.5 cm class and 407 trees ha^{-1} in the >12.5 cm to 17.5 cm class.

Tree density significantly declined in higher DBH classes, with only 120 trees ha^{-1} and 60 trees ha^{-1} in the >17.5 cm to 22.5 cm and >22.5 cm to 27.5 cm classes, respectively. Notably, no individuals were recorded in DBH classes above 27.5 cm, including >32.5 cm to 37.5 cm and >37.5 cm.

The observed DBH distribution reflects a reverse J-shaped pattern, typical of young and regenerating mangrove stands. The dominance of smaller diameter classes indicates a high rate of recruitment and regeneration, while the absence of large-diameter trees suggests limited representation of mature individuals. This may be due to recent establishment, selective harvesting, natural disturbance, or environmental constraints that inhibit long-term growth.

Such a structure is indicative of an early to mid-successional stage, where the forest is actively regenerating but has not yet reached maturity. Continued protection and monitoring will be essential to support the transition toward a more structurally diverse and ecologically stable mangrove ecosystem.

The height class distribution of mangrove trees in Baradimata Creek revealed a unimodal pattern (Fig. 18). Tree density was highest in the >2.2 m to 2.9 m height class, with 1,640 individuals ha^{-1}, followed by the >3.6 m to 4.3 m class with 1,340 individuals ha^{-1} and the >2.9 m to 3.6 m class with 973 individuals ha^{-1}. The lowest densities were recorded in the >5.7 m (27 individuals ha^{-1}) and >5.0 m to 5.7 m (93 individuals ha^{-1}) categories. The shortest height class (≥0.8 m to 1.5 m) had 233 individuals ha^{-1}, while the >1.5 m to 2.2 m class recorded 540 individuals ha^{-1}.

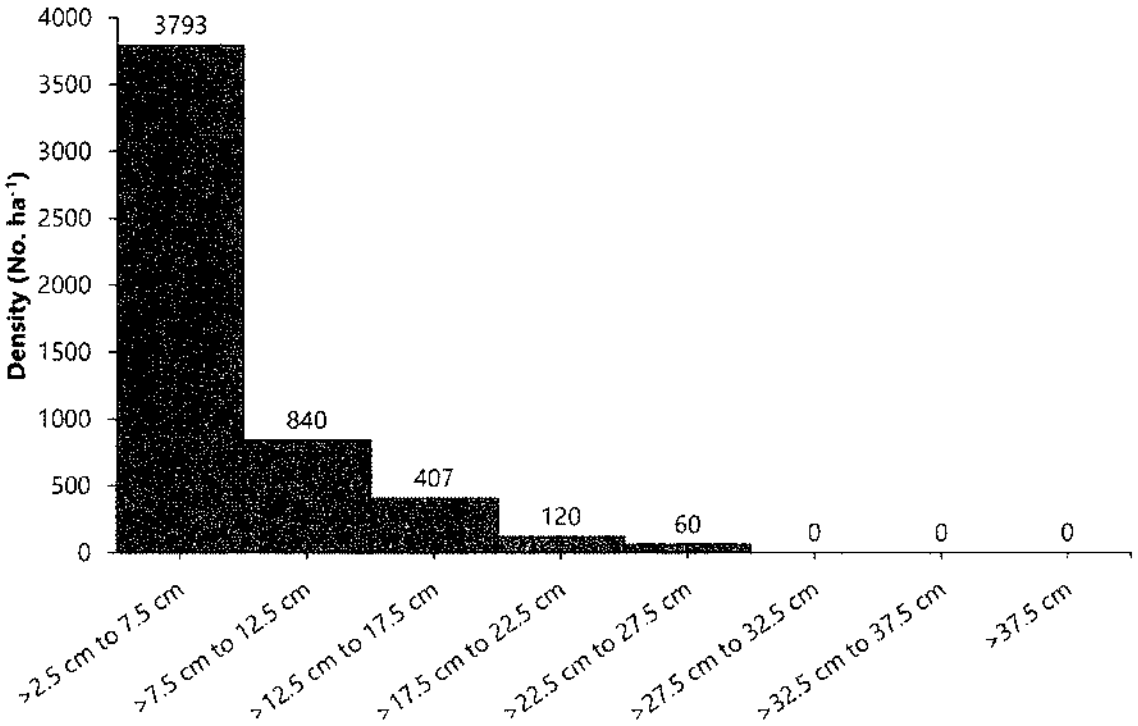


Fig. 17. Mangrove tree density by DBH (cm) size classes in Baradimata Creek

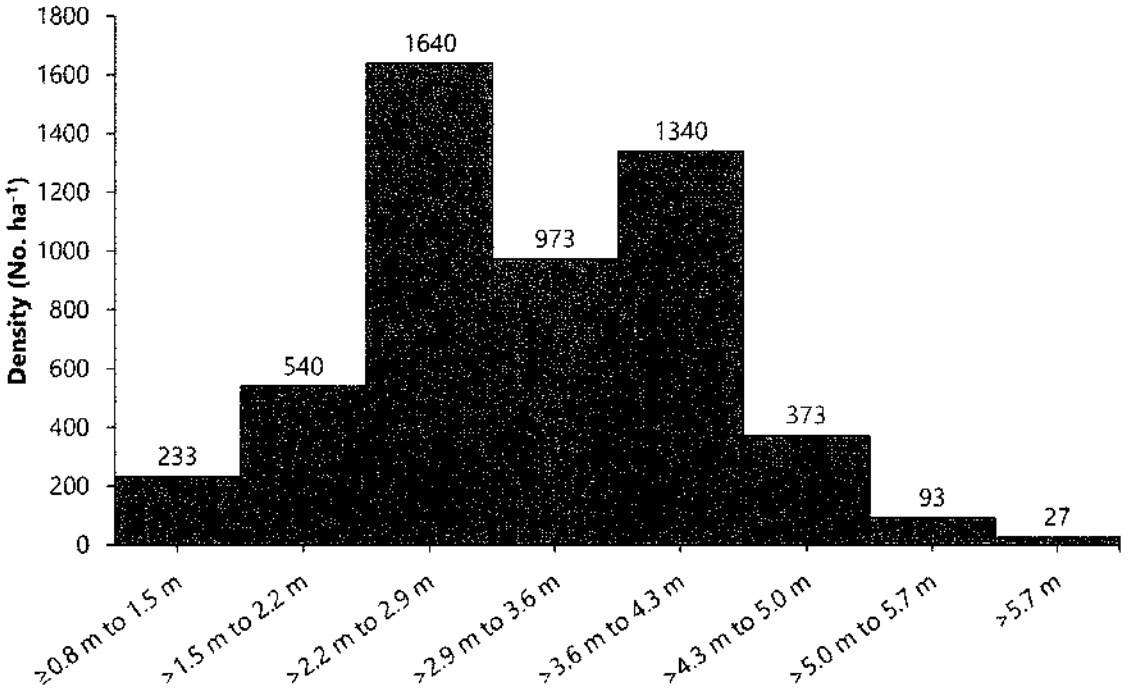


Fig. 18. Mangrove tree density by height (m) size classes in Baradimata Creek

The dominance of trees in the >2.2 m to 4.3 m height range indicates that the mangrove stand in Baradimata Creek is primarily composed of young to mid-aged individuals. The relatively low density of trees in the taller height classes (>5.0 m) suggests a limited presence of mature trees, potentially reflecting either recent regeneration, past disturbance, or environmental limitations affecting tree growth. The presence of trees in the shorter height classes also indicates ongoing recruitment. Overall, the structure suggests a regenerating or early successional mangrove forest in the creek.

The seedling (*A. marina*) density in Baradimata Creek was estimated at 1,16,000 seedlings ha^{-1}, indicating active natural regeneration within the mangrove stand.

Fig. 19. Mangroves along the Baradimata Creek

c. Navinal-Bocha Creeks including Bocha Island

The Navinal–Bocha Creek system is a complex tidal network, with Navinal Creek located adjacent to the Adani Port and Bocha Creek connecting to Navinal in the north, leading to the formation of Bocha Island, which supports substantial dense mangrove cover. The mouths of these creeks receive strong tidal inflow, particularly Navinal Creek, as its mouth serves as a primary water entry point to the port. Moving northward, Navinal Creek narrows and flows eastward to connect with Bocha Creek. The creek banks support fair to good

mangrove growth, with Bocha Island exhibiting dense mangrove stands. The spatial distribution of mangroves in 2021 and 2023 is illustrated in Figures 20 to 22, and the corresponding area statistics are provided in Table 6.

The analysis shows that the mangrove cover in the system remained largely stable, with only a marginal decrease of 6 hectares (~1.1%) between 2021 and 2023. Dense mangrove cover declined from 287.25 ha to 281.13 ha, with most of the reduction observed in the southernmost part of the coastline. Scattered mangroves also showed a decline, primarily along creek edges, likely due to periodic tidal submergence and inundation, resulting in natural stress and erosion along the mangrove fringe.

Conversely, a slight increase of 0.5% in sparse mangrove cover was observed across the Navinal–Bocha Island and Bocha Creek system, indicating localized regrowth or transitional changes. Overall, the mangroves appear to be in stable condition, supported by normal tidal flow patterns.

Table 6. Data on distribution of mangroves in 2021 and 2023 in Navinal- Bocha Creek system

Category	Area in Hectares	
	2021	2023
Dense	287.33	284.33
Sparse	53.17	55.71
Scatter	193.52	188.07
Total	**534.02**	**528.11**

However, the overall increase in mangrove in the Navinal-Bocha Creek system shows prevalence of normal conditions, specific attention was drawn in the case of Navinal Creek in the conservation due to formation of sand spits. It was postulated that continued growth of sand spit across the creek might reduce tidal flow in future, which may affect the growth of the mangroves. In this regard, it is pertinent to draw the following made for mangroves in Navinal Creek in the Conservation plan:'

Sand/silt spits were observed on the banks of Navinal Creek and some of them were extending close to Bocha Island. If such spits continue to grow, they may obstruct tidal flow leading to reduced tidal water supply to the northern banks of Navinal Creek and the Bocha Island. Therefore, assessment of the health of mangroves should also be carried out along the Navinal Creek. If the health of

the mangroves either remains at the current condition or improves, the situation should be monitored once in every two years using high-resolution satellite images. If there are signs of degradation of mangroves due to decrease of flow of tidal waters in the interior parts of the Navinal Creek, Bocha island that are fed by tidal waters of Navinal Creek, then it would be necessary to deepen the Navinal Creek to facilitate movement of tidal water

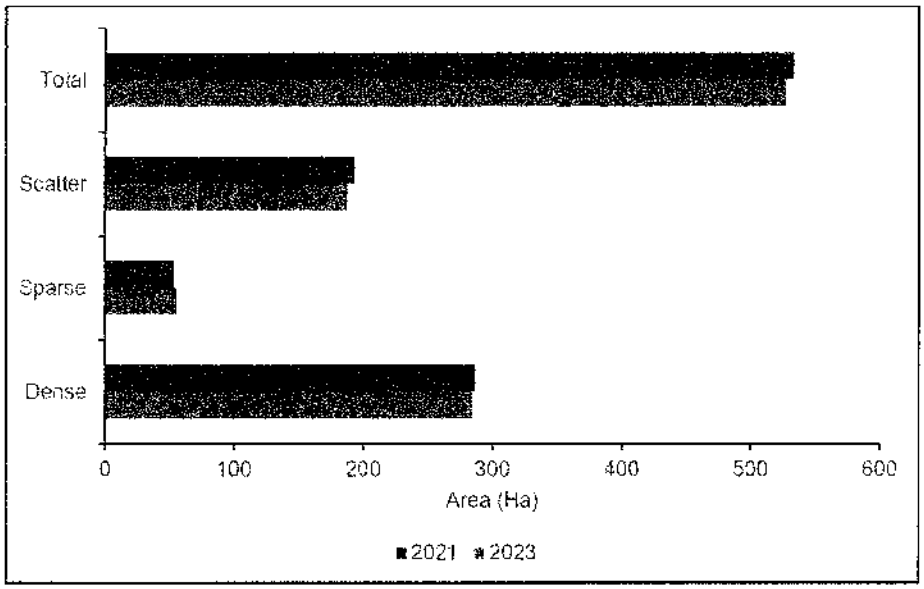


Fig. 20. Comparison on distribution of mangroves between 2021 and 2023 in Navinal-Bocha Creek system

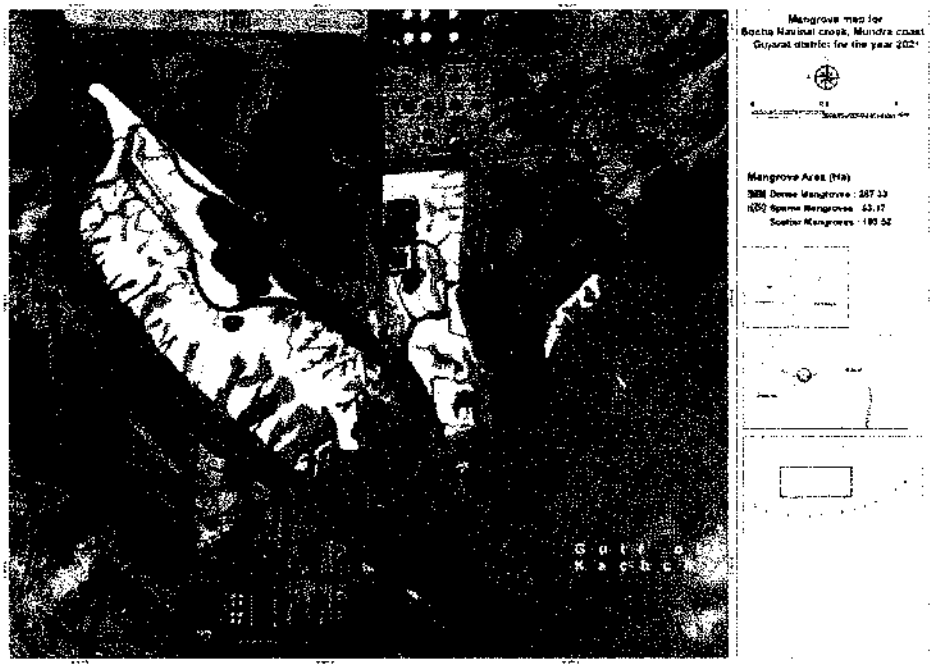


Fig. 21. Distribution of various categories of mangroves Navinal-Bocha Creek system for the year 2021

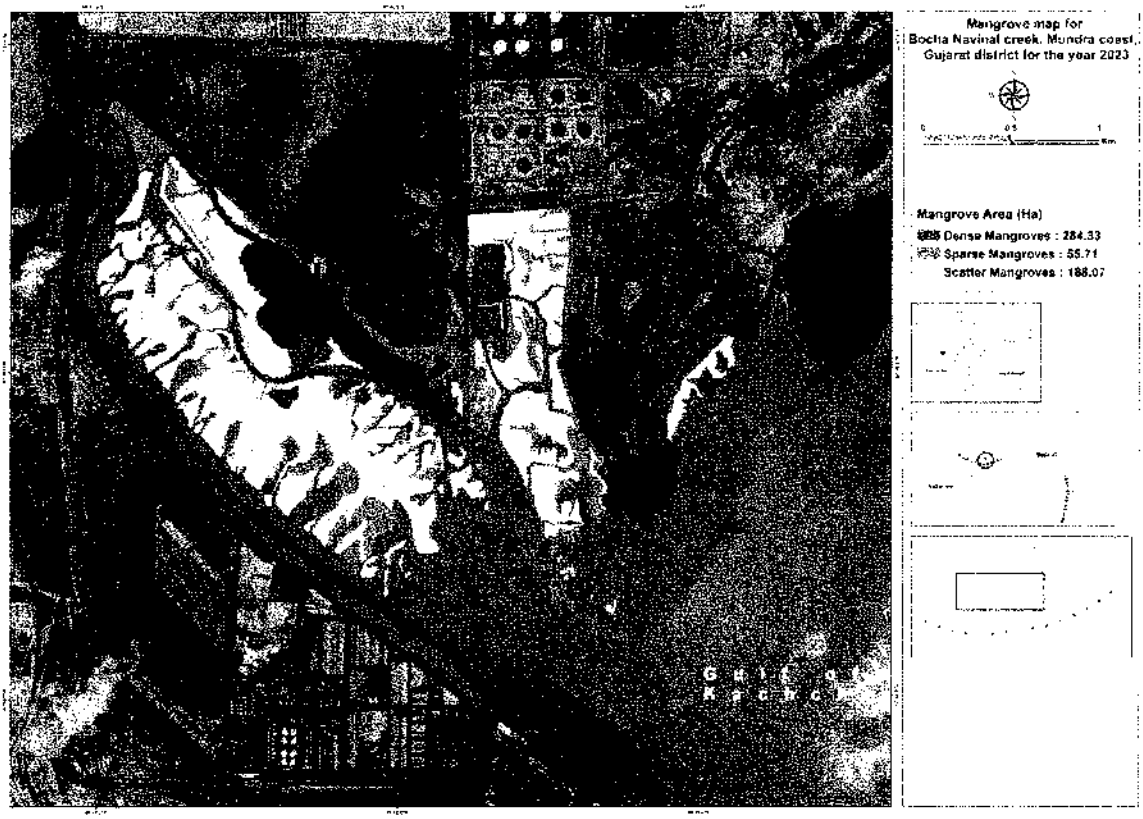


Fig. 22. Distribution of various categories of mangroves of Navinal-Bocha Creek system for the year 2023

Change analysis in Navinal-Bocha Creeks including Bocha Island

The change analysis, carried out using GIS overlay techniques to evaluate inter-conversion among dense, sparse, and scattered mangrove categories, indicates a net loss of dense mangroves totalling 0.6 hectares, primarily concentrated at the tip of Bocha Island (Fig. 23). This observation aligns with the findings from the Conservation Plan, which had reported a loss of 5.33 hectares of dense mangroves in the same location during the period 2011 to 2016–17.

The current results confirm that erosion at the tip of Bocha Island is ongoing, contributing to the continued loss of dense mangrove cover. However, a marginal gain of 1.22 hectares in sparse mangroves was recorded, which may be attributed to regrowth or colonization in adjacent mudflat areas, indicating some level of natural recovery within the system.

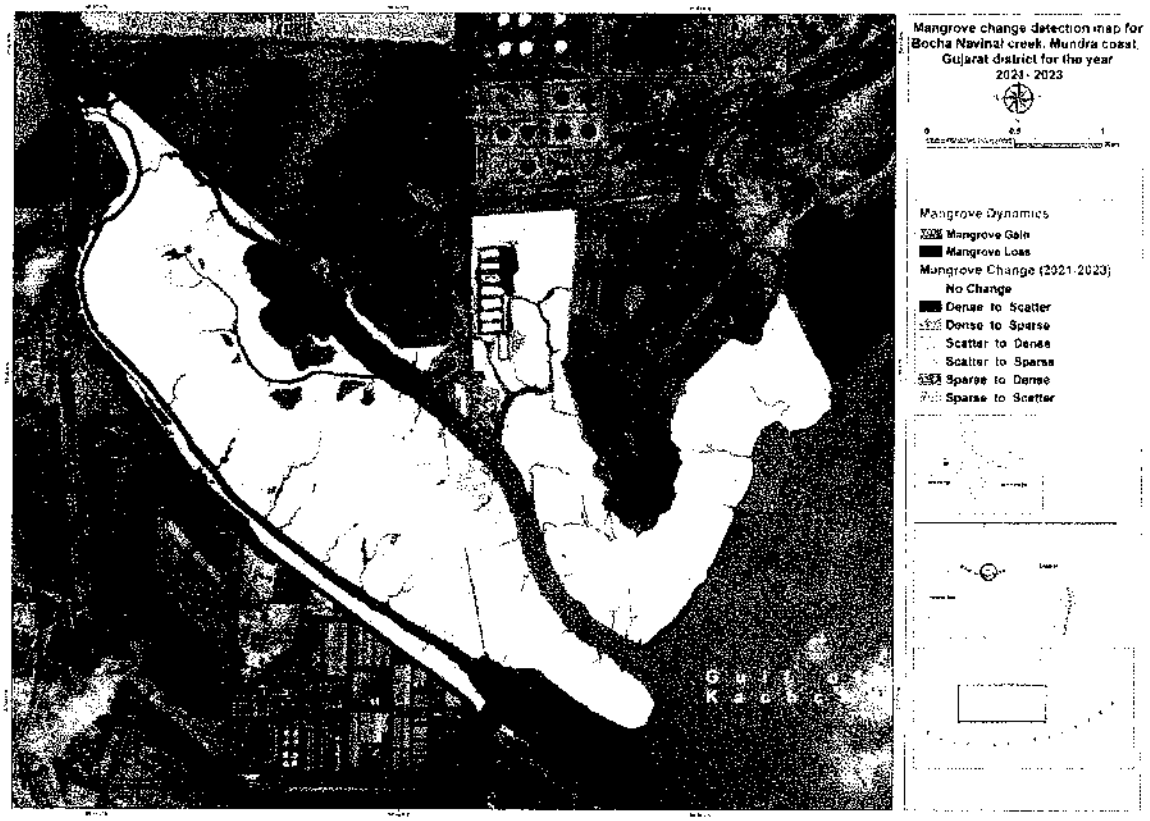


Fig. 23. Result of change analysis from 2021 to 2023 on categories of mangroves in Navinal-Bocha Creek system

Vegetation Structure in Navinal-Bocha Creek

The mangrove stand structure in Navinal-Bocha Creek was predominantly composed of *Avicennia marina*, which emerged as the most abundant species based on its high Importance Value Index (IVI = 264.13). It was followed by *Ceriops tagal* (IVI = 20.01) and *Rhizophora mucronata* (IVI = 15.86). The overall density of mangrove trees was estimated at 4,533 trees ha^{-1}, with a corresponding basal area of 25.17 m^2 ha^{-1}, indicative of a well-established and mature mangrove stand. Among the species, *A. marina* exhibited the highest density, accounting for 3,958 trees ha^{-1} and a basal area of 24.36 m^2 ha^{-1}. This was followed by *R. mucronata* with 333 trees ha^{-1} (0.46 m^2 ha^{-1}) and *C. tagal* with 242 trees ha^{-1} (0.34 m^2 ha^{-1}).

The mean diameter at breast height (DBH) of trees in the Navinal-Bocha Creek mangrove stand was 6.75 cm, with values ranging from 2.83 cm to 41.36 cm. The average tree height was 2.57 m, varying between 1.0 m and 5.2 m, indicating a population structure largely composed of small- to medium-sized individuals.

Among the species, *Avicennia marina* exhibited an average DBH of 7.13 cm (range: 2.83–41.36 cm) and an average height of 2.62 m (range: 1.0–5.2 m). *Ceriops tagal* had an average DBH of 4.22 cm (range: 3.09–4.26 cm) and an average height of 1.91 m (range: 1.9–2.1 m). *Rhizophora mucronata* showed an average DBH of 4.09 cm (range: 3.25–6.20 cm) and an average height of 2.41 m (range: 2.0–4.0 m).

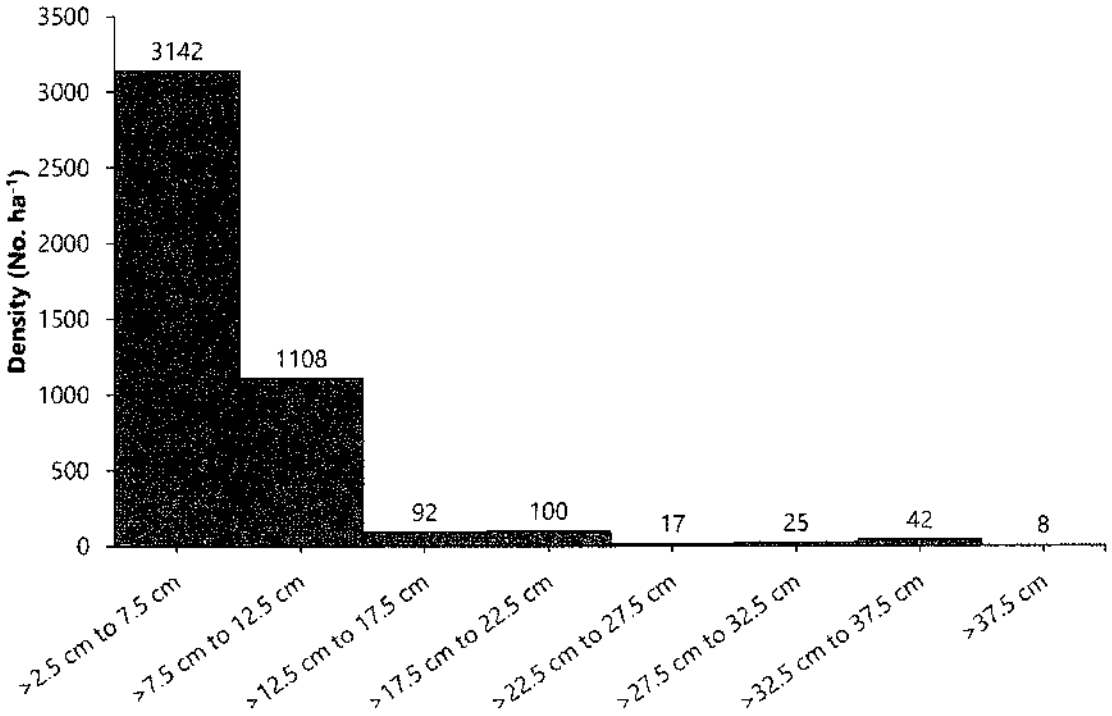


Fig. 24. Mangrove tree density by DBH (cm) size classes in Navinal-Bocha Creek

The diameter class distribution of mangrove trees in Navinal-Bocha Creek revealed a highly skewed structure, dominated by individuals in the lower DBH ranges (Fig. 24). The highest tree density (3,142 trees ha^{-1}) was recorded in the smallest diameter class of >2.5 cm to 7.5 cm, followed by 1,108 trees ha^{-1} in the 7.5 cm to 12.5 cm class. Tree density declined sharply beyond this range, with only 92–100 trees ha^{-1} observed in the mid-diameter classes (12.5 cm to 22.5 cm). The higher diameter classes (>22.5 cm) had very low densities, ranging from eight to 42 trees ha^{-1}.

This distribution indicates a population dominated by younger or regenerating individuals, with a progressively decreasing number of larger, mature trees. Such a pattern is characteristic of a developing or regenerating mangrove

stand, where recruitment is active but the proportion of older individuals remains low.

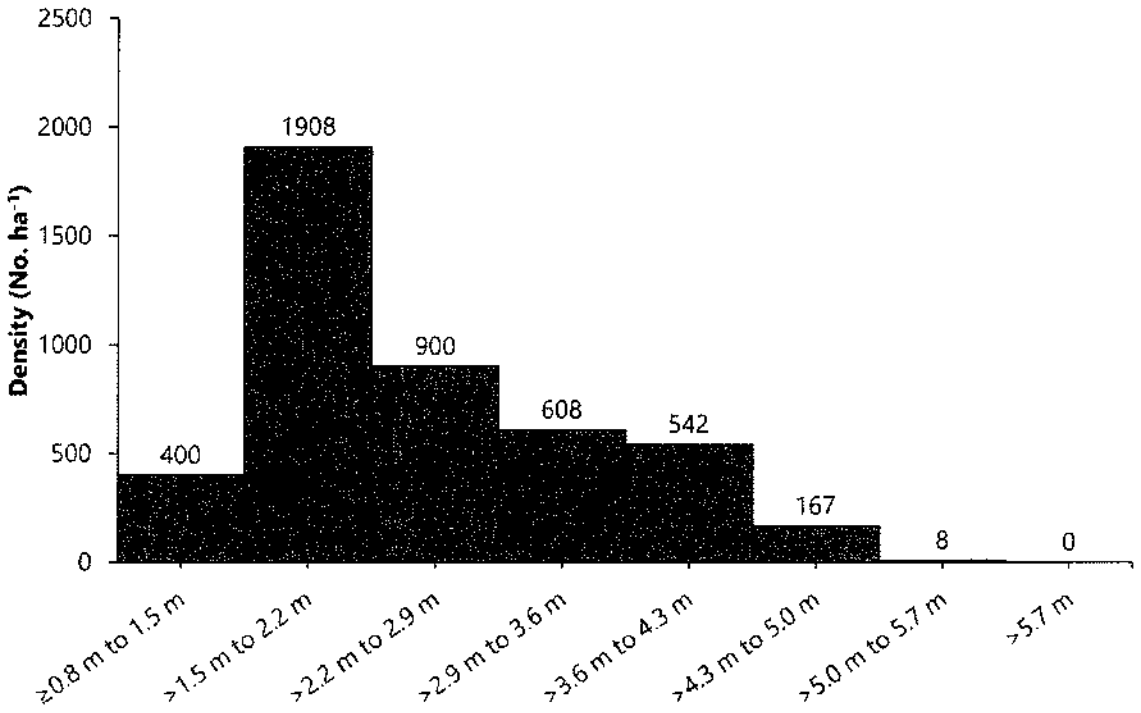


Fig. 25. Mangrove tree density by height (m) size classes in Navinal-Bocha Creek

The height class distribution of mangrove trees in Navinal-Bocha Creek exhibited a unimodal pattern, with the majority of individuals concentrated in the mid-height range (Fig. 25). The highest density (1,908 trees ha^{-1}) was recorded in the 1.5 m to 2.2 m height class, followed by 900 trees ha^{-1} in the 2.2 m to 2.9 m class. Smaller individuals (0.8 m to 1.5 m) accounted for 400 trees ha^{-1}.
A gradual decline in density was observed in higher height classes: 608 trees ha^{-1} (2.9 m to 3.6 m), 542 trees ha^{-1} (3.6 m to 4.3 m), and 167 trees ha^{-1} (4.3 m to 5.0 m). Very few individuals were recorded in the tallest height classes, with only eight trees ha^{-1} in the 5.0 m to 5.7 m range and none beyond 5.7 m.

This pattern indicates a predominance of small- to medium-sized trees within the population, suggesting either a regenerating stand or one under environmental or anthropogenic constraints that limit vertical growth.

The seedling density of *Avicennia marina* and *Rhizophora mucronata* in Navinal-Bocha Creek was estimated at 33,333 seedlings ha^{-1}, indicating active natural regeneration within the mangrove stand.

Fig. 26. Mangroves along the Navinal-Bocha Creek

(Photographs in the last row show brown dust deposits likely originating from the adjacent port region)

Mangrove erosion along the creek has occurred primarily due to natural processes such as bank erosion (Fig. 27). Despite the diversion of two channels upstream in Bocha Creek, afforestation efforts involving *Avicennia marina* were undertaken. During the present survey, natural mangrove colonization was observed, with scattered individuals establishing alongside the salt marsh species *Suaeda nudiflora* (Fig. 28), indicating resilience and ongoing regeneration in the altered landscape.

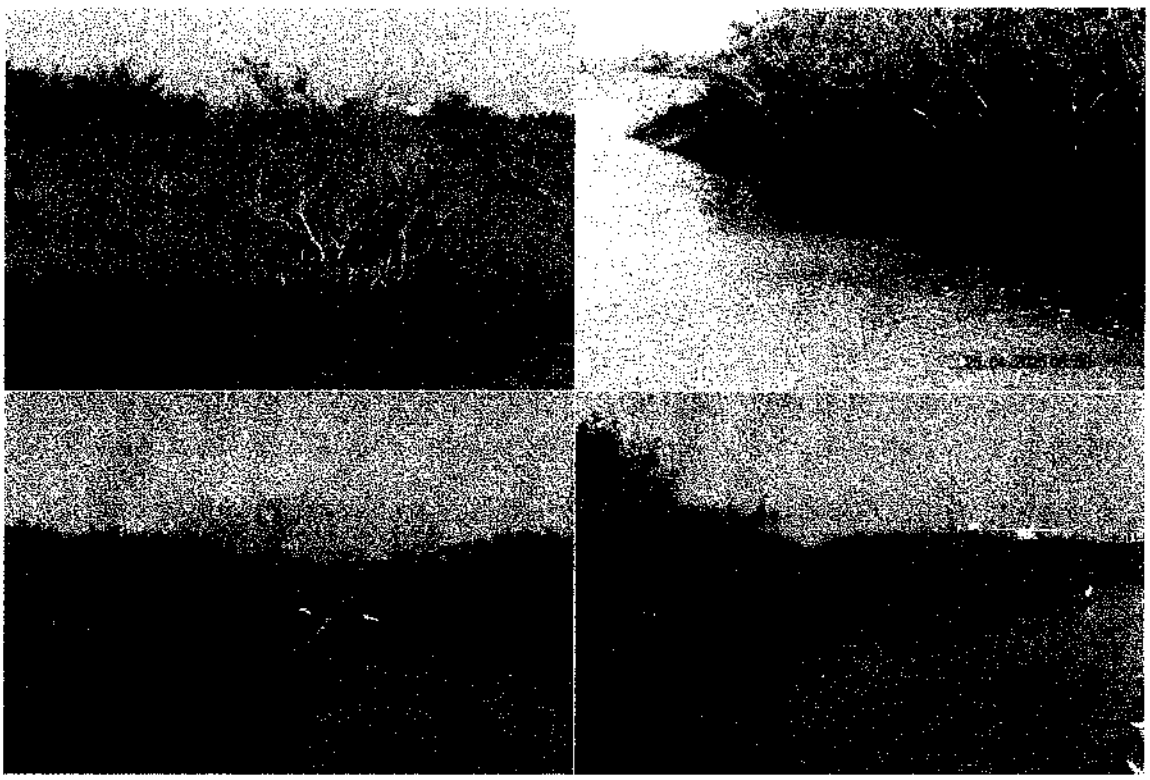


Fig. 27. Bund Erosion in the Navinal-Bocha Creek

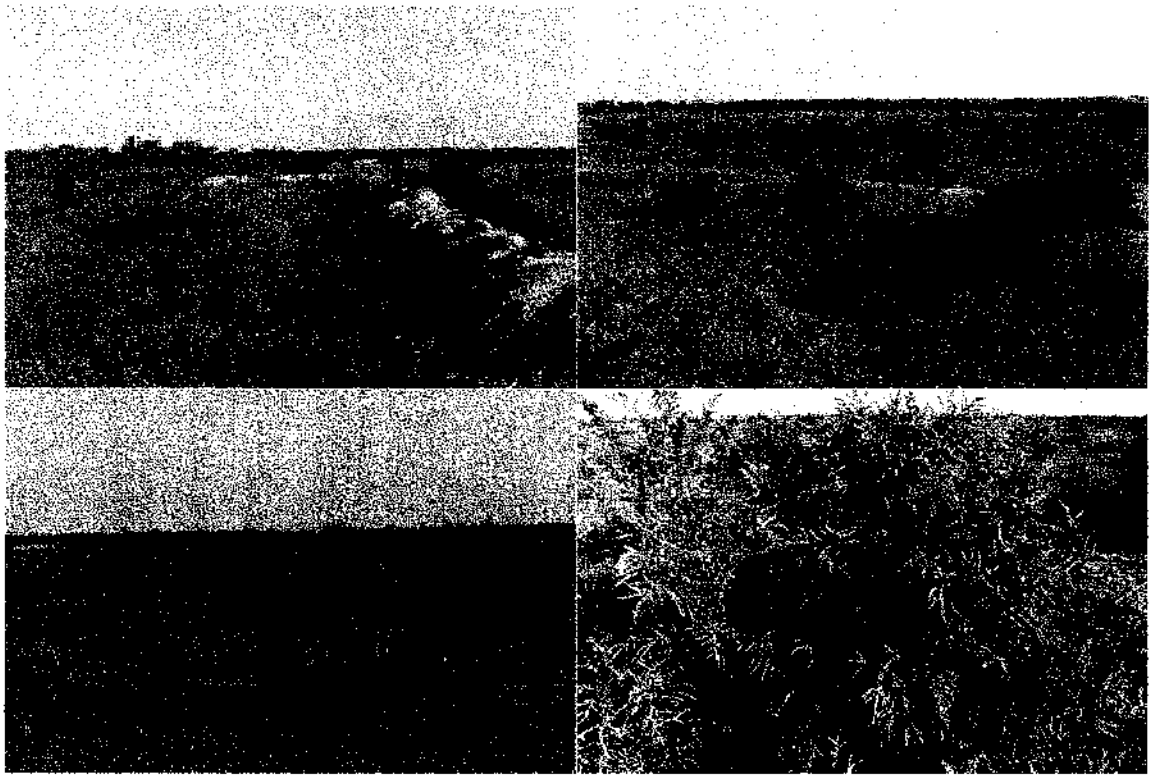


Fig. 28. Natural colonization of mangroves in the newly opened channel (*Suaeda nudiflora* – right bottom)

d. Khari Creek

Khari Creek experiences normal tidal flow, with settlements located in its northern part, particularly near Junabunder village. The distribution of mangroves between 2021 and 2023 was analysed, and the results are presented in Table 7 and Figure 29, with mangrove categories detailed in Figures 30 and 31. The analysis indicates a marginal increase of 1 hectares, representing a 0.34% increase in total mangrove cover compared to 2021. This minor growth is primarily attributed to the conversion of sparse mangroves into both dense and scattered categories, particularly along the tip of the island, reflecting natural transitional changes associated with annual tidal variations.

In contrast, a notable gain of approximately 8 hectares was observed in the scattered mangrove category, indicating natural expansion over adjacent mudflats and colonization near the creek mouth. This suggests that, despite minor losses, the overall mangrove ecosystem in Khari Creek remains dynamic and stable, with signs of healthy regeneration.

Table 7. Distribution of various categories of mangroves in 2021 and 2023 in Khari Creek

Category	Area (Hectares)	
	2021	**2023**
Dense	208.95	209.97
Sparse	57.63	32.45
Scatter	35.20	57.63
Total	**301.78**	**300.05**

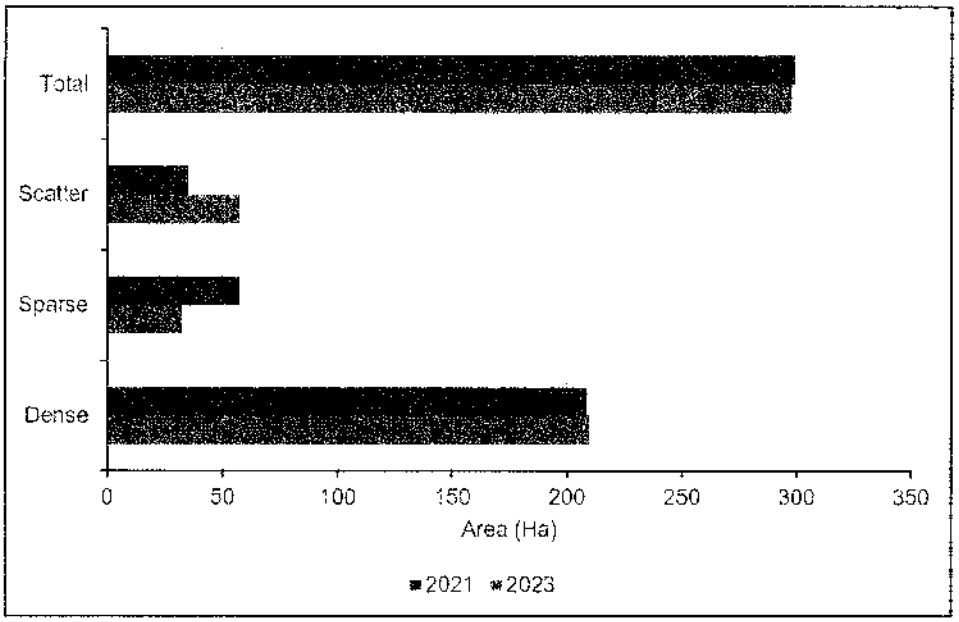


Fig. 29. Comparison of mangroves in 2021 and 2023 in Khari Creek

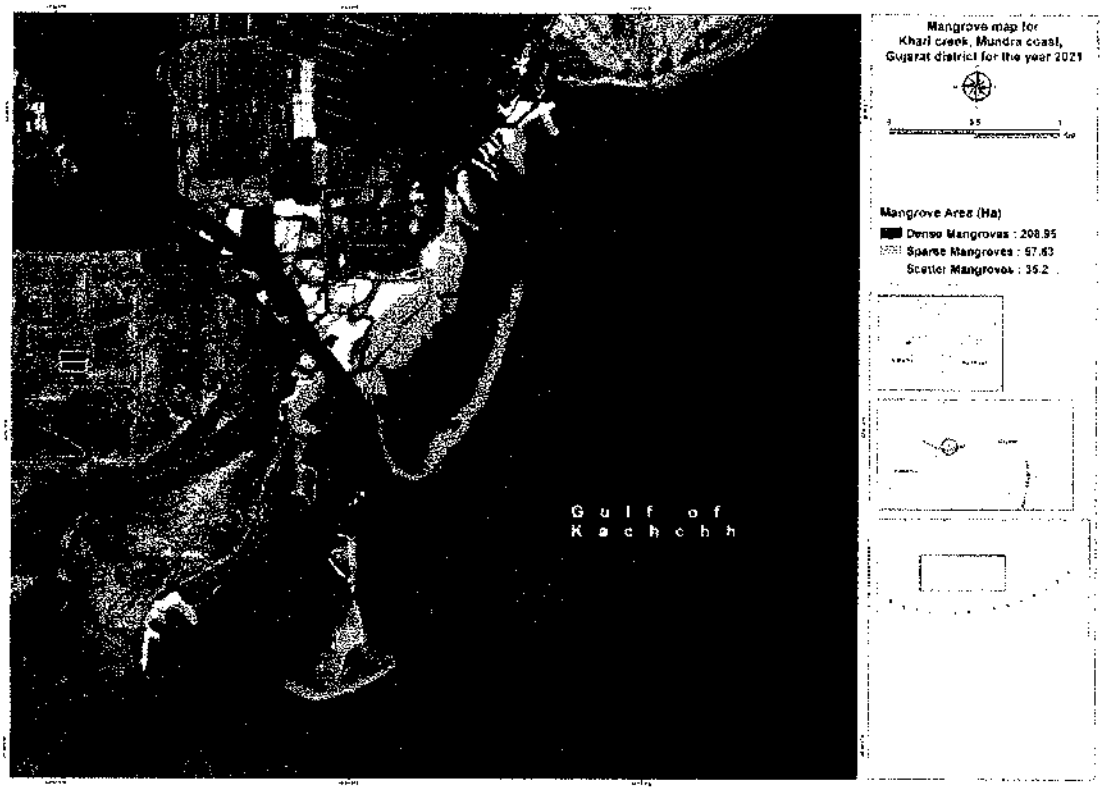


Fig. 30. Distribution of various categories of mangroves in Khari Creek system for the year 2021

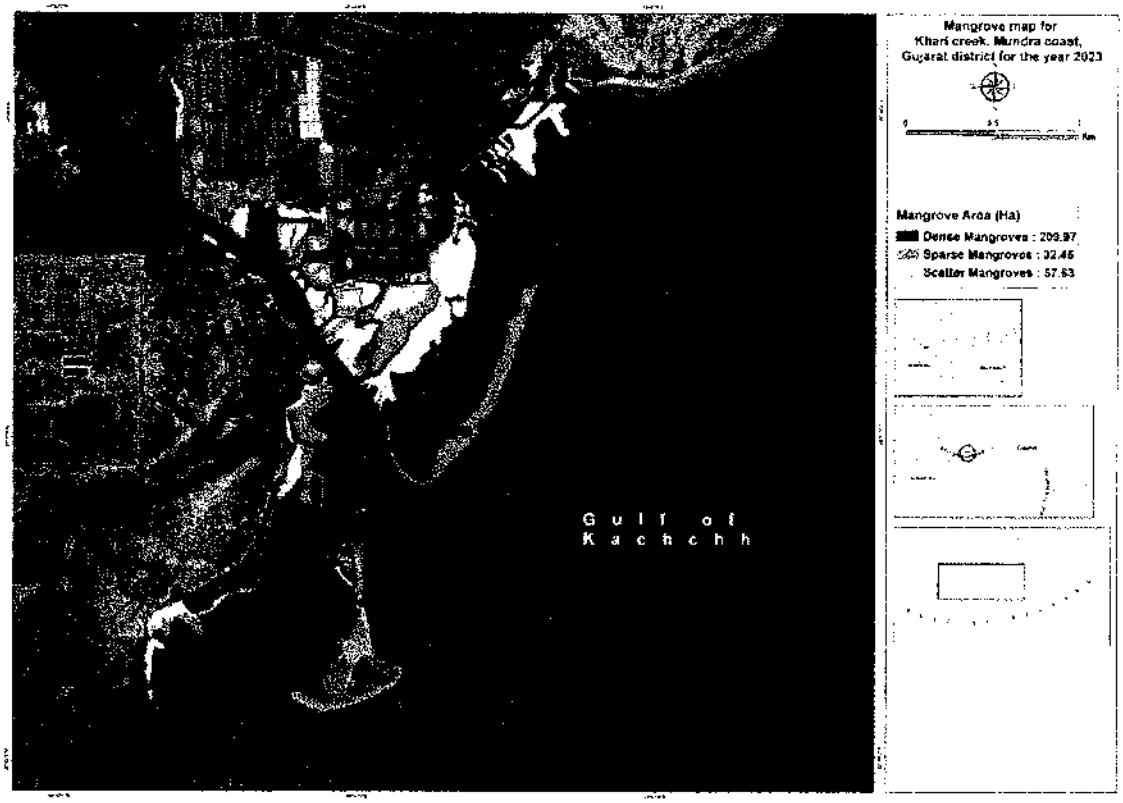


Fig. 31. Distribution of various categories of mangroves in Khari Creek system for the year 2023

Change analysis in Khari Creek

An assessment of Khari Creek between 2021 and 2023 reveals a mixed pattern of mangrove change, characterized by both localized loss and noticeable gain across different zones of the creek system (Fig. 32). A significant loss of approximately 3.5 hectares was recorded at the southern tip of the creek, where the water body opens into the tidal zone. This area is subject to intense tidal currents, wave energy, and sediment transport, which can destabilize younger mangrove stands. The loss is likely due to natural coastal dynamics, including tidal erosion and scouring of exposed mud banks, Submergence stress due to prolonged waterlogging during high tides, etc. In contrast to the loss at the tip, significant gains in mangrove cover were observed in the interior parts of the creek and along mudflat regions near the creek mouth.

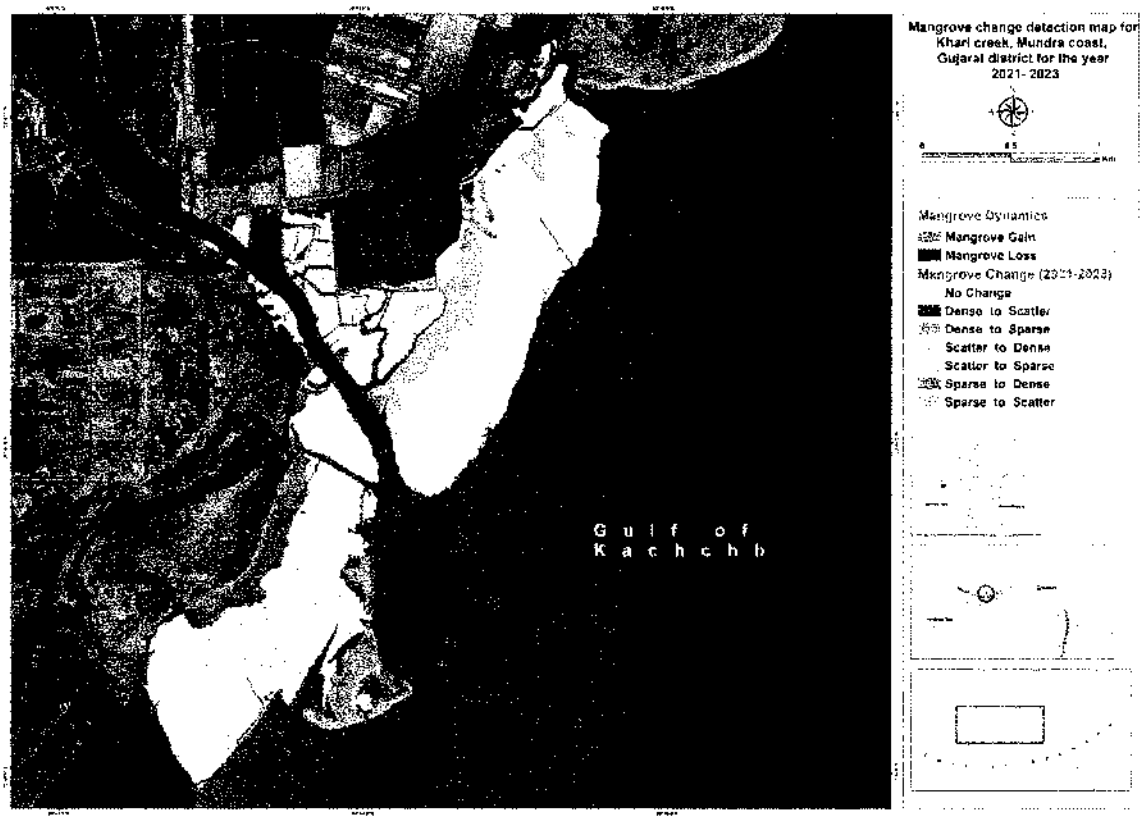


Fig. 32. Result of change analysis from 2021 to 2023 on categories of mangroves in Khari Creek system

Vegetation Structure in Khari Creek

The mangrove stand structure in Khari Creek was primarily dominated by *Avicennia marina*, which was identified as the most abundant species (IVI = 300). The density of *A. marina* was estimated at 4,300 trees ha^{-1}, with a

corresponding basal area of 33.96 m^2 ha^{-1}, indicating a well-established stand. The mean diameter at breast height (DBH) of the trees was 8.23 cm, with values ranging from 2.61 cm to 38.34 cm. The average tree height was recorded at 2.84 meters, ranging from 1.4 m to 6.2 m, reflecting a population structure dominated by small- to medium-sized individuals.

The diameter at breast height (DBH) class distribution of mangrove trees in Khari Creek reveals a population structure skewed towards smaller diameter classes (Fig. 33). The highest density was recorded in the smallest DBH class of >2.5 cm to 7.5 cm, with 3,045 trees ha^{-1}. This was followed by 455 trees ha^{-1} in the 7.5 cm to 12.5 cm class and 436 trees ha^{-1} in the 12.5 cm to 17.5 cm class. Tree density declined progressively with increasing diameter, with 245 trees ha^{-1} in the 17.5 cm to 22.5 cm class and sharply lower densities beyond this range—45 and 55 trees ha^{-1} in the 22.5–32.5 cm classes, and only nine trees ha^{-1} each in the 32.5–37.5 cm and >37.5 cm classes.

This distribution suggests that the mangrove stand in Khari Creek is primarily composed of younger or regenerating individuals, with a relatively low proportion of mature trees in the higher diameter classes. The dominance of smaller DBH classes reflects ongoing recruitment and a dynamic, regenerating stand structure.

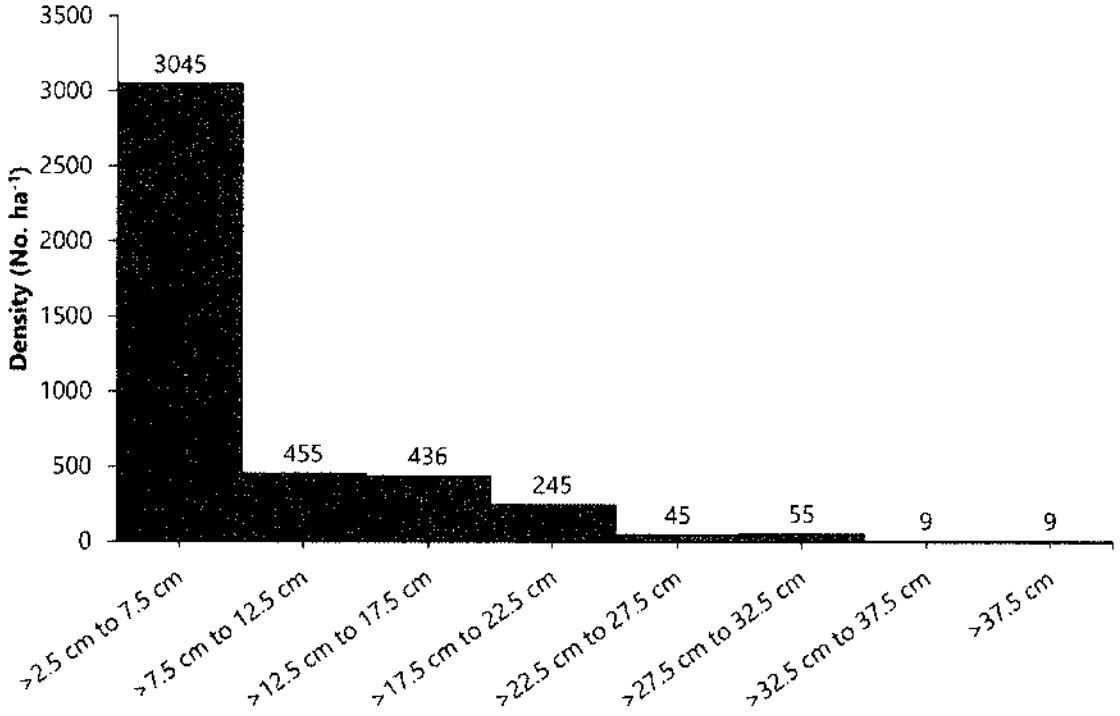


Fig. 33. Mangrove tree density by DBH (cm) size classes in Khari Creek

The height class distribution of mangrove trees in Khari Creek reflects a population dominated by medium-height individuals. The highest tree density was recorded in the 1.5 m to 2.2 m class, with 1,582 trees ha^{-1}, followed by the 2.2 m to 2.9 m class with 1,045 trees ha^{-1}.

The smallest height class (0.8 m to 1.5 m) contained 245 trees ha^{-1}, while moderate densities were observed in the mid- to upper-height ranges: 382 trees ha^{-1} in the 2.9 m to 3.6 m class, 473 in the 3.6 m to 4.3 m class, and 355 in the 4.3 m to 5.0 m class. Tree density declined further in the tallest height classes, with 200 trees ha^{-1} in the 5.0 m to 5.7 m range and only 18 trees ha^{-1} beyond 5.7 m.

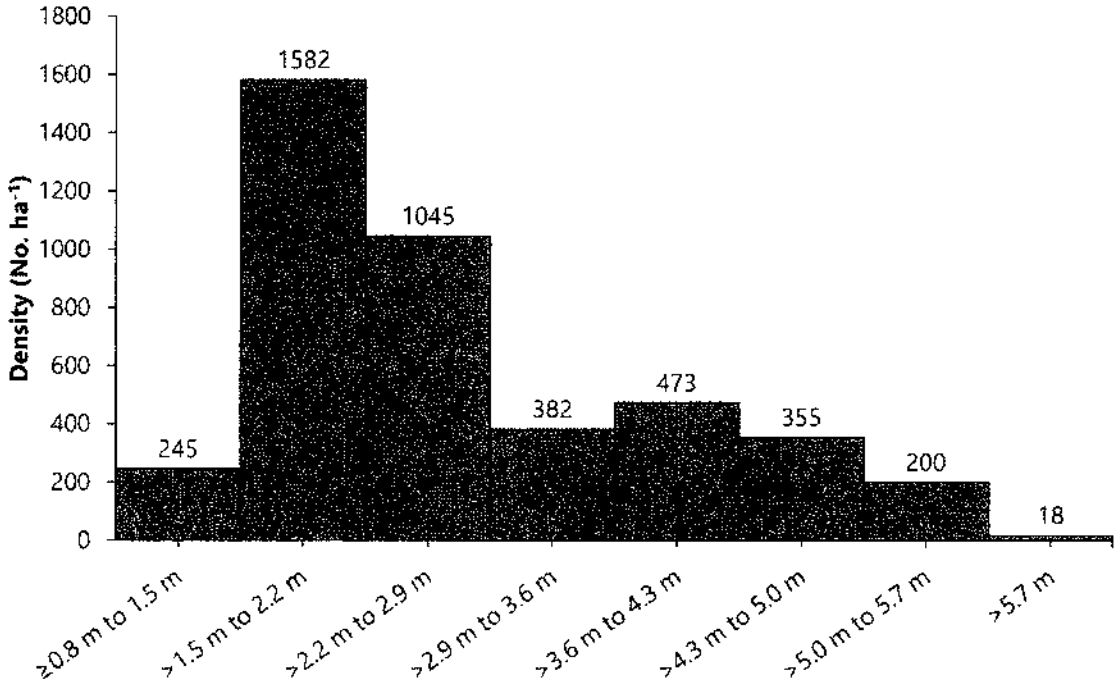


Fig. 34. Mangrove tree density by height (m) size classes in Khari Creek

This distribution suggests a well-established and vertically stratified stand, with dominance of small to medium trees and a moderate representation of taller individuals, indicative of a maturing mangrove population with ongoing regeneration.

The seedling density of *Avicennia marina* in Khari Creek was estimated at 76,667 seedlings ha^{-1}, indicating active natural regeneration within the mangrove stand.

Fig. 35. Mangroves along the Khari Creek

7. INFERENCE

- The study of mangrove distribution across four key creek systems reveals that the mangroves in the region are generally healthy and stable, with natural inter-category conversions and minor localized losses influenced by both natural and other factors.
- The overall health of mangroves in the creeks in and around APSEZ was assessed by comparing WorldView-3 images from 2021 and 2023, revealing a stable growth of approximately 2 hectares, which accounts for a minimal change of about 0.08% of the mangrove area. The analysis indicates that the mangrove and tidal systems in the creeks remain largely undisturbed and continue to flourish during this period.
- Overall stand structure of mangroves in the creeks in and around APSEZ was assessed to be:
    - Three mangrove species were recorded in the region: *Avicennia marina*, *Ceriops tagal*, and *Rhizophora mucronata.*
    - The overall mangrove tree density was estimated at 4,857 trees ha^{-1}, with a corresponding basal area of 26.26 m^2 ha^{-1}.
    - Species-wise Density and Basal Area:
        - *Avicennia marina*: 4,677 trees ha^{-1}, 26.01 m^2 ha^{-1}
        - *Ceriops tagal*: 75 trees ha^{-1}, 0.11 m^2 ha^{-1}
        - *Rhizophora mucronata*: 104 trees ha^{-1}, 0.14 m^2 ha^{-1}
    - *A. marina* exhibited the highest IVI (288.13), followed by *C. tagal* (6.77) and *R. mucronata* (5.10).
    - Mean Diameter at Breast Height (DBH): 6.81 cm (range: 2.61–41.36 cm)
    - Mean Tree Height: 2.90 m (range: 0.80–6.20 m)
- The Kotdi Creek system shows an overall marginal decrease of 1% decline (6.43 ha), primarily due to a reduction in scatter category, which is likely caused by anthropogenic disturbances such as clearing. Slight increase in dense and sparse mangroves suggests natural succession and good tidal flow (up to 4.5–7.4 km).
- The Baradimata Creek system has an overall gain of ~16 ha, especially due to formation of new dense mangroves. Decrease in scatter and sparse (~0.7%) attributed to hydrodynamic impacts on edge zones; some inter-conversion was observed.
- Bocha Navinal Creek has six ha total loss (1.1%), mainly in dense and scattered categories, especially near Bocha island tip, due to natural erosion and tidal inundation. Sparse category increased, indicating regrowth or colonization on mudflats. Formation of sand spits near

Navinal Creek could threaten future tidal inflow, necessitating regular monitoring and possibly channel deepening.

- Khari Creek shows a slight decrease of 1.7 ha, along with an increase of 22 ha in scattered mangroves, suggesting natural expansion over exposed mudflats. Sparse mangroves decreased due to conversion into both dense and scattered, reflecting normal ecological progression.
- Small area of mangrove has been cleared on the downstream bank of the Navinal Creek (22°44'58.89"N 69°42'17.17") (Fig. 36) by the Gujarat Maritime Board (GMB) for the development of facilities as per their EC & CRZ clearance Vide F. No. IA-J-11013/40/2020-IA-I dated 18th Aug, 2021.
- Ship anchoring by the GMB in the Bocha Island leads to loss of mangrove trees in trees (Fig. 37)
- Bank erosion was observed in the downstream of the Navinal Creek (Fig. 38) and upstream region of the Bocha Creek (Fig. 39), affecting the mangrove vegetation along the creek banks (Fig. 38). However, the Port Authority, as recommended in the Integrated Management Plan prepared by NCSCM and directed by the MoEF&CC has implemented erosion control measures (Fig. 40). These measures were part of the compliance actions following the Environmental Clearance (EC) conditions and MoEF&CC final order (F. No. 10-47/2008-IA.III) was issued on 18 September 2015".

Fig. 36. Mangrove cleared on the downstream bank of the Navinal Creek by the Gujarat Maritime Board for the development of facilities as per their approval from MoEF&CC

Fig. 37. Ship anchoring in Bocha Island by GMB Port

Fig. 38. Bank erosion observed in Navinal Creek

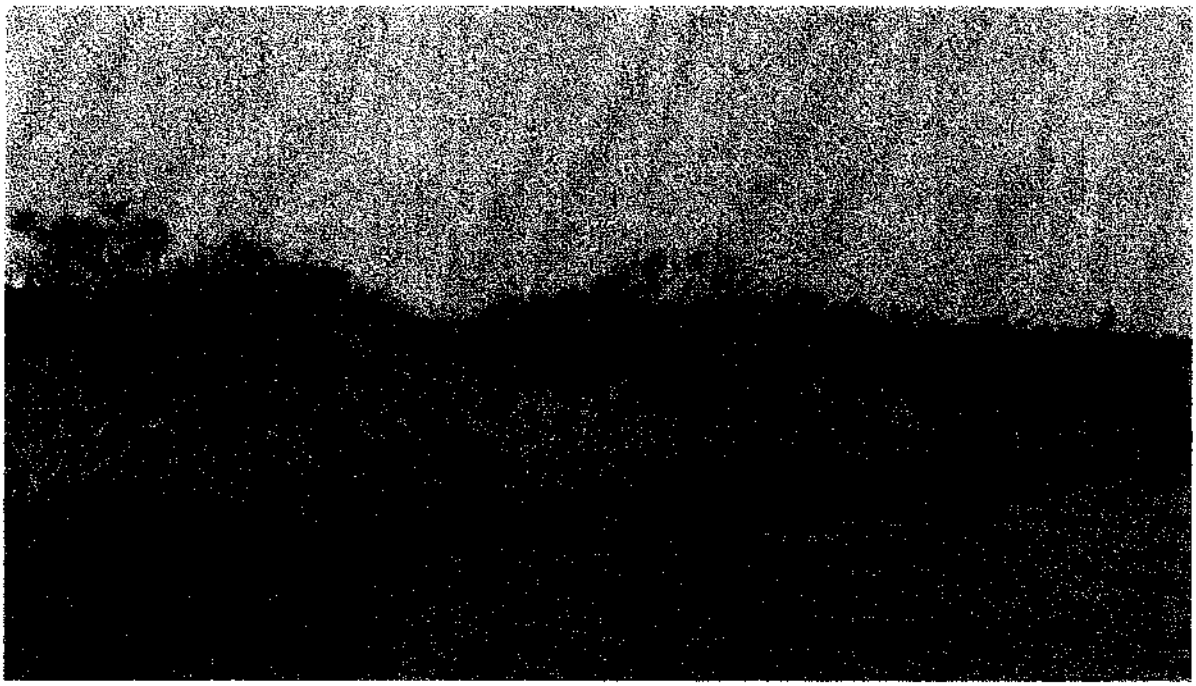


Fig. 39. Bank erosion observed in Bocha Creek

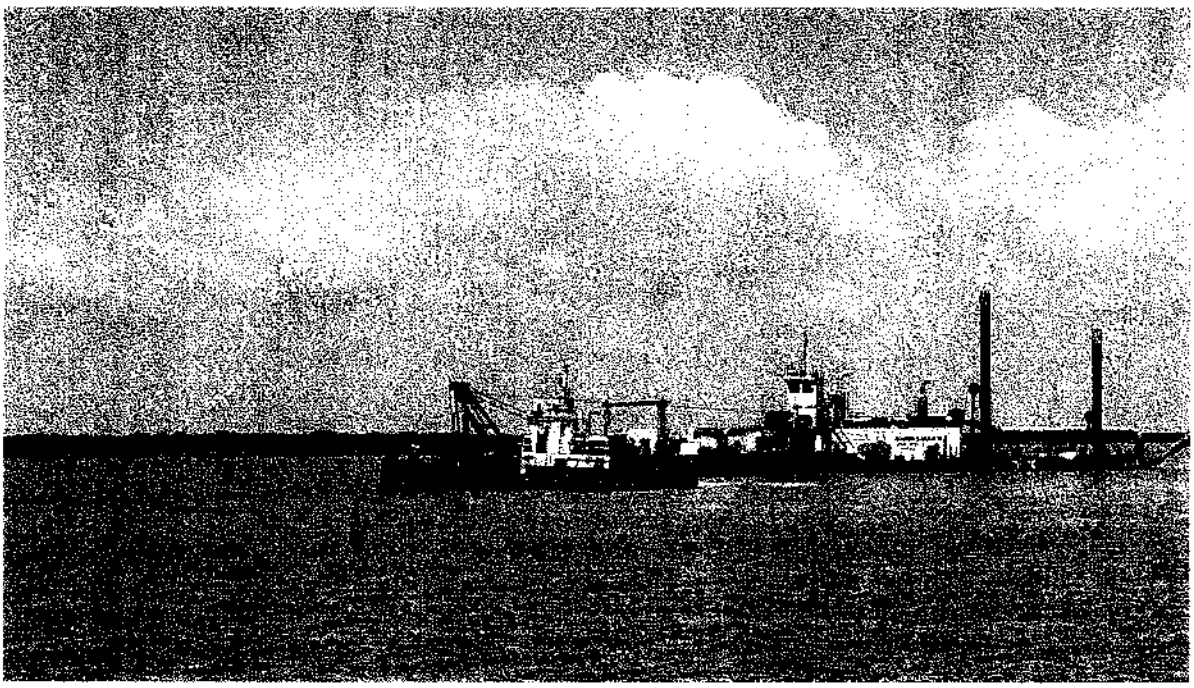


Fig. 40. Dredgers deployed near the Bocha Island as part of the erosion control measures

Annexure – 2

adani
Foundation

Adani Foundation

CSR Gujarat

Kutch – Dahej - Hazira

Six Monthly Report 2025-26




Adani Foundation
Adani House, Port Road, Mundra – Kutch 370 421
[info@adanifoundation.com] [www.adanifoundation.com]

INDEX

CSR Kutch

Environment Sustainability

Environment Sustainability

Adani Foundation Environmental Initiatives.

The Adani Foundation is committed to environmental conservation and biodiversity preservation, essential for maintaining ecological balance. Significant progress has been made through the development of 162 hectares of mangrove forest, which contributes to enhancing coastal biodiversity and ecosystem resilience.

Action to Environment Sustainability

FOCUS AREAS

- Water Sustainability
- Terrestrial Biodiversity
- Coastal Biodiversity
- Soil Conservation

Till date Water conservation Work

145 Pond Deepening

209 Bore & Wells

355 Rainwater Harvesting

30 Check Dams

25 Percolation Wells

Water Conservation Project

In recent years, the villages near our operational area have experienced significant enhancements in both the availability and quality of water. These improvements stem from our focused efforts in managing and conserving groundwater and surface water resources.

Key interventions—

- pond deepening,
- strengthening of check dams,
- installation of rainwater harvesting systems, borewell drilling, and clearing of river inlets—have together increased water storage capacity.

Till the date

Pond Deepening- 145 Village pond
Check dam Re-Strenghtning – 30

Farmers Benifitted -1760

Storage capacity Increase – 2171435Cum.

Current year

Pond Deepening - 05 Village pond

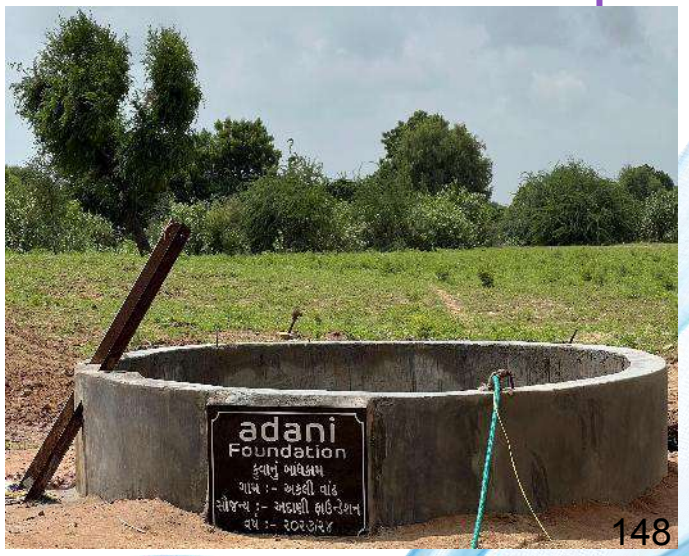
Check dam Re-strenghtining-01

Farmer -300 famer
Land irrigated- 1800 Acre

8.0% Increase in Revenue

9.00 % TDS Reduction

Rs 1200 Reduce in health expenses Monthly



Roof Top Rainwater Harvesting

Project Highlights

- 355 RRWHS units built across 355 homes, positively impacting more than 1,760 people.
- TDS levels below 100 meeting WHO standards for safe drinking water.
- First-time rainwater harvesting enabled for the community, ensuring quality drinking water and reducing financial burdens

Vision:

- To transform in to water-positive village, ensuring the community has access to quality drinking water

Impact:

- The initiative ensured quality drinking water, alleviated financial burdens, and improved the overall health of the community. It also promoted long-term water security and sustainability for Modhva.

(Sustainable Solution for Drinking water):

1760+
Residents benefited

97.73% Less TDS than local municipality water
Gundiyali – 4410 TDS

Rs. 1125
monthly Saved on drinking water

Rs. 3000
yearly saved on health expense

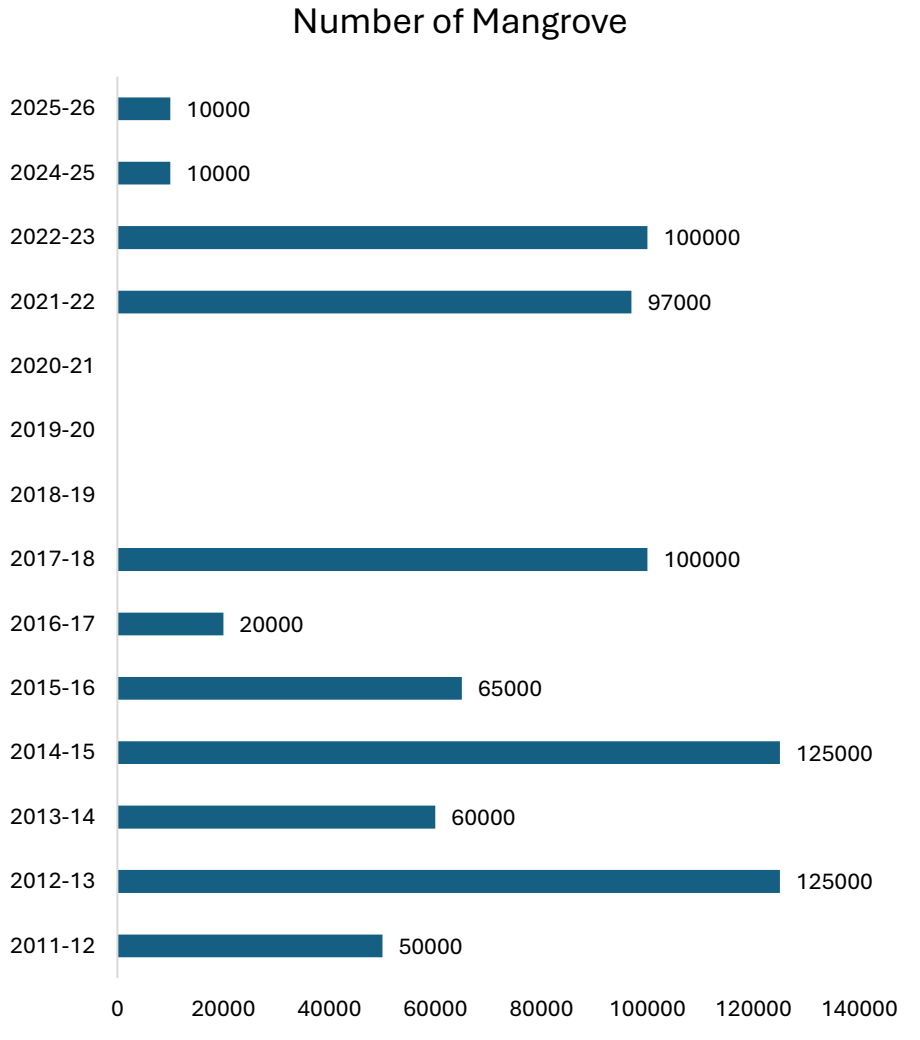
Coastal Biodiversity

Mangrove Restoration Success – Luni Coast

Initiated in 2010, the mangrove restoration project led to the development of 162 hectares of dense mangrove forest along the Luni coast.,

Additional 20 hectares of multi-species mangroves were established, with all plantations meticulously maintained and regularly monitored.

These flourishing ecosystems now support a rich diversity of marine life and migratory birds, making a significant positive impact on the local environment.



Terrestrial Biodiversity

Vruksh Se Vikas – Massive Drive

Beginning in 2014, we have initiated a transformative effort by conducting widespread tree planting campaigns in partnership with local communities and forestry authorities.

Adani Van:

Adani Foundation has initiated the **'Adani Van'** project, aimed at planting extensive areas with medicinal, fruit-bearing, and bird-friendly trees to create optimal habitats for nesting and resting. This initiative employs the Miyawaki plantation method alongside a drip irrigation system. The development of the Van involves active community participation, with Adani Foundation providing maintenance for three years.

Within six months, we have established six Adani Vans, planting 33330 trees across 24 acres in the villages of N Khakhar, Borana, and Dhrub.

Till Date **17** Adani Van 1.22 Trees @58 acres

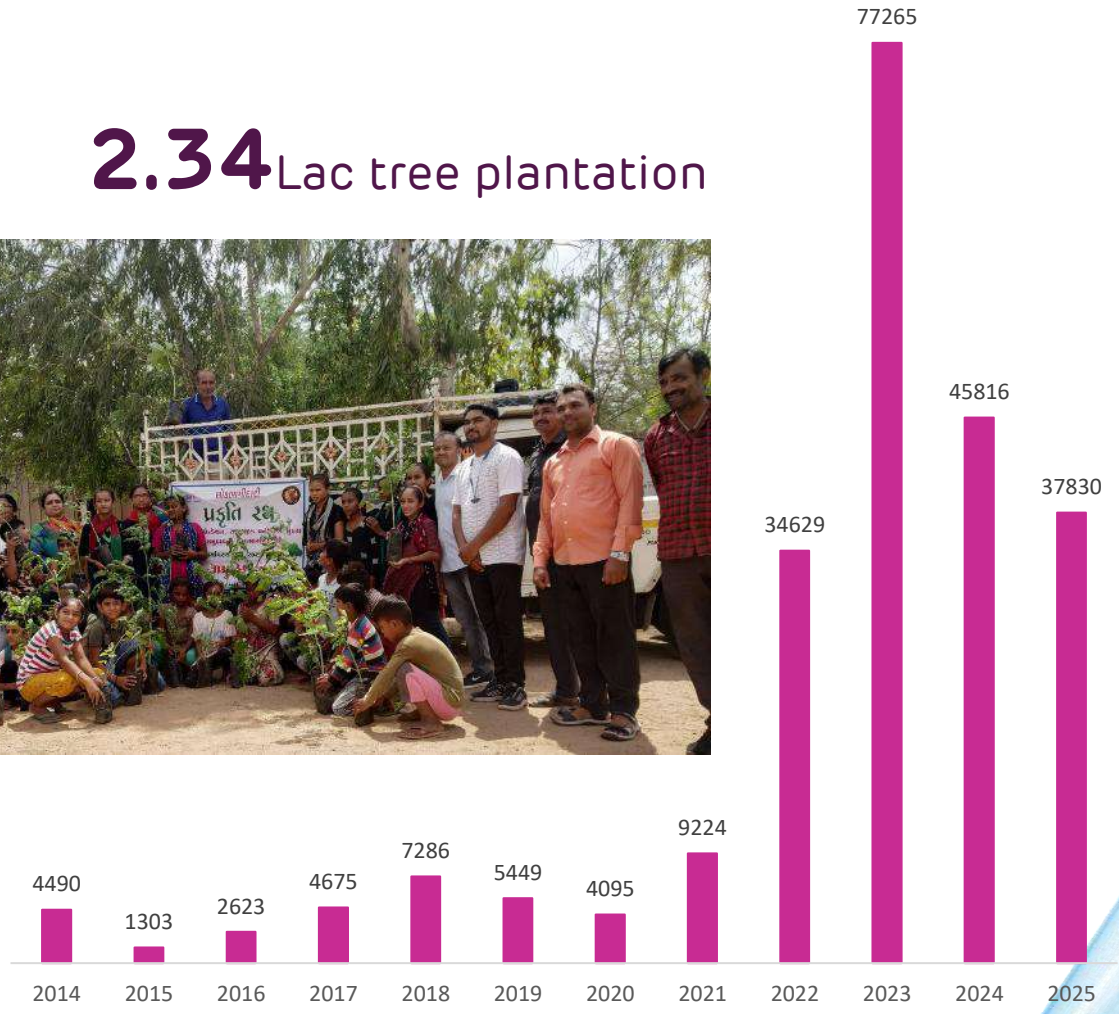
Vruksh Se Vikas – Massive Drive

Prakrutik Rath: Fostering Community Engagement Through Environmental Initiatives

Prakrutik Rath is a distinctive program that unites communities to plant trees in schools, temples, and public areas. Having distributed the Rath moves from village to village, encouraging active involvement. This method not only boosts local greenery but also deepens the community's bond with nature and promotes environmental stewardship.

Under our Vruksh Se Vikas initiative, we have planted 2.34 Laca trees so far, enhancing the ecosystem and supporting carbon sequestration. This program provides enduring advantages for both the environment and the surrounding communities.

2.34 Lac tree plantation



River Cleaning Initiatives – Bhuki & Kevdi Rivers

Objective: To enhance water resources, restore ecological balance, and foster active community participation for healthy rivers and a better future.

Phase 1: Assessment & Planning

•Baseline surveys conducted

•Engagement with stakeholders

Phase 2: Cleaning Operation

•Manual and mechanical removal of debris and polythene bags

•Segregation and disposal of waste

Phase 3: Awareness & Capacity Building

•Community workshops

•Distribution of reusable cloth bags

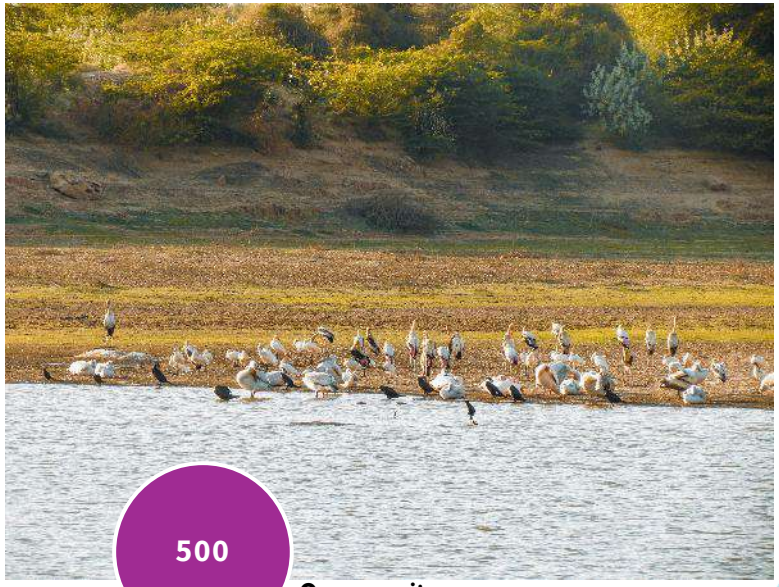
•Installation of waste collection points

Phase 4: Monitoring & Sustainability

•Regular water quality checks planned

•Setting up "River Watch Committees"

Pond deepening and Renovation – Jam Bhuraji Pond



Introduction

Jam Bhuraji Pond, located in Khavda (historically Kunaria), Kutch, Gujarat, is a vital water body supporting the local community, livestock, wildlife, and traditional cultural practices. In 2024/25, the pond underwent a significant deepening and renovation, aiming to address water scarcity and enhance ecological resilienc

Background

- **Village History:** Kunaria is a 350-year-old village, originally settled by Rajput and Luhana communities. The land was granted by Jam Saheb, and the village is known for its unique "Pagdi" ceremony, which appoints a new Jam for 40 villages.
- **Pond Construction:** The pond was initially constructed in 2012 under drought relief efforts by Bani Vikas Trust and Sujlam Suflam Yojana. It was renovated and deepened in 2024/25 by Adani Foundation

Project Rationale

- **Water Scarcity:** The region faces frequent droughts and water shortages, impacting agriculture, livestock, and daily life.
- **Ecological Need:** The pond is a critical habitat for birds and wildlife, and its health directly affects local biodiversity.
- **Community Demand:** The pond serves as the main water source for 350 villagers, livestock from four villages, and nearby Maldhari communities

7000 cum **Increased Storage:** Deepening has significantly increased the pond's capacity,

3500 **Reliable water supply for irrigation, livestock, and household use.**

10 Types **Biodiversity Boost: Migratory Birds**

500 **Community Cohesion Resilience: :**

Project Utthan

FLAGSHIP EDUCATION PROGRAM

Strengthening Government Primary Schools

•Adopting and upgrading government primary schools & High school to model schools.

Appointing an Utthan Sahayak

•Assigning a dedicated facilitator in each school to act as a catalyst for change.

Providing Resources and Facilities

•Ensuring schools are equipped with necessary resources and infrastructure

Introducing Vedic Math's & Abacus

•Increasing students' logical and mathematical skills through Vedic Math's and Abacus training.

Capacity Building for Government School Teachers

•Conducting training programs to improve teachers' skills and teaching methods.

Special Focus on 'Priya' Vidyarthi's (Progressive Learners)

•Providing additional support and tutoring for progressive learners.

Training Students for Competitive Exams

•Preparing students for various competitive examinations.

Project Utthan: Empowering Education at the Grassroots since 2018

Initiated by the Adani Foundation in partnership with the Government of Gujarat, Project Utthan is a pioneering effort to uplift learning outcomes in government schools. Through targeted academic support, enriched environments, and community involvement, the project aims to build strong foundational skills and reduce dropout rates among students.

• Primary schools	• High schools	• Students	• Progressive learner	• IT on Wheels	• Adani competitive coaching center
69	12	11532	1151	3235	2726

Key Strategic Initiatives of Utthan

Main streaming Progressive learners

- 2776 students of classes 4 & 5 were assessed.
- 1151 students emerged as progressive learners
- Personalized learning through different activities and TLM
- 220 students mainstreamed.

Library Activity

- Library books issues & Activities planned every Saturday.
- 45000+ Books issued.
- 300+ Oasis workshop arranged to increase reading habits of students.

IT on wheels

- 1187 primary & 1448 high school students are learning basic computer skills.
- Students gain essential computer skills, enhancing their digital literacy and preparing them for future academic and career opportunities.

Mothers Meet

- Mothers' meetings conducted every second Saturday in Utthan schools.
- Over 95,00 mothers have joined.
- Guidance on exams, scholarships, and healthy eating.
- Home visits and discussions on academic performance.

Competitive Exam

- 1050 passed and 21 students made it to the merit list.
- 2726 students are preparing for exams like JNV, NMMS, PSE, and CET.
- Meetings with 560 high school parents to encourage their support.

उत्थान by adani | Foundation

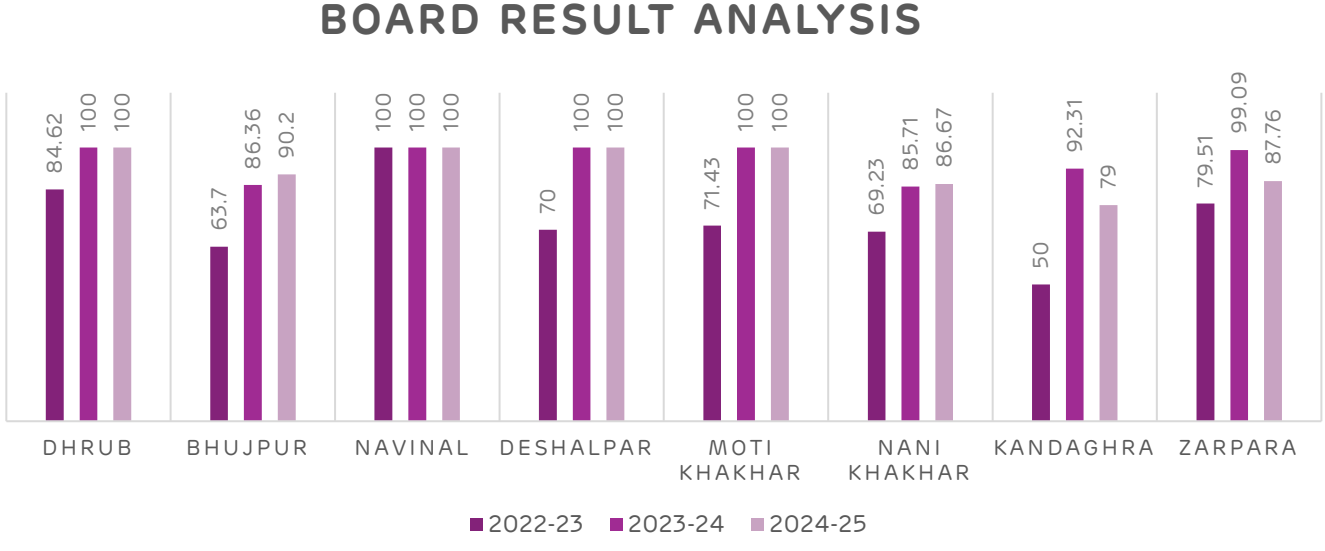
Impact in Action

Gunotsav & Board Results

4 High Schools Achieved
100% Pass Rate in Results

Gunotsav Primary School Performance

- **Gunotsav Results:** Gunotsav grades are assessment by GoG as part of its statewide initiative to assess and enhance the quality of education in government schools.
- All Utthan-supported schools showed a marked rise in Gunotsav grades, with many moving up to A & B categories—reflecting the positive impact of targeted academic and co-curricular interventions.



Abacus & Vedic Maths

Utthan initiative has introduced Abacus and Vedic Mathematics in 54 primary and 08 high schools. Abacus is a tool used for performing arithmetic calculations, while Vedic Mathematics is an ancient system of Indian mathematics that simplifies complex calculations.

1800 Abacus students

1302 Vedic math's Students

Celebrating Learning, Culture & Growth Through Day celebration

- Monthly Celebrations : Utthan Adani Foundation organizes 1–2 themed days each month across schools to enrich the learning experience.
- Engaging Activities : Events include cultural programs, competitions, and recreational games that spark creativity and participation.
- Joyful Learning Environment : These celebrations foster enthusiasm, improve student engagement, and make learning more enjoyable.
- Positive Impact : Regular celebrations have led to increased attendance, improved confidence, and stronger school-community connections.

Day celebration - **10,000+** Students
Participated from various school

360° Career Guidance for Utthan High School Students

- Adani Foundation has launched a comprehensive career guidance program for all Utthan High School students, powered by personalized psychometric assessment.
- The initiative begins with a deep evaluation of each student's interests, strengths, and aspirations, generating a tailored career report.
- Based on these insights, students receive focused one-on-one counseling to explore suitable career paths and make informed decisions.
- This 360° approach bridges the gap between education and employability, equipping youth with clarity, confidence, and direction.
- It fosters self-awareness, future readiness, and aligns with the Foundation's mission to nurture holistic youth development.

Career guidance –**1400+** students
powered by Psychometric assessment

Adani Vidya Mandir

Bhadreshwar

Adani Vidya Mandir, Bhadreshwar (AVMB) is a model institution dedicated to transforming lives through free, inclusive, and holistic education. Serving students from Economically Weaker Sections, especially the fisherfolk community, AVMB provides comprehensive support—uniforms, books, stationery, nutritious meals, and quality learning—at no cost.

The school fosters a nurturing environment where every child is empowered to dream big and achieve their potential. Through structured pedagogy, co-curricular engagement, and strong community ties, AVMB ensures that learning goes beyond textbooks. Its emphasis on values-based education, cultural identity, and student leadership prepares learners for the challenges of the 21st century.

Aligned with NEP 2020 and UN SDG 4 (Quality Education), AVMB champions equity, creativity, and lifelong learning—building a foundation for a brighter, more inclusive future.

AVMB

Academic Excellence
- 100% pass rate in Class 10 SSC Board Exam (2024–25); 2 students secured A1 grades
- Average score rose to 75.41%; subject-specific teacher training and inter-school collaboration
- Bharat Ko Jano exam participation and structured assessments

Co-Curricular & Cultural Growth
- 587 students engaged in CCA activities; winners at Kala Mahakumbh and National Singing Competition
- Celebrations: Ashadhi Bij, Guru Purnima, Independence Day, Promise Wall tribute
- Storytelling, Rakhi making, Doodle the Google competitions

Infrastructure & Institutional Support
- Free provision of academic essentials and meals
- Balvatika Praveshotsav welcomed 80 new learners and 120+ parents
- Teacher training in Adobe Express.

Community Engagement & Leadership
- Interactive PTMs, student-led event planning, and cultural hosting. Empowered students with leadership roles

Wellness & Sports Achievements
- Yoga Day with 205 students; National Sports Day participation
- Kho-Kho and Athletics: multiple wins and district-level qualifications
- Dedicated coaching and mentorship for physical development

Celebrating Excellence and Holistic Development

100%

result in 10th board examinations

Project Udaan

Igniting Aspirations in Youth

- Adani Foundation's Project Udaan empowers youth through immersive educational tours to key Adani Group facilities, offering real-world exposure beyond the classroom.
- Students gain firsthand insights into industries like ports, power, and refineries, sparking curiosity and ambition for future careers.
- The initiative nurtures entrepreneurial thinking, leadership qualities, and a vision for innovation among school and college students.
- Faculty participation strengthens academic-industry linkages, enriching the learning ecosystem.
- Project Udaan has become a catalyst for inspiring young minds to dream big and pursue meaningful, future-ready paths.

229 institute visit

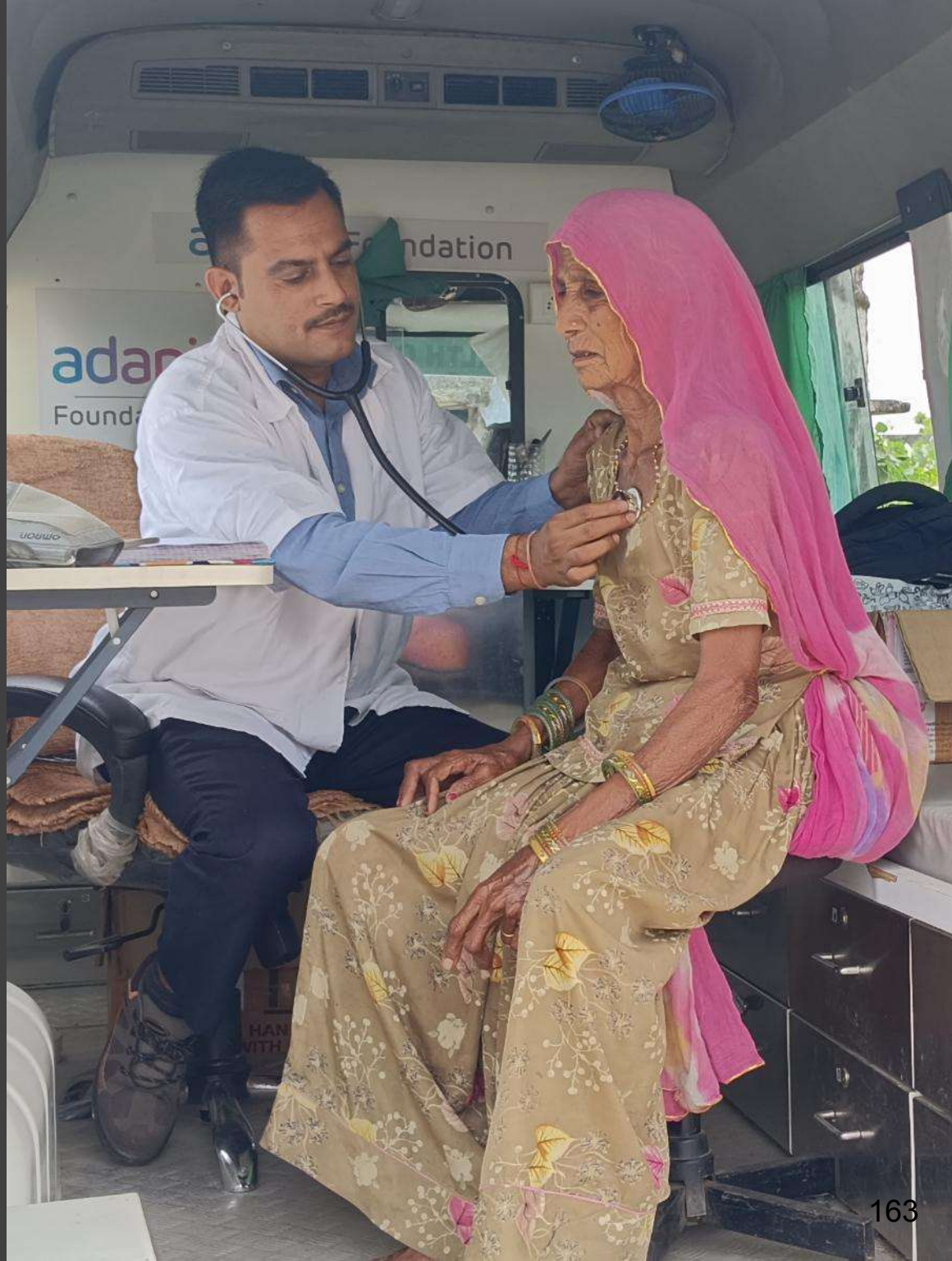
5 Corporate visit

16380 Participants

Community Health

Adani Foundation – Advancing Healthcare & Community Well-being

- Adani Foundation's healthcare mission is rooted in the belief that quality medical care should be accessible to all, especially underserved communities. Through initiatives like Mobile Health Care Units (MHCU), general and special health camps, medical support, and rural clinics, the Foundation delivers preventive and curative services directly to those in need.
- Focused on community health, awareness, and sustainability, it also runs programs on addiction recovery and supports labor colonies with regular medical outreach. Aligned with the vision of equitable healthcare, the Foundation's efforts contribute to SDG 3 (Good Health & Well-being).

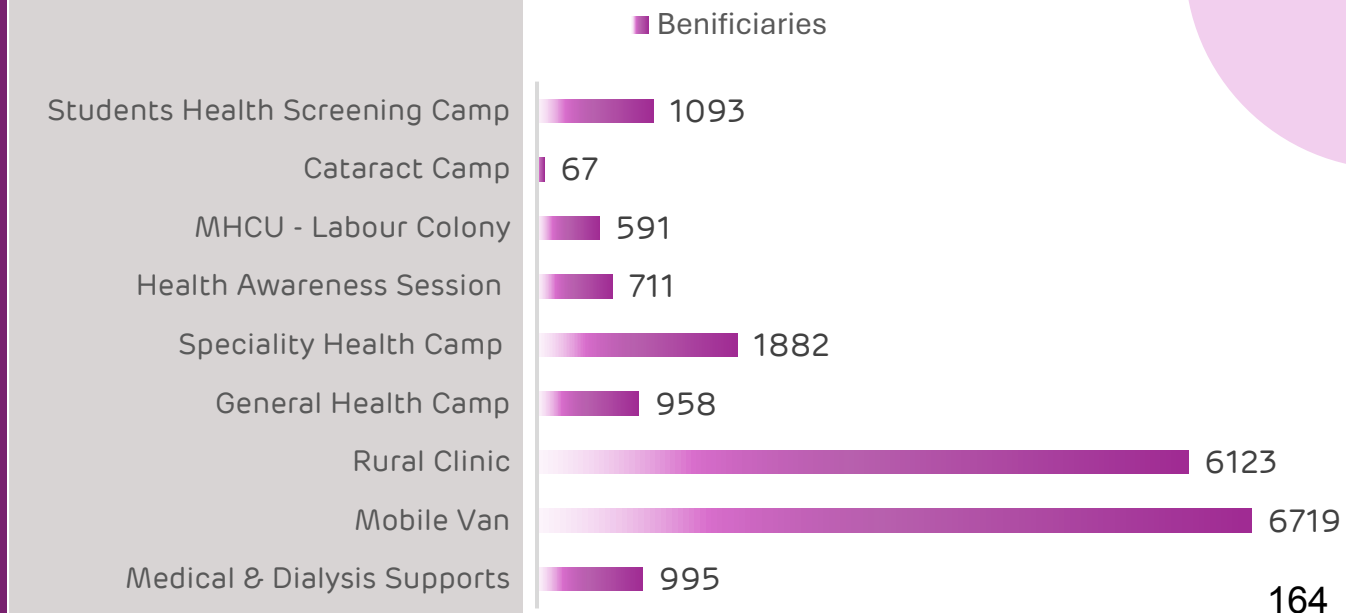


Community Health

Adani Foundation shows a strong commitment to community health through diverse healthcare initiatives. It ensures accessible medical care for underserved and remote populations. These efforts promote early diagnosis, better health outcomes, and increased awareness.

The Foundation's proactive approach drives large-scale, meaningful impact in public health across rural and urban areas.

BENIFICIARIES



Health

Mobile Health Care Units, Rural Clinic Services & Medical Support

- Adani Foundation's Mobile Health Care Units and Rural Clinics have transformed healthcare access in remote regions, delivering consistent medical support directly to the doorstep of underserved communities.
- These services have significantly improved health outcomes, built trust in formal healthcare systems, and reinforced the Foundation's role as a catalyst for inclusive and impactful public health development.

- **9867 individuals** benefited from MHCU and Rural clinic services.
- **33%** average savings on healthcare-related costs.
- **42%** People are aware and become health Conscious

- Adani Foundation's medical support program has provided critical care to 1,071 underprivileged patients, addressing serious health issues like kidney and heart conditions at Adani Hospital Mundra.
- In life-threatening cases, patients are stabilized and referred to GKGH, Bhuj, with full coordination for advanced treatment—ensuring no one is left behind in their journey to recovery.

29-Villages
31-MHCU
Stoppage
7-Rural clinic

TB Awareness & Nutritional Support Program

- Adani Foundation organized a focused TB awareness initiative in Mundra Block, enhancing health literacy among affected individuals through expert-led sessions.
- Patients received vital education on symptoms, medication, hygiene, diet, and lifestyle from healthcare professionals including the District TB Health Officer.
- The program promoted early detection, treatment adherence, and holistic recovery practices such as regular exercise.
- Continuous care and monitoring ensured sustained impact, reinforcing the Foundation's commitment to inclusive and resilient community health.

Awareness and Screening Drive in Mundra Schools

- Adani Foundation conducted health and hygiene awareness sessions across primary schools in Mundra Block, fostering lifelong wellness habits among children and educators.
- Over 584 students and teachers participated in interactive sessions focused on hygiene practices and healthy living.
- Comprehensive health screenings were carried out for 1,093 students, enabling early detection of health issues and timely intervention.
- Core topics included handwashing, dental care, nutrition, personal cleanliness, and environmental health.
- The initiative significantly boosted health awareness and preventive care among school children, reinforcing the Foundation's commitment to nurturing healthier communities.

Beneficiaries – 1093 Health & Hygiene Awareness

Sustainable Livelihood Development

Women Empowerment

82 SHG

- Women were mobilized into SHGs through formal registration, laying the foundation for collective growth and financial inclusion.
- **(80 SHGs)**

12 Skill Building

- Tailored workshops and hands-on training empowered members with entrepreneurial, financial, and operational skills.
- **(12 Workshop – 1000 Women's)**

60 Exposure & Learning

- Exposure visits to successful enterprises inspired SHG members, boosting confidence and sparking innovative ideas.

52 Need-Based Support

- Adani Foundation provided timely support—equipment, funding, and guidance—based on each group's evolving needs and goals.

1450 Community Impact

- SHGs now uplift entire communities—enhancing household income, promoting leadership, and driving social change.

"CHETNA" - initiative with gender diversity

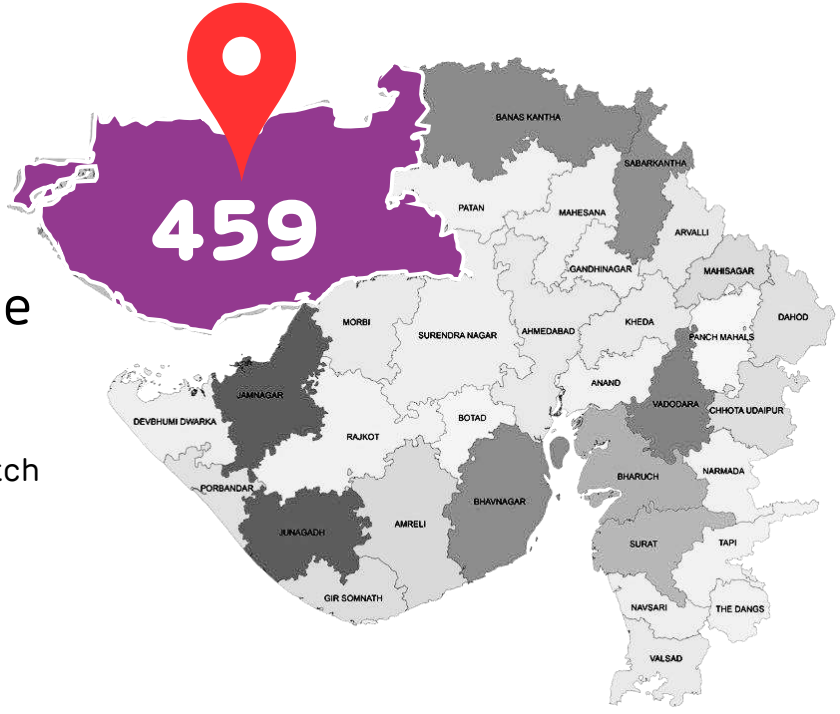
- Women Mobilization & Employment Facilitation : Adani Foundation, in partnership with Unnati Portal and Adani Solar, mobilized and counseled women and their families, enabling them to confidently enroll, attend interviews, and secure jobs.
- Empowerment Through Opportunity : Women from Kutch began working in formal roles, gaining financial independence, self-confidence, and inspiring broader community acceptance of female workforce participation.

Till Now

600+ Female
Joined Adani Solar
@Pan India

459 are from Kutch

76.50%



Rs. 1.8 lakhs/annum
12th pass candidates

Rs. 2.16 lakhs/annum
Graduate candidates

Creating Opportunities for Women

Mobilization and Counseling

Parental Engagement

Travel Assistance

Interview Support

Trees & Fodder: Growing Green, Sustaining Life

Objectives

- Promote environmental conservation through afforestation and land restoration
- Support rural livelihoods by strength hening agricultural sustainability
- Foster community participation in ecological development
- Monitor and enhance the effectiveness of green initiatives

17 Adani Van Sites

1.22 Lacs Tress Planted

16 Villages

Estimated increase in green cover (area or 58 acres)

Activities

- **Tree Plantation Drive**: Identified suitable locations for afforestation and community greening
- **Fodder Support Initiative**: Provided regular fodder supply at all core villages, Ensured livestock health and supported sustainable farming practices
- **Sustainability** : Engaged with local communities to align conservation goals. fostering long-term environmental stewardship and rural empowerment.

Impact

- **Ecological Balance**: Increased green cover and biodiversity in targeted villages
- **Agricultural Sustainability**: Improved fodder availability boosted livestock productivity and farmer income
- **Community Empowerment**: Strengthened local ownership of environmental projects
- **Long-Term Resilience**: Enhanced environmental awareness and stewardship across rural areas

Swawlamban

Objectives

- **Enable Access to Government Schemes :** Facilitate awareness, documentation, and enrollment for Divyang individuals in welfare programs.
- **Promote Educational & Career Readiness:** Provide study kits, guidance, and resources for competitive exam preparation and job opportunities.
- **Enhance Mobility & Daily Living** Support with medical certificates, bus passes, and assistive equipment to improve independence and quality of life.

Divyang Support & Scheme Facilitation

Activities

- Conducted awareness drives and assisted with document verification to help Divyang beneficiaries enroll in government schemes.
- Facilitated access to welfare programs like Sant Surdas and marriage assistance, along with issuing medical certificates and bus passes for improved mobility.
- Provided exam preparation kits and assistive equipment, while celebrating Divyang Day through job placements and recognition.
- Implemented the **Swavlamban Project** to promote self-reliance and skill development among differently-abled individuals.

Impact

- Social Inclusion & Dignity Divyang individuals gained access to entitlements, boosting confidence and community participation.
- Improved Livelihood Opportunities Job placements and exam support opened pathways for financial independence and career growth.
- Strengthened Rural Outreach Village-level engagement ensured that even remote beneficiaries received timely support and recognition.

Swawlamban : Divyang Support & Scheme Facilitation

- Government Scheme Facilitation: Divyang individuals supported with medical certificates, bus passes, Sant Surdas benefits, and marriage assistance through documentation and enrollment help.
- Empowerment & Inclusion: Provided competitive exam kits, assistive equipment, and job placement support, fostering self-reliance and social dignity under the Swavlamban Project.

Activity	
Job Fair	105
Sawavlaban IG Support	92
AF Equpment Support	177
Competitive exam	62
AF Neo motion EV	48
Total	484

Scheme Detail	Gov. Support Rs/Month.	Total Beneficiaries	Total Amount per Month (INR) last 4 year
Widow Pension	1250	663	23315100
Bal seva Ayog	2000	49	3430000
Divyang pension	1000	62	759000
Niradhar Pension	1000	126	3755000
Palak Mata Pita	3000	5	696000
Bus pas	Free ST	515	-
Divyang Govt sadhan sahay	8000	175	1400000
Divyang certificate	0	573	-
Total		2168	31955100

Fisherfolk Community

Empowering Fisherfolk Community

Objective

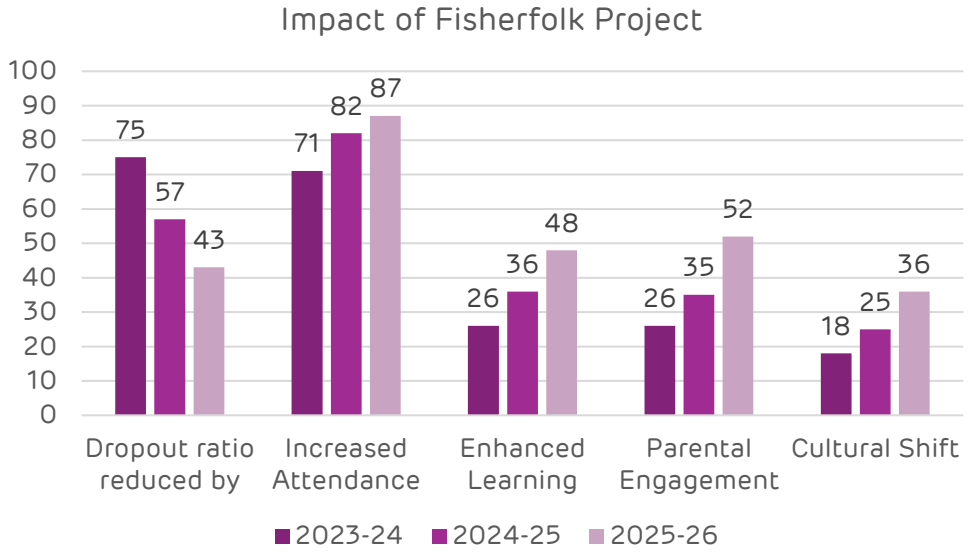
- To empower the fisherfolk community by improving access to education, creating employment opportunities for youth, and providing essential facilities that support long-term development and social upliftment.

Activity

- Distributed education kits to HSC and graduation-level students, including notebooks, guides, stationery, and study bags.
- Facilitated job opportunities and skill development for youth through community engagement and support programs.
- Provided daily transportation for 86 school-going children to ensure consistent access to education.
- Awarded scholarships totaling ₹3,58,765 to 34 students for higher secondary and technical education.

Impact

- Increased school attendance and reduced dropout rates among fisherfolk children.
- Enabled financially challenged students to continue higher education without barriers.
- Strengthened youth empowerment and community resilience through education and employment support.



Empowering Fisherfolk Community

Job initiatives:

Acting as a bridge between industries and fisherfolk youth, the Adani Foundation facilitated job placements for 30 fisherfolk as RTG operators, in the HR department, and as supervisors in APSEZ companies.

In the APSEZ area and colony, 45 fisherfolk youth have been offered professional painting roles. To ensure they are skilled for the role, they underwent comprehensive training in partnership with Asian Paints.

This initiative has enhanced their livelihoods and provided sustainable employment opportunities.

Vashat Nameada	Population	Water Quantity
Luni Bandar	384 (116 HH)	17.5 kl
Bavdi Bandar	535 (107 HH)	20 kl

Potable water Distribution:

Providing access of potable Drinking water Facilities to Nine fisherfolk vasahat on Daily bases, either By Water tanker or Linkage with Nearest Gram panchayat.

More than 5000 Fisherfolk Population are getting benefit which impact on their health and well-being.

Community Infrastructure Development Initiative

Objectives

- Enhance rural and coastal infrastructure to improve quality of life
- Strengthen access to sanitation, education, and community spaces
- Promote sustainable development through water conservation and ecological restoration
- Empower communities with better connectivity and public amenities

Activities

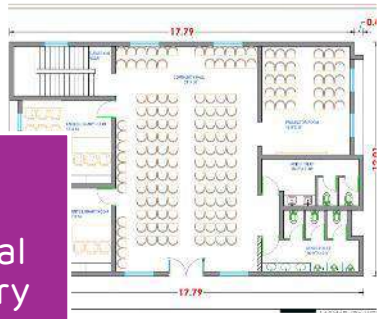
- Constructed common gathering sheds, Samajik Vikas Kendras, and community centers
- Built digital libraries and training centers to promote education and skill development
- Developed approach roads, culverts, and entry gates for improved mobility
- Renovated and built Gaushala sheds and Gauchar land for livestock support
- Installed sanitation facilities including toilet blocks and pink toilets in schools
- Deepened ponds, cleaned rivers, and desilted dams for water conservation
- Supported civil works in crematoriums and public spaces
- Restored roads and infrastructure in fisherman settlements and remote areas

Impact

- Improved access to essential services and public spaces for thousands of villagers
- Strengthened rural connectivity, boosting local trade and transport
- Enhanced hygiene and sanitation, especially for women and schoolchildren
- Revived water bodies, improving groundwater levels and agricultural sustainability
- Supported livestock and dairy-based livelihoods through Gaushala infrastructure
- Fostered digital literacy and community learning through educational facilities
- Promoted inclusive development and social cohesion across multiple villages
- Enabled long-term resilience and environmental stewardship in underserved regions

Community Infrastructure Development Initiative

3
Pond deepening



4
Digital Library

9
Common gathering Shed

2
Gaushala Development

25
RRWHS

2
Community Center

2
Check dam strengthening

24 Km.
Restrength-ening of Approach Road

AGEL KHAVDA

Education – Project Utthan:

- Supported **12 high schools** in Khavda through the Utthan initiative, expanding coverage to the entire region.
- Deployed **Utthan Sahayaks** to strengthen core subjects like Maths, Science, and English.
- Engaged **Community Mobilizers** to promote school enrollment and retention, especially for girls.
- Conducted **scholastic and co-scholastic activities** to enhance academic performance and holistic development.
- Visible improvement in student learning outcomes after **three years of continuous educational support**.

1500+
Students benefited

54.49%
Increase in admissions

43.11%
Rise in Girls' admission

Activities	Beneficiaries	No. of Schools
Utthan project in Khavda	**1500+ Students**	**12 High Schools**
Sports and Music Equipment, Library cupboard & books	1000+ students	Supported in 12 High schools and 2 Primary Schools
Education Kit Support (Utthan Notebooks & Bag)	1000+ students	Supported in 12 High schools
Tournament for 12 High school (Badminton & Cricket)	500+ people	12 High schools

Community Health

- **Specialist Healthcare Access:** Deployed expert doctors to Khavda CHC and conducted multi-specialist health camps in remote villages, ensuring regular consultations and treatment.
- **Maternal Health Support:** Facilitated safe transportation and medical care for 166 pregnant women from border villages, improving maternal outcomes.
- **Community Impact:** Over **5,000 patients** benefited from specialist services and **900+ villagers** received direct care through outreach camps.

42
Villages benefited

5,187
villagers benefited by medical services

Adani Arogya Karyakram Khavda CHC OPD:					
Gynec.	Pedia.	Ortho	General	Optho.	Total
1402	2078	257	344	973	5054

Specialty Health Camp in Khavda Villages:						
Gynec.	Pedia.	General	Ortho	Optho.	ANC Women	Total
214	238	246	95	74	66	653

Women Empowerment:

- Formed **9 SHGs** and enrolled **95 women** into the Khavda Mahila Vikas Sangathan, promoting savings and financial inclusion.
- Conducted **85 SHG meetings** and **24 business sessions** to build entrepreneurial skills and livelihood awareness.
- Reached **610 women** through empowerment activities, strengthening leadership, financial literacy, and community bonds.

CID – Water Conservation

- Constructed 13 rainwater harvesting ponds to store monsoon water for community and wildlife use.
- Installed 6 drinking water wells in remote villages to improve daily access to clean water.
- Enhanced public health and sanitation by providing reliable water infrastructure in underserved areas.

Climate Action:

- Created Adani Van by planting 2,000 trees, boosting green cover in Khavda.
- Promoted environmental sustainability and climate resilience through afforestation efforts.
- Engaged school children in plantation care, fostering ecological awareness and community participation.

AGEL Dayapar

Water Conservation

- Planned **expansion and deepening of 9 village ponds** to increase rainwater retention and storage.
- Held **consultative meetings with local communities** to finalize pond locations and encourage grassroots involvement.
- Aimed at **enhancing groundwater levels** and ensuring reliable water supply for farming and livestock needs.

SLD – Kamdhenu:

- Awareness meetings on modern dairy farming in villages, engaging local cattle owners.
- Organized vaccination camps across villages, covering 1,647 animals (1,410 camels + 237 cattle).
- Improved livestock health and productivity by reducing disease risk and promoting sustainable care practices.

Community Health:

- General health camps in five villages, reaching underserved rural populations.
- Conducted student health check-ups at Dumra during AGEL Foundation Day.
- Partnered with ICDS teams for women and child health awareness sessions.
- Provided follow-up care for Neo Motion wheelchair beneficiaries to enhance mobility.
- Ensured referrals and community engagement, with 9 patients sent to GKGH Bhuj and active participation from local leaders.

Benefited **923** with direct healthcare services.

SLD

- Initiated Adani Van with MOU signing, aiming to create a model for inclusive community development.
- Celebrated 29th Foundation Day with a Mega Volunteering Program, engaging 50+ employees and 560 students in health, safety, and environmental activities.

Education

- Distributed 620 school kits and organized experiential learning activities during AGEL Foundation Day, benefiting 560 students.
- Laid the foundation stone for a Nature Class cum Open Theatre, promoting outdoor learning and environmental awareness.

AKBPTL Tuna

Education : Utthan

Introduction

- Adani Foundation signed an MoU with DPEO to implement **Project Utthan** in **5 primary schools** across Anjar taluka, including Tuna and nearby villages.

Activities

- Appointed **Utthan Sahayaks**, supported **1339 students**, and ran **competitive coaching** and **English sessions**.
- Conducted **library activities**, **mothers' meetings**, and **home visits** to boost learning and parental involvement.
- Celebrated key days like **Teachers' Day** and **Hindi Diwas** to promote inclusive education.

Impact

- Identified **350 progressive learners**; **50 students mainstreamed**.
- Issued **7500+ books** and engaged **1500+ mothers** in academic support.
- Strengthened **government schools** through personalized learning and community participation.

Health

- Organized **general health camps** at Vira and Rampar villages, benefiting **344 patients** through early disease detection and basic treatment.
- Raised **awareness on hygiene, nutrition, and lifestyle diseases**, improving health literacy in underserved communities.
- Conducted **multi-specialty health camps** in Tuna CSR villages, offering gynecology, pediatrics, and eye care services to **244+ patients**.
- Referred **6 patients** to GKGH Bhuj for advanced care, ensuring timely diagnosis and improved healthcare access.

Awareness sessions

- Conducted health and hygiene awareness sessions across Mundra Block primary schools, engaging 247+ students and teachers.
- Promoted daily hygiene practices and healthy lifestyle habits to prevent infections and boost overall well-being.
- Completed health screenings for 240 students, supporting early detection and timely care.

Climate Action:

- 2 ponds deepening in Rampar Tuna to enhance water retention and support groundwater recharge.
- Developed “Adani Van” green zone with tree plantation, promoting biodiversity and ecological balance.
- Installed drip irrigation and fencing to ensure sustainable growth and protection of the plantation.

Adani Skills & Education

Education

Vision

- Empower youth with future-ready skills by bridging education and employability gaps, fostering sustainable development and local job creation.

Mission

- Deliver industry-relevant training through finishing schools.
- Collaborate with communities and industries for inclusive employment.
- Boost regional growth by aligning skills with local job markets.

Objectives

- Set up a Finishing School in Mundra Sitre for advanced sectoral training.
- Launch hands-on skill development projects.
- Organize job drives and community outreach.
- Partner with Unnati Life for localized career support.
- Encourage entrepreneurship and vocational education.

Challenges Addressed

- Academic qualifications without practical skills.
- Limited industry exposure and job readiness.
- Education-employment disconnect causing underemployment and migration.

- **45 Job drives**
- **4,500 Youth participated in the interview process.**
- **Over 1,200 candidates were successfully selected.**

Adani skills & Education

Skills

Vision

- To empower women through skill development, enabling financial independence and fostering community growth.

Mission

- To provide high-quality, hands-on training in traditional and modern vocations such as beauty therapy, mud work, dori work, artisan card making, and moti work—equipping women with the tools to start their own businesses.

Objectives

- Deliver specialized training programs through Adani Foundation.
- Promote self-employment and entrepreneurship among women.
- Preserve and enhance local crafts and skills.
- Create sustainable livelihood opportunities within the community.

Training	Numbers of women
Beauty therapy	80
Mud Work	40
Dori Work	32
Artisan card making	68
Moti work	10

Event

Under the “Swavalamban” program, 50 differently-abled individuals were empowered with self-employment resources and electric wheelchairs, promoting independence and dignity. The initiative inspired enthusiasm and hope, guided by the spirit of Seva Hi Sadhana, and reinforced Adani Foundation’s commitment to inclusive development.

Adani Foundation organized an exam prep camp at GIMS Bhuj for 62 Divyang candidates in Kutch, offering study kits and expert guidance. The initiative promotes equal opportunity and self-reliance, reflecting the Foundation’s commitment to inclusive development.

Event

Adani Foundation organized a medical camp during Navratri to support pilgrims walking to Mata no Madh. With doctors, medicines, and emergency transport, the initiative ensured health and safety while honoring cultural devotion. The camp not only provided essential medical care but also strengthened community trust through compassionate service and cultural alignment.

Adani Foundation inaugurated a new Balvatika at Zarpara School, creating a nurturing early learning space for young children. The initiative benefits 38 girl students, promoting foundational education and inclusive growth. This effort reflects the Foundation's commitment to empowering communities through quality education.

Event

Adani Foundation, extended resource support to 50 women entrepreneurs from 5 SHGs. The initiative aimed to strengthen their entrepreneurial journey by providing essential tools, training, and opportunities —empowering women toward sustainable livelihoods.

Adani Foundation celebrated Foundation Day with JNV Dumra students through a series of impactful activities, including tree plantation, environmental awareness sessions, safety training, and health check-ups. The initiative aimed to foster ecological responsibility, personal well-being, and community engagement among young learners.

Event

Adani Foundation employees actively participated in the Employee Volunteering Program, contributing to the distribution of nutrition kits at GK General Hospital. This initiative reflects their commitment to community welfare and promoting better health outcomes.

At Bhujpur, over 50 women received training in parlor services, empowering them to start and manage their own small businesses. Many participated during vacations or spare time to enhance their skills and boost self-employment opportunities. This initiative promotes economic independence and skill development among rural women.

Event

To support higher education among students from the fishing communities of Mundra and Mandvi talukas, Adani Foundation distributes educational kits annually. This year, over 80 children benefited from the initiative, which also included transportation arrangements to ensure better access to learning resources.

The renovation of Mamal Sagar near Bhujpur has enabled water storage of over 22,500 CUM, significantly benefiting more than 50 farms in the area. This initiative has also led to a notable improvement in groundwater levels, supporting sustainable agriculture and local water security.

Event

A 2-kilometer stretch of road in the Deshalpar (Kanthi) farm area was cleaned and treated with GSB, significantly improving local transportation. This development benefits orchard residents by easing school commutes for children and facilitating smoother market access for farmers to transport their produce.

In the villages of Tragadi and Modhva, a community shed was constructed to support the local fishing community. This facility will serve as a valuable space for social gatherings, events, and collective activities, benefiting all residents in the area.

STORIES

Empowering Dreams— From the Tides to Triumph

Hasan Kadar's journey began in the fishing village of Tragadi, where his family's daily life was shaped by the rhythms of the sea. Although the expectation was for him to follow the family tradition, Hasan dreamed of something greater—a career in engineering that would allow him to chart his own course.

He attended primary school in Tragadi and later completed high school in Nana Bhadiya, demonstrating an unwavering thirst for knowledge. However, the financial realities of his family's situation threatened to halt his studies after graduation. Hasan understood well that achieving ambitious goals often requires either substantial resources or a fortunate break.

At a time when his future looked uncertain, the Adani Foundation extended a helping hand. Their financial support enabled Hasan to enroll in a diploma program in electrical engineering, where he threw himself into his studies and excelled academically.

Today, Hasan is not only advancing in his profession but also serves as an inspiration to those around him.

"Today, Hasan stands as a successful engineer.He wholeheartedly acknowledges the pivotal role played by the Adani Foundation in his journey, expressing, "Dreaming of something and achieving it are separated by a vast distance. For me, my dream of becoming an engineer felt unattainable. But the Adani family appeared as a blessing, turning my dream into reality.

STORIES

A Journey of Grit and Gratitude: Najir's Remarkable Achievement

Najir Manjaliya, a bright student from the fishing village of Bhadreshwar in Kutch, overcame financial challenges to pursue his dream of education. In 2023, he joined Adani Vidya Mandir Bhadreshwar in Class IX and quickly adapted to its disciplined and nurturing environment. With unwavering dedication and support from his teachers, Najir excelled academically and scored an impressive 93.33% in his Class X SSC Board Examination. Grateful for the guidance he received, Najir now aspires to become an IAS officer, embodying the transformative power of education and perseverance.

STORIES

Perseverance Enabled through Adani Foundation Support

Gafurbhai Luhar, born in 1973 in Motikhakhar village in Gujarat's Mundra taluka, experienced paralysis in both legs at the age of five due to illness and complications from medical treatment. Despite living with a 65% disability, he continued his education with the assistance of his father, completing up to the seventh standard.

Following the passing of his parents, Gafurbhai resided with his elder brother but sought independence by selling vegetables locally. He was provided a three-wheeled cycle by the Adani Foundation; however, challenging road conditions and the 400-meter distance to his shop presented significant mobility barriers. Seasonal changes further exacerbated these difficulties.

Upon sharing his challenges with an Adani Foundation representative, Gafurbhai was subsequently provided with an electric wheelchair. This assistance greatly improved his mobility, enabling him to travel between his home and his shop efficiently, and participate in community activities independently. He acknowledges the support received from the Adani Foundation in enhancing his quality of life and appreciates their responsiveness to his situation.

STORIES

Journey of Healing and Resilience:

Tirthavandan Maharaj Saheb, a 50-year-old ascetic recognized for his disciplined and spiritual way of life, resided within a family comprising four brothers and two sisters. Notably, his younger brother, aged 19, had also committed to an ascetic lifestyle. Despite his dedication, Maharaj Saheb encountered significant health challenges that tested his resilience.
Approximately one year ago, Maharaj Saheb underwent a routine hernia repair in Mumbai. Unexpectedly, he experienced severe postoperative pain at the surgical site, which resulted in six months of immobility and substantial limitations in walking and daily activities. Seeking further evaluation, he traveled to Surat, where an MRI identified post-operative neuritis of the inguinal nerves, considered responsible for his persistent symptoms.
Upon his arrival at Adani Hospital in Mundra, Maharaj Saheb was welcomed by a compassionate team of healthcare professionals who provided thorough and attentive care. The treatment plan, carefully tailored to his unique needs, included advanced pain management, physiotherapy, and ongoing support to address his post-operative complications. Over the course of his stay, Maharaj Saheb gradually regained strength and mobility, which marked a significant turnaround from his previous state of immobility.
With the support of hospital staff, Maharaj Saheb made a strong recovery and can now walk and engage in daily spiritual practices. He expressed deep gratitude to the Adani Foundation.

STORIES

An Initiative by the Adani Foundation

The Tejasvi Saheli Group, established in 2017 under the aegis of the Adani Foundation, serves as a notable example of community-driven women empowerment. The group originated in Baroi village with 12 women who, post-tailoring training at the Adani Skill Development Centre, sought to achieve economic independence.

With Adani foundational support and resources the Tejasvi Saheli Group started manufacturing school bags and clothing, steadily expanding their market to nearby towns like Bhuj and Anjar. Demonstrating adaptability, the group quickly pivoted during the COVID-19 pandemic to manufacture masks for a government contract, ensuring ongoing income while serving public health needs. Their entrepreneurial evolution continued in 2021 as they diversified into handicrafts, formed strategic partnerships, and participated in exhibitions, which significantly boosted their monthly earnings.

By 2024, the group had grown to 17 members, acquired additional equipment, opened a dedicated center, and secured major orders for designer Navratri attire, resulting in members earning between ₹13,000 and ₹14,000 monthly.

Till the date cumulative earnings of the Group stand at ₹44,96,600 This journey exemplifies how targeted support, skill development, and market responsiveness can drive sustainable economic empowerment for women within a community.

STORIES

"Empowering Independence

Alarkhiya Jusab, aged 48, is a resident of Mota Paiya village of Khavda Taluka. Born with a disability affecting both legs, has relied on manual mobility since childhood. Following the loss of their father, daily responsibilities and challenges increased his Struggle significantly.

After his elder brother's marriage and subsequent relocation, he became solely responsible for the care of his elderly mother and household tasks. To support the family, he rented a small cabin in Khavda from a local village leader and stocked it with essential goods to earn an income. Despite these efforts, substantial obstacles remained, faced difficulties to returning home due to the distance of the bus stop and frequent refusal by passing vehicles to provide transportation,

Previously, traversing the village manually had subjected Alarkhiya to ridicule. Upon learning of his Struggle , we contact and assessed and support a battery-operated vehicle which has paly pivotal role to improve his quality of life.

Now, he is able to commute daily with ease and provide enhanced care for his mother. This case highlights the transformative role of focused community support and accessible technology in promoting independence, dignity, and improved well-being.

Honorable Governor of Gujarat Visited Mundra Solar Pvt Limited – Female Technical Solar Associate

Handing over Process by Honorable Governor of Gujarat at Bhopa Wandh Solar Village

Bhoomi Pujan for Gaushala and Adani Van in Wanki, a Library in Beraja, and a Library cum Education Center in Mota Bhadiya. Additionally, the pond beautification and deepening work was initiated in Kandagra.

Appreciation letter from important stakeholder(s)

॥ વંદે માતરમ ॥ ॥ શ્રી ગૌ માતાય નમઃ ॥

ટ્રસ્ટ રજી નં. ઈ-૩૬૯૯/કચ્છ.

શ્રી મુરલીધર ગૌસેવા ટ્રસ્ટ

ગામ : ગુંદાલા, તા. મુન્દ્રા-કચ્છ.

સન્માન પત્ર

દાતા સન્માન સમારંભ – ૨૦૨૫

અદાણી ફાઉન્ડેશન

સુકા ચારાના સહયોગ

આપશ્રી દ્વારા શ્રી મુરલીધર ગૌ સેવા ટ્રસ્ટ-ગુંદાલા ને જે સહયોગ મળેલ છે જે બદલ અમો આપશ્રીના ઋણી છીએ...

આગામી સમયમાં આપશ્રી જીવનમાં સફળતાના સોપાનો સર કરો અને દીર્ઘાયુ જીવન મેળવો તેવી પ્રાર્થના સહ

આપની ઉજ્જવળ કારકિર્દીની શુભેચ્છા પાઠવીએ છીએ અને આપશ્રી સતત આ રીતે ગૌસેવાના કાર્યો કરતા રહો તેવી અપેક્ષા સહ...

આપના આભારી...

શ્રી મુરલીધર ગૌસેવા ટ્રસ્ટ–ગુંદાલા

॥ વેદ વિના મતિ નહી,
ગાય વિના ગતિ નહી ॥

॥ વિના સહકાર નહી ઉદ્ધાર ॥

શ્રી સમાધોઘા વા.વિ.પ્રા.શાળા નં.-૧

તા.મુંદરા-કચ્છ.

આભારપત્ર

પરમ સ્નેહીશ્રી
અદાણી ફાઉન્ડેશન
મુંદરા.

આથી શ્રી સમાધોઘા વા.પિ.પ્રા.શાળા -૧ પરિવાર હર્ષની લાગણી અનુભવે છે કે શ્રી અદાણી ફાઉન્ડેશન (એજ્યુકેશન વિભાગ-મુંદરા) મુંદરાના શિક્ષણના હિતોને પ્રાધાન્ય આપીને શાળા કક્ષા લેવલના અનેક વિધ પ્રોગ્રામ ચલાવી રહ્યા છે. જેના થકી મુંદરાના શિક્ષણમાં પ્રગતિશીલ કાર્ય થયું છે.

સબબ આ પ્રોજેકટ પૈકીનો એક પ્રોજેકટ એટલે "ઉત્થાન પ્રોજેકટ" જેના થકી શ્રી સમાધોઘા વા.પિ.પ્રા.શાળા -૧ શાળાને બાલા પેન્ટીંગનો મહંદ અંશે લાભ મળેલ છે. જે શૈક્ષણિક કાર્યમાં ખૂબ જ ઉપયોગી થયેલ છે. તેમજ શાળામાં પર્યાવરણલક્ષી વાતાવરણ બનાવવા માટે આપશ્રી દ્વારા બગીચામાં ટપક પદ્ધતી અને ફૂલછોડ સાથેનું ખુબ જ ઉત્તમ અને ઉપયોગી કાર્ય કરેલ છે. જે બદલ એસ.એમ.સી. અને શાળા પરીવાર આપશ્રીનો ખૂબ ખૂબ હૃદય પૂર્વક આભાર વ્યકત કરે છે.

ભવિષ્યમાં પણ શાળામાં અદાણી ફાઉન્ડેશ અને ઉત્થાન પ્રોજેકટ અંતર્ગત વિશેષ કાર્યો થાય અને બાળકોના શૈક્ષણિક કાર્યમાં અને શાળા સંકુલમાં ઉપયોગી રહો તેવી અપેક્ષા સાથે શુભકામના...

તારીખ : ૨૮/૦૩/૨૦૨૫
સ્થળ : શ્રી સમાધોઘા વા.પિ.પ્રા.શાળા નં.૧

એસ.એમ.સી. તથા શાળા પરિવાર
શ્રી સમાધોઘા વા.પિ.પ્રા.શાળા નં.૧
મુંદરા-કચ્છ.

આભાર પત્ર

આદરણીય પંકતીબેન શાહ

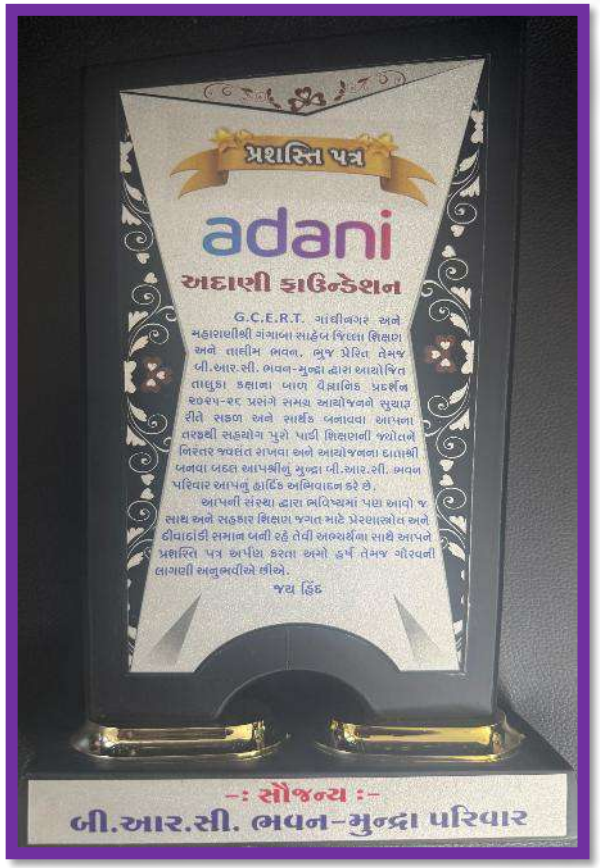
અદાણી ફાઉન્ડેશન, મુંદરા.

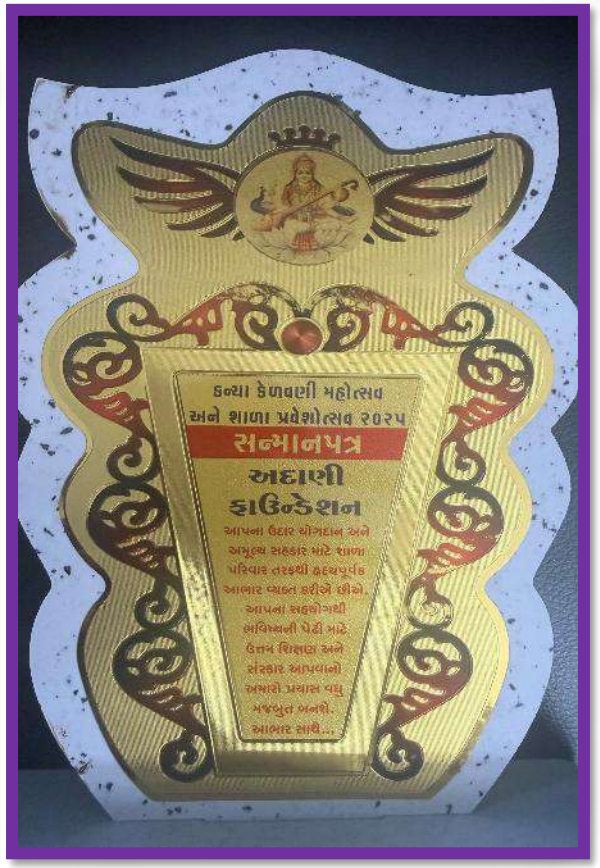
જય ભારત સહ સાથે જણાવવાનું કે અદાણી ફાઉન્ડેશન ની સમાજ માટે પ્રેરણારૂપ મહિલા સશક્તિકરણ ની ડામગીરી તમે કરી રહ્યા છો તે અમારા માટે પ્રેરણા અને પ્રોત્સાહન આપી રહ્યા છે આપ ના સહકાર અને માર્ગદર્શન હેઠળ શ્રી સમુધ્ધ ફાઉન્ડેશન નાના કપાયા દ્વારા મહિલાઓ તથા બાળકો માટે પ્રવૃત્તિ તેમજ રોજગાર મળી રહે તેવા પ્રયાસો હાથ ધરીએ છીએ શ્રી સમુધ્ધ ફાઉન્ડેશન ના પ્રમુખ હેમાક્ષી ઉદય કુમાર રાણા તરફથી છેલ્લા ત્રણ વર્ષથી આપ ના સહકાર અને માર્ગદર્શન હેઠળ મુન્દ્રા તાલુકાના નાનાકપાયા ગામ ની બહેનો સાથે મળીને રંગોલી તેમજ શાન્તીવન કોમપલેક્ષ ખાતે ચાલી રહેલી ફુડ સીસ્ટર સે સ્વસહાય જુથ ગ્રુપ દ્વારા બહેનો પોતાની રોજગારી મેળવી રહી છે તે બદલ શ્રી સમુધ્ધ ફાઉન્ડેશન વતી અમે આપના સહયોગ બદલ આભાર વ્યકત કરીએ છીએ તેમજ આગળ પણ આપણા સહકાર ની અપેક્ષા સહ...

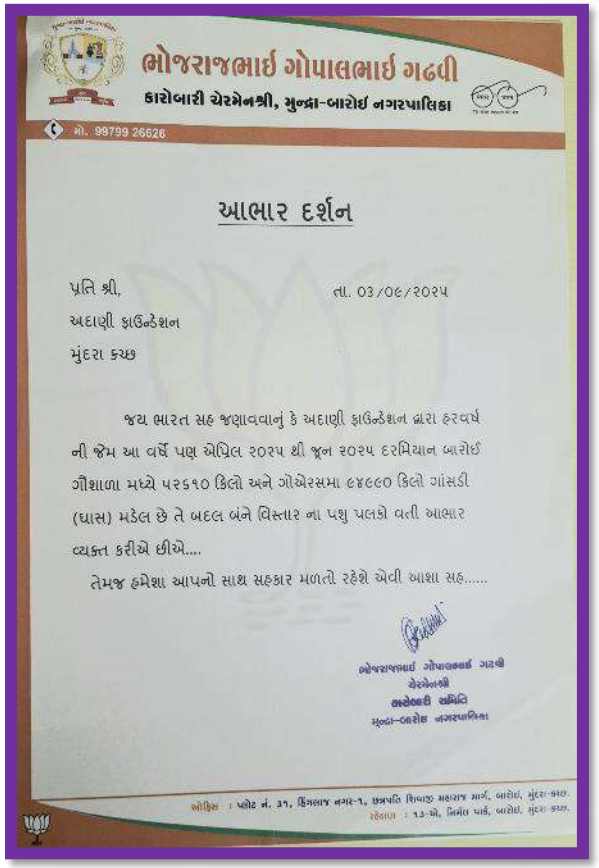
હેમાક્ષી ઉદય કુમાર રાણા તેમજ ટીમ

શ્રી સમુધ્ધ ફાઉન્ડેશન, નાના કપાયા

Appreciation letter from important stakeholder(s)







Annexure – 3

Outlook

FW: User is not active - GCP-usq79i

From Chiragsing Rajput <Chiragsing.Rajput@adani.com>
Date Tue 10/7/2025 1:05 PM
To Bhagwat Swaroop Sharma <Bhagwat.Sharma1@adani.com>; Radheshyam Singh <Radheshyam.Singh@adani.com>
Cc Anil Trivedi <Anil.Trivedi@adani.com>

FYIP....

Regards,
Chiragsing Rajput

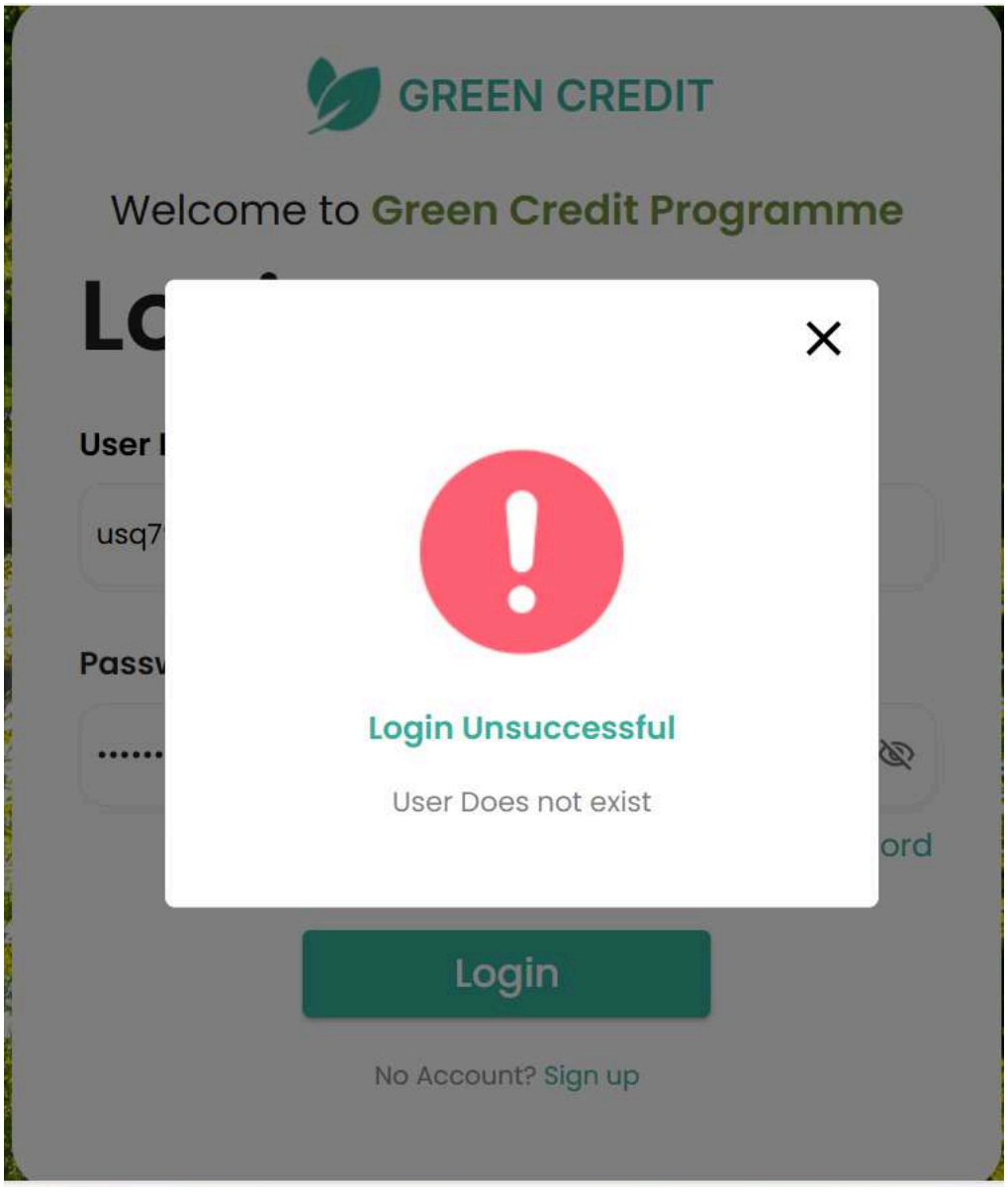
From: query_gcp@icfre.org <query_gcp@icfre.org>
Sent: 07 October 2025 10:40
To: Chiragsing Rajput <Chiragsing.Rajput@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir,
Thank you for showing interest in participating in the **Green Credit Programme (GCP)**.
Please note that the **GCP portal is currently under upgradation as per the revised methodology and guidelines for tree plantation based green credits**. You may proceed with the registration process. As soon as the portal is fully ready to work as per the revised methodology and guidelines, **verification and activation of your registered IDs will be updated**. It may take two to four weeks.
We appreciate your patience and cooperation. You can visit our website "moefcc-gcp.in" for more information.
With regards,
Ajay Kumar, Scientist – E
Green Credit Cell,
ICFRE, Dehradun

-----"Chiragsing Rajput" <Chiragsing.Rajput@adani.com> wrote: -----
To: "query_gcp@icfre.org" <query_gcp@icfre.org>
From: "Chiragsing Rajput" <Chiragsing.Rajput@adani.com>
Date: 09/26/2025 12:16PM
Subject: RE: User is not active - GCP-usq79i

Dear Sir,

Still, it is showing User does not exist. Please do the needful accordingly.



Regards,
Chiragsing Rajput

From: query_gcp@icfre.org <query_gcp@icfre.org>
Sent: 16 September 2025 16:30
To: Chiragsing Rajput <Chiragsing.Rajput@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir,
Thank you for showing interest in participating in the **Green Credit Programme (GCP)**.
Please note that the **GCP portal is currently under upgradation as per the revised methodology and guidelines for tree plantation based green credits**. You may proceed with the registration process. As soon as the portal is fully ready to work as per the revised methodology and guidelines, **verification and activation of your registered IDs will be updated**. It may take two to four weeks.
We appreciate your patience and cooperation. You can visit our website "moefcc-gcp.in" for more information.
With regards,
Ajay Kumar, Scientist – E
Green Credit Cell,
ICFRE, Dehradun

-----"Chiragsing Rajput" <Chiragsing.Rajput@adani.com> wrote: -----
To: "query_gcp@icfre.org" <query_gcp@icfre.org>
From: "Chiragsing Rajput" <Chiragsing.Rajput@adani.com>
Date: 09/09/2025 02:17PM
Cc: "Anil Trivedi" <Anil.Trivedi@adani.com>, "Bhagwat Swaroop Sharma" <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir / Madam,

We are awaiting for your reply in subjected matter.

Regards,
Chiragsing Rajput
M No. +91 9687678443

From: Chiragsing Rajput
Sent: 25 July 2025 18:48
To: query_gcp@icfre.org
Cc: Anil Trivedi <Anil.Trivedi@adani.com>; Bhagwat Swaroop Sharma <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir / Madam,

We are awaiting for your reply in subjected matter.

Regards,
Chiragsing Rajput

From: Chiragsing Rajput
Sent: 26 June 2025 12:58
To: query_gcp@icfre.org
Cc: Anil Trivedi <Anil.Trivedi@adani.com>; Bhagwat Swaroop Sharma <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir / Madam,

We are awaiting for your reply in subjected matter.

Regards,
Chiragsing Rajput

From: Chiragsing Rajput
Sent: 13 June 2025 12:03
To: query_gcp@icfre.org
Cc: Anil Trivedi <Anil.Trivedi@adani.com>; Bhagwat Swaroop Sharma <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir / Madam,

Is there any update regarding activation of private entity users under Green Credit Programme?

Regards,
Chiragsing Rajput

From: query_gcp@icfre.org <query_gcp@icfre.org>
Sent: 15 May 2025 09:20
To: Chiragsing Rajput <Chiragsing.Rajput@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir,

The Green Credit Programme is currently in its piolet stage, hence at this stage only Eco-restoration cum tree plantation based green credit activities in this direction only the PSUs are allowed to participate as entity and State Forest Departments as Implementing Agency. Private entities may be allowed later. We will keep you informed as we progress and expand the program to private entities participation. Your user ID, if created, will be activated accordingly.

Thank you for your understanding and enthusiasm towards Green Credit Programme.

With Regards,

Green Credit Cell, ICFRE

-----"Chiragsing Rajput" <Chiragsing.Rajput@adani.com> wrote: -----
To: "query_gcp@icfre.org" <query_gcp@icfre.org>
From: "Chiragsing Rajput" <Chiragsing.Rajput@adani.com>
Date: 05/12/2025 06:54PM
Cc: "Anil Trivedi" <Anil.Trivedi@adani.com>, "Bhagwat Swaroop Sharma" <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir/ Madam,

Awaiting for your reply in line with trailing mail.

Regards,
Chiragsing Rajput
M No. +91 9687678443

From: Chiragsing Rajput
Sent: 29 April 2025 18:47

To: query_gcp@icfre.org
Cc: Anil Trivedi <Anil.Trivedi@adani.com>; Bhagwat Swaroop Sharma <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir/ Madam,

In line with trailing mail, is there any update regarding expand the Green Credit program to the private entities participation?

Regards,
Chiragsing Rajput
M No. 9687678443

From: query_gcp@icfre.org <query_gcp@icfre.org>
Sent: 25 February 2025 15:54
To: Chiragsing Rajput <Chiragsing.Rajput@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir,

The Green Credit Programme is currently in its piolet stage, hence at this stage only Eco-restoration cum tree plantation based green credit activities in this direction only the PSUs are allowed to participate as entity and State Forest Departments as Implementing Agency. Private entities may be allowed later. We will keep you informed as we progress and expand the program to private entities participation. Your user ID, if created, will be activated accordingly.

Thank you for your understanding and enthusiasm towards Green Credit Programme.

With Regards,

Green Credit Cell, ICFRE

-----"Chiragsing Rajput" <Chiragsing.Rajput@adani.com> wrote: -----
To: "query_gcp@icfre.org" <query_gcp@icfre.org>
From: "Chiragsing Rajput" <Chiragsing.Rajput@adani.com>

Date: 02/17/2025 11:52AM
Cc: "Anil Trivedi" <Anil.Trivedi@adani.com>, "Bhagwat Swaroop Sharma" <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir/ Madam,

In line with trailing mail, is there any update regarding expand the Green Credit program to the private entities participation?

Regards,
Chiragsing Rajput
M. No. +91 9687678443

From: Chiragsing Rajput
Sent: Friday, February 7, 2025 5:45 PM
To: query_gcp@icfre.org
Cc: Anil Trivedi <Anil.Trivedi@adani.com>; Bhagwat Swaroop Sharma <Bhagwat.Sharma1@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir/ Madam,

In line with trailing mail, is there any update regarding expand the Green Credit program to the private entities participation?

Regards,
Chiragsing Rajput

From: query_gcp@icfre.org <query_gcp@icfre.org>
Sent: Wednesday, October 16, 2024 11:40 AM
To: Chiragsing Rajput <Chiragsing.Rajput@adani.com>
Cc: Anil Trivedi <Anil.Trivedi@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear sir,

The Green Credit Programme is currently in its piolet stage, hence at this stage only the PSUs are allowed to participate as entity and State Forest Departments as Implementing Agency. Private entities may be allowed later. We will keep you informed as we progress and expand the program to private entities participation. Your user ID, if created, will be activated accordingly.

Thank you for your understanding and enthusiasm towards Green Credit Programme.

With Regards,

Green Credit Cell, ICFRE

-----"Chiragsing Rajput" <Chiragsing.Rajput@adani.com> wrote: -----
To: "query_gcp@icfre.gov.in" <query_gcp@icfre.gov.in>
From: "Chiragsing Rajput" <Chiragsing.Rajput@adani.com>
Date: 10/10/2024 11:35AM
Cc: "Anil Trivedi" <Anil.Trivedi@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir,

In line with the discussion held with Dr. Sanjay Singh (Administrator) yesterday, we came to know that, at present the Green Credit Programme scheme is live for Government institutes/ agencies only.

As of now the said scheme is not in existence for private agencies / industrial sectors.

We are requesting you to please let us know, as and when this scheme become live for private agencies / industrial sectors.

Thanks & Regards,
Chiragsing Rajput
Environment Department | Adani Ports & Special Economic Zone Ltd.
Mob +91 9687678443 | Ext. 59523 | chiragsing.rajput@adani.com | www.adani.com
Adani Corporate House, 3rd Floor, North Wing, Shantigram, Ahmedabad - 382421, Gujarat, India.

From: Chiragsing Rajput
Sent: Friday, September 27, 2024 12:16 PM
To: query_gcp@icfre.gov.in
Cc: Anil Trivedi <Anil.Trivedi@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir / Madam,

Kindly do the needful to resolve the query as per trailing mail.

Regards,
Chiragsing Rajput

From: Chiragsing Rajput
Sent: Tuesday, September 17, 2024 2:16 PM
To: 'query_gcp@icfre.gov.in' <query_gcp@icfre.gov.in>
Cc: Anil Trivedi <Anil.Trivedi@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir / Madam,

Kindly do the needful to resolve the query as per trailing mail.

Regards,
Chiragsing Rajput

From: Chiragsing Rajput
Sent: Wednesday, September 11, 2024 10:41 AM
To: query_gcp@icfre.gov.in
Cc: Anil Trivedi <Anil.Trivedi@adani.com>
Subject: RE: User is not active - GCP-usq79i

Dear Sir / Madam,

Kindly do the needful to resolve the query as per trailing mail.

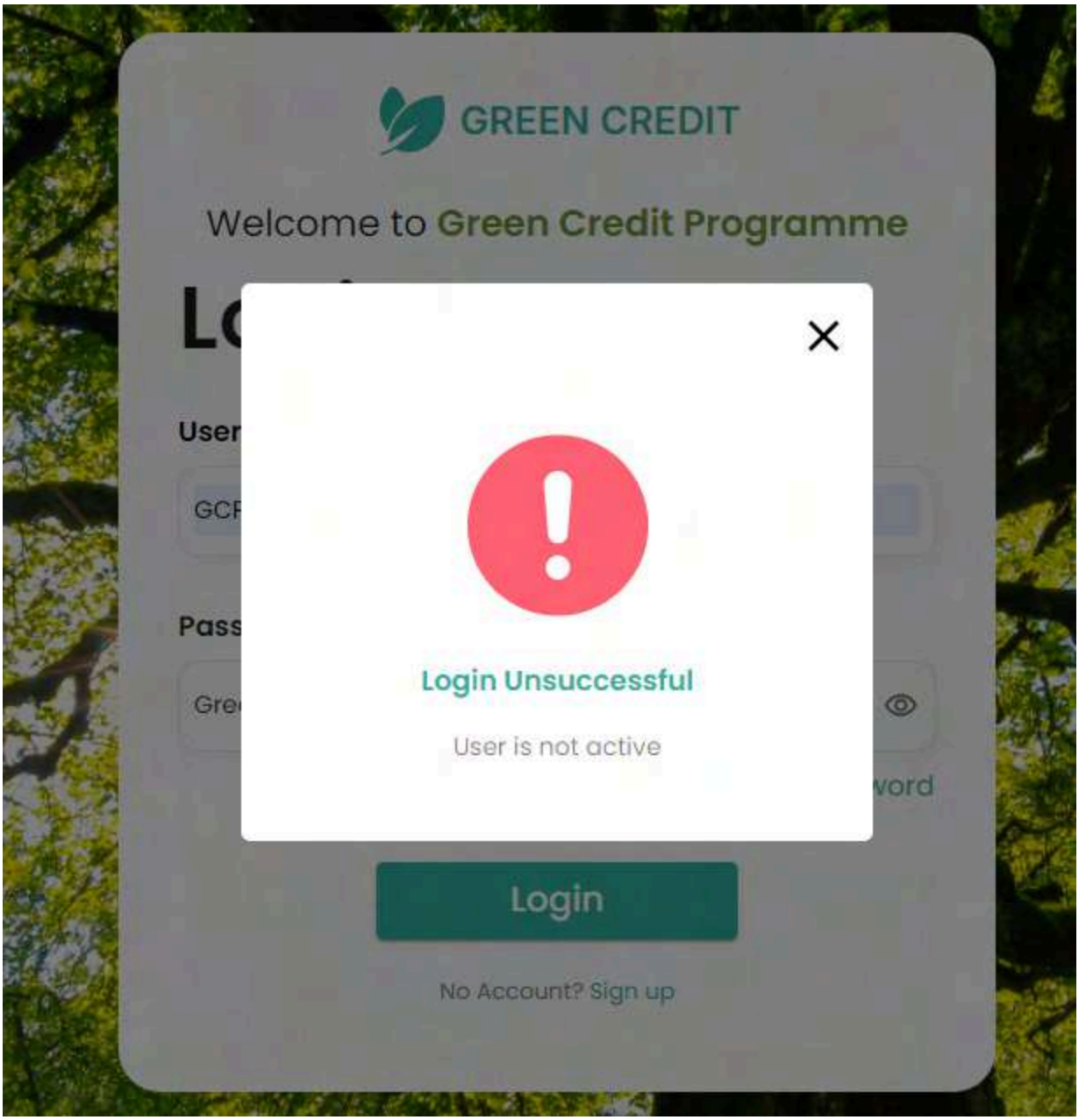
Regards,
Chiragsing Rajput

From: Chiragsing Rajput
Sent: Friday, September 6, 2024 1:59 PM
To: query_gcp@icfre.gov.in
Cc: Anil Trivedi <Anil.Trivedi@adani.com>
Subject: User is not active - GCP-usq79i

Dear Sir / Madam,

We have registered under Green Credit Programme and user id generated as **GCP-usq79i.**

However, while trying to login, the error is showing that user is not active. Kindly do the needful to resolve the same.



Thanks & Regards,
Chiragsing Rajput
Environment Department | Adani Ports & Special Economic Zone Ltd.
Mob +91 9687678443 | Ext. 59523 | chiragsing.rajput@adani.com | www.adani.com
Adani Corporate House, 3rd Floor, North Wing, Shantigram, Ahmedabad - 382421, Gujarat, India.

DISCLAIMER: The information contained in this electronic message and any other attachment to this message are intended solely for the addressee and may contain information that is confidential, privileged and exempt from disclosure under applicable law. If you are not the intended recipient, you are hereby formally notified that any use, copying or distribution of this e-mail, in whole or in part, is strictly prohibited. Please immediately notify the sender by return e-mail and delete all copies of this e-mail and any attachments from your system. Any views or opinions presented in this email are solely those of the author and do not necessarily represent those of the company.

WARNING: Computer viruses can be transmitted via email. The recipient should check this email and any attachments for the presence of viruses. Adani Group accepts no liability for any damage caused by any virus transmitted by this email.

Disclaimer:Please do not print this email unless it is absolutely necessary.

This email is exclusively intended for the addressee(s) and may contain proprietary, confidential or privileged information. If you are not the intended recipient, you should not disseminate, distribute or copy this e-mail. Please notify the sender immediately and destroy all copies of this message and any attachments.

Warning: Computer viruses can be transmitted via email. The recipient should check this email and any attachments for the presence of viruses. ICFRE accepts no liability for any damage caused by any virus transmitted by this email.

www.icfre.gov.in

DISCLAIMER: The information contained in this electronic message and any other attachment to this message are intended solely for the addressee and may contain information that is confidential, privileged and exempt from disclosure under applicable law. If you are not the intended recipient, you are hereby formally notified that any use, copying or distribution of this e-mail, in whole or in part, is strictly prohibited. Please immediately notify the sender by return e-mail and delete all copies of this e-mail and any attachments from your system. Any views or opinions presented in this email are solely those of the author and do not necessarily represent those of the company.

WARNING: Computer viruses can be transmitted via email. The recipient should check this email and any attachments for the presence of viruses. Adani Group accepts no liability for any damage caused by any virus transmitted by this email.

Disclaimer:Please do not print this email unless it is absolutely necessary.

Annexure – 4

Compliance Report of Marine EMP

Sr. No.	Suggested Measures	Compliance Status
✍ **Construction Phase:**		
✍ **Dredging and Reclamation Management Plan**		
1	Installation of silt screens around the dredging area to prevent dispersion of suspended sediment plume into the adjacent areas and fish species from entering the activity area.	Being Complied Silt curtains is being provided during dredging activity around the dredging area to prevent dispersion of suspended sediment plume into the adjacent areas and fish species from entering the activity area. For further details regarding control measures for dredging activity, please refer to Water Quality Monitoring and Preservation condition no 3.2 of the EC and CRZ clearance.
2	Turbidity levels will be maintained as to the baseline data by continuous monitoring and proper care by way of stopping the activities whenever there is increase in turbidity by way of land sliding/bottom turbulence so avoid any impact either to water quality or to marine organisms	Being Complied Dredging activity is being carried out in proper manner so that turbidity level can be maintained.
3	Dredge Management Programme shall include measures to avoid entrapment of macro marine fauna.	Complied Dredging activity is being carried out through a well-trained / skilled manpower/ team in line with the SOP / management plan. All the measures are being taken to avoid entrapment of macro marine fauna.
4	Dredging shall be done in a planned manner following grid pattern	Complied Dredging activity is being carried out in planned manner so no adverse impact will happen on marine ecology.
5	Sheet piling will be done around the project area to avoid spreading and sliding of reclaimed sediments into the marine environment.	Complied This compliance covers points 5 & 6.
6	The land (mostly inter tidal) to be reclaimed with dredged material will be separated from adjoining land by creating containment bund for effective compaction on the soil	Total 3.07 MCuM Capital dredging or reclamation is carried out in CRZ area (except CRZ-IA area) since Oct'24 to Sep'25 for Expansion of Waterfront

Sr. No.	Suggested Measures	Compliance Status
	and avoid runoff into adjoining land	Development Plan in line with approved EC & CRZ Clearance. Out of which 1.52 MCuM is carried out during the compliance period Apr'25 to Sep'25. Total 3.07 MCuM Capital dredging or reclamation is carried out in CRZ area (except CRZ-IA area) since Oct'24 to Sep'25 for Expansion of Waterfront Development Plan in line with approved EC & CRZ Clearance. Out of which 1.52 MCuM is carried out during the compliance period Apr'25 to Sep'25.. The entire quantity 3.07 MCum of capital dredged material was used for reclamation / level raising within approved area. While carrying out reclamation, containment bund / sheet piling will be made for effective compaction on the soil and avoid runoff into adjoining land.
7	Shoreline Protection Techniques such as Sand by passing if any will be carried.	Complied. Shoreline protection is being taken while carrying out dredging / reclamation activity.
8	Detailed borehole analysis of sub-surface seabed sediments for sediment characteristics analysis to identify heavy metal or other pollutant contamination	Complied. For further details regarding water & marine monitoring, please refer to specific condition no 1.12 of the EC and CRZ clearance.
9	If the sediment is contaminated it shall be treated before being utilized for reclamation purpose	Point Noted and Agreed Sediment/ dredged material to be utilized for reclamation / level raising is being analyzed before using.
10	Detailed biological analysis of benthic community richness and population in the sites proposed for reclamation	Complied. For further details regarding marine monitoring, please refer to specific condition no 1.12 of the EC and CRZ clearance.
11	Dredging shall only be done in fair weather period, daytime and avoid fish breeding and migratory	Complied Dredging activity is being done in fair

Sr. No.	Suggested Measures	Compliance Status
	seasons.	weather, daytime and during none fish breeding and spawning seasons only and dredged material is being disposed-off in line permission granted in EC & CRZ Clearance.
12	To compensate the loss of mangroves in the reclamation area, mangroves afforestation measure is being executed in the nearby areas.	Complied. There is no mangrove or mangrove buffer area present in the area proposed for reclamation / level raising. For further details regarding mangrove conservation & afforestation, please refer to specific condition no 1.5 & 1.6 of the EC and CRZ clearance.
13	Utmost care shall be taken to ensure that the drainage pattern of the intertidal areas and creeks are not altered due to the proposed activities.	Complied. For further details regarding creek conservation, please refer to specific condition no 1.13 of the EC and CRZ clearance.
✍ **Construction of Breakwater, SBM, Island Jetty and Berth (quay lengths)**		
1	Care should be taken to prevent the contaminated runoff from the construction site entering into the marine environment and nearby natural streams, if any, by isolating the area of development from the surrounding waters.	Complied Recently developed additional quay length in South port @ 615 meter (400 meter Jetty for Liquid / Gas / Cryogenic cargo handling + 215 meter Multi-purpose T2 Jetty extension) along with its related infrastructure facilities / back-up area has been developed for increase in Cargo Handling Capacity i.e. Liquid Cargo & Container Cargo by developing new berths along with its supporting infrastructure facilities/ utilities and regularizing General / Dry Cargo handling capacity in line with existing port capacity. And balance proposed expansion, construction of new berth/berth quay length extension, backup area and other activity will be carried out phase wise as per future business requirement basis. No new construction of Breakwater, Sea Island jetty and SPM has been undertaken. Advance construction methodology is being applied for construction of berth to
2	Proper silt barriers and floater booms shall be deployed around the construction site in water environment to avoid dispersion of debris/ sediment plume.	
3	During construction of breakwater and New port the spillage of construction materials and oil spill from these heavy machinery/ equipment shall be well maintained	
4	The best suitable and minimal impact methodology shall be adopted for piling to avoid the impact of noise and vibration on the marine species by controlling the rate of dredging and by isolating the area devoid of any pelagic species.	

Sr. No.	Suggested Measures	Compliance Status
		avoid marine water contamination as well as isolating the area of development from the surrounding waters. For further details regarding control measures during construction activity, please refer to specific condition no 1.9, 1.17 & 3.2 of the EC and CRZ clearance.
5	Grab dredging shall be done in areas of sandy stratum.	Point Noted and Agreed
6	Storage areas for sand and soil, and all work areas must be at least 20m away from the high-water mark	Complied.
7	Construction site near water need to be kept tidy to prevent tools and debris from falling into the water and damaging the environment	Point Noted and being complied
8	Project proponent shall appoint a supervisor to be present at construction site for inspection and smooth operation	Point Noted and being complied
9	Any accidents at site including spillage of construction materials, fuel oil, debris etc shall be contained and removed immediately.	Point Noted and Agreed
10	Any such accidents shall be reported immediately by the site supervisor to keep track and avoid any further incidents.	Point Noted and Agreed
11	Construction activities shall be limited to daytime to prevent the increased possibility of risk due to night time and reduce the impact of artificial lighting on marine ecological environment.	Point noted and being complied.
12	The existing mangrove afforestation program shall be adopted for compensating the loss of mangroves, if any due to the proposed construction.	Complied. For further details regarding mangrove conservation & afforestation, please refer to specific condition no 1.5 & 1.6 of the EC and CRZ clearance.
13	During installation of offshore SPM‟s/SBM‟s and a sea island jetty appropriate mooring system shall be adopted based on detailed engineering study to reduce footprint area	Point Noted and Will be complied
14	Emergency preparedness and spill control measures such as floater booms, skimmers shall be present	Point Noted and Will be complied

Sr. No.	Suggested Measures	Compliance Status
	either in the proposed SPM‟s/SBM‟s and a sea island jetty or in readily available manner to prevent any incidents of spill, system failure and transportation facility rupture.	
Water Quality Maintenance and Protection of Marine Organisms: Sub-Sea Pipelines and Intake, Outfall Pipeline		
As a part of WFDP-Expansion, we have not undertaken any activity w.r.t. laying of Sub-Sea Pipelines and Intake, Outfall Pipeline. Once it is initiated, we will comply all the measures suggested / recommended in EMP.		
1	During laying of sub-sea pipelines, the major action of concern is the spillage of on-board fuel/oil from vessel or pipe laying instruments	Point Noted and Will be complied
2	Spill control measures shall be available on-board to contain any spill while laying of the pipelines	
3	The installation activity shall be done avoiding peak photosynthesis period of the day to reduce the impact on plankton population	
4	Marine environmental monitoring shall be done during the pre-installation and post installation stage to analyze the change in baseline environment.	
5	Since the area has very poor algal growth, as the sandy/muddy substratum is associated with relatively high turbidity which does not support the growth of algal species and patchy occurrence of seaweed species minimal temporary impact is envisaged on the marine environment due to pipeline installation	
Operation Phase:		
Dredging Management Plan		
1	Silt screens shall be installed around the maintenance dredging areas and spoil disposal site to contain the sediment plume dispersing into the surrounding environment.	Being Complied The entire quantity of maintenance dredged material is being disposed off in deep sea at identified locations. For further details regarding control measures for dredging activity, please refer to Water Quality Monitoring and Preservation condition no 3.2 of the EC and CRZ clearance.

Sr. No.	Suggested Measures	Compliance Status
2	Sediment screens also help in preventing fishes from entering into the activity core zone to avoid any possible injury or death	Point Noted and Agreed
3	Disposal shall be done during fair weather period and avoid peak photosynthesis period avoiding the impact on planktons and other benthic species in the vicinity	Point Noted and Agreed
4	Detailed benthic species analysis shall be done in the identified disposal sites to mitigate the impact on benthic species caused by smothering effect	Point Noted and Being Complied For further details regarding Marine Water Quality Monitoring condition no 1.12 of the EC and CRZ clearance.
5	Due to strong tidal currents and water circulation the disposed sediments will be majorly dispersed into the marine environment causing minimal temporary impact in the disposal site as the benthic species have the ability to rejuvenate back to the baseline scenario	Point Noted and Agreed
6	The dredged spoil shall be analyzed for heavy metal and other pollutant concentration prior to disposal	Point Noted and Agreed
7	Noise mitigation measures such as bubble barriers/curtains, double pile, filled double pile, double walled air-filled sleeve around the pile, can be used to reduce noise generated from piling.	Point Noted and Agreed
Cargo handling in the proposed Waterfront and Offshore Berths/Jetty:		
Recently developed additional quay length in South port @ 615 meter (400 meter Jetty for Liquid / Gas / Cryogenic cargo handling + 215 meter Multi-purpose T2 Jetty extension) along with its related infrastructure facilities / back-up area has been developed for increase in Cargo Handling Capacity i.e. Liquid Cargo & Container Cargo by developing new berths along with its supporting infrastructure facilities/ utilities and regularizing General / Dry Cargo handling capacity in line with existing port capacity. And balance proposed expansion, construction of new berth/berth quay length extension, backup area and other activity will be carried out phase wise as per future business requirement basis. All the mitigation measures to avoid air, water or land contamination is being taken and the same will be implanted during proposed expansion activity also.		
Multipurpose Cargo Handling in Ports		
1	Handling of Multipurpose cargo (coal, iron ore, limestone, fertilizers, food grains, cement, etc), hazardous cargo (Ethylene,	Point Noted and being complied with. APSEZ is being fully implemented the provisions of proper handling of

<table>
<tr><th>Sr. No.</th><th>Suggested Measures</th><th>Compliance Status</th></tr>
<tr><td></td><td>Propylene (Propene), Butadiene, Pentane, etc) and liquid/ gas/ cryogenic cargo (LNG, propane, LPG, etc) has the possibility of contaminating the marine environment when coming into contact</td><td>Multipurpose cargo (coal, iron ore, limestone, fertilizers, food grains, cement, etc). Also, we are fully implementing & following coal handling guidelines for coal handling activity.

Oil spill contingency plan is in place to handle Tier 1 level oil spills considering different accident scenarios, and the vulnerable areas are identified and mitigation plan is prepared.

Oil spill contingency response plan is being updated on regular basis and the same was last updated on July 2025 is in place and implemented. Updated Oil spill contingency response plan attached as Annexure 6.

In order to analyzed marine water quality, marine sampling (surface, bottom & sediment) is being carried out at a location nearby SPM by NABL and MoEF&CC accredited agency namely M/s. Unistar Environment and Research Labs Pvt. Ltd., Vapi. Summary of the same for duration from Apr'25 to Sep'25 is mentioned below.

Total Sampling Locations: 09 Nos.
(Frequency: Once a month)
<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit</th><th colspan="3">Surface</th><th colspan="3">Bottom</th></tr>
<tr><th>Min</th><th>Max</th><th>Avg.</th><th>Min</th><th>Max</th><th>Avg.</th></tr>
<tr><td>pH</td><td>--</td><td>7.96</td><td>8.28</td><td>8.17</td><td>7.81</td><td>8.4</td><td>8.01</td></tr>
<tr><td>BOD (3 Days @ 27 oC)</td><td>mg/L</td><td>2.4</td><td>3.5</td><td>2.96</td><td>BDL (MDL:1.0)</td><td>BDL (MDL:1.0)</td><td>BDL (MDL:1.0)</td></tr>
<tr><td>TSS</td><td>mg/L</td><td>112</td><td>164</td><td>138.15</td><td>86</td><td>132</td><td>113.59</td></tr>
<tr><td>DO</td><td>mg/L</td><td>6.37</td><td>7.04</td><td>6.69</td><td>6.27</td><td>6.83</td><td>6.56</td></tr>
<tr><td>Salinity</td><td>ppt</td><td>35.71</td><td>36.71</td><td>36.16</td><td>36.62</td><td>37.45</td><td>37.05</td></tr>
<tr><td>TDS</td><td>mg/L</td><td>35140</td><td>36640</td><td>35726</td><td>35996</td><td>37250</td><td>36517</td></tr>
</table>
*BDL – Below Detection Limit
*MDL – Minimum Detection Limit
Please refer Annexure – 5 for detailed analysis reports. Approx. INR 8.73 Lakh has been spent for all environmental monitoring activities during the compliance period i.e. FY 2025-26 till Sep'25 for overall APSEZ, Mundra.</td></tr>
<tr><td>2</td><td>The cargo handling facility and</td><td>Point Noted and Agreed</td></tr>
</table>

Sr. No.	Suggested Measures	Compliance Status
	operations shall be monitored by an site supervisor	
3	In case of a cargo spill the cargo handling activity shall be kept on halt based on spill quantity and immediate action for removal of cargo spilt shall done	Point Noted and Agreed
4	Cargo handling shall be done only during fair weather period	Point Noted and Agreed
5	Spillage or leak of liquid and other hazardous cargo during handling from vessel to onsite facility shall be contained in the manner of utilizing floater booms and skimmers.	Point Noted and being complied with. For detailed information please refer to specific condition no. 1.18 of EC & CRZ compliance.
6	In case of a dense liquid utmost care shall be taken to avoid any spill accidents because dense liquid when settling onto seabed destroys the benthos in the region.	Point Noted and Agreed
7	Possible dusty cargos shall be water sprayed to reduce the particulate emissions arising during cargo handling	Point Noted and Agreed
8	Mechanization of cargo handling facility will further reduce the possibilities of spillage and accidents	Point Noted and being Complied with.
9	The Multipurpose cargo include hazardous cargo and liquid/gas/cryogenic cargo emergency response and preparedness plan shall be place	Complied. For detailed information please refer to specific condition no. 1.19 of EC & CRZ compliance.
10	Online monitoring system for pressure gauges, operation valves, pipeline pressure, transfer point junctions, storage tanks, etc shall be installed and periodically maintained.	Point Noted and being complied with.
11	Floating, marking buoys, Signboards will be displayed to educating the seafarers about the orientation of approach channel	Point Noted and being complied with.
12	Acoustic Barriers and Enclosures and the conveyor galleries will be covered.	Complied. Please refer to specific condition 1.15 of EC & CRZ compliance report for further details.
Liquid Cargo Handling in Offshore Facilities:		
1	Emergency preparedness plan for	Complied

Sr. No.	Suggested Measures	Compliance Status
	handling liquid cargo in the offshore facilities shall be in place	Please refer to specific condition 1.19 of EC & CRZ compliance report for further details.
2	In case of an unlikely event of spillage of liquid cargo while handling from vessel to facility, it shall be immediately acted upon by containing the spill and removing from the marine environment	Complied This reply covers condition no 2 & 3
3	If the spillage or leak occurs during transporting the liquid cargo from the offshore facility to the Port, the source shall be cut-off to prevent major disaster and the leak/ spill shall be handled through floater booms, skimmers, biological degradation and suction methods.	Please refer to specific conditions 1.18 & 1.19 of EC & CRZ compliance report for further details.
4	Pressure sensors in the pipeline transportation system shall be regularly monitored to ensure no leak in the system.	Point Noted and being complied with.
5	Periodical monitoring for quality assurance of pipeline system and offshore facility has to be done.	Being Complied
6	Trained personnel shall be employed for liquid cargo handling in areas of manual operation to avoid accidents.	Complied
7	An online monitoring system shall be installed in Port for monitoring the handling/ transportation of liquid cargo from off-shore facility to port.	Point Noted and being complied with.
8	The monitoring shall include pipe pressure sensors, valves/ junctions/joints pressure sensors, flow velocity and automized cut-off systems.	Point Noted and being complied with.
9	Emergency response team shall be deployed in such a manner to address any possible event in the shortest response time and period.	Complied Please refer to specific condition 1.19 for further details.
10	Ensure that slop tanks will be provided to barges/ workboats for collection of liquid/ solid waste	Point Noted and Agreed
11	Floating, marking buoys, Signboards will be displayed to educating the seafarers about the orientation of approach channel	Point noted and being complied with.
Discharge from ETP, Desalination Plant and Bilge Water:		

Sr. No.	Suggested Measures	Compliance Status
At present no sea discharge from ETP as well as bilge water. The existing Outfall channel is suitable for 300 MLD Desalination capacity. For additional desalination plant capacity will have intake & outfall with pipeline system.		
1	Continuous online monitoring system of the combined discharge from ETP and Desalination Plant shall be done to ensure that the outfall characteristics does not exceed the CPCB discharge standards.	Will be complied Continuous online monitoring system of the combined discharge from ETP and Desalination Plant will be provided once pipeline with diffuser system laid.
2	The outfall shall be diluted with raw sea water in an mixing chamber prior to disposal into marine environment to avoid change in baseline conditions	Outfall will be diluted with raw sea water in a mixing chamber prior to disposal into marine environment to avoid change in baseline conditions.
3	The outfall diffusers shall be monitored via flow sensors to ensure proper dispersion of outfall.	Will be complied Outfall diffusers will be monitored via flow sensors to ensure proper dispersion of outfall once pipeline with diffuser system laid.
4	Periodical monitoring of marine water, sediment and other biological components shall be done to analyze the change in baseline conditions if any.	Complied. Periodical monitoring of marine water, sediment and other biological components is being carried out at regular interval including existing intake and outfall points. The same will be continued after proposed expansion also. Please refer to specific condition no 1.12 of EC & CRZ compliance for further details.
5	Maximum utilization of treated waste water from ETP shall be done with the port to reduce the outfall quantity	Will be complied Maximum utilization of treated water from ETP will be done for horticulture purposes within port premises. Sea discharge will be done if it does not confirm the permissible norms for on land utilization.
6	Discharge of waste into the sea will be prohibited	Point Noted and Agreed
7	Oil Spill control measures will be adopted	Complied. Please refer to specific condition no 1.18 of EC & CRZ compliance for further details.
8	Ensure that slop tanks will be provided to barges/ workboats for	Point Noted and Complied

Sr. No.	Suggested Measures	Compliance Status
	collection of liquid/ solid waste	
9	Discharge of treated wastewater as per marine discharge standards	Complied Please refer to Water Quality Monitoring and Preservation condition no 3.3 of EC & CRZ compliance with further details.
10	Ships will be prohibited from discharging wastewater, bilge, oil wastes, etc. into the nearshore as well as harbour waters by adopting International Convention for the Prevention of Pollution from Ships (MARPOL) 1974/1978, Consolidated Edition, IMO, 1991, including 1992 amendments to Annex 1 and 2002 amendments.	Point Noted and Being Complied with. Please refer to Water Quality Monitoring and Preservation condition no 3.3 of EC & CRZ compliance with further details.
11	Ships shall conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 m in depth prior to calling at a Shipyard Cum Captive jetties including LNG Terminal.	Point Noted Please refer to specific condition no 1.21 of EC & CRZ compliance for further details
12	Regular Interactions shall be initiated with the fishing community and conflicts, if any with fishing community shall be amicably resolved in all cases.	Point Noted and being complied with Please refer to specific condition 1.26 & 1.29 of EC & CRZ compliance for further details regarding CSR activities by Adani foundation.
13	Shoreline Protection Techniques such as Sand by passing if any will be carried.	Point Noted and Agreed
Measures to maintain the Beaches/Sand Dunes and to conserve Turtle Nesting sites		
There are no Beaches, Sand Dunes and Turtle Nesting sites around the project site. Hence, below measures are not applicable to our project.		
1	The fixture will be mounted as low as possible to minimize light trespass and the lowest amount of light needed for the task shall be used.	Not Applicable
2	Long wavelength lights will be used wherever possible. Low pressure sodium (LPS) lights are considered more desirable than HPS sources. Short wavelength (blue) and broad spectrum sources such as metal halide, mercury vapour, fluorescent or halogen lights will be avoided.	
3	Amber filters on HPS lights will be	

Sr. No.	Suggested Measures	Compliance Status
	used if HPS lights use cannot be avoided,	
4	White lights that emit ultraviolet light will not be used.	
5	Strong blue or green spectral elements (eg. mercury vapour lights) will be limited as far as possible.	
6	Lights will be directed downward and will be shielded to avoid overhead glow on cloudy nights	
7	To mitigate the erosion related issues, sand by passing / Beach nourishment is considered as one way to mitigate erosion. The classical mitigation measures such as shore walls, groynes, etc is completely avoided since it may prohibit access of sea turtles to nearby nesting beaches.	
8	Awareness programmes for local fisher population, company laborers and employees shall be undertaken to highlight sea turtle conservation. Awareness regarding fisheries related issues is also necessary among fishing community.	
9	Incidental capture of turtles in shrimp trawls and gill nets account for more deaths than all other human activities combined. In addition to the trawl entanglement, sea turtles have been killed after becoming entangled in other types of fishing gear, such as, gill nets, long lines (hook and line), and lobster or crab pot lines.	
10	Creation of awareness among villagers and fishermen shall be undertaken as part of conservation measures.	

Annexure – 5

“Half Yearly Environmental Monitoring Reports “

For,

adani
Ports and Logistics

M/S. ADANI PORTS & SPECIAL ECONOMIC ZONE LTD. (WFDP-West Port)

PLOT NO: - NAVINAL ISLAND, Village - MUNDRA, Tal. – Mundra, DIST. - KUTCH - 370421.

Monitoring Period: April – 2025 to September - 2025

Submitted By

UniStar
Environment and Research Labs Pvt. Ltd.

UniStar Environment & Research Labs Pvt. Ltd.

Plot No. 51 Vibrant Business Park Vapi, Dist. Valsad 396191 l Gujarat l India

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF STP OUTLET WATER

SR.NO.	TEST PARAMETERS	UNIT	WFDP WEST PORT STP OUTLET						GPCB Permissible Limit	TEST METHOD
			Apr-25		May-25		Jun-25			
			11-04-2025	25-04-2025	01-05-2025	12-05-2025	05-06-2025	16-06-2025		
1.	pH @ 25 ° C	--	7.24	7.33	7.14	7.52	7.28	7.46	6.5 to 9	IS 3025 (Part-11):2022
2.	Total Suspended Solids	mg/L	12	14	16	14	12	16	100	APHA 24th Ed.2023,2540 -D
3.	Biochemical Oxygen Demand (BOD) (5 days at 20 ° C)	mg/L	29.4	17.5	24.2	18.4	24.5	39.9	30	APHA 24th Ed.2023,5210-B
4.	Residual chlorine	mg/L	7.3	5.3	6.7	5	6	8	0.5 Min.	APHA 24th Ed.2023,4500-Cl-G
5.	Fecal Coliform	MPN Index/100 ml	4.25	7.6	4.1	5.2	4.4	4.6	1000	IS 3025 (Part-11):2022

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF STP OUTLET WATER

SR.NO.	TEST PARAMETERS	UNIT	WFDP WEST PORT STP OUTLET						GPCB Permissible Limit	TEST METHOD
			Jul-25		Aug-25		Sep-25			
			01-07-2025	14-07-2025	04-08-2025	18-08-2025	02-09-2025	20-09-2025		
1	pH @ 25 ° C	--	7.52	7.41	7.36	7.58	7.17	6.86	6.5 to 9	IS 3025(Part-11):2022
2	Total Suspended Solids	mg/L	18	18	14	16	10	18	100	APHA 24th Ed.2023,2540
3	Biochemical Oxygen Demand (BOD) (5 days at 20 ° C)	mg/L	44.2	48.2	30.2	32.4	36.2	44.1	30	APHA 24th Ed.2023,5210
4	Residual chlorine	mg/L	9.4	9.2	8	8.2	7.5	8.2	0.5 Min.	APHA 24th Ed.2023,4500-Cl-G
5	Total Nitrogen	mg/L	8.4	8.8	8.6	8.5	9.5	9.8	--	APHA 24th Ed.,2023,4500-B, C
6	Total Phosphorus	mg/L	0.8	0.82	0.75	0.81	0.84	0.87	--	APHA 24th Ed.,2023,4500-P, D
7	Fecal Coliform	MPN Index/100ml	90	60	80	70	50	80	1000	IS 3025 (Part-11):2022

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

RESULTS OF ETP OUTLET WATER

SR.NO.	TEST PARAMETERS	UNIT	LIQUID TERMINAL						GPCB Limit	TEST METHOD
			Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25		
			27-04-2024	12-05-2025	05-06-2025	14-07-2025	18-08-2025	02-09-2025		
1	pH @ 27 ° C	--	7.45	6.91	7.35	7.68	7.74	7.47	6.5 to 8.5	IS 3025(Part 11):2022
2	Temperature	^{0}C	31	31	30.5	30	30	30	40	IS 3025(Part 9):2023
3	Colour	Pt. Co. Scale	40	40	50	60	50	50	100	IS 3025(Part 4):2021
4	Total Suspended Solids	mg/L	24	22	28	26	28	74	100	APHA 24th Ed.2023,2540 – D
5	Oil & Grease	mg/L	BDL(MDL:4.0)	BDL(MDL:4.0)	BDL(MDL:4.0)	BDL(MDL:4.0)	BDL(MDL:4.0)	BDL(MDL:4.0)	10	IS 3025(Part 39):2021
6	Ammonical Nitrogen	mg/L	24.5	28.6	32.2	25.2	22.6	35.4	50	IS 3025(Part 34):1988,
7	BOD (3 days at 27 ^{0}C)	mg/L	21	24.5	26	23	24	23	30	IS 3025(Part 44):2023
8	COD	mg/L	72.4	88.4	87.8	76.4	85.2	86.2	100	IS 3025(Part 58):2023
9	Chloride (as Cl) $^-$	mg/L	262.5	240	349.9	402.4	333.6	441.5	600	IS 3025(Part 32):1988
10	Sulphate (as SO_4)	mg/L	36	32	36.4	42	48	66	1000	IS 3025(Part 24):2022
11	Total Dissolved Solids	mg/L	710	744	760	1010	1000	1120	2100	APHA 24th Ed.2023,2540- C
12	Percent Sodium	%	47.13	46.3	47.44	47.65	46.47	46.55	60	By Calculation
13	Phenolic Compound	mg/L	BDL(MDL:0.1)	BDL(MDL:0.1)	BDL(MDL:0.1)	BDL(MDL:0.1)	BDL(MDL:0.1)	BDL(MDL:0.1)	1	IS 3025(Part 43):2022

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

SR. NO.	TEST PARAMETERS	UNIT	LIQUID TERMINAL						GPCB Limit	TEST METHOD
			Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25		
			27-04-2024	12-05-2025	05-06-2025	14-07-2025	18-08-2025	02-09-2025		
14	Sulphide as S	mg/L	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.1)	BDL(MDL:0.05)	BDL(MDL:0.05)	2	APHA 24th Ed.2023,4500 S^{-2} F
15	Sodium Absorption ratio	--	2.90	3.1	3.3	3	3.1	3.2	26	By Calculation
16	Copper as Cu	mg/L	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	**3**	IS 3025(Part 42):1992
17	Lead as Pb	mg/L	BDL(MDL:0.01)	BDL(MDL:0.01)	BDL(MDL:0.01)	BDL(MDL:0.01)	BDL(MDL:0.01)	BDL(MDL:0.01)	0.1	APHA 24th Ed.2023,3111-B
18	Cadmium as Cd	mg/L	BDL(MDL:0.003)	BDL(MDL:0.003)	BDL(MDL:0.003)	BDL(MDL:0.003)	BDL(MDL:0.003)	BDL(MDL:0.003)	2	APHA 24th Ed.2023,3111-B
19	Fluoride as F	mg/L	0.62	0.59	0.44	0.51	0.48	0.68	2	APHA 24th Ed.2023,4500 F, D
20	Residual Chlorine	mg/L	BDL(MDL:0.1)	BDL(MDL:0.1)	BDL(MDL:0.1)	0.62	BDL(MDL:0.1)	BDL(MDL:0.1)	0.5 Min.	APHA 24th Ed.2023,4500-Cl-G

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

MARINE WATER MONITORING SUMMARY REPORT

RESULTS OF MARINE WATER [M1 LEFT SIDE OF BOCHA CREEK - N 22°45'183" E 069°43'241"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	8.09	7.88	8.18	8.02	8.14	7.92	8.11	7.94	8.14	8.02	8.06	7.98	IS 3025(Part 11) :2022
2.	Temperature	°C	29.8	29.7	29.9	29.8	29.8	29.7	29.7	29.6	29.6	29.5	29.5	29.4	IS 3025 (Part 9):2023
3.	Total Suspended Solids	mg/L	116	88	122	94	118	86	134	110	142	116	148	122	APHA 24th Ed., 2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	3	BDL(MDL :1.0)	2.4	BDL(MDL :1.0)	2.8	BDL(MDL :1.0)	2.9	BDL(MDL :1.0)	2.6	BDL(MDL :1.0)	2.7	BDL(MDL :1.0)	IS 3025 (Part 44):2023
5.	Dissolved Oxygen	mg/L	6.83	6.73	6.65	6.55	6.83	6.73	6.65	6.55	6.71	6.6	6.57	6.47	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	36.54	37.15	36.68	37.28	36.52	37.15	36.4	36.98	36.32	36.84	36.12	36.71	By Calculation
7.	Oil & Grease	mg/L	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	IS 3025 (Part 39) :2021
8.	Nitrate as NO_3	µmol/L	2.1	1.77	2.74	2.58	3.06	2.74	3.55	3.23	3.06	2.9	2.74	2.58	APHA 24th Ed. 2023,4500 NO3-B
9.	Nitrite as NO_2	µmol/L	0.283	0.261	0.304	0.283	0.37	0.326	0.283	0.261	0.304	0.283	0.261	0.239	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	4.11	4.06	4.32	4.27	4.85	4.79	3.59	3.48	3.42	3.39	3.59	3.48	APHA 24th Ed. 2023,4500- NH3 B
11.	Phosphates as PO_4	µmol/L	1.26	1.16	1.37	1.26	1.26	BDL(MDL :0.4)	1.58	1.37	1.47	1.37	BDL(MDL :0.4)	1.16	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	6.493	6.091	7.364	7.133	8.28	7.856	7.423	6.971	6.784	6.573	6.591	6.299	APHA 24th Ed. 2023,4500 NH3 - B
13.	Petroleum Hydrocarbon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	35324	36140	35604	36320	35426	36124	35140	36350	35174	36290	35210	36118	IS 3025(Part 16):2023
15.	COD	mg/L	32.7	20.4	27.9	16	29.1	16.6	24.4	12.2	28.1	16.1	32.2	20.1	IS 3025(Part 58):2023

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.
Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M1 LEFT SIDE OF BOCHA CREEK - N 22°45'183" E 069°43'241"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A	Phytoplankton														
1.	Chlorophyll	mg/m³	3.06	3.26	3.07	3.27	3.06	3.26	3.07	3.25	3.06	3.26	3.07	3.25	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	7	1.54	6	1.55	7	1.54	8	1.55	7	1.54	6	1.56	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10^3/L	113	92	112	91	113	92	112	91	113	93	112	92	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Coscinodiscus*	*Odontella*	*Nitzschia*	*Biddulphia*	*Nitzschia*	*Biddulphia*	*Thalassiothrix*	*Dinophysis*	*Thalassiothrix*	*Dinophysis*	*Thalassiothrix*	*Dinophysis*	APHA (24th Ed. 2023)10200A-G
			Diploneis	*Rhizosolenia*	*Diploneis*	*Rhizosolenia*	*Pinnularia*	*Rhizosolenia*	*Surirella*	*Pinnularia*	*Surirella*	*Pinnularia*	*Biddulphia*	*Pinnularia*	
			Rhizosolenia	*Coscinodiscus*	*Rhizosolenia*	*Coscinodiscus*	*Rhizosolenia*	*Coscinodiscus*	*Navicula*	*Thalassiothrix*	*Navicula*	*Thalassiothrix*	*Navicula*	*Thalassiothrix*	
			Dinophysis	*Grammatophora*	*Dinophysis*	*Grammatophora*	*Dinophysis*	*Grammatophora*	*Thallassiosira*	*Grammatophora*	*Nitzschia*	*Grammatophora*	*Nitzschia*	*Grammatophora*	
			Thalassionema	*Thallassiosira*	*Biddulphia*	*Navicula*	*Biddulphia*	*Navicula*	*Skeletonema*	*Ceratium*	*Skeletonema*	*Ceratium*	*Skeletonema*	*Ceratium*	

B	Zooplankton								
1	Abudance(Population)	noX103/ 100 m3	66	67	66	67	66	66	APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Crustacean Larvae*	*Oikoplura*	*Oikoplura*	*Egg(Fish and Shrimps)*	*Egg(Fish and Shrimps)*	*Egg(Fish and Shrimps)*	
			Egg(Fish and Shrimps)	*Pinnularia*	*Pinnularia*	*Oikoplura*	*Oikoplura*	*Oikoplura*	
			Copepods	*Copepods*	*Copepods*	*Copepods nauplii*	*Copepods nauplii*	*Copepods nauplii*	
			Crustacean	*Copepods nauplii*	*Copepods nauplii*	*Crustacean*	*Crustacean*	*Crustacean*	
			Bivalve Larvae	*Thalassionema*	*Thalassionema*	*Bivalve Larvae*	*Bivalve Larvae*	*Bivalve Larvae*	
3	Total Biomass	ml/100 m³	13.66	13.67	13.66	13.67	13.66	13.66	

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M1 LEFT SIDE OF BOCHA CREEK - N 22°45'183" E 069°43'241"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
C	Microbiological														
1	Total Bacterial Count	CFU/ml	112		113		112		114		112		112		APHA 24th Ed.2023,9215-C
2	Total Coliform	/100ml	12		13		12		13		14		14		APHA 24thEd.2023,9222-B
3	Ecoli	/100ml	87		88		87		88		89		89		IS :15185:2016
4	Enterococcus	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023,9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

GUJARAT VAPI.

Mr. Nitin Tandel
Technical Manager

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

RESULTS OF SEDIMENT ANALYSIS [M1 LEFT SIDE OF BOCHA CREEK - N 22°45'183" E 069°43'241"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1.	Organic Matter	%	0.46	0.51	0.48	0.44	0.48	0.52	IS: 2720 (Part 22):1972
2.	Phosphorus as P	µg/g	554.3	564.8	546	522	534	542	IS: 10158 :1982, Method B
3.	Texture	--	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Lab SOP No. UERL/CHM/LTM/108
4.	Petroleum Hydrocarbon	µg/g	N.D.	ND	ND	ND	ND	ND	APHA 24th Ed.2023,5520 F
5.0	Heavy Metals								
5.1	Aluminum as Al	%	4.03	4.08	3.58	3.62	3.59	3.44	IS3025(Part 55):2003
5.2	Total Chromium as Cr+3	µg/g	154.6	162.5	148.6	132.5	124.6	111.5	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.3	Manganese as Mn	µg/g	674.2	710.5	684.2	642.8	623.5	615.2	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.4	Iron as Fe	%	3.94	3.99	3.85	3.75	3.77	3.74	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.5	Nickel as Ni	µg/g	44.8	46.2	44.2	49.5	48.2	44.6	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.6	Copper as Cu	µg/g	58.2	62.8	58.6	51.2	46.4	42.8	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.7	Zinc as Zn	µg/g	115.6	121.5	125.6	112.4	115.2	120.4	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.8	Lead as Pb	µg/g	2.02	2.11	2.18	1.95	1.82	1.68	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.9	Mercury as Hg	µg/g	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	EPA 7471B (Extraction &Analytical Method) :2007

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M1 LEFT SIDE OF BOCHA CREEK - N 22°45'183" E 069°43'241"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
D	Benthic Organisms								
1	Macrobenthos	--	*Isopods*	*Isopods*	*Isopods*	*Foraminiferan*	*Foraminiferan*	*Foraminiferan*	APHA (24th Ed. 2023)10500
			Polychates	*Polychates*	*Polychates*	*Decapods Larvae*	*Decapods Larvae*	*Decapods Larvae*	
			Sipunculids	*Sipunculids*	*Sipunculids*	*Amphipods*	*Gastropods*	*Gastropods*	
			Amphipods	*Foraminiferan*	*Foraminiferan*	*Polychates*	*Polychates*	*Polychates*	
2	MeioBenthos	--	*Herpectacoids*	*Gastropods*	Herpectacoids	Turbellarians	*Turbellarians*	*Turbellarians*	
			Decapods Larvae	*Decapods Larvae*	*Decapods Larvae*	*Foraminiferan*	*Foraminiferan*	*Foraminiferan*	
3	Population	no/m²	366	367	366	367	366	366	

ENVIRONMENT & RESEARCH LABS PVT. LTD. * UNISTAR GUJARAT VAPI.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

RESULTS OF MARINE WATER [M2 MOUTH OF BOCHA & NAVINAL CREEK - N 22°44'239" E 069°43'757"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	8.12	7.96	8.19	8.4	8.24	8.04	8.18	7.95	8.22	7.98	8.12	7.94	IS 3025(Part 11):2022
2.	Temperature	°C	29.9	29.8	30	29.9	29.9	29.8	29.7	26.6	29.6	28.5	29.5	29.4	IS 3025(Part 9):2023
3.	Total Suspended Solids	mg/L	136	112	142	118	132	110	146	118	152	124	156	132	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	3.1	BDL(MDL :1.0)	2.8	BDL(MDL :1.0)	2.9	BDL(MDL :1.0)	3.1	BDL(MDL :1.0)	2.5	BDL(MDL :1.0)	2.6	BDL(MDL :1.0)	IS 3025(Part 44):2023
5.	Dissolved Oxygen	mg/L	6.73	6.53	6.55	6.35	6.73	6.53	6.55	6.35	6.6	6.4	6.47	6.27	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	36.08	37.12	36.18	37.19	36.22	37.02	36.05	36.87	35.98	36.74	35.86	36.62	By Calculation
7.	Oil & Grease	mg/L	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	IS 3025(Part 39):2021
8.	Nitrate as NO_3	µmol/L	2.58	2.42	2.42	2.26	2.74	2.58	3.06	2.74	3.39	3.23	3.06	2.9	APHA 24th Ed.2023,4500 NO3-B
9.	Nitrite as NO_2	µmol/L	0.37	0.348	0.261	0.239	0.304	0.283	0.326	0.304	0.283	0.261	0.304	0.283	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	4.01	3.95	4.22	4.16	4.74	4.69	3.64	3.59	3.53	3.48	3.48	3.42	APHA 24th Ed.2023,4500-NH3 B
11.	Phosphates as PO_4	µmol/L	1.05	BDL(MDL :0.4)	1.16	BDL(MDL :0.4)	1.26	1.05	1.16	BDL(MDL :0.4)	BDL(MDL :0.4)	BDL(MDL :0.4)	1.16	1.05	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	6.96	6.718	6.901	6.659	7.784	7.553	7.026	6.634	7.203	6.971	6.844	6.603	APHA 24th Ed.2023,4500 NH3 - B
13.	Petroleum Hydrocarbon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	36120	36880	36244	37010	35966	36848	35744	36820	35712	36540	35644	36380	IS 3025(Part 16):2023
15.	COD	mg/L	36.8	24.5	31.9	20	33.3	20.8	28.5	16.3	32.1	20.1	36.3	24.2	IS 3025(Part 58):2023

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M2 MOUTH OF BOCHA & NAVINAL CREEK - N 22°44'239" E 069°43'757"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A	Phytoplankton														
1.	Chlorophyll	mg/m³	2.95	2.65	2.96	2.66	2.97	2.67	2.96	2.66	2.97	2.67	2.98	2.66	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	2.05	2.02	2.04	2.01	2.03	2.02	2.02	2.01	2.01	2.02	2.02	2.04	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10³/L	91	143	92	142	91	141	92	142	93	143	92	142	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Thalassiothrix*	*Pinnularia*	*Thalassiothrix*	*Pinnularia*	*Dinophysis*	*Pinnularia*	*Navicula*	*Thalassiothrix*	*Surirella*	*Thalassiothrix*	*Surirella*	*Thalassiothrix*	APHA (24th Ed. 2023)10200A-G
			Surirella	*Biddulphia*	*Surirella*	*Biddulphia*	*Surirella*	*Biddulphia*	*Skeletonema*	*Surirella*	*Pinnularia*	*Surirella*	*Pinnularia*	*Surirella*	
			Navicula	*Navicula*	*Navicula*	*Navicula*	*Nitzschia*	*Navicula*	*Rhizosolenia*	*Navicula*	*Rhizosolenia*	*Navicula*	*Melosira*	*Navicula*	
			Thallassiosira	*Rhizosolenia*	*Cyclotella*	*Rhizosolenia*	*Cyclotella*	*Rhizosolenia*	*Dinophysis*	*Thallassiosira*	*Dinophysis*	*Thallassiosira*	*Dinophysis*	*Thallassiosira*	
			Skeletonema	*Skeletonema*	*Skeletonema*	*Thallassiosira*	*Skeletonema*	*Thallassiosira*	*Thalassionema*	*Skeletonema*	*Thalassionema*	*Skeletonema*	*Thalassionema*	*Skeletonema*	
B	Zooplankton														
1	Abudance (Population)	noX10 3/ 100 m3	42		43		42		41		43		43		APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Crustacean Larvae*		*Crustacean Larvae*		*Crustacean Larvae*		
			Copepods		*Oikoplura*		*Nitzschia*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		
			Copepods nauplii		*Copepods nauplii*		*Copepods nauplii*		*Copepods*		*Copepods*		*Copepods*		
			Crustacean		*Crustacean*		*Pinnularia*		*Crustacean*		*Crustacean*		*Copepods nauplii*		
			Bivalve Larvae		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		
3	Total Biomass	ml/100 m³	15.1		15.2		15.1		15.2		15.1		15.1		

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M2 MOUTH OF BOCHA & NAVINAL CREEK - N 22°44'239" E 069°43'757"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
C	Microbiological														
1	Total Bacterial Count	CFU/ml	134		135		134		132		134		134		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	34		36		37		36		35		35		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	12		13		12		11		11		11		IS :15185:2016
4	Enterococcus	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

GUJARAT VAPI.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M2 MOUTH OF BOCHA & NAVINAL CREEK - N 22°44'239" E 069°43'757"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1.	Organic Matter	%	0.52	0.56	0.52	0.49	0.52	0.51	IS: 2720 (Part 22):1972
2.	Phosphorus as P	µg/g	604.2	614.1	596.6	612.5	586	592	IS: 10158 :1982, Method B
3.	Texture	--	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Lab SOP No. UERL/CHM/LTM/108
4.	Petroleum Hydrocarbon	µg/g	ND	ND	ND	ND	ND	ND	APHA 24th Ed.2023,5520 F
5.0	Heavy Metals								
5.1	Aluminum as Al	%	3.98	4.05	3.82	3.74	3.66	3.56	IS3025(Part 55):2003
5.2	Total Chromium as Cr+3	µg/g	152.3	164.8	146.2	138.4	142.5	132.4	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.3	Manganese as Mn	µg/g	704	723	688	702	685	644.5	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.4	Iron as Fe	%	4.12	4.11	3.95	3.88	3.76	3.68	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.5	Nickel as Ni	µg/g	38.9	40.5	42.2	38.6	40.2	42.8	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.6	Copper as Cu	µg/g	49.5	51.6	52.4	46.2	44.6	41.3	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.7	Zinc as Zn	µg/g	112.4	115.5	120.2	114.6	111	130.4	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.8	Lead as Pb	µg/g	2.08	2.16	1.95	2.02	1.96	1.74	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.9	Mercury as Hg	µg/g	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	EPA 7471B (Extraction &Analytical Method) :2007

Continue...

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M2 MOUTH OF BOCHA & NAVINAL CREEK - N 22°44'239" E 069°43'757"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
D			Benthic Organisms						
1	Macrobenthos	--	*Decapods Larvae*	*Polychates*	*Polychates*	*Foraminiferan*	*Foraminiferan*	*Foraminiferan*	APHA (24th Ed. 2023)10500
			Isopods	Isopods	*Isopods*	*Gastropods*	*Gastropods*	Gastropods	
			Amphipods	*Amphipods*	*Gastropods*	*Isopods*	*Isopods*	*Isopods*	
			Sipunculids	*Sipunculids*	*Sipunculids*	*Sipunculids*	*Amphipods*	*Amphipods*	
2	MeioBenthos	--	*Foraminiferan*	*Foraminiferan*	*Decapods Larvae*	*Herpectacoids*	*Sipunculids*	*Sipunculids*	
			Herpectacoids	*Herpectacoids*	*Herpectacoids*	*Polychates*	*Polychates*	*Polychates*	
3	Population	no/m²	301	302	301	302	301	301	

GUJARAT VAPI. ENVIRONMENT & RESEARCH LABS PVT. LTD. UNISTAR

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

RESULTS OF MARINE WATER [M3 EAST OF BOCHAISLANOT DETECTED - N 22°46'530" E 069°41'690"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	8.17	8.04	8.28	8.11	8.22	8.09	8.17	8.02	8.25	8.08	8.16	8.02	IS 3025(Part 11):2022
2.	Temperature	°C	29.8	29.7	29.8	29.6	29.7	29.6	29.6	29.5	29.5	29.4	29.4	29.3	IS 3025(Part 9):2023
3.	Total Suspended Solids	mg/L	124	108	134	118	142	124	156	122	144	108	146	118	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	3.2	BDL(MDL: 1.0)	3.4	BDL(MDL: 1.0)	3.1	BDL(MDL: 1.0)	3.3	BDL(MDL: 1.0)	2.8	BDL(MDL: 1.0)	2.7	BDL(MDL: 1.0)	IS 3025(Part 44):2023
5.	Dissolved Oxygen	mg/L	6.73	6.63	6.55	6.45	6.73	6.63	6.55	6.45	6.6	6.5	6.47	6.37	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	35.98	37.24	36.21	37.35	36.18	37.16	36.12	36.98	35.88	36.74	35.72	36.68	By Calculation
7.	Oil & Grease	mg/L	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	IS 3025(Part 39):2021
8.	Nitrate as NO_3	µmol/L	2.9	2.74	2.58	2.26	2.9	2.74	3.39	3.06	3.55	3.39	3.23	3.06	APHA 24th Ed.2023,4500 NO3-B
9.	Nitrite as NO_2	µmol/L	0.413	0.391	0.348	0.326	0.304	0.283	0.348	0.304	0.261	0.239	0.261	0.239	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	4.11	4.06	4.11	4.01	4.64	4.58	3.74	3.69	3.59	3.48	3.39	3.32	APHA 24th Ed.2023,4500-NH3 B
11.	Phosphates as PO_4	µmol/L	1.16	1.05	1.05	BDL(MDL: 0.4)	1.16	1.05	1.47	1.37	1.58	1.47	1.37	1.26	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	7.423	7.191	7.038	6.596	7.844	7.603	7.478	7.054	7.401	7.109	6.881	6.619	APHA 24th Ed.2023,4500 NH3
13.	Petroleum Hydrocarbon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	35520	36260	35760	36554	35500	36110	35380	36288	35464	36350	35320	36110	IS 3025(Part 16):2023
15.	COD	mg/L	28.6	16.3	24	12	25	12.5	20.4	8.1	24.1	12	28.2	16.1	IS 3025(Part 58):2023

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M3 EAST OF BOCHAISLANOT DETECTED - N 22°46'530" E 069°41'690"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A			Phytoplankton												
1.	Chlorophyll	mg/m³	2.41	2.46	2.42	2.47	2.41	2.46	2.42	2.47	2.41	2.46	2.45	2.44	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	1.65	1.41	1.66	1.42	1.67	1.43	1.66	1.42	1.65	1.41	1.55	1.42	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10³/L	154	96	155	97	154	96	153	97	152	96	150	94	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Pinnularia*	*Coscinodiscus*	*Pinnularia*	*Coscinodiscus*	*Pinnularia*	*Coscinodiscus*	*Melosira*	*Cyclotella*	*Melosira*	*Cyclotella*	*Melosira*	*Cyclotella*	APHA (24th Ed. 2023)10200A-G
			Biddulphia	*Pinnularia*	*Biddulphia*	*Pinnularia*	*Biddulphia*	*Pinnularia*	*Pinnularia*	*Pinnularia*	*Pinnularia*	*Pinnularia*	*Pinnularia*	*Pinnularia*	
			Navicula	*Rhizosolenia*	*Navicula*	*Rhizosolenia*	*Navicula*	*Rhizosolenia*	*Skeletonema*	*Skeletonema*	*Rhizosolenia*	*Skeletonema*	*Rhizosolenia*	*Skeletonema*	
			Thallassiosira	*Dinophysis*	*Thallassiosira*	*Dinophysis*	*Thallassiosira*	*Dinophysis*	*Thallassiosira*	*Thallassiosira*	*Thallassiosira*	*Thallassiosira*	*Thallassiosira*	*Thallassiosira*	
			Skeletonema	*Thalassionema*	*Skeletonema*	*Thalassionema*	*Skeletonema*	*Thalassionema*	*Thalassionema*	*Thalassionema*	*Thalassionema*	*Thalassionema*	*Thalassionema*	*Thalassionema*	
B			Zooplankton												
1	Abudance (Population)	noX10 3/ 100 m3	41		42		41		43		41		41		APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Copepods*		*Copepods*		*Rhizosolenia*		*Crustacean*		*Crustacean*		*Crustacean*		
			Copepods nauplii		*Copepods nauplii*		*Crustacean Larvae*		*Copepods nauplii*		*Copepods nauplii*		*Copepods nauplii*		
			Egg(Fish and Shrimps)		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Crustacean Larvae*		*Crustacean Larvae*		*Crustacean Larvae*		
			Crustacean		*Pinnularia*		*Oikoplura*		*Crustacean*		*Crustacean*		*Egg(Fish and Shrimps)*		
			Bivalve Larvae		*Bivalve Larvae*		*Thalassionema*		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		
3	Total Biomass	ml/100 m³	15.3		15.2		15.3		15.2		15.3		15.3		

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M3 EAST OF BOCHAISLANOT DETECTED - N 22°46'530" E 069°41'690"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25	Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM		
C			Microbiological											
1	Total Bacterial Count	CFU/ml	142		143		144		143		144	144		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	32		31		30		31		33	33		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	21		22		21		20		22	22		IS :15185:2016
4	Enterococcus	/100ml	Absent		Absent		Absent		Absent		Absent	Absent		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent	Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent	Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent	Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI.

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M3 EAST OF BOCHAISLANOT DETECTED - N 22°46'530" E 069°41'690"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1.	Organic Matter	%	0.62	0.45	0.52	0.46	0.49	0.46	IS: 2720 (Part 22):1972
2.	Phosphorus as P	µg/g	624.3	596.5	602	582	566	552	IS: 10158 :1982, Method B
3.	Texture	--	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Lab SOP No. UERL/CHM/LTM/108
4.	Petroleum Hydrocarbon	µg/g	ND	ND	ND	ND	ND	ND	APHA 24th Ed.2023,5520 F
5.0	Heavy Metals								
5.1	Aluminum as Al	%	4.12	4.03	4.12	3.92	3.74	3.62	IS3025(Part 55):2003
5.2	Total Chromium as Cr+3	µg/g	130.2	136.4	114	121	116	118	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.3	Manganese as Mn	µg/g	524.6	550.8	546.2	564.2	554	582.2	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.4	Iron as Fe	%	3.94	3.88	3.67	3.71	3.54	3.62	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.5	Nickel as Ni	µg/g	44.3	49.4	48.6	51.2	48.6	43.2	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.6	Copper as Cu	µg/g	38.24	42.2	41.3	44.5	42.3	39.5	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.7	Zinc as Zn	µg/g	124.6	111.5	115.2	104.5	111.2	125	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.8	Lead as Pb	µg/g	2.03	1.95	1.84	1.76	1.55	1.62	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.9	Mercury as Hg	µg/g	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	EPA 7471B (Extraction &Analytical Method) :2007

Continue...

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M3 EAST OF BOCHAISLANOT DETECTED - N 22°46'530" E 069°41'690"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
D	Benthic Organisms								
1	Macrobenthos	--	Polychates	*Polychates*	*Amphipods*	*Gastropods*	*Gastropods*	*Decapods Larvae*	APHA (24th Ed. 2023)10500
			Gastropods	*Gastropods*	*Gastropods*	*Isopods*	*Isopods*	*Isopods*	
			Isopods	*Isopods*	*Isopods*	*Amphipods*	*Amphipods*	*Amphipods*	
			Sipunculids	*Sipunculids*	*Sipunculids*	*Sipunculids*	*Sipunculids*	*Sipunculids*	
2	MeioBenthos	--	*Herpectacoids*	*Herpectacoids*	*Herpectacoids*	*Polychates*	*Polychates*	*Foraminiferan*	
			Polychates	*Polychates*	*Polychates*	*Herpectacoids*	*Herpectacoids*	*Herpectacoids*	
3	Population	no/m²	297	298	297	296	297	297	

Mr. Nilesh Patel
Sr. Chemist

GUJARAT VAPI. UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD.

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M4 JUNA BANOT DETECTEDAR N 22°47'577" E 069°43'620"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	8.15	8.01	8.24	8.09	8.21	8.11	8.24	8.06	8.22	8.09	8.14	7.91	IS 3025(Part 11):2022
2.	Temperature	°C	29.7	29.6	29.8	29.7	29.7	29.6	29.5	29.4	29.4	29.3	29.3	29.2	IS 3025(Part 9):2023
3.	Total Suspended Solids	mg/L	124	106	112	94	134	108	162	114	132	110	142	124	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	3.1	BDL(MDL: 1.0)	2.7	BDL(MDL: 1.0)	2.9	BDL(MDL: 1.0)	2.6	BDL(MDL: 1.0)	2.7	BDL(MDL: 1.0)	2.9	BDL(MDL: 1.0)	IS 3025(Part 44):2023
5.	Dissolved Oxygen	mg/L	6.93	6.73	6.75	6.55	6.94	6.73	6.75	6.55	6.81	6.6	6.67	6.47	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	36.42	37.32	36.58	37.44	36.27	37.28	36.32	37.14	36.17	36.94	36.02	36.88	By Calculation
7.	Oil & Grease	mg/L	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	IS 3025(Part 39):2021
8.	Nitrate as NO_3	µmol/L	2.74	2.58	2.9	2.58	3.23	3.06	3.06	2.9	3.71	3.55	3.39	3.23	APHA 24th Ed.2023,4500 NO3-B
9.	Nitrite as NO_2	µmol/L	0.413	0.391	0.304	0.283	0.239	0.217	0.283	0.261	0.326	0.304	0.283	0.261	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	4.16	4.06	3.95	3.9	4.53	4.48	3.8	3.74	3.69	3.64	3.64	3.59	APHA 24th Ed.2023,4500-NH3 B
11.	Phosphates as PO_4	µmol/L	1.16	BDL(MDL: 0.4)	1.05	BDL(MDL: 0.4)	1.16	BDL(MDL: 0.4)	1.05	BDL(MDL: 0.4)	1.16	BDL(MDL: 0.4)	BDL(MDL: 0.4)	BDL(MDL: 0.4)	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	7.313	7.031	7.154	6.763	7.999	7.757	7.143	6.901	7.726	7.494	7.313	7.081	APHA 24th Ed.2023,4500 NH3 - B
13.	Petroleum Hydrocarbon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	36380	37090	36640	37250	36580	37138	36234	36940	35860	36520	35486	36322	IS 3025(Part 16):2023
15.	COD	mg/L	32.7	20.4	27.9	16	29.1	16.6	28.5	12.2	32.1	16.1	28.2	20.1	IS 3025(Part 58):2023

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M4 JUNA BANOT DETECTEDAR N 22°47'577" E 069°43'620"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A	Phytoplankton														
1.	Chlorophyll	mg/m³	2.36	3.1	2.37	3.2	2.36	3.1	2.37	3.2	2.36	3.1	2.35	3	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	2.2	9	2.1	8	2.2	7	2.1	6	2.2	7	2.1	8	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10³/L	155	87	154	88	155	87	154	88	155	89	154	88	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Coscinodiscus*	*Surirella*	*Surirella*	*Surirella*	*Coscinodiscus*	*Surirella*	*Thallassiosira*	*Coscinodiscus*	*Thallassiosira*	*Coscinodiscus*	*Thallassiosira*	*Coscinodiscus*	APHA (24th Ed. 2023)10200A-G
			Diploneis	*Biddulphia*	*Diploneis*	*Biddulphia*	*Diploneis*	*Biddulphia*	*Melosira*	*Diploneis*	*Melosira*	*Diploneis*	*Melosira*	*Diploneis*	
			Rhizosolenia	*Navicula*	*Thalassiothrix*	*Coscinodiscus*	*Skeletonema*	*Coscinodiscus*	*Nitzschia*	*Rhizosolenia*	*Nitzschia*	*Rhizosolenia*	*Nitzschia*	*Rhizosolenia*	
			Dinophysis	*Thallassiosira*	*Navicula*	*Thallassiosira*	*Navicula*	*Thallassiosira*	*Rhizosolenia*	*Dinophysis*	*Rhizosolenia*	*Dinophysis*	*Rhizosolenia*	*Dinophysis*	
			Thalassionema	*Skeletonema*	*Thalassionema*	*Skeletonema*	*Thalassionema*	*Skeletonema*	*Pleurosigma*	*Thalassionema*	*Pleurosigma*	*Thalassionema*	*Pleurosigma*	*Thalassionema*	

B	Zooplankton														
1	Abudance (Population)	noX10 3/ 100 m3	35		36		35		37		36		36		APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Oikoplura*		*Oikoplura*		*Copepods nauplii*		*Copepods nauplii*		*Copepods nauplii*		*Copepods nauplii*		
			Copepods nauplii		*Rhizosolenia*		*Rhizosolenia*		*Crustacean Larvae*		*Crustacean Larvae*		*Egg(Fish and Shrimps)*		
			Crustacean Larvae		*Crustacean Larvae*		*Egg(Fish and Shrimps)*		*Oikoplura*		*Oikoplura*		*Oikoplura*		
			Crustacean		*Crustacean*		*Crustacean*		*Bivalve Larvae*		*Bivalve Larvae*		*Copepods nauplii*		
			Bivalve Larvae		*Bivalve Larvae*		*Bivalve Larvae*		*Oikoplura*		*Oikoplura*		*Oikoplura*		
3	Total Biomass	ml/100 m³	14.28		14.27		14.26		14.27		14.26		14.26		

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M4 JUNA BANOT DETECTEDAR N 22°47'577" E 069°43'620"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
C			Microbiological												
1	Total Bacterial Count	CFU/ml	106		107		106		108		110		110		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	42		43		42		41		41		41		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	10		11		10		12		12		12		IS :15185:2016
4	Enterococcus	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI.

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M4 JUNA BANOT DETECTEDAR N 22°47'577" E 069°43'620"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1.	Organic Matter	%	0.48	0.54	0.52	0.47	0.44	0.48	IS: 2720 (Part 22):1972
2.	Phosphorus as P	µg/g	552.4	562.4	649.4	624.2	611.2	614	IS: 10158 :1982, Method B
3.	Texture	--	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Lab SOP No. UERL/CHM/LTM/108
4.	Petroleum Hydrocarbon	µg/g	ND	ND	ND	ND	ND	ND	APHA 24th Ed.2023,5520 F
5.0	Heavy Metals								
5.1	Aluminum as Al	%	4.11	4.15	3.82	3.76	3.64	3.58	IS3025(Part 55):2003
5.2	Total Chromium as Cr+3	µg/g	132.4	142.3	135.4	123.4	120	112.2	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.3	Manganese as Mn	µg/g	522.4	534.4	510.2	498.6	485	490.5	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.4	Iron as Fe	%	3.95	4.01	3.85	3.72	3.64	3.72	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.5	Nickel as Ni	µg/g	41.3	42.4	44.2	48.6	46.5	41.6	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.6	Copper as Cu	µg/g	58.6	64.5	62.1	66.7	65.2	55.8	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.7	Zinc as Zn	µg/g	440.6	466.5	456.2	172.5	180.5	164.2	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.8	Lead as Pb	µg/g	2.05	2.15	1.86	1.71	1.66	1.48	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.9	Mercury as Hg	µg/g	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	EPA 7471B (Extraction &Analytical Method) :2007

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M4 JUNA BANOT DETECTEDAR N 22°47'577" E 069°43'620"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
D	Benthic Organisms								
1	Macrobenthos	--	*Foraminiferan*	*Amphipods*	*Amphipods*	*Sipunculids*	*Sipunculids*	Sipunculids	APHA (24th Ed. 2023)10500
			Gastropods	*Gastropods*	*Gastropods*	*Decapods Larvae*	*Decapods Larvae*	*Decapods Larvae*	
			Isopods	*Isopods*	*Isopods*	*Polychates*	*Polychates*	*Polychates*	
			Sipunculids	*Sipunculids*	*Turbellarians*	*Isopods*	*Isopods*	*Foraminiferan*	
2	MeioBenthos	--	*Herpectacoids*	*Herpectacoids*	*Herpectacoids*	*Turbellarians*	Gastropods	*Gastropods*	
			Polychates	*Turbellarians*	*Decapods Larvae*	*Herpectacoids*	*Herpectacoids*	*Herpectacoids*	
3	Population	no/m²	301	302	303	301	302	302	

GUJARAT ENVIRONMENT & RESEARCH LABS PVT. LTD. VAPI.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M5 TOWARDS WESTERN SIDE OF EAST PORT – N 22°46'041" E 069°47'296"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	8.21	7.97	8.14	7.99	8.16	8.04	8.19	8.01	8.23	8.05	8.13	8.02	IS 3025(Part 11):2022
2.	Temperature	°C	29.7	29.6	29.8	29.7	29.7	29.6	29.5	29.4	29.4	29.3	29.3	29.2	IS 3025(Part 9):2023
3.	Total Suspended Solids	mg/L	138	114	130	108	146	122	138	106	142	114	152	118	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27oC)	mg/L	2.8	BDL(MDL: 1.0)	2.4	BDL(MDL: 1.0)	3.1	BDL(MDL: 1.0)	3.4	BDL(MDL: 1.0)	3.1	BDL(MDL: 1.0)	3	BDL(MDL: 1.0)	IS 3025(Part 44):2023
5.	Dissolved Oxygen	mg/L	6.63	6.53	6.45	6.35	6.63	6.53	6.45	6.35	6.5	6.4	6.37	6.27	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	35.74	37.11	35.86	37.24	35.88	37.11	35.74	36.82	35.71	36.74	35.74	36.66	By Calculation
7.	Oil & Grease	mg/L	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	IS 3025(Part 39):2021
8.	Nitrate as NO3	µmol/L	3.23	3.06	3.06	2.74	2.74	2.58	3.23	2.9	3.06	2.9	2.9	2.74	APHA 24th Ed.2023,4500 NO3-B
9.	Nitrite as NO2	µmol/L	0.348	0.326	0.348	0.326	0.304	0.283	0.239	0.217	0.348	0.326	0.239	0.217	APHA 24th Ed.2023,4500NO2 B
10.	Ammonical Nitrogen as NH3	µmol/L	3.95	3.9	4.01	3.9	4.37	4.32	3.9	3.85	3.74	3.69	3.69	3.64	APHA 24th Ed.2023,4500-NH3 B
11.	Phosphates as PO4	µmol/L	1.26	1.16	1.16	1.05	1.16	BDL(MDL: 0.4)	1.37	1.26	1.05	1.16	1.16	BDL(MDL: 0.4)	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	7.528	7.286	7.418	6.966	7.414	7.183	7.369	6.967	7.148	6.916	6.829	6.597	APHA 24th Ed.2023,4500 NH3 - B
13.	Petroleum Hydrocarbon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	35230	36110	35610	36380	35434	36108	35390	36180	35410	36240	35380	36160	IS 3025(Part 16):2023
15.	COD	mg/L	20.4	16.3	16	12	16.6	12.5	12.2	8.1	16.1	12	20.1	16.1	IS 3025(Part 58):2023

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M5 TOWARDS WESTERN SIDE OF EAST PORT – N 22°46'041" E 069°47'296"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A			Phytoplankton												
1.	Chlorophyll	mg/m³	3.11	3.12	3.12	3.11	3.11	3.12	3.12	3.13	3.11	3.12	3.12	3.11	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	2.2	1.22	2.1	1.23	2.2	1.22	2.1	1.21	2.2	1.22	2.4	1.25	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10^3/L	122	112	123	113	122	112	124	113	126	112	125	114	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Diplonеis*	*Navicula*	*Diplonеis*	*Navicula*	*Navicula*	*Navicula*	*Navicula*	*Pinnularia*	*Navicula*	*Pinnularia*	*Navicula*	*Pinnularia*	APHA (24th Ed. 2023)10200A-G
			Rhizosolenia	*Skeletonema*	*Rhizosolenia*	*Skeletonema*	*Biddulphia*	*Skeletonema*	*Biddulphia*	*Biddulphia*	*Biddulphia*	*Biddulphia*	*Biddulphia*	*Rhizosolenia*	
			Nitzschia	*Rhizosolenia*	*Nitzschia*	*Rhizosolenia*	*Nitzschia*	*Rhizosolenia*	*Nitzschia*	*Navicula*	*Nitzschia*	*Navicula*	*Odontella*	*Dinophysis*	
			Cyclotella	*Dinophysis*	*Cyclotella*	*Biddulphia*	*Cyclotella*	*Biddulphia*	*Cyclotella*	*Thallassiosira*	*Cyclotella*	*Thallassiosira*	*Cyclotella*	*Coscinodiscus*	
			Pleurosigma	*Thalassionema*	*Pleurosigma*	*Thalassionema*	*Pleurosigma*	*Thalassionema*	*Pleurosigma*	*Skeletonema*	*Pleurosigma*	*Skeletonema*	*Pleurosigma*	*Skeletonema*	
B			Zooplankton												
1	Abudance (Population)	noX10 3/ 100 m3	52		51		50		52		51		52		APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Copepods nauplii*		*Nitzschia*		*Nitzschia*		*Crustacean Larvae*		*Crustacean Larvae*		*Crustacean Larvae*		
			Crustacean Larvae		*Crustacean Larvae*		*Crustacean Larvae*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		
			Oikoplura		*Oikoplura*		*Oikoplura*		*Copepods*		*Copepods*		*Copepods nauplii*		
			Bivalve Larvae		*Bivalve Larvae*		*Bivalve Larvae*		*Crustacean*		*Crustacean*		*Crustacean*		
			Oikoplura		*Oikoplura*		*Oikoplura*		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		
3	Total Biomass	ml/100 m^3	14.13		14.12		14.11		14.12		14.11		14.12		

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M5 TOWARDS WESTERN SIDE OF EAST PORT – N 22°46'041" E 069°47'296"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
C			Microbiological												
1	Total Bacterial Count	CFU/ml	148		147		146		144		146		145		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	32		31		32		31		32		30		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	16		15		14		13		11		12		IS :15185:2016
4	Enterococcus	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

GUJARAT VAPI. UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD.

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M5 TOWARDS WESTERN SIDE OF EAST PORT – N 22°46'041" E 069°47'296"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1.	Organic Matter	%	0.58	0.62	0.58	0.54	0.49	0.47	IS: 2720 (Part 22):1972
2.	Phosphorus as P	µg/g	634.5	644	610	612	620	608	IS: 10158 :1982, Method B
3.	Texture	--	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Lab SOP No. UERL/CHM/LTM/108
4.	Petroleum Hydrocarbon	µg/g	N.D.	ND	ND	ND	ND	ND	APHA 24th Ed.2023,5520 F
5.0	Heavy Metals								
5.1	Aluminum as Al	%	4.12	4.18	3.86	3.74	3.65	3.46	IS3025(Part 55):2003
5.2	Total Chromium as Cr+3	µg/g	154.6	162.5	152.4	148.5	144.2	131.1	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.3	Manganese as Mn	µg/g	605.4	610.4	596.2	604.2	582.5	490.1	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.4	Iron as Fe	%	4.21	4.33	4.11	3.84	3.75	3.65	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.5	Nickel as Ni	µg/g	48.6	52.4	55.4	51.6	52.2	55.4	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.6	Copper as Cu	µg/g	52.6	62.5	60.3	49.8	44.2	38.6	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.7	Zinc as Zn	µg/g	112.4	118.5	121.4	110.6	102.3	110.8	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.8	Lead as Pb	µg/g	2.03	2.11	1.96	2.02	1.92	1.86	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.9	Mercury as Hg	µg/g	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	EPA 7471B (Extraction &Analytical Method) :2007

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M5 TOWARDS WESTERN SIDE OF EAST PORT – N 22°46'041" E 069°47'296"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
D			Benthic Organisms						
1	Macrobenthos	--	*Amphipods*	*Amphipods*	*Amphipods*	*Isopods*	*Isopods*	*Isopods*	APHA (24th Ed. 2023)10500
			Polychates	*Sipunculids*	*Polychates*	*Polychates*	*Polychates*	*Gastropods*	
			Isopods	*Isopods*	*Isopods*	*Sipunculids*	*Sipunculids*	*Sipunculids*	
			Gastropods	*Gastropods*	*Gastropods*	*Amphipods*	*Amphipods*	*Amphipods*	
2	MeioBenthos	--	Decapods Larvae	Decapods Larvae	Foraminiferan	Polychates	Herpectacoids	*Herpectacoids*	
			Herpectacoids	*Gastropods*	*Herpectacoids*	*Foraminiferan*	*Foraminiferan*	*Polychates*	
3	Population	no/m²	306	305	306	307	306	305	

GUJARAT VAPI. UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

RESULTS OF MARINE WATER [M7 EAST PORT N 22°47'120" E 069°47'110"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	29.7	8.02	8.25	8.05	8.26	8.11	7.96	7.84	8.12	7.95	8.09	7.92	IS 3025(Part 11):2022
2.	Temperature	°C	142	29.6	29.8	29.7	29.7	29.6	29.6	29.5	29.5	29.4	29.4	29.3	IS 3025(Part 9):2023
3.	Total Suspended Solids	mg/L	2.9	118	136	108	128	112	144	118	130	122	154	126	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	6.83	BDL(MDL: 1.0)	3.1	BDL(MDL: 1.0)	2.8	BDL(MDL: 1.0)	2.9	BDL(MDL: 1.0)	3.2	BDL(MDL: 1.0)	3.1	BDL(MDL: 1.0)	IS 3025(Part 44):2023
5.	Dissolved Oxygen	mg/L	35.82	6.73	6.65	6.55	6.83	6.73	6.65	6.55	6.71	6.6	6.57	6.47	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	BDL(MDL: 2.0)	37.09	36.02	37.26	36.14	37.12	35.92	36.94	35.88	36.74	35.96	36.71	By Calculation
7.	Oil & Grease	mg/L	2.9	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	IS 3025(Part 39):2021
8.	Nitrate as NO_3	µmol/L	0.413	2.58	3.23	3.06	2.9	2.74	2.58	2.42	3.39	3.23	3.23	2.9	APHA 24th Ed.2023,4500 NO3-B
9.	Nitrite as NO_2	µmol/L	3.8	0.391	0.37	0.348	0.326	0.304	0.283	0.261	0.261	0.239	0.283	0.261	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	1.16	3.74	4.01	3.95	4.22	4.11	3.95	3.9	3.8	3.69	3.69	3.64	APHA 24th Ed.2023,4500-NH3 B
11.	Phosphates as PO_4	µmol/L	7.113	BDL(MDL: 0.4)	1.26	1.16	1.05	BDL(MDL: 0.4)	1.16	BDL(MDL: 0.4)	BDL(MDL: 0.4)	BDL(MDL: 0.4)	1.16	1.05	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	ND	6.711	7.61	7.358	7.446	7.154	6.813	6.581	7.451	7.159	7.203	6.801	APHA 24th Ed.2023,4500 NH3
13.	Petroleum Hydrocarbon	µg/L	36150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	24.5	36930	36440	37124	36090	36920	36260	37050	36324	36990	36310	36780	IS 3025(Part 16):2023
15.	COD	mg/L			20	16	20.8	16.6	24.4	20.4	28.1	24.1	24.2	20.1	IS 3025(Part 58):2023

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

RESULTS OF MARINE WATER [M7 EAST PORT N 22°47'120" E 069°47'110"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A			Phytoplankton												
1.	Chlorophyll	mg/m³	3.06	2.5	3.07	2.6	3.06	2.7	3.07	2.6	3.06	2.7	3.07	2.8	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	2.5	1.77	2.6	1.78	2.7	1.77	2.6	1.77	2.7	1.78	2.8	1.74	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10³/L	91	123	92	122	91	123	92	122	91	121	90	122	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Nitzschia*	*Thalassiothrix*	*Nitzschia*	*Rhizosolenia*	*Nitzschia*	*Rhizosolenia*	*Diploneis*	*Coscinodiscus*	*Diploneis*	*Coscinodiscus*	*Diploneis*	*Coscinodiscus*	APHA (24th Ed. 2023)10200A-G
			Pinnularia	*Surirella*	*Pinnularia*	*Surirella*	*Odontella*	*Surirella*	*Rhizosolenia*	*Diplonei s*	*Rhizosolenia*	*Diplonei s*	*Rhizosolenia*	*Diplonei s*	
			Odontella	*Navicula*	*Dinophysis*	*Navicula*	*Dinophysis*	*Navicula*	*Nitzschia*	*Rhizosolenia*	*Nitzschia*	*Rhizosolenia*	*Nitzschia*	*Rhizosolenia*	
			Dinophysis	*Thallassiosira*	*Pleurosigma*	*Thalassionema*	*Pleurosigma*	*Thalassionema*	*Thalassiothrix*	*Dinophysis*	*Thalassiothrix*	*Dinophysis*	*Thalassiothrix*	*Dinophysis*	
			Surirella	*Skeletonema*	*Surirella*	*Skeletonema*	*Cyclotella*	*Skeletonema*	*Pleurosigma*	*Thalassionema*	*Pleurosigma*	*Thalassionema*	*Cyclotella*	*Thalassionema*	
B			Zooplankton												
1	Abudance (Population)	noX10 3/ 100 m3	41		40		42		41		40		42		APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Nitzschia*		*Nitzschia*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		
			Pinnularia		*Pinnularia*		*Coscinodiscus*		*Oikoplura*		*Oikoplura*		*Oikoplura*		
			Odontella		*Odontella*		*Odontella*		*Copepods nauplii*		*Copepods nauplii*		*Copepods nauplii*		
			Dinophysis		*Dinophysis*		*Dinophysis*		*Crustacean*		*Crustacean*		*Crustacean*		
			Surirella		*Surirella*		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		
3	Total Biomass	ml/100 m³	16.58		16.57		16.56		16.55		16.54		16.52		

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M7 EAST PORT N 22°47'120" E 069°47'110"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
C			Microbiological												
1	Total Bacterial Count	CFU/ml	92		93		92		91		92		94		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	27		26		27		26		25		26		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	10		11		10		11		10		16		IS :15185:2016
4	Enterococcus	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

GUJARAT VAPI.

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M8 RIGHT SIDE OF BOCHA CREEK N 22°45'987" E 069°43'119"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	29.8	7.99	8.27	8.03	8.24	8.12	8.22	7.95	8.18	7.99	8.11	7.97	IS 3025(Part 11):2022
2.	Temperature	°C	122	29.7	29.9	29.8	29.8	29.7	29.6	29.5	29.5	29.4	29.4	29.3	IS 3025(Part 9):2023
3.	Total Suspended Solids	mg/L	3.2	104	134	124	142	118	164	128	152	114	154	120	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	6.93	BDL(MDL: 1.0)	3.5	BDL(MDL: 1.0)	2.9	BDL(MDL: 1.0)	3.3	BDL(MDL: 1.0)	3.1	BDL(MDL: 1.0)	3.2	BDL(MDL: 1.0)	IS 3025(Part 44):2023
5.	Dissolved Oxygen	mg/L	36.15	6.73	6.84	6.65	7.04	6.83	6.85	6.65	6.91	6.71	6.77	6.57	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	BDL(MDL: 2.0)	37.18	36.35	37.29	36.34	37.31	36.02	37.04	36.11	36.84	35.96	36.81	By Calculation
7.	Oil & Grease	mg/L	2.9	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	IS 3025(Part 39):2021
8.	Nitrate as NO_3	µmol/L	0.435	2.74	3.39	3.23	3.06	2.9	2.74	2.58	3.06	2.9	3.23	2.9	APHA 24th Ed.2023,4500 NO3-
9.	Nitrite as NO_2	µmol/L	3.9	0.413	0.391	0.37	0.348	0.326	0.217	0.196	0.261	0.239	0.304	0.283	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	1.16	3.85	4.11	4.01	4.06	3.95	4.06	3.9	3.8	3.74	3.8	3.69	APHA 24th Ed.2023,4500-NH3
11.	Phosphates as PO_4	µmol/L	7.235	1.05	1.05	BDL(MDL: 0.4)	1.37	1.16	1.05	BDL(MDL: 0.4)	1.16	BDL(MDL: 0.4)	BDL(MDL: 0.4)	BDL(MDL: 0.4)	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	ND	7.003	7.891	7.61	7.468	7.176	7.017	6.676	7.121	6.879	7.334	6.873	APHA 24th Ed.2023,4500 NH3
13.	Petroleum Hydrocarbon	µg/L	35430	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	24.5	36120	35860	36380	35460	36060	35284	36192	35350	36210	35410	36164	IS 3025(Part 16):2023
15.	COD	mg/L		16.3	20	12	20.8	12.5	28.5	20.4	32.1	24.1	28.2	20.1	IS 3025(Part 58):2023

Continue…

RESULTS OF MARINE WATER [M8 RIGHT SIDE OF BOCHA CREEK N 22°45'987" E 069°43'119"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A			Phytoplankton												
1.	Chlorophyll	mg/m³	3.1	3.12	3.2	3.11	3.1	3.12	3.2	3.11	3.1	3.12	3.2	3.2	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	1.5	1.6	1.4	1.5	1.3	1.4	1.2	1.3	1.3	1.2	1.2	1.1	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10³/L	112	107	111	108	112	107	113	106	112	107	114	104	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Odentella*	*Cyclotella*	*Odentella*	*Cyclotella*	*Odentella*	*Cyclotella*	*Nitzschia*	*Diploneis*	*Nitzschia*	*Diploneis*	*Nitzschia*	*Diploneis*	APHA (24th Ed. 2023)10200A-G
			Rhizosolenia	*Pinnularia*	*Rhizosolenia*	*Pinnularia*	*Rhizosolenia*	*Pinnularia*	*Grammatophora*	*Rhizosolenia*	*Grammatophora*	*Rhizosolenia*	*Grammatophora*	*Rhizosolenia*	
			Coscinodiscus	*Skeletonema*	*Coscinodiscus*	*Skeletonema*	*Coscinodiscus*	*Skeletonema*	*Diploneis*	*Nitzschia*	*Diploneis*	*Nitzschia*	*Diploneis*	*Nitzschia*	
			Grammatophora	*Thallassiosira*	*Grammatophora*	*Thallassiosira*	*Grammatophora*	*Thallassiosira*	*Thalassiothrix*	*Cyclotella*	*Thalassiothrix*	*Cyclotella*	*Thalassiothrix*	*Grammatophora*	
			Thallassiosira	*Thalassionema*	*Thallassiosira*	*Thalassionema*	*Thallassiosira*	*Thalassionema*	*Pleurosigma*	*Pleurosigma*	*Pleurosigma*	*Pleurosigma*	*Pleurosigma*	*Pleurosigma*	
B			Zooplankton												
1	Abudance(Population)	noX10 3/ 100 m3	32		33		32		33		34		32		APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Coscinodiscus*		*Coscinodiscus*		*Odontella*		*Oikoplura*		*Oikoplura*		*Oikoplura*		
			Diploneis		*Egg(Fish and Shrimps)*		*Egg(Fish and Shrimps)*		*Copepods nauplii*		*Copepods nauplii*		*Egg(Fish and Shrimps)*		
			Rhizosolenia		*Rhizosolenia*		*Rhizosolenia*		*Crustacean Larvae*		*Crustacean Larvae*		*Crustacean Larvae*		
			Dinophysis		*Bivalve Larvae*		*Bivalve Larvae*		*Crustacean*		*Crustacean*		*Crustacean*		
			Thalassionema		*Thalassionema*		*Thalassionema*		*Bivalve Larvae*		*Bivalve Larvae*		*Bivalve Larvae*		
3	Total Biomass	ml/100 m³	14.77		14.78		14.77		14.76		14.77		14.78		

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M8 RIGHT SIDE OF BOCHA CREEK N 22°45'987" E 069°43'119"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM			
C			Microbiological												
1	Total Bacterial Count	CFU/ml	14		13		12		14		13		10		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	11		12		11		10		11		18		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	10		13		12		11		9		10		IS :15185:2016
4	Enterococcus	/100ml	6		7		6		7		6		8		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI.

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M8 RIGHT SIDE OF BOCHA CREEK N 22°45'987" E 069°43'119"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1.	Organic Matter	%	0.58	0.62	0.58	0.52	0.58	0.61	IS: 2720 (Part 22):1972
2.	Phosphorus as P	µg/g	611.4	615.4	620.2	586.5	602	611	IS: 10158 :1982, Method B
3.	Texture	--	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Lab SOP No. UERL/CHM/LTM/108
4.	Petroleum Hydrocarbon	µg/g	N.D.	ND	ND	ND	ND	ND	APHA 24th Ed.2023,5520 F
5.0	Heavy Metals								
5.1	Aluminum as Al	%	4.06	4.11	3.96	3.82	3.76	3.68	IS3025(Part 55):2003
5.2	Total Chromium as Cr+3	µg/g	148.6	152.6	148.4	139.8	144.2	128.6	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.3	Manganese as Mn	µg/g	594.5	602.4	592	568.5	554.6	560.7	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.4	Iron as Fe	%	4.11	4.16	3.96	3.79	3.66	3.59	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.5	Nickel as Ni	µg/g	46.5	48.2	44.7	48.2	44.3	49.2	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.6	Copper as Cu	µg/g	52.2	56.4	52.5	55.2	52.3	55.4	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.7	Zinc as Zn	µg/g	124.3	128.5	130.4	124.1	124.9	116.2	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.8	Lead as Pb	µg/g	2.03	2.11	1.96	1.82	1.75	1.68	EPA 3050B/7000B (Extraction &Analytical Method):2007
5.9	Mercury as Hg	µg/g	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	BDL(MDL:0.05)	EPA 7471B (Extraction &Analytical Method) :2007

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF SEDIMENT ANALYSIS [M8 RIGHT SIDE OF BOCHA CREEK N 22°45'987" E 069°43'119"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	TEST METHOD
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
D			Benthic Organisms						
1	Macrobenthos	--	*Polychates*	*Gastropods*	*Gastropods*	*Polychates*	*Polychates*	*Polychates*	APHA (24th Ed. 2023)10500
			Decapods Larvae	*Decapods Larvae*	*Decapods Larvae*	*Amphipods*	*Amphipods*	*Amphipods*	
			Isopods	*Isopods*	*Isopods*	*Isopods*	*Isopods*	*Sipunculids*	
			Sipunculids	*Sipunculids*	*Sipunculids*	*Sipunculids*	*Herpectacoids*	*Herpectacoids*	
2	MeioBenthos	--	*Herpectacoids*	*Herpectacoids*	*Herpectacoids*	*Foraminiferan*	*Foraminiferan*	*Foraminiferan*	
			Turbellarians	*Turbellarians*	Turbellarians	Turbellarians	Turbellarians	*Turbellarians*	
3	Population	no/m²	368	367	368	367	368	366	

ENVIRONMENT & RESEARCH LABS PVT. LTD. * UNISTAR GUJARAT VAPI.

Mr. Nilesh Patel
Sr. Chemist

Mr. Nitin Tandel
Technical Manager

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M11 MPT T1 JETTY N 22°42'278" E 069°43'450"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	8.23	8.06	8.21	8.04	8.25	8.14	7.98	7.82	8.24	8.09	8.1	7.93	IS 3025 (Part 11):2022
2.	Temperature	°C	29.9	29.8	30	29.9	29.9	29.8	29.6	29.5	29.5	29.4	29.4	29.3	IS 3025 (Part 9):2023
3.	Total Suspended Solids	mg/L	132	110	140	118	134	110	142	118	136	122	144	128	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	3.1	BDL(MDL: 1.0)	2.9	BDL(MDL: 1.0)	3.2	BDL(MDL: 1.0)	3.1	BDL(MDL: 1.0)	2.9	BDL(MDL: 1.0)	3.2	BDL(MDL: 1.0)	IS 3025 (Part 44):2023
5.	Dissolved Oxygen	mg/L	6.63	6.53	6.55	6.45	6.73	6.63	6.55	6.45	6.6	6.5	6.47	6.37	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	36.52	37.33	36.71	37.45	36.52	37.31	36.18	37.01	36.22	36.86	36.09	36.94	By Calculation
7.	Oil & Grease	mg/L	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	BDL(MDL: 2.0)	IS 3025 (Part 39):2021
8.	Nitrate as NO_3	µmol/L	3.23	3.06	3.55	3.39	3.39	3.23	3.23	2.9	3.55	3.39	3.39	3.06	APHA 24th Ed. 2023,4500 NO3-B
9.	Nitrite as NO_2	µmol/L	0.391	0.37	0.391	0.37	0.37	0.348	0.304	0.283	0.283	0.261	0.261	0.239	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	4.06	4.01	3.9	3.85	4.06	3.95	4.11	4.01	3.85	3.8	3.95	3.85	APHA 24th Ed. 2023,4500- NH3 B
11.	Phosphates as PO_4	µmol/L	1.05	BDL(MDL: 0.4)	1.26	1.16	1.37	1.26	1.58	1.47	1.26	1.37	1.37	1.26	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	7.681	7.44	7.841	7.61	7.82	7.528	7.644	7.193	7.683	7.451	7.601	7.149	APHA 24th Ed. 2023,4500 NH3 - B
13.	Petroleum Hydrocarbon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	35510	36420	35740	36840	35322	35996	35190	36088	35220	36120	35314	36142	IS 3025(Part 16):2023
15.	COD	mg/L	24.5	20.4	20	16	20.8	16.6	28.5	24.4	32.1	28.1	28.2	24.2	IS 3025(Part 58):2023

Continue…

RESULTS OF MARINE WATER [M11 MPT T1 JETTY N 22°42'278" E 069°43'450"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A			Phytoplankton												
1.	Chlorophyll	mg/m³	2.6	2.7	2.7	2.6	2.6	2.7	2.7	2.6	2.6	2.7	2.4	2.8	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	2.3	1.3	2.4	1.2	2.3	1.1	2.2	1.2	2.1	1.3	2	1.4	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10³/L	133	122	134	123	133	122	131	121	132	122	131	120	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Dinophysis*	*Navicula*	*Odontella*	*Cyclotella*	*Cyclotella*	*Surirella*	*Odontella*	*Nitzschia*	*Odontella*	*Nitzschia*	*Odontella*	*Nitzschia*	APHA (24th Ed. 2023)10200A-G
			Pinnularia	*Skeletonema*	*Rhizosolenia*	*Pinnularia*	*Pinnularia*	*Skeletonema*	*Rhizosolenia*	*Pinnularia*	*Rhizosolenia*	*Pinnularia*	*Rhizosolenia*	*Pinnularia*	
			Thalassiothrix	*Rhizosolenia*	*Coscinodiscus*	*Skeletonema*	*Thalassiothrix*	*Rhizosolenia*	*Coscinodiscus*	*Odontella*	*Coscinodiscus*	*Odontella*	*Coscinodiscus*	*Odontella*	
			Grammatophora	*Dinophysis*	*Grammatophora*	*Thallassiosira*	*Rhizosolenia*	*Cyclotella*	*Grammatophora*	*Dinophysis*	*Grammatophora*	*Dinophysis*	*Pleurosigma*	*Dinophysis*	
			Ceratium	*Thalassionema*	*Thallassiosira*	*Thalassionema*	*Ceratium*	*Thalassionema*	*Thallassiosira*	*Surirella*	*Thallassiosira*	*Surirella*	*Thallassiosira*	*Surirella*	

B			Zooplankton						
1	Abudance(Population)	noX103/ 100 m3	32	30	31	34	36	34	APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Diploneis*	*Diploneis*	*Diploneis*	*Decapoda*	*Decapoda*	*Decapoda*	
			Rhizosolenia	*Rhizosolenia*	*Rhizosolenia*	*Copepods*	*Copepods*	*Oikoplura*	
			Nitzschia	*Nitzschia*	*Nitzschia*	*Crustacean Larvae*	*Crustacean Larvae*	*Crustacean Larvae*	
			Thalassiothrix	*Coscinodiscus*	*Coscinodiscus*	*Crustacean*	*Crustacean*	*Bivalve Larvae*	
			Pleurosigma	*Pleurosigma*	*Pleurosigma*	*Oikoplura*	*Oikoplura*	*Oikoplura*	
3	Total Biomass	ml/100 m³	15.22	15.21	15.22	15.22	15.21	15.2	

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M11 MPT T1 JETTY N 22°42'278" E 069°43'450"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM			
C			Microbiological												
1	Total Bacterial Count	CFU/ml	236		237		236		234		236		234		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	42		41		40		42		40		42		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	30		32		31		30		32		30		IS :15185:2016
4	Enterococcus	/100ml	13		12		11		12		10		11		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI.

Mr. Nitin Tandel
Technical Manager

RESULTS OF MARINE WATER [M12 SPM N 22°40'938" E 069°39'191"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1.	pH	--	8.17	8.06	8.22	8.01	8.27	8.16	8.04	7.81	8.14	8.03	8.09	7.89	IS 3025 (Part 11):2022
2.	Temperature	°C	29.9	29.8	30	29.9	29.8	29.7	29.6	29.5	29.5	29.4	29.4	29.3	IS 3025 (Part 9):2023
3.	Total Suspended Solids	mg/L	130	110	142	118	122	96	138	102	124	110	132	114	APHA 24th Ed.,2023,2540- D
4.	BOD (3 Days @ 27°C)	mg/L	3	BDL(MDL :1.0)	2.8	BDL(MDL :1.0)	3.4	BDL(MDL :1.0)	2.8	BDL(MDL :1.0)	2.5	BDL(MDL :1.0)	3.1	BDL(MDL :1.0)	IS 3025 (Part 44):2023
5.	Dissolved Oxygen	mg/L	6.83	6.73	6.75	6.65	6.94	6.83	6.75	6.65	6.81	6.71	6.67	6.57	APHA 24th Ed.2023,4500-O, B
6.	Salinity	ppt	36.56	37.28	36.52	37.38	36.29	37.11	36.44	37.19	36.25	37.03	36.22	36.94	By Calculation
7.	Oil & Grease	mg/L	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	BDL(MDL :2.0)	IS 3025 (Part 39):2021
8.	Nitrate as NO_3	µmol/L	3.39	3.23	3.23	3.06	2.9	2.74	3.39	3.23	3.23	3.06	3.55	3.39	APHA 24th Ed. 2023,4500 NO3-B
9.	Nitrite as NO_2	µmol/L	0.435	0.391	0.413	0.391	0.37	0.348	0.326	0.304	0.239	0.217	0.283	0.261	APHA 24th Ed.2023,4500NO_2B
10.	Ammonical Nitrogen as NH_3	µmol/L	4.11	4.01	4.27	4.22	4.16	4.06	4.11	4.01	3.74	3.69	4.01	3.95	APHA 24th Ed. 2023,4500- NH3 B
11.	Phosphates as PO_4	µmol/L	1.26	1.16	1.37	1.26	1.47	1.37	1.37	1.26	1.26	1.16	1.47	1.37	APHA 24th Ed.2023,4500-P, D
12.	Total Nitrogen	µmol/L	7.935	7.631	7.913	7.671	7.43	7.148	7.826	7.544	7.209	6.967	7.843	7.601	APHA 24th Ed. 2023,4500 NH3 - B
13.	Petroleum Hydrocarbon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	APHA 24th ED.2023,5520 F
14.	Total Dissolved Solids	mg/L	35790	36610	35940	36840	36120	36880	36340	37116	36300	37060	36146	36944	IS 3025(Part 16):2023
15.	COD	mg/L	28.6	24.5	24	20	25	20.8	28.5	24.4	32.1	28.1	36.3	32.2	IS 3025(Part 58):2023

Continue…

RESULTS OF MARINE WATER [M12 SPM N 22°40'938" E 069°39'191"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
A			Phytoplankton												
1.	Chlorophyll	mg/m³	2.2	2.3	2.1	2.2	2.2	2.1	2.1	2.2	2.2	2.1	2.1	2	APHA (24th Ed. 2023)10200A-G
2.	Phaeophytin	mg/m³	1.18	1.48	1.17	1.47	1.16	1.46	1.17	1.47	1.16	1.46	1.14	1.44	APHA (24th Ed. 2023)10200A-G
3.	Cell Count	No. x 10³/L	78	133	76	132	77	133	76	132	77	133	78	135	APHA (24th Ed. 2023)10200A-G
4	Name of Group Number and name of group species of each group	--	*Ceratium*	*Melosira*	*Ceratium*	*Rhizosolenia*	*Surirella*	*Rhizosolenia*	*Skeletonema*	*Odontella*	*Skeletonema*	*Odontella*	*Skeletonema*	*Odontella*	APHA (24th Ed. 2023)10200A-G
			Pinnularia	*Dinophysis*	*Pinnularia*	*Dinophysis*	*Pinnularia*	*Dinophysis*	*Grammatophora*	*Rhizosolenia*	*Grammatophora*	*Rhizosolenia*	*Grammatophora*	*Rhizosolenia*	
			Odontella	*Skeletonema*	*Odontella*	*Skeletonema*	*Grammatophora*	*Skeletonema*	*Nitzschia*	*Coscinodiscus*	*Nitzschia*	*Coscinodiscus*	*Nitzschia*	*Coscinodiscus*	
			Thalassiothrix	*Thallassiosira*	*Thalassiothrix*	*Thallassiosira*	*Thalassiothrix*	*Thallassiosira*	*Thalassiothrix*	*Grammatophora*	*Thalassiothrix*	*Grammatophora*	*Coscinodiscus*	*Pinnularia*	
			Thallassiosira	*Thalassionema*	*Thallassiosira*	*Melosira*	*Rhizosolenia*	*Melosira*	*Pleurosigma*	*Thallassiosira*	*Pleurosigma*	*Thallassiosira*	*Pleurosigma*	*Thallassiosira*	
B			Zooplankton												
1	Abudance (Population)	noX10 3/ 100 m3	72		70		71		70		71		70		APHA (24rd Ed. 2023)10200 G
2	Name of Group Number and name of group species of each group		*Nitzschia*		*Nitzschia*		*Nitzschia*		*Copepods*		*Copepods*		*Copepods*		
			Grammatophora		*Grammatophora*		*Grammatophora*		*Oikoplura*		*Oikoplura*		*Oikoplura*		
			Diploneis		*Diploneis*		*Egg(Fish and Shrimps)*		*Crustacean Larvae*		*Crustacean Larvae*		*Crustacean Larvae*		
			Thalassiothrix		*Thalassiothrix*		*Thalassiothrix*		*Crustacean*		*Crustacean*		*Crustacean*		
			Pleurosigma		*Pleurosigma*		*Pleurosigma*		*Bivalve Larvae*		*Bivalve Larvae*		*Egg(Fish and Shrimps)*		
3	Total Biomass	ml/100 m³	14.56		14.56		14.57		14.56		14.55		14.52		

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

RESULTS OF MARINE WATER [M12 SPM N 22°40'938" E 069°39'191"]

SR. NO.	TEST PARAMETERS	UNIT	Apr-25		May-25		Jun-25		Jul-25		Aug-25		Sep-25		TEST METHOD
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
C			Microbiological												
1	Total Bacterial Count	CFU/ml	262		262		264		266		264		266		APHA 24th Ed.2023,9215 -C
2	Total Coliform	/100ml	51		51		52		50		52		50		APHA 24thEd.2023, 9222-B
3	E.coli	/100ml	42		42		41		40		41		40		IS :15185:2016
4	Enterococcus	/100ml	34		34		31		32		31		30		IS:15186:2002
5	Salmonella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS:15187:2016
6	Shigella	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		APHA 24thEd.2023, 9260-E
7	Vibrio	/100ml	Absent		Absent		Absent		Absent		Absent		Absent		IS: 5887 (Part V):1976

Mr. Nilesh Patel
Sr. Chemist

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI.

Mr. Nitin Tandel
Technical Manager

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Results of Ambient Air Quality Monitoring

Name of Location		West Port – West Basin Main Gate						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
1.	03-04-2025	82.36	33.38	27.13	31.56	0.81	--	NOT DETECTED
2.	07-04-2025	85.37	34.18	29.52	33.29	0.84	3.79	NOT DETECTED
3.	10-04-2025	83.17	32.54	26.79	30.15	0.77	3.86	NOT DETECTED
4.	14-04-2025	76.28	28.64	23.46	27.81	0.7	3.72	NOT DETECTED
5.	17-04-2025	80.17	30.52	25.58	29.37	0.74	3.77	NOT DETECTED
6.	21-04-2025	78.47	29.17	23.95	27.63	0.67	3.68	NOT DETECTED
7.	24-04-2025	74.27	26.82	20.18	24.39	0.72	3.56	NOT DETECTED
8.	28-04-2025	76.19	28.57	22.46	26.58	0.65	3.61	NOT DETECTED
9.	01-05-2025	80.12	29.78	25.45	28.56	0.67	3.18	NOT DETECTED
10.	05-05-2025	75.43	32.32	30.67	34.21	0.81	3.8	NOT DETECTED
11.	08-05-2025	70.98	30.98	25.32	28.98	0.65	3.92	NOT DETECTED
12.	12-05-2025	75.65	33.43	24.32	27.56	0.45	3.7	NOT DETECTED
13.	15-05-2025	77.34	31.23	22.32	25.45	0.93	3.68	NOT DETECTED
14.	19-05-2025	75.43	28.98	21.12	24.45	0.45	3.6	NOT DETECTED
15.	22-05-2025	71.23	24.31	19.89	22.32	0.84	3.45	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		West Port – West Basin Main Gate						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
16.	26-05-2025	73.23	27.65	20.67	23.45	0.74	3.58	NOT DETECTED
17.	29-05-2025	80.54	26.78	23.12	26.78	0.7	3.65	NOT DETECTED
18.	02-06-2025	74.39	27.53	22.78	25.61	0.68	3.52	NOT DETECTED
19.	05-06-2025	77.13	29.12	25.43	29.35	0.75	3.46	NOT DETECTED
20.	09-06-2025	72.28	25.74	23.11	26.45	0.62	3.38	NOT DETECTED
21.	12-06-2025	66.59	23.45	19.88	22.31	0.65	3.32	NOT DETECTED
22.	16-06-2025	68.42	24.96	20.53	24.04	0.58	3.46	NOT DETECTED
23.	19-06-2025	71.65	27.63	23.72	26.43	0.62	3.54	NOT DETECTED
24.	23-06-2025	75.48	30.17	25.81	28.14	0.66	3.62	NOT DETECTED
25.	26-06-2025	72.35	28.58	23.87	27.13	0.56	3.49	NOT DETECTED
26.	30-06-2025	70.69	27.41	21.13	24.46	0.60	3.4	NOT DETECTED
27.	03-07-2025	68.49	24.26	19.39	23.16	0.59	--	NOT DETECTED
28.	07-07-2025	72.37	27.31	21.72	25.46	0.64	3.49	NOT DETECTED
29.	10-07-2025	65.48	22.27	18.14	22.4	0.62	3.41	NOT DETECTED
30.	14-07-2025	63.49	20.58	17.36	21.67	0.54	3.36	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		West Port – West Basin Main Gate						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
31.	17-07-2025	68.19	24.83	19.28	22.3	0.57	3.44	NOT DETECTED
32.	21-07-2025	72.39	27.13	22.38	26.49	0.6	3.52	NOT DETECTED
33.	24-07-2025	70.18	26.59	21.46	25.52	0.58	3.48	NOT DETECTED
34.	28-07-2025	64.57	24.96	18.58	22.15	0.53	3.40	NOT DETECTED
35.	31-07-2025	67.13	25.04	20.12	24.58	0.59	3.45	NOT DETECTED
36.	04-08-2025	65.18	23.51	18.56	22.46	0.52	3.37	NOT DETECTED
37.	07-08-2025	68.52	24.89	20.13	24.81	0.56	3.42	NOT DETECTED
38.	11-08-2025	74.26	27.46	24.56	29.11	0.65	3.53	NOT DETECTED
39.	14-08-2025	70.25	26.35	22.03	26.37	0.61	3.49	NOT DETECTED
40.	18-08-2025	73.43	28.69	25.89	29.18	0.58	3.56	NOT DETECTED
41.	21-08-2025	64.17	21.1	19.42	23.31	0.48	3.41	NOT DETECTED
42.	25-08-2025	66.29	23.47	20.15	24.86	0.42	3.46	NOT DETECTED
43.	28-08-2025	69.84	26.62	22.79	27.18	0.53	3.52	NOT DETECTED
44.	01-09-2025	67.64	25.48	24.15	28.42	0.46	3.32	NOT DETECTED
45.	04-09-2025	70.28	28.12	26.63	30.86	0.58	3.41	NOT DETECTED

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Name of Location		West Port – West Basin Main Gate						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
46.	08-09-2025	74.24	32.36	29.88	32.47	0.68	3.54	NOT DETECTED
47.	11-09-2025	67.11	26.83	25.42	29.73	0.55	3.47	NOT DETECTED
48.	15-09-2025	72.36	29.11	28.79	32.15	0.63	3.6	NOT DETECTED
49.	18-09-2025	65.49	24.91	21.17	24.68	0.51	3.36	NOT DETECTED
50.	22-09-2025	64.39	22.86	19.67	22.15	0.36	3.25	NOT DETECTED
51.	25-09-2025	66.19	25.24	22.37	26.53	0.49	3.28	NOT DETECTED
52.	29-09-2025	62.57	24.89	24.56	28.53	0.53	3.38	NOT DETECTED
Permissible Value as per NAAQMS		**100.0**	**60.0**	**80.0**	**80.0**	**2.0**	**---**	**5.0**
Test Method		**IS - 5182, Part- 23**	**UERL/AIR/ SOP/11**	**IS - 5182, Part - 2**	**IS - 5182, Part - 6**	**IS - 5182, Part - 10**	**Gas analyzer**	**IS – 5182, Part – 11**

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Results of Ambient Air Quality Monitoring

Name of Location		West Port – Horti Culture						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
1.	03-04-2025	85.28	39.46	32.73	27.35	0.86	--	NOT DETECTED
2.	07-04-2025	82.36	36.58	30.62	34.91	0.80	2.94	NOT DETECTED
3.	10-04-2025	76.59	33.15	25.43	30.58	0.72	2.83	NOT DETECTED
4.	14-04-2025	78.35	34.98	26.71	32.11	0.75	2.77	NOT DETECTED
5.	17-04-2025	83.26	38.72	29.49	34.37	0.67	2.86	NOT DETECTED
6.	21-04-2025	86.73	40.51	32.51	37.28	0.74	3.00	NOT DETECTED
7.	24-04-2025	81.45	37.78	28.37	32.86	0.82	2.9	NOT DETECTED
8.	28-04-2025	84.59	39.15	30.46	35.14	0.85	2.93	NOT DETECTED
9.	01-05-2025	83.21	35.23	30.67	35.67	0.56	2.45	NOT DETECTED
10.	05-05-2025	80.45	33.56	29.87	34.12	0.78	2.87	NOT DETECTED
11.	08-05-2025	77.32	30.67	34.23	37.65	0.8	2.90	NOT DETECTED
12.	12-05-2025	74.23	33.78	31.21	34.21	0.65	2.81	NOT DETECTED
13.	15-05-2025	80.45	37.34	29.98	32.12	0.78	2.98	NOT DETECTED
14.	19-05-2025	84.32	36.12	30.89	34.56	0.68	3.12	NOT DETECTED
15.	22-05-2025	79.56	35.54	26.54	30.98	0.87	2.95	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		West Port – Horti Culture						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
16.	26-05-2025	81.23	36.87	32.12	35.64	0.76	2.99	NOT DETECTED
17.	29-05-2025	74.32	33.21	31.45	34.38	0.67	3.01	NOT DETECTED
18.	02-06-2025	76.14	33.91	29.83	33.14	0.61	2.63	NOT DETECTED
19.	05-06-2025	73.4	31.48	26.47	29.85	0.56	2.66	NOT DETECTED
20.	09-06-2025	78.49	34.59	27.35	31.42	0.58	2.54	NOT DETECTED
21.	12-06-2025	81.25	36.84	32.18	36.57	0.7	2.73	NOT DETECTED
22.	16-06-2025	75.59	30.42	29.17	33.45	0.63	2.68	NOT DETECTED
23.	19-06-2025	69.15	27.65	25.86	28.16	0.51	2.46	NOT DETECTED
24.	23-06-2025	73.82	29.14	27.63	31.98	0.58	2.52	NOT DETECTED
25.	26-06-2025	79.17	32.46	28.91	32.34	0.62	2.60	NOT DETECTED
26.	30-06-2025	75.13	33.45	30.54	33.61	0.56	2.66	NOT DETECTED
27.	03-07-2025	71.39	30.46	27.12	31.57	0.52		NOT DETECTED
28.	07-07-2025	67.94	26.83	25.48	29.25	0.48	2.61	NOT DETECTED
29.	10-07-2025	73.47	32.68	29.42	34.28	0.59	2.65	NOT DETECTED
30.	14-07-2025	74.93	31.24	31.49	25.13	0.64	2.72	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		West Port – Horti Culture						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
31.	17-07-2025	70.69	28.57	28.35	33.64	0.60	2.67	NOT DETECTED
32.	21-07-2025	66.38	25.73	25.39	30.97	0.55	2.57	NOT DETECTED
33.	24-07-2025	74.25	34.19	30.56	34.14	0.63	2.63	NOT DETECTED
34.	28-07-2025	69.48	29.57	27.24	32.40	0.59	2.55	NOT DETECTED
35.	31-07-2025	71.24	31.41	29.07	33.35	0.62	2.6	NOT DETECTED
36.	04-08-2025	68.93	28.78	26.51	30.48	0.55	2.56	NOT DETECTED
37.	07-08-2025	71.25	29.42	28.31	31.96	0.59	2.61	NOT DETECTED
38.	11-08-2025	74.16	32.49	29.11	34.17	0.64	2.69	NOT DETECTED
39.	14-08-2025	70.45	30.15	26.31	32.23	0.57	2.63	NOT DETECTED
40.	18-08-2025	67.49	27.84	25.47	28.56	0.52	2.54	NOT DETECTED
41.	21-08-2025	64.25	25.13	23.62	26.38	0.46	2.49	NOT DETECTED
42.	25-08-2025	69.12	26.49	26.43	30.21	0.48	2.44	NOT DETECTED
43.	28-08-2025	72.15	28.75	27.22	31.06	0.54	2.52	NOT DETECTED
44.	01-09-2025	71.35	30.13	28.46	32.17	0.59	2.56	NOT DETECTED
45.	04-09-2025	68.57	27.46	25.32	19.86	0.54	2.44	NOT DETECTED

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Name of Location		West Port – Horti Culture						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
46.	08-09-2025	75.49	33.57	27.59	32.48	0.64	2.6	NOT DETECTED
47.	11-09-2025	77.48	34.17	30.13	35.63	0.7	2.67	NOT DETECTED
48.	15-09-2025	73.28	32.15	26.49	31.37	0.67	2.62	NOT DETECTED
49.	18-09-2025	69.41	27.84	24.52	28.48	0.61	2.45	NOT DETECTED
50.	22-09-2025	66.79	24.64	22.39	27.11	0.52	2.34	NOT DETECTED
51.	25-09-2025	69.48	26.71	23.89	29.31	0.57	2.41	NOT DETECTED
52.	29-09-2025	74.25	31.89	26.74	31.48	0.62	3.51	NOT DETECTED
Permissible Value as per NAAQMS		**100.0**	**60.0**	**80.0**	**80.0**	**2.0**	**---**	**5.0**
Test Method		**IS - 5182, Part- 23**	**UERL/AIR/ SOP/11**	**IS - 5182, Part - 2**	**IS - 5182, Part - 6**	**IS - 5182, Part - 10**	**Gas analyzer**	**IS – 5182, Part – 11**

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Results of Ambient Air Quality Monitoring

Name of Location		WEST PORT - PMC OFFICE						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
1.	03-04-2025	78.46	34.87	28.14	31.96	0.71	--	NOT DETECTED
2.	07-04-2025	81.35	36.71	29.75	33.42	0.75	3.76	NOT DETECTED
3.	10-04-2025	85.48	39.06	33.13	38.57	0.82	3.82	NOT DETECTED
4.	14-04-2025	77.47	33.56	28.74	32.15	0.67	3.7	NOT DETECTED
5.	17-04-2025	74.38	31.84	25.49	29.68	0.6	3.67	NOT DETECTED
6.	21-04-2025	80.53	34.36	29.5	33.24	0.72	3.69	NOT DETECTED
7.	24-04-2025	86.47	37.39	33.25	37.71	0.76	3.77	NOT DETECTED
8.	28-04-2025	84.18	34.51	31.63	35.29	0.82	3.81	NOT DETECTED
9.	01-05-2025	76.12	32.43	27.12	30.67	0.67	3.23	NOT DETECTED
10.	05-05-2025	79.43	34.56	29.78	32.45	0.54	3.67	NOT DETECTED
11.	08-05-2025	81.23	38.12	26.54	29.56	0.46	3.8	NOT DETECTED
12.	12-05-2025	76.23	32.12	33.21	36.21	0.62	3.54	NOT DETECTED
13.	15-05-2025	70.87	30.98	29.98	32.12	0.57	3.66	NOT DETECTED
14.	19-05-2025	82.34	32.12	31.45	34.54	0.66	3.58	NOT DETECTED
15.	22-05-2025	82.12	34.56	32.65	35.65	0.57	3.71	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		WEST PORT - PMC OFFICE						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
16.	26-05-2025	80.98	31.23	28.11	31.23	0.78	3.83	NOT DETECTED
17.	29-05-2025	77.45	35.32	27.23	30.98	0.67	3.83	NOT DETECTED
18.	02-06-2025	78.31	34.75	26.57	29.81	0.58	3.61	NOT DETECTED
19.	05-06-2025	80.13	35.47	28.36	31.17	0.63	3.72	NOT DETECTED
20.	09-06-2025	75.63	32.45	25.46	28.07	0.54	3.64	NOT DETECTED
21.	12-06-2025	81.03	35.87	30.93	34.67	0.58	3.78	NOT DETECTED
22.	16-06-2025	77.35	29.14	28.41	32.52	0.51	3.68	NOT DETECTED
23.	19-06-2025	67.95	26.58	23.47	26.85	0.43	3.51	NOT DETECTED
24.	23-06-2025	70.59	28.32	25.86	29.43	0.48	3.55	NOT DETECTED
25.	26-06-2025	66.87	25.34	24.26	27.39	0.45	3.42	NOT DETECTED
26.	30-06-2025	68.42	27.91	26.68	29.36	0.51	3.46	NOT DETECTED
27.	03-07-2025	65.24	26.15	23.68	28.17	0.48	--	NOT DETECTED
28.	07-07-2025	69.58	28.63	24.89	30.11	0.55	3.37	NOT DETECTED
29.	10-07-2025	72.35	30.63	27.14	33.46	0.63	3.44	NOT DETECTED
30.	14-07-2025	67.58	27.35	26.59	30.72	0.58	3.48	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		WEST PORT - PMC OFFICE						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
31.	17-07-2025	75.48	33.12	30.36	35.38	0.65	3.56	NOT DETECTED
32.	21-07-2025	71.2	30.62	27.64	32.91	0.61	3.5	NOT DETECTED
33.	24-07-2025	73.59	31.27	28.46	32.28	0.57	3.58	NOT DETECTED
34.	28-07-2025	66.19	25.84	24.13	28.97	0.54	3.42	NOT DETECTED
35.	31-07-2025	70.94	27.38	25.73	30.42	0.59	3.47	NOT DETECTED
36.	04-08-2025	73.16	30.15	26.84	30.19	0.62	3.52	NOT DETECTED
37.	07-08-2025	77.35	33.46	29.53	34.75	0.65	3.64	NOT DETECTED
38.	11-08-2025	75.16	31.49	27.16	31.62	0.6	3.68	NOT DETECTED
39.	14-08-2025	72.16	28.16	24.82	29.73	0.64	3.61	NOT DETECTED
40.	18-08-2025	68.46	27.91	21.13	26.21	0.55	3.56	NOT DETECTED
41.	21-08-2025	70.88	30.42	23.96	27.64	0.59	3.51	NOT DETECTED
42.	25-08-2025	74.16	34.76	26.84	31.26	0.66	3.63	NOT DETECTED
43.	28-08-2025	77.86	36.1	27.81	32.81	0.71	3.66	NOT DETECTED
44.	01-09-2025	76.58	35.29	28.46	32.47	0.73	3.61	NOT DETECTED
45.	04-09-2025	74.36	33.18	26.57	30.17	0.77	3.55	NOT DETECTED

Continue…

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Name of Location		WEST PORT - PMC OFFICE						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
46.	08-09-2025	70.36	31.28	29.43	33.46	0.68	3.42	NOT DETECTED
47.	11-09-2025	73.28	32.49	31.13	35.87	0.64	3.48	NOT DETECTED
48.	15-09-2025	78.56	35.91	33.76	37.63	0.72	3.65	NOT DETECTED
49.	18-09-2025	75.13	33.15	31.72	34.91	0.75	3.58	NOT DETECTED
50.	22-09-2025	68.94	27.56	25.49	28.74	0.63	3.46	NOT DETECTED
51.	25-09-2025	67.49	25.48	24.12	28.68	0.6	3.39	NOT DETECTED
52.	29-09-2025	70.14	29.42	26.78	30.25	0.66	3.5	NOT DETECTED
Permissible Value as per NAAQMS		**100.0**	**60.0**	**80.0**	**80.0**	**2.0**	**---**	**5.0**
Test Method		**IS - 5182, Part- 23**	**UERL/AIR/ SOP/11**	**IS - 5182, Part - 2**	**IS - 5182, Part - 6**	**IS - 5182, Part - 10**	**Gas analyzer**	**IS – 5182, Part – 11**

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Results of Ambient Air Quality Monitoring

Name of Location		LPG Terminal Substation						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
1.	03-04-2025	74.82	29.18	23.83	27.42	0.8	--	NOT DETECTED
2.	07-04-2025	71.43	27.53	22.59	25.9	0.85	3.78	NOT DETECTED
3.	10-04-2025	77.69	30.64	26.18	30.43	0.77	3.83	NOT DETECTED
4.	14-04-2025	75.37	28.67	25.63	28.88	0.74	3.8	NOT DETECTED
5.	17-04-2025	70.82	25.41	21.94	26.58	0.69	3.72	NOT DETECTED
6.	21-04-2025	76.87	26.48	25.74	29.24	0.75	3.75	NOT DETECTED
7.	24-04-2025	81.42	31.79	28.35	32.73	0.83	3.84	NOT DETECTED
8.	28-04-2025	78.55	28.36	26.14	30.51	0.78	3.78	NOT DETECTED
9.	01-05-2025	72.34	27.65	22.45	26.56	0.78	3.11	NOT DETECTED
10.	05-05-2025	70.56	26.23	21.12	24.67	0.65	3.68	NOT DETECTED
11.	08-05-2025	73.23	31.23	24.56	28.98	0.71	3.76	NOT DETECTED
12.	12-05-2025	74.23	26.45	23.23	27.67	0.68	3.87	NOT DETECTED
13.	15-05-2025	69.87	24.32	20.98	24.32	0.61	3.76	NOT DETECTED
14.	19-05-2025	75.23	25.34	24.32	28.78	0.77	3.65	NOT DETECTED
15.	22-05-2025	80.12	29.98	27.87	31.23	0.81	3.71	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		LPG Terminal Substation						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
16.	26-05-2025	77.23	26.56	25.32	29.89	0.74	3.8	NOT DETECTED
17.	29-05-2025	75.23	28.76	23.12	27.56	0.69	3.76	NOT DETECTED
18.	02-06-2025	70.21	26.19	21.87	25.34	0.65	3.5	NOT DETECTED
19.	05-06-2025	67.69	25.45	19.57	22.76	0.58	3.37	NOT DETECTED
20.	09-06-2025	64.38	22.81	18.42	22.12	0.52	3.32	NOT DETECTED
21.	12-06-2025	60.47	19.35	15.76	18.45	0.57	3.43	NOT DETECTED
22.	16-06-2025	65.49	23.53	17.42	21.56	0.63	3.56	NOT DETECTED
23.	19-06-2025	68.47	25.26	19.47	22.81	0.68	3.58	NOT DETECTED
24.	23-06-2025	58.74	20.65	16.77	20.35	0.50	3.47	NOT DETECTED
25.	26-06-2025	63.25	21.43	18.35	23.65	0.57	3.53	NOT DETECTED
26.	30-06-2025	67.12	23.71	20.52	24.12	0.64	3.61	NOT DETECTED
27.	03-07-2025	65.73	23.15	18.35	22.74	0.57	--	NOT DETECTED
28.	07-07-2025	62.91	21.83	15.48	19.11	0.53	3.51	NOT DETECTED
29.	10-07-2025	67.58	25.25	17.89	21.47	0.6	3.59	NOT DETECTED
30.	14-07-2025	71.42	28.74	20.26	24.29	0.66	3.68	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		LPG Terminal Substation						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
31.	17-07-2025	70.85	26.32	19.76	25.09	0.62	3.63	NOT DETECTED
32.	21-07-2025	67.54	24.98	17.56	22.31	0.55	3.57	NOT DETECTED
33.	24-07-2025	60.43	21.46	14.19	17.76	0.47	3.49	NOT DETECTED
34.	28-07-2025	58.97	17.68	13.81	15.96	0.44	3.47	NOT DETECTED
35.	31-07-2025	62.47	21.34	16.62	20.37	0.52	3.56	NOT DETECTED
36.	04-08-2025	61.28	22.96	15.28	20.16	0.49	3.47	NOT DETECTED
37.	07-08-2025	65.74	24.2	17.46	23.48	0.55	3.52	NOT DETECTED
38.	11-08-2025	70.63	27.48	21.59	25.68	0.62	3.65	NOT DETECTED
39.	14-08-2025	67.42	26.59	20.41	24.13	0.58	3.62	NOT DETECTED
40.	18-08-2025	59.21	21.47	15.63	20.18	0.5	3.54	NOT DETECTED
41.	21-08-2025	63.43	23.46	16.13	18.62	0.54	3.57	NOT DETECTED
42.	25-08-2025	66.78	26.22	18.46	23.24	0.58	3.62	NOT DETECTED
43.	28-08-2025	69.37	28.68	22.38	27.26	0.63	3.68	NOT DETECTED
44.	01-09-2025	66.57	26.48	19.25	23.11	0.51	3.61	NOT DETECTED
45.	04-09-2025	61.39	24.13	16.43	20.65	0.35	3.35	NOT DETECTED
46.	08-09-2025	64.52	26.11	17.34	21.27	0.43	3.42	NOT DETECTED

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Name of Location		LPG Terminal Substation						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
47.	11-09-2025	71.38	29.87	22.54	26.15	0.68	3.56	NOT DETECTED
48.	15-09-2025	66.25	25.41	20.96	24.31	0.58	3.39	NOT DETECTED
49.	18-09-2025	68.58	28.76	23.45	26.57	0.63	3.24	NOT DETECTED
50.	22-09-2025	60.81	21.53	16.64	20.39	0.44	3.17	NOT DETECTED
51.	25-09-2025	65.32	27.24	18.35	22.24	0.39	3.29	NOT DETECTED
52.	29-09-2025	62.49	25.63	16.52	20.75	0.47	2.33	NOT DETECTED
Permissible Value as per NAAQMS		**100.0**	**60.0**	**80.0**	**80.0**	**2.0**	**---**	**5.0**
Test Method		**IS - 5182, Part- 23**	**UERL/AIR/ SOP/11**	**IS - 5182, Part - 2**	**IS - 5182, Part - 6**	**IS - 5182, Part - 10**	**Gas analyzer**	**IS – 5182, Part – 11**

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Results of Ambient Air Quality Monitoring

Name of Location		Adani Guest House				
Sr. No.	Date of Monitoring	Parameter with Results				
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³
1.	03-04-2025	74.21	21.53	16.15	20.81	NOT DETECTED
2.	07-04-2025	77.53	23.15	17.84	22.11	--
3.	10-04-2025	70.49	19.83	15.62	19.31	--
4.	14-04-2025	67.42	16.54	12.68	16.42	--
5.	17-04-2025	65.14	15.42	11.15	15.48	--
6.	21-04-2025	70.43	17.69	15.38	19.66	--
7.	24-04-2025	67.43	14.37	14.65	18.52	--
8.	28-04-2025	64.92	15.11	13.77	17.46	--
9.	01-05-2025	73.23	19.89	15.67	19.87	--
10.	05-05-2025	75.67	22.56	16.34	20.67	--
11.	08-05-2025	68.98	18.78	17.89	21.34	--
12.	12-05-2025	66.12	15.45	14.43	18.78	--
13.	15-05-2025	63.23	14.23	12.12	16.78	--
14.	19-05-2025	68.98	16.56	16.67	20.98	--
15.	22-05-2025	63.45	12.78	13.21	17.56	--

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		Adani Guest House				
Sr. No.	Date of Monitoring	Parameter with Results				
		PM_{10} $\mu g/m^3$	$PM_{2.5}$ $\mu g/m^3$	SO_2 $\mu g/m^3$	NO_2 $\mu g/m^3$	CO mg/m^3
16.	26-05-2025	61.23	14.65	12.12	15.67	--
17.	29-05-2025	64.56	15.78	14.23	18.23	--
18.	02-06-2025	65.48	16.38	14.76	17.49	--
19.	05-06-2025	61.42	15.42	13.25	16.53	--
20.	09-06-2025	56.48	13.28	11.76	14.29	--
21.	12-06-2025	53.28	12.87	10.86	13.57	--
22.	16-06-2025	58.48	14.85	12.53	15.64	--
23.	19-06-2025	51.54	13.92	12.88	16.11	--
24.	23-06-2025	47.58	10.46	9.23	13.24	--
25.	26-06-2025	53.46	15.13	11.47	14.59	--
26.	30-06-2025	50.97	14.84	12.45	15.21	--
27.	03-07-2025	54.38	14.94	13.42	16.76	NOT DETECTED
28.	07-07-2025	57.64	16.38	16.43	20.12	--
29.	10-07-2025	50.39	13.82	13.27	17.53	--
30.	14-07-2025	53.19	14.25	14.06	18.21	--
31.	17-07-2025	55.91	15.11	16.49	20.47	--

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		Adani Guest House				
Sr. No.	Date of Monitoring	Parameter with Results				
		PM_{10} $\mu g/m^3$	$PM_{2.5}$ $\mu g/m^3$	SO_2 $\mu g/m^3$	NO_2 $\mu g/m^3$	CO mg/m^3
32.	21-07-2025	48.38	13.59	12.72	15.48	--
33.	24-07-2025	45.39	13.12	8.83	11.29	--
34.	28-07-2025	51.25	14.89	10.64	14.23	--
35.	31-07-2025	55.81	15.12	13.25	17.48	--
36.	04-08-2025	49.28	15.55	11.69	14.26	--
37.	07-08-2025	46.92	14.23	9.76	12.34	--
38.	11-08-2025	54.16	16.84	11.65	13.75	--
39.	14-08-2025	57.64	18.35	14.21	18.61	--
40.	18-08-2025	50.16	15.82	12.35	15.27	--
41.	21-08-2025	44.29	13.62	9.11	12.46	--
42.	25-08-2025	48.76	15.28	11.36	15.2	--
43.	28-08-2025	53.42	16.49	13.53	16.98	--
44.	01-09-2025	56.13	14.72	12.83	16.25	--
45.	04-09-2025	59.49	16.47	15.65	19.36	--
46.	08-09-2025	62.38	19.11	17.67	21.34	--
47.	11-09-2025	57.53	15.62	13.25	16.58	--

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Name of Location		Adani Guest House				
Sr. No.	Date of Monitoring	Parameter with Results				
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³
48.	15-09-2025	51.39	13.46	11.91	13.24	--
49.	18-09-2025	46.73	11.93	8.75	10.83	--
50.	22-09-2025	41.28	10.35	7.98	10.11	--
51.	25-09-2025	49.58	12.35	10.62	14.35	--
52.	29-09-2025	54.38	14.53	13.14	16.46	--
Permissible Value as per NAAQMS		**100.0**	**60.0**	**80.0**	**80.0**	**2.0**
Test Method		**IS - 5182, Part- 23**	**UERL/AIR/ SOP/11**	**IS - 5182, Part - 2**	**IS - 5182, Part - 6**	**IS - 5182, Part - 10**

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Results of Ambient Air Quality Monitoring

Name of Location		CT-4 RMU-2						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
1.	03-04-2025	82.53	32.36	31.41	36.17	0.81	--	NOT DETECTED
2.	07-04-2025	79.81	30.64	29.43	33.69	0.77	4.16	NOT DETECTED
3.	10-04-2025	76.51	27.15	27.96	32.48	0.73	4.11	NOT DETECTED
4.	14-04-2025	80.13	32.19	30.42	35.16	0.80	4.21	NOT DETECTED
5.	17-04-2025	83.45	34.56	32.27	37.52	0.88	4.26	NOT DETECTED
6.	21-04-2025	76.81	29.28	27.15	32.19	0.79	4.15	NOT DETECTED
7.	24-04-2025	78.54	30.71	28.57	33.78	0.83	4.19	NOT DETECTED
8.	28-04-2025	82.43	34.65	31.43	36.55	0.91	4.23	NOT DETECTED
9.	01-05-2025	80.34	30.89	27.89	31.23	0.76	4.12	NOT DETECTED
10.	05-05-2025	78.45	28.78	31.21	35.34	0.65	4.28	NOT DETECTED
11.	08-05-2025	74.34	25.56	25.65	29.98	0.70	4.18	NOT DETECTED
12.	12-05-2025	79.45	30.98	29.89	33.23	0.78	4.22	NOT DETECTED
13.	15-05-2025	80.12	31.23	30.76	34.23	0.81	4.16	NOT DETECTED
14.	19-05-2025	74.34	28.78	26.56	29.98	0.75	4.22	NOT DETECTED
15.	22-05-2025	77.21	26.78	27.34	31.23	0.87	4.25	NOT DETECTED

Continue…

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		CT-4 RMU-2						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
16.	26-05-2025	80.78	30.98	29.98	32.43	0.76	4.15	NOT DETECTED
17.	29-05-2025	76.56	27.67	30.12	34.23	0.82	4.22	NOT DETECTED
18.	02-06-2025	74.38	26.77	28.15	32.64	0.74	4.10	NOT DETECTED
19.	05-06-2025	77.35	29.13	29.97	32.98	0.78	4.21	NOT DETECTED
20.	09-06-2025	80.81	32.64	32.13	36.47	0.84	4.37	NOT DETECTED
21.	12-06-2025	78.13	28.79	28.42	33.11	0.76	4.27	NOT DETECTED
22.	16-06-2025	70.18	24.26	25.31	29.84	0.61	4.00	NOT DETECTED
23.	19-06-2025	67.48	23.65	22.76	26.49	0.58	3.88	NOT DETECTED
24.	23-06-2025	72.35	26.82	24.36	28.12	0.65	4.11	NOT DETECTED
25.	26-06-2025	75.27	27.64	26.83	31.52	0.70	4.18	NOT DETECTED
26.	30-06-2025	70.63	25.11	24.77	28.61	0.67	4.06	NOT DETECTED
27.	03-07-2025	72.19	24.86	23.91	28.13	0.65	--	NOT DETECTED
28.	07-07-2025	66.59	21.28	19.75	23.59	0.59	4.00	NOT DETECTED
29.	10-07-2025	69.42	23.65	20.14	26.42	0.63	3.91	NOT DETECTED
30.	14-07-2025	64.38	19.86	17.64	22.9	0.55	3.85	NOT DETECTED
31.	17-07-2025	68.68	21.4	19.32	24.89	0.58	3.96	NOT DETECTED

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Name of Location		CT-4 RMU-2						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
32.	21-07-2025	70.13	26.57	21.38	26.57	0.65	4.13	NOT DETECTED
33.	24-07-2025	62.18	22.91	16.39	21.11	0.60	3.87	NOT DETECTED
34.	28-07-2025	60.49	18.73	15.34	19.69	0.51	3.83	NOT DETECTED
35.	31-07-2025	65.37	20.45	17.58	22.71	0.55	3.94	NOT DETECTED
36.	04-08-2025	67.58	22.16	20.47	25.64	0.59	4.12	NOT DETECTED
37.	07-08-2025	70.16	24.74	23.46	27.89	0.64	4.21	NOT DETECTED
38.	11-08-2025	73.15	27.38	26.73	30.16	0.71	4.35	NOT DETECTED
39.	14-08-2025	69.43	23.54	22.91	26.79	0.68	4.28	NOT DETECTED
40.	18-08-2025	62.13	20.19	16.42	21.42	0.60	4.15	NOT DETECTED
41.	21-08-2025	64.61	21.63	17.84	21.18	0.62	4.24	NOT DETECTED
42.	25-08-2025	68.46	24.98	21.76	26.39	0.72	4.30	NOT DETECTED
43.	28-08-2025	70.17	25.86	23.51	27.48	0.68	4.36	NOT DETECTED
44.	01-09-2025	73.18	29.74	26.46	31.87	0.65	4.43	NOT DETECTED
45.	04-09-2025	75.19	32.45	29.11	33.62	0.73	4.51	NOT DETECTED
46.	08-09-2025	69.58	25.47	23.56	26.89	0.61	4.37	NOT DETECTED
47.	11-09-2025	72.49	30.58	27.13	31.25	0.76	4.64	NOT DETECTED

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Name of Location		CT-4 RMU-2						
Sr. No.	Date of Monitoring	Parameter with Results						
		PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	HC µg/m³	Benzene µg/m³
48.	15-09-2025	77.38	33.46	30.68	36.14	0.83	4.71	NOT DETECTED
49.	18-09-2025	71.22	27.56	25.31	29.45	0.77	4.62	NOT DETECTED
50.	22-09-2025	64.29	24.31	21.35	24.22	0.59	4.41	NOT DETECTED
51.	25-09-2025	67.58	26.4	24.48	27.87	0.62	4.47	NOT DETECTED
52.	29-09-2025	69.32	29.84	25.1	29.23	0.70	4.33	NOT DETECTED
Permissible Value as per NAAQMS		**100.0**	**60.0**	**80.0**	**80.0**	**2.0**	**---**	**5.0**
Test Method		**IS - 5182, Part- 23**	**UERL/AIR/ SOP/11**	**IS - 5182, Part - 2**	**IS - 5182, Part - 6**	**IS - 5182, Part - 10**	**Gas analyzer**	**IS – 5182, Part – 11**

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Results of Noise Level Monitoring

Location Name		West Port – West Basin Main Gate					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Day Time					
		21-04-2025	19-05-2025	19-06-2025	21-07-2025	21-08-2025	18-09-2025
1	06:00 to 07:00	61.5	66.2	65.9	64.8	64.5	63.8
2	07:00 to 08:00	62.9	63.9	64.8	66.5	65.8	63.9
3	08:00 to 09:00	64.1	66.1	67.1	64.7	66.3	65.4
4	09:00 to 10:00	63.8	61.2	68.5	66.7	66.7	67.1
5	10:00 to 11:00	62.4	62.8	68.2	65.5	67.4	67.8
6	11:00 to 12:00	63.7	68.9	69.1	65.9	65.8	66.4
7	12:00 to 13:00	65.7	65.4	68.4	68.1	67.9	67.3
8	13:00 to 14:00	65.3	69.1	68.3	65.7	66.1	66.5
9	14:00 to 15:00	63.2	62.4	67.5	68.2	66.5	64.2
10	15:00 to 16:00	65.8	69.7	69.2	66.8	67.4	67.3
11	16:00 to 17:00	66.2	62.2	67.5	68.4	67.2	65.4
12	17:00 to 18:00	62.6	68.2	65.7	66.5	64.5	64.9
13	18:00 to 19:00	66.7	63.1	64.2	68.1	65.7	63.8
14	19:00 to 20:00	64.5	65.7	66.6	64.8	65.4	64.7
15	20:00 to 21:00	63.6	61.4	64.2	65.4	64.4	64.2
16	21:00 to 22:00	58.7	66.8	64.7	61.8	63.5	62.5
Day Time		<75 dB (A)					

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Location Name		West Port – West Basin Main Gate					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) – Night Time					
		21-04-2025	19-05-2025	19-06-2025	21-07-2025	21-08-2025	18-09-2025
1	22:00 to 23:00	61.5	63.2	62.1	57.6	56.3	55.6
2	23:00 to 24:00	63.8	63.8	63.4	60.8	58.7	57.1
3	24:00 to 01:00	63.2	64.1	63.9	59.9	61.3	59.8
4	01:00 to 02:00	63.4	61.9	62.7	62.5	64.9	63.6
5	02:00 to 03:00	60.8	62.4	61.8	64.1	63.2	61.5
6	03:00 to 04:00	61.3	63.9	62.4	61.3	63.8	63.4
7	04:00 to 05:00	62.3	60.4	63.8	60.7	61.4	61.3
8	05:00 to 06:00	59.8	62.3	63.2	58.6	60.7	56.5
Night Time		<70 dB (A)					
Test Method		IS: 9989 : 1981					

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Results of Noise Level Monitoring

Location Name		West Port – Horti Culture					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Day Time					
		24-04-2025	22-05-2025	23-06-2025	24-07-2025	25-08-2025	22-09-2025
1	06:00 to 07:00	63.2	64.4	63.6	63.5	62.8	62.3
2	07:00 to 08:00	65.2	68.8	65.4	65.7	64.3	65.2
3	08:00 to 09:00	66.4	65.3	65.2	68.2	65.8	64.7
4	09:00 to 10:00	65.4	68.5	66.9	65.5	65.5	65.7
5	10:00 to 11:00	67.3	62.3	65.4	63.7	63.7	64.5
6	11:00 to 12:00	66.7	66.1	63.8	63.7	64.5	65.8
7	12:00 to 13:00	67.6	61.8	65.5	66.7	65.1	65.7
8	13:00 to 14:00	66.5	65.5	66.7	64.9	65.4	64.3
9	14:00 to 15:00	65.1	69.2	67.3	66.4	66.8	66.4
10	15:00 to 16:00	64.8	67.8	68.6	68.1	65.4	65.7
11	16:00 to 17:00	64.7	62.8	64.3	63.9	63.4	64.9
12	17:00 to 18:00	65.5	63.3	66.4	65.8	65.2	65.7
13	18:00 to 19:00	63.2	63.7	63.5	67.3	66.5	66.7
14	19:00 to 20:00	62.9	64.6	63.9	68.4	67.1	66.4
15	20:00 to 21:00	64.8	66.9	65.1	66.3	65.3	65.5
16	21:00 to 22:00	60.2	65.8	63.2	63.2	62.9	63.8
Day Time		<75 dB (A)					

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Location Name		West Port – Horti Culture					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Night Time					
		24-04-2025	22-05-2025	23-06-2025	24-07-2025	25-08-2025	22-09-2025
1	22:00 to 23:00	63.3	60.3	61.6	60.8	61.7	60.3
2	23:00 to 24:00	62.3	62.4	61.3	63.1	62.5	62.4
3	24:00 to 01:00	63.4	62.3	64.5	60.8	64.8	63.6
4	01:00 to 02:00	62.5	55.2	63.3	61.3	62.4	62.5
5	02:00 to 03:00	63.5	62.9	62.7	63.7	62.6	63.2
6	03:00 to 04:00	63	60.7	62.3	62.4	61.3	60.8
7	04:00 to 05:00	61.3	61.2	63.4	61.8	62.4	60.1
8	05:00 to 06:00	59.6	60.5	62.4	60.4	61.7	62.4
Night Time		<70 dB (A)					

Test Method	IS: 9989 : 1981

Rajnish D. Gohil
(Chemist)

GUJARAT VAPI. UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Results of Noise Level Monitoring

Location Name		WEST PORT - PMC OFFICE					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Day Time					
		28-04-2025	26-05-2025	26-06-2025	28-07-2025	28-08-2025	25-09-2025
1	06:00 to 07:00	59.2	65.3	65.2	61.8	63.4	64.4
2	07:00 to 08:00	60.5	63.2	65.8	63.7	62.5	65.7
3	08:00 to 09:00	63.7	66.2	64.7	66.1	63.8	66.3
4	09:00 to 10:00	64.1	69.6	68.7	63.9	66.7	66.5
5	10:00 to 11:00	66.2	65.9	68.3	65.2	65.5	64.3
6	11:00 to 12:00	65.3	68.5	67.5	68.5	66.8	64.8
7	12:00 to 13:00	65.4	60.7	62.3	65.3	66.5	67.3
8	13:00 to 14:00	64.3	63.7	64.5	64.6	66.2	65.7
9	14:00 to 15:00	65.9	65.8	65.9	65.7	65.3	64.3
10	15:00 to 16:00	64.8	66.3	67.3	66.8	66.7	66.9
11	16:00 to 17:00	63.1	67.8	67.4	65.3	66.1	65.2
12	17:00 to 18:00	64.5	69.2	68.7	68.4	67.5	66.5
13	18:00 to 19:00	64.8	67.5	66.1	66.3	65.4	64.3
14	19:00 to 20:00	60.8	64.9	63.5	64.8	65.8	65.7
15	20:00 to 21:00	61.8	62.7	64.8	63.2	64.1	64.3
16	21:00 to 22:00	59.6	63.4	62.8	60.5	60.7	61.3
Day Time		<75 dB (A)					

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Location Name		WEST PORT - PMC OFFICE					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Night Time					
		28-04-2025	26-05-2025	26-06-2025	28-07-2025	28-08-2025	25-09-2025
1	22:00 to 23:00	61.9	59.6	63.3	59.1	58.2	58.6
2	23:00 to 24:00	62.7	60.3	62.7	61.3	60.8	59.8
3	24:00 to 01:00	60.7	63.5	60.3	63.1	62.7	56.4
4	01:00 to 02:00	63.4	62.4	61.8	62.3	62.8	57.9
5	02:00 to 03:00	62.3	60.2	62.5	59.9	61.3	60.2
6	03:00 to 04:00	60.2	64.2	63.7	58.3	60.2	61.4
7	04:00 to 05:00	60.7	58.2	61.2	60.8	60.5	59.5
8	05:00 to 06:00	60.4	62.1	63.1	59.6	58.4	60.8
Day Time		<70 dB (A)					

Test Method	IS: 9989 : 1981

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Rajnish D. Gohil
(Chemist)

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Results of Noise Level Monitoring

Location Name		LPG Terminal Substation					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Day Time					
		17-04-2025	15-05-2025	16-06-2025	17-07-2025	18-08-2025	15-09-2025
1	06:00 to 07:00	63.8	63.2	62.1	60.8	60.1	58.7
2	07:00 to 08:00	62.7	60.8	62.9	62.7	61.4	60.3
3	08:00 to 09:00	63.8	68.2	65.4	64.5	63.5	61.8
4	09:00 to 10:00	64.6	65.9	64.3	63.5	64.8	63.4
5	10:00 to 11:00	65.8	69.1	66.4	65.7	65.7	64.2
6	11:00 to 12:00	65.1	62.6	67.8	66.3	66.3	65.8
7	12:00 to 13:00	64.8	64.4	67.3	68.2	65.7	66.8
8	13:00 to 14:00	65.7	62.5	69.8	68.8	67.8	64.3
9	14:00 to 15:00	64.5	65.4	68.4	67.5	67.4	65.8
10	15:00 to 16:00	67.1	68.7	64.3	64.1	66.5	66.1
11	16:00 to 17:00	65.6	62.4	65.1	66.7	66.7	63.4
12	17:00 to 18:00	64.3	60.7	63.2	65.5	66.2	65.7
13	18:00 to 19:00	64.7	63.8	64.5	63.7	64.5	65.2
14	19:00 to 20:00	65.7	69.4	65.8	64.2	64.2	62.1
15	20:00 to 21:00	62.6	65.5	66.4	65.7	62.2	60.5
16	21:00 to 22:00	61.5	68.1	64.1	63.8	63.1	59.7
Day Time		<75 dB (A)					

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Location Name		LPG Terminal Substation					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) – Night Time					
		17-04-2025	15-05-2025	16-06-2025	17-07-2025	18-08-2025	15-09-2025
1	22:00 to 23:00	62.1	61.9	60.4	60.2	59.6	57.4
2	23:00 to 24:00	61.3	62.7	60.4	63.1	61.4	59.3
3	24:00 to 01:00	63.4	63.8	61.4	62.5	64.3	61.5
4	01:00 to 02:00	64.3	60.1	59.8	63.8	62.3	62.7
5	02:00 to 03:00	62.8	61.9	59.7	62.7	62.7	62.4
6	03:00 to 04:00	61.4	63.7	60.5	61.8	61.8	60.8
7	04:00 to 05:00	61.3	63.5	62.3	58.4	59.7	60.3
8	05:00 to 06:00	60.3	57.9	61.6	56.9	57.4	58.6
Night Time		<70 dB (A)					

Test Method	IS: 9989 : 1981

Rajnish D. Gohil
(Chemist)

GUJARAT VAPI. UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Results of Noise Level Monitoring

Location Name		Adani Guest House					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Day Time					
		19-04-2025	17-05-2025	17-06-2025	12-07-2025	16-08-2025	13-09-2025
1	06:00 to 07:00	57.4	60.9	58.6	58.7	58.5	57.2
2	07:00 to 08:00	59.4	66.5	62.3	62.3	60.8	58.4
3	08:00 to 09:00	60.3	68.4	64.6	64.8	65.7	60.5
4	09:00 to 10:00	62.4	61.8	65.8	66.5	67.4	62.4
5	10:00 to 11:00	63.7	67.4	66.4	63.7	66.9	64.5
6	11:00 to 12:00	64.3	61.1	64.3	67.9	66.2	65.7
7	12:00 to 13:00	64.2	63.9	66.2	64.3	66.1	66.5
8	13:00 to 14:00	65.7	69.9	68.1	66.3	65.6	64.3
9	14:00 to 15:00	64.3	65.7	67.4	65.2	65.1	65.3
10	15:00 to 16:00	66.6	60.4	67.2	63.5	64.7	65.9
11	16:00 to 17:00	65.5	69.4	65.6	64.6	65.5	64.1
12	17:00 to 18:00	66.3	66.1	63.2	66.7	66.8	66.7
13	18:00 to 19:00	64.1	62.4	65.7	64.5	65.3	65.8
14	19:00 to 20:00	64.5	65.5	64.3	66.4	66.7	64.2
15	20:00 to 21:00	64.1	62.1	63.8	61.3	63.5	63.8
16	21:00 to 22:00	58.9	64.8	59.8	60.4	62.2	58.2
Day Time		<75 dB (A)					

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Location Name		Adani Guest House					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) – Night Time					
		19-04-2025	17-05-2025	17-06-2025	12-07-2025	16-08-2025	13-09-2025
1	22:00 to 23:00	58.7	55.3	56.4	59.5	58.6	57.1
2	23:00 to 24:00	60.4	56.7	56.9	58.6	59.3	58.3
3	24:00 to 01:00	59.8	55.8	53.8	60.5	61.2	55.6
4	01:00 to 02:00	61.3	54.2	55.2	59.4	59.4	56.7
5	02:00 to 03:00	60.6	60.5	51.3	57.2	57.2	57.2
6	03:00 to 04:00	59.4	51.4	52.8	55.8	55.2	56.9
7	04:00 to 05:00	60.8	54.5	54.3	57.6	56.3	57.4
8	05:00 to 06:00	58.2	55.4	55.6	56.3	56.7	57.2
Night Time		<70 dB (A)					

Test Method	IS: 9989 : 1981

R. D. Gohil

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Results of Noise Level Monitoring

Location Name		CT-4 RMU-2					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) - Day Time					
		23-04-2025	20-05-2025	21-06-2025	15-07-2025	20-08-2025	17-09-2025
1	06:00 to 07:00	63.7	62.4	64.3	62.6	60.7	62.5
2	07:00 to 08:00	64.5	63.9	66.8	64.5	63.4	61.9
3	08:00 to 09:00	65.7	65.7	65.4	65.2	63.1	64.5
4	09:00 to 10:00	66.2	66.2	68.2	67.7	64.6	66.8
5	10:00 to 11:00	66.2	65.4	68.5	68.3	66.3	67.3
6	11:00 to 12:00	66.9	67.8	69.4	68.5	65.5	66.2
7	12:00 to 13:00	67.4	67.4	68.6	67.8	65.4	64.8
8	13:00 to 14:00	66.2	66.2	65.8	64.5	65.7	65.6
9	14:00 to 15:00	65.3	64.3	67.2	66.9	64.3	64.2
10	15:00 to 16:00	65.7	65.7	66.4	64.3	66.8	65.7
11	16:00 to 17:00	67.1	67.1	67.9	65.7	65.3	65.8
12	17:00 to 18:00	65.4	63.2	65.4	66.4	66.1	65.3
13	18:00 to 19:00	65.2	65.2	64.1	65.6	66.8	66.3
14	19:00 to 20:00	63.4	63.4	65.8	66.8	66.3	65.9
15	20:00 to 21:00	63.8	62.8	65.4	64.3	64.3	65.7
16	21:00 to 22:00	61.3	62.2	62.3	63.7	61.5	63.5
Day Time		<75 dB (A)					

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Location Name		CT-4 RMU-2					
Sr. No.	Sampling Date and Time	Noise Level Leq. dB(A) – Night Time					
		23-04-2025	20-05-2025	21-06-2025	15-07-2025	20-08-2025	17-09-2025
1	22:00 to 23:00	61.3	60.8	61.7	62.8	61.3	61.5
2	23:00 to 24:00	63.2	62.4	63.3	60.5	61.8	62.4
3	24:00 to 01:00	63.5	63.5	62.7	64.3	62.3	60.6
4	01:00 to 02:00	64.3	63.8	60.4	61.6	62.5	58.6
5	02:00 to 03:00	64.6	64.2	59.9	62.4	63.7	59.8
6	03:00 to 04:00	62.4	62.4	60.4	64.1	62.5	59.4
7	04:00 to 05:00	61.2	61.2	60.7	62.6	61.3	60.4
8	05:00 to 06:00	60.8	60.3	61.4	60.1	58.6	60.5
Night Time		<70 dB (A)					

Test Method	IS: 9989 : 1981

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Results of Stack Monitoring

Sr. No.	Parameter	Unit	Sep – 2025		GPCB LIMIT	Method of Test
			D.G.Set No. S-1 (1500 KVA)	D.G.Set No. S-2 (1500 KVA)		
			02-09-2025	02-09-2025		
1	Particulate Matter	mg/Nm^3	21.42	23.85	**150**	**IS 11255 (Part - 1)**
2	Sulfur Dioxide as SO_2	ppm	16.58	16.77	**100**	**IS 11255 (Part - 2)**
3	Oxides of Nitrogen as NO_X	ppm	25.39	20.38	**50**	**IS 11255 (Part - 7)**

Rajnish D. Gohil
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

UniStar
Environment and Research Labs Pvt. Ltd.

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

MoEF&CC Recog. Environmental Laboratory under The EPA, 1986 (02.04.2025 to 29.03.2028) | NABL (ISO/IEC 17025: 2017) Accredited Testing Laboratory (TC-15345) (22.01.2025 to 22.09.2026) | QCI-NABET Accredited EIA & GW Consultant Organisation | GPCB Recognized Environmental Auditor (Sch-II) | ISO 9001: 2015 Certified Company | ISO 45001: 2018 Certified OHS Management System

Sr. No.	Parameter	Unit	Sep-25	GPCB LIMIT	Method of Test
			D.G. Set-1 (2000 KVA)		
			27-09-2025		
1	Particulate Matter	mg/Nm3	29.94	**150**	**IS 11255 (Part - 1)**
2	Sulphur Dioxide	ppm	13.85	**100**	**IS 11255 (Part - 2)**
3	Oxide of Nitrogen	ppm	25.79	**50**	**IS 11255 (Part - 7)**
4	Carbon Monoxide	mg/Nm3	4.4	--	**UERL/AIR/SOP/18**
5	Non Methyl Hydro Carbon	ppm	Not Detected	--	**UERL/AIR/SOP/27**

Nikunj D. Patel
(Chemist)

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. * GUJARAT VAPI.

Jaivik S. Tandel
(Manager - Operations)

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

Minimum Detection Limit

Ambient Air Quality Monitoring

Sr. No.	Test Parameter	Unit	MDL
1	Particulate Matter (PM10)	µg/m3	5 µg/m3
2	Particulate Matter (PM10)	µg/m3	5 µg/m3
3	Sulphur Dioxide (SO2)	µg/m3	4 µg/m3
4	Nitrogen Dioxide (NO2)	µg/m3	5 µg/m3
5	Carbon Monoxide (CO)	mg/m3	0.01 mg/m3
6	Ammonia (NH3)	µg/m3	5 µg/m3
7	Ozone (O3)	µg/m3	5 µg/m3
8	Lead (Pb)	µg/m3	0.5 µg/m3
9	Nickle (Ni)	ng/m3	1 ng/m3
10	Arsenic (As)	ng/m3	1 ng/m3
11	Benzene	µg/m3	1µg/m3
12	Benzo(o)Pyrene	ng/m3	0.1 ng/m3
14	Hydro Carbon	µg/m3	1 µg/m3

Stack Emission Monitoring

Sr. No.	Test Parameter	Unit	MDL
1	Suspended particulate matter	mg/Nm3	2 mg/Nm3
2	Sulphur Dioxide SOX	mg/Nm3	4 mg/Nm3
3	Oxides of Nitrogen NOX	mg/Nm3	5 mg/Nm3

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

STP Outlet			
Sr. No.	**Test Parameter**	**Unit**	**MDL**
1	pH @ 25 ° C	--	2
2	Total Suspended Solids	mg/L	4
3	Biochemical Oxygen Demand (BOD) (5 days at 20 ° C)	mg/L	1
4	Residual chlorine	mg/L	0.1
5	Fecal Coliform	MPN/100	<2

Plot No.51, Vibrant Business Park,
NH No.48, GIDC, Vapi-396195
Dist-Valsad (Gujarat), India
Phone + 91 260 2433966/2425610
Email : response@uerl.in Website : www.uerl.in

ETP Outlet			
Sr. No.	**Test Parameter**	**Unit**	**MDL**
1	Colour	Pt. Co. Scale	5
2	pH @ 27 ° C	--	2
3	Temperature	0C	5
4	Total Suspended Solids	mg/L	4
5	Total Dissolved Solids	mg/L	4
6	COD	mg/L	2
7	BOD (3 days at 27 0C)	mg/L	1
8	Chloride (as Cl) -	mg/L	1
9	Oil & Grease	mg/L	4
10	Sulphate (as SO_4)	mg/L	1
11	Ammonical Nitrogen	mg/L	5
12	Phenolic Compound	mg/L	0.1
13	Copper as Cu	mg/L	0.05
14	Lead as Pb	mg/L	0.01
15	Sulphide as S	mg/L	0.1
16	Cadmium as Cd	mg/L	0.003
17	Fluoride as F	mg/L	0.2
18	Residual Chlorine	mg/L	0.1
19	Percent Sodium	%	--
20	Sodium Absorption ratio	--	--

Annexure – 6

RISK ASSESSMENT STUDY AND PREPARATION OF CONTINGENCY PLAN FOR MARINE OIL SPILLS AT ADANI PORTS AND SPECIAL ECONOMIC ZONE LTD., MUNDRA

Final Report

JULY 2025

Client

ADANI PORTS AND SPECIAL ECONOMIC ZONE LTD
Mundra

Environ Software Pvt. Ltd.

#60/4, Environ Towers,4th Floor, Hosur Main Road, Electronic City, Bangalore - 560 100

Certificate of Endorsement

I hereby certify that:

1. The oil spill contingency plan for the facility under my charge has been prepared with due regard to the relevant international best practices, international conventions, and domestic legislation.

2. The nature and size of the possible threat including the worst-case scenario, and the resources consequently at risk have been realistically assessed bearing in mind the probable movement of any oil spill and clearly stated.

3. The priorities for protection have been agreed, taking into account the viability of the various protections and clean up options and clearly spelt out.

4. The strategy for protecting and cleaning the various areas have been agreed and clearly explained.

5. The necessary organization has been outlined, the responsibilities of all those involved have been clearly stated and all those who have a task to perform are aware of what is expected of them.

6. The levels of equipment, materials and manpower are sufficient to deal with the anticipated size of spill. If not, back-up resources been identified and, when necessary, mechanisms for obtaining their release and entry to the country have been established.

7. Temporary storage sites and final disposal routes for collected oil and debris have been identified.

8. The alerting and initial evaluation procedures are fully explained are fully explained as well as arrangement for continual review of the progress and effectiveness of the clean-up operation.

9. The arrangement for ensuring effective communication between shore, sea and air have been described.

10. All aspects of plan have been tested and nothing significant found lacking.

11. The plan is compatible with plans for adjacent areas and other activities.

12. The above is true to the best of my knowledge and belief.

13. I undertake to keep the plan updated at all times and keep the Indian Coast Guard informed of any changes through submissions of a fresh certificate of endorsement.

Seal

Signature :
Name
Designation : Dy. Conservator
Organization: Adani Ports and SEZ Limited, Mundra

Date:
Place:

CONTINGENCY PLANNING COMPLIANCE CHECKLIST

Port Authority: APSEZL

Description		Complied Yes/ No	Remarks
RISK ASSESSMENT			
1	Whether the facility produces/ handles/ uses/ imports/ stores any type of petroleum product	Yes	Petroleum products are directly transferred from vessels through pipelines
2	Whether risk assessment is done	Yes	Chapter-2 Page No. 17 & Chapter-4 Part-B report
3	Who did the risk assessment		Environ Software Pvt Ltd
4	Whether maximum volume of oil spill that can occur in the worst-case scenario is considered	Yes	25000 T Chap2, refer Para 2.5.3-page No: 21 & Chapter-4 Part-B report
5	Whether relative measure of the probability and consequences of various oil spills including worst case scenario are taken into account	Yes	Chapter2 refer para 2.5.3 Page No. 23 & Chapter-4 Part-B report
6	Whether all types of spills possible in the facility are considered including Grounding, Collision, Fire, Explosion, Rupture of hoses	Yes	Chapter2 refer para 2.1.1 Page No. 17 & Chapter-4 Part-B report
7	Please specify the list of oils considered for risk assessment	Crude, HSD & Fuel Oil	Chapter2 refer para 2.8 Page No. 24 & Chapter-4 Part-B report
8	Whether the vulnerable areas are estimated by considering maximum loss scenario and weather condition	Yes	Chapter2 refer para 2.12 Page No. 31
9	Whether impacts on the vulnerable areas are made after considering the Marine protected areas, population, fishermen, saltpans, mangroves, corals and other resources within that area	Yes	Chapter2 refer para 2.12- & 2.13-Page No. 31,32 & Chapter-3 Part-C report
10	Whether measures for reduction of identified high risks are included by reducing the consequences through spill mitigation measures	Yes	Chapter7 refer fig.7.1 Page No. 66
11	Whether steps have been considered to reduce risks to the exposed population by increasing safe, distances by acquiring property around the facility, if possible	Yes	Chapter 7 refer fig 7.1 Page No. 66
12	Whether risk levels are established for each month after considering the probability with tide and current and consequences of each such spill	NA	
13	Whether prevention and mitigation measures are included in the plan	Yes	Chapter8 refer para 8.1 Page No 84
14	Whether the spill may affect the shoreline. (length of the shoreline with coordinates)	Yes	Part-B report, chapter 5-OS modelling tables (Jan, July, Oct) page nos. 58-66
15	Whether time taken the oil spill to reach ashore	Yes	Part-B report, chapter 5-OS

	in each quantity of spill in various months are mentioned in the plan		modelling tables (Jan, July, Oct) page nos. 58-66
16	Whether sensitivity mapping has been carried out	Yes	Part-C report, chapter 3, refer para 3.1-page no. 5
17	Does the sensitivity mapping clearly identify the vulnerable areas along with MPAs, corals, fishermen community, saltpans, mangroves and other socio- economic elements in the area	Yes	Part-C report chapter 3, refer para 3.1-page no. 5
18	Do the sensitivity maps indicate area to be protected on priority	Yes	Part-C report Annexure-1 refer fig A.1.8-page no. 37
19	Does the map indicate boom deployment locations	Yes	Part-C report Annexure-1 refer fig A.1.1(a), (b)-page no. 35
20	Whether any Marine. Protected Area will be affected	Yes	Part-C report chapter 3, refer para 3.15-page no. 17
21	Whether total number of fishermen likely to be affected is mentioned in the plan	No	
22	Whether any saltpan in the area is going to be affected	No	
23	Whether any mangroves in the area will be affected by a spill	No	
Preparedness			
24	Whether any containment equipment is available	Yes	Chapter4, refer para 4.2 Page No. 43
25	Whether any recovery equipment is available	Yes	Chapter4 refer para 4.2 Page No. 43
26	Whether the facility is having any temporary storage capacity	Yes	Chapter4 refer para 4.1 Page No. 43
27	Whether location of the oil spill response equipment is mentioned in the plan	Yes	Chapter4 refer para 4.1 Page No. 43
28	Whether suitable vessels available for deploying the boom, skimmer etc	Yes	Chapter4 refer para 4.4 Page No. 44
29	Whether OSD held with facility	Yes	5000 Ltrs – Page No: 50
30	Whether the OSD held with the facility is approved for use in Indian waters	Yes	
31	Whether the facility has MoU with other operators for tier-1 preparedness	Yes	Oil companies, HMEL Operators
32	Whether the list of oil spill response equipment available with each agency in MoU is deliberated	Yes	Chapter 9 refer para 9.1 page no. 89
33	Whether the facility has any MoU with private OSRO	Yes	Chapter 9 refer para 9.4 page no. 91
34	Whether the procedure for evoking the mutual aid is clearly described in the plan	Yes	
35	Whether additional manpower is available	Yes	Chapter 10 refer para 10.2.3 page no. 106
36	Whether list of approved recyclers is mentioned in the plan	Yes	Chapter 10 refer para 10.2.1 Page No 105
37	Whether NEBA (Net Environmental Benefit	Yes	Part-D report, chapter 1,

	Analysis) has been undertaken		refer 1.2-page no. 2
38	Whether the areas from priority protection have identified in the plan	Yes	Part-D report, chapter 2, refer para 2.2-page no. 13
39	Whether relevant authorities and stakeholders were consulted for NEBA and during the areas for priority protection	Yes	Part-D report chapter 3
40	Whether District administration has been appraised of the risk impact of oil spills?	Yes	Part-D report
Action Plan			
41	Whether the plan outlines procedure for reporting of oil spills to Coast Guard	Yes	Chapter 2, refer para 2.6-page no. 22
42	Whether the oil spill response action is clearly mentioned	Yes	Chapter 3, refer para 3.1-page no. 36
43	Whether the action plan includes all duties to be attended in connection with an oil spill	Yes	Chapter 3, refer para 3.1 page no. 36
44	Whether the action plan includes key personnel by their names and designation viz. COO, ICO	Yes	Chapter 5-page no. 54
45	Whether alternate coverage is planned to take care of the absence of a particular person [in cases where action plan is developed basis names]	Yes	
46	Whether the plan includes assignment of all key coordinators viz. the Communication Controller, Safety Coordinator, Emergency management team, Administration and Communication Coordinator and Safety Coordinator	Yes	Chapter 10-page no. 93
47	Whether contact directory containing numbers of key response and management personnel is intimated in the plan	Yes	Chapter10 Page No. 93
48	Whether approved recyclers are identified for processing recovered oil and oily debris	Yes	Chapter10 Page No. 104
49	Whether the shoreline likely to be affected is identified	Yes	
50	Whether final report on the incident is submitted to CGHQ as per NOS-DCP 2015	NA	
51	Whether the spill incident and its consequences are informed to fishermen and other NGOs for environment protection through media	NO	
Training and Exercises			
52	Whether mock fire I emergency response drills are specified in the plan	Yes	Chapter 5 refer para 5.2, page no. 54
53	Whether the mock drills cover all types of probable oil spills	Yes	Chapter 5 refer para 5.2, page no. 54
54	Whether the plan mentions list of trained manpower	Yes	Chapter 5 refer para 5.3, page no. 55
55	Whether records for periodic mock drills are maintained in a well defined format	Yes	Quaterly
56	Whether the plan to updated according to the findings in mock-drills and exercises	Yes	

57	What is the frequency of updatron / review of contingency plan?	Yes	As an when required
58	Periodicity of joint exercise with mutual aid partners	Yes	
59	Frequency of mock-drills for practice	Yes	Twice in a year Chapter 12 Page no.131
60	Whether the records for periodic mock drills are maintained in a well defined format	Yes	Chapter 5
61	Frequency of updation / review of contingency plan	Yes	As an when required

We, hereby, declare that the all information appended above and true and correct to my knowledge or belief

Date Chief Conservator / Installation Manager

VERIFIED

Date (District Commander ICG) or his representative

Date Regional Commander ICG)or his representative

This is to state that at the request of Adani Ports & SEZL (AP &SEZL), the undersigned persons have prepared the Oil Spill Contingency Plan (OSCP). This OSCP has been prepared for oil spillage assessed based on the Risk Assessment carried out for various Port activities including loading / unloading operations of Crude / HSD / FO at berths, SPM, subsea pipeline leakage and Vessel collision / Grounding.

CONFIDENTIALITY CLAUSE

The report has been prepared based on studies 1. Hydrodynamic, 2. Oil Spill fate and weathering characteristics 3. Environmetal Senstivity Mapping and 4. NEBA carried out for preparation of OSCP for Adani Ports & SEZL as per the work order dated 19th February, 2022 and is considered confidential. No part of this report may be release to any outside organization unless explicity advisied by the owners in writing.

Issued By:
Environ Software Pvt Ltd

Prepared by

Dr N M Anand Dr G S Reddy Dr. Rashmi

Reviewed by
Ms. Smitha, Environmental Engineer

Report Revision Record

Document No.		**ENVR 2022-003-R1**			**Page:**	

Introduction of

ABOUT ENVIRON

Environ Software Pvt. Ltd.

Environ Software (P) Ltd was incorporated in October 1998 and is located at Bangalore- the Silicon Valley of INDIA. It has a team of highly skilled and dedicated staff, specializing in Coastal Engineering, Hydraulics, Mechanical Engineering and Computer Science & Engineering. Environ is a multi-disciplinary software development and consulting firm focusing primarily on solutions to problems involving Air, Water and Soil pollution through the in-house, state-of-the-art computational tools. It is capable of solving a wide variety of coastal and marine pollution related problems that include prediction of currents and tides, flood forecasting, morphological changes of estuarine bed and effects on marine population due to discharge of various industrial pollutants and construction of marine structures.

The company is also capable of predicting the spread of various pollutants in air media, emitted from the industries and vehicles. Environ also provides numerical solution to the problems related to sub-surface flows and transport of pollutants. The company also provides full service on field monitoring studies to measure and asses conditions in oceans, coastal areas, lakes, rivers and in air pollution monitoring.

Apart from dealing with complex environmental issues the company is developing a sophisticated Computational Fluid Dynamics (CFD) software, with appropriately chosen numerical methods and physical models for solving Fluid flow, Heat Transfer and Radiation problems. It is capable of solving incompressible, compressible, and two phase flows etc, with different integrated solvers. The company is also concentrating on the development of dedicated software for a specific application because the user is more oriented in many other things than looking for new developments in numerical methods.

Hydrodyn™

Environ

e-solution for pollution

Environ products are absolutely user friendly which requires minimal training. The highlights of the products of Environ are interactive, high quality Pre- and Post-Processor utilities which promises enhanced performance.

Environ was developed softwares for Library Automation, Institutional Management and Company Automation etc. based on client/Server, Internet/ e-Business and Wireless Application tools.

STRATEGIC AREAS

Scientific Simulation Software

Scientific simulation software products are self-contained, absolutely user friendly and integrated with pre- and post processor utilities.

- Air Pollution Simulation Models (APSM)
- Surface Water Pollution Simulation Models (SWPSM)
- Ground Water Pollution Simulation Models (GWPSM)
- Noise Pollution Simulation Models (NPSM)
- Fluid Dynamics Simulation Models (FDSM)

Consultancy Services offered

Internet and e-Business Development

- Complete e-business solution
- Business to Customer and Business to Business Solutions
- Web Design and Consultancy
- Support & Maintenance of launched web sites
- Wireless Applications

Client/Server Applications

- Modelling of Air, Water, Ground Water Pollution & Fluid Dynamic and Heat Transfer Applications
- Environmental Modelling & Impact Assessment
- Risk Assessment/Analysis
- Hazardous Waste water Management
- Library Management System for complete library automation
- Customized Application Development viz. Inventory control, Accounts etc.
- Medical Transcription Monitoring System

1. *Development of Scientific Simulation Software for*
   - Air Pollution, Surface Water pollution and Ground Water Pollution and Noise pollution problems
2. *Consultancy Services offered for*
   - Modelling of Air, Water, Ground Water Pollution & Fluid Dynamic and Heat Transfer Applications
   - Environmental Modelling & Impact Assessment
   - Risk Assessment/Analysis, Hazardous Waste water Management
3. *Internet and e-Business Developmentr*
   - Complete e-business solution
   - Business to Customer and Business to Business Solutions
   - Web Design and Consultancy
   - Support & Maintenance of launched web sites
   - Wireless Applications
4. *Client/Server Applications*
   - Library Management System for complete library automation
   - Customized Application Development viz. Inventory control, Accounts etc.
   - Medical Transcription Monitoring System.

Contents

SECTION III – DATA DIRECTORY

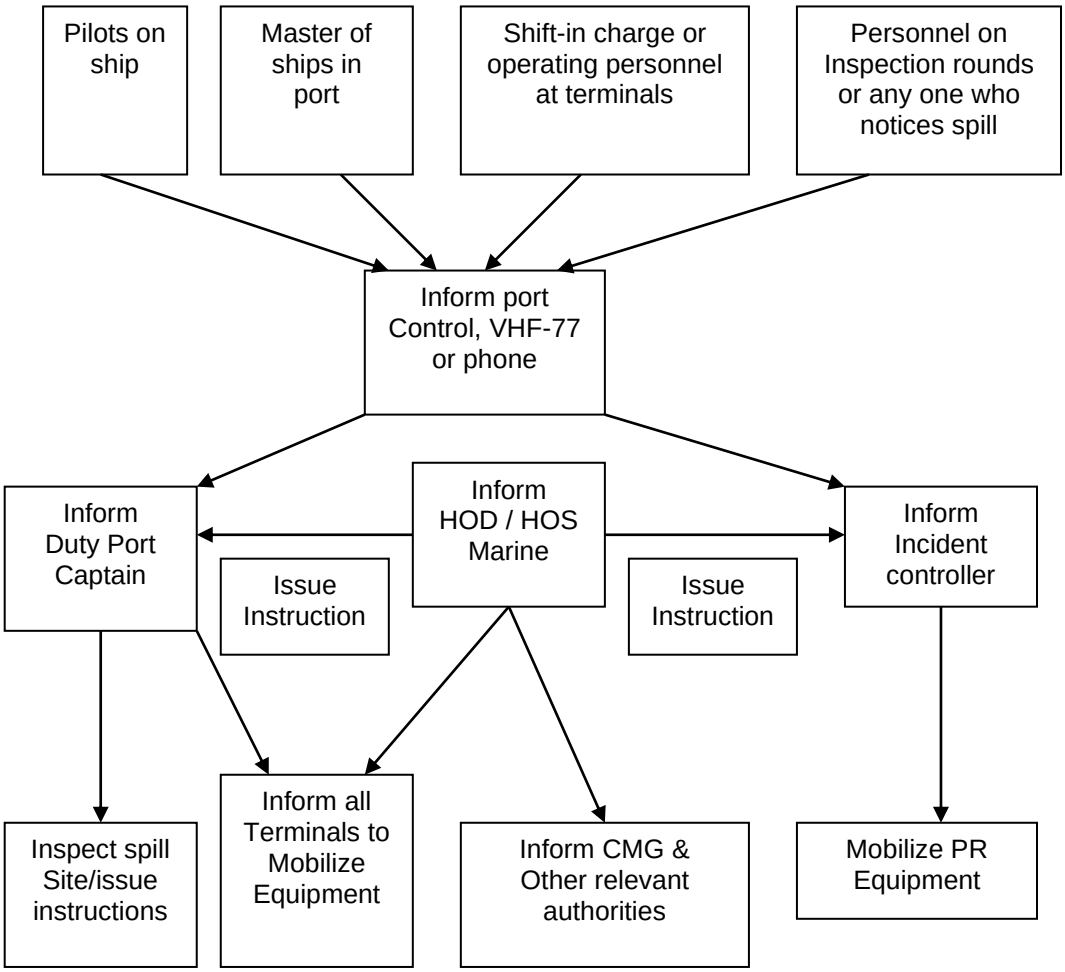
ABBREVIATIONS

APSEZL	Adani Ports & Special Economic Zone Limited
ADIOS	Automated Data Inquiry for Oil Spills
CC	Communications Coordinator
CCA	Central Coordinating Authority
CGHQ	Coast Guard Head Quarters
CIC	Chief Incident Controller
CISF	Central Industry Security Force
CMG	Crisis Management Group
CMT	Crisis Management Team
COC	Communication and Operations Center
CTTL	Chemical Terminal Trombay Ltd.
DCA	District Coordinating Authority
DCC	District Contingency Committee
DHQ	Coast Guard District Head Quarters
DNV	Det Norske Veritas
ECC	Emergency Control Center
EG	Environment Group
ESI	Environmental Sensitivity Index
HFO	Heavy Fuel Oil
HM	Harbour Master
IAP	Incident Action Plan
IC	Incident Controller
IDRN	Indian Disaster Resource Network
IM	Incident Manager
IMD	India Meteorological Department
IMO	International Maritime Organization
IMT	Incident Management Team
IOCL	Indian Oil Corporation Ltd.
IPIECA	International Petroleum Industry Environmental Conservation Association
JD	Jawahar Dweep
LAG	Local Action Group
LCA	Local Combat Agency
LO	Logistics Officer
LST	Local Action Group Support Team
MARPOL 73/78	International Convention for the Prevention of Pollution from ships 1973 as modified by the protocol of 1978

MMd	Mercantile Marine Department
MoU	Memorandum of Undertaking
MPC	Marine Pollution Coordinator
MRU	Marine Response Unit
NEBA	Net Environmental Benefit Analysis
NFPA	National Fire Protection Association
NOS-DCP	National Oil Spill Disaster Contingency Plan
NRT	National Response Team
OPRC Convention	International Convention on Oil Pollution Preparedness, Response and Co-operation 1990
OSC	On screen Coordinator
OSD	Oil Spill Dispersant
OSR	Oil Spill Response
OSRO	Oil Spill Response Organization
OSRO-M	Oil Spill Response Organization-Manager
OSRO-S	Oil Spill Response Organization-Specialist
PC	Port Control
POC	Participating Oil Company
POL	Petroleum, Oil and Lubricants
SA	Statutory Agency
SC	Shoreline Coordinator
SCBA	Self-Contained Breathing Apparatus
SRV	Spill Response Vessel
UNCLOS	United Nations Convention on Laws of the Sea
VHF	Very High Frequency

OILSPILL CONTINGENCY PLAN

Contingency Chart to deal with Oil Spill



FINAL MEASURES

- Coordinate at District, State, National level including MOST if crisis level 2 or 3
- Informs Coast Guard-clean up contractors
- Restore berth operational
- Question witnesses
- Complete maritime accident report
- Give press reports
- Survey and cost damage to port installation
- Hold meeting of all concerned parties
- Seek compensation
- Distribute final report to concerned authorities.

PREFACE

Adani Ports and Special Economic Zone Limited (APSEZL), Mundra has awarded the project to M/s Environ Software Pvt Ltd to carry out the Risk Assessment Study, Sensitivity area mapping and preparation of Oil Spill Contingency Plan for Tier-1 Oil Spill Response (OSR) facility for (APSEZL). This report contains the Strategy Plan & operation plan which describes the scope of the plan including the geographical coverage, oil spill modeling studies, perceived risks, spill response and clean-up strategy, equipment, storage facilities, responsibilities and action plans, communication, etc.

The report also presents the characteristics and weathering processes of oil, the impact of oil spills on the marine environment and agencies to be informed in case of emergency. The report elaborates on the strategy plan for the oil spill as per IMO guidelines as well as the responsibilities of regional and national oil spill combating agencies.

Marine Sensitivity Atlas has been prepared for areas all along the coasts of Gulf of Kutch region. Environmental sensitivity mapping also done based on the available data of environmental, biological and industrial information.

The report also includes specific instructions for responders, once the spill occurs, response plan based on NEBA studies for combating operations for spilled oil. This is to ensure that emergency action by responders gets underway promptly and in an orderly manner. The statutory regulations, area of operations, training and competence is also included in the report.

We express our gratitude to Mr. Yogesh Nandaniya, Mr. Sudhakar Singh, Capt. Sachin Srivastava Head-Marine Services, Mr. Sanjay Kewalramani COO-TAHSL, Capt. Rajat Garg, Mr. Mangal Choudhary of **APSEZL** for their assistance and suggestions during the preparation and successful completion of this project. We are thankful to the above officers for providing information on oil spill contingency plan and acknowledge the valuable information provided by them.

Dr. G. S. Reddy
(Managing Director)

EXECUTIVE SUMMARY

APSEZL, Mundra handles the majority of its cargo and liquid products traffic through the South and West port terminals. There are several berths and Jetties at Mundra for berthing of cargos. Two subsea pipelines connect the onshore to the IOCL, HEML SPMs. There are 11 Container Berths, 16 Multi-purpose Berths, 1 LNG Jetty and two SPMs with back-up facilities at Mundra for berthing cargo vessels and oil tankers. Two subsea pipelines connect the SPMs (IOCL and HMEL) to onshore oil terminals at Mundra.

The location of Cargo Berths, SPMs and marine facilities of **APSEZL** are situated approximately at 572000m Easting and 2515500m Northing. The berths are located in the north bank of Gulf of Kutch at Mundra. The berths are operating for cargo operability and potential to meet the future demands. Sufficient clearance to the existing surroundings has been maintained, including a minimum encroachment into the greenbelt and adequate distance to populated areas. The layout of the complex allows space for future extension, without compromising desired safety and separation distances within the complex or to adjacent port activities.

The main objective of the study is to carry out risk analysis of oil spills for various activities of port operations and to the assess the impact of major accidental hazards from the facilities on the marine population and property within and outside the battery limit of the facilities and on coastal environment. Results of the study will be useful in preparation of response plan for containment of oil spills, in case if it occurs during loading / unloading operations / accidents. The results will also be useful in developing a meaningful emergency and response plan.

At present **APSEZL**, Mundra has the responsibility to deal with Tier-1 oil spill within port limits. The **APSEZL**, Mundra has entered into MOU with neighboring ports and others to deal with Oil spills. The funding is by ports and others. The Consultant assessed the OSR Equipment available with the Port and agencies in the vicinity of **APSEZL**, Mundra. The existing mechanism to deal with Tier-1 oil spill response through a specialist agency where there is no capital cost and manpower by the **APSEZL**, Mundra is appropriate in the present circumstances.

Based on Gap Analysis a new Equipment list is suggested which incorporates some of the recommendations of NOS DCP-2018.

The following studies were carried out as integral part of Oil Spill Contingency Plan

A. Quantitative Risk Assessment of oil spill for AP & SEZL

The oil spill risks at **APSEZL**, Mundra are evaluated in consideration with the probability of a spill occurring and the consequences. The risk assessment has been made considering many factors i.e., Frequency of vessel movement, Operation time of the port, Vessel condition, Performance of vessel crew, Traffic density, Weather conditions, Type of oils handling, relevant past data, identification of Hazard, Frequency, Consequence and risk estimation.

After carrying out the detailed study of the offshore facilities which include the surface facilities viz., platforms, berths / Jetties, vessels and subsurface pipelines and all other associated infrastructure required for port operations of **APSEZL**, Mundra, the causes of spill scenarios identified are as following.

- Operations at Berth
- Spills due to Collision/Grounding in the Tanker route
- Bunker/ fuelling operations
- Ship distress / sinking
- Spill due to rupture in subsea pipeline corridor (size of crack-1")
- Rupture of export line due to movement and landing along the coast.
- Bunkering of HSD / Crude for vessels

Based on the above factors and failure frequency of port operation facilities, the following spill quantity are estimated.

- Spill due to Loading arm failure at Jetty: (167 m^3, at pumping rate of 10000 m^3/h crude oil for 1 min)
- Spill due to rupture of sub-sea crude oil pipeline from refinery to shore tanks: (2611 tons of crude for 36 hrs)
- Spill due to Tanker Collision at Jetty having capacity between 1,00,000-3,00,000 metric tons (25000 tons)
- Spill due to collision or grounding in the Tanker route (25000 tons)

The following spill locations were identified based on port operations.

- Crude oil spill of 700t at selected SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Fuel oil spill of 700t at selected West Port(S5), Vessel route(S7), LNG Jetty(S8), South basin (S9), Mundra Ports(S11), MICT/AMCT(S12)
- Crude oil spill of 10000t at SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Crude oil spill of 25000t at SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Fuel oil spill of 100t at selected West Port (S5, S6), LNG Jetty(S8), South basin (S9,

S10), Mundra Ports(S11), MICT/AMCT(S12), East Basin(S13), North Basin(S14)

- HSD oil spill of 50t at selected West Port(S5), LNG Jetty(S8), South basin (S9), Mundra Ports(S11)
- HSD oil spill of 20t at selected West Port(S6), South basin (S10)

Continuous Spills

- Crude oil spill of 10000 m^3/hr for 1 min at selected SPM-HMEL(S1), SPM-IOCL(S2)
- Crude oil spill of 10000 m^3/hr for 1 min at selected VLCC Jetty (S15)
- Crude oil spill of 10000 m^3/hr for 1 min at sub-sea pipeline route (S3)

The details for estimating the quantitative risk assessment at spill locations are discussed in **PART-B-OILSPILL MODELING STUDIES** of the report.

B. Assess Oil Spill trajectory in the worst-case scenario in different weather and sea conditions;

The prediction of fate and transport of oil spill plays a major role in the analysis of risks due to oil spills. It is computed based on the surface water currents and wind speed.

Modeling the hydrodynamic processes is an integral part for modeling the fate and transport of oil spills. The basic oil-spill model developed at Environ Software (P) Ltd was used in the present work to estimate the risk assessment due to oil spills for various weathering and meteorological conditions.

Hydrodynamic modeling studies carried out using the Hydrodyn-FLOSOFT for predicting tidal levels and current for a period of one year (12 months). For all possible port facilities, spring and neap tide conditions has been simulated. The details for Hydrodynamic modeling studies are discussed in **PART-A-HYDRODYNAMIC MODELING STUDIES** of the report.

Fifteen spill locations at and around Adani Port and SEZ Limited, Mundra regions and 35 oil spill scenarios are considered for oil spill simulations.

Details of Oil Spill Scenarios

Table. 4.4. Details of Oil Spill Scenarios

Comp. Runs	Spill Location	WD (m)	Spill Qty	Type of oil	Spill Location Co-ordinates
A	**SPMs**				
1	SPM-HMEL (S1)	29.50	700 tons	Crude	69° 37' 23.19" E, 22° 40' 59.06" N
2			10000 tons	Crude	
3			25000 tons	Crude	
4			10000 m^3/h for 1 min	Crude	
5	SPM-IOCL (S2)	28.45	700 tons	Crude	69° 39' 14.05" E, 22° 40' 47.21" N
6			10000 tons	Crude	
7			25000 tons	Crude	
8			10000 m^3/h for 1 min	Crude	
B	**VLCC Jetty**				
9	Spill Location (S15)	15.71	700 tons	Crude	69° 40.78' E, 22° 43.6' N
10			10000 tons	Crude	
11			25000 tons	Crude	
12			10000 m^3/h for 1 min	Crude	
C	**Pipeline**				
13	Crude oil spill of 2611 tons at the pumping rate of 12500 m^3/hr (2611 Tons of crude for 36 hrs) along the pipeline corridor at a select (midway) point of subsea pipeline in the pipeline routes. -- Spill point: (**S3)**	21.20	12500 m3/hr for 3hr	Crude	69° 39' 43.35" E, 22° 42' 36.39" N
D	**Tanker Route**				
14	Instantaneous crude oil spill of 25000t along the tanker route at select location. Spill point: S4	22.54	25000 tons	Crude	69°32'11.38'' E, 22°36'1.13" N
E	**West Basin (berths)**				
15	100 tons (due to Berthing incident/ collision) at the West Basin berths (FO) Spill point: **S5**	14.61	100 tons	FO	69°34'13.99'' E, 22°45'15.54" N
16	50 Tons (due to Berthing incident/ collision (diesel oil tanks) at the West Basin berths (HSD) Spill point: **S5**		50 tons	HSD	69°34'13.99'' E, 22°45'15.54" N

17	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berths -- Spill point: **S5**		700 tons	FO	69°34'13.99'' E, 22°45'15.54" N
18 & 19	In the maneuvering basin: ○ 20 Tons of HSD oil due to Tug Impact (HSD) ○ 100 Tons of FO due to Tug Impact Spill point: **S6**	14.48	20 Tons 100 Tons	HSD FO	69°34'22.75'' E, 22°45'5.33" N
20	Along the vessel route at one location: Instantaneous oil spill of 700t along the tanker route at a select location. (FO): Spill point: **S7**	17.08	700 tons	FO	69°33'40.66'' E, 22°43'36.31" N
F	**LNG berth**				
21	100 tons (due to Berthing incident/ collision) at the LNG berth (FO) -- Spill point: S8	13.76	100 tons	FO	69°33'40.66'' E, 22°43'36.31" N
22	50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the LNG berth (HSD) –Spill point: **S8**		50 tons	HSD	69°33'40.66'' E, 22°43'36.31" N
23	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth-- Spill point: **S8**		700 Tons	FO	69°33'40.66'' E, 22°43'36.31" N
G	**South Basin (berths)**				
24	100 tons (due to Berthing incident/ collision) at the LNG berth (FO) -- Spill point: **S9**		100 Tons	FO	69°39'38.08'' E, 22°43'32.54" N
25	50 Tons (due to Berthing incident/ collision (diesel oil tanks) at the South Basin berths (HSD) – Spill point: S9	14	50 Tons	HSD	69°41'3.53'' E, 22°43'50.33" N
26	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth -- Spill point: S9		700 Tons	FO	69°41'3.53'' E, 22°43'50.33" N
27 & 28	At the turning circle: ○ 20 Tons of HSD oil due to Tug Impact	17	20 Tons 100 Tons	HSD FO	69°41'33.62'' E, 22°44'6.49" N

	○ 100 Tons of FO due to Tug Impact Spill point: S10				
H	**MMPT**				
	At the existing MPT1 berth: : Spill Point S11	20.80			69°42'20.45'' E, 22°43'32.17" N
29	100 tons (due to Berthing incident/ collision) at the berth (FO) -- Spill point: S11		100 Tons	FO	69°42'20.45'' E, 22°43'32.17" N
30	50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the berth (HSD) – Spill point: S11		50 Tons	HSD	69°42'20.45'' E, 22°43'32.17" N
31	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth : Spill point S11		700 Tons	FO	69°42'20.45'' E, 22°43'32.17" N
I	**MICT / AMCT Berths:**				
	At the existing MICT / AMCT Berths: : Spill point S12				69°42'56.30'' E, 22°44'36.69" N
32	100 tons (due to Berthing incident/ collision) at the (FO) - Spill point S12	15.12	100 Tons	FO	69°42'56.30'' E, 22°44'36.69" N
33	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth - Spill point S12		700 Tons	FO	69°42'56.30'' E, 22°44'36.69" N
34	100 tons (due to Berthing incident/ collision) at the East Basin berths (FO) Spill point: **S13**	20.0	100 Tons	FO	69° 45' 37.58" E 22° 47' 10.73" N
35	100 tons (due to Berthing incident/ collision) at the North Basin berths (FO) Spill point: **S14**	0.5	100 Tons	FO	69° 41' 35.79 E 22° 46' 6.76 N

Hydrodyn-OILSOFT, a dedicated software for oil spill trajectory modeling was used for prediction of oil spill scenarios at selected locations in and around **APSEZL** facilities for various meteorological and hydrological conditions considering the worst-case oil spill scenario of instantaneous / continuous spills. The output of the model indicates the amount of spill that can

take place and time taken by the spill (Hourly/Day basis) to reach the shoreline or protected areas such as mangroves, environmentally sensitive receptors, eco-sensitive zones, etc.). From the oil spill modelling studies, the following conclusion could be drawn.

- The spill volume and time taken to reach the coast and losses during its movement have been calculated.
- The percentage of spill volume reaching the coast, extent of oiling on the coast in metres, likely vulnerable areas, spill analysis, have been calculated.
- Resources such as tidal flats, islands and coastal areas which are likely to be threatened from oil spills have been identified.
- It can be concluded that the spills would move towards Sikka coast, Kalubhar Island, Mundra Port and Vadinar coastal Zones during early of January.
- During the early of July, spills would move towards towards Kandla, Adani Port boundaries within 2 hours from spill start. Some spill scenarios such as Tanker Entry shows the spill staying in open ocean for long period of time.
- It can be noticed that the spill oil would reach Sikka and Vadinar coast. Some spill scenarios such as Tanker Entry, shows the spill staying in open ocean for long period of time.

The details for Oil spill trajectory and weathering studies are discussed in **PART-B- OIL SPILL FATE AND TRAJECTORY MODELING STUDIES** of the report.

C Environmental Sensitivity mapping of the areas likely to be affected by the oil spill

The objective of the study is to produce a tool for oil spill responders by providing an overview of resources vulnerable to oil spills, i.e., natural resources (Mangroves, Mudflats, Reef flats, Sandy Area, Sea Birds/Birds Nesting Area, Marine Mammals (Dolphins, Dugongs, Whales), Turtle Nesting Areas, Marine National Park, Marine Sanctuary, Forest Area) and Human activities (Fishing zones, Industrial Sea water Intakes, outfall, Ports, jetties etc.)

The Environmental Sensitivity Index has been prepared based on the latest satellite information as well as available secondary data information of Gulf of Kutch region. This study is made as a part of the preparations for Risk Analysis study of oil spills in the Mundra region, Gulf of Kutch. The study covers the region between latitude Lat 22˚ 44′ 18.89” N and longitude 69° 46’ 42.67” is in Mundra region. The entire area of Gulf of Kutch has been divided into 12 zones and collected all marine sensitive information and prepared the Environmental sensitivity Index Mapping and Atlas based on IMO guidelines for the **APSEZL**, Mundra area.

Identified the most sensitive site and resources potentially exposed to oil spills due to the handling of crude oil in the **APSEZL**, Mundra region. The coastal sensitive areas including biological, industrial and socio-economic resources are identified and prepared Environmental Sensitivity Index (ESI) mapping of the areas likely to be affected by the oil spill. The details of ESI are discussed **in PART-C: SENSITIVITY INDEX MAPPING** of the report

D. Oil Spill Response equipment and manpower to deal with the assessed quantity of the oil spill

Various response options (Mechanical equipment's, in-situ burning, dispersants and shoreline booming) have been discussed based on various spill scenarios of **APSEZL**, Mundra considering coastal marine sensitivity analysis of Gulf of Kutch region. The Net Environmental Benefit Analysis (NEBA) has been formulated considering all available response options for oil spills and selected the techniques that will provide the best opportunities to minimize consequences for the environment.

The study has been divided the potential relative Impact ranging from 1 (None) to 4(High). Likewise, the impact modification factor was also divided from 1 (None) to 4 (High) for four categories of response options (Mechanical equipment's, in-situ burning, dispersants and shore line booming). The intermediately ranges for both axes were then further divided to provide some more definition to the matrix. The risk ranking matrix for this NEBA was based on Environmental, Industrial and Biological sensitive areas risk assessment matrices generated.

The NEBA process is to evaluate the consequences of Natural Attenuation, which serves as a baseline. All subsequent rankings are relative to the baseline, i.e., are conditions better or worse for each resource when using each individual response options. Using the risk ranking matrix requires estimating the proportion of the resource affected, and how long it will take the resource to recover. Based on the total impact mitigation score and ranking of High (4), Low (- 4) was assigned.

Based on the NEBA analysis selected best multiple response options are mechanical and dispersants among other response options available for APSEZL Mundra

NEBA studies has been carried out based on available response options to be prepared as a part of Oil Spill Contingency Plan for **APSEZL**, Mundra region. The details of NEBA studies are discussed **in PART-D: NET ENVIRONMENT BENEFIT ANALYSIS** of the report.

In accordance with the National Oil Spill Disaster Contingency Plan (NOSDCP) all the Ports are required to maintain Tier-I Oil Spill Response (OSR) facilities. Accordingly, **APSEZL**, Mundra has

to set up and sustain Tier-I (up to maximum spill volume of 700 Tonnes) OSR facilities in Mundra in co-ordination with neighboring companies operating at these Ports. For this purpose, APSEZL, Mundra and other Participating Companies (HMEL) has executed a Memorandum of Understanding (MOU) for sustenance of Tier-1 OSR facilities for combating oil spills at and surrounding area within Mundra region. The oil spill response facilities and required manpower are estimated based on risk assessment study and oil weathering condition to deal with expected quantity of spill and should be placed in the vicinity of **APSEZL** has been provided in the Annexures.

E. Comprehensive oil spill contingency plan (OSCP) for the APSEZL, Mundra

The report consists of the following sections

Strategy section

This part consists of oil spill risk assessment, response objectives and strategies, organization and details of response equipment's. This section is designed to help responders understand in advance the expected oil spill scenarios, the ways and means to respond effectively and to minimize pollution of the environment. This part of the plan is from **Chapter 2** to **Chapter 6**.

Action and operation section

This section includes specific instructions for responders, once the spill occurs, on what to do and how to do, for each oil spill incident. This is to ensure that emergency action by responders gets underway promptly and in an orderly manner. This part is from **Chapter 7** to **Chapter 10**.

Data directory

This part includes information on Coastal facilities, Access roads, Telephones, Hotels, shoreline resources available with various organizations, Sensitivity area Mapping, primary oil spill equipment available, communication facilities etc., statutory regulations, area of operation, training and competence, weathering data on Hydrodyn-OILSOFT, Mud flat shore cleanup techniques, OSD Specifications, Oil Spill Management plan of **APSEZL**, oil spill response decision tree, IMO Guidelines on OSR to areas full of. This part is Chapter 11.

PROJECT TEAM OF ENVIRON SOFTWARE (P) LTD

Name of the Person Involved	Project Designation	Role and Responsibility
Dr G S Reddy	Project Leader	Assessing the data required Managing the team and Supervision of data inputting the model Analyzing the output data Report preparation
Ms. Smitha Dr Rashmi Ms. Jyoti Kerkar Mr. GS Pavan Reddy Mr. Rajesh Ms. Lakshmi	Team Members	Data interpretation & Simulation runs Prepare the tools for report preparation Preparing the input data for model Simulation runs Digitizing the satellite Maps Graphical outputs preparation Report preparation

1. INTRODUCTION

1.1 Contingency Plan:

Oil spill contingency planning is the process of developing a suitable spill response capability that is in compliance with the local regulatory framework and commensurate with the oil spill risks of an organization or facility. This document provides guidance on the contingency planning process for potential oil spills in or on water following an accidental release of oil into the marine or aquatic environment during the handling, transport, production or storage of oil products.

The intensity of marine traffic has increased tremendously along the Indian coasts, especially increase of oil tankers for transporting the petroleum products. Hence, there is an increased risk of occurrence of oil spills along the vessel route, Berth/Ports during terminal operations. The spills also occur due to collision/grounding of vessels. The oil spills will lead to marine environmental pollution and damage the ecosystem including marine infrastructure facilities of Ports and Harbors. Hence, oil industries and ports should have individual capabilities to handle the response activity in case of spills. The procedures prepared at various levels for handling the spills is called as the Contingency Plan. The study area as shown in Fig 1.1 provides a location of APSEZL, Mundra including cargo berths / Jetties and SPMs.

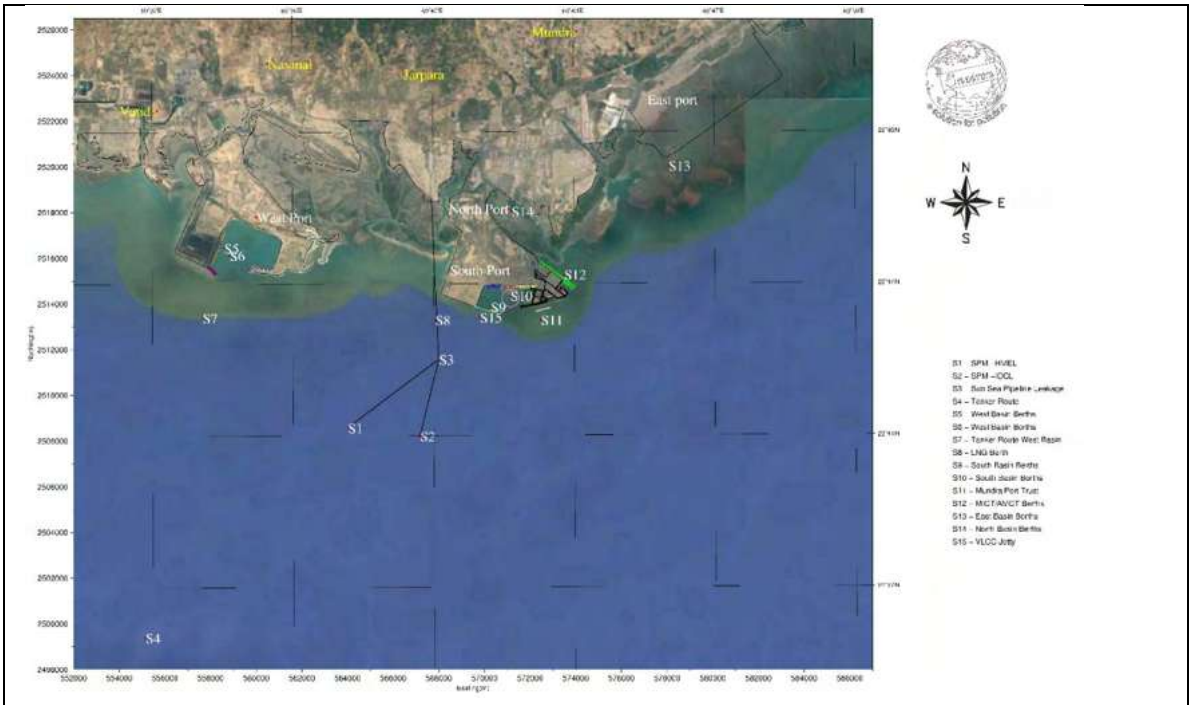


Fig.1.1 Cargo berths / Jetties of APSEZL, in the Mundra region, Gulf of Kutch

1.2 Description of operations at APSEZL, in Mundra

The APSEZL, Mundra, is located (Lat 22˚ 44′ 18.89" N, long 69˚ 41′ 35.62" E) at Mundra in Gulf of Kutch, protected by the southern / northern coast of Gulf of Kutch. The deep waters in the Gulf provide ample shelter for shipping throughout the year. The entrance of the Ports which has approaches from the mouth of Gulf of Kutch at Okha, at a distance of about 90 km from Mundra.

The approach channels to the APSEZL ports are deepened to meet the requirement of cargo vessels. With good lighting arrangements navigation is allowed at the port round the clock.

APSEZL, Mundra has been operational since Oct 1998 when the construction of primary infrastructure and a multi-purpose terminal for dry and liquid Bulk cargo was completed. Presently APSEZL, Mundra has 11 Container Berths, 16 Multi-purpose Berths, 1 - LNG, 1 - VLCC and 2 - SPMs with back-up facilities.

The location of the Berths situated at Mundra is approximately at Latitude: 22˚ 44′ 18.89" N, Longitude: 69˚ 41′ 35.62" E. The berths are located in the northern bank of Gulf of Kutch region. The berthing jetties are for operating vessel operability and has the potential to meet the future demands. APSEZL has developed Cargo berths, approaches and turning circles to handle vessels at the Berth.

APSEZL, Mundra, currently owns and operates several marine facilities located at Mundra, Gulf of Kutch. The Mundra port facility is located on the West Coast of India in Gulf of Kutch about 50 km west of Kandla in District Bhuj of Gujarat state.

The APSEZL, Mundra handles the majority of its dry and liquid products traffic through the South, West terminals. There are several berths and Jetties at Mundra for berthing of cargos. Two subsea pipelines connect the onshore to the IOCL, HEML SPMs (Fig.1.1).

APSEZL, Mundra has developed various marine facilities which include four mega scale basins i.e., South Basin and West Basin at Mundra in last five years. Fig.1.2 gives the overall layout of the Mundra port facilities and, Fig.1.3, Fig.1.4 gives the zoomed-up portion of the port layout considered for this study.

Fig.1.2 Overall layout of the APSEZL, Mundra port facilities showing spill locations selected

Fig.1.3 Zoomed portion showing marine facilities of South Basin and spill locations selected

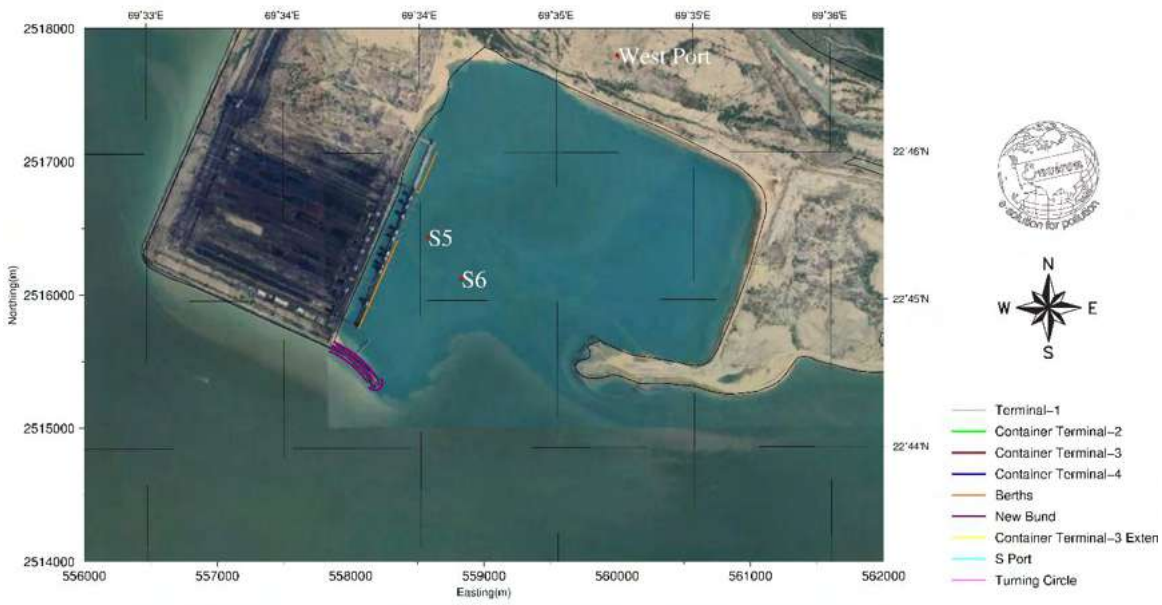


Fig.1.4 Zoomed portion showing marine facilities of West Basin and spill locations selected

Existing berths and Proposed Jetties

There are 16 existing berths at MMPT 1, MMPT 2, MMPT 3, MICT, AMCT catering to liquid, Container as well as General cargo. APSEZL, Mundra is under progress for expanding the Terminal-2 and Terminal-3 for handling container and dry cargos.

West Basin

West Basin is about 10 nautical miles west of the existing terminals of Mundra port. Four Berths are located at approx. 22° 45' 14.82" E and 69° 34' 6.23" N, off Tunda Wandh falling in Taluka Mundra. The basin is also planning to expand with 3 more additional berths for handling dry cargo. Two power plants are located North of these berths, in barren waste land. National Highway 8A extension passes through north side of the power plant sites at a distance of approximately 6 km.

South Basin

The south basin is in western side of the existing port on Navinal Island. Six berths are located at approx. 22° 44′ 18.89" N, 69° 41′ 35.62" E. It has presently 6 operational berths. It has an enclosed turning basin and necessary back up area. The basin is also planning to expand with two container berths (CT-5) for handling Container cargo.

VLCC Jetty:

The development of jetty facilities is in progress for handling VLCC at Mundra for Crude oil operations.

The oil spill risk analysis studies are to be carried out for all these facilities within the Mundra port limit which comprise of the SPMs, West basin, South basin, LNG Jetties, proposed VLCC jetty and existing berths as shown in Fig.1.1, Fig.1.2, Fig.1.3, Fig.1.4 and Fig.1.5. Hence, mathematical modeling studies for predicting the fate and oil spill trajectory due to spills if any at Port operations facilities for various seasons is mandatory for OSCP. Oil spill modeling is to be carried out as part of the Oil Spill Contingency Plan to identify the suitable combating operations for controlling the spills.

1.3 Purpose of the Plan

APSEZL, Mundra is committed to properly manage any oil spill incident that may arise during the course of the port operational activities in order to minimize the impact on personnel, environment, ecology, socio-economy, property, company's financial position and its reputation. As part of regulatory requirements, APSEZL, Mundra is mandated to establish an Oil Spill Contingency Plan (OSCP) for Tier-1 response capabilities, duly approved by the regulatory authorities, and which includes an effective response system with trained personnel and a pre-established organization structure as well as the capability to mobilize and respond to the spill incident in the least amount of time. The primary purpose of the plan is to facilitate the implementation of the necessary actions to stop or minimize the discharge of oil/chemicals and to mitigate its effects using best response facilities and use of oil spill dispersants (OSD).

1.4 Objectives of the Plan

The objectives of the OSCP are:

- To establish a rapid and effective system for detection and reporting of spills, with adequate measures for preparedness for oil and chemical pollution;
- To facilitate rapid and effective response to spill events with adequate measures to protect the health and safety of personnel, community, socio economic resources and protection of the marine environment;
- To establish appropriate response techniques to prevent, control, and combat oil and chemical pollution during spills, and disposal of contained material in an environmentally sound manner;
- To establish the communication channels essential for the coordination of tasks needed to deal with a pollution incident, and
- To ensure that the plan provides an integrated response together with the National Oil Spill Disaster Contingency Plan (NOS-DCP 2018).

1.5 Applicability and Geographical Limits of the Plan

This OSCP provides the response procedures and arrangements available for oil spill incidents during the port operations in the APSEZL, Mundra limits. It assigns roles and responsibilities for different personnel during an emergency.

The plan covers all spill incidents that occur within the block area and are likely to affect the marine environment and coastline along the block area. It must be noted that this document is not restrictive in nature and is developed in order meet requirements specified under statutory requirements presented for handling oil spill emergencies. The level of response will be guided by the response strategies defined in this document and will be governed by the severity of the spill event, its effect on the health and safety of the employees and contractors, impacts on the environment and Port reputation.

The scope of this plan extends to the entire area and beyond depending upon the trajectory of the spill. The geographical coordinates of the spill locations in the Mundra region as shown in Figure.1.1. The locations within the limits of study domain are Ports, Port operational facilities at South / West / MPT port facilities etc. The sensitive areas including berths / jetties, mangrove vegetation, biological resources are to be protected with better response plan adopting well-planned tactical response methods.

1.6 Authorities and Responsibilities

Prevention of accidental oil spillage is APSEZL, Mundra first priority. Port operating facilities will be designed, installed and operated in such a manner so as to minimize possibility of oil spills. Facilities, resources and support provided by third parties are also required to meet international pollution prevention design and operation standards.

The Oil Spill Contingency Plan (OSCP) has been prepared based on National Oil Spill – Disaster Contingency Plan (NOS-DCP) and the provision of Merchant Shipping Act, 1958 and Major Port Trusts Act, 1963.

Risks of oil spills associated with APSEZL, Mundra operations are and as such several measured for oil spill contingency planning were taken by port.

APSEZL, Mundra shall be responsible for any clean-up responses and all other incidental and consequential costs of whatsoever nature resulting from oil spills due to their activities/ operations. APSEZL, Mundra Man (Manager) is incident Response Coordinator. The Port is committed to integrate in its operations ways to identify oil spill risks, prevent oil spills, and to implement appropriate changes in its contingency plan for spill response and clean-up strategies. To achieve this, APSEZL, Mundra policy will be to:

- Respond immediately to any oil spill incident with the objective of protecting Marine & Human life and to minimize environmental impacts;
- Work and consult with appropriate government bodies and the local community to address any issues relating to oil spills in a timely manner;
- Provide adequate training and information to enable employee and contractors to adopt environmentally responsible work practices and to be aware of their responsibilities in the prevention and clean-up of oil spill.
- Develop emergency plans and procedures so that incidents (accidental releases) can be responded to in a timely manner.
- Develop and maintain management system to identify, control and monitor risks and to comply with Statutory Regulations and Industry Guidelines.
- Assess the situation and take timely and appropriate action where third-party interests are involved, such as products or chartered vessels from nearby ports / agencies etc.
- Ascertain that each identified employee is responsible for the implementation of this policy in association with his specific duties. This includes contractors and employees.

1.7 Coordinating Committee

Crisis Management Group (CMG) will be the coordinating committee for oil spill response operations under Facility level oil spill contingency plan for APSEZL, Mundra. Oil spill response plan identifies the APSEZL, Mundra spill response organization, team responsibilities, communications and the procedures to respond all possible oil spill emergencies within the Port limits.

The assigned duties with respect to conduct of operation as mentioned here under will accordingly be required to be discharged by each On Scene Commander (OSC) (in the event of multiple ops). On Scene Coordinator (OSCo)/ Chief OSCo is responsible for undertaking all possible and feasible actions to respond to spill and direct the response team / teams at site. He is to decide the best response action required to be adopted as per situation and guide the response team/ teams accordingly.

The callout system for an oil spill incident is identical to any other emergency as contained in disaster management plan of APSEZL, Mundra. Emergency Control Team (ECT) will arrange mobilization of additional resources like Emergency Response Team (ERT) as when, required.

Emergency Control Team

The ECT will compromise the following members

- Chief Operating Officer APSEZL, Mundra
- Incident Control Officer (HOS – Marine / Duty Port Captain)
- Site Emergency Coordinator (Senior Pilot and Duty Radio Officer)

- Fire Coordinator (HOS – Fire / HOS -Safety)
- HOS – Security / Duty Security officer
- Medical Superintendent
- Marine Pollution Coordinator – Manager (Marine /Pollution Control)
- Traffic Coordinator - Duty Port Captain
- Communications Officer (Duty Port Captain / Marine Control in-Charge)
- Chief Emergency Controller (Head -HSE)
- Civil Coordinator (HOS – Environment Cell / HOS Estate)
- Marine Engineering Coordinator (HOS – SPM / Diving Team in-Charge)
- HOD – Corporate Affairs
- HOS-Legal & HOD Estate

1.7.1 Statutory Requirements

As a part of this Plan, the port, facility or the identified ECT (Emergency Control Team) is responsible to undertake spill mitigation operations apart from managing, acquiring and maintaining oil spill response equipment and resources appropriate for response as per the Risk Category-A (NOSDCP-2018). Equipment, resources and personnel will be stockpiled at one or more suitable location/s as necessary to meet response requirements within shortest period.

The ECT is responsible for executing all the response mechanisms and procedures identified by the Plan and maintain trained personnel to undertake the operations.

An oil spill contingency plan is based on the understanding of the regulatory framework in which the assets and operations are located and in which the planning and response actions will be carried out.

This section summarizes the relevant national and international legislations related to oil spill response.

1.7.2 Enforcement Agencies and Authorities

At national level, various regulations have been formulated to ensure that oil spills are adequately notified and handled with least impacts on the aquatic and terrestrial environment along with public health and safety.

- Merchant Shipping Act 1958 and Amendment in 2003: This Act requires oil companies to clean up any oil spill from offshore petroleum related activities whether at sea or ashore.

- Environment Protection Act 1986 and EIA Notification, 2006: The Ministry of Environment and Forests and Climate Change (MoEF & CC) while granting environmental clearance to oil and gas projects requires the company to establish oil spill control capabilities.
- Section 32 of the Water (Prevention and Control of Pollution) Act 1974: The Gujarat State Pollution Control Board (GPCB) holds the power to prevent discharge of hazardous and polluting materials into the sea or tidal waters.
- Coast Guard Act, 1978: The Act requires every owner, operator of a port facility, oil installation, and offshore installation to prepare and implement oil spill disaster contingency plan.
- Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008 (PNGSOOR), G.S.R. 469(E): These Rules have been formulated through Sections 5, 6 and 7 of the Oilfields (Regulation and Development) Act, 1948 (53 of 1948). It requires operators to undertake risk assessment related to activities and prepare safety management systems and emergency response plans pursuant to the provisions of the Rules.

Indian Coast Guard

The Indian Coast Guard is the national coordinating authority for marine oil spills. Under the Coast Guard Act, 1978, the CG is responsible for control of pollution at sea and protection of marine environment. Indian Coast Guard has prepared and implemented a National Oil Spill Disaster Contingency Plan (NOS-DCP). As per the Act, all spills are required to be reported to the Coast Guard. In the event of a spill, the nearest Coast Guard station will be notified. When a spill is reported, the Coast Guard will monitor the movement of spill while APSEZL, Mundra takes the response measures.

Oil Industry Safety Directorate (OISD)

Oil Industry Safety Directorate (OISD) is a technical directorate under the Ministry of Petroleum and Natural Gas that formulates and coordinates the implementation of a series of self-regulatory measures aimed at enhancing the safety in the oil and gas industry in India. OISD maintains a database of accidents taking place in the oil industry and also investigates the major incidents, therefore has to be notified of incidents in offshore installations.

1.7.3 Statutory Requirements

International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)

MARPOL 73/78 is the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978. The Protocol desires to achieve the complete elimination of intentional pollution of the marine environment by oil and other harmful substances and the minimization of accidental discharge of such substances. The Convention includes regulations

aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes.

- Annex I: Regulations for the Prevention of Pollution by Oil;
- Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk;
- Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form;
- Annex IV: Prevention of Pollution by Sewage from Ships;
- Annex V: Prevention of Pollution by Garbage from Ships; and
- Annex VI: Prevention of Air Pollution from Ships.

Regulation 37 of MARPOL Annex-I require that oil tankers of 150 gross tonnage and above and all ships of 400 gross tonnage and above carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP). Regulation 17 of MARPOL Annex-II makes similar stipulations that all ships of 150 gross tonnage and above carrying noxious liquid substances in bulk carry an approved shipboard marine pollution emergency plan for noxious liquid substances. The latter may be combined with a SOPEP and should be referred to as a Shipboard Marine Pollution Emergency Plan (SMPEP).

The SOPEP/ SMPEP must include:

- Procedures for reporting oil pollution incidents.
- List of authorities and persons to be contacted in the event of an incident.
- Detailed description of immediate action to be taken to reduce or control discharge of oil following an incident.
- Procedures and point of contact for coordinating spill response actions with national and local authorities.

The International Maritime Organization (IMO) has produced the following guidelines to facilitate the preparation of such plans:

- Guidelines for the Development of Shipboard Marine Pollution Emergency Plans, 2010 Edition which includes Guidelines for the development of Shipboard Oil Pollution Emergency Plans (SOPEP) (resolution MEPC.54 (32), as amended by resolution MEPC.86(44)).
- Guidelines for the development of Shipboard Marine Pollution Emergency Plans of Oil and/or Noxious Liquid Substances (Resolution MEPC.85 (44), as amended by resolution MEPC.137 (53)).

MARPOL also gives guidelines for reporting pollution incidents to the authorities and outlines standard report formats.

International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990

The IMO's Marine Environment Protection Committee developed this Convention to provide a framework for international cooperation for combating major oil pollution incidents. The Convention has the following key elements:

- precautionary and preventative measures are important in the avoidance of oil pollution in the first instance;
- prompt and effective action is essential to minimize possible damages in the event of pollution;
- contingency planning needs to be emphasized and the role of the oil and shipping industries should be included within these plans;
- the need for mutual assistance, international cooperation and information exchange (on response capabilities and reporting incidents);
- the 'polluter pays' principle; and
- the importance of related international instruments on liability and compensation, including the 1992 Civil Liability Convention (1992 CLC) and the 1992 Fund Convention.

Article-3 of the International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990, also requires operators of offshore units under the jurisdiction of Parties to have oil pollution emergency plans or similar arrangements which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents.

1.8 Mutual aid Agreement

For the port activities suitable agency will be hired for supporting logistics for port operations. As a part of the service, necessary emergency services will also be sought from the port authority.

As per the National Oil Spill Disaster Contingency Plan (NOS-DCP), all Ports or facilities handling oil and oil products are required to maintain Tier-I Oil Spill Response (OSR) capabilities to undertake response activity within their area of operation.

Accordingly, the ports of APSEZL, Mundra is required to set up and sustain Tier-I OSR facilities in Mundra region in co-ordination with HMEL operating at these Port. For this purpose, APSEZL, Mundra and other Participating viz. HMEL, Mundra have executed a Memorandum of Understanding (MOU) for sustenance of Tier-1 OSR facilities for combating oil spills at and in surrounding area within Adani Mundra / GOK.

Under the said MOU, it has been decided to put in place Tier-1 Oil Spill Response Services in Mundra Region for conduct of Oil Spill Operations and mitigation of Pollution within the identified area of operation.

1.9 Geographical Limits of the Plan:

The scope of this plan extends to following locations facilities stretched and facilities over a geographical area of more than 100 Sq Km with multiple operations going on same time.

- Ports of Adani
- Transshipment facilities at APSEZL, Mundra
- Adani West and South Ports
- Kandla Port, Essar Port at Vadinar, Coast Guard Jetty
- Intake and outfalls

1.10 Interface with ROSDCP and NOSDCP

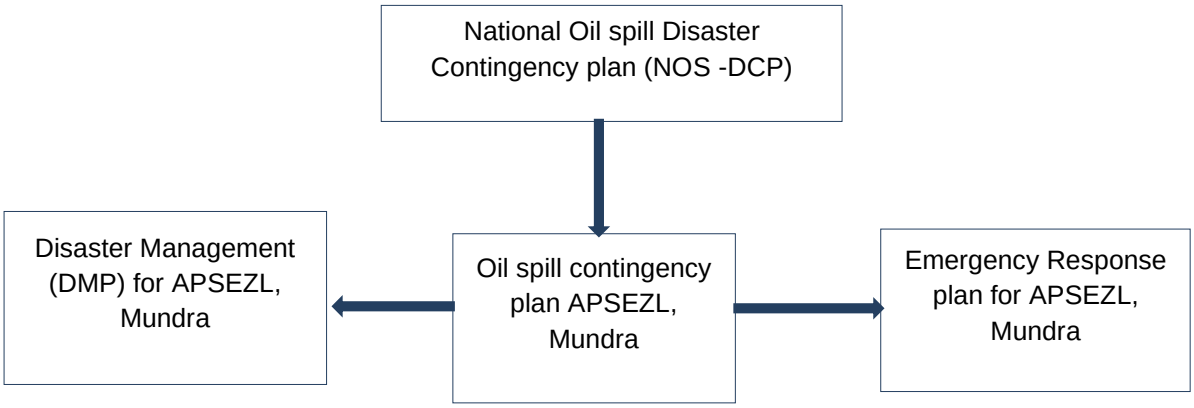
National Oil Spill Disaster Contingency Plan is aimed at coordination of resource agencies to combat an oil spill in Indian waters and also spells the actions required of oil handling facilities i.e., to prepare contingency plans for respective facilities and to develop Tier-I response capabilities and also to report oil spills.

Render resources for pollution response when called for, Report Oil Spills, prepare contingency plans for respective spill scenario, set up Tier-I response facilities and Use of Oil Spill dispersants (OSD) in accordance with Plan.

Of the three tiers of response envisaged and planned to handle a spill situation in consonance with quantum of spill, Tier-1 is the primary and first step of responses, to be mounted by the facility where the spill takes place.

While, NOS-DCP outlines the response activities as per Tier system of addressable of spill, the facility plan is the instrument to address the spill scenario at local level. Tier-1 being the first and primary response level has to be executed and undertaken by the facility handling polluting cargo, for which purpose drafting of a CP is the primary requirement.

A spill situation could arise out of an incident or a number of incidents that could be either natural or man-made leading to emergencies. In the event of multiple emergencies, while the spill response will be undertaken as per this Plan, response to other emergencies will be as per APSEZL, Mundra Emergency Response Plan. This plan interfaces with following documents as illustrated below:



This Oil Spill Contingency Plan has the direct interface with the following plans, manual, guideline and standards of APSEZL, Mundra and Port Operational program:

- APSEZL, Mundra – Disaster Management Plan
- Regional Oil Disaster Contingency Plan (ROSDCP)
- National Oil spill Disaster Contingency plan (NOS -DCP)

2. QUANTITATIVE RISK ASSESSMENT OF OIL SPILLS

The oil spill may generally occur either from transportation or from offshore facilities which include the surface facilities viz., platforms, berths / jetties, vessels and subsurface pipelines and all other associated infrastructure required for the transport / port operations. The spilled oil moves in the directions of resultant wind and current and finally gets stranded in the coast or in the sea. If the spill reaches the coast, it will damage the coastal sensitive areas, which are to be protected with proper response equipment in a planned response manner.

The risk is to be assessed that are posed to sensitive areas in and around of APSEZL, Mundra regions and then address those problems by identifying suitable response methods to prevent biological / industrial / socio-economic sensitive areas from exposer to oil spill and how best to advise the local authority of the dangers that could be posed by the spill and how to address them and to repair the damage done by the spill.

2.1 Identification of Port Operational activities and Risks

APSEZL, Mundra currently owns and operates several marine facilities located at Mundra, Gulf of Kutch. The Mundra port facility is located on the West Coast of India in Gulf of Kutch about 50 km west of Kandla in District Bhuj of Gujarat state.

The APSEZL, Mundra handles the majority of its dry and liquid products traffic through the South and west, terminals. There are several berths and jetties at Mundra for berthing of cargos. Two subsea pipelines connect the onshore to the IOCL, HEML SPMs.

The location of the APSEZL is situated at Mundra at approximately Lat 22˚ 44′ 18.89” N, long 69˚ 41′ 35.62” E. The berths are located in the North bank of Mundra region. The berthing jetties are for operating vessel operability and potential to meet the future trends. APSEZL, Mundra has developed berths, approaches and turning circles to handle vessels at the Berth.

Existing berths and Jetties

There are 21 existing berths at MMPT 1, MMPT 2, MMPT 3, MICT, AMCT catering to liquid, Container as well as General cargo. M/s Adani also planning to expand MPT-T2 for handling dry cargos.

West Basin

West Basin is about 10 nautical miles west of the existing terminals of Mundra port. Four Berths are located approx. at 22° 45' 14.82" E and 69° 34' 6.23" N, off Tunda Wandh falling in Taluka Mundra. The basin is also planning to expand with 3 more additional berths for handling dry cargo. Two power plants are located North of these berths, in barren waste land. National Highway 8A extension passes through north side of the power plant sites at a distance of approximately 6 km.

South Basin

The south basin is in western side of the existing port on Navinal Island. Six berths are located approx. at Lat 22˚ 44′ 18.89" N, long 69˚ 41′ 35.62" E. It has presently 6 operational berths. It has an enclosed turning basin and necessary back up area. The basin is also planning to expand with two container berths for handling liquid cargo.

VLCC Jetty:

The development of jetty facilities is in progress for handling VLCC at Mundra for Crude oil operations.

Hence, mathematical modeling studies for predicting the fate and oil spill trajectory due to spills if any at Port operations facilities for various seasons is mandatory for OSCP. Oil spill modeling to be carried out as a part of Oil Spill Contingency Plan to identify the suitable combating operations for controlling the spills.

Oil Spill Scenarios Including Worst Case Discharge

Evaluating oil spill risks requires consideration of two factors, namely the probability of a spill occurring, and the consequences.

The potential oil spill scenarios from the APSEZL, Mundra marine facilities and associated activities are summarized in the next sections. In practice, due to preventive actions such as training, operating procedures and engineered solutions, potential spills are likely to be smaller. Larger oil spills being extremely unlikely.

The events and scenarios presented here are indicative only. Though accounting every eventuality is not practicable, however the above scenarios represent a broad cross section of possible oil spill incidents. The credible release quantities given are only an indication but the actual oil spill may vary significantly.

Risk Assessment Methodology

Risk Assessment exercise is primarily for the concern of environmental pollution caused by accidental spillage of oil in and around the APSEZL, Mundra Port facilities. The factors which may influence the risk includes the followings:

- Exposure time of the port due to transit of ship
- Performance of ship's crew, including pilot
- Hydrographic and meteorological conditions;

The present Risk Assessment exercise has been carried out in stages as follows:

- ✓ Gathering of relevant information and data;
- ✓ Hazard Identification;
- ✓ Frequency Estimation;
- ✓ Consequence Estimation;
- ✓ Risk Estimation.

The oil spill may occur generally during transportation of crude/fuel oil from the offshore facilities which include the surface facilities viz., platforms, berths / jetties, vessels and subsurface pipelines and all other associated infrastructure required for the transport operations. The causes of oil spill during operations of APSEZL in the Mundra region along the North Coast of Gulf of Kutch are broadly defined under the following sections.

2.1.1 Sources of oil spill:

At various port operational facilities that can lead to the oil spill are given below: Also, worst case scenario i.e. Worst case volume and likely volume can be mentioned.

- ➢ Operations at Jetty / berth - loading / unloading
- ➢ Spills due to Collision/Grounding in the Tanker route
- ➢ Bunker/ fuelling operations
- ➢ Ship distress / sinking
- ➢ Spill due to rupture in subsea pipeline corridor (size of crack-1")
- ➢ Rupture of export line due to movement and landing along the coast.

2.2 Failure frequency of pipeline, transfer and storage tank

The damage of pipelines is subjected number of factors such as corrosion, age of pipeline, life of pipeline and length. The reliability data of pipelines are presented here from the international database and hence these can be taken as indicative.

The probabilities of pipe ruptures are presented below:

d ≤ 50 mm	1 x 10^{-10}/m hr.
50 < d ≤ 150 mm	3 x 10^{-11}/m hr.
d > 150 mm or greater	1 x 10^{-11}/m hr.
Sub-Sea pipeline failure	6.1 x 10^{-12}/m hr.
where 'd' is the diameter of pipe	

The probability of hose failures is presented below:

Loading arm failure	3 x 10^{-8}/hr.
Flexible hose pipe failure	4 x 10^{-5}/hr.
Atmospheric storage tank failure rate	3 x 10^{-4}/yr

Flow lines	Partial rapture	1.25 x 10-5 / year
Flow lines	Total rapture	1.25 x 10^{-5} / year
Block value		3-11" – 1.08 x 10^{-4}/year
Flange Joints		3-11" -- 5.56 x 10^{-5}/year

Based on the above failure frequency, it is apparent that the failure rate of the flexible hose pipe ranks higher. The failure rate of above ground pipeline depends on the pipe size and its length. As the pipe diameter increases, the failure rate decreases and as the length increases, the failure rate increases. The failure rate of underground pipeline is relatively much lesser compared to that of above ground pipeline. The underground pipelines are well designed to take care of corrosion etc.

Based on the past 10 years accidental data, it is observed that the frequency of oil spills is around 1.7 x 10^{-6} per cargo vessel transferred.

2.2.1 Quantity of oil leaked – pipelines

The quantity of oil spilled can be calculated based on size of the rupture and also for hole leaks taking account the diameter of hole and flow rate. The formula for total calculation is

Volume of spill = 2πrLv

r = radius of pipeline

L = length of pipeline

v = flow velocity

2.3 Sub-sea Pipeline Damage

There was a pipeline leakage at Bombay high and observed the flow and pressures monitored continuously at platform and Uran terminal after the pumping has been stopped. Before stopping pumping, the leak rate is high due to higher pressure than hydrostatic pressure and leak rate would reduce gradually after stopping the pumping. The details of spill volumes are furnished in Table 2.1.

Table 2.1 Pipeline spill volume (m^3)

Time in hours after rupture	Spill Size
1	1900
3	3400
6	5300
12	9000
24	13500
36	14100

In case of total rupture of the 48" pipeline running from SPM to onshore oil terminal, the pump will be shutdown automatically within few minutes and the volume of spill would be around 20 m3 only.

The failure rate of loading arm is extremely low because of the sophisticated safety systems incorporated in the design.

2.4 Cargo Operations or Transfer frequencies

Since 1974, International Tanker Owners Pollution Federation Limited (ITOPF), London has maintained a database of oil spills from tankers, combined carriers and barges. This covers all accidental spillages except those resulting from acts of war. The database (Table.2.6) contains information on both the spill itself (amount and type of oil spilt, cause and location) and the vessels involved. For historical reasons, spills are generally categorized by size (<7 tons, 7-700 tons and >700 tons) although the actual amount spilt is also recorded. Information based on nearly 10,000 incidents, found that the vast majority (85%) fall into the smallest category i.e., <7 tons. Information is gathered from both published sources, such as the shipping press and other

specialist publications, and also from vessel owners and their insurers. Not surprisingly, information from published sources generally relates to large spills, often resulting from collisions, groundings, structural damage, fires and explosions, whereas the majority of individual reports relate to small operational spillages. The details of the spills occurred based on the ITOPF data collected are presented in Table. 2.2

Table- 2.2: Number of oil spills occurred during 1974 to 2010 and their causes and the spill quantity

	<7 Tones	7-700 Tones	>700 Tones	TOTAL
OPERATIONS				
Loading/Discharging	3157	385	37	3579
Bunkering	562	33	1	596
Other Operations	1250	61	15	1326
ACCIDENTS				
Collisions	180	337	132	649
Groundings	237	269	160	666
Hull Failures	198	57	55	310
Equipment Failures	202	39	4	245
Fires & Explosions	84	33	34	151
Other/Unknown	1975	121	22	2118
TOTAL	7845	1335	460	9640

Table-2.2 gives the number of oil spills occurred along with quantity of oil spilled and the operations associated during 1974 to 2010 It is found that, most spills from tankers result from routine operations such as loading, discharging and bunkering which normally occur in ports or at oil terminals, the majority of these operational spills are small with some 81% involving quantities of less than 7 tons and accidents involving collisions and groundings generally give rise to much larger spills, with at least 4% involving quantities in excess of 700 tons.

The exact quantity of spill from each of the above incident is difficult to predict due to the variables of operating conditions and the length of risk exposure. Maximum risks associated with the events may be considered while devising the oil spill contingency plan. The spill scenarios range from extremely negligible quantities to enormous quantities in rare catastrophic events. The simulation of oil spills does not vary significantly in various scenarios except for the magnitude of impact zone and the quantity involved in such impacts. The software is intended to use for specific scenarios, through a few simulations are made in this report considering the worst-case scenarios.

The failure rate of loading arm is extremely low because of the sophisticated safety systems incorporated in the design. Accidental release of any chemical due to catastrophic rupture of

tanks and ship collision are also relatively very low. The impact due to failure of storage tanks and ship collisions on environment are very high because of the large quantity released when compared to the pipe failure.

For the purpose of simulation, the below given scenarios are taken into account considering the above spill risks.

2.5 Operational Leakage

2.5.1 Spill due to Loading arm failure at Jetty: (pumping rate of 10000 m^3/hr crude oil for 1 min)

Crude pumping rate from the tanker will be around 6500 m^3/hr to 10000 m^3/hr. In the present study, maximum pumping rate of 10000 m^3/hr has been considered to assess the risk on a higher side. The Safety Break Away Coupling in the crude oil transfer hose will be activated within few seconds in the event of hose rupture or failure. Again, for the sake of assessing higher risk, a response time of 1 min is considered to estimate the amount of oil that would spill at the Jetty. Thus, the quantity of crude oil spill has been estimated as 167 m^3 in the event of loading arm failure.

2.5.2 Spill due to rupture of sub-sea crude oil pipeline from refinery to shore tanks: (2611 Tons of crude for 36 hrs)

Crude oil pumping rate from the tanker will be in the range of 12500m^3/hr – 6500 m^3/hr. In the present study, to assess the maximum risk the pumping rate of 12500 m^3/hr has been considered to be on higher risk side. The minimum wall thickness of sub-sea crude oil pipeline is 15.6 mm and the maximum thickness is 24 mm. Moreover, all along, 5 inches concrete cladding is provided on the surface of the pipeline. Hence crude oil pipelines designed, constructed and laid as per the international norms are safe and leakages are extremely rare during its designed life. However, a rupture of size 1” has been assumed for assessing the quantum of oil spill through sub-sea pipeline.

Pump discharge pressure on-board will be 10 kg/cm^2 at tanker manifold and crude oil thus will be pumped to the COT tanks without any boosting device in-between. As the level in the tanker depletes, discharge pressure would also be reduced. Moreover, with the distance the crude oil pressure inside the pipe drops. For the sake of assessing the amount of oil spill in case of rupture of sub-sea pipeline, a pressure of 10 kg/cm^2 and a water column height of 20 m have been considered.

In the present study, for the sake of assessing the amount of oil spill in case of rupture the response has been considered as 36 hr for quantification of oil spill. Accordingly, the quantity of Crude oil spill has been estimated to be 2611 tons.

2.5.3 Spill due to Tanker Collision at Jetty having capacity between 1,00,000-3,00,000 metric tons

Crude Oil is received at Jetty by ocean tankers having capacity between 1,00,000 - 3,00,000 metric tons. Crude oil is pumped to shore tanks by pipeline from the SPM. In the present scenario, collision of the vessel at the jetty or tanker route with another vessel enroute to other terminals can cause partial damage to the vessel's cargo tanks (not more than 3 Nos. Cargo tanks) leading to a maximum oil spill of about 700 tons to 25,000 tons of crude oil. Hence, in the present study the probable quantities of crude oil spills due collision at Jetty are considered as 700 tons, 10000 tons and 25,000 tons.

2.5.4 Spill due to collision or grounding in the Tanker route

Tankers are expected to call at the Jetty frequently to load these oil products. These tankers may meet accidents like collision with other vessels or grounding in the vicinity of the Jetty. In case of such accidents the spillage may vary depending on the size of the tanker, the extent of damage and number of cargo tanks ruptured. In the present study the probable quantity of spills in the tanker route considered for modelling is about 25000 tons.

As can be seen above the spill scenarios mentioned above range from extremely negligible quantities to enormous quantities in rare catastrophic events. The simulation of oil spills does not vary significantly in various scenarios except the magnitude of impact zone and the quantity involved in such impacts. The software is intended for use by the client for specific scenarios, through a few hypothetical simulations are made in this report considering the worst-case scenarios.

The failure rate of loading arm is extremely low because of the sophisticated safety systems incorporated in the design. Accidental release of any chemical due to catastrophic rupture of tanks and ship collision are also relatively very low. The impact due to failure of storage tanks and ship collisions on environment are very high because of the large quantity released when compared to the pipe failure.

2.6 Risk assessment of oil spill in APSEZL, Mundra area

a) Oil spill risk analysis and modeling studies for **APSEZL** at operating facilities in Mundra Region, Gulf of Kutch (**Part B of the report**)

b) Mapping of Marine Sensitive areas in the Coastal areas of Gulf of Kutch region (**Part-C of the report**)

The two documents mentioned above deal extensively with oil spill risk analysis & trajectory and mapping of marine sensitive areas based on the available data information. These two studies follow the structure of and are compliance with the "IPIECA-A guide to contingency planning for oil spills on water and are aligned with the Indian coast guard "National Oil Spill Disaster Contingency plan" These important documents provide all details of the local environment, risks of the oil spill Tier-I credible spill, fate of the spills, sensitivity mapping of the area and local, regional and country wide response capabilities.

These documents shall be used in conjunction with the oil spill response plan.

2.7 Spill locations and scenarios

Based on above oil spill risk analysis the following 15 oil spill scenarios are considered for simulations as shown in Fig. 2.1.

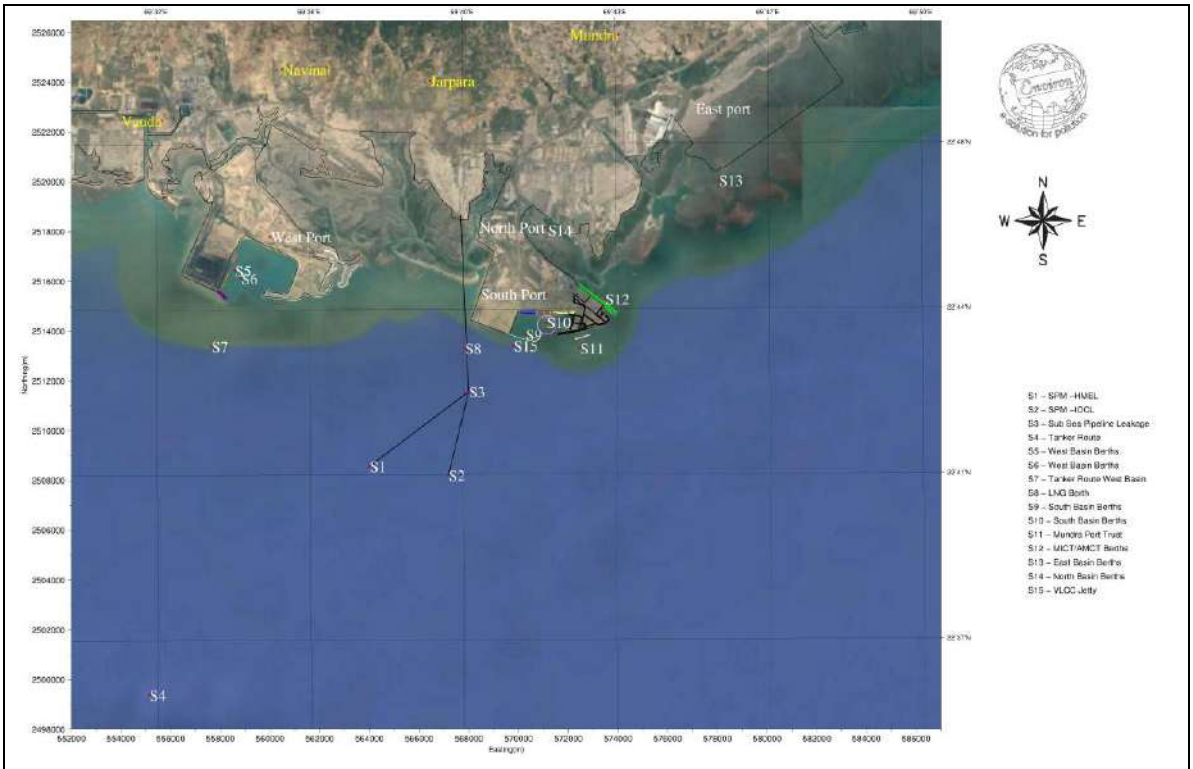


Fig.2.1 Spill Locations considered in **APSEZL** at Mundra region

- SPMs (S1, S2)
- VLCC Jetty (S15)
- Sub-sea pipeline(S3)

- Tanker entry into the Ports (S4)
- Adani West Port berths (S5, S6, S7)
- LNG Berth (S8)
- Adani South Port berths (S9, S10)
- Mundra Port (S11)
- MICT / AMCT Berths (S12)

The following are oil spill risks identified in terms of quantities and spill types

- Crude oil spill of 700t at selected SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Fuel oil spill of 700t at selected West Port(S5), Vessel route(S7), LNG Jetty(S8), South basin (S9), Mundra Ports(S11), MICT/AMCT(S12)
- Crude oil spill of 10000t at SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Crude oil spill of 25000t at SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Fuel oil spill of 100t at selected West Port (S5, S6), LNG Jetty(S8), South basin (S9, S10), Mundra Ports(S11), MICT/AMCT(S12)
- HSD oil spill of 50t at selected West Port(S5), LNG Jetty(S8), South basin (S9), Mundra Ports(S11)
- HSD oil spill of 20t at selected West Port(S6), South basin (S10)

Continuous Spills

- Crude oil spill of 10000 m^3/hr for 1 min at selected SPM-HMEL(S1), SPM-IOCL(S2)
- Crude oil spill of 10000 m^3/hr for 1 min at selected VLCC Jetty (S15)
- Crude oil spill of 10000 m^3/hr for 1 min at sub-sea pipeline route (S3)

2.8 Types of Oil Likely to Spilled

Oil Type

The majority of oil handling at Port area will be crude oil. The International Tank Owners Pollution Federation (ITOPF) classifies oil into four (4) groups based on their specific gravity. Typically, crude oils will fall into Group 2 (with specific gravity 0.8 – 0.85, API 35 – 45) or Group 3 (with specific gravity 0.85 – 0.95, API 17.5 -35). The behaviour of a particular crude oil may differ from the general pattern depending on its properties and environmental conditions at the time of the spill.

The other oils that will be used for Cargo / tankers are fuel oils. The specific gravity of Fuel oil is typically in the range of 0.9-0.95 (API 25 – 35) and viscosity 6.5 cst / 50°C. Fuel oil will spread slowly on water and should evaporate less quantity within a few days upon release onto the sea

surface. Evaporation can be enhanced by higher wind speeds, warmer water and air temperatures. A small percentage may also dissolve.

The following characteristics of oils are used for modelling study

Table.2.3 Type of oils selected for oil spill modelling studies

Chemical and Physical Properties	Fuel Oil	Crude Oil	HSD
Sp. Gr	0.9	0.85	0.86
API	25.72	41.27	25.72
Surface Tension	0.0028Nm^{-1}	0.003Nm^{-1}	0.0028Nm-1
Viscosity of Oil	6.5X10^{-6} m^2/s	3.822X10^{-6} m^2/s	3.822X10-6 m2/s
Molar Volume	0.0002 m^3/mol	0.0002 m^3/mol	0.00023 m3/mol
Wax content (%)	912-19%	12-19%	03-44%
Pour point (˚C)	35 deg C	18 to 30 deg C	60 C - 180 C

2.9 Hazardous Noxious substances (HNS) Spills

HNS spills involve a wide range of chemicals and other substances that can pose significant hazards to human health, marine life, and the environment. Effective response to HNS spills requires specialized knowledge and resources due to the diverse properties of these substances.

HNS constitutes gas, liquids and solids phase which when spilled in water will purely Float (F), Evaporate (E), Sink(S) or Dissolve (D) or in certain combinations of these physical characteristics discussed below.

Evaporators

The volatile liquids are less dense than sea water and has low solubility and forms vapor cloud the same way as that of gas. The Liquid (LPG) which forms vapor substance and dissolves in the water and vapors may form flammable over the water surface.

Floaters:

Non-volatile liquids are less dense than the sea water. The floating substance may not significantly evaporate and dissolve. Some non-volatile liquids are not significantly evaporated, but slowly dissolves. Some son-volatile liquids are slowly evaporated, without dissolving in water. A floating substance can either slowly evaporates or get dissolved (0.15%). The extent of solubility will determine whether toxic concentrations might occur in water. This type of product will completely disappear with time.

Dissolvers

Dissolver is a substance which dissolves in water and does not rapidly evaporate. The degree of solubility of the substance and the turbulence in the water column will determine whether toxic concentrations in the water column will occur. Such substances will dissolve in water and will rapidly evaporate.

Sinkers

Skinners comprises of products which are denser than sea water, and; when the density of a liquid is higher than that of sea-water, then the solubility is considered to differentiate between sinkers and a sinker/ dissolver:

The physical and chemical properties of HNS handled at Port is furnished in Annexure-17.

2.10 Probable Fate of Spilled Oil

The physical and chemical characteristics of spilled oil change almost immediately when spilled in the marine environment due to evaporation, dispersion, emulsification, dissolution, oxidation, sedimentation and biodegradation. All of these processes that set in together are collectively referred to as oil weathering and decide the final fate of spilled oil and quantities that would need to be removed physically. If the oil is persistent and does not vaporize immediately or disperses and comes ashore, then the costs in terms of clean up, damages and economic loses can be considerable. Some of the weathering processes that spilled oil goes through and the time duration of these processes which are important for emergency response and need to be taken into account by the responders, are provided in Table 2.4 below:

Table.2.4: Oil Weathering Processes

Process	Description	Importance	Time Frame
Evaporation	Conversion of liquid to gaseous state. Lighter factions are lost first.	Major process accounting for loss of oil. At 15°C gasoline will evaporate completely over a 2-day period, 80% of diesel fuel and 40% of light crude, 20% of heavy crude and about 5- 10% of Bunker C fuel.	< 5 days
Emulsification	Small water droplets get mixed into liquid oil. Water content will reach 50-80%.	Will increase the amount of pollutant to be recovered by a factor of 2 - 4.	Onset may be delayed but emulsification process will start rapidly.
Natural	Breakup of an oil slick	Removes oil from water surface	< 5 days

Process	Description	Importance	Time Frame
Dispersion	into small droplets		
Dissolution	Mixing of soluble oil components into water	Water soluble components are most toxic	< 5 days
Biodegradation	Breaking of oil by microbes into smaller compounds and finally to water and carbon dioxide	Rate depends on oil type, temperature, nutrients, oxygen and amount of oil	Weeks to months
Formation of tar balls	Breakup of heavy crudes and refined oils into small patches with long persistence	Hard to detect	Days to weeks

In this present study, the oil type considered is **'**weathering' type which is typically used for all the oil spill trajectory prediction studies. Non weathering oil is an oil type that does not change chemically or physically over time in the marine environment. Weathering processes like evaporation, emulsification etc., affect spills and no-weathering oils doesn't considered these processes hence the trajectory oil spill analysis for non-weathering type represents worst case scenario.

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill whilst oxidation, sedimentation and biodegradation are long term processes which determine the ultimate fate of oil. Fig.2.2 shows schematic diagram of weathering processes with time.

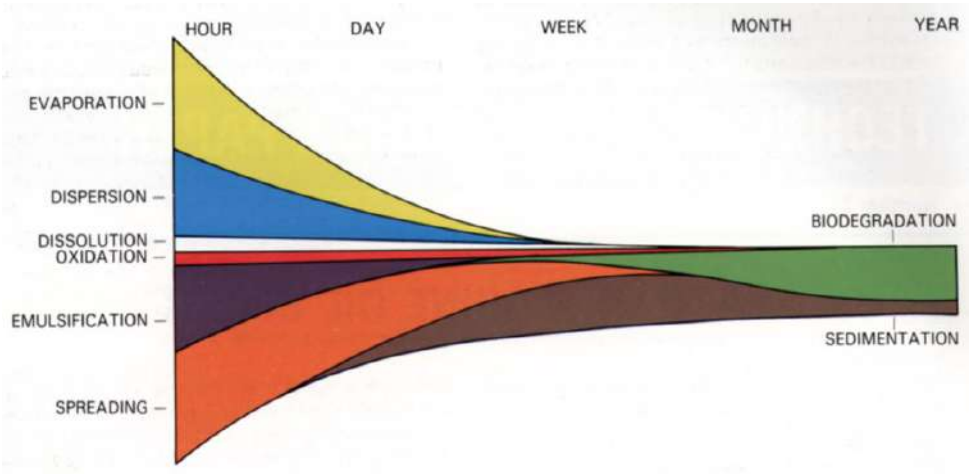


Fig.2.2 shows schematic diagram of weathering processes with time.

2.11 Appearance and Thickness of Oil Slick

Depending on the properties of the spilled oil, the thickness of oil slick can range from a tenth of a micron to hundreds of microns. The colour of oil film post spreading is a good measure of quantity of oil that may be contained within the slick.

- When direct light from the sun contacts a very thin oil film (<0.1 micron; µm), much of the light is reflected back to the observer as grey or silver sheen.
- If the film is thicker (perhaps 0.1 to 3 µm), the light passes through the film and is reflected off the oil-water interface and back to the viewer. The observer will then see a film that can range from rainbow to darker-colored sheens.
- For very thick films (> 3 µm), the light is absorbed and the slick appears dark colored (i.e., black or brown) to the observer. However, the viewer can no longer determine film thickness based on colour. If the slick is dark-colored, the observer cannot tell whether the film is 3 µm or 100 µm thick.

In order to quantify oil thickness, the following thumb rules are used:

Table.2.5: Appearance and Thickness of Slick

Appearance	Thickness
Silver Sheen	0.0001mm
Rainbow sheen	0.003 mm
Light brown/ Black slick	0.1 mm
Dark brown/ Black slick	> 1 mm

To determine an approximate quantity of spilled oil in the event of a spill, the following formula is used:

V = L x W x T /100

Where, L = Length of slick (in metres)
W = Width of slick (in metres)
T = Thickness of slick (in mm)
V = Volume of spilled oil (in cubic metres)

2.12 Development of oil spill scenarios including worst case spill

Spill Size

In the present study, series of scenarios considered based on operational activities, a worst-case scenario and logarithmic multiple up to 25000 tons (instantaneous) and 550 m^3 (continuous) has been considered for the model study.

Simulations were made for the following scenarios at Adani Mundra region:

Table.2.6 Details of Oil Spill Scenarios

Comp. Runs	Spill Location	WD (m)	Spill Qty	Type of oil	Spill Location Co-ordinates
A	**SPMs**				
1	SPM-HMEL (S1)	29.50	700 tons	Crude	69° 37' 23.19" E, 22° 40' 59.06" N
2			10000 tons	Crude	
3			25000 tons	Crude	
4			10000 m^3/h for 60 sec	Crude	
5	SPM-IOCL (S2)	28.45	700 tons	Crude	69° 39' 14.05" E, 22° 40' 47.21" N
6			10000 tons	Crude	
7			25000 tons	Crude	
8			10000 m^3/h for 1 min	Crude	
B	**VLCC Jetty**				
9	Spill Location (S15)	15.71	700 tons	Crude	69° 40.78' E, 22° 43.6' N
10			10000 tons	Crude	
11			25000 tons	Crude	
12			10000 m3/hr for 1 min	Crude	
C	**Pipeline**				
13	Crude oil spill of 2611 tons at the pumping rate of 12500 m3/hr for 60 sec (2611 Tons of crude for 36 hrs) along the pipeline corridor at a select (midway) point of subsea pipeline in the pipeline routes. -- Spill point: (**S3)**	21.20	12500 m3/hr for 3hr	Crude	69° 39' 43.35" E, 22° 42' 36.39" N
D	**Tanker Route**				
14	Instantaneous crude oil spill of 25000t along the tanker route at select location. Spill point: S4	22.54	25000 tons	Crude	69°32'11.38'' E, 22°36'1.13" N
E	**West Basin (berths)**				

15	100 tons (due to Berthing incident/ collision) at the West Basin berths (FO) Spill point: **S5**	14.61	100 tons	FO	69°34'13.99'' E, 22°45'15.54" N
16	50 Tons (due to Berthing incident/ collision (diesel oil tanks) at the West Basin berths (HSD) Spill point: **S5**		50 tons	HSD	69°34'13.99'' E, 22°45'15.54" N
17	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berths -- Spill point: **S5**		700 tons	FO	69°34'13.99'' E, 22°45'15.54" N
18 & 19	In the maneuvering basin: ○ 20 Tons of HSD oil due to Tug Impact (HSD) ○ 100 Tons of FO due to Tug Impact Spill point: **S6**	14.48	20 Tons 100 Tons	HSD FO	69°34'22.75'' E, 22°45'5.33" N
20	Along the vessel route at one location: Instantaneous oil spill of 700t along the tanker route at a select location. (FO): Spill point: **S7**	17.08	700 tons	FO	69°33'40.66'' E, 22°43'36.31" N
F	**LNG berth**				
21	100 tons (due to Berthing incident/ collision) at the LNG berth (FO) -- Spill point: S8	13.76	100 tons	FO	69°33'40.66'' E, 22°43'36.31" N
22	50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the LNG berth (HSD) –Spill point: **S8**		50 tons	HSD	69°33'40.66'' E, 22°43'36.31" N
23	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth-- Spill point: **S8**		700 Tons	FO	69°33'40.66'' E, 22°43'36.31" N
G	**South Basin (berths)**				
24	100 tons (due to Berthing incident/ collision) at the LNG berth (FO) -- Spill point: **S9**		100 Tons	FO	69°39'38.08'' E, 22°43'32.54" N
25	50 Tons (due to Berthing	14	50 Tons	HSD	69°41'3.53'' E, 22°43'50.33" N

	incident/ collision (diesel oil tanks) at the South Basin berths (HSD) – Spill point: S9				
26	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth -- Spill point: S9		700 Tons	FO	69°41'3.53'' E, 22°43'50.33" N
27 & 28	At the turning circle: ○ 20 Tons of HSD oil due to Tug Impact ○ 100 Tons of FO due to Tug Impact Spill point: S10	17	20 Tons 100 Tons	HSD FO	69°41'33.62'' E, 22°44'6.49" N
H	**Mundra Port**				
	At the existing MPT1 berth: : Spill Point S11				69°42'20.45'' E, 22°43'32.17" N
29	100 tons (due to Berthing incident/ collision) at the berth (FO) -- Spill point: S11		100 Tons	FO	69°42'20.45'' E, 22°43'32.17" N
30	50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the berth (HSD) – Spill point: S11	20.80	50 Tons	HSD	69°42'20.45'' E, 22°43'32.17" N
31	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth: Spill point S11		700 Tons	FO	69°42'20.45'' E, 22°43'32.17" N
I	**MICT / AMCT Berths:**				
	At the existing MICT / AMCT Berths: : Spill point S12				69°42'56.30'' E, 22°44'36.69" N
32	100 tons (due to Berthing incident/ collision) at the (FO) - Spill point S12	15.12	100 Tons	FO	69°42'56.30'' E, 22°44'36.69" N
33	700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth - Spill point S12		700 Tons	FO	69°42'56.30'' E, 22°44'36.69" N
34	100 tons (due to Berthing incident/ collision) at the East Basin berths (FO) Spill point: **S13**	20.0	100 Tons	FO	69° 45' 37.58" E 22° 47' 10.73" N
35	100 tons (due to Berthing	0.5	100 Tons	FO	69° 41' 35.79 E

	incident/ collision) at the North Basin berths (FO) Spill point: **S14**				22° 46' 6.76 N

Results of scenario:

Hydrodyn-OILSOFT is a dedicated software for oil spill trajectory modeling. This software is used for the prediction of oil spill scenarios in the Mundra region for various meteorological and hydrological conditions.

Knowledge of probable movement of an oil slick gives a distinct advantage while planning response strategies. Thus, for instance, no major clean-up operation is necessary if the modeling results indicate that the spilled oil would remain at sea thereby sparing the shore ecology. On the contrary, if modeling results are suggestive of shoreward drift and predict that particular ecologically sensitive or important areas would be hit, effective counter measures such as deployment of deflection booms, containment and recovery of oil etc. can be effectively taken.
The results of various numerical runs are discussed in the following sections. The detailed results of the simulations are available in the tabular form in the oil spill risk analysis (**PART-B of the OSCP**).

During the year representative spill locations in Adani Mundra would move towards coastal areas during all seasons depending on the spill residence time as delineated in **Part-B of the OSCP**.

The behavior of slick movement is more or less similar in various scenarios irrespective of quantities of oil spilled. The area of oil spread differs depending on the source quantities. The details of spill losses during its movement and time taken to reach the coast boundaries from all locations have been discussed in **Part-B of the OSCP**.

2.13 Environmental sensitivity index mapping

The mapping of the sensitivity of the environment to accidental oil pollution is an essential step in oil pollution preparedness, response and coordination efforts. 'Sensitivity' relates to the efforts of accidental marine pollution involving hydrocarbons. Sensitivity mapping has been prepared which provides a basis for the definition of priorities for protection and clean-up to the On-scene commander, on-site responders and information to plan the best suited response strategy to the decision makers. Sensitivity mapping has been used to support the development of the response strategy for oil spill contingency plan. Elements which have been considered sensitive to oil spill are: protected areas, important areas for biodiversity, sensitive ecosystems, critical habitats, endangered species, and key natural resources.

Sensitivity maps prepared has covered the areas of coast at risk of spillage originating from the facilities and provide information about the various types of environments that may be affected by a spill (sand beached, rocky coast, marshes, etc.) for which the clean-up equipment should be suited. Sensitivity maps prepared also included the mapping of coastal, sub-tidal habitats and information on the potential impact of dispersed oil in the water column so as to support the decision on the use of oil spill dispersant.

The shorelines are of high priority areas for protection because they are difficult to clean once the spill washed to shore. According to the sensitivity and importance of the shoreline, the following order of priority is set in shoreline cleaning:

- Marshes and mangroves.
- Coral reef flats which are exposed at low tide.
- Raised fossil reefs with undercuts which allow the floating oil to penetrate boulder and Cobble beaches.
- Pebble and cobble beaches.
- Beaches of mixtures of sand, pebbles and cobbles.
- Exposed beach rock.
- Port harbour/Jetty/Berth

The details of the environmental sensitivity map including ecologically sensitive areas and economic resources for the APSEZL, Mundra have been provided as Part-C of the OSCP.

2.14 Environmental resources, priorities for protection

Amenity areas, economically important tourist and recreation facilities, bathing beaches, ecologically sensitive areas, industrial or drinking water intakes, fisheries, Marine culture, sea birds, marine mammals and other resources likely to be threatened shall be identified. In most of the oil spill incident, it may not be possible to prevent some oil coming ashore, and in some circumstances, it might be advantageous to deflect the oil to a another less important chosen place onshore. It is therefore necessary to decide in advance which areas are to be given priority for protection. Before making such decisions, a wide variety of interested parties should be consulted.

The environmental sensitivity with key ecologically sensitive areas and economic infrastructures Mundra surrounding areas are

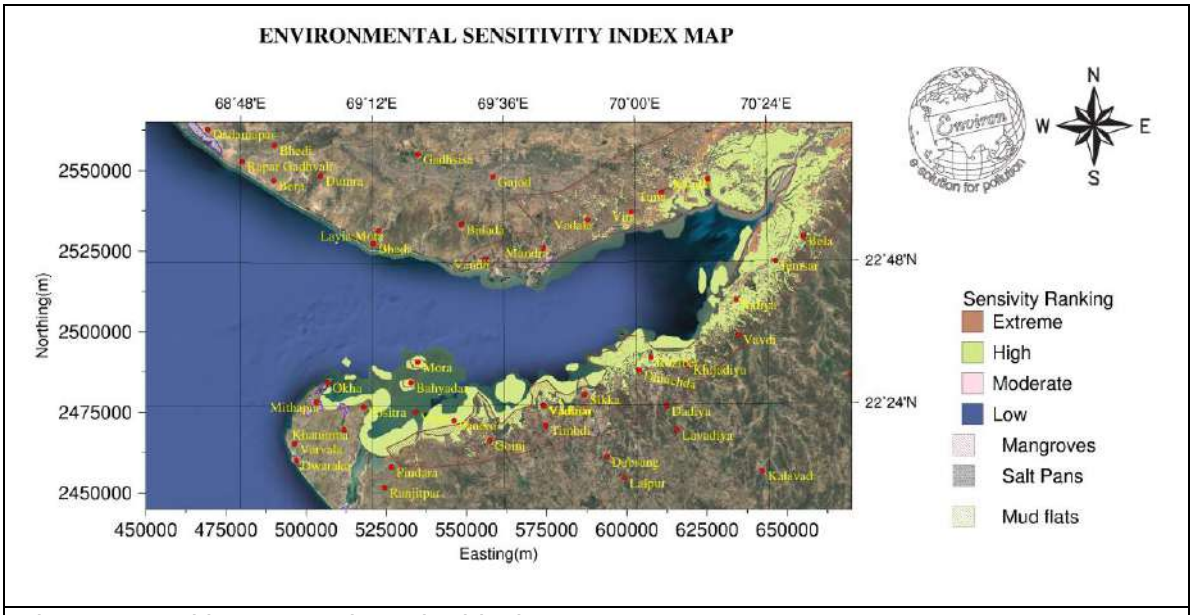


Fig 2.3: Sensitive areas along the block

It is endowed with a great diversity of natural ecosystems, of which the major systems are salt pans, intertidal zones, sand dunes, mangroves, creeks and Open Ocean. The biological sensitive resources are discussed in detail below.

Biological Resources

Various Biological resources are discussed in Part-C (Sensitivity Mapping Studies) of the report which are sensitive to oil spills. As per the IMO standards, each species indicated with symbol and color. Species that are especially vulnerable to the effects of oil spills are Bird, Fish, and Marine Mammal. The Biological resources, which are vulnerable to the effects of oil spills are categories are then further divided by grouping species together by similar taxonomy, morphology, life history, and/or sensitivity to spilled oil.

When a biological resource exists in a small area (such as a bird nesting site), it is indicated by a symbol. When a biological resource encompasses a larger area, it is represented by a polygon with a specific pattern and color.

The information of all categories of biological resources is displayed on shoreline sensitivity maps is provided in Part-C of the report.

Industrial Resources

Various industrial resources i.e., Intake, outfalls, Port /Jetty, salt pans that are vulnerable to oil spills is discussed in Part-C of the report and also shown in Annexure-2. They are indicated by a symbol with specific pattern and color.

Human Use Resources

Human-use resources that may be either negatively impacted by an oil spill or used as access points for oil spill cleanup are typically marked with a symbol. Most human-use features (such as public beaches and aquaculture facilities) exist in a small area and are represented by human – use point symbols. Larger areas such as parks, preserves, protected areas, and wildlife refuges are shown as polygons.

The area from Okha to Kandla is marked by number of creeks, mangrove vegetation, Mudflats, salt pans, APSEZL installations and number of landing points etc. The coastline from Positra to Bedi stretching south into Gulf of Kutch is highly developed in terms of manmade structures and has large extends of mudflats with mangrove vegetation and marine sensitive areas. The further stretch up to Navalakki is the hub of commercial activity and includes Adani, Kandla Port Installations.

All categories of sensitive zones along the coastal areas of APSEZL region as well as creeks are displayed on ESI maps which are to be protected and placed at Annexure-2 of Part-C of the report.

2.15 NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA)

The objective of a NEBA is to consider all available response options for an oil spill and select those techniques that will provide the best opportunities to minimize consequences for the environment. This section of the report provides an overview of the approach used to prepare the NEBA in support of oil spill response planning for Adani Ports and SEZ Limited, Mundra. The analysis is largely based on information discussed in **Oil spill Modeling Studies (Part-B of the OSCP)** and **Marine Sensitivity Area Mapping** (**Part-C of OSCP**).

This qualitative, NEBA analysis was conducted for oil spill contingency planning purposes, and is dependent upon a variety of input sources. It is intended to address the overall risk for the oil spills. Because it is intended to be a broad analysis of a large-scale event, there is no specific season or trajectory analysis that will account for every possible spill scenario. However, it should represent likely exposure risks and levels of concern.

To conduct this study, the following important factors were considered and/or employed:

- The comprehensive trajectory modeling using state-of-the-art models and including oil spill scenario carried out (**PART-B** of the project report)
- Risk matrix which has been prepared based numerous other studies;

- Design of a scenario representing a high-volume discharge incident for this area; and
- Use of the above assumptions that were conservative and evaluated maximum extent of the impact.

Recommendations Concerning Response Options

All of the response options evaluated offer the potential for a net improvement over natural attenuation, and none have material adverse consequences. All of them should be discussed and considered when developing an oil spill response plan. It is always assumed that a combination of response techniques will be used, as appropriate, to minimize oil exposure to sensitive resources and to promote rapid recovery of the ecosystem as a whole. The OSRP provides information on the integration and activation of multiple response options for this Project Area.

However, the response options vary greatly in their potential effectiveness in association with a large-scale scenario, as summarized below (from least to most beneficial):

- **On-water In-situ Burning (ISB) –** This response option is severely restricted by seasonal day length, year-round weather conditions and strong tidal currents and large tidal ranges, most of spill trajectories reached the coast before proper weathering and logistical constraints. As a result, it is unlikely to offer substantial Net Environmental benefits.

- **On-water mechanical recovery –** On-water mechanical recovery resources are generally easier to obtain and deploy in larger numbers. The option is viable for open waters in the Mundra Port region. This option is effective for smaller, confined spills, the estimated oil recovery for large-volume scenarios is generally associated with low ecological benefit.

- **Shoreline protection and recovery –** As a result of the high probability of shoreline contact indicated in trajectory spill modeling studies (**PART-B**), this response option will have more overall effect, except in the cases where spills are moving away from the shore. The deployment of shore line protection and recovery gears are quite difficult due to the fact that the existence of very strong tidal currents as well as large tidal ranges and most of the coastal zonal areas the west coast are inaccessible by road. Due to the above reasons, this is not showing much Net benefit over Natural attenuation.

- **Dispersant application –** This response option was shown to be effective in substantially reducing surface oil in treated areas. While it can be very effective in treating fresh oil, surface oil reduction is predicted to be 40-60% in the first 4 days of the spill. Crude oil concentrations in the upper 10 to 20 m of the water column would increase

in treated areas for a very short period, but would rapidly dilute and therefore not pose a long-term risk to the ecosystem. Quick application of dispersants within an hour is highly recommended offering Net environmental Benefit to the Higher Deg

3. EQUIPMENT, SUPPLIES AND SERVICES

There are a number of techniques to remove the oil floating on the sea. The spill combating equipment's should be selected in relation to the assessment of the risk of spills and to the defense of agreed priorities for protection. The equipment must be chosen for the anticipated range of weather conditions and oil types. Various equipment's used are: booms, skimmers, absorbents, dispersants/bioremediates and burning. NEBA Studies has been carried out based on APSEZL, Mundra facilities, coastal geo-information and port operational conditions. Recommended multiple response methods i.e., mechanical equipment or dispersants /bioremediates based on NEBA studies, put into use in case of oil spill.

3.1 Equipment and Supplies

The response equipment required for mounting an operation consists of equipment for offshore and shoreline operations and could include following spill equipment's

Offshore & shoreline Equipment's

- Booms, Skimmers, Absorbents, boats / tugs / response vessel
- Protective clothing for everybody (including boots and gloves), spare clothing.
- Cleaning material, rags, soap, detergents, brushes.
- Equipment to clean clothes, machinery, etc., with jets of hot water.
- Plastic bags (heavy duty) for collecting oily debris.
- Heavy duty plastic sheets for storage areas especially for the lining of temporary storage pits.
- Spades, shovels, scrapers, buckets, rakes
- Ropes and lines
- Anchors, buoys
- Lamps and portable generators
- Whistles
- First Aid material.

Other special equipment which may be used are:

- Workboats
- Trucks / cars (four-wheel drive)
- Radio transmitter / receivers
- Workshop / repair facilities
- Bulldozers, mechanical scrapers and similar earthmoving
- Equipment

- Vacuum trucks
- Tank trailers
- Life vests
- Explosive meters

The response operations carried out for both offshore and onshore as discussed below.

3.2 Offshore Operations:

The minimum oil spill equipment required for response in terms of containment, recovery and disposal will be maintained at APSEZL at Mundra and onboard the tugs fitted with fire contain remote controlled fire monitors. The equipment maintained at marine control room will be the first to be deployed for containment and would be augmented by movement of additional equipment as required by the situation. The details of total equipment required for response operations are as follows.

Sr. No	ITEM	QTY	CAPACITY
1	Inflatable boom for Fast Response	2000 m	
2	Weir Type Skimmer	2	50m^3/hr
3	Multi Skimmer	2	50 m^3/hr
4	Vacuum Skimmer	2	30 m^3/hr
5	Floating storage tank	2	10 m^3
6	Oil spill Applicator with spray arms type with 2 nozzles	1	
7	Bio Remediation (lit)	2000L	
8	Dispersants-type-III	3000L	
9	Personnel Protective Kit	30	
10	Oil Absorbent Kit	2	

The list of equipment available with Adani Ports and SEZ Limited, Mundra is given in the Appendix-15

3.3 Shoreline operations

Shoreline operations will be undertaken by local civil administrative as per their contingency Plan. Taking into account the spill movement and area sensitivity, the Equipment will be mobilized along with manpower to the site by the local administrative authority. The procedures laid down in Operations Manual will be available for reference to clean up teams along with expertise held with responders. The details of spill equipment for shore cleanup are as follows.

Sr. No	ITEM	QTY	CAPACITY
1	Shoreline Cleanup Equipment's Mini Vacuum pumps capacity (25 m3)	2	
2	Floating storage tank (10T)	2	
3	Absorbent (oil only) 80 L Kit for quick oil spill response	1	
4	Sorbent pads 20-inch x 20 inch (nos)	500	
5	Sorbent Boom size min 5inch dia, min length 5 feet	250	

Based on the oil spill modeling study, it has been observed that an oil spills at berth locations / SPM / tanker route will reach the coast within hours (Part-B: Report). Accordingly, the resources required for Tier-1 response plan are estimated as below:

3.4 Additional equipment and response

While, the equipment held with response team will be available for initial and first response, the additional requirements would be met from equipment held by participating companies being addressed by this Plan. As per the NOS-DCP18 (Appendix-15), the ports are under Category-A as per the risk Category, hence, additional equipment's are to be procured listed in Appendix-15 for compliance with NOSDCP.

In the event of a decision being taken by the team managing the spill, the equipment held with the participating units will be made available to response teams. The details of equipment held at different locations are placed as follows.

Additional equipment and location

LIST OF RESOURCES AVAILABLE-ADANI PORTS and SEZ LIMITED, MUNDRA						
Tugs Available for Oil Spill Containment						
Name of Tug	**Type**	**BHP**	**OSD**	**AFFF**	**Capacity (cum/Hr)**	**BP**
Dolphin No. 4	ASD	2200 X 2	3000 ltr	2000 ltr	1200	55
Dolphin No. 7	ASD	2200 X 2	3000 ltr	2000 ltr	1200	55
Dolphin No. 10	ASD	3000 X 2	3000 ltr	-	-	70
Dolphin No. 11	ASD (DSV)	2200 X 2	3000 ltr	2000 ltr	1200	55
Dolphin No. 14	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Dolphin No. 15	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Dolphin No. 16	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Dolphin No. 17	ASD	3000 X 2	3000 ltr	-	-	70
Dolphin No. 18	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Brahmini	ASD	2000 x 2	3000 ltr	2000 ltr	1200	65
Bitarni	ASD	2000 x 2	3000 ltr	2000 ltr	1200	65
Khushboo	Fixed screw	401 X 2	-	-	-	10
Dolphin No. 4, 7, 11, 14, 15, 16, 17, 18, Brahmini and Bitarni are fitted with Oil Spill Dispersant boom and proportionate pump to mix OSD and Sea water as required. The tugs are also fitted with a fire curtain and remote-controlled fire monitors. All above ten Tugs have class notation as Harbour Tugs and are certified to work within						

the Harbour limits only.

2. Reception Facility: 12" pipe line, connected to a slop tank at chemical tank farm.

Dolphin 11 has firefighting system of 1200 m3/hr along with 20 ton lifting "A" frame and diving support facility.

Location of Oil Spill Equipment: The Oil Spill Equipment stored in SPM Store.

RESOURCES/EQUIPMENTS WITH AVAILABLE APSEZL, MUNDRA

ITEM	Available in the present
Inflatable Booms with accessories (Material: Neoprene/rubber/neoprene rubber)	2000
Fence Boom (Material: Neoprene/rubber/neoprene rubber/PU/PV)	235 m
Skimmer (20 TPH 50% weir type, 50% Brush type)	(2+2)
OSD Applicator with Spray arms type along with 02 Nozzles system and 02 hand lancers (No)	4
Oil Spill Dispersant (chemical dispersant) (litres)	5000
Bio remediation (litres)	0
Flex barge 10 Tons (no)	2
Weir boom 100 m with minimum 02 weirs with power pack and accessories (nos) Or Integrated containment cum recovery system with power pack and accessories	4
Sorbent boom size min 5-inch dia, min length 5 feet (no)	500
Sorbent pads min 20-inch X 20 inch (no)	2000
Shoreline cleanup equipment – Mini vacuum pumps capacity 25 m^3	2
200 m shoreline sealing boom with power pack and accessories (material: neoprene/rubber/neoprene rubber) (nos)	3
VOC Portable Monitor	0
Level A protection:	5
Level B protection	10
Level C protection	20
Level D protection	30
Work Boats	4
Tugs	4
IMO Level 1	20
IMO Level 2	18
IMO Level 3	7

Facilities in the marine control room

1. Tidal stream guage: this can accurately read the prevalent rate of flow and direction of current.
2. Tide guage: for accurately calculating the height of tide at any given time.
3. Wind guage: for direction and speed of wind
4. VHF sets (fixed and portable) with complete range of marine frequencies to be used for field operations.

In the event of an ongoing spill or a spill that requires declaring of Tier 2 or 3 responses, the additional equipment and manpower held with any other OSRO or facility will be sourced in an accelerating manner including resourcing from the National / international spill handling companies. Contact details of companies holding equipment in India and International OSROs are listed below.

LIST OF ADDITIONAL RESOURCES AND INTERNATIONAL OSROs

1. Australian Marine Oil Spill Centre

PO Box 305
Victoria 3214
Australia
Tel + 61 3 5272 1555 Fax + 61 3 5272 1839
Mail: amose@amosc.com.au
Web: http://www.aip.com.au

2. Fast Oil Spill Team

C/o PIM 40 G 23 Tour Elf

92078 Paris- La Defense Cedex France
Tel: + 33 1 4744 5636 Fax : + 33 1 4744 2677
Mail : giefost@club-internet.fr

3. Oil Spill Response Ltd

Oil Spill Services Centre
Lower William Street Northam
Southampton SOI 1 QE, UK
Tel: + 44 1703 331 551 Fax: + 44 1703 331 972
Mail: osrl@osrl.co.uk
Web: http://www.oilsillresponse.com

4. Petroleum association of Japan

Oil Spill response Department
Keidanren Building
9-4, 1 – Chome, Ohtemachi
Chiyoda- Ku,
Tokyo 100, Japan
Tel: + 81 3 3279 3819 Fax: + 81 3 3242 5688

Mail: mail@pcs.gr.ip

Web : http://www.pcs.gr.ip

3.5 Inspection, maintenances, and Testing

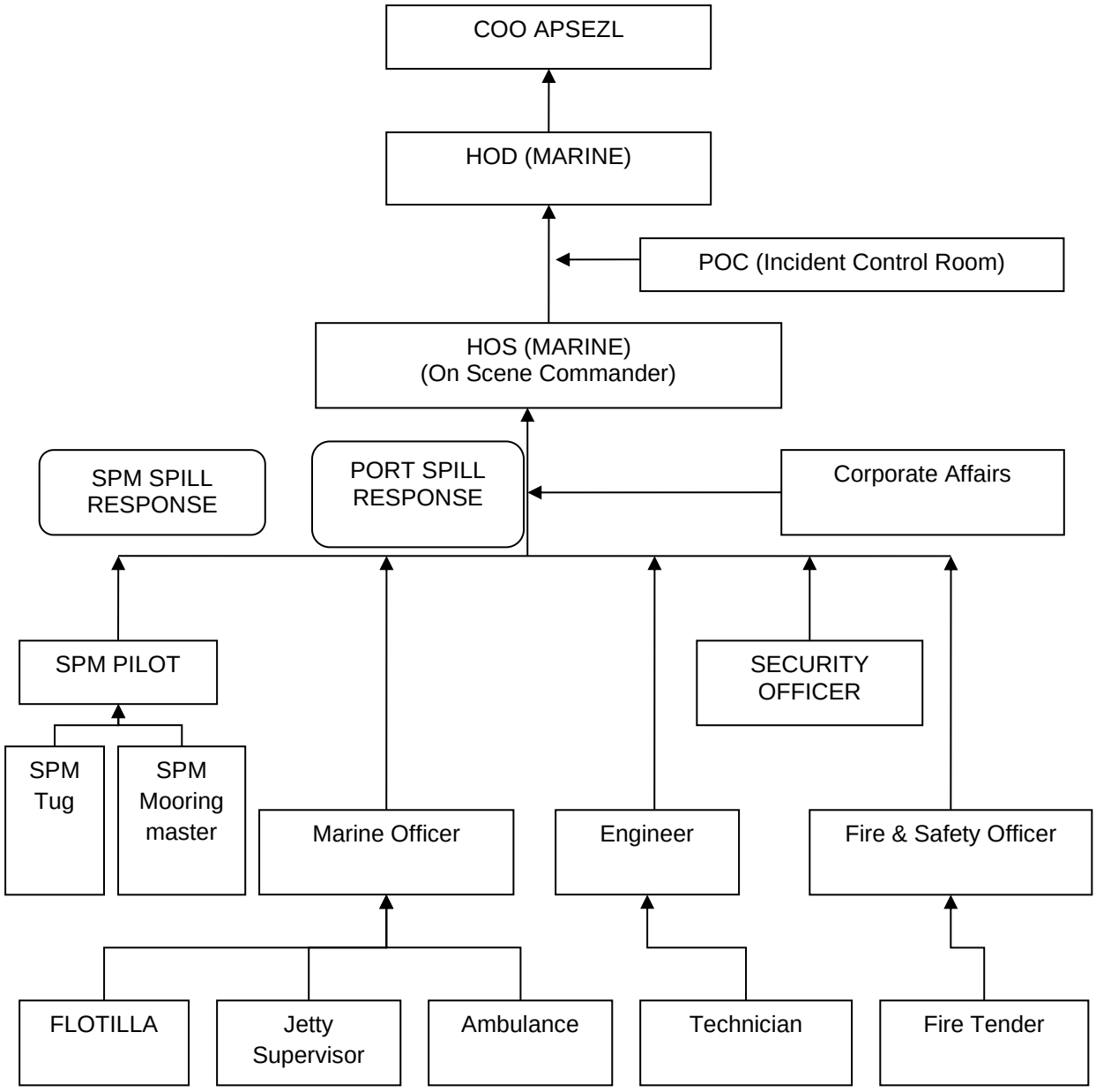
The oil spill response equipment will be maintained in highest state of operational readiness. This is achieved through a planned maintenance, inspection and testing program. A record of inspection, maintenance and test will be maintained.

The response team will be responsible for regular testing and mock drills. All personal assigned with the task of operation of this equipment are adequately trained and their level of competency will be maintained by conducting regular exercises.

Hands on training to personnel will be given by actually deploying the equipment and checking their effectiveness. Similarly, crew of support vessels will also be kept trained by regular, periodic training and exercises.

4. OIL SPILL MANAGEMENT

Management of the oil spill response operations will be undertaken by a Spill Management Team involving personnel and having various levels of responsibilities in their exiting operational areas. The Organization Chart for Oil Spill Response is giving below.



4.1 Crisis Management Team (CMT) / Chief Operating Officer (COO)

CMT is the primary unit for incident management and is composed of senior manager from various departments for providing advice and resources and take on the spot decision to meet any immediate requirements arising during the response operation.

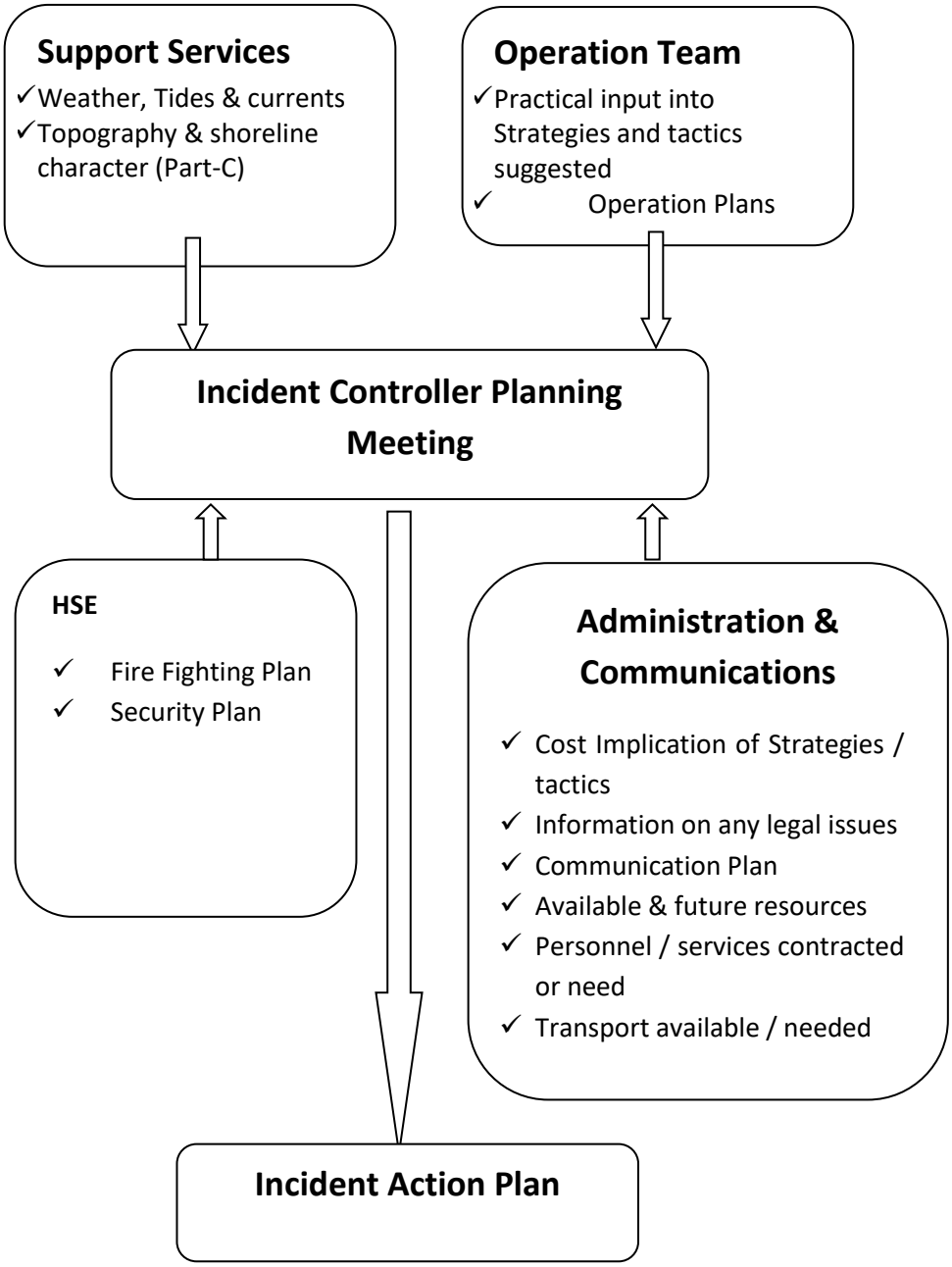
The major functions that would need to be carried out by CMT to discharge the Plan are as per table 4.1

Table.4.1: Major functions of Crises Management Team

Field operations	✓ Initiation, Control of Operations and response activity
	✓ Emergency Control room functions
	✓ Implementing tired response and disposal
	✓ Shoreline cleaning (when initiated through this CP)
	✓ Planning and strategy
Admin and logistics	✓ Victuals
	✓ Transport
	✓ Additional manpower and equipment
	✓ Security
Technical matters	✓ Cargo ops, availability of response items, repairs
Liaison	✓ Communication- operational and with other
	✓ Government / non govt. authorities, Media
Legal	✓ Documentation of damages, claims and
	✓ compensation, notifications
Health and safety	✓ Medical assistance

4.2 Incident Organization Chart

CMT is the primary unit for incident management and is composed of senior manager from various departments for providing advice and resources and take on the spot decision to meet any immediate requirements arising during the responses. Organizational chart as follows



4.3 Financial Authorities

The financial Authorities of APSEZL, Mundra is as per the existing organization structure. At the time of the crises, the need of the hour will be understood and requirements of OSC / ERT will be met at a faster rate than normal. Since all head of Department (HODs / HOS marine) would be available, immediate on the spot approval will be accorded.

4.4 Functional Designations

Following functional designations stand identified and notified through the Plan, to give effect to this Plan:

i. Chief Operating Officer APSEZL Mundra
ii. Incident Control Officer (HOS – Marine / Duty Port Captain)
iii. Site Emergency Coordinator (Senior Pilot and Radio Officer)
iv. Fire Coordinator (HOS – Fire / HOS -Safety)
v. HOS – Security / Duty Security officer
vi. Medical Superintendent
vii. Marine Pollution Coordinator – Manager (Marine /Pollution Control)
viii. Traffic Coordinator - Duty Port Captain
ix. Communications Officer (Duty Port Captain / Duty Radio Officer)
x. Chief Emergency Controller (Head -HSE)
xi. Civil Coordinator (HOS – Environment Cell / HOS Estate)
xii. Marine Engineering Coordinator (HOS – SPM / Diving Team in-Charge)
xiii. HOD – Corporate Affairs
xiv. HOS-Legal & HOD Estate

4.5 Manpower availability (on-site, on-call)

As per the policy of port, the marine department would be providing required man power for all the OSR activities. However, various departments providing assistance of water craft, vehicles, cranes etc. for movement of men and material: would provide necessary manpower and their departments, as required, so as to continue the OSR operations uninterrupted.

4.5.1 A float Operations and Response Team/ Teams

In an emergency, the personnel available at or near the incident site play vital role. This concept is made use of in nominating the key persons. It is necessary to nominate a functionary as the Incident Controller who is invariably a shift-in-charge of the facility. The Incident Controller tackling the emergency in real times requires the support from various other services i.e., Fire & Safety, Medical Services covering communication, transport and personal functions etc. A key person for each of these services therefore, should be nominated.

Overall, in charge of these activities is Chief Operating Officer – Mundra Port. The different functional coordinators, designated, will co-ordinate with Chief Controller in their respective functional areas. It is suggested that key personal chart be developed, giving the names, designation, telephone nos. of top-level personnel who will act as coordinators in different disciplines/services. The duties and the responsibilities of various Key Persons and Coordinators

need to be written down on a chart and should be made available across the organization at the site / location.

Roles & Responsibilities of key persons

Incident Control Officer – (HOS – Marine / Duty Port Captain)

- Directs and co-ordinates all field operations at the scene of the accident
- Assess incident/crisis at site, nature, location, severity, casualties, resource requirement
- Classifies incident - Advises Exe. Controller, Civil Defense, Dy. Conservator, Traffic Manager - regarding crisis severity status and emergency level, wind direction, temperature, casualties and resource requirements.
- Conducts initial briefing to Chairman
- Activates elements of the terminal emergency plan/ site response actions
- Protect port personnel and the public
- Directs security/firefighting/oil spillage/gas leakage/vessel accidents/natural calamities, cargo operations shutdown
- Search for casualties and arrange first aid and hospitalization
- Brief or designate a person to brief, personnel at the incident scene
- Determine information needs and inform Crisis Management Group
- Coordinates all functional heads in field operations group to take action
- Manages incident operations to mitigate for re-entry and recovery
- Coordinate search and rescue operations
- Arrange evacuation of non-essential workers to assembly points –outside port
- Arranges tugs, mooring boats and pilot(s) for sailing vessel(s)
- Co-ordinates actions, requests for additional resources and periodic tactical and logistical briefings with Site Emergency Coordinator
- Coordinate incident termination and cleanup activities
- Instructs various emergency squads as necessary

Site Emergency Coordinator – (Senior Pilot and Radio Officer)

- Direct operations from the emergency control center with assistance from Crisis Management Group
- Take over central responsibility from the Site incident controller (SIC)
- Decide level of crisis and whether to activate off site emergency plan
- Instruct SIC to sound appropriate alarm
- Direct the shutting down, evacuation and other operations at the port
- Monitor onsite and off-site personal protection, safety and accountability

- Monitor that causalities if any are given medical aid and relatives informed
- Exercise direct operational control of the works outside the affected works
- Monitor control of traffic movements within the port
- Coordinate with the senior operating staff of the fire, police and statutory authorities
- Issue authorized statements to the news media
- Review and assess possible developments to determine the most probable course of events
- Authorize the termination of the emergency situation by sounding the all-clear siren-continuous long single tone siren for one minute
- Control rehabilitation of affected areas after emergency
- Arrange for a log of the emergency

Fire Coordinator – (HOS - Fire / HOS -Safety)

- (Under the direction of the Incident Control Officer)
- Announces fire incident point over the public address system and evacuates workers to the assembly points
- Informs fire station immediately and leads firefighting team to the incident location
- Informs SIC if external fire tender / fire-fighting equipment / materials/mutual aid is required
- If necessary, arranges and activates other fire-fighting equipment
- Arranges safety equipment e.g., fire suits, protective gloves and goggles, breathing apparatus
- In liaison with Civil Engineering Department, ensures that adequate water pressure is maintained in the fire hydrant system/at the area supply
- Maintains adequate records

HOS - Security / Duty Security Officer

- Directs, gate security and facilitates evacuation, transport, first aid, rescue
- Controls the entry of unauthorized persons and vehicles-disperses crowd
- Permits the entry of authorized personnel and outside agencies for rescues operations without delay. Liaises with State police
- Allows the entry of emergency vehicles such as ambulances without hindrances
- Ensures that residents within port area are notified about disaster and instructs to evacuate if necessary
- Ensure that all people are aware of the assembly points, where the transportation vehicles are available
- Ensure that the people are as per the head count available with the assembly point section of that area

- Liaise with the Chief Medical Officer to ensure first aid is available at the assembly points
- Carry out a reconnaissance of the evacuated area before declaring the same as evacuated and report to SIC.

Medical Superintendent

- Direct medical team
- Set up casualty collection center arrange first aid posts
- Arrange for adequate medicine, antidotes, oxygen, stretchers etc.
- Contact and cooperate with local hospitals and ensure that the most likely injuries can be adequately treated at these facilities e.g., burns
- Advise Chief Emergency Controller on industrial hygiene and make sure that the facility personnel are not exposed to unacceptable levels of toxic compounds
- Make arrangements for transporting and treating the injured
- Inform the hospitals of the situation in case of a toxic release and appraise them of the antidotes necessary for the treatment
- Maintain a list of blood groups of each employee with special reference to rare blood groups
- Liaise with Govt. Hospitals/Red Cross

Marine Pollution Coordinator – Manager (Marine / pollution control)

- Minimizes the impact of an accident on the environment for which it would develop methodologies to control hazardous spills
- Monitors cooperation with emergency response squads to conduct the actual cleanup work during and after the emergency.
- In case of fire and specially if the fire involves toxic/flammable materials, to ensure responsible actions for containing the run off fire water and other water from the damaged units
- Determines the level of contamination of the site as a result of the accident
- During cyclones/floods arranges sand bags and transfers important plans and documents to higher levels

Traffic Coordinator – Duty Port Captain

- Directs operation staff
- Prepares vessels to vacate from berth
- Arranges to protect cargo in vicinity from damage
- Arranges to segregate and shift cargo in sheds
- Submits consolidated list of dangerous goods in port including tankers in port and tank farms in port area

- Coordinates with ship owners / agents/C & F agents/stevedores

Communications Officer – (Duty Port Captain / Duty Radio Officer)

- Ensure telephone operator/signal room advises entire emergency team
- On receipt of instructions from the chief Incident controller, notifies the fire brigade/police/hospitals/district collector/mutual aid partners
- Keep the switchboard open for emergency calls and transmit the same to the concerned personnel effectively
- Refrain from exchanging any information with authorized persons unless authorized to do so by the Chief Incident Controller
- Maintains contact with other vessels through VTMS

Chief Emergency Controller – (Head - HSE)

- Inform district emergency authorities-District Collector, Medical Officer-Coast Guard Pollution control -Inspector of factories-Inspector of Dock Safety & Health,
- Activate the off-site plan if necessary
- Liaise with Jt. Secy./Director MOST (Ministry of Shipping) or relevant Govt. authority
- Inform the media

Civil Coordinator – (HOS – Environment cell / HOS - Estate)

- Inform Gujarat Pollution Control Board and other environmental agencies about the incident for getting necessary guidance
- Instruct the contractors to carry out urgent civil works if required
- Hire the barges for collecting the spilled oil, if required

Marine Engineering Coordinator – (HOS – SPM / Diving Team in-charge)

- Organize the tugs for combating the pollution
- Start the rigging of pollution combating equipment on tugs/launches
- Hire additional crafts if required

HOD- Corporate affairs:

- Collect detailed information periodically and liaise with press about the incident
- Arrange transport facilities, if required
- Inform local authorities/District Collector about the incident (as per EAP)

HOS - Legal & HOD - Estate:

- Issue notice under Major Port Trusts Act, Indian Ports Act(Prevention & Control of Pollution) Rules, etc.; to the defaulting master/owner/agent
- Arrange for settlement of claims related to the pollution (as per EAP)

The functions of response team can be assigned to an identified and qualified OSRO also. In such an event of nomination, all functions with respect to response team and On Scene Co-coordinator will be carried out by the OSRO or OSRO representative, while, CMT and CIC will continue to function hitherto.

Response resources like equipment to be deployed having been identified in terms of quantity and location, additional resources like Spill Response Vessel (SRV) and work boat etc. along with responders would be as per identification and notification by CMT leader. In the event of an OSRO being assigned the responsibility to provide resources, OSRO will have to mobilize the different units.

4.6 Availability of additional manpower

The response team is to comprise of a Manager, Specialists, responders, response workers apart from the crew of the vessel or work boat assigned to response duties. The team and additional resource composition are

(i) Incident Manager / OSRO Manager
(ii) OSC- Incident Controller/On Scene Coordinator
(iii) SR Vessel and Captain
(v) Responders
(v) Vessel crew
(vi) Work boat, master and crew

Additional responders or additional teams could be assembled during response ops as the requirement demands.

4.7 Advisors and experts – Spill Response, Wildlife, and Marine Environment:

Advices as felt necessary is to be sought from the commanding officer, ICG, Jamnagar, who look after such affairs related to oil spill response of Gujarat State Commander Coast Guard Region, Jamnagar may be approached in case, any need arises or as directed by CO, ICG.

Advice on wild life and marine environment is provided Ministry Environment and Forest and Gujarat State Government Department

In case, it is felt that private consultant / advisor opinion is required, Clean Sea Enterprise at Mumbai may be contacted in consultation with the component authority

4.8 Training / Safety schedules and drill / exercise programmed

4.8.1 Training:

APSEZL, Mundra personnel, who have a role / responsibility for oil spill response and emergency management, shall undergo training appropriate to their role / responsibilities.

APSEZL, Mundra will ensure that their emergency response personnel, who are required to operate oil spill equipment, undergo training for effective deployment of equipment and devices.

Masters of Tugs and APSEZL, Mundra Vessels are to ensure that their crews are fully trained in department of equipment and devices held on board.

4.8.2 Drill / exercise program

The purpose of exercises and drills is to test the knowledge of persons and members associated with response activity and maintain them in the highest state of readiness and professional competence. The exercises would aim to assess acquaintance of response teams with operation ability and initiation of Plan and also the knowledge of operational parameters.

For this purpose, it is required to conduct both in house training and evaluation exercises and also multi agency co-ordination exercises.

In addition to classroom training, the responders would need to go through regular internal and external exercises that would include deployment of equipment to demonstrate level of proficiency. With respect to management of operations in consonance with the plan, it is desirable to conduct real time CP exercises with all industrial stack holders involved. Such an exercise conducted at a large magnitude would need to incorporate the staff from APSEZL, Mundra Participating Companies and the Indian Coast Guard and scheduled as mutually agreed.
The purpose of exercises and drills would be to check the following:

1. **Organizational and Planning**

   a. Knowledge of Contingency Plan and Procedures
   b. Personnel Notifications and Staff Mobilization
   c. Ability to operate as per CP and Operations Manual

2. **Operational Response**

   a. Oil spill assessment
   b. Response equipment selection
   c. Containment strategies
   d. Spilled oil recovery techniques
   e. Disposal of recovered oily water and contaminated material

3. **Response Support**

   a. Communications
   b. Logistics
   c. Personnel support
   d. Documentation

Types of exercise

Exercise requirement as per contract is to conduct internal and external exercise. In addition to classroom training exercise are include deployment of equipment to demonstrate satisfactory of proficiency. External exercises are to incorporate with the staff from APSEZL, Mundra, participating companies and the Indian Coast Guard.

Type: A: Internal exercises lasting approx. one day for ensuring OSR readiness of all equipment, services and personnel.

Type B: Emergency response exercise (Tier-1) is to be conducted twice in a year

Type C: This exercise designed to test either specific scenarios or emergency plans includes external participation (i.e. mutual aid, govt. agencies)

5. COMMUNICATION AND CONTROL

5.1 Incident Control Room and Facilities

The core operational team discharging the functions of incident control, administration and management is designated as Crisis Management Team/s (CMT) operating from the identified persons unless the magnitude of operations dictates manning of any particular operation by one operator only. (As far as practicable, both functions should be located at same site.)

Any person who observes a spill or gets an information of a spill or observes a situation that could lead a potential spill, may pass the available information with maximum possible details to any one control centre located in the Port Administrative building.

In the event, the response activity is assigned by the APSEZL to an OSRO, the OSRO will appoint a manager in addition to incident manager to undertake the responsibility of meeting the demands of response teams.

A permanent location is to be designated as Communication and Ops Centre (COC) by the authority responsible for execution of this plan. Both functions are to be manned by different of – port control, control and operations Room, Harbour master, by fastest means available (All incidents of soil whatever magnitude are to be reported to HM by Port Control Room or COC)

Contact Details

Port Control (MMPT Marine Control)	Landline- APSEZL, Mundra	02838-255739
	VHF – APSEZL, Mundra	VHF Channel -77 & 16
COC (MMPT Marine Control)	Landline No	02838-255739
	Mobile	98252 28673
	VHF	VHF Channel -77 & 16
Harbour Master / CIC	Landline – APSEZL, Mundra	02838-277727
	Mobile	6359883102

5.2 Field Communication Equipment

An effective inter-facility communication system among various departments/ agencies will be maintained with Operators. Communication will be established during the port operation in Mumbai and with the operators.

5.2.1 Equipment

The communication centre is to be provided the following equipment

- VHF - 4 Nos.
- Walkie talkies – as per the number of response teams and functional team leaders
- Telephone (Landline or wireless) – 2 Nos,
- Computer and printer with internet and projector facility

5.2.2 Publications

- Copy of CP and appendixes
- Details of CMT, OSRO organization and their contact details
- Charts of Mundra harbor, Tide Table
- Large scale charts showing layout of POL and cargo berths
- GA plan of a typical oil tanker
- Location map of jetties, berthing and landing facilities available in Mumbai estuary along with facilities available
- Telephone contact directory of all emergency aid and medical services, port offices and local administration authority
- OSRP of APSEZL, Mundra and HMEL

5.3 Reports, Manuals, Charts and Incident Logs

The log incident Report from (as per sample below) has been developed to ensure that the basic information required to formulate a response to an Oil Spill Emergency is obtained during the notification (if required). Port Control / Harbour Master / Communication and Ops Centre will complete the form and dispatch to the concerned authorities by the fastest means. In all cases, the original status report forms will be handed over to ECT, who in turn would maintain the fastest means. In all cases, the original status report forms will be handed over to ECT, who in turn, would maintain record of all such documents.

The personal Log forms and the Continuation Sheets are to be used during the emergency response to record the contacts and actions carried out during the emergency. After "stand-down" the Personal Log Form and the Continuation Sheets, are numbered, signed and handed over to the Harbour Master. All incident logs and records will be maintained.

INCIDENT LOG

INCIDENENT INFORMATION

INCIDENT TITLE (Name of Vessel) ----------

Incident Number (Sq number/ dd /mm/ yyyy)----------

1.DETAILS

Time of recording ……..… (24 hr format) Date ……..

Day……

Person / Organization reporting incident

Name …….. Designation …….

Contact number ……

2. INCIDENT

Name of VESSEL …… Location ……..……

Position (if not alongside) Latitude ……

Longitude ……..……

Sounding……..…..

Incident details

Time ……. (Of incident, 24 hrs format) Date ……..

Cause of spill

Type of oil

Estimated quantity of spill

Details of damage to vessel / installation

3. COMMENTS

1. Recorded by

Name ----------

Time ----------

Note: FOUR COPIES OF INFORMATION ARE TO BE RECORDED. RETAINING ONE FOR OFFICE RECORD, THREE COPIES ARE TO BE CIRCULATED ONE EACH TO CHIEF INCIDENT CONTROLER OSC / RESPONDER/ INCIDENT CONTROLER VESSEL MASTER

The personal log form (and continuation sheets) has been developed to allow all personnel involved on the emergency response to maintain a personal log of event. The personal log forms and the continuation sheets are to be used during the oil spill response to record the contacts and activities carried out during such emergency.

Incident Logs are must for logging of all the events taking place. This will help in preparation a comprehensive incident report on a day-to-day basis as well as on completion of operation.

After the repose work is over, the personnel log form (as per sample below) and the continuation sheet are to be numbered, signed and handed over to the Deputy Conservator.

PERSONAL LOG (ALL MEMBSERS OF SPILL RESPONSE ORGANISATION)

Incident Title ----------Number---------- ----(as per)

_____

Date ----------

Name ----------Designation (as per C P) ----------

Time of Rx / Forwarding Info Activity requested by/ demanded of another Member/s Observations on days operations

Note – Copy of Personal Log is to be handed over to COC daily or as earliest as possible on completion of a schedule

6. INITIAL PROCEDURES

Oil spill being one of the emergencies in the potential list of emergencies in the port operations, the initial activation of emergency plans commences from the site level irrespective of the magnitude of the event. Since not all the emergencies lead to oil spills, the activation of emergency response is oriented towards the required technical and operational mitigation APSEZL, Mundra Emergency Response Plans at the site, project and port level (Tier-1) takes precedence to the oil spill response plans in the initial events.

The initial actions that will be taken by APSEZL, Mundra in the event of an oil spill will comprise of following procedures, as detailed subsequently:

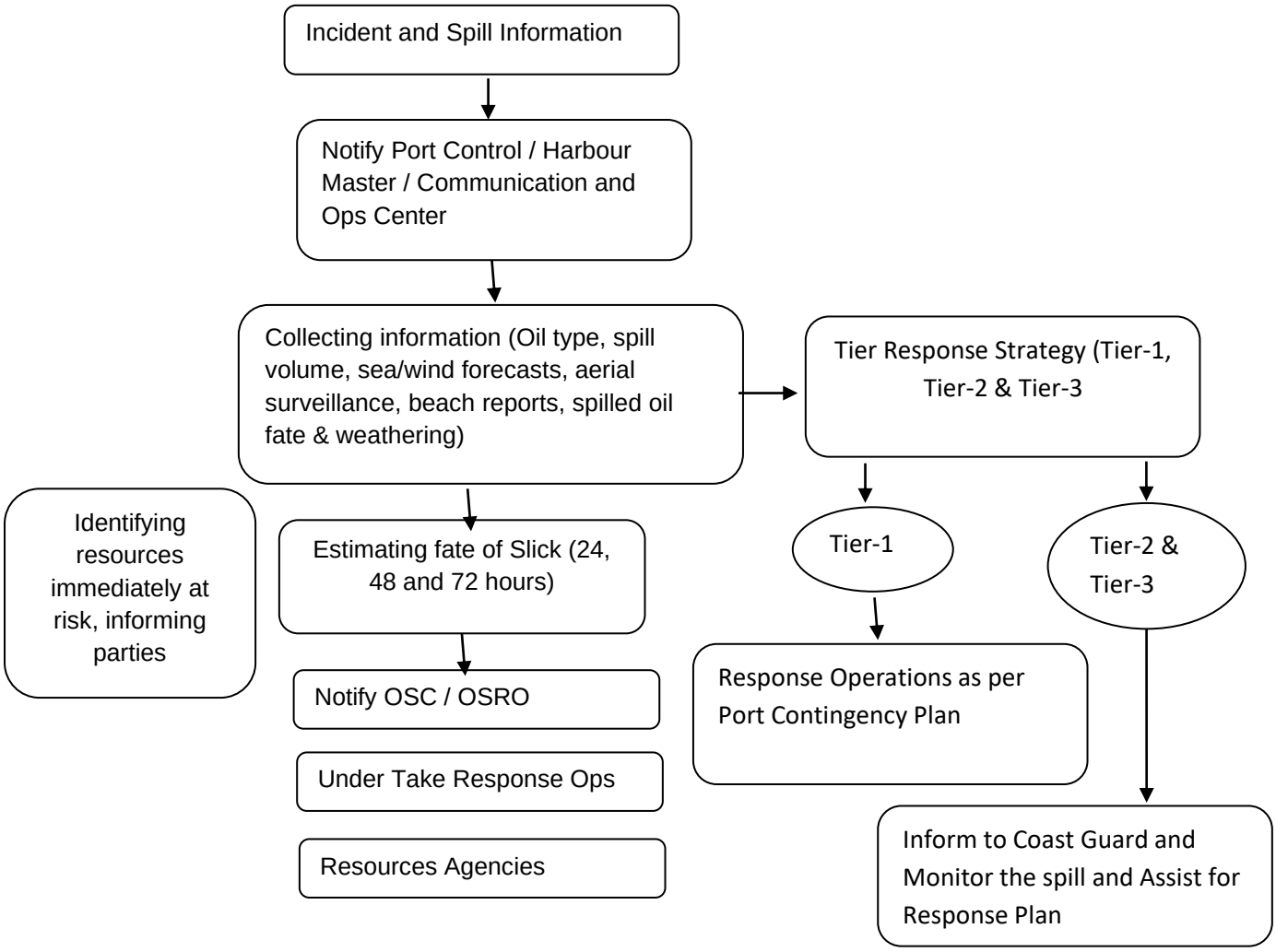


Fig.6.1 Flow chart for Incident and information

6.1 Notification of oil spill to Concerned Authorities

A trigger to activate emergency response can be done by any individual either working in Port Administrative roles or in contractual arrangements based on his initial observations or inferred potential threats in the process or hazards involved in operations. The escalation of emergency from the observer to the Port Control / Harbour master must be fast and unhindered. Following communication channels shall be used by the individuals at the work site to communicate emergency:

- **Shout about the event** – viz., leak, spill, fire, gas release, collapse, fall, etc. depending on the event so as to catch the attention of others in the vicinity.
- **Hand signals:** When there is no other means of communication, hand signals shall be used to convey the above events.
- **Walkie-talkies and other marine communications:** when the individuals have proper communication facilities viz. walkie talkie, VHF or mobile phones, the details of the incident shall be communicated to Port Control / Harbour master.

Once the nature, source & quantity of oil spill is assessed then the following procedure to be followed for notifying the oil spill

1) In the event of an oil spill, the spill observer will alert and notify the Port authorities of the spill. The spill will be reported to the Port Control / Harbour master. Preliminary information on the location of the spill, spill size, oil type, release rates and any injuries will be provided to the Port Control / Harbour master (**Appendix – 5 Prescribed Formats**). The Port Control / Harbour master will thereafter notify the Agent / response Agencies. In case the Port Control / Harbour master is activated, the Crisis Management Team Leader will be notified.
2) A preliminary estimate of the response Tier will be undertaken by the OSC. The OSC will allocate appropriate Tier level using guidelines given in earlier sections. *ECT* will be activated for Tier-1 spills while EMT will be activated for Tier 2/3 spills.
3) The spill event will also be reported to the APSEZL, Mundra Authority, Indian Coast Guard and other relevant authorities by the CMT Leader, in the prescribed formats. The CMT Leader and OSC will also have the responsibility to manage and mobilize external resources. If required, the CMT Leader will liaise with ECT for information and support requests.
4) The OSC will also need to collect information on the oil type and sea/ wind forecasts of the region which will assist in handling the spill. Aerial surveillance will be initiated if required to assess the extent of the spill and record the size and location of the slick. The response team deployed onshore in case of spill reaches the shore will also be instrumental in generating reports

5) The fate and movement of the slick will be estimated as part of the initial response actions. Assessment of oil slick trajectory will be undertaken as per the following:
   a. Obtain information on tides, direction / speed of current and wind.
   b. Using the information on current and wind, predict the trajectory and speed of the spill movement.
   c. Draw the slick on a chart (map) with co-ordinates, showing position and predicted the movement of the oil
   d. Record observations on form provided in **Appendix - log Book Format**.
6) The colour of the oil on water will indicate its thickness. The volume of oil will be calculated based on the area and colour of oil visible from the aerial observation.
7) Once the size and movement of the spill are known, it is possible for the Incident Controller to assess the potential danger to people and nearby installations, and if necessary, to set safety exclusion zones. The predicted movement of the slick is also important for guiding responders to the right locations for clean-up. The Incident Controller must also gather additional key information about the incident from the On-Scene Commander.

6.1.1 Reporting of oil spill incident

In case of reporting of oil spill incidents, the following information is to be provided by the incident observer.

- Location of the spill
- Likely source of the spill
- Area impacted at the time of observation
- General observation of movement of slicks (based on winds and currents)

Upon receipt of such first information report, the same should be forwarded to the CMT leader through the fastest means of communication through the channels defined above. The person intimating about the incident (including near miss) shall not be made responsible for any actions relevant to spill response unless he is a member of the team relevant to the response. Prompt intimation of such incidents and near misses shall be encouraged by Mundra Port as a part of incident reporting and management system. Concerned authorities will be intimated according to the statutory requirements.

6.2 Preliminary Estimate of Response Tier

6.2.1 Preliminary Assessment of the Incident

The OSC along will make a preliminary assessment of the incident by contacting the person reporting the spill. If needed, the OSC may take assistance/ guidance from ICG Coordinator and other Government Agency. The following will be the broad objectives:

- Evaluating the magnitude and impact of the discharge or threat of discharge on the public health, welfare, and the environment
- Determining in which jurisdiction the incident occurred
- Determining or confirming the responsible party
- Determining or confirming the source of the spill
- Assessing the need for state assistance; and
- Assessing the feasibility of removal and determining the equipment needed to remove the oil.

6.2.2 Containment and Control

Clean-up actions must begin as soon as possible to minimize the effect on natural and other resources. These actions shall include locating the source of the discharge and preventing any further spillage, placement of containment boom to control the spread of oil and to protect sensitive areas, measuring and sampling, physical removal of the oil from water and land, the use of chemicals to herd or disperse the oil, and in-situ burning. The official coordinating response to the spill must address many questions, including:

- How large an area will the spill cover?
- How thick will the slick be?
- How fast and in what direction will the slick drift?
- When and where will the oil hit the shoreline?
- What will happen to the oil if it is not removed?
- What is the value and sensitivity of the resources at risk?
- The answers to these questions will determine what response actions are taken.

6.3 Notifying Key Team Members and Authorities

The port authorities such as, HOD-Marine, Fire Officer and other HODs will be informed over phone /Mobile phone, and same be also logged at ECR. Upon confirmation of the incident with Authority reporting spill, inform to CMG and initiate notifications to the CG for all larger spills of more than 700 tons and intimation to international experts for response reediness.

6.4 Manning Control Room – MMPT Marine Control

The Emergency Control Room (ECR) would function with the members of Emergency Control Team (ECT) and they will consist of following:

- HOD-Marine Services
- HOS-Marine Services

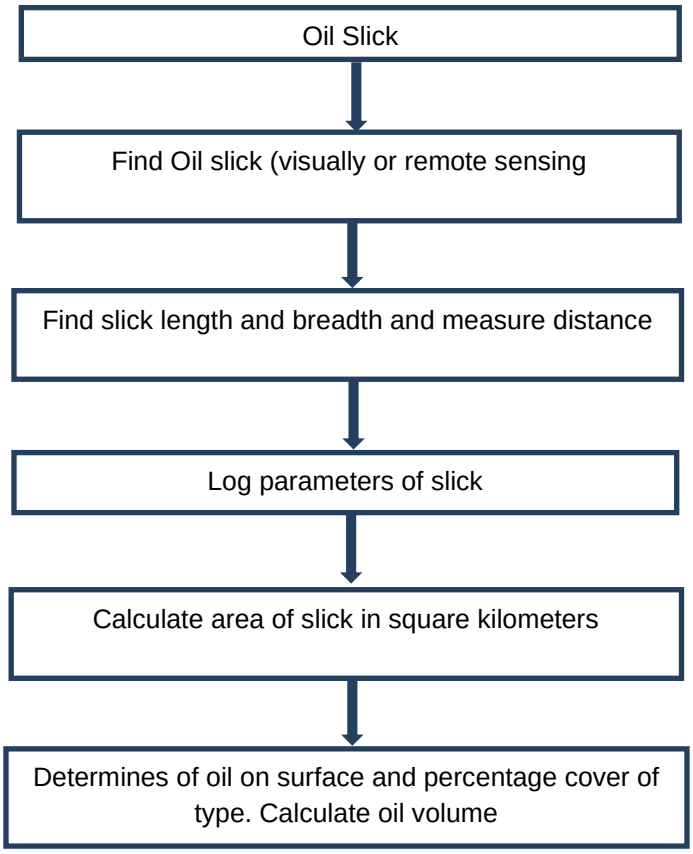
- SPM In-Charge
- Duty Port Captain
- Security In-charge
- Radio Officer

6.5 Collecting Information (oil type, sea/ wind forecasts, aerial surveillance, beach reports)

In case of oil spill reported, intimate to various department of Port Organization. The department will notify the following information to OSRO / Agencies

i. Marine department will provide all the relevant data i.e., Tide conditions at that time, Tide timings, Current, Wind direction / speed, Weather forecast for 3 days next to that day to ECR. The Vessel movements, Vessel position in harbour, Water crafts availability for pollution response activities. Relevant Navigation Charts and any other important data / information available may also be provided to ECR. Also, number of Security personnel available at that time will be made available.
ii. Security department to provide information regarding availability of type and number of vehicles available for transportation of men and equipment's. Also, number of Casual labors available at that time will be made available.
iii. Fire department to indicate readiness about FIRE CONTINGENCY including OILFIRE and also number of spare Life Jackets available.
iv. ECT is ensure that no individual working/supervising/observing OSR operations/Exercise without life jackets "ON"
v. OSC is to collect following information immediately in case of oil spill

Surveillance and tracking of oil at sea immediately after the spill, carry out the surveillance for assessing the quantity and of spilled oil:



The OSC is to collect the following information immediately in case of oil spill, with the help of Master of the vessel/aircraft.

- Time spill occurred
- Position in Latitude/ Longitude and also with reference to any prominent land mark
- Visual appearance, apparent thickness of oil and extent of area covered
- Percentage cover of various thickness of oil
- Existing weather condition and weather forecast
- Current, tide and wind conditions;
- Immediate availability of support vessels, equipment and man power specifying time factor as well
- Estimate oil spill trajectory and likely area and time of its landfall;
- Volume of each oil type.
- General comments on oil appearance (shape, direction of movement).
- General comments on weather.
- Appearance of oil at sea.

Code	Colour	Oil Type	Thickness	Volume/km²
1	Silvery	Sheen	0.0001mm	0.1m³
2	Iridescent	Sheen	0.0003mm	0.3m³
3	Black/dark brown	Crude/Fuel Oil	0.1mm	100m³
4	Brown/Orange	Emulsion	1mm	1000m³

Movement of oil on the sea surface: Oil will move at 100% of the current speed and approximately 3% of the wind speed.

6.6 Estimating fate of Oil Slick (24, 48 and 72hours)

While predicting the movement of the oil spill, state of tide and currents along with prevailing wind must be taken in to account. Schematic diagram of weathering process with time and typical fraction of Crude Oil is shown the following figure.

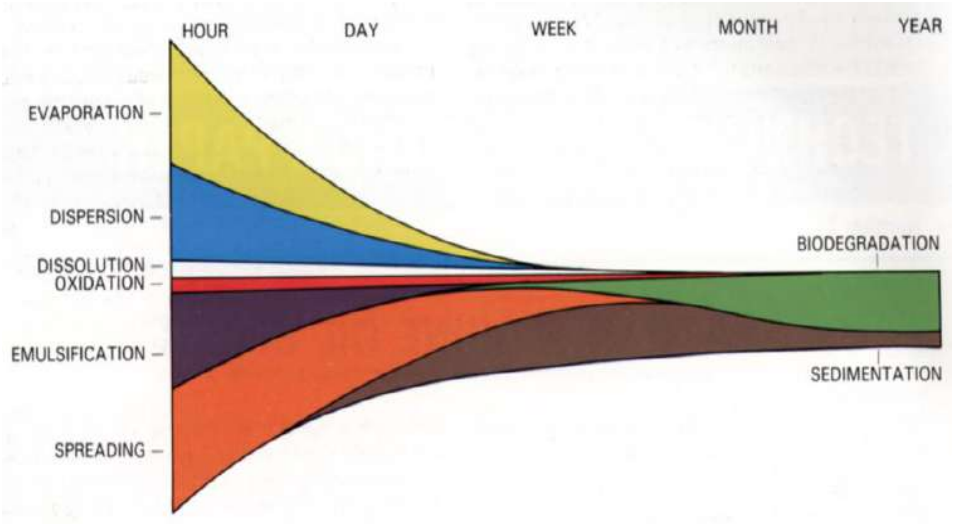


Fig.6.2: Schematic diagram of weathering process with time and typical fraction of Crude Oil

6.7 Identifying Resources Immediately at Risk, Informing Parties

The resources immediately at risk can be mangroves adjacent to the Port area, nearby Port Area. Depending upon the place of spill, the resources at risk will be found out.

Based on initial observations & assessment of oil spill and inputs from oil spill modelling studies, the resources at risk is to be identified by OSC. Relevant stakeholders/ parties to be informed to take appropriate action.

Continuous watch on working frequencies used by ships, port and terminal for POL cargo ops

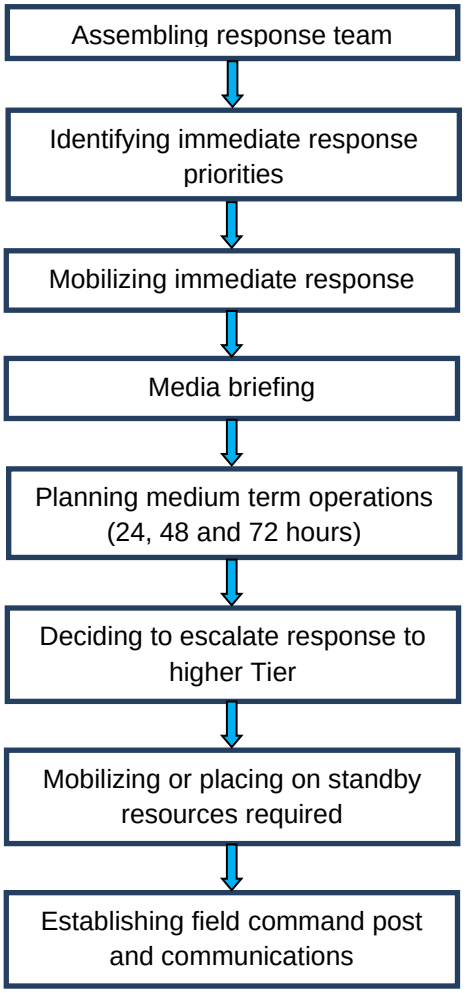
- Watch on Ch 16 at all times
- Log all information on in respect of an oil spill (with maximum details) received through keeping watch or from any other source
- In case of first receipt of information, pass all the details regarding spill to CMT leader to facilitate complete or partial activation of team or response actions by OSRO
- Pass all information regarding spill to OSRO and duty vessel or Tug assigned response duties
- Remain in constant touch with designated response team leader and response/support vessels as per working channel decided for operations
- Collect weather information on from MET dept on weather conditions in the area including wind direction & speed, tide condition and other weather parameters (all received information is to be logged)
- Provide weather data to operational teams as demanded

6.7.1 Oil Spill Modeling Studies

The fate weathering characteristics of spilled oil is predicted for various hydrological, Meteorological and oceanographical conditions. The details of computational various sceneries are presented in detail (Report-Part-B)

7. OPERATION PLANNING

The response operations planning will follow the initial response actions. The procedures to be adopted have been discussed below:



1) After assessing the Tier of response based on the size, type and fate of spill, the CMT will initiate the response operations. The immediate response priorities will be identified and immediate response options will be mobilized. The response priorities for APSEZL, Mundra will be in the following order:

People residing in fishing villages and other establishments along the coastline and personnel on board the vessels

a. Environmentally sensitive areas
b. Assets i.e. rig/supply vessels
c. Minimum reputational damages

2) The CMT will release a media briefing for ensuring that the information pertaining to the spill event is well communicated to the relevant authorities and coastal communities. The onshore response base at the nearest Ports (Adani) will also notify the coastal communities/stakeholders through verbal and written communication channels.

3) Once the spill has been assessed thoroughly, the decision on which response strategy to use is crucial in the first few hours of the spill. The preferred strategy for an offshore spill has been presented below and detailed subsequently:

RESPONSE OPS 1: Monitor, Evaluate and Sample: when spill is drifting away from coast and if the oil is headed towards the shore
RESPONSE OPS 2: Containment and Recovery
RESPONSE OPS 3: Dispersant Application
RESPONSE OPS 4: Shoreline Protection and Deflection Booming
RESPONSE OPS 5: Shoreline Clean-up: *in case the spill reaches the shore*
RESPONSE OPS 6: Waste Management

4) The response operations will be monitored by the OSC on continuous basis through records and hourly reports from the response team. Based on the ongoing response operations, it will be the responsibility of the CMT Leader, in consultation with OSC, to decide whether the response Tier has to be escalated to the next level and intervention of relevant authorities such as Indian Coast Guard will be required to handle the spill event.

7.1 Assembling full Response Team

Area of operation of this Plan being confined to APSEZL, Mundra. All responses and actions would get limited to coastal zone and within the Mundra region.

7.1.1 Crises Management Team /s (CMT)

The core operating team discharging the functions of Incident control, administration and management is designated as Crises Management Team/s(CMT) operating from the identifier control center located within in the port Administrative Building.

7.1.2 CMG

Apart, from the designated CMT, another senior level team designated as Core Management Group (CMG), headed by the respective head of APSEZL, Mundra, will get activated in times of major spill crises that may require liaison with senior level state, center authorities or other

agencies. The functions of CMG will be same as CMT (as mentioned in 9.1) with a view to provide support to operations in terms of administrative requirements, CMG will assemble on the recommendations of Chief Incident Controller.

This Plan formulates the polices and strategies to be followed on case of a response and to be executes on the ground by CMT along with response team or Oil Spill Response Operation (OSRO)

The operational spill prevention provision of the CP will be discharges by three CMTs – headed by Chief Incident Controller, one each for the area of Jurisdiction of APSEZL, Mundra. Duties and responsibilities of all the three teams would largely remain the same – as spelled in this Contingency Plan (CP), with additions and amendments undertaken by each team as per operational situation and requirements particular to their area of operation. Each team would be responsible for operations in their respective area of jurisdiction.

7.2 Identifying Immediate Response Priorities

Major actions that would be required to be taken when a spill occurs are mentioned below. While, some actions like containment are required to be initiated immediately following a spill, some actions like shore line clean up etc. will get initiated in due time. The purpose of fast response is to minimize hazards to human health and environment the following response is accordingly addressed through the Contingency Plan and Operational Manual.

- Stoppage of discharge and containing spill within a limited area
- Defining size, position and content of spill, direction, and speed of movement and likelihood of affecting sensitive habitants
- Notification to private companies or governments agencies responsible for cleanup actions
- Movement of trained personnel and equipment to site.
- Initiation of Responsibility
- Ensuring safety of responsible personnel and public
- Oil Removable and disposal

Crises Management Team (CMT), with the help of oil slick movement simulation data and prevailing weather condition, would priorities which are to be protected first. By selecting the appropriate strategy, the CMT can derive an indicative strategy path to mitigate the effects of an oil spill, consistent with safe practice and net environmental benefit.

7.3 Mobilizing Immediate Response

The moment oil spills detected; the actions initiated should be part standard drills carried out i.e

i. Operation department to sound alert to various departments to start preparing for OSR activities.
ii. HOD-Marine to muster ERT, carry out briefing about nature of oil spill, start preparations for the movement of OSR equipment's. Safety equipment's, teaches, lifelines life jackets working gloves rain coat, communication equipment sect be checked for their corrections
iii. Security department to mobilize vehicles at the assembly place i.e. Near port head office building
iv. ECT to coordinate with ECR to take stock of the situation.

The OSR equipment, both on-board vessel and onshore, have been sourced keeping in mind a Tier-1 response of 700 tons of crude that can be responded to, in one full day of ten working hours. This equipment will be operated keeping existing weather conditions in mind. For adverse conditions, no response will be effective. During normal weather conditions, advancing skimming system will be operated from the vessel that will keep on operating at 3 knots speed. Once the advancing system is in place and the recovery started, the oily water mixture will be pumped into the vessel tanks or the floating towable tank as per the availability. CMG Officers at Administrative office and OSC will exchange internal communication and keep incident appraised. Clean-up actions must begin as soon as possible to minimize the effect on natural and other resources. These actions shall include locating the source of the discharge and preventing any further spillage, placement of containment boom to control the spread of oil and to protect sensitive areas, measuring and sampling, physical removal of the oil from water and land, the use of chemicals to disperse the oil. The official coordinating response to the spill must address many questions, including:

- How large an area will the spill cover?
- How thick will the slick be?
- How fast and in what direction will the slick drift?
- When and where will the oil hit the shoreline?
- What will happen to the oil if it is not removed?
- What is the value and sensitivity of the resources at risk?
- The answers to these questions will determine what response actions are taken.

Dispersants shall be used as per the Indian Coast Guard policy and Guidelines for use of Oil Spill Dispersants (OSD) in Indian waters. The OSC must obtain clearance from the Indian Coast Guard before applying chemical dispersants.

RESPONSE OPS 1: MONITOR, EVALUATE AND SAMPLE

1) This is the preliminary action that must be taken once a spill has been confirmed. Following a Oil Spill on water this should be CMG first response as it must be recognized that sometimes

the safest and most efficient response will be to let the product naturally dissipate, whilst at the same time employing safety measures.

2) Aerial surveillance provides the best option for monitoring a spill; however visual observation from sea level may be the only option initially. This will not give a reliable overall picture especially for larger oil spill events. As practically possible, aerial surveillance will commence to monitor and assess the oil spill. Aerial surveillance will enable:
    a. Determine the size, quantity and location of the slick
    b. Determine the movement of the slick
    c. Noting of any changes in appearance and distribution of the slick
    d. Forecasting of areas at risk
    e. Reporting of effectiveness of response measures

3) Aerial surveillance will be used to direct containment, recovery operations and offshore dispersant. It can also be used to assess and monitor the successfulness of these strategies.
    a. Before take-off:
        i. take the equipment: Map/Chart, polarizing sunglasses, stopwatch, calculator, notebook, pencils, GPS (handheld with remote aerial and spare batteries), digital camera and spare batteries, and multiple surveillance reporting forms,
        ii. Obtain latest weather forecasts and current conditions

    b. During the flight:
        i. start observation at an altitude of >1500ft or >450m for a good overall picture
        ii. ensure there is a good viewing window, or consider flying with door open
        iii. ensure there are communications with the pilot

4) Prior to flying, obtain information last known position of slick(s) and plot on a map. Manual plotting or oil spill modelling can provide an estimation of the slick position. On water oil moves at approximately 100% of current speed and direction, and 3% of wind speed and direction. Computer modelling of oil fate and trajectory will have to be undertaken, if required.

5) If there is an uncertainty as to the exact location or extent of spill, a spiral pattern can be used to investigate the area of interest. The shape and thickness distribution of fairly fresh oil spills depend on the oil properties, wind and currents. The wind spreads and elongates the spill, eventually cutting it into windrows and finally fragmenting. The thickest patches move furthest downwind to what is termed the "leading edge" of the slick. Where practical, long search legs should be aligned at 90 deg. to the direction of the prevailing wind to increase the chances of oil detection as wind rows will lie parallel to the wind direction.

6) Fly the length and width of the slick and record the time taken and the aircraft speed. Once the speed and times to fly the length and width are recorded, the area can then be calculated.

7) The next step is to conduct an oil spill sampling. The technique for oil spill sampling has been presented below:

Table 7.1: Technique for Oil Spill Sampling

S. No.	Technique for Oil Spill Sampling	
1	Equipment	Sampling from an oil slick itself and submission of the samples require use of correct and necessary equipment (oil sample boxes). Each oil sample box contains detailed instructions with a description of sampling including gathering, referencing, labelling storage and forwarding procedure.
2	Frequency	For offshore spills a minimum of 1 sample per slick per day where possible.
3	Sample Size	• Un weathered oils that are liquid and subsequently free of water - 10ml; • Oil exposed to sea surface and forming water-in-oil emulsion 'chocolate mousse'-10ml; • Over size water discharge of 100 ppm from a moving tanker or 15 ppm from a fixed source is suspected- 1litre of discharge; • If such quantities cannot be collected, sampling of any quantity should still be attempted;
4	Collection method	• Skim the oil off the surface of the water with great care, ensuring maximum oil content and minimum water. A bucket may be required to collect the sample initially; • Avoid using metal tools containing nickel / vanadium-based alloys to collect the sample, as these are contained naturally within any crude oils and therefore may cause problems when analysed; • Any collection of lumpy tar/waxy pollutant should be placed directly into sample containers, with no attempt to hear or melt these samples; • Oil collected attached to floating debris, or seaweeds etc., should be placed along with the debris/seaweeds directly into the sampling container; • The sample containers should be sealed and labelled as soon as possible to minimize the evaporation of the oil's higher fractions.
5	Container Sealing, packing and Transporting	• Where possible, all samples should be securely packed, and sealed using screw topped containers and fireboard boxes to ensure safe carriage of the samples; • Sample containers should be glass with a large neck and a screw cover and a seal which would not be affected by oil, e.g. no waxed caped seals; • All sample containers should be sealed with a tamper proof seal; • Any bags should be sealed with a label which is signed with overlap on bag and label; • Plastic/metal containers are discouraged as can react with the sample and interfere with analysis; • Samples should be stored in a refrigerator/ cold room at less than 5^{o}C in the dark; • When transporting the materials, dangerous good instructions should be followed; • Vermiculite should be used to surround the samples in the box for protection and to absorb any seepage; • Each sample should be clearly labelled with an identification number, date,

S. No.	Technique for Oil Spill Sampling	
		time, location, and signature of the sampler, these details should also be recorded on a log form.

8) The weather conditions will be continuously monitored. Factors that should be considered when assessing oil spill movement and weathering include:
   a. Currents
   b. Tides
   c. Weather (including wind direction and speed)
   d. Wave height (sea state)
   e. Sea temperature, salinity
   f. Spill size / volume (m^3)
   g. Spill thickness (estimated by color e.g. sheen, rainbow)
   h. Type of oil spilt (viscosity, pour point, specific gravity, dispersion, evaporation)

RESPONSE OPS 2: OFFSHORE CONTAINMENT AND RECOVERY

1) Effective offshore recovery requires trained operators, suitable equipment, well maintained equipment, vessel logistics, aerial support, temporary storage, transportation and waste disposal.

2) Even in the most ideal conditions recovery rates will never be and are actually more likely to be around 10 — 20%. The faster the response, the better the recovery rate as the spill will have had less time to spread and fragment.

3) Operations are unlikely to be possible in wave heights exceeding 2m (failure of boom with oil being washed over) or in winds of more than 35 km/hr.

4) Vessels suitable to deploy offshore boom must have sufficient deck space to house boom reels and power packs and sufficient vessel power rating (bollard pull) to tow the boom. Typically, these vessels need to have a low smooth stern without a rail. In addition, vessels need sufficient deck space to allow safe crew movement. To accommodate these arrangements minimum deck sizes are:
   a. Deck space to stow 2 x 10 ft containers safely and allow personnel movement
   b. At least 2m stern to deploy and inflate the boom.
   c. Offshore boom towing vessel at least a 1.5 tones bollard pull and 400 hp engine

5) Steps to carry out offshore containment and containment techniques are listed below:

a. Identify the thickest concentrations of oil. Aerial surveillance is the best method of directing vessels to the most concentrated area of the spill to conduct containment and recovery operations.
b. Sites for containment and recovery operations should be selected where the collection will reduce the likelihood of the oil impacting sensitive sites.
c. Ensure communication can be established between the aircraft and the vessel either or via the command team.
d. Deploying containment boom will limit further of the oil and concentrate the oil for recovery. Eddies behind the booms are an indication that they are towed too fast. Maximum speed is dependent on the amount of oil contained in the boom, boom characteristics and wave conditions. Typically, a speed of 0.5 – 1.0 knots is required for effective operations.
e. Oil lost under the boom will appear as or droplets rising 2-10m behind the boom. Sheens will often be present even when the boom is functioning well.
f. When towing a sectioned boom that has been joined in a 'U' configuration, an odd number of sections of boom should be used to prevent having a join in the center of the boom from which oil can more easily escape.
g. To avoid sharp stress or snatching on a towed boom, lines between boom ends and the vessel should be of sufficient length. 50 m or more would be appropriate for towing a 400 m length of boom.

6) Steps to carry out recovery of spilled oil and recovery techniques are listed below:

a. Skimmers that are used to recover oil from the water all incorporate:
    i. an oil recovery element
    ii. notation or support
    iii. pump or vacuum device to transfer recovered oil and water to a temporary storage device
b. Skimmers will need continuous maintenance by specially trained staff with a supply of spare parts
c. The effectiveness of a skimmer is determined by how quickly it can collect the oil, and how well it minimizes the water to oil ratio collected.
d. Recovered oil could be pumped into an inflatable storage barge or the recovery oil tank of a standby vessel.
e. Wave motion reduces the effectiveness of most skimmers. In calm waters better performance can be achieved if the skimmer is suited to the viscosity of the oil in question.
f. Floating debris, both natural (e.g. sea weeds, sea grasses, trees and branches) and manmade (e.g. plastic, glass, timber) can affect a skimmer's performance. Skimmers

may need trash screens and regular unblocking where debris is common, such as near urban areas or the mouths of river.

RESPONSE OPS 3: DISPERSANT APPLICATION

1) The use of dispersants should be the primary response strategy to prevent the oil from coming onshore due to the limitations of booming operations offshore, the time taken to deploy the booms, the encounter rate due to the spreading of the oil and also sea conditions. However**,** dispersants will be used only on crude oils which do not disperse naturally and after obtaining the approval from the Indian Coast Guard.

2) The effectiveness of the dispersant on the oil slick must be monitored, and this is best done by observing the sprayed area. Where there is a coffee-colored plume in the water, this generally indicates effective dispersion of the oil. Where the oil has resurfaced there will be black patches.

3) Dangers to consider during dispersant operations are - fire or explosion risk, exposure of personnel to dispersant, weather conditions allow safe operation of vessels and aircraft and ability to control aircraft in the aerial spraying zone.

4) For effective use of dispersants, following considerations to be noted:

   a. Dispersant should only be applied to crude and not light oils such as diesel or heavy oil such as HFO.
   b. Dispersant effectiveness will decrease as the viscosity of oil increases.
   c. It is unlikely that dispersant will be effective on emulsified crudes.

5) Steps to carry out dispersant application by vessel has been outlined below:

   a. Aerial surveillance should be utilized for all dispersant application operations to direct operations and monitor the effectiveness. The dispersant operation must be at the thickest portion of the slick (leading edge) and not the thinner iridescent silvery sheen areas. Dispersant application should be considered in offshore and near shore to prevent oil entering environmentally sensitive areas onshore.

   b. The following techniques should be utilized during dispersant application:
      i. Vessel speed should normally be between 5 - 10 knots.
      ii. The spray arms or spray nozzle should be mounted at the bow to avoid the effect of the bow wave which can push the oil beyond the spray width. The bow wave will also provide the required mixing energy. Dispersant should be applied when steaming into the wind.

iii. Agitation will be required to produce the required mixing energy. In calm sea states the bow wave of the vessel should be sufficient. Applying dispersant in conditions above a Force 5 is not recommended as the turbulence will cover the oil and spray droplets will be blown away.

iv. Typically, the most efficient dispersant to oil ratio (DOR) is 1:20, but on fresh oils, this can be a lot less (1:100). The correct application is determined by the pump rate and the vessel speed (knots). For most modern chemical dispersants, an application rate of approximately 1:30-1:50 (DOR) should be applied. Refer to the manufacturer's information for application rates

v. A visual check of the Spray area will indicate dispersant effectiveness. A grey / coffee color plume indicates successful dispersion. Spraying too much dispersant will result in a cloudy white plume, too little and there will be no effect.

c. Below guidelines should be followed during dispersant application:

i. Do not spray if the slick gets close to fishing boats

ii. Dispersant should be applied by trained operators, with proper safety equipment, and with experience in use of the spray equipment

iii. Do not use dispersants in water depths LESS THAN 20m. Reason: insufficient depth for adequate dilution and possible impacts on seabed (benthic) marine life

iv. Ensure the dispersant has been approved for use and any necessary authorization has been granted

v. All dispersants should be clearly labelled and stored with the appropriate supporting documents.

RESPONSE OPS 4: SHORELINE PROTECTION AND DEFLECTION BOOMING

1) Areas that should be protected include environmental and socio-economic sensitivities, with consideration of the time of the year. Protection booming is generally feasible across small bays, inlets and river mouths with currents (< 1 knot) and breaking waves < 1.5 ft (0.5 m) and on straight coastline areas to protect specific sites, where breaking waves <1.5 ft (0.5 m).

2) Deployment of shoreline protection will be supervised by trained Response Teams deployed to location that can assist in training and local personnel such as the Fire Service and volunteers. A local workforce would be to provide manpower.

3) Due to the long inter-tidal zone of the coastline, it will not be practical to use booms from the shoreline for protection. If any deflection booming is to be done, it has to be deployed beyond the surf zone from the coastline. This can be done by deploying the offshore booms in a

deflection configuration which will require two boats - however the limitation will be the area covered by a single length of boom.

4) For deflection booming the length of the boom has to be towed in a straight line between two vessels and angled in such a manner to deflect the oil away from the coastline concerned. Deflection booming operations must be done as far away from the shoreline as possible. Knowledge of the depth of the water is important to allow for sufficient under keel clearance for the vessels and also the draft of the boom.

5) Where possible, protective booms should be deployed at an angle to the approaching slick to divert oil away from any sensitive area, for example bird breeding grounds. When wave amplitude exceeds 1.5ft (0.5m) or currents exceed 3 knots, protective booms should be moved to calmer waters if possible as boom are likely to fail. Booming will be ineffective if the current speed at right angles to the face of the boom (due to water current or speed of towing vessels) exceeds 0.75 knots.

6) The use of oil snares strung on ropes is also a practical strategy to prevent or minimize oil from stranding on the shoreline. In order to implement this strategy, the following need to be considered.
    a. The snares need to be deployed beyond the low water mark of the inter-tidal zone and surf zone.
    b. Suitable shallow draft boats will be required - Using the fishermen and their boats will be the most practical approach.
    c. The snares attached to ropes will have to be tied to stakes at intervals of about 50 meters, parallel to the coastline.

RESPONSE OPS 5: SHORELINE CLEAN-UP

1) The purpose of shoreline clean-up should be to produce a net environmental benefit. Clean-up techniques can be damaging and, in some circumstances, oiled shorelines are best left to recovery naturally.
2) In many areas, bays and other inshore areas may also be somewhat protected from the extensive contamination by the flushing action of tidal currents and the natural outflow of streams and rivers. As a result, much of the shoreline may not require a widespread active cleaning effort unless it is heavily contaminated.
3) Where active shoreline clean-up is required, priorities for restoration can be established based on both the environmental sensitivity and oil persistence factors. Preference should be given to in-situ cleaning techniques such as in-place washing of rocky shores, use of shoreline cleaning agents, in-situ burning and bioremediation. Use of these techniques will minimize the amount of oily material collected and subsequent hauling requirements.

4) In general, heavily contaminated areas should be cleaned first so that bulk oil is not remobilized impacting Other areas:
    a. Stage 1: Removal of heavy contamination and floating oil
    b. Stage 2: Clean-up of moderate contamination, stranded oil and oiled beached materials.
    c. Stage 3: Clean-up of lightly contaminated shorelines and removal of oily stains.
5) Appropriate techniques to use will depend on the characteristics of both the area oiled and of the oil, but include:
    a. Natural recovery
    b. Low or high pressure ambient or warm water flushing
    c. Manual clean-up
    d. Mechanical removal, e.g. graders, scrapers, vacuum systems
    e. Sediment relocation
    f. Absorbents
    g. Washing
6) Following options for shoreline oil recovery and temporary storage will be considered:

a. Vacuum trucks

i. Vacuum trucks are a highly effective and rapid means of recovering and transporting liquid oil.
ii. They are most effective when there are large volumes of oil contained in a particular location, can be used to recover oil from land or water, but may be limited by difficult access to the spill areas.
iii. Vacuum skimmers should not to be used with volatile oil. Ideally a duckbill or manta ray skimmer head should be fitted to the suction nozzle as these provide the most efficient means of recovering a thin layer of oil.

b. Portable skimmers and pumps

i. Portable skimmers and pumps are used to collect small to moderate concentrations of oil, or to pump larger volumes from areas where trucks are unable to go.
ii. Hand held vacuum units are ideal for recovering oil that is floating on a very shallow layer of water.
iii. Weir Skimmers require calm, still water and are good for all low viscosity oils. Oleophilic skimmers can be used in ‘choppy’ water, recover 90% oil to water, and are good for low to medium viscosity oils.
iv. Oil should be pumped to a temporary storage location (tank, 55-gallon drums, pillow tanks, lined pit) which is safe, above flood levels, protected from rain, and sited to allow ease of access for future collection and transfer of the oil.

c. Manual recovery and sorbents

i. Sorbents are produced in a variety of forms (booms, pads, sweeps, snares, granules etc.) for use in specific locations and for specific types of oil spill clean-up.

ii. Sorbents are generally best used for absorbing minor spills of oil on hard surfaces, and for final clean-up of spills (e.g. helping to remove sheen or to wipe oily residue off solid objects).

d. Temporary storage

i. Fast tanks can be used for collecting recovered oil/water mixtures. Containers used for temporary storage must be tough and resistant to puncturing. Free-standing containers must be adequately strong to contain the weight of oil.

ii. Excavated pits may be used for storage and should be lined with heavy gauge plastic (PVC) sheeting to minimize soil contamination.

7) In the stage of final clean-up, the endpoint should be determined for each oiled site. Endpoints should be realistic and obtainable for the spill conditions.

RESPONSE OPS 6: WASTE MANAGEMENT

1) Oil spill response operations have the potential to generate liquid and solid wastes. The types and quantities of waste materials largely depends on the amount of oil that reaches the shoreline and on the specific clean-up methods employed.
2) Waste from an oil operation includes:
   a. recovered oily wastes
   b. non-oily materials generated from the operation and supporting activities
   c. materials contaminated with solvents, dispersants and fuels, gray water and unoiled wastes.
3) The types and volumes of waste generated by response activities are determined by the response objectives set during the spill management.

s

Table.7.2: Techniques for Waste Disposal

Technique	Effect on waste stream	Type of Waste
At-sea response options	Recovery operations will give potentially rise to a large quantity of waste oil and water for treatment. The type of oil spilled will have an effect on resultant waste; in particular viscous and waxy oils will entrain debris and can create large volumes of waste. They can also	• Oiled equipment/ vessels/ PPE • Recovered oil/ oily water • Oiled vegetation • Oiled sorbent materials • Oiled flotsam and jetsam/ debris

	present severe handling difficulties.	• Animal carcasses
Dispersant Application	Waste concentrations are minimal as the oil is dispersed in the water column and allowed to biodegrade naturally.	• No hydrocarbon waste is generated • PPE • Empty dispersant drums/ considerations
Shoreline Clean up	The type of oil spilled will often have an effect on the amount of oily waste generated. Waste segregation and minimisation techniques are critical to ensure an efficient operation. These should be established at the initial recovery site and maintained right through to the final disposal site. Waste sites should be managed in such a way as to prevent secondary pollution.	• Oiled equipment/ vessels/ PPE • Animal carcasses • Recovered oil/ oily water • Oiled vegetation • Oiled sorbent materials • Oiled beach material • Oiled flotsam and jetsam/ debris

7.4 Response Techniques for HNS Spill

This response techniques for spilled HNS in water is discussed in Table.7.3 The response method has a specific designation *-marks indicate groups of substances for which the methods are applicable.

Table:7.3 Application of various response techniques to different behavior groups

	Gas Phase		Liquid and Solid Phase (F, FD, D, SD, S groups only)									
Group Method	G	G D	E	E D	F E		F	F D	D E	D	S D	S
Predicting the spread in Air	*	*	*	*	*				*			
Predicting the spread in on water surface					*		*	*				
Predicting the spread in in water body		*		*				*	*	*	*	
Monitoring the spread in air	*	*	*	*	*				*			
Monitoring the spread in water body		*		*				*	*	*	*	*
Combating water soluble gas clouds		*										
Combating spills that float on water							*					
Combating spills that dissolve in		*		*				*	*	*	*	

water												
Combating spills that sink to the bottom											*	*

Group designations

G	Gas	**F**	Floater
GD	Gas/Dissolver	**FD**	Floater/dissolver
E	Evaporator	**DE**	Dissolver/Evaporator
ED	Evaporator/dissolver	**D**	Dissolver
FE	Floater/Evaporator	**SD**	Sinker/Dissolver
FED	Floater/Evaporator/ Dissolver	**S**	Sinker

Response Techniques

A number of response options for HNS spills as discussed in the following sections

- Response operation for gases or volatile liquids type of spills
- Response operation for floaters type of spills
- Response operation for dissolvers type of spills
- Response operation for sinkers type of spills

The effectiveness of these methods can be limited by chemical type and weathering, weather and sea state, or logistics. The response actions need to be taken as fast as possible to prevent escalation. The details for spill response techniques for HNS spill is furnished in Appendix-18

7.5 Media Briefing

APSEZL, Mundra has designated staff that will interact with press, public, govt. and media briefing during emergency. The most important aspect of retaining the credibility of a company is to release the first press statement immediately after a major incident. As the news channels and print media are expected to react quickly to an incident for the purpose of "first reporting" and "breaking news", it is important to get prepared to issue the first press statement at the earliest possible moment. The EMT and CMT leaders shall coordinate with the site team to get as much information as possible to draft a press statement with the help of Public Affairs Coordinator. The information must be:

- Specific and accurate to the extent of the event at the time of reporting
- Activities currently hand to minimize and control

- Immediate projected plans for mitigation Information should not reflect any projections or perceptions of consequences or damage details (as they require assessment)
- No contradictory points in the statement
- Not attributing to a particular cause (as it would require investigations later)
- The key facts and messages to be included in further statements will be agreed between Group media, Business and country crisis Team leaders during conference calls.
- Group media will then distribute final statements to all crisis teams and other internal audiences as appropriate. NB: only final drafts should be used to minimize confusion.
- Additional useful facts on the specific crisis as well as relevant background information and generic Q and A's should be proactively sent to group media by Business and country communications colleagues as quickly as possible.
- Group media will disseminate agreed answers or statements on board questions areas being asked by the media. Business and country communications colleagues will ensure the necessary information is provided as quickly as possible.
- Group media will provide a synopsis of key issues in media coverage to all crisis teams Business and country communications colleagues will provide input as appropriate.

The draft statement prepared by the Public Affairs coordinator must be vetted by the EMT/ CMT Leader (as the case may be) and seen by the Head of Departments perspective before release. As the time is the essence of the effectiveness to deal with the media, all these actions must be parallel worked out with consultations among the leaders irrespective of their locations and timelines. The authorized personnel of Corporate Communication dept. shall release the statement through the applicable outlets (viz. print/ TV or web). The format of the press release statement is placed in "APPENDIX-12"

7.6 Planning Medium-Term Operations (24-, 48- And 72-Hours)

The likelihood of oil spill taking place are from two factors mostly, during vessel operations and secondly due to collision / grounding.

Since, during vessel operation, OSRO personnel as well as vessel staff present at the site, any spill taking place could be tackled immediately as response time will be less and spill damage control could be done quickly. Therefore, quantity of oil spilling into water is expected to be minimum and the spill could be controlled easily. In this case, dispersants, sorbents may be used and whole operation is likely not to last more than 24 hours. In fact, OSR items are kept handily in OSRV to use any time.

However, in case of oil spill occurring due to collision, it is certainly going to be at a higher magnitude. As, when the collision takes place, every body's attention is likely towards safety of the vessel i.e. to avoid vessel getting grounded, avoid colliding with other vessels, preventive actions against fire or carryout firefighting, damage control action against folding as soon. It is anticipated that in case of collision the oil spoil is likely to occur due to rupture of or crack in fuel tanks.

In case of rupture fuel tanks, a sudden gush of oils will be there, and for some time it would be incontrollable. By that time any effective damage control action is taken, a substantial amount of oil would have already gone overboard. This would necessitate immediate oil containment measures, as well as starting oil recovery action. This spill recovery action may go well beyond 48 hours, keeping weather and sea condition in mind, because one does not know at what time of the day or night accident takes place which will determine the time delay in appreciation of the situation and mobilization of OSR team and equipment's. It may clearly be understood that appreciation of oil slick between sunset and sunrise is quite difficult and at times it may be fully incorrect, hence slight time delay may be anticipated.

Such incidents don't happen quite often, but very rarely. Hence regimes of OSR and equipment's shall be maintained at all times.

The oil spill scenario through crude fuel tank / tanks is not very different than previous one, because due to cracked / fractions / material failure occurred in the fuel oil tank / tanks, oil would continue leaking in a small /moderate rate. But it would be difficult to locate the source / point of oil leak and by the time source / point of leak is detected, suitable action is initiated and leak is arrested, a sizable quantity of oil would have already been over board. Detection of oil leak will become more difficult if the crack / fracture develops after some time due collision realter structural stress and ship is secured alongside jetty with the damaged / leaking side situated between ships ode and jetty. The problem will become more compounded if the accident takes place after sunset during sever monsoon conditions and detection of oil slick in the night would be really quite difficult. Like above aerial (i) here also one cannot deploy OSR men and equipment's preciously and reaction time to deploy OSR men and equipment, subsequently recovery of spilled oil is going to take more or less the same time.

Here are the vessels taken on consideration are visiting ships of various sizes in all weathering conditions but not the minor vessels or tug boats

7.7 Deciding to Escalate to Response to Higher Tier

When the spill response action has been initiated by ECT and ERT has started the recovery action, spill incident reporting has been made to concerned authorities, and then if OSC feels that quantum of oil spilled appears to be much more than what was reported earlier and the oil spill needs to be re-assessed and deserves a higher response, he informs the same to ECT.

At this juncture, the OSC and members of ECT should re-inspect the spill site and assess the oil slick thickness, its size, status of spilled oil and decide accordingly. If ECT is convinced that spill report deserves upwards revision and the level of Tier Response needs to be raised, it should take necessary steps to raise the oil spill reporting level. This decision will help to initiate higher oil spill response activities as well as alert other neighboring agencies, with whom APSEZL, Mundra has the MOU with oil companies, Coast Guard Authorities, Port authorities, Pollution Control Board, Hospitals, and other organizations.

The procedure of informing all concerned agencies / organizations of higher spilled oil threat perception remains the same. However, care is to be taken in spill assessment and giving exact quantum of oil spilled as large difference in quantity of spilled in water and oil recovered from water may not be interpreted in a correction fashion.

7.8 Mobilizing or Placing on Standby Resources Required

When the decision to raise the Tier level of oil spill has been/ is being taken, a review of APSEZL, Mundra own spill response capability is also to be done simultaneously. Once it is felt that additional resources are required, the concerned agencies are to be alerted immediately, and mobilization action for those equipment/ items should be initiated without losing any time. It should be borne in mind that mobilization of resources from out stations is a time consuming and cumbersome exercise, therefore it should be calculated well before the anticipated arrival time of the Pollution Response Equipment on account of:

(i) Transportation time by rail/ road/ sea/ air.
(ii) Time taken by Custom/ Government formalities.
(iii) Time taken in loading/ unloading.
(iv) Availability of specialized loading / unloading machineries and accessories.
(v) Availability of suitable berthing facility for the craft intended to be used.

It is also very important to keep in mind as who is going to operate that pollution response equipment which are being mobilized. In case the equipment is coming with one set of man power, then from where their relief would come and in case only equipment is provided then, do

we possess required trained manpower for operating this equipment? All such matters are to be deliberated upon in detail by the OSC and ECT together during operation/ exercise planning stage itself. Otherwise, it would be very difficult to mobilize desired manpower at the eleventh hour.

For obtaining additional equipment the local Oil Companies and nearby ports, with which APSEZL, Mundra may have a contact, are to be contacted. Requirement of extra manpower to meet the requirement of running this equipment has to be thought off well in advance.

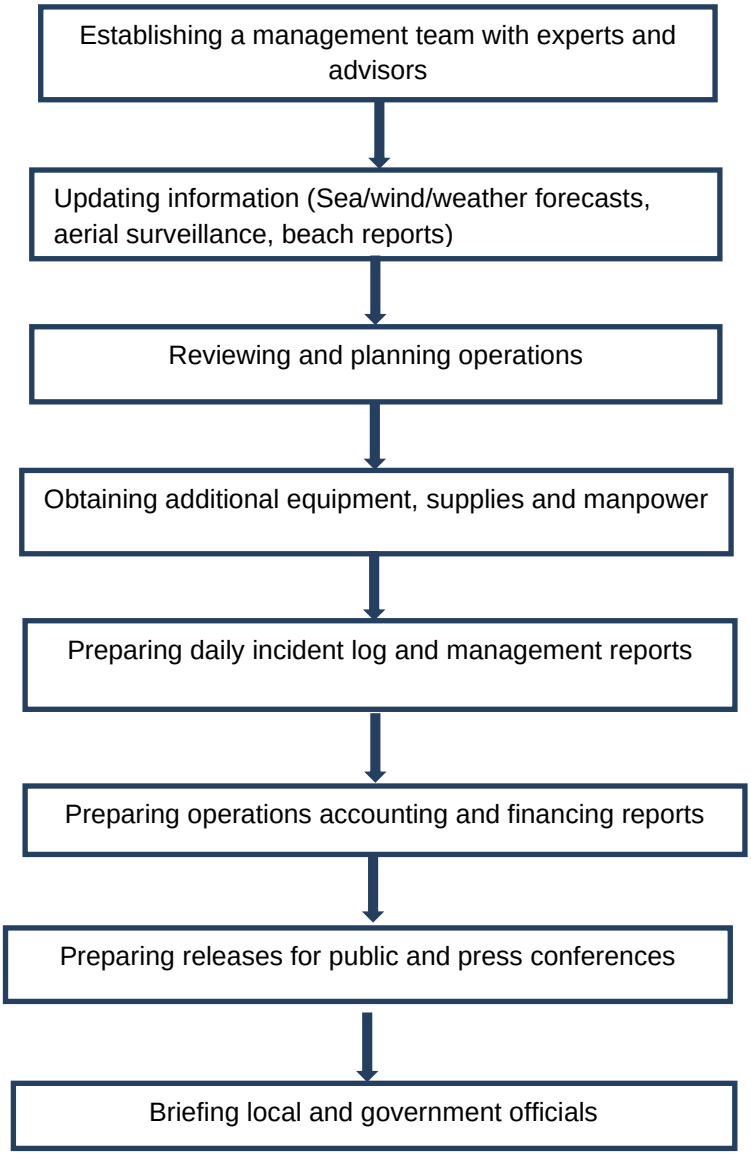
APSEZL, Mundra has having all oil spill equipment readily placed nearby the ports, which can be mobilized at any eventuality. The Indian Coast guard is fully equipped and trained to deal with TIER II and TIER III spills.

7.9 Establishing field Command Post and Communications

The OSC will be equipped with portable VHF and mobile phone. The OSR team leaders would also be having hand held VHF sets (They can also be provided with mobile phones). Therefore, establishing filed command post is considered not necessary, unless the spill of large magnitude.

8. CONTROL OF OPERATIONS

Local control of operation will rest with Expert selected within the Adani (OSC) and work in the coordination with Indian Coast Guard and internal Port Administration expert groups (CMT). Security aspect of the pollution area should be considered and unauthorized persons gaining access to the area to be restricted. A safety zone (Exclusion Zone) of 500mtrs surrounding oil slick will be established to avoid hindrance in the oil spill cleaning process.



1) Once the response action mechanism is decided, the OSC will establish a response management team with experts and advisors who will support APSEZL, Mundra with the response operations. The team will consist of wildlife and marine experts to provide inputs with respect to ecologically sensitive areas.

2) The OSC will maintain updated information on sea, wind and weather forecasts, aerial surveillance, beach reports, etc. to ensure smooth response operations. Ready reckoners will be maintained for reference by the response team. The response operations will be reviewed on ongoing basis by the OSC and ECT Leader and any changes in planning will be communicated to the response team.

3) If case additional equipment, supplies and manpower will be required for the response operations, the OSC will notify the ECT. The Logistics Controller will be responsible for ensuring that the resources reach the contaminated site at the earliest from the resource base.

4) Daily incident log and management reports will be prepared and maintained by the OSC till the spill is completely under control. Subsequent accounting and financing reports will also be developed and shared with the corporate ECT.

5) The CMT will be responsible for preparing releases for public and press conferences on the response operations. All local and government officials will be briefed on periodic basis under the spill is controlled and the shoreline clean up works are completed.

8.1 Establishing Management Team with Experts and Advisors

Incident management team comprises of well-trained high-level professionals, experts in the field. APSEZL, Mundra has access to the national and internal special training related to oil spill response and emergency management. APSEZL, Mundra has MOU with HMEL for supporting Oil Spill Response operation. For attending to spills of higher magnitude (Tier-2 and above) will inform Coast Guard and support for oil spill response Plan.

The OSR have a stock of equipment available at their Base which is ready on round the clock basis for mobilization on an authorized call from the members. A list of APSEZL Advisor Committee is

1. COO 2. HOD-Marine 3. HOS-Marine 4. Duty Port Captain.

8.2 Updating information (Sea/ Wind/ Weather Forecasts, Aerial Surveillance, Beach Reports)

The Marine Control (MMPT) is entrusted the responsibility of providing initial information of area pertaining to wind direction & speed, water current, tide position at the time of oil spill, high water & low water timings, sea condition, swell and wave heights, weather forecasts & existing weather warning, navigational warnings, any Coast Guard in contact, any other relevant information

available. All this information is to be provided to ECR automatically the moment information about the oil spill is received.

All this information is to be automatically updated as and when they are received. In addition, regular inputs on the state of coastal areas are to be obtained from local sources.

8.3 Reviewing and Planning Operations

The ongoing operations will be assessed and reviewed as, when the ECT considers it necessary or suggested by OSC. This is necessary to upgrade the level of operations or scale down the operations due to different prevailing factors. Review of operations is an ongoing process and accordingly the planning is to be reoriented to maximize the utilization of men and machinery without compromising on safety of both. Here operational rest to men and machinery should also be kept in mind, because response teams can be rotated at regular intervals but continuous running machinery also needs rest after certain stipulated continuous running hours.

8.4 Obtaining additional Equipment, Supplies and Manpower

Logistic support is one of the key functions of ECT, which work under Logistic Department of APSEZL, Mundra, which provides and maintains personnel, materials, facilities and services as and when required by EMT. The assignment of any member of the ECT to a function will be made by OSC, of substitute, taking in consideration the sponsor competencies available at any time at site and the type of incident. These assignments will be likely to change during the action as and when additional staff becomes available. The ECT may contact any other staff and in case they are reachable, request their involvement in incident Management activities at site or elsewhere.

In the event of an ongoing spill or a spill that requires declaring of Tier 2 or 3 responses, the additional equipment and manpower held with any other OSRO or facility will be sourced in an accelerating manner including resourcing from the National / international spill handling companies. Contact details of companies holding equipment in India and International OSROs are listed below.

LIST OF ADDITIONAL RESOURCES AND INTERNATIONAL OSROs

1. **Australian Marine Oil Spill Centre**

   PO Box 305
   Victoria 3214
   Australia
   Tel + 61 3 5272 1555 Fax + 61 3 5272 1839
   Mail: amose@amosc.com.au
   Web: http://www.aip.com.au

2. **Fast Oil Spill Team**

C/o PIM 40 G 23 Tour Elf
92078 Paris- La Defense Cedex France
Tel: + 33 1 4744 5636
Fax : + 33 1 4744 2677
Mail : giefost@club-internet.fr

3. **Oil Spill Response Ltd**

Oil Spill Services Centre
Lower William Street Northam
Southampton SOI 1 QE, UK
Tel: + 44 1703 331 551 Fax: + 44 1703 331 972
Mail: osrl@osrl.co.uk
Web: http://www.oilsillresponse.com

4. **Petroleum association of Japan**

Oil Spill response Department Keidanren Building
9-4, 1 – Chome, Ohtemachi Chiyoda- Ku,
Tokyo 100, Japan
Tel: + 81 3 3279 3819
Fax: + 81 3 3242 5688
Mail: mail@pcs.gr.ip
Web : http://www.pcs.gr.ip

8.5 Preparing Daily Incident Log and Management Reports

OSR is overall in-charge of operations, he will delegate suitable and available persons to carry out the above function. Log sheets are to be filled for running of all operations and equipment as early as possible, since filling it later increases the chances of vital information getting missed. However at the end of the day, preferably time ending at 20:00 hours starting from 20:01 hours of the previous day, (or it may be from 08:01 hours to 08:00 hours of the previous day) a Daily Summery of events is to be prepared and submitted to the leader of ECT, who in turn would prepare the report consulting all the members of the ECT and forward it to management.

This report should cover following details as minimum:

(a) Manpower deployed
(b) Equipment deployed
(c) Weather conditions encountered
(d) Amount of oil recovered from sea
(e) Amount of oil transferred for storage & disposal
(f) Progress on shore cleaning efforts (as the case may be)
(g) Difficulties encountered
(h) Lessons learnt

The details of log sheet to mention action taken daily and observations made is furnished in **"APPENDIX-5"**

8.6 Preparing Operations Accounting and Financing Reports

ECT Leader is overall in charge of operation. It will be financial responsibility to prepare accounting and financing report. Claims should be based on expenses actually incurred that these are made as a direct expense of an incident and that the expense incurred are reasonable. The following aspects are to be considered while assessing cost of an oil spill combating, operating and prepare of claims:

a) Delineation of the area affected describing the extent of pollution and identifying the most heavily contaminated. This may be best presented as a map or chart accompanied with photographs.
b) Summary of events including a description of work carried out in different areas and the working methods chosen in relation to the circumstantial evidence linking as pollution with the ship involved in the incident (e.g. chemical analysis).
c) Labour costs (numbers and categories of workers, rates of pay days, hours worked, total Costs etc.).
d) Data on which work was carried out (daily or weekly costs).
e) Material costs (consumable materials, utilized fuel, food shelter facilities, etc.).
f) Finance shall assist ECT Leader in (preparing /scrutinizing) settling claims under the Guidance of CFO.

8.7 Preparing Releases for Public and Press Conferences

Information to media is to be release by the person identified through respective Media policy of the Organization. In the event of non-authorization of any one person, the Media release will be made by person nominated by him after authorization of the Organization.

The daily report of actions taken on a particular day as prepared by COC and OSC is to be shared with the person nominated to brief the media. Each press brief is too cleared by authorized person prior being provided to media.

While, providing factual details and information to media assists in passing the situation reports to public likely to be affected by a spill, it is advisable not to sensualize information with unwanted figures or actions that could shock or distress the public.

Most of the factual information like precautions required by public to be taken with respect to fishing activity, closure of beaches, demand for beach cleaning volunteers could be disseminated through media.

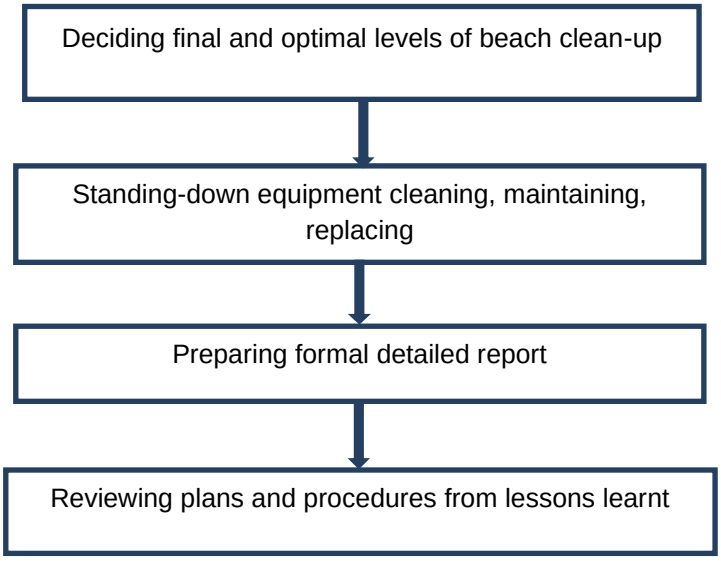
8.8 Briefing Local and Government Officials

Port has designated staff who will interact with press, public, Govt. and media briefing the details of emergency after clearance from ECT. In case of oil spill designation will be addressed to Incident Commander for managing the Media some of the General Guidelines that need to be followed:

- Ensure that in all communication care for human life and welfare is demonstrated Above everything else;
- Provider as much information as possible based upon facts only and refrain from Assigning any cause or speculation towards the incident;
- In case a suitable reply cannot be framed for the caller taker a number and offer to call back later or transfer to an individual who would be able to answer;
- Avoid any comments or statement that could be constructed as anger or distaste for a person or persons or any particular policy;
- Treat the media with respect – they need to be on our side.
- Be precise and to the point.
- Ensure that the Media is aware that they would be able to get accurate information only from the Company and that they would like the facts to be known.
- Anticipate in advance what queries may come and be prepared.
- The ECT or any other authorized personnel, must issue press releases and statements only.
- Ensure that relatives are advised prior to the names of any personnel being made public.
- Prior to the Next of Kin being informed by the police DO NOT release the names of any casualties to next of kin, the press or the public.

9. TERMINATION OF OPERATIONS

9.1 Termination of response operations



1) After obtaining the mutually agreed & desired outcome of the spill operations, the response operations will be terminated. A post spill evaluation will be conducted. The final and optimal levels of beach clean-up will be decided and recorded.

2) All the equipment used for the spill response operations will be cleaned and maintained accordingly. An inventory of items that has been consumed will be prepared and list of supplies that need to be replaced will be made.

3) The OSC in consultation with the CMT Leader and onsite response team will prepare a formal detailed report including the details of the spill, actions taken, levels of clean up, etc. The report will be used for internal reference purpose within the organization. The current OSCP and related procedures will be reviewed and updated based on lessons learnt.

9.2 Deciding final and optimal level of Beach Clean-up

The coastal stretches of Gulf of Kutch are varied in terms of biologically, industrially and socio-economically sensitive. The coast also has large stretches of Mangroves with mud flats. The tidal flats will be exposed during low tide conditions and currents are stronger during flood and ebb in the central channel. Hence, the hydrological features of the estuary will influence the distribution / spread of spilled oil and rapidly moves towards the coastal stretches.

The cleaning up of shoreline beaches are the most important in view of public interventions. Since, the clean-up of shoreline is very tedious and complex in execution alone, APSEZL, Mundra will coordinate the local administration, to involve local authorities (e.g. PCB and other civic bodies) in decision making process.

It would always be borne in mind that while in effort to clean up it should not end up doing more harm than good. It will be also be prudent to seek the advice of ecology experts from State Pollution Control Board and from other authorities/ agencies i.e. Indian Coast Guard, Central Pollution Control Board, State Forest and Fisheries department officials.

NEBA (Net Environmental Benefit Analysis) shall be taken into account deciding on selecting the best response option or optimal clean-up of beaches, Mangroves and other environmentally sensitive locations. Inspect segments/ section of shoreline that Clean-up Operations team declare ready for sign-off before final approval. Some stretches are required booms for protections of APSEZL, Mundra and marine sensitive area along the Gulf of Kutch.

Responsibility: Shoreline Assessment Team.
Methods:

- Operations notify the Shoreline Assessment Team Coordinator that a segment is ready for inspection.
- Inspect the segment against agreed-upon clean-up endpoints (preferably using the same team that did the original survey). The original field sketch can be very helpful for evaluating effectiveness of the clean-up.
- Identify additional clean-up needed using standard shoreline assessment terminology forms and sketches, or develop special forms for this purpose
- Recommend segment for final inspection.
- Recommend any longer-term monitoring or iterative procedures needed.

9.3 Standing-down equipment, cleaning, maintaining, replacing

It is important to remember that emergencies can be immediately followed by another one, hence it is of utmost importance to maintain the inventory of equipment. Hence, used equipment will be cleaned and maintained, if required to be replaced at the earliest. It will be the direct responsibility of the operators of the equipment to restore after the operations. All the spill equipment and machines are to be cleaned as per the OEM's guidelines, necessary maintenance to be carried out and then equipment stored in in their respective places.

9.4 Preparing formal Detailed Report

After the operations are complete, the OSC is to be prepare the detailed report covering all the aspects of the oil spill cleanup, which will include success and failures as well as per the prescribed format. The report contains all detailed elements of incidents, including daily actions, response and Communication, parties involved, equipment used also containing financial and strategy report summary. The report is to be forwarded to HOD-Marine for submission to CMT.

9.5 Reviewing Plans and Procedures from Lessons Learnt

A detailed and comprehensive review of plans will be carried out in the light of the incident will immensely help in improving standards of safety quality of response and quickness of the response. A through debriefing, brain storming and lesson learning session will be held under the guidance of CMT Leader. The report received from IC/OSC and gives its recommendations to the CMT of port administration for further action.

9.6 Investigation

Every oil pollution incidence is followed by investigation both by the Port as well as Nodal agencies in order to assist such investigations complete and accurate records, as specified below, shall be maintained

1. Certificates and records of equipment issued by regulatory authorities.
2. Log Book showing weather and details of the incidents.
3. Chronological record of loading / discharging bunkering including agreed plans of such loading/ discharging/ bunkering.
4. Brief report on spill including: i) Time, ii) Location, iii) Cause and, iv) Type of oil.
5. Samples of spilled oil shall be taken as per procedures described.
6. Estimate of amount spilled and the process of such estimation
7. Copies of notification & update reports
8. Record relating to direction and rate of spread
9. Weather reports and recorded weather in log book and
10. Where possible photographic evidence shall also be collected. Such photograph records shall be identified with date, time and location.

Where any original evidence is demanded by Nodal Authorities, photocopies of such evidence be retained and the concerned authority shall request to certify the same as true copy of the original.

10. DATA DIRECTORY

10.1 MAPS/CHARTS

10.1.1 Coastal facilities, Access roads, Telephones, Hotels, etc.

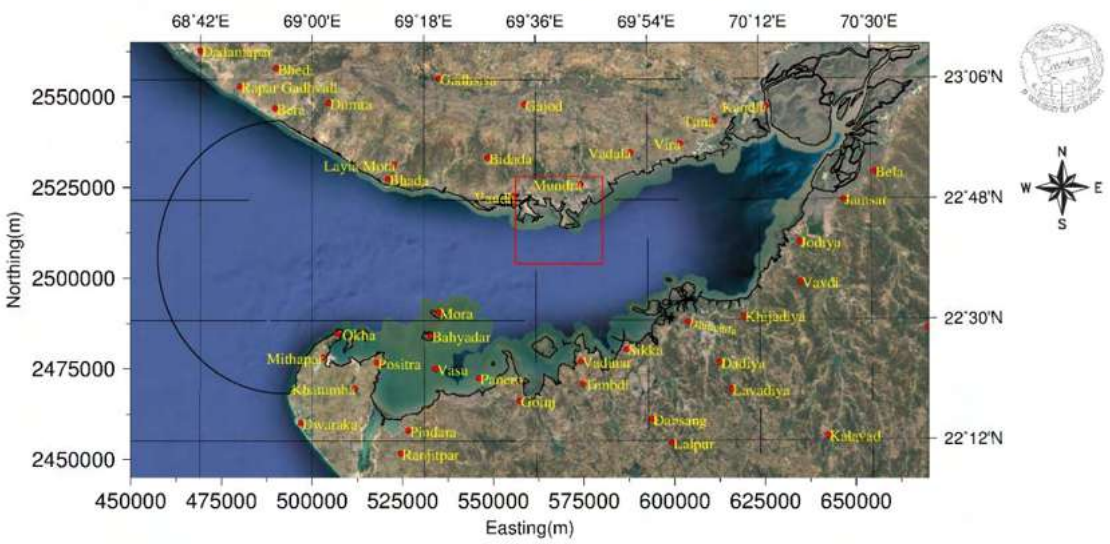


Fig.10.1 Google Map showing APSEZL facilities in the Mundra region

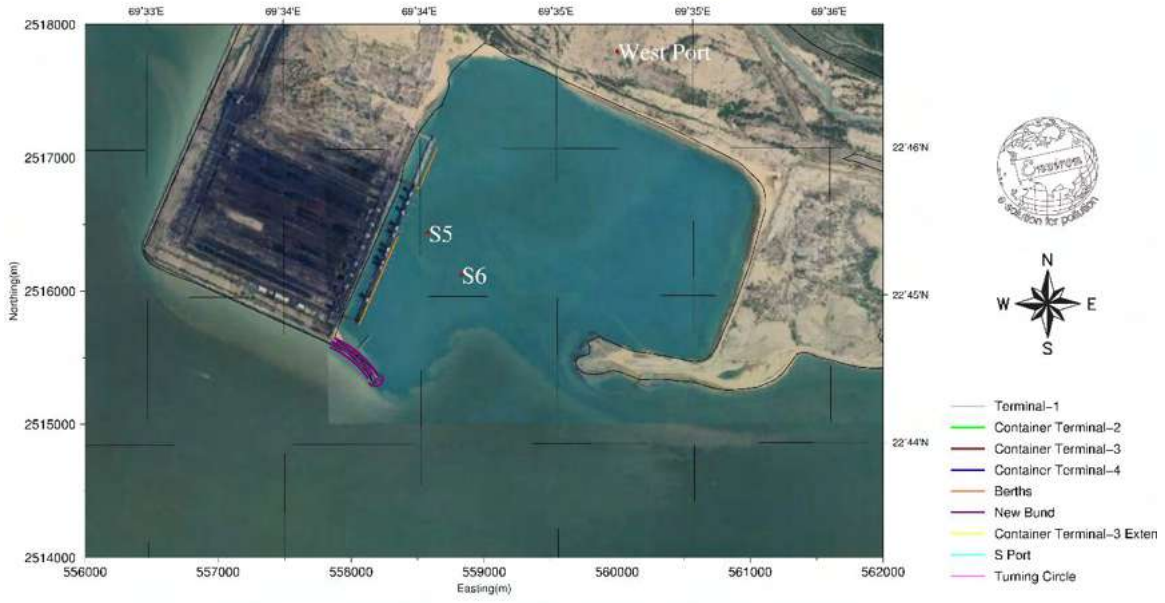


Fig.10.1(a) Google Map showing Adani West Port facilities in the Mundra region

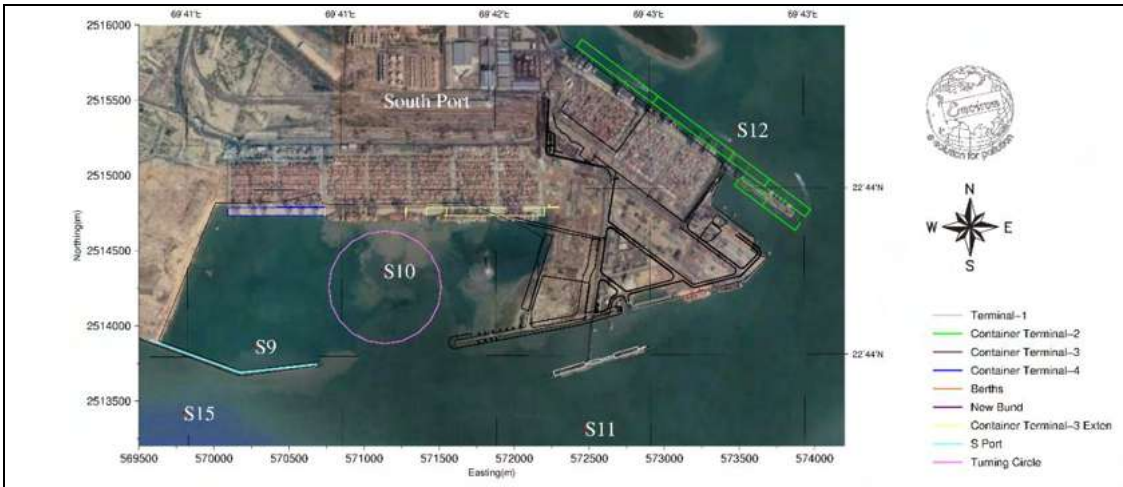


Fig.10.1(b) Google Map showing Adani south Port facilities in the Mundra region

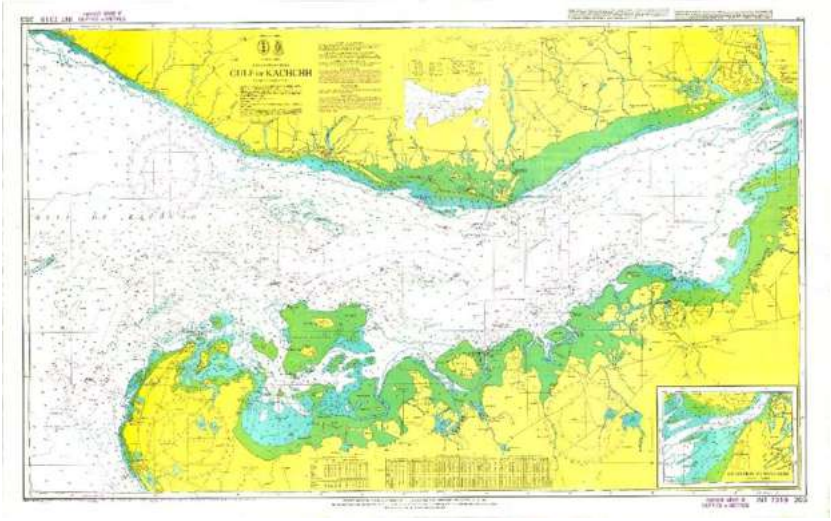


Fig.10.2 NHO Chart Showing Mundra region, Gulf of Kutch

Table.10.1 Contact Details of Spill Information Center

Sl No	Address of Centre	Contact Details
1	Indian Coast Guard Headquarters. National Stadium Complex Coast Guard DHQ -1(GJ). Near RGT College ... Okha Port, Gujarat – 361 350	Tel: 02892 263421. Fax: 0-22 24333727
2	Indian Coast Guard Headquarters. CP25+RRF, Vadinar, Gujarat 361010	Tel: 0-22 – 24222696 Fax: 0 – 22 - 24222696
	Indian Coast Guard Headquarters. gh-4 garden, udhyog bhavan, Sector 11, Gandhinagar, Gujarat 382011	

Table.10.2 Contact Details of District Administrative Authorities

Place Name	Address of Centre	Contact Details
Bhuj (Kutch)	District Collector Office Near Circuit House, Mandvi Road, Nr. Mota Bandh, Bhuj (Kachchh) Gujarat – 370001	Phone: +91 2832 250650 Fax: +91 2832 250430 Email: collector-kut@gujarat.gov.in
Jamnagar	District Collector Office, Jilla Seva Sadan, Sharu Section Road, Jamnagar - 361002	Collector, Jamnagar • +91 288 2555869 • +91 288 2555899 • collector-jam@gujarat.gov.in
Khambhalia	District Collector Office 1st Floor, Lalpur Bypass Road, Dharampur, Khambhalia, Gujarat - 361305	91 2833 232805 +91 2833 232102 collector-devbdwarka@gujarat.gov.in

Table.10.3 Contact Details of Gujarat Fisheries Development Council

Sl No.	Address of Centre	Contact Details
1	Commissioner of Fisheries 3rd Floor, Block no-10, Jivraj Mehta Bhavan, Gandhinagar, Gujarat 382010	Phone No: -079- 232-53729 Fax No:- 079-232-53730

Table.10..4 State Pollution Control Board – Regional Offices

	Address of Centre	Contact Details
Gandhi nagar	**Gujarat Pollution Control Board** Paryavaran Bhavan, Sector-10A, Gandhinagar-382010.	**Phone:** (079) 2323 2152 **Fax :** (079) 2323 2156, 2322 2784, 2323 2161 gpcbchairman@gmail.com, chairman-gpcb@gujarat.gov.in **Member Secretary**:
Morbi	Regional Center RR4F+6P7, Scientific Vadi, Sardar Nagar, Morbi, Gujarat 363641	Tel : 02822 228 001
Jamnagar	Regional Center Sardar Patel Commercial Complex, Rameshwar Nagar regional centre Kasturba Gandhi Vikas Gruh Marg, Bedi Bandar Road Jamnagar- 361 008	**Telephone** (0288) 2752366 **Fax:** (0288) 2753540 **Email:** ro-gpcb-jamn@gujarat.gov.in
Bhuj	Regional Centre Katira Commerical Complex-1, Nr.Manglam 4 Rasta,Sanskar Nagar, Nr.I.Tax Ofic,Bhuj 370001	**Telephone: (02832) 250620** **Fax: -** **Email:** ro-gpcb-kutw@gujarat.gov.in

10.1.2 Coastal Charts, Currents, Tidal Information Prevailing Winds

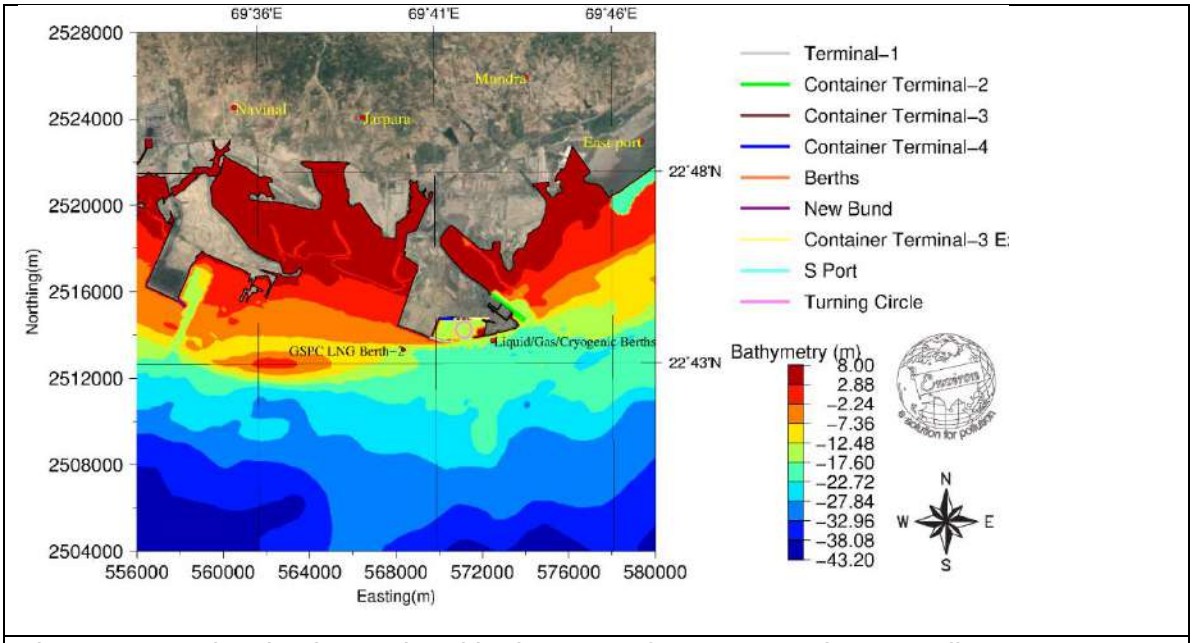


Fig.10.3 Map showing interpolated bathymetry of APSEZL and surrounding areas.

Tide and Current information

Tide:

The tidal planes were assessed and shown in Table below

The Highest Astronomical Tide (HAT) is estimated to be about +6.4 m above chart datum (CD), and the Lowest Astronomical Tide (LAT) to be at 0.0 m CD.

Table: Tidal information at Mundra

Tide	Height (m) above CD
Mean High Water Springs	5.8
Mean High Water Neaps	4.6
Mean Low Water Neaps	2.1
Mean Low Water Springs	1.0

Currents

Currents in the approaches to the port are dominated by the tidal flows, with predictable variations over diurnal, monthly and annual time scales. Currents in this part of the Gulf flow parallel to the natural sea-bed contours. Currents can be relatively strong, with speeds in excess of 3.0 Knots reported at sometimes of the year. The Admiralty Chart shows currents off Navinal point to be 3.0

Knots East & West bound. It is observed that the currents are usually aligned with the bed contours and are stronger in deeper waters off the coast. The impact of future development over the existing coast-line can be determined by the change in current speed resulting from the proposed developments.

Waves

In past HR Wallingford (HRW) has studied the wave climate considering wave energy from locally generated waves and swell propagating in to the Gulf of Kachchh from the Arabian Sea. The results of the study carried out by HRW are presented in the Table below.

Design Waves at Mundra

Direction Sector (ºN)	Return Period (years)	Inshore Direction (ºN)	Hs (m)	T2 (sec)
210	1	222	1.2	5.0
	5	222	1.4	5.3
	20	221	1.6	5.8
	100	221	1.8	6.1
240	1	226	1.5	5.4
	5	226	1.7	5.8
	20	225	1.8	6.1
	100	225	2.0	6.5
270	1	239	1.4	5.5
	5	236	1.7	6.3
	20	236	1.8	6.7
	100	235	2.0	7.4
300	1	240	0.8	5.2
	5	240	0.9	5.6
	20	239	1.0	6.2
	100	238	1.2	6.7

Cyclones

Cyclonic disturbances strike North-Gujarat, particularly the Kachchh and Saurashtra regions, periodically. These disturbances generally originate over the Arabian Sea. Generally during June, the storms are confined to the area north of 15°N and east of 65°E. In August, the initial stages, they move along the northwest course and show a large latitudinal scatter. West of 80°E, the tracks tend to curve towards north. During October the direction of movement of a storm is to the west in the Arabian Sea. However, east of 70°E some of the storms move north-northwest and later recurves northeast to strike Gujarat-north Mekran coast.

Wind

There are strong winds at times at Mundra Port. The wind directions are shown in Figure below. In the period lasting over months March to May the wind direction is generally SWW (225˚ - 250˚) and velocity varies from 20 to 25 Knots. June through August the wind direction is predominantly SW and velocity varies from 25 to 30 Knots with short gusts going up to 35 to 40 Knots. Towards end of September and through October wind direction changes to NE with velocities ranging from 7 to 10 Knots. Direction remaining same the velocity varies 10 knots to 25 Knots in the period November to January. February is the calm period when wind direction is southerly with velocity in the range of 7 Knots. Stormy weather may generate winds having velocity up to 100 Knots which should be taken as the worst-case scenario for design of tall structures and heavy-duty cranes.

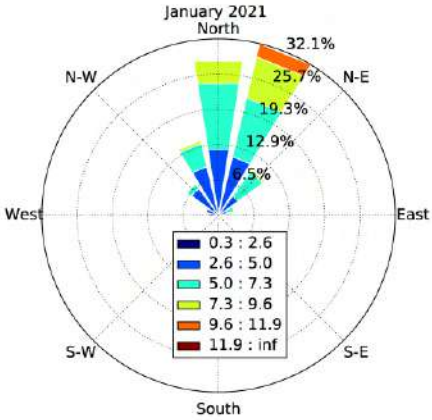


Fig.10.4(a) Wind Rose diagram for the month of January 2021

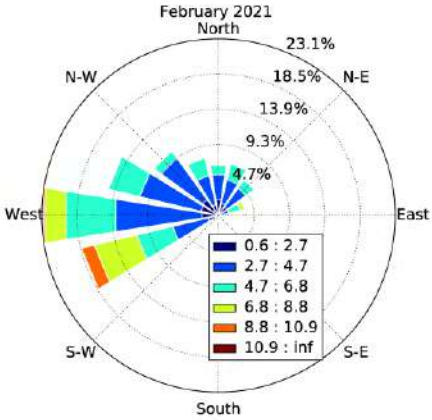


Fig.10.4(b) Wind Rose diagram for the month of February 2021

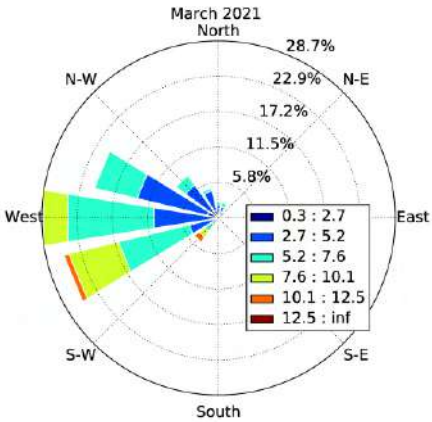


Fig.10.4(c) Wind Rose diagram for the month of March 2021

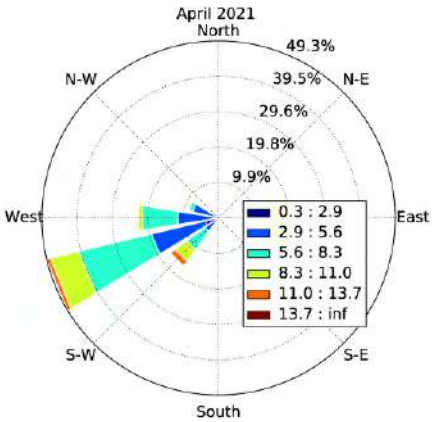


Fig.10.4(d) Wind Rose diagram for the month of April 2021

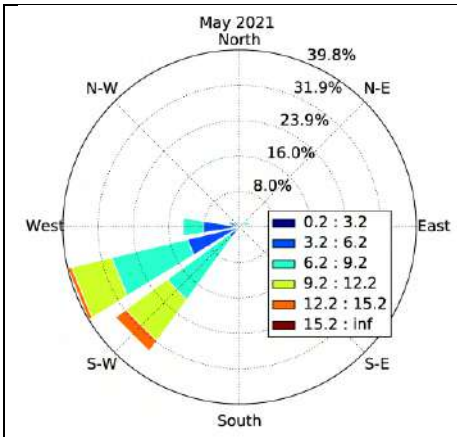


Fig.10.4(e) Wind Rose diagram for the month of May 2021

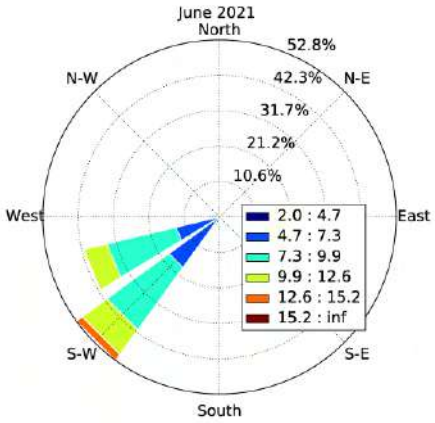


Fig.10.4(f) Wind Rose diagram for the month of June 2021

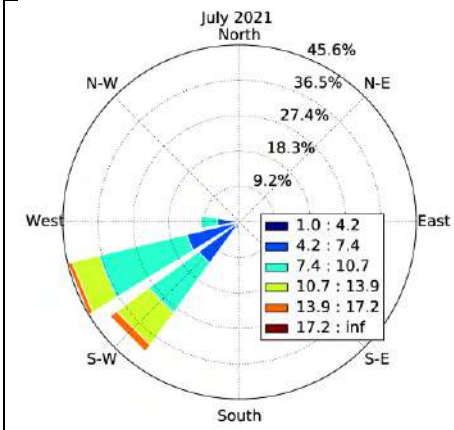


Fig.10.4(g) Wind Rose diagram for the month of July 2021

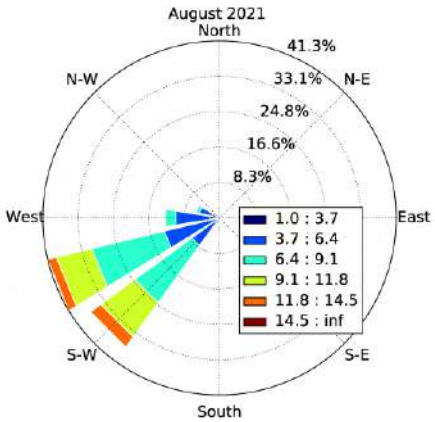


Fig.10.4(h) Wind Rose diagram for the month of August 2021

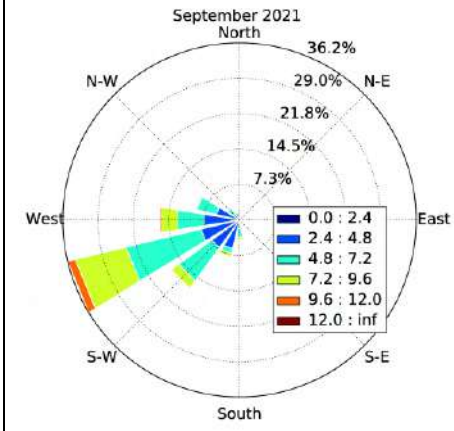


Fig.10.4(i) Wind Rose diagram for the month of September 2021

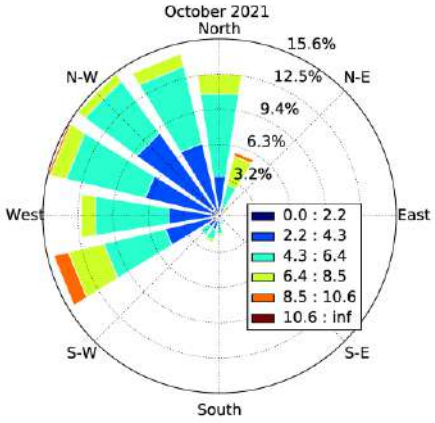


Fig.10.4(j) Wind Rose diagram for the month of October 2021

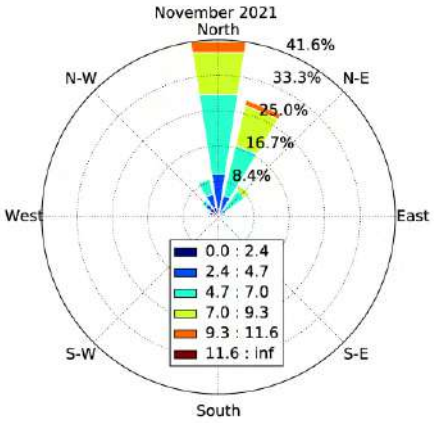


Fig.10.4(k) Wind Rose diagram for the month of November 2021

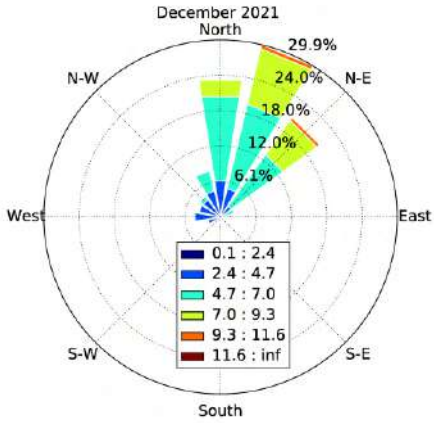


Fig.10.4(l) Wind Rose diagram for the month of December 2021

Rainfall:

The climate of the region has a regular seasonal variation determined by the occurrence of 2 Annual monsoons. The southwest monsoon period extends from June to September. November to March is the period for the North East monsoon. Most of the Annual rainfall occurs during the south west monsoon, the average monthly rainfall being about 45 cm. The average annual rainfall over 20 years is 193 cm.

Humidity & Temperature:

Relative humidity ranges from 61% to 87% being the highest in the monsoon period. During the winter months (Nov-Jan) relative humidity ranges from 61% to 72%. Mean daily temperature ranges from 24 Degrees C to 33 Degrees C except during the winter period when the minimum temperature may fall to about 19 Degrees. The hotter months are March, April, May and June.

10.1.3 Risk Locations and probable Fate of Oil

As with any oil transportation, oil spill risks are associated with Adani port operations. They may vary from a few litres of accidental spill of crude oil / Fuel Oil from offshore vessels to several thousands of tons of oil during collision / grounding situations. In line with the standard industry practice, APSEZL, Mundra is also prepared to mitigate spills of importance from routine operations (Tier-1), while oil spill situations of higher magnitude are dealt with industry co-operation and external intervention. However, it is required to have a fair understanding of the risks and probability of spills arising out of its operations and their consequences due to movement and landing along the coast.

The operations of APSEZL, Mundra are broadly defined under the following:

- Vessel operations- loading / unloading
- Vessel collision, or grounding
- Bunker/ fuelling operations
- Vessel distress / sinking
- Pipeline ruptures /accidental spills from sub-sea/over the sea/shore approach (in the tidal zone) pipelines
- Rupture of export line

The exact quantity of spill from each of the above incident is difficult to predict due to the variables of operating conditions and the length of risk exposure. Maximum risks associated with the events may be considered while devising the oil spill contingency plan. The spill scenarios range from extremely negligible quantities to enormous quantities in rare catastrophic events. The simulation of oil spills does not vary significantly in various scenarios except for the magnitude of impact zone and the quantity involved in such impacts. The software is intended to use for specific scenarios, through a few hypothetical simulations are made in this report considering the worst-case scenarios.

Instantaneous spills (Ref. Fig.11.5)

- Crude oil spill of 700t at selected SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Fuel oil spill of 700t at selected West Port(S5), Vessel route(S7), LNG Jetty(S8), South basin (S9), Mundra Ports(S11), MICT/AMCT(S12)
- Crude oil spill of 10000t at SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Crude oil spill of 25000t at SPM-HMEL(S1), SPM-IOCL(S2), VLCC Jetty (S15)
- Fuel oil spill of 100t at selected West Port (S5, S6), LNG Jetty(S8), South basin (S9,S10), Mundra Ports(S11), MICT/AMCT(S12)
- HSD oil spill of 50t at selected West Port(S5), LNG Jetty(S8), South basin (S9), Mundra Ports(S11)
- HSD oil spill of 20t at selected West Port(S6), South basin (S10)

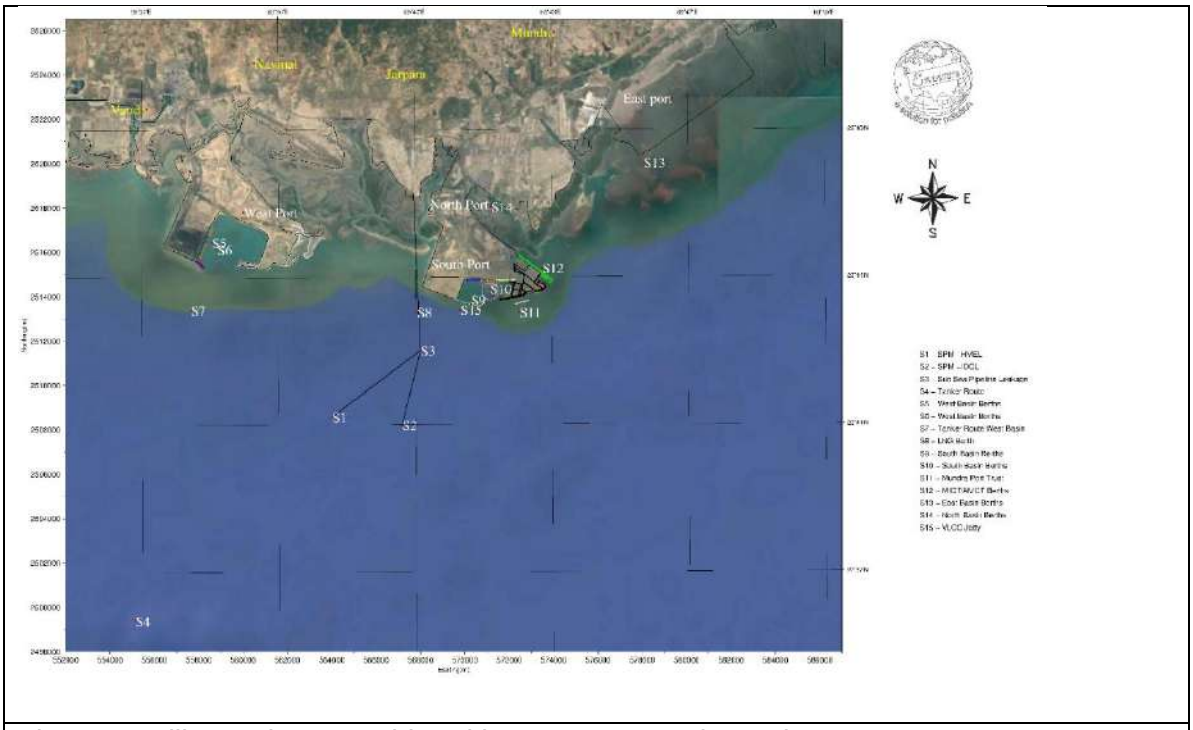


Fig.10.5 Spill Locations considered in APSEZL Mundra region

Continuous spills (Ref. Fig.11.5)

- Crude oil spill of 10000 m^3/hr for 1 min at selected SPM-HMEL(S1), SPM-IOCL(S2)
- Crude oil spill of 10000 m^3/hr for 1 min at selected VLCC Jetty (S15)
- Crude oil spill of 10000 m^3/hr for 1 min at sub-sea pipeline route (S3)

The spill scenarios range from extremely negligible quantities to enormous quantities in rare catastrophic events. The simulation of oil spills does not vary significantly in various scenarios except the magnitude of impact zone and the quantity involved in such impacts.

Detailed Maps and charts for all spill scenarios including probable fate of oil are discussed extensively in PART-B of the report (PART-B: OIL SPILL FATE AND TRAJECTORY MODELING STUDIES)

The following are the risk locations in the Harbour zones of APSEZL, Mundra

- RIL Ports & Terminals, New Bedi Port, Essar Jetties in southern side of Gulf
- Bedi Port, Kalubar Tapu, mora island, Narara Reff, Pirotan Island
- Vadinar Oil Terminal, Borl, Mandvi Beach, Modhva Beach, Tata power Limited (CGPL) intake and outfalls, Adani West Port, Adani South Port, Tuna Port, Kandla Ports, BTC Port Navlakhi
- Sikka coast
- Adani Ports (South, East, West and North)

10.1.4 Sensitivity Area Mapping of Gulf of Kutch

The coast of Gulf of Kutch has tidal flats, mangroves and sand bars etc (Fig.11.6). There is a need to protect the ecosystem and marine environment during the oil handling activities. The resources likely to be threatened are discussed in PART-C of the Report:

The coastal areas of Gulf of Kutch coast abound in marine wealth and industrial activities. It is endowed with a great diversity of natural ecosystems, of which the major systems are salt pans, intertidal zones, sand dunes, mangroves, creeks and Open Ocean. Vulnerability index of shores in order of increasing vulnerability to oil spill damages as per Gundlach and Hayes 1978.

SENSITIVE AREAS

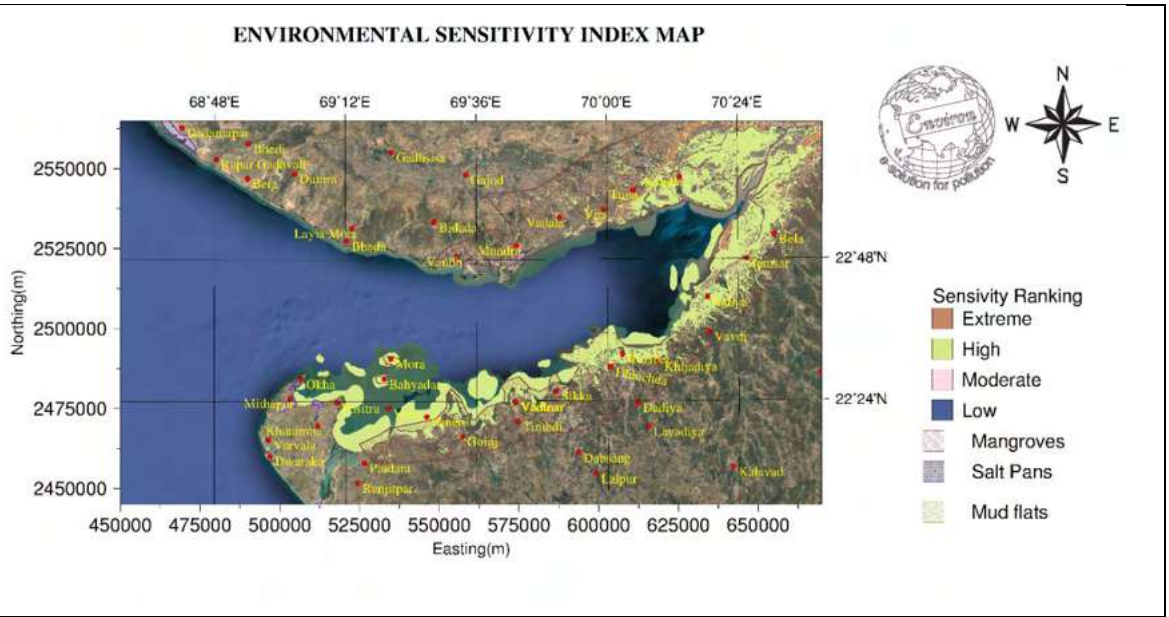


Fig.10.6 Sensitivity Index Mapping for coast of Gulf of Kutch

10.1.5 Sea Zones and Response Strategies

Sea zones can be classified based on depth of water i.e. deep water and shallow water zones. The response strategy will be different for different sea zones. The response options i.e. dispersant and burning can be done for deep water zones where there are not much marine life and the same response options cannot be used for shallow water since the marine activities will be exist along the coasts.

Response strategy for sea zones has been discussed in section 3.3

10.1.6 Coastal

Response strategy for coastal zones has been discussed in section 3.5

10.1.7 Shoreline zones and clean-up strategies

A number of shoreline response strategies are available as per table below, but shorelines should be assessed so see whether these are suitable. This will depend on:

- Rate and likelihood of natural cleaning
- Access for personnel and machinery
- Nature and distribution of the Oil/HNS
- Shoreline character
- Availability of personnel and machinery
- Safety issues
- Environmental sensitivity to Oil/HNS and cleanup methods

Table 10.5: Application of techniques to different shoreline types

	PRIMAY CLEANUP				
	Pumping / skimming	**Mechanical removal**	**Manual removal**	**Natural recovery**	**Comments**
Rocks, Boulders and Artificial structures	V	NA	V	+	Poor access may prevents pumping /skimming. Exposed/ remote shorelines best left to natural recovery
Cobbles, Pebbles and shingle	V	X	V	+	Exposed / remote Shorelines best left to natural recovery
Sand	V	+	V	+	Heavy equipment only applicable on firm beaches
Mud flats marshes and mangroves	+	X	+	V	Operation preferably carried out on the water from small, shallow drought vessels.

FINAL CLEANUP							
	Low pressure flushing	High Pressure washing/Sand	Dispersants	Natural organic sorbents	Batch recovery	Natural recovery	Comments
Rocks, Boulders and Artificial structures	NA	V	+	+	NA	V	Avoid excessive abrasion of rocks/artificial structures. Cleanup of boulders difficult and often gives poor results.
Cobbles, Pebbles and shingle	V	X	+	+	+	+	If load bearing character good, consider pushing oiled material to surf zone to enhance natural recovery
Sand	V	X	+	NA	+	+	Solid oil can be recovered using beach cleaning machines. Enhance natural recovery by ploughing/harrowing
Mud flats marshes and mangroves	+	X	X	+	NA	V	Operations should preferably be carried out on the water from small, shallow-drought vessels.

V : Viable + = Possibly useful X = Not recommended NA : Not Applicable

10.1.8 Oil and Waste storage disposal sites

An efficient and monitored disposal of waste includes immediate classification, segregation, packing and labelling source.

	Packaging	Storage Capacity$_{(m^3)}$
ON WATER	On board Storage	100 to >1,000
	Barges	10 to 10000
	Flexible / towards bladders or tanks	500 to 15000
SHORELINE	Plastic bags or sacks	0.25 to 15,000
	Super sacks	0.5 to 2.5

	Barrels or drums	~0.2
	Portable tanks	1 to 5
	Skips or dumpsters	10 to 40
	Lined pits	Up to 200
	Vacuum trucks	7.5 to 20

WASTE DISPOSAL OPTIONS

WASTE	PRIMARY OPTION	SECONDARY OPTION	ALTERNATE OPTION
Fresh Oil	Refining	Fuel blending	Ex-Situ burning
Weathered	Fuel blending	Land Treatment	Landfill
Emulsions	Fuel Blending	Land Treatment	Landfill
Hydraulic Fuels	Refining		
Oil debris	Incineration	Open burning	Landfill
Oily PPE	Incineration	Landfill	
Oily Sand / Gravel	Ex-situ burning	Land treatment	Landfill
Oily sorbents	Fuel blending	Incineration	Landfill
Oily Wastewater	Electrocoagulation treatment		
Animal car cases	For research	Incineration	
Domestic c waste	Incineration	Landfill	
Non oily debris	Incineration	Landfill	
Pallets	Recycle/reuse	Open burning	Landfill
Paper board	Recycle/reuse	Open burning	Landfill
Drums	Recycle/reuse	Landfill	
Hazardous wastes	Social handling storage treatment		

Table 10.6: Approved Waste Handling Contractors:

Sl. No.	Name	Waste Permitted and Quantity allowed
1	M/s. Daya Lubricants Pvt. Ltd. Bldg. No. 11, Waliv Phata, Prime Industrial Estate, Sativali Road, Village Valiv Phata, Vasai (E), Thane 401208	Used Oil 3000 KLA Waste Oil 14400 KLA
2	M/s. North East Lubrica Pvt. Ltd. S. No. 404, Abitghar, Tal- Vada, Dist. Thane – 421 303	Used Oil 9000 KLA Waste Oil 9000 KLA
3	M/s. Deepak & Company B 20, Road No. 16, Wagle Industrial Estate, Thane – 400 604	Used Oil 18500 KLA

4	M/s. Tax Oil Lubricants Pvt. Ltd. R-591, MIDC Industrial Area, Rabale, Navi Mumbai – 400 701	Waste Oil 12960
5	Chemicals Pvt. Ltd. Plot No. A-10, MIDC Industrial Area, Ambernath, Dis. Thane	Used Oil 6000 KLA Waste Oil 8550 KLA
6	M/s. Meghani Enterprises H-14, Shah & Diwan Industrial Complex, Udyognagar Chintupada, Mahim Village, Palghar, Dist. Thane	Used Oil 4500 KLA
7	M/s. Al Ali Mohammed Industrial Sr. No. 57-1/2, Village Ghatesh Khurd Khanivali Road, Tal- Wada, Dist – Thane - 421303	Used Oil 6000 KLA Waste Oil 18000 KLA
8	M/s. Tribo Lubes Pvt. Ltd. Takai Adoshi Road, Village Honad, Post- Saigaon Survey No. 13/7A, 14/3, 15/16, Tal – Khalapur, Dist – Raigad	Used Oil 7500 KLA Waste Oil 9000 KLA
9	M/s. Spear Petroleum Pvt. Ltd. 152, A, 15th Floor Maker Chamber No. III, Nariman Point, Mumbai – 400 021	Waste Oil 11000 KLA
10	M/s. Balaji Rang Udyog Pvt. Ltd. Plot No. 44, MIDC Taloja Industrial Area Taloja, 410 208 Dist. Raigad	Waste Oil 15000 KLA
11	M/s. Shiva Petrochem Synth Specialists Ltd. Plot No. 2/3, Shah & Divan Indl Area, Opp. BIDCO Studio, Vill – Mahim, Palghar, Dist. Thane	Used Oil 10800 KLA

10.1.9 Sensitive Maps / Atlas

Environmental Sensitive Maps has been prepared based on available data of environmental, biological and industrial sensitive areas of various seasons covering the entire coast of Gulf of Kutch and Adani port regions. The study covers the region between longitudes of 68°E and 71°E and the latitudes of 22°N and 23°N. The sensitivity map as shown in Fig.11.6.

The detailed description of mapping of sensitive areas has been discussed in Part-C of report (**PART-C: OF THE OSCP**)

10.2 LISTS

10.2.1 Primary oil spill equipment

Table 10.7: LIST OF OSR EQUIPMENT/ITEMS AT Adani Ports & SEZL

SL No	Description of Resources	Qty
	Canadine fence boom (reel model 7296/8496 with power pack,towing	1 no

1	bridles and tow lines-235 meter)	
2	Power pack with boom reel with hydraulic hoses	2no
3	Power pack-20kv with boom reel with hydraulic hoses	2no
4	Lamor side collector system (recovery capacity 123 m^3 /hr (side collector LSC-3C/2300(01C02-P536). Oil transfer pump OT A 50 with oil transfer hose set	2no 2sets
5	Lamor minimax 12m3 skimmer	2sets
6	Power pack for skimmers with hydraulic hoses	4no
7	Power pack -20 KV for skimmers with hydraulic hoses	1no
8	Floating tank(25m3)	1no
9	Foot pumps for floating tank	6no
10	Oil spill dispersants	5000ltr
11	Portable dispersant storage tank: 1000 ltr capacity	1no
12	Portable pumps	2no
13	Two -way hydraulic maneuvering panel	2no
14	Oil containment boom -length 2000 meters, height-1500 mm, draft-900mm, free board-600mm	2000 mtr
15	Current buster room -fasflo-75 (for response in fast current)	2no
16	Skimmer -KOMARA 15 duplex skimmer system with floating IMP 6 PUMP	4no
17	12.5T flexible floating storage tank (PUA).	3no
18	Diesel driven transfer pump for flex barge	2no
19	Site hose kit for the transfer pump for flex barge	2no
20	3” and 2” hose adaptor for transfer pump and hose	2no
21	Shoreline cleanup equipment	
22	Mini vac system	5no
23	OSD applicator =oil dispersant spry unit (20 ltr) for use on beach and inter tidal zones	2no
24	Startank with capacity 1000 liter(10m3)	2no
25	Sorbent boom pack (12.5cm*4m)	500 mtr
26	Sorbent pad	2000 nos

In the event of oil spill, Traffic, Mechanical as well as Civil department of APSEZL Mundra shall provide required facility with regard to catering, housing, transportation, field sanitation and shelter etc

Additional support equipment's shall be hired as per requirement by emergency coordinator and Mumbai Port will be delegated this duty.

10.2.2 Sources of manpower

Sources of Manpower:

The following are the sources of manpower to combat any oil spill incident in APSEZL, Mundra:

A. OSR Manpower
B. Adani Port Fire Department
C. Adani Port Employees and Workers
D. Adani Crisis Management Team
E. Volunteers from Colleges and Other Maritime Collegs near to shore.

A: OSR Manpower:

MANPOWER		
1	IMO Level 1	20
2.	IMO Level 2	18
3.	IMO Level 3	7
4.	Other	

1. Adani Ports SEZ Limited, Mundra:

DESIGNATION	APPOINTED MEMBER
Chief Incident Controller (CIC)	Head-Marine
Commander	HOS Marine & DPC
Member Admin & Finance	Head Admin and Head Finance
Member HSE & Media	Head HSE and Head Corporate
Member legal	Head Legal
Member Tech	Head ES

2. DISTRICT ADMINISTRATION

Place Name	Address of Centre	Contact Details
Bhuj (Kutch)	**District Collector Office** Near Circuit House, Mandvi Road, Nr. Mota Bandh, Bhuj (Kachchh) Gujarat – 370001	Phone: +91 2832 250650 Fax: +91 2832 250430 Email: collector-kut@gujarat.gov.in

Jamnagar	District Collector Office, Jilla Seva Sadan, Sharu Section Road, Jamnagar - 361002	Collector, Jamnagar • +91 288 2555869 • +91 288 2555899 • collector-jam@gujarat.gov.in
Khambhalia	District Collector Office 1st Floor, Lalpur Bypass Road, Dharampur, Khambhalia, Gujarat - 361305	91 2833 232805 +91 2833 232102 collector-devbdwarka@gujarat.gov.in

Contact Details of Gujarat Fisheries Development Council

Sl No.	Address of Centre	Contact Details
1	Commissioner Of Fisheries 3rd Floor, Block no-10, Jivraj Mehta Bhavan, Gandhinagar, Gujarat 382010	Phone No: -079- 232-53729 Fax No:- 079-232-53730

State Pollution Control Board – Regional Offices

	Address of Centre	Contact Details
Gandhi nagar	**Gujarat Pollution Control Board** Paryavaran Bhavan, Sector-10A, Gandhinagar-382010.	**Phone :** (079) 2323 2152 **Fax :** (079) 2323 2156, 2322 2784, 2323 2161 gpcbchairman@gmail.com, chairman-gpcb@gujarat.gov.in **Member Secretary** :
Morbi	Regional Center RR4F+6P7, Scientific Vadi, Sardar Nagar, Morbi, Gujarat 363641	**Tel** : 02822 228 001
Jamnagar	Regional Center Sardar Patel Commercial Complex, Rameshwar Nagar regional centre Kasturba Gandhi Vikas Gruh Marg, Bedi Bandar Road Jamnagar- 361 008	**Telephone** (0288) 2752366 **Fax:** (0288) 2753540 **Email:** ro-gpcb-jamn@gujarat.gov.in
Bhuj	Regional Centre Katira Commerical Complex-1, Nr.Manglam 4 Rasta,Sanskar Nagar, Nr.I.Tax Ofic,Bhuj 370001	**Telephone:** (02832) 250620 **Fax:** - **Email:** ro-gpcb-kutw@gujarat.gov.in

10.2.3 Local and National Government contacts

Emergency Contact Directory

Note: Below is the contact detail for Emergency Contact directory. Radio officer will circulate the emergency contact detail through email for any changes in contact details. Final update copy of contact detail will available in Radio Room. Entire document will not be revised due to change in contact details.

	VHF CHANNELS	
	VTMS VHF CH	16/73
	MUNDRA VHF CH	16/77

List of Important Telephone Numbers of Govt. Officials and other neighboring Organizations (Expert and Advisors) related to Spill Combating Plan

SN.	Company	Name and Designation	Telephone Numbers
1.	APSEZL, Mundra	Chief Operating Officer Head Marine Pollution Response Officer Port Control	02838-6272602838-255727 02838-255727 02838-255761 02838-255739
2.	Kandla Port Trust	Chairman Dy. Conservator Harbor Master Signal Station	02836-233001 / 234601 02836-223585 / 220235 02836-270201 02836-270194 / 549
3	Indian Oil Corporation, Mundra	CM (Ops) Manager (Ops) Control Room	02838- 222194 02838- 222197 02838- 224444
4	Indian Oil Corporation, Vadinar	DGM (Ops) Manager Tech Services Port Control	02833-256527 02833-256464 02833-256555
5	Reliance Petroleum Ltd Jamnagar	Marine Chief Senior Port Captain Port Control	0288-4013607 0288-4013750 0288-4012600 / 4012610
6	The Commanding Officer Indian Coast Guard Station, Mundra	ICGS, Mundra Station Ops Officer	02838 - 271402 & 03 (Tel) 02838 – 271404 (Fax)
7	The Commander Coast Guard Region (North West), Gandhinagar	COMCG (NW) Regional Ops & Plans Officer	079-23243241 (Tel) 079-23243283 (Fax)
8	The Commander No.1 Coast Guard District (Guj), Porbandar	COMDIS-1 District Ops & Plans Officer	0286-2214422 (Tel) 0286-2210559 (Fax)

9	The Commander Coast Guard Region (West) Mumbai	COMCG (W) Regional Ops & Plans Officer	022-24376133 (Tel) 022-24333727 (Fax)
10	The Officer-in-Charge Coast Guard Pollution Response Team (West), Mumbai	PRT (W) Officer-in-Charge	022-23722438 (Tel) 022-23728867 (Fax)
11	Gujarat Maritime Board	Vice Chairman & CEO Chief Nautical Officer	079-23238346 / 23238363 079-23234716
12	Ministry of Environment Govt. of Gujarat	Director (Environment)	079-23252154 / 23251062 079-23252156 (Fax)
13	Gujarat Pollution Control Board	Environmental Engineer	079-232 22756 079-232 22784 (Fax)

List of Important Telephone Numbers of Adani Group Personnel

S.No.	Description / contact person / designation	Telephone Nos.	
		Landline	Mobile
01	Capt. Sachin Srivastava, Head – Marine	02838 - 255727	+91 6359883102
02	Head of Section 1 - Marine	02838 – 255730	+91 6359631088
03	Head of Section 2 - Marine	02838- 255947	+91 6357160037
04	Mr. Sanjay Kewalramani, Head-Marine Technical	02838- 255844	91 9925150056
05	Mr. Yogesh Nandaniya, Manager-SPM	02838- 2562379	91 6359775168
06	Mr. Hari Govindan V	91-2838 - 285072	91 9879104805
07	Marine control, APSEZL	02838 – 255333 / 255761	91 9825228673
08	Port Operation center, APSEZL	02838 –255762	91 9825000949
09	Port security Control, APSEZL	02838 – 289322	91 9825000933
10	Head - Security, APSEZL		+91 9109988165
11	Head - Health, safety & Environment, APSEZL	02838 - 255718	+91 9884869471
12	Head - Fire Dept. APSEZL	02838 – 255857	91 7069083035

13	Occupational Health Centre	02838 - 255710	91 8980015070
14	Head-Admin Department	02838 – 255159	+91 8660183841
15	Head Finance	02838 – 255711	+91 9879114993
16	Head Corporate	NA	+91 6358940500

10.2.4 Specification of Oil commonly traded:

OIL HANDLED AT APSEZL, MUNDRA

1. Qatar Crude
2. Persian Gulf Crude
3. Motor Spirit
4. High Speed Diesel Oil
5. Naphtha
6. Furnace Oil
7. Light Diesel Oil
8. Industrial Furnace Oil
9. Reformate / Benzene
10. Maya Crude Oil
11. Arabian Crude Oil
12. Russian Crude Oil

CHARACTERSTICS OF DIFFERENT CLASS OF OILS

OIL TYPE	DENSITY	Viscosity	Pour point C	Flash point C
	(kg/l) At 15C	mPas at 20C		
Crude oil	0.8- 0.95	1-100	+10 to – 35	Variable
Gasoline	0.70 – 0.78	0.5	NA	Less than 0
Kerosene	0.8	2	Less than – 40	38-60
Jet fuel	0.8	1.5-2	Less than – 40	38-60
Diesel oil	0.85	5	-5 to -30	More than 55
Light FO IFO60	0.9	60 at 50 C	+ 50 to -20	More than 60
Medium FO IFO 180	0.9	180 at 50 C	+ 30 to – 20	More than 60
Heavy FO IFO 380	0.99	380 at 50 C	+ 30 to – 20	More than 60

10.2.5 Information sources

APSEZL, MUNDRA OIL SPIL CONTIGENCY PLAN-2019

NATIONAL OIL SPILL DISASTER CONTIGENCY PLAN

IPECA GUIDELINES

11. CONCLUSIONS AND RECOMMENDATIONS

Based on the relevant studies, carried out Risk Assessment of spills, Contingency Plan for APSEZL, Mundra the following conclusions can be drawn:

- The hydrodynamic model runs have been made for prediction of tides and currents for a period of 1 year.
- Sensitivity mapping has been done for the study area considering environmental, ecological, social, economic and other factors.
- Oil Spill Modeling studies have been carried for various spill scenarios for s period of one year.
- NEBA Study has been carried for selecting best response options based on coastal information and spill scenarios.
- The details of spill volume and time taken to reach the coast and losses during its movement have been furnished in the report for preparedness.
- The percentage of spill volume reaching the coast, extent of oiling on the coast in metres, likely vulnerable areas, spill analysis, have been furnished in the report to estimate the fate of the spill.
- Oil spill contingency plan has been prepared as per NOS-DCP 2018 guidelines and presented in Strategy Plan. Strategy plans have been discussed in detail and formulated based on the risk analysis. Resources required to combat oil spills have been identified and furnished along with specifications.
- Prepared the environmental sensitivity Maps based on biological, environmental and socio-economic sensitive areas.
- Sensitivity Atlas has been prepared for coastal areas of Gulf of Kutch.
- APSEZL, Mundra will be placed an Oil Spill Response Plan and is equipped with certain items like adsorbents / absorbents etc for combating small spills in case of any accidental leakages if any. Certain additional combating equipment's are suggested in the report to cater for the oil spill risk.
- Strategy plan has been discussed in detail and formulated based on the risk assessment study.
- Response plan has been formulated based on the contingency plan.

General Recommendations

- Priority should be given to combat the oil spills by physical means such as booms and skimmers. Oil Spill dispersants should be used only if necessary, depending on the clean-up situation and assessment of damage that is likely to occur to the environment. Only those dispersants recommended and approved by Indian Coast Guard (ICG) should be put into use only after obtaining permission from ICG.
- Training as per IMO guidelines should be given to the concerned operating staff involved in oil spill combating.
- Mock drills should be conducted twice in a year.

12. REFERENCES

.No	Title	Year	Client_Name
1	Oil spill contingency plan for offshore oil & gas exploration and appraisal in KG_DWHP_2017/1 & KG_OSHP_2017/1 Blocks in Bay of Bengal, East Godavari District, Andhra Pradesh, Gulf of Kutch, Gujarat , Gulfof Khambhat, Maharashtra and Tamil Nadu Blocks	2019	ABC Techno Labs Pvt Ltd, Chennai
2	Oil spill modeling studies for oil field development in KS Block, East Coast and West Coast of India for ONGC, Mumbai	2019	Oil and Natural Gas Corporation (ONGC), Mumbai
3	Modeling studies for predicting the changes in flow regime, sedimentation and in water qualities for the proposed laying of sub-sea pipelines off Modhva Coast, Gulf of Kutch, Gujarat	2019	Eco Chem Sales and Services-Surat, Gujarat
4	Modeling studies for change in flow regime, and oil spill for the proposed Laying of sub-sea Pipelines from Mumbai Refinery to Rasayani through Thane Creek, Maharashtra	2019	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & BPCL
5	Numerical modeling studies for the hydrodynamic behavior, ship navigation simulation studies and oil spill contingency management plan due to the proposed LNG Terminal at Port Blair, Andaman & Nicobar Islands, India	2018	Vimta Labs, Hyderabad & SEIL Nellore
6	Hydrodynamic modeling studies for predicting the changes in flow regime, erosion / deposition due to the proposed development of marine facilities for conveyor belt at Virpur Village, Devbhoomi Dwarka	2017	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai
7	Oil spill risk analysis and modeling studies for GSPC LNG Ltd (GLL), at Mundra in Gujarat State, India.	2017	Vimta Labs, Hyderabad
8	Numerical modeling studies for the hydrodynamic behavior, ship navigation simulation studies and oil spill contingency management plan due to the proposed LNG Terminal at Port Blair, Andaman & Nicobar Islands, India	2017	Vimta Labs, Hyderabad
9	Modeling of fate and trajectory of oil spill	2016	BG Exploration and Production (India) Limited, Mumbai
10	Hydrodynamic modeling studies for changes in the flow regime, erosion / deposition due to the proposed development of Cargo Jetty at Vadinar, Gulf of Kutch	2016	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai
11	Numerical modelling studies for predicting the impacts on the flow regime & morphology due to the proposed development of cargo berth at MbPT, Thane Creek	2016	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai
12	Mathematical modeling for simulation of trajectory, fate and weathering characteristics of HSD oil spill in the coastal waters of Bedi, Gulf of Kutch	2016	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai
13	Oil spill modeling studies for an offshore oil & gas exploratory drilling project in the Palar Block in the Bay of Bengal	2016	AECOM & Cairn India Limited, Noida
14	1. Stochastic oil spill modelling, net environment benefit analysis studies and response plan for Adani Hazira Port, Hazira, Surat 2. Mapping of marine sensitive areas in the coastal areas of Hazira, Gujarat 3. Net environment benefit analysis studies and response	2015	Adani Hazira Port Private Limited, Hazira

	plan for Adani Hazira Port, Hazira, Surat		
15	Oil spill response plan development for Cairn CB/OS-2 Suvali onshore and offshore facility, Gulf of Khambhat , Gujarat	2015	Cairn Energy Pvt. Ltd., Suvali
16	1. Oil spill risk assessment, net environment benefit analysis studies and response plan for Reliance Industries Limited SPM at Hazira, Surat.2. Mapping of marine sensitive areas in the coastal areas of Hazira, Gujarat. 3. Net environment benefit analysis studies and response plan for Reliance Industries Limited SPM at Hazira, Surat	2015	Reliance Industries Ltd., Hazira
17	1. Oil spill risk analysis and modelling studies for ESSAR Bulk Terminal Ltd at Hazira in Gulf of Khambhat, Gujarat 2. Mapping of marine sensitive areaa in the coastal areas of Hazira, Gujarat 3. Net environment benefit analysis studies and response plan for ESSAR Bulk Terminal Limited, Hazira	2015	ESSAR Bulk Terminal Limited, Hazira.
18	Oil spill risk assessment study and contingency planning for Panna-Mukta Oil Fields of BGEPIL, West Coast of India	2015	BG Exploration and Production (India) Limited, Mumbai
19	Oil spill risk assessment for Panna Field	2015	BG Exploration and Production (India) Limited, Mumbai
20	Risk analysis of fuel oil spills during service vessel operations at and around the proposed jetty in the offshore of Bhogat, Arabian Sea	2015	Bhagavathi Anna Lab Pvt. Ltd. Hyderabad
21	Numerical modeling studies for predicting the impacts on flow regime and morphology due to the marine facilities for LNG Jetty, oil spill contingency planning and ship navigation studies at Krishnampatnam, Eastcoast of India	2014	Vimta Labs Pvt. Ltd., Hyderabad
22	Oil spill risk assessment study and contingency planning for Panna-Mukta Oil Fields of BGEPIL, West Coast of India	2014	BG Exploration and Production (India) Limited, Mumbai
23	1. Modeling studies for changes in the flow regime, sedimentation processes due to the proposed development of marine facilities in Chhara Port 2. Mathematical modelling for simulation of trajectory, fate and weathering characteristics of oil spills in the coastal waters off Chhara	2014	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai
24	Modelling and simulation of oil spill trajectory for Ravva Oil Field, East Coast of India	2013	Cairn India Limited, Noida
25	1. Oil spill modeling studies for oil field development in Andaman Nicobar Basin in East Coast of India for ONGC, Mumbai. 2. Oil spill modeling studies for oil field development in Cauvery Basin in East Coast of India for ONGC, Mumbai. 3. Oil spill modeling studies for oil field development in Mahanadi Basin in East Coast of India for ONGC, Mumbai.	2013	Oil and Natural Gas Corporation (ONGC), Mumbai
26	Oil spill risk assessment and contingency planning for the marine facilities of Adani Ports and Special Economic Zone Limited, Mundra	2013	Adani Port & Special Economic Zone Limited, Mundra
27	Oil spill risk assessment study and contingency planning for Panna-Mukta Oil Fields of BGEPIL, West Coast of India	2013	BG Exploration and Production (India) Limited, Mumbai
28	Oil spill risk assessment study and contingency planning for Krishna	2013	Oil and Natural Gas

	- Godavari Basin, East Coast of India - oil spill trajectory and weathering characteristics for spills at well locations GS-15 -1, GS-15-4 and G-1.		Corporation (ONGC), Eastern Offshore Asset
29	Oil spill risk assessment and contingency planning for the coal jetty facility of RIL at Dahej, Gujarat	2013	Reliance Industries Ltd., Mumbai
30	Numerical modeling studies for predicting the impacts on the shore line and morphology due to proposed marine infrastructure activities at Sikka, Gulf of Kutch and validating the changes / impacts with respect to CRZ Regulations 2011	2012	Reliance Industries Ltd., Mumbai
31	Mathematical modeling for simulation of trajectory, fate and weathering characteristics of oil spills and pesticide spills in the coastal waters off Mumbai / Dahanu	2012	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & ICMAM, Chennai
32	Mathematical modeling for simulation of trajectory, fate and weathering characteristics of oil spill and pesticide dispersion in the coastal waters of Thane	2012	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & Maharashtra Pollution Control Board (MPCB)
33	Oil spill risk assessment and contingency planning for the existing marine facilities of Reliance Industries Limited Jamnagar , Gujarat	2012	Reliance Industries Ltd., Jamnagar
34	Risk assessment study of marine oil spills for KPT SPMs and Product Jetty, Vadinar, Gulf of Kutch	2012	CSIR-National Institute of Oceanography (NIO) , Goa & Kandla Port Trust (KPT), Vadinar
35	Oil spill risk assessment study and contingency planning for Krishna - Godavari Basin, East Coast of India	2012	Asian Consultant Engineers Ltd & Oil & Natural Gas Corporation (ONGC)
36	Oil spill risk assessment study and contingency planning for Panna-Mukta Oil Fields of BGEPIL, West Coast of India	2012	BG Exploration and Production (India) Limited, Mumbai
37	Oil spill risk assessment and contingency planning for KG Basin, East Coast of India	2012	Senes consultants India Limited, Hyderabad & Oil and Natural Gas Corporation (ONGC), Mumbai
38	Oil spill risk assessment and contingency planning for KG , East Coast of India	2012	Oil and Natural Gas Corporation, Mumbai
39	Oil spill risk assessment study for the accidental pipeline ruptures of the 203 km long 30” dia trunk line.	2012	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai
40	Oil spill risk assessment and contingency planning for the augmented marine facilities of RDMT Jetty, Dahej, Gujarat	2012	Reliance Industries Ltd., Mumbai
41	Report on numerical modeling studies for predicting the oil spill trajectories & weathering for select cases of spill at FPSO location in KG Basin, East Coast of India for RIL	2012	Reliance Industries Ltd., Mumbai
42	Mathematical modeling for simulation of trajectory, fate and weathering characteristics of oil spills and pesticide spills in the coastal waters off Mumbai / Dahanu- Phase I & II	2012	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & ICMAM, Chennai
43	Oil spill risk assessment due to crude oil leak from the ruptures in the	2012	Oil and Natural Gas

	30" oil trunk pipeline from Mumbai High to Uran		Corporation (ONGC), Mumbai
44	Oil spill risk assessment due to oil spill in the offshore waters off Mumbai Port	2012	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai
45	Numerical modelling studies for oil spill risk assessment and response plan for RIL Jamnagar marine facilities	2012	Reliance Industries Ltd.
46	Risk assessment study of marine oil spills for existing & proposed extension of jetties & SPMs of Vadinar Oil Terminal Limited at pathfinder inlet, Gulf of Kutch, Jamnagar	2011	Vadinar Oil Terminal Limited (VOTL), Jamnagar
47	Oil spill risk assessment study for IOCL at Vadinar Coast, Gulf of Kutch, Jamnagar	2011	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & Indian Oil Corporation Limited
48	Risk assessment study of marine oil spills for KPT SPMs and Product Jetty, Vadinar, Gulf of Kutch	2011	CSIR-National Institute of Oceanography (NIO), Goa & Kandla Port Trust, Vadinar
49	Comprehensive risk analysis study of existing SPM facilities of IOCL in Gulf of Kutch at Vadinar, Gujarat	2011	Indian Oil Corporation Limited, Pipelines Division, Noida
50	Oil spill risk analysis and contingency plan for Multi Cargo Port by Adani Hazira Port Private Limited, Hazira, Surat	2011	Adani Hazira Port Pvt. Ltd., Surat
51	Oil spill risk analysis and contingency plan for ESSAR Bulk Terminal Limited, Hazira	2010	ESSAR Bulk Terminal Limited, Hazira.
52	Oil spill assessment studies for the oil spill occurred at SPM in the Panna Oil Field	2009	BG Exploration and Production India Limited, Mumbai
53	Oil spill risk assessment study for the extension of proposed marine facilities of Vadinar Oil Terminal Limited product jetties at Vadinar coast of Kutch Jamnagar.	2009	Vadinar Oil Terminal Limited (VOTL), Jamnagar
54	Oil spill assessment studies for the oil spill occurred at coastal waters of Goa	2009	CSIR-National Institute of Oceanography (NIO), Goa
55	Oil spill risk analysis and contingency plan for GMB Ports	2009	Gujarat Maritime Board, Gujarat
56	Oil spill risk analysis and contingency plan for single point mooring off Mundra	2008	CSIR-National Institute of Oceanography (NIO), Goa & HPCL-Mittal Pipelines Limited, New Delhi
57	Oil spill risk analysis for all the operational facilities of Cairn Energy, Gulf of Kutch	2008	Cairn Energy India Pvt. Ltd. (CEIL), Rajasthan
58	Risk analysis of Algeria crude oil spills during unloading operations at and around SPM and pipeline corridor in the offshore of Bhogat, Arabian Sea.	2008	CSIR-National Institute of Oceanography (NIO), Goa & Cairn Energy India Pvt. Ltd (CEIL)
59	Oil spill risk analysis and contingency plan for all the operational facilities of ONGC and its associated operations with respect to oil spill in Bombay High	2008	CSIR-National Institute of Oceanography (NIO), Goa & Oil and Natural Gas Corporation (ONGC)

60	Oil spill risk analysis and contingency plan for container berths at JNPT, Navi Mumbai	2008	CSIR-National Institute of Oceanography (NIO), Goa & Jawaharlal Nehru Port Trust, Navi Mumbai
61	Oil spill risk analysis and contingency plan for all the operational facilities of BG Exploration and Production India Limited and its associated operations with respect to oil spill in Panna-Mukta Oilfield	2007	BG Exploration and Production India Limited, Mumbai
62	Oil spill risk analysis and contingency plan for proposed SPM of HPCL Visakhapatnam	2007	CSIR-National Institute of Oceanography (NIO), Goa & Hindustan Petroleum Corporation Ltd., Mumbai
63	Oil spill risk analysis and contingency plan for liquid cargo jetty at JNPT, Navi Mumbai	2007	CSIR-National Institute of Oceanography (NIO), Goa & Bharat Petroleum Corporation Limited, Mumbai
64	Oil spill risk assessment study and predicting the shoreline impact due to RIL's SPM operations at Hazira	2007	Reliance Industries Ltd., Hazira
65	Oil spill risk analysis and preparation of oil spill contingency plan for Paradip Port, Bhubaneswar	2006	CSIR-National Institute of Oceanography (NIO), Goa & Indian Oil Corporation Limited, Bhubaneswar
66	Oil spill risk analysis and oil spill contingency plan for IOCL,Port Blair Port	2006	CSIR-National Institute of Oceanography (NIO), Goa & Indian Oil Corporation Limited, Port Blair, Andaman
67	Oil spill risk analysis and preparation of oil spill contingency plan for Budge-Budge Port of Indian Oil Corporation, Kolkata	2006	CSIR-National Institute of Oceanography (NIO), Goa & Indian Oil Corporation Limited, Kolkata
68	Oil spill risk assessment study for marine facilities of ESSAR Oil Ltd at Vadinar Coast off Gulf of Kutch, Jamnagar	2005	Essar Oil Limited, Refinery Division, Jamnagar
69	Oil spill risk analysis and contingency plan for CB/OS-2 block, Gulf of Khambhat	2004	Cairn Energy Pvt. Ltd., Chennai
70	Oil spill risk analysis and contingency plan for Hazira Port, Hazira	2004	Hazira Port Trust Private Limited (HPPL), Hazira
71	Oil spill risk analysis and contingency plan for Ravva Oil Field, East Coast of India	2004	Cairn Energy Pvt. Ltd., Chennai
72	Oil spill risk analysis and contingency plan for BPCL, Mumbai	2003	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & Bharat Petroleum Corporation Ltd., Mumbai
73	Quantitative oil spill risk analysis studies and Oil spill contingency planning for HPCL	2003	CSIR-National Institute of Oceanography (NIO), Goa & Hindustan Petroleum Corporation Ltd. Visakh Refinery
74	Marine emergency management plan for Crude Oil and Pol Jetty of CPCL	2002	CSIR-National Institute of Oceanography (NIO), Goa & Chennai Petroleum

			Corporation Ltd., Nagapattinam, Tamilnadu
75	Oil spill risk assessment study for IOCL operations at SBMS at Vadinar Coast, Gulf of Kutch, Jamnagar	2002	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & IOCL, Vadinar
76	Oil spill modelling and shoreline sensitivity mapping	2001	CSIR-National Institute of Oceanography (NIO), Regional Center, Mumbai & Dabhol Power company, Dabhol

13. APPENDIX

APPENDIX-1: MODELING OF HYDRODYNAMIC PROCESSES

Modeling the hydrodynamic processes is an integral part of modeling of fate and transport of oil spills. The basic oil-spill model which was used earlier for risk analysis of oil spills (Ref. Projects completed : www.environsoftware.com) and to track the oil-spill trajectories has been further improved to be used in the present work to estimate risks due to oil spills for various weathering and meteorological conditions.

Adani Ports bounded on the coast of Gulf of Kutch, on the north, south and east by Navalakhi. The currents of the region are tide-driven and assumed the water column is well mixed. These features make the numerical modeling task, as a 2-D hydrodynamical model is sufficient to accurately reproduce the tides and currents of the Gulf of Kutch.

The computational runs in order to obtain better accuracy in the prediction of oil spill trajectory and weathering processes, a finer mesh is adopted to represent the study area for modeling purpose. The study covers the region between latitude 22° N and 23˚N and longitude 68˚ 42' E and 70˚30' E is in Gulf of Kutch, West coast of India. The model simulated for all months and results are presented graphically. The detailed description of Hydrodynamic Processes is discussed in the report **(PART-A: REPORT ON HYDRODYNAMIC MODELING STUDIES)**

APPENDIX-2: MODELING OF FATE AND TRAJECTORY OF SPILLED OIL

Knowledge of probable movement of an oil slick gives a distinct advantage while planning response strategies. Thus, for instance, no major clean-up operation is necessary if the modeling results indicate that the spilled oil would remain at sea thereby sparing the shore ecology. On the contrary, if modeling results are suggestive of shoreward drift and predict that particular ecologically sensitive or important areas would be hit, effective counter measures such as deployment of deflection booms, containment and recovery of oil etc. can be effectively taken.

Hydrodyn-OILSOFT dedicated software for oil spill trajectory modeling is used for prediction of oil spill scenarios at i) Undetected pipeline leakage (ii)Hose-failure (iii) Spills at Oil Jetties (iv)Collision / Grounding (v)Leakages in creeks (vi)Major accident at oil Jetty / collision & Grounding in the channel route for various meteorological and hydrological conditions. The detailed description of Fate and weathering characteristics of spilled oil for various hydrodynamic and meteorological conditions are discussed in the report **(PART-B: REPORT ON OIL SPILL FATE AND TRAJECTORY MODELING STUDIES)**

APPENDIX-3: SENSITIVITY INDEX MAPPING AND ATLAS

There is a pressing need of having marine sensitive area Atlas of coastal areas of Gulf of Kutch, West coast of India which can fulfill the requirement of various organizations including the state governments in taking policy decisions. **Environ Software Pvt. Ltd** has been prepared marine sensitive area Atlas of the Gulf of Kutch regions as well as Adani ports with technical inputs from the available data sources. Latest satellite data has been used to map various coastal lands, biological, environmental and geographical features and prepared the sensitivity index mapping with regards to oil spill risk assessment and management. The detailed description of marine sensitive areas discussed in the report **(PART-C: REPORT ON SENSITIVITY INDEX MAPPING AND ATLAS)**

APPENDIX-4: NET ENVIRONMENT BENEFIT ANALYSIS

Net Environmental benefit Analysis Table for selecting suitable response equipment's & Strategy. The spills at selected locations stranded the coast of Gulf of Kutch, West coast of India for various seasons of year 2021. The weathering will take place based on oil on surface.

Zonal representation of the spill standard to the coast or at open sea, volume of oil floating on the surface and oil losses for various tidal conditions are furnished in the Appendix-2 (**Part-B of the report**). The suitable response equipment's will be selected based on NEBA studies discussed in the report **(PART-D: NET ENVIRONMENT BENEFITS ANALYSIS)**

APPENDIX -5: OIL SPILL REPORT FORM

INITIAL OIL SPILL REPORT FORM PARTICULARS OF PERSON / ORGANIZATION REPORTING INCIDENT

OIL SPILL REPORT FORM

Particular of Person/Organization

Reporting Incident

Title: Risk Assessment Study, Sensitivity Area Mapping and Preparation of Oil Spill Contingency Plan and Allied Works for Tier-1 Oil Spill Response (OSR) Facility For Adani Port & SEZ Limited

Organization: APSEZL, Mundra

Telephone/ Mobile / Telex / Fax number:
Date / Time: ...

- Spill Location: SPMs (S1, S2)
- VLCC Jetty (S15)
- Sub-sea pipeline(S3)
- Tanker entry into the Ports (S4)
- Adani West Port berths (S5, S6, S7)
- LNG Berth (S8)
- Adani South Port berths (S9, S10)
- Mundra Port (S11)
- MICT / AMCT Berths (S12)

Type and quantity of oil spill: ... Type: HSD, Fuel oil and crude oil

Scenarios: Instantaneous and continuous

Quantity: 700t, 10000t and 25000t and 10000 m3/h for 60 sec, 10000m3/h for 1 min..

Cause of oil spill : . By accidents involving loading and unloading operations at berth, VLCC, barges, pipelines, storage facilities, Vessel breaking down, transportation, handling, routine maintenance activities etc....

Response to spillage, if any : .....

Any other information : .....

.....

DAILY INCIDENT LOG

DAILY INCIDENT LOG - TEAM LEADER - OIL SPILL RESPONSE GROUP

Name..... Rank .....

Notification received. ONSHORE / OFFSHORE / INSIDE HARBOUR

Time ..... Date .....

Day ..... Shift .....

LOCATION OF THE INCIDENT

Name of the VESSEL / PLACE ..... Area.....

Latitude ..... Longitude .....

Distance from North Breakwater .....NM Sounding .....

.....

Incident occurred Incident Severity (tick one)

Time ..... Date ..... Minor / Major / Tier I / Tier II / Tier III

Brief details of incident and action taken

.....

.....

WEATHER DATA

Wind Speed ..... Wind Direction ..... Sea State .....

Current Speed ..... Current Direction ..... Visibility .....

Sea Temperature..... Air Temperature ..... Fog / Mist.....

Rain / Precipitation ..... Humidity ..... Cloud cover .....

OPERATION DATA

Type of Boom / Booms deployed..... Total Length .....In Depth .....

Power Pack Running hrs ..... Skimmer Running hrs .....

Oil Recovered from water ..... Liters / Tons Oil transferred ashore .....Litres/Tons

Oil / Sludge cleared from shore .....Kg Sorbents pads use .....Nos.

O.S.D used .....Liters Saw Dust used .....Kg

LOGISTICS AND MANPOWER

Name and type of the vessel / boats available for assistance .....

Name and type of the vehicles available for assistance .....

Manpower utilized ...

Fireman ..... Security Services men ..... Casual Labourers .....Others.....

FORM COMPLETED BY

Name .....

Rank / Designation.....

Signature .....

Time ..... Date .....

On completion, this form is to be handed over to OSC, who in turn after his comments would hand over this form to ECR Team Leader. In absence of any OSC it may be handed over to ECR Team Leader directly

PERSONAL LOG FORM (To be forwarded to HSE Manager)

Form Completed By:

Name .....

Designation .....

Signed ..... Date ...../...../.....

TIME (24 hour Clock)	COMMUNICATION (To / From)	ACTION / MESSAGE

APPENDIX –6: POLREP INFORMATION

The following information must be provided to the coast guard as and when the facts when becomes available. The information is required to generate POLREP reports to government through the coast guard.

1. Identity of informant
2. Time of information receipt
3. Source of spill
4. Probable Cause of spill
5. Type of oil
6. Color code information
7. Configuration
8. Radius
9. Tail
10. Volume
11. Quantity
12. Weathered or fresh
13. Density
14. Viscosity
15. Wind
16. Wave height
17. Current
18. Layer thickness
19. Ambient air temperature
20. Ambient sea temperature
21. Predicted slick movement
22. Confirm classification of spill size

APPENDIX -7: POLAR MESSAGES FORMAT

Address		
Date		From To
Identification		Time Group
Serial Number		
Part I (POLAR WARN)	1	Date and time
	2	Position
	3	Incident
	4	Overflow
	5	Acknowledge
Part ii (POLINF)	1	Date and Time
	2	Position
	3	
	4	
	5	Characteristic of Pollution
	6	Source and Cause of pollution
	7	Wind direction and speed
	8	Current or tide
	9	Sea state and visibility
	10	Drift of pollution
	11	Forecast
	12	Identify of observer and ships on scene
	13	Action taken
	14	Photograph or samples
	15	Name of other agencies informed
Part iii (POLFAC)	1	Date and time
	2	Request for assistance
	3	Cost
	4	Pre-arrangements for the delivery
	5	Assistance to where and how
	6	Other agencies requested
	7	Change of command
	8	Exchange of information
	9	Names and number of personnel
	10	Description of equipment
	11	ETA and arrival information
	12	Place of embarkation
	13	Place of disembarkation

APPENDIX -8: OIL SPILL PROGRESS REPORT

Incident name	
Updated by :	
Date :	Time (Local)
Summary of Incident Response Operation :	
Summary of Incident Response Resource Utilization :	
Number of Aircraft:	Number of Vessels m
Dispersant used: Liters	Length of Boom in use
Number of recovery devices:	Number of storage devices
Sorbent used: Kg	Bioremediation Used
Number of personnel:	Number of Vehicles:
Specialist Equipment:	
Oil Spill Balance Sheet:	
Total amount of oil spilled:	Tonnes
Total amount of oil recovered:	Tonnes
Outstanding amount of spilled oil:	Tonnes
Mass balance:	Tonnes
Estimated natural weathering:	Tonnes
Mechanically agitated	Tonnes
Chemically dispersed	Tonnes
Skimmer recovered	Tonnes
Sorbent recovered	Tonnes
Manually recovered	Tonnes
Bioremediated::	Tonnes
Other….	Tonnes

APPENDIX-9: OIL SPILL REPORT FORM

Complete the oil spill report form as under using the details of notifications and information known and report to the Adani Ports & SEZL**.**

Spill Notification Pro Forma

Fax To: Tele No:

IDENTITY OF OBSERVER / REPORTER		
Full Name:	Organization Company:	
Contact Telephone No,:	Contact E-mail:	
INCIDENT DETAILS		
Operator / organization / company responsible for incident:		
Date of Incident:	Time of incident:	
Installation / facility:	Fixed/Mobile(delete as applicable)	Field Name:
Latitude:	Longitude:	Quad & Block no:
Oil release / Chemical release or permitted discharge Notification (tick below and complete column details as applicable).		
Oil release	Chemical release Notification	Permitted discharge Notification
Max Released (tones):	Quantity Released (kgs):	Max oil discharged (tones):
Min released (tones):	Chemical Name:	Min oil discharged (tones):
Type of oil:	Chemical Use:	Type of oil:
Tier of response (1,2 or 3): (as per Oil pollution emergency Plan)	%Oil if OBM or base oil:	Oil conc. In discharge:
	Warning Label:	Discharge rate M3 / hr
Appearance:	Appearance:	Appearance:
Approx. release area on sea surface (m2 or km2):	Approx. release area on sea surface (m2 or km2):	Approx. release area on sea surface (m2 or km2):
Is release ongoing? YES/NO (if YES notification must be updated & reported each 24 hr period unless otherwise directed by Indian Coast Guard) Release since last report (tones): Total Release till date (tones):		
Source of pollution		
Cause of pollution:		
Steps taken to prevent re occurrence / respond to incident:		
Release likely to reach Median Line YES/NO: Shore YES/NO If YES approx location/ time:		
Photograph Taken: YES/NO	Samples taken for analysis:	
WEATHER CONDITIONS		
Wind Speed (knots):	Wind Direction (0-360):	
Beaufort scale (1-12):	Wave Height (Meters):	

APPENDIX-10: APPLICATION FOR SEEKING COASTGUARD APPROVAL

FOR OSD APPLICATION

Fax To: Tele No:

IDENTITY OF OBSERVER / REPORTER			
Full Name:		Organization Company:	
Contact Telephone No		Contact E-mail:	
DETAILS OF SPILLS			
Quantity	Particulars of oil	Date of incident	Time of Incident
LOCATION			
Latitude:	Longitude:	Depth of Water	
LOCATION			
Landmark			
Oil Type:			
QUANTITIES OF OIL SPILLED AND SOURCE:			
DESCRIPTION OF SLICKS			
Dimensions		Color	
OTHER METHODS OF RESPONSE BEING APPLIED OR CONSIDERED			
WEATHES CONDITIONS			
Wind Speed (Knots):		Wind Direction (0-360)	
Beaufort scale (1-12):		Wave Height (Meters):	
SENSITIVE AREAS IN PROXIMITY AND TYPE			
PARTICULARS OF OSD			
Name of OSD Held with	Quantity held with	Whether the OSD approved for use in Indian waters-	
Toxicity (LC50 value for 96 hours)	Efficiency	Solubility	

APPENDIX – 11 : PRESS RELEASE FORMAT

INITIAL PRESS STATEMENT FORM - POLLUTION INCIDENT

Public Statement Number 1.

An oil spill occurred at ..... hours of date in the facilities of Adani port, West coast of India.

The location of the incident is ...../..... in the offshore of Adani facilities.

.....

The situation is under control / not yet under control / out of control. The installation involved in the incident / accident is in a stable and safe / unstable and unsafe condition. The Oil spill Response Team in being / has already mobilized to deal with the situation. So far ..... litres/ tonnes of Oil has been recovered.

Further statement will be issued in light of any further developments. The news media should contact **HSE Manager** of the Adhani for any additional information.

Signature .....
Name of the installation Manager .....

Date ..... Time .....

Place: .....

NOTE: When, Typed, this Form must be signed by the installation Manager / Emergency Control Team Leader and forwarded to General Manager. Under no circumstances the press statement be released to the NEWS Media without the approval of the concerned authority.

APPENDIX – 12: LIST OF IMPORTANT TELEPHONE NUMBERS

List of Important Telephone Numbers of Adani Group Personnel

SN.	Company	Name and Designation	Telephone Numbers
1.	APSEZL, Mundra	Chief Operating Officer Head Marine Pollution Response Officer Port Control	02838-6272602838-255727 02838-255727 02838-255761 / 289170 (Fax) 02838-255739
2.	Kandla Port Trust	Chairman Dy. Conservator Harbor Master Signal Station	02836-233001 / 234601 02836-223585 / 220235 02836-270201 02836-270194 / 549
3	Indian Oil Corporation, Mundra	CM (Ops) Manager (Ops) Control Room	02838- 222194 02838- 222197 02838- 224444
4	Indian Oil Corporation, Vadinar	DGM (Ops) Manager Tech Services Port Control	02833-256527 02833-256464 02833-256555
5	Reliance Petroleum Ltd Jamnagar	Marine Chief Senior Port Captain Port Control	0288-4013607 0288-4013750 0288-4012600 / 4012610
6	The Commanding Officer Indian Coast Guard Station, Mundra	ICGS, Mundra Station Ops Officer	02838 - 271402 & 03 (Tel) 02838 – 271404 (Fax)
7	The Commander Coast Guard Region (North West), Gandhinagar	COMCG (NW) Regional Ops & Plans Officer	079-23243241 (Tel) 079-23243283 (Fax)
8	The Commander No.1 Coast Guard District (Guj), Porbandar	COMDIS-1 District Ops & Plans Officer	0286-2214422 (Tel) 0286-2210559 (Fax)
9	The Commander Coast Guard Region (West) Mumbai	COMCG (W) Regional Ops & Plans Officer	022-24376133 (Tel) 022-24333727 (Fax)
10	The Officer-in-Charge Coast Guard Pollution Response Team (West),	PRT (W) Officer-in-Charge	022-23722438 (Tel) 022-23728867 (Fax)

	Mumbai		
11	Gujarat Maritime Board	Vice Chairman & CEO Chief Nautical Officer	079-23238346 / 23238363 079-23234716
12	Ministry of Environment Govt. of Gujarat	Director (Environment)	079-23252154 / 23251062 079-23252156 (Fax)
13	Gujarat Pollution Control Board	Environmental Engineer	079-232 22756 079-232 22784 (Fax)

List Of Important Telephone Numbers Of Adani Group Personnel

S.No.	Description / contact person / designation	Telephone Nos.	
		Landline	Mobile
01	Capt. Sachin Srivastava, Head – Marine	02838 - 255727	+91 6359883102
02	Capt. Divya Gupta, HOS-Marine	02838 – 255730	+91 6359631088
03	Capt. Rajat Garg. , HOS-Marine	02838- 255947	+91 6357160037
04	Mr. Sanjay Kewalramani, Head-Marine Technical	02838- 255844	91 9925150056
05	Mr. Yogesh Nandaniya, Manager-SPM	02838- 2562379	91 6359775168
06	Mr. Hari Govindan V	91-2838 - 285072	91 9879104805
07	Marine control, APSEZL	02838 – 255333 / 255761	91 9825228673
08	Port Operation center, APSEZL	02838 –255762	91 9825000949
09	Port security Control, APSEZL	02838 – 289322	91 9825000933
10	Head - Security, APSEZL		+91 9109988165
11	Head - Health, safety & Environment, APSEZL	02838 - 255718	+91 9884869471
12	Head - Fire Dept. APSEZL	02838 – 255857	91 7069083035
13	Occupational Health Centre	02838 - 255710	91 8980015070

14	Head-Admin Department	02838 – 255159	+91 8660183841

Agencies for Supplying Shore Cleanup Equipment and Safety Gears		
Agency	**Addres**	**Contact Number**
M/s Envirocare Systems	4-B, Apeejay surrendra House, 4th Floor, 24, Baroda Street, Mumbai – 400009 Email: envirocaresystems1@gmail.com Web: www.envirocaresystems.net	Phone: (022)23486637.23485474, 23487400. Fax: (022) 23488284
M/s HiTech Elastomers Ltd. Works	798, Rankapur, Nr. Santej Sola-Kalol State Highway, Ta. Kalol Dist. Gandhinagar – 384002. Email: sales@hitechelastomers.com	Phone: +91-2764-286010, 286806,268112. Cell: 9824654669 Fax: +91-2764-286010
M/s Sadhav Shipping Limited	521, Loha Bhavan, P. D'Mello Road, Masjid (East), Mumbai – 400 009. Email:shipping@sadhav.com, osv@sadhav.com Web: www.sadhav.com	Tel: 022-2348 25/24 Fax: 022-2348 25/26

CONTACT DETAILS OF LOCAL ADMINISTRATIVE AUTHORITIES

1. DISTRICT ADMINISTRATION

Place Name	Address of Centre	Contact Details
Bhuj (Kutch)	**District Collector Office** Near Circuit House, Mandvi Road, Nr. Mota Bandh, Bhuj (Kachchh) Gujarat – 370001	Phone: +91 2832 250650 Fax: +91 2832 250430 Email: collector-kut@gujarat.gov.in
Jamnagar	District Collector Office, Jilla Seva Sadan, Sharu Section Road, Jamnagar - 361002	Collector, Jamnagar • +91 288 2555869 • +91 288 2555899 • collector-jam@gujarat.gov.in
Khambhalia	District Collector Office 1st Floor, Lalpur Bypass Road, Dharampur, Khambhalia, Gujarat - 361305	91 2833 232805 +91 2833 232102 collector-devbdwarka@gujarat.gov.in

2. FISHERIES

Sl No.	Address of Centre	Contact Details
1	Commissioner of Fisheries 3rd Floor, Block no-10, Jivraj Mehta Bhavan, Gandhinagar, Gujarat 382010	Phone No: -079- 232-53729 Fax No:- 079-232-53730

3. STATE POLLUTION CONTROL BOARD – REGIONAL OFFICES

	Address of Centre	Contact Details
Gandhinagar	**Gujarat Pollution Control Board** Paryavaran Bhavan, Sector-10A, Gandhinagar-382010.	**Phone:** (079) 2323 2152 **Fax** : (079) 2323 2156, 2322 2784, 2323 2161 gpcbchairman@gmail.com, chairman-gpcb@gujarat.gov.in **Member Secretary**:
Morbi	Regional Center RR4F+6P7, Scientific Vadi, Sardar Nagar, Morbi, Gujarat 363641	Tel : 02822 228 001
Jamnagar	Regional Center Sardar Patel Commercial Complex, Rameshwar Nagar regional centre Kasturba Gandhi Vikas Gruh Marg, Bedi Bandar Road Jamnagar- 361 008	**Telephone** (0288) 2752366 **Fax:** (0288) 2753540 **Email:** ro-gpcb-jamn@gujarat.gov.in
Bhuj	Regional Centre Katira Commerical Complex-1, Nr.Manglam 4 Rasta,Sanskar Nagar, Nr.I.Tax Ofic,Bhuj 370001	Telephone: (02832) 250620 Fax: - Email: ro-gpcb-kutw@gujarat.gov.in

APPENDIX–13: CONTINGENCY PLANNING COMPLIANCE CHECKLIST

Port Authority: **Adani Ports & SEZL**

Description		Complied Yes/ No	Remarks
RISK ASSESSMENT			
1	Whether the facility produces/ handles/ uses/ imports/ stores any type of petroleum product	Yes	Petroleum products are directly transferred from vessels through pipelines
2	Whether risk assessment is done	Yes	Chapter-2 Page No. 17 & Chapter-4 Part-B report
3	Who did the risk assessment		Environ Software Pvt Ltd
4	Whether maximum volume of oil spill that can occur in the worst-case scenario is considered	Yes	25000 T Chap2, refer Para 2.5.3-page No: 21 & Chapter-4 Part-B report
5	Whether relative measure of the probability and consequences of various oil spills including worst case scenario are taken into account	Yes	Chapter2 refer para 2.5.3 Page No. 23 & Chapter-4 Part-B report
6	Whether all types of spills possible in the facility are considered including Grounding, Collision, Fire, Explosion, Rupture of hoses	Yes	Chapter2 refer para 2.1.1 Page No. 17 & Chapter-4 Part-B report
7	Please specify the list of oils considered for risk assessment	Crude, HSD & Fuel Oil	Chapter2 refer para 2.8 Page No. 24 & Chapter-4 Part-B report
8	Whether the vulnerable areas are estimated by considering maximum loss scenario and weather condition	Yes	Chapter2 refer para 2.12 Page No. 31
9	Whether impacts on the vulnerable areas are made after considering the Marine protected areas, population, fishermen, saltpans, mangroves, corals and other resources within that area	Yes	Chapter2 refer para 2.12- & 2.13-Page No. 31,32 & Chapter-3 Part-C report
10	Whether measures for reduction of identified high risks are included by reducing the consequences through spill mitigation measures	Yes	Chapter7 refer fig.7.1 Page No. 66
11	Whether steps have been considered to reduce risks to the exposed population by increasing safe, distances by acquiring property around the facility, if possible	Yes	Chapter 7 refer fig 7.1 Page No. 66
12	Whether risk levels are established for each month after considering the probability with tide and current and consequences of each such spill	NA	
13	Whether prevention and mitigation measures are included in the plan	Yes	Chapter8 refer para 8.1 Page No 84
14	Whether the spill may affect the shoreline.	Yes	Part-B report, chapter 5-OS

	(length of the shoreline with coordinates)		modelling tables (Jan, July, Oct) page nos. 58-66
15	Whether time taken the oil spill to reach ashore in each quantity of spill in various months are mentioned in the plan	Yes	Part-B report, chapter 5-OS modelling tables (Jan, July, Oct) page nos. 58-66
16	Whether sensitivity mapping has been carried out	Yes	Part-C report, chapter 3, refer para 3.1-page no. 5
17	Does the sensitivity mapping clearly identify the vulnerable areas along with MPAs, corals, fishermen community, saltpans, mangroves and other socio- economic elements in the area	Yes	Part-C report chapter 3, refer para 3.1-page no. 5
18	Do the sensitivity maps indicate area to be protected on priority	Yes	Part-C report Annexure-1 refer fig A.1.8-page no. 37
19	Does the map indicate boom deployment locations	Yes	Part-C report Annexure-1 refer fig A.1.1(a), (b)-page no. 35
20	Whether any Marine. Protected Area will be affected	Yes	Part-C report chapter 3, refer para 3.15-page no. 17
21	Whether total number of fishermen likely to be affected is mentioned in the plan	No	
22	Whether any saltpan in the area is going to be affected	No	
23	Whether any mangroves in the area will be affected by a spill	No	
Preparedness			
24	Whether any containment equipment is available	Yes	Chapter4, refer para 4.2 Page No. 43
25	Whether any recovery equipment is available	Yes	Chapter4 refer para 4.2 Page No. 43
26	Whether the facility is having any temporary storage capacity	Yes	Chapter4 refer para 4.1 Page No. 43
27	Whether location of the oil spill response equipment is mentioned in the plan	Yes	Chapter4 refer para 4.1 Page No. 43
28	Whether suitable vessels available for deploying the boom, skimmer etc	Yes	Chapter4 refer para 4.4 Page No. 44
29	Whether OSD held with facility	Yes	5000 Ltrs – Page No: 50
30	Whether the OSD held with the facility is approved for use in Indian waters	Yes	
31	Whether the facility has MoU with other operators for tier-1 preparedness	Yes	Oil companies, HMEL Operators
32	Whether the list of oil spill response equipment available with each agency in MoU is deliberated	Yes	Chapter 9 refer para 9.1 page no. 89
33	Whether the facility has any MoU with private OSRO	Yes	Chapter 9 refer para 9.4 page no. 91
34	Whether the procedure for evoking the mutual aid is clearly described in the plan	Yes	
35	Whether additional manpower is available	Yes	Chapter 10 refer para 10.2.3 page no. 106

36	Whether list of approved recyclers is mentioned in the plan	Yes	Chapter 10 refer para 10.2.1 Page No 105
37	Whether NEBA (Net Environmental Benefit Analysis) has been undertaken	Yes	Part-D report, chapter 1, refer 1.2-page no. 2
38	Whether the areas from priority protection have identified in the plan	Yes	Part-D report, chapter 2, refer para 2.2-page no. 13
39	Whether relevant authorities and stakeholders were consulted for NEBA and during the areas for priority protection	Yes	Part-D report chapter 3
40	Whether District administration has been appraised of the risk impact of oil spills?	Yes	Part-D report
Action Plan			
41	Whether the plan outlines procedure for reporting of oil spills to Coast Guard	Yes	Chapter 2, refer para 2.6-page no. 22
42	Whether the oil spill response action is clearly mentioned	Yes	Chapter 3, refer para 3.1-page no. 36
43	Whether the action plan includes all duties to be attended in connection with an oil spill	Yes	Chapter 3, refer para 3.1 page no. 36
44	Whether the action plan includes key personnel by their names and designation viz. COO, ICO	Yes	Chapter 5-page no. 54
45	Whether alternate coverage is planned to take care of the absence of a particular person [in cases where action plan is developed basis names]	Yes	
46	Whether the plan includes assignment of all key coordinators viz. the Communication Controller, Safety Coordinator, Emergency management team, Administration and Communication Coordinator and Safety Coordinator	Yes	Chapter 10 page no. 93
47	Whether contact directory containing numbers of key response and management personnel is intimated in the plan	Yes	Chapter10 Page No. 93
48	Whether approved recyclers are identified for processing recovered oil and oily debris	Yes	Chapter10 Page No. 104
49	Whether the shoreline likely to be affected is identified	Yes	
50	Whether final report on the incident is submitted to CGHQ as per NOS-DCP 2015	NA	
51	Whether the spill incident and its consequences are informed to fishermen and other NGOs for environment protection through media	NO	
Training and Exercises			
52	Whether mock fire I emergency response drills are specified in the plan	Yes	Chapter 5 refer para 5.2, page no. 54
53	Whether the mock drills cover all types of probable oil spills	Yes	Chapter 5 refer para 5.2, page no. 54
54	Whether the plan mentions list of trained manpower	Yes	Chapter 5 refer para 5.3, page no. 55

55	Whether records for periodic mock drills are maintained in a well defined format	Yes	Quarterly
56	Whether the plan to updated according to the findings in mock-drills and exercises	Yes	
57	What is the frequency of updatron / review of contingency plan?	Yes	As an when required
58	Periodicity of joint exercise with mutual aid partners	Yes	
59	Frequency of mock-drills for practice	Yes	Twice in a year Chapter 12 Page no.131
60	Whether the records for periodic mock drills are maintained in a well defined format	Yes	Chapter 5
61	Frequency of updation / review of contingency plan	Yes	As an when required

We, hereby, declare that the all information appended above and true and correct to my knowledge or belief

Date Chief Conservator / Installation Manager

VERIFIED

Date (District Commander ICG) or his representative

Date Regional Commander ICG)or his representative

APPENDIX–14: TRAINING AND COMPETENCY

The Installation Manager in consultation with the Head, HSE shall determine the oil spill training needs and priorities on a regular basis.

Attendance

All the Site ERT members shall attend oil spill response awareness training. Personnel having specific roles to play in the plan shall be trained in areas specific to their needs. IMO divides the OSR training in three different levels, as given below

Level-1

To provide field personnel and Supervisor, responsible for undertaking on site cleanup operations, an overview of the techniques available for recovering spilled oil and cleaning polluted shorelines.

Level-2

Supervisor I On-scene Commander I Incident Controller: To provide senior personnel with the skills necessary to co-operate and supervise response operations, in a timely, organized and effective manner.

Level-3

Administrators and Senior Managers: to provide senior personnel with an awareness of the role and responsibilities requires in the management of spills of national signification.

Training courses are required to meet both statutory and Adani Ports and SEZ Limited, Mundra requirements for oil spill response preparedness and safe operations.

Records

Records demonstrating that personnel have satisfactorily completed the designated training course shall be maintained.

APPENDIX-15: COMPILATION LIST OF OIL SPILL RESPONSE EQUIPMENT AS PER NOS-DCP-2018 AND AVAILABLE EQUIPMENT WITH Adani Ports & SEZL

Sr. No.	ITEM	As per NOS-DCP 2018	Available in the present
(1)	(2)	(3)	(4)
Pollution response Equipment	Inflatable Booms with accessories (Material: Neoprene/rubber/neoprene rubber)	2000 with 04 power pack	2000
	Fence Boom (Material: Neoprene/rubber/neoprene rubber/PU/PV)	1000 m	235 m
	Skimmer (20 TPH 50% weir type, 50% Brush type)	6	(2+2)
	OSD Applicator with Spray arms type along with 02 Nozzles system and 02 hand lancers (No)	4	4
	Oil Spill Dispersant (chemical dispersant) (litres)	3000	5000
	Bio remediation (litres)	2000	0
	Flex barge 10 Tons (no)	4	2
	Weir boom 100 m with minimum 02 weirs with power pack and accessories (nos) Or Integrated containment cum recovery system with power pack and accessories	4 Or 2	4
	Sorbent boom size min 5-inch dia, min length 5 feet (no)	500	500
	Sorbent pads min 20-inch X 20 inch (no)	2000	2000
	Shoreline cleanup equipment – Mini vacuum pumps capacity 25 m^3	5	2
	200 m shoreline sealing boom with power pack and accessories (material: neoprene/rubber/neoprene rubber) (nos)	3	3
	VOC Portable Monitor	4 Nos	0
	Level A protection: • Positive pressure, full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA; • Totally encapsulated chemical and vapor protective suit;	5	

	• Inner and outer chemical resistant gloves; • Disposable protective suit, gloves and boots;		
	Level B protection: • Positive pressure, full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA; • Inner and outer chemical resistant gloves; • Face shield; • Hooded chemical resistant clothing; • Coveralls • Outer chemical resistant boots	10	
	Level C protection: • Full-face air purifying respirators • Inner and outer chemical-resistant gloves • Hard hat • Escape mask • Disposable chemical resistant outer boots	20	
	Level D protection: • Gloves • Coveralls • Safety glasses • Face shield • Chemical-resistant, steel-toe boots or shoes	30	
Vessels	Work Boats	4	
	Tugs	4	
Manpower	IMO Level 1	20	20
	IMO Level 2	10	18
	IMO Level 3	4	7

Additional equipment and location

LIST OF RESOURCES AVAILABLE-ADANI PORTS and SEZ LIMITED, MUNDRA						
Tugs Available for Oil Spill Containment						
Name of Tug	**Type**	**BHP**	**OSD**	**AFFF**	**Capacity (cum/Hr)**	**BP**
Dolphin No. 4	ASD	2200 X 2	3000 ltr	2000 ltr	1200	55
Dolphin No. 7	ASD	2200 X 2	3000 ltr	2000 ltr	1200	55
Dolphin No. 10	ASD	3000 X 2	3000 ltr	-	-	70
Dolphin No. 11	ASD (DSV)	2200 X 2	3000 ltr	2000 ltr	1200	55
Dolphin No. 14	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Dolphin No. 15	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Dolphin No. 16	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Dolphin No. 17	ASD	3000 X 2	3000 ltr	-	-	70
Dolphin No. 18	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
Brahmini	ASD	2000 x 2	3000 ltr	2000 ltr	1200	65
Bitarni	ASD	2000 x 2	3000 ltr	2000 ltr	1200	65
Khushboo	Fixed screw	401 X 2	-	-	-	10

Dolphin No. 4, 7, 11, 14, 15, 16, 17, 18, Brahmini and Bitarni are fitted with Oil Spill Dispersant boom and proportionate pump to mix OSD and Sea water as required. The tugs are also fitted with a fire curtain and remote-controlled fire monitors.

All above ten Tugs have class notation as Harbour Tugs and are certified to work within the Harbour limits only.

2. Reception Facility: 12" pipe line, connected to a slop tank at chemical tank farm.

Dolphin 11 has firefighting system of 1200 m3/hr along with 20 ton lifting "A" frame and diving support facility.

Location of Oil Spill Equipment: The Oil Spill Equipment stored in SPM Store.

APPENDIX-16: Vendor List

Sr No.	Equipment	Vendor List
1.	Boom complete with all accessories.	Lamor, Elastec / American Marine, ECOservice NEFTEGAZ, Markleen, Vikoma, Desmi, Spilcare, Al Maritim, Expandi, Aqua Guard
2.	Oil recovery free floating skimmer along with suitable pump and hydraulic Power Pack complete with all accessories.	Lamor, Elastec / American Marine, ECOservice NEFTEGAZ, Markleen, Vikoma, Desmi, Spilcare, Al Maritim, Expandi, Aqua Guard
3.	Oil recovery vacuum skimmer with suitable vacuum/suction pump coupled to a diesel engine complete with all accessories.	Lamor, Elastec / American Marine, ECOservice NEFTEGAZ, Markleen, Vikoma, Desmi, Spilcare, Al Maritim, Expandi, Aqua Guard
4.	Oil Spill Dispersant spray system and all required accessories.	Lamor, Elastec / American Marine, ECOservice NEFTEGAZ, Markleen, Vikoma, Desmi, Spilcare, Al Maritim, Expandi, Aqua Guard

5.	Oil Spill Dispersant, Concentrate Type-3 combined	As per the Guidelines of Indian Coast Guard
6.	Absorbent (oil only) kit, for quick oil spill response	Lamor, ECOservice NEFTEGAZ, Markleen, Spilfyter, Spilcare, Al Maritim, Expandi, Spilltech, Aqua Guard
7.	Dedicated Oil Spill Response Vessel	Local with requisite Inland Vessels certifications and latest survey and insurance
8.	Work Boat	Local with requisite Inland Vessels certifications and latest survey and insurance

APPENDIX-17: List of HNS handled with their properties

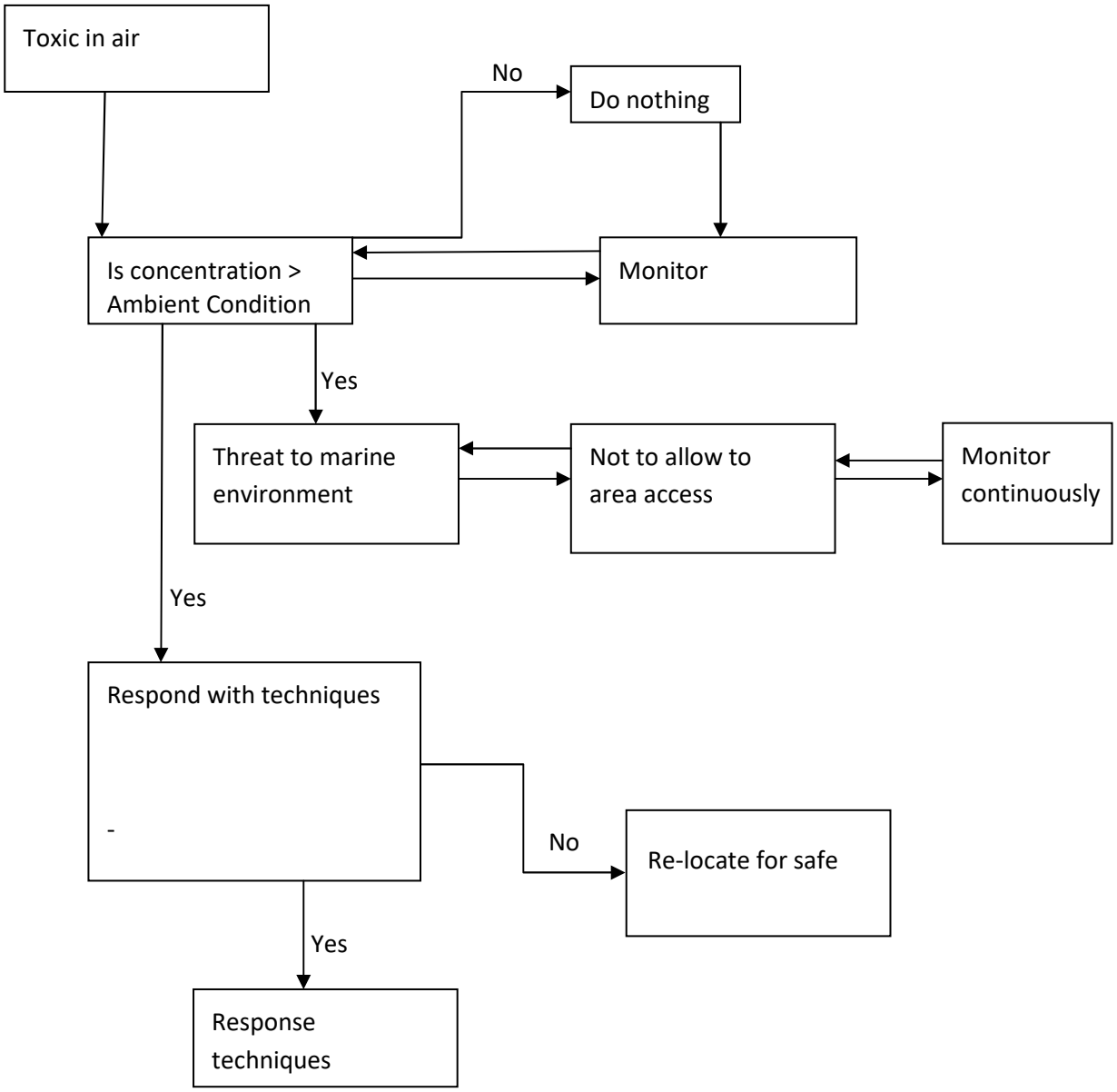
Sl No	Chemical	**Physical state**	**Color**	**Flash Point**	**Boiling Point**	**Melting Point**	**Solubility in water**
1	Alkenes	Solid	White	183 °C	342 – 390 °C	35 °	Soluble in hydrocarbon
2	AWL-Crude palm Oil	Liquid	Reddish yellow	Above 200 °C	N/A	33 – 39 °C	Insoluble in water
3	AWL-Crude glycerin	Liquid	Brownish	187 °C	290 °C	180 °C	Soluble in water
4	AWL-Distilled topped palm kernel Fatty Acid	Liquid	White to yellowish	>100 °C	>240 °C @760 mm Hg	25 -28 °C	-
5	AWL-Fatty Acid	Solid	Yellowish white	>200 °C	-	50 – 58 °C	Non soluble in water, Soluble in alcohol, ether, chloroform, acetone
6	AWL-Lauric Acid	Solid	Light yellow	130 °C	undetermined	32 – 38 °C	-
7	AWL-palm Stearin	Solid oil	Yellowish white	Above 200 °C	N/A	44 °C Min	Insoluble
8	AWL-PKFAD	Liquid	Yellowish (crude) clear (distilled)	>100 °C	>260 °C at 760 mm Hg	-	Soluble
9	AWL-PSA	Solid	Yellowish	Not available	Not available	>48 °C	Not available
10	AL-S.CG	Liquid	Pale to dark brown	199 °C	Not available	18 °C	Water solubility is infinite
11	AWL-SPSFA	Solid	Yellowish	Not available	Not available	52 °C	Not available
12	Base Oil 2CST	Liquid	Light Amber	>140 °C	Not available	Not available	Insoluble in water
13	Bitumen	Solid	Black	220 °C	Not availabl	Not available	Soluble in water <0.1 g/l

					e		
14	CBFS_MSDS	Viscous Liquid	Light to Dark Brown	77 – 110 °C	200 °C	Not available	Negligible at 20 °C
15	CDSBO – Crude Degummed Soya Bean Oil	Liquid	Pale yellow to brownish yellow	282.22 °C	Not available	-20 °C	Insoluble in cold water
16	CPKO	Solid	White Flake	>287.8 °C	Not available	Not available	Not available
17	Crude Sunflower seed oil	Liquid	-	Not available	Not available	Not available	Insoluble in water
18	Csfo	Liquid	-	>200 °C	Not available	Not available	Insoluble in water
19	DNA	Liquid	Colorless	12 °C	80 °C	Not available	Soluble in water
20	FATACU Fatty Acid	Liquid	Green yellow	170 °C	Not available	Not available	Not available
21	FO-CAPL	Liquid	Dark brown to black	>66 °C	Not available	Not available	Not available
22	GTL Fluid G80 SDS	Liquid	Colorless	>80 °C	202 – 275 °C	Not available	Negligible
23	Heavy Aromatic	Liquid	Clear, yellow	45 – 55 °C	155 – 210 °C	Not available	130 mg/L
24	HSD	Liquid	Straw or dark yellow	Not available	110 – 375 °C	Not available	Insoluble
25	Petrelab	Liquid	Colorless	Not available	275 – 307 °C	< -50 °C	Insoluble
26	Linolenic acid	Liquid	Not available	113 °C	Not available	Not available	Not available
27	Methanol	Liquid	Transparent	12 °C	64.7 °C	-97.8 °C	Miscible with water
28	MSDS PYGAS	Liquid	Colorless	Not Available	45 – 240 °C	-20 °C	Negligible
29	Philips Kerosene	Liquid	Light yellow or light green	38 – 66 °C	149 – 300 °C	-40 °C	0.1 %

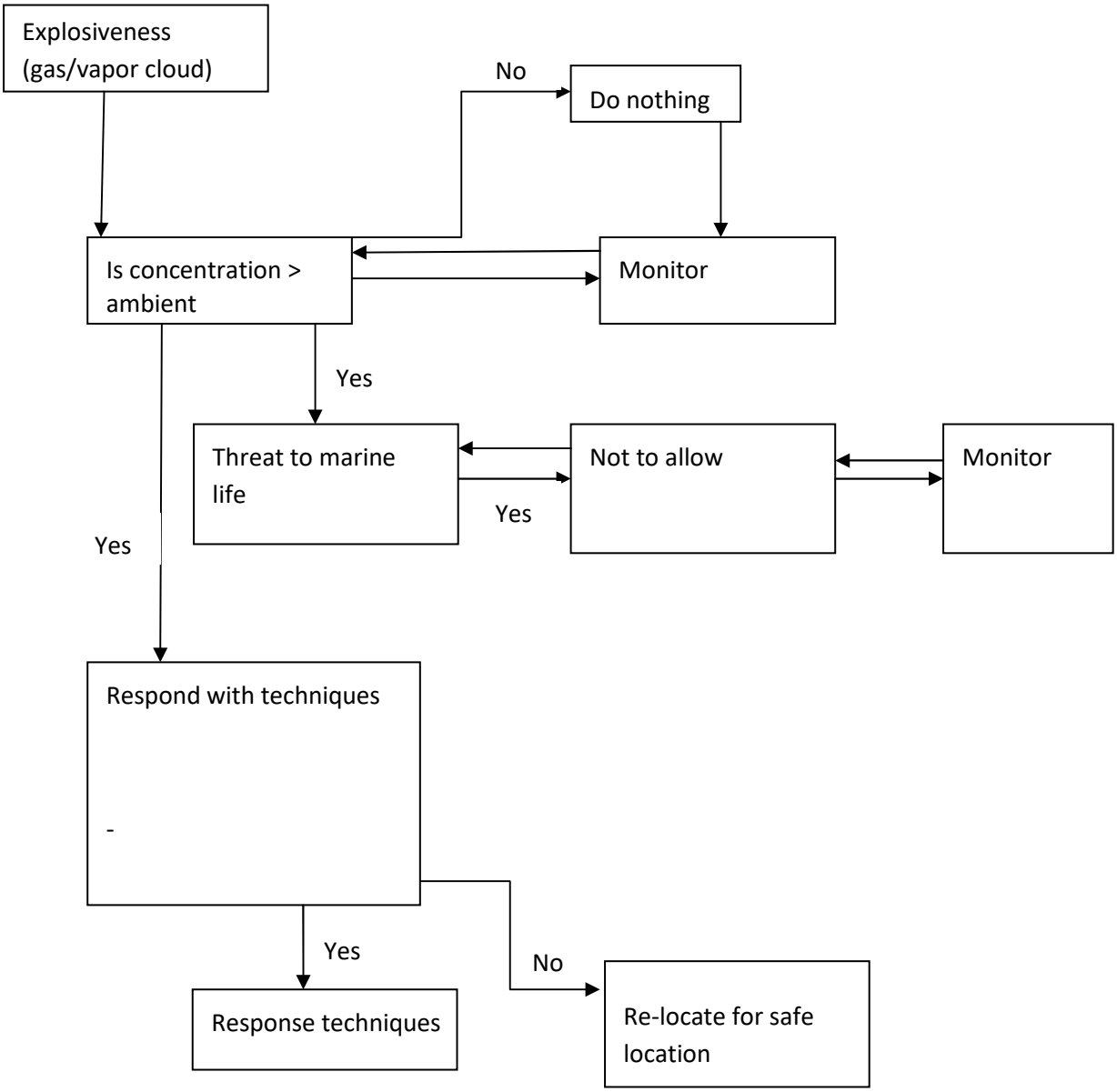
APPENDIX-18: Response techniques for HNS spill

Response to Gas or Volatile liquids

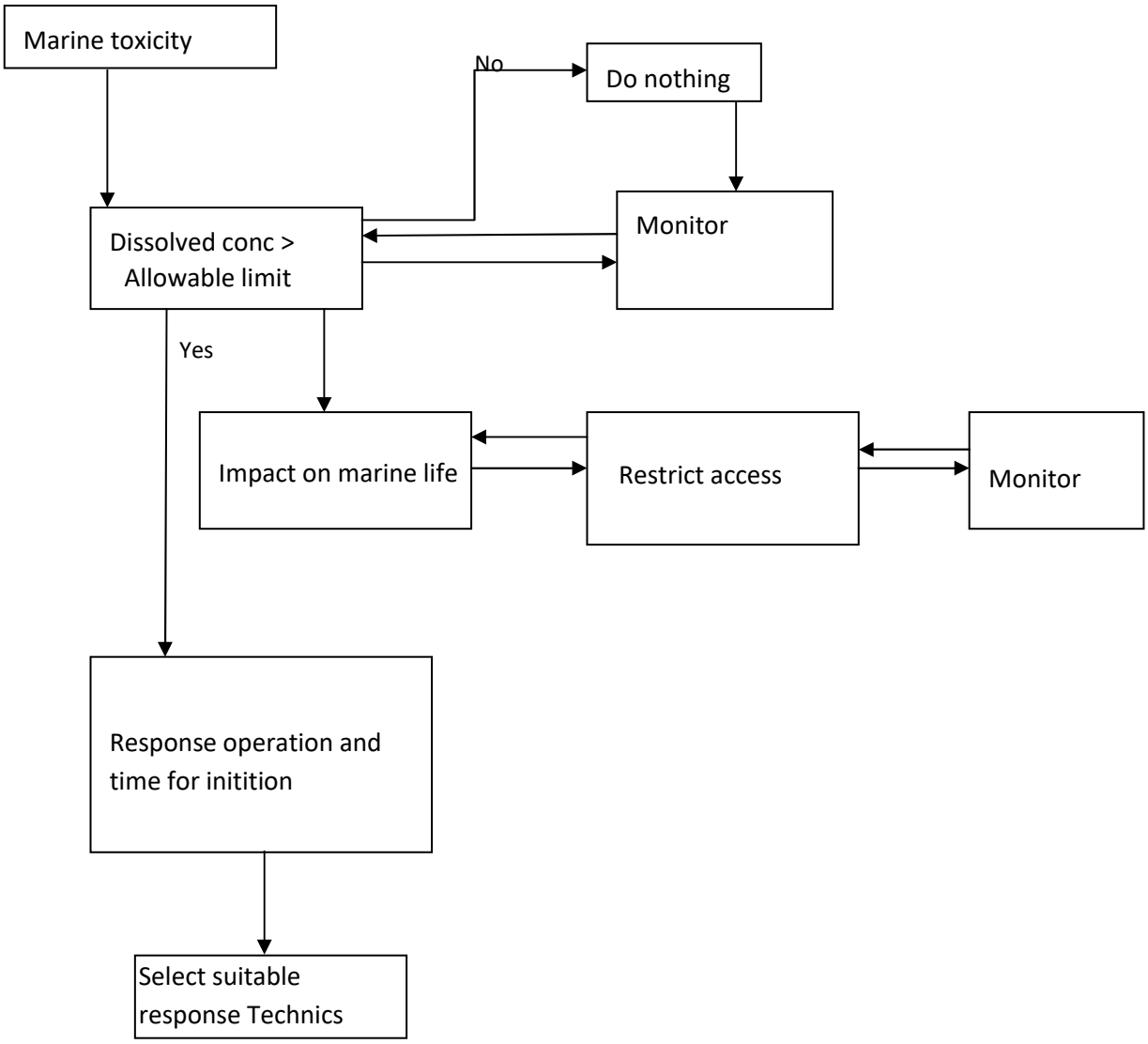
Flow Diagram responding to substances that is toxic in air



Flow Diagram for responding to substances that form explosive gaseous/vapor clouds



Flow Diagram for responding to water soluble toxic substances



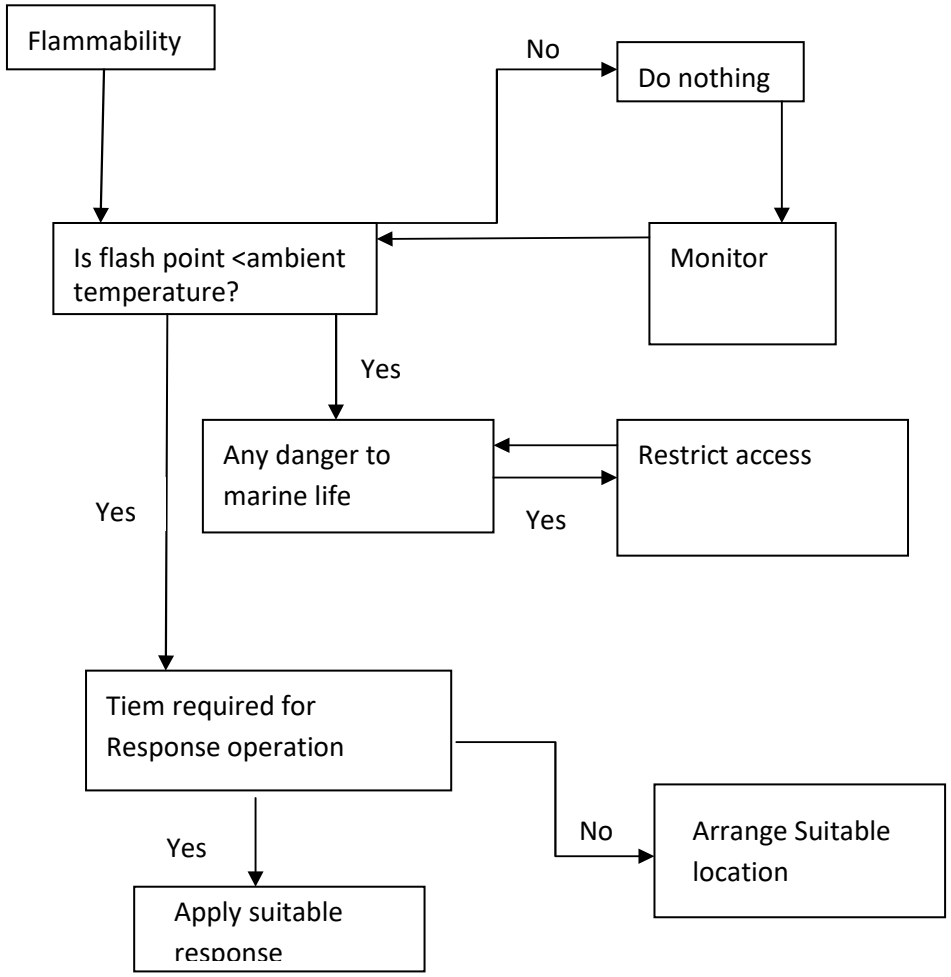
Response techniques for toxic substances

Controlled burning

If the gas is inflammable, controlled ignition and subsequent burning may be considered. Gases vapor clouds can be cleared by water spraying to reduce the fire and explosion of inflammable gases. This response operation is possible only during no wind condition.

Response to Floaters

Flow Diagram for responding to floating flammable substances



Flow Diagram for responding to floating substances which persist on the water surface

Response Techniques for Floaters

Use of fire-fighting foam

Fire-fighting foam can be sprayed onto a Floater to reduce the risk of fire and explosion if it is flammable, or to suppress vapors if it is toxic.

Use of sorbents

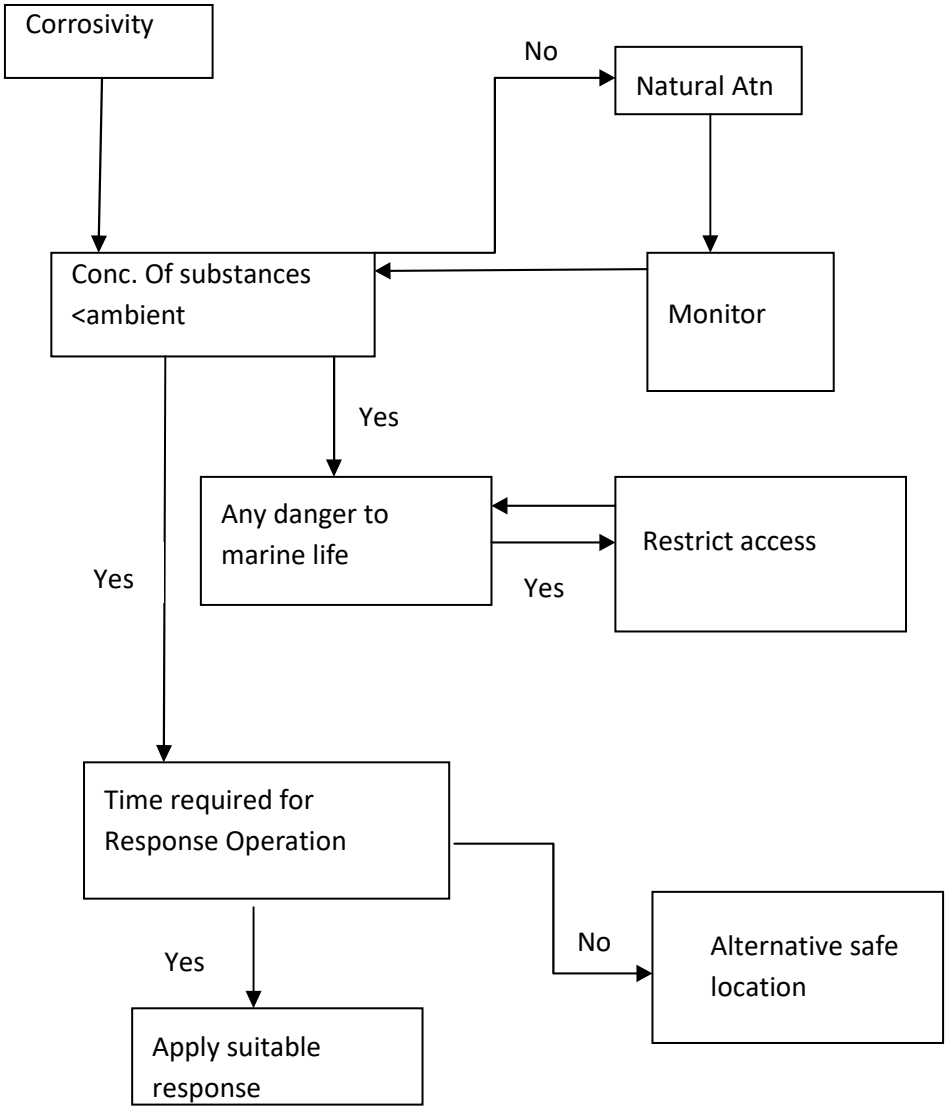
Sorbents (as sheets, pillows or booms or as powder or granulated material) could be applied to the slick for subsequent collection and recovery of the HNS from the sorbent. Polypropylene sorbents used for the recovery of spilled oil would be suitable for the recovery of hydrocarbons, but other liquid HNS may not be amenable to this technique.

Contain and recover

Booms could be used to contain the slick, unless it has already spread too thinly due to low viscosity. The slick could be recovered by using some types of skimmers. Belt skimmers and sorbent rope skimmers are used for the recovery of some chemicals, e.g. octanol and dioctyl phthalate. Skimmers constructed from stainless steel, aluminum alloy or coated with Teflon (interior) are resistant to aggressive chemicals.

Response to Techniques for Dissolvers

Flow Diagram for responding to soluble corrosive substances



Response technique for Dissolvers

HNS spills that dissolve in water can be treated with various response agents in order to reduce or “neutralize” their harmful effects. Examples of chemical treating agents are:

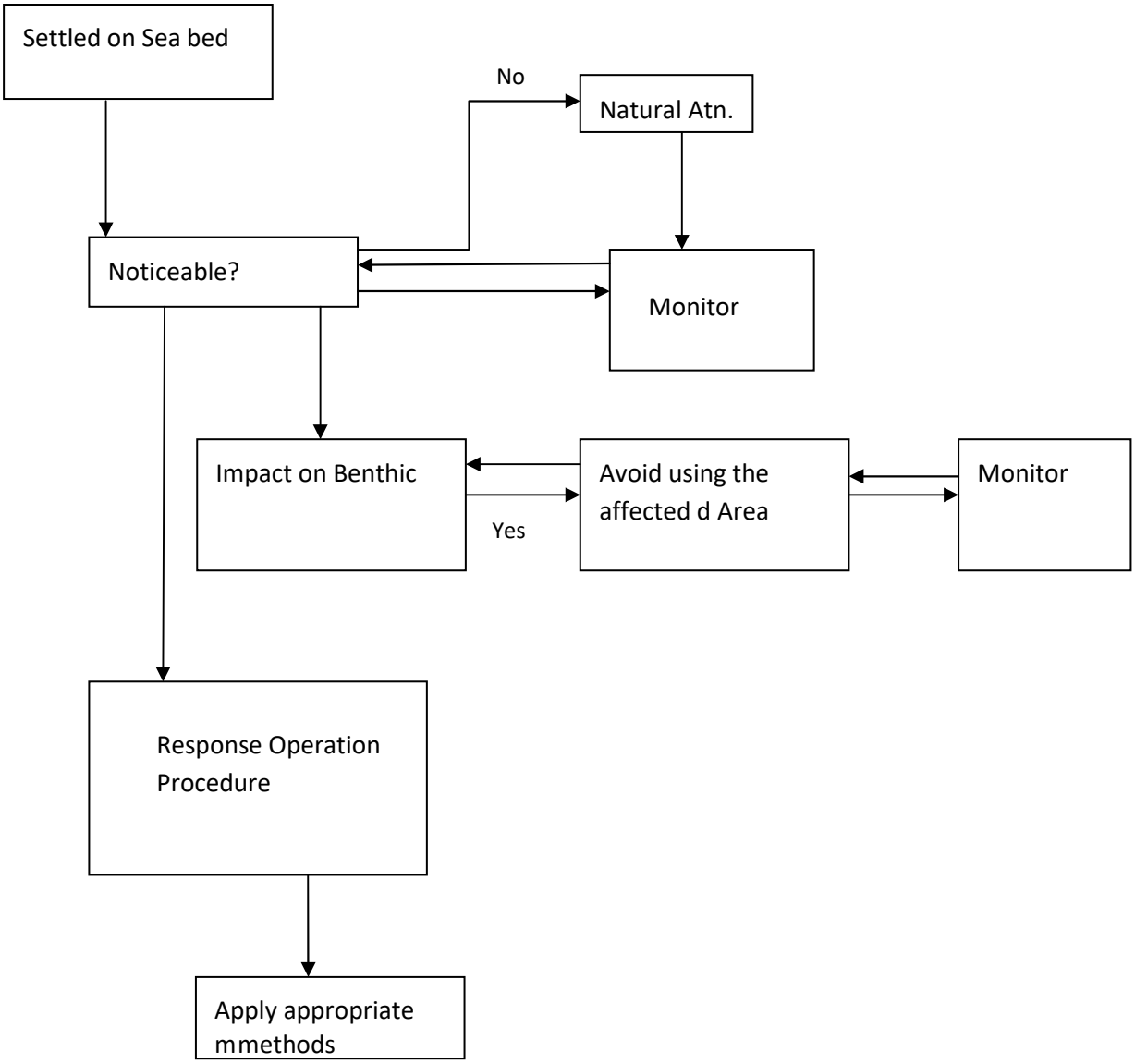
- Neutralizing agents;
- Flocculation agents;
- Oxidizing agents;
- Reduction agents;
- Gelling agents;
- Activated carbon;
- Complexing agents; and
- Ion exchangers.

Neutralization

Acid Spills can be neutralized with sodium bicarbonate ($NaHCO_3$) and monosodium phosphate (NaH_2PO4) to neutralize spills of alkalis.

Response to Sinkers

Flow Diagram for responding to substances which have impact on benthic biota (sinkers)



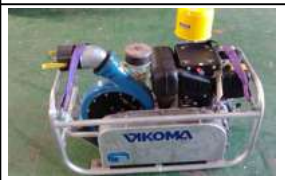
Recovery of HNS from sea bed

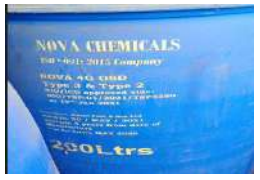
If a Sinker HNS has sunk to the sea bed and is considered to threat to the marine environment and response to be carried out.

The dissolved oils are mixed with sedimentation and forms tar balls, sinks to the sea bed. The material can be pick-up or cleaned using Mechanical, hydraulic and Pneumatic dredgers

APPENDIX-19: Inventory of Oil spill equipment

INVENTORY OF OIL SPILL RESPONSE RESOURCES

Sr No.		Equipment	Make Type/Model	Qnt Ops	Ops	Non-ops	Total	Equipment photos	Remark
1	**Oil Containment Equipments:**								
	A	Inflatable Bulkhead boom	Make: Vikoma International Limited Model: BULKHEAD 1500	2000 mtr.	2000 mtr.	0	2000 mtr.	 	
	a)	Inflator, Back Pack type	Make : Vikoma International Limited Model: PB 580 Type: Backpack Inflator	4	4	0	4	 	
	b)	Inflator, Electric	Make: Vikoma International Limited Serial no.: AP/0080-0174 Model no.: AP/0080-E	2	2	0	2	 	
	c)	Power Pack (GP 10)	Make: Vikoma International Limited Type: Hydraulic Model: GP10	6	6	0	6	 	
	B	Canadyne Fence boom	Make: Canadyne Technologies INC. Model: Boom Reel 7296 HE	235 Mtr.	235 Mtr.	0	235 Mtr.	 	
2	**Oil Recovery equipments:**								
	a)	Skimmer (Brush/Disc)	Make : Vikoma International Model: Komara 15 Type : Komara Duplex Skimming Capacity: 15 m3/hr	4	4	0	4	 	
	B	Intigrated Containment cum Recovery System (Current Buster Boom)	Make: Vikoma International Limited Type: Current Buster Boom Model: FASFLO 75	2	2	0	2	 	

	a)	Power pack (GP 70) for Fasflo Skimmer	Make: Vikoma International Limited Type: Hydraulic Model : GP70	2	2	0	2	 	
3	**Temporary Storage Facility:**								
	a)	Flex Floating Barge	Make: Vikoma International Limited Model: FT/0030 Capacity : 12.5 T	3	3	0	3		
	b)	Flex Floating Barge	Make: Vikoma International Limited Capacity : 25 T	1	1	0	1		
4	**OSD Spraying System:**								
	a)	Fiited on Tugs	All Tugs are fitted with Oil Spill Dispersent boom and proportionate pumps for mixture of OSD with Sea Water as required.	9	9	0	9		
5	**Oil Spill Dispersant:**								
	a)	Chemical OSD	Make: Nova Chemicals Type: NOVA 4G Type II and III Expiry : May 2026	3400 Ltr.	3400 Ltr.	0	3400 Ltr.	 	
	b)	Bio Remediation	Make: Sunchem Industries Purchase year: Oct 2022 Expiry: Oct 2027	2000 Ltr.	2000 Ltr.	0	2000 Ltr.	 	
6	**Shoreline Response Equipments:**								
	a)	Mini Vaccum Pump	Make: Vikoma International LTD Model:V190 Type: Lobe Pump Max flow: 25 m3/hr	5	5	0	5	 	

	b)	Portable Tank - Temporary Oil Storage	Make: Vikoma International Limited Capacity: 10 T	5	5	0	5		
	c)	Pump, Oil Transfer	Make: Vikoma International Serial No.: V190 Capacity: 15 m3/hr	2	2	0	2	 	
	d)	OSD Applicator with Spray arms	Make : Vikoma International Type: Back Pack Capacity: 20 Ltr.	5	5	0	5		
	e)	Sorbent Boom	Make : Vikoma International Limited Size: 12.5 CM X 4 M	500	500	0	500		
	f)	Sorbent pad	Make: Vikoma International Limited Size: 40 CM x 52 CM	2000	2000	0	2000		
	g)	VOC Portable Monitor (MultiGas Detector)	Make: Honeywell Technologies Model: BW Flex 4 Type: Portable Multigas detector	4	4	0	4		

Environ Software Pvt. Ltd.

Corporate Office:

Environ Towers, 60/4, 4th Floor,
Hosur Road, Konappana Agrahara,
Electronic City, Bangalore-560 100. India.
Tel:+91-80-2852 2191, +91-94497 50282
Fax:+91-80-2852 2192
E-mail:environ@environsoftware.com, environ@environcs.com

Branch Office:

T.R Residency, No.A/T-1,
3rd Floor,Sao Paulo,
Taleigao, GOA-403 002. India.
Tel:+91-832-2452069

www.environsoftware.com

www.environinfotech.com

www.environtechnologies.com

Annexure – 7

AREA LEVEL POLLUTION RESPONSE TRAINING/EXERCISE- 2025 REPORT
21 Apr 2025

Date: 21 Apr 2025	**Exercise:** Area Level PR Exercise
Name: Mr. Saket Kumar	**Position:** Radio Officer
Contact Number: 7874604321	**Location:** APSEZL, Mundra

Date: 21 Apr 2025 : Final Planning and Tabletop Exercise

0930-1230 hrs: Tabletop Exercise carried out at Adani house, APSEZ Mundra. Participants- ICGS, Mundra, Deendayal Port Kandla, APSEZ Mundra and HMEL.

Date: 21 Apr 2025 : Mock OSR Drill

Location- Near IOCL SPM (22^0 41' N 069^0 39.2' E)/APSEZL, Mundra

Drill Activity Timeline:

1430 hrs.: Tug Ocean Citrine reported to Marine Control that two in nos 6 inches hole observed in Port fuel tank and oil spillage observed into sea. There is no casualties. Maneuvering capability is intact. There are 33 crew on board, head count taken and all present.

1431 hrs.: Marine Control informed Marine HOD/HOS and all concerned departments.

1431 hrs.: Marine Control informed all vessels at anchor regarding oil spill near IOCL SPM area. The control room requested all underway vessels to pass 5 miles from IOCL SPM.

1435 hrs.: Ocean Citrine team was asked to take the sounding of damaged tanks, carry out cold repairs if possible by Divers and transfer fuel to another tank.

1435 hrs : Dol 11 and KB 48 with PR team proceeded to sight.

1440 hrs.: Dol 11 reached on sight and commenced boom deployment.

1440 hrs.: Capt. Hemant Dhruv, Marine HOS informed ICGS Mundra, Deendayal Port Kandla, Reliance Sikka and ICGS Vadinar about the incident through phone.

1445 hrs : Marine control informed all tugs to be stand by with OSD and Firefighting at short notice.

1446 hrs.: Marine Control informed Tug Dol 17 to stand by with OSD for Spraying nearby area.

1447 hrs.: Informed commercial team, environment cell and Liquid Control Room about the drill/incident to be in immediate readiness.

1448 hrs.: Security department were informed to allow entry of authorized persons, emergency vehicles without any delay and OHS/Adani hospital to be on alert.

1448 hrs : Marine control informed both boats to be stand by.

1450 hrs : Marine Control informed jetty team to deploy one hydra for loading/unloading of OSR equipment at SPM Store and jetty.

1450 hrs : Ocean Citrine informed that spill is spread in an area of around 150-200 m^2.

1455 hrs.: Ocean Citrine commenced internal fuel transferring from damaged tank. Dol 11 both OSD Boom ready and obtain permission from Authority for OSD spraying.

1500 hrs : OSD spraying permission granted.

1500 hrs.: Ocean Citrine informed damaged hole is blanked by divers. The Approx 600-700 ltrs fuel spilled into sea.

1510 hrs : Dol 11 reported Boom paid out now commenced forming U-formation to contain spilled oil.

1515 hrs : U-formation completed, OSD spraying commenced.

1530 hrs : Oil recovery commenced by skimmer.

1540 hrs : Contained oil approx. 600 ltrs recovered and stored in tank.

1545 hrs : Boom recovery commenced.

1618 hrs : Boom recovered and drill called off.

1630 hrs.: Area assessed by diving team and confirmed all clear.

1635 hrs.: Informed environment team for water sampling of spillage area.

1700 hrs.: Environment team informed that area is clear of oil and no environment impact observed.

1715 hrs.: De-briefing carried out onboard Dol-11 and shared learnings.

1800 hrs.: Recovered oil handed over for disposal at Oil Water Separator unit.

1900 hrs.: Environment team informed that GPCB approved recycler has collected the disposed oil.

Personnel & Boats Participated in Drill

Off Shore team:

1. Capt. Prasoon Roy-APSEZL
2. Capt. Sandeep Bisht – Deendayal Port Kandla
3. Dy Comdt GS Rathore – ICGS Mundra
4. Mr Yogesh Nandaniya-APSEZL
5. Mr, Saket Kumar-APSEZL
6. Mr. Ramdas Pavale-APSEZL
7. Mr. Ashok Tiwari - HMEL
8. Mr. Khagendra Kumar - HMEL
9. Mr. Santosh Rasam-APSEZL
10. Mr. Ayush Jha, APSEZL
11. Mr. Harsh Parmar -APSEZL
12. Mr. Jayesh Parmar-APSEZL
13. Mr. Shashikant Padave-APSEZL
14. Mr. Abhishek Pathak-APSEZL
15. Mr. Viral Bamaniya-APSEZL
16. M/s Sea Care – 5 Persons
17. ICGS Mundra – 5 Persons
18. Virag CSE - 6 Persons
19. Tug Dol 11, Dol 17, KB 47 & KB 48

Onshore team:

1. Capt. Hemant Dhruv
2. Mr. Vikram P Singh
3. Mr. Sunny Jai
4. Mr. Shubham Agre
5. Mr. Anish Kumar

Drill Performance Monitoring:

Sl. No	Activity	Time Taken
1.	Time taken to shift OSR equipment from SPM Store to load on DSV tugs	NA / 200-meter Fence boom and 1- skimmer is kept 24 x 7 on Tug Dol-11.
2.	Time taken for Tug cast off from time information given.	NA
3.	Time taken from tug cast off to Reach at Location.	05 min.
4.	Time taken for deploying 250-meter boom and skimmer after reaching at site.	30 min.
5	Time taken for U formation and deployment of skimmer.	10 min.

Observations:

SR. NO.	POINTS	ACTION TAKEN	TARGET DATE	RESPONSIBILITY	REMARKS
1	Capt. Prasoon suggested that during boom laying and recovery operations, PR team on tug Dolphin 11 to be divided into two teams standing by on either side of boom so that no person is required to cross the boom during operations.	Point discussed during de-brief	10.06.2025	PR Team /Dol-11	

Initial Planning Conference, Tabletop Exercise and Mock Drill

Initial Planning Conference at ICGS Mundra

Tabletop Discussion and planning with the participants

Tabletop & Final Planning Conference at Adani house

PR Drill snap – 21 Apr 2025

Area Level Pollution Response Exercise at IOCL SPM
Boom Laying from Tug DoI-11

U-Formtion	J-Formation & Skimmer Operations

OSD Boom operations	
	
De-briefing onboard DoI-11	
	

Annexure – 8

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

Date	:	16th September 2025
Time	:	11:00 Hr
Location	:	Tank -11 (Encloser-01)
Type/Text of the Scenario	:	Fall from height during tank maintenance activity due to dizziness. (No major Injury)

INTRODUCTION:

On 16th May at 10:00 hrs. PTW no APSEZ-LT-2025-2348 was issued to M/s CR-03 for scaffolding erection on Tank No. 11. Job Supervisor Mr. Abhay Rajput conducted a TBT and began the activity. Around 11:00 hrs, Mr. Akhilesh Kumar (I.P.) was assigned to fix the guardrail at a 6-meter height. While ascending the ladder, he felt dizzy and fell from approximately 2.5–3 meters.

The supervisor, who witnessed the fall, immediately informed the safety officer nearby. The safety officer assessed the situation and activated MCP No. 44. Upon hearing the siren, the Shift In-Charge relayed the message via VHF and instructed Mr. Yogirajsinh Zala to investigate. He confirmed a fall incident and informed the Control Room. The Shift In-Charge then dispatched Mr. Ganeswara Rao, Operations Manager, to the site.

After evaluating the situation, Mr. Rao escalated the incident and instructed the Control Room to declare an emergency. He assumed the role of Site Incident Controller (SIC). The Shift In-Charge notified LT-HOD, LT-HOS, POC, OHC, Fire Team, OHS, and Security via calls and VHF.

Mr. Rama Rao, HOS – LT Operations, promptly arrived at the Control Room and took charge as Chief Incident Controller (CIC).

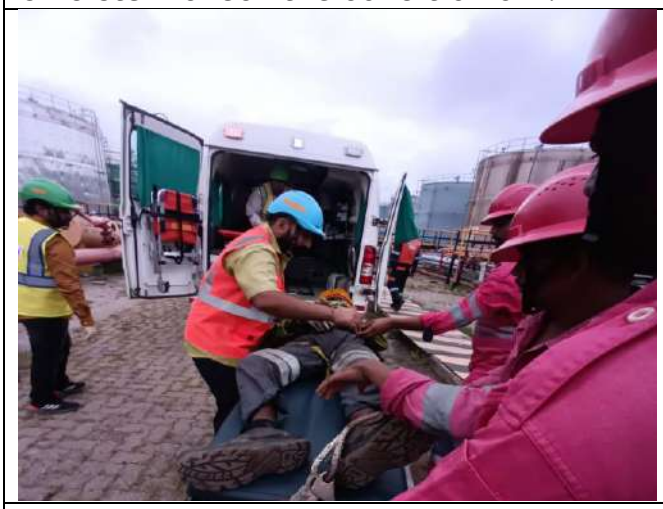
LOCATION (WITH PHOTOGRAPH):

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

SEQUENCE OF EVENTS WITH PHOTOGRAPHS:

Scaffolder Fall from Height during ascending the ladder	**SIC reached at site and declared on site emergency**
	
SIC brief the incident to emergency response teams.	**SIC direct to the OHC team**
	
Fire Team Rescuing the I.P	**Fire Team Rescuing the I.P**
	

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

OHC staff check the condition of I.P	I.P shifted to OHC for further treatment.
	
Incident area secured for further investigation	Ensuring no LEL & Toxic vapour through multi gas detector.
	
All personnels are moved towards assembly point	Briefing of incident to the gathering at assembly point
	

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

RESPONSE TIME:

#	Description		Exact Time
1.	Person Fall from height	:	11:11
2.	Job crew broke the MCP for arranging the rescue	:	11:12
3.	First responder informed to LT control room regarding emergency scenario	:	11:13
4.	Incident controller comes on site	:	11:15
5.	Declaration of Emergency	:	11:16
6.	Ambulance reaching time at incident Point	:	11:20
7.	Safety Shift in-charge reaching time at incident point	:	11:20
8.	Security team reaching time at incident point	:	11:21
9.	Fire Team reaching time at incident Point	:	11:16
10.	Rescue Arrangement at site	:	11:18
11.	OHC Team Check the condition of person	:	11:21
12.	Person shift to OHC by ambulance	:	11:22
13.	First person at Assembly Point	:	11:16
14.	Last person at Assembly Point	:	11:36
15.	Maintenance Arrangement at site	:	11:26
16.	Termination of Emergency and All clear siren	:	11:27

COMMUNICATION & ACTIONS:

Action By	Information To / Action By	Remarks
First Responder	Information given to shift in charge about situation / scenario by VHF	
Site Incident Controller	Assess the site and declare on-site emergency.	
Department / Area In-charge	Inform to POC, Security, Fire, Medical, Safety etc.	
OHC	OHC team response was quick. Ambulance reached on site and given first aid treatment and moved to HOC for further treatment.	
Fire Services	Firemen reached at site and rescued the person from the incident location. Fire tender reached at site in quick time.	
Safety Team	Reached at site on time.	
Security Control Room	Barricade the incident area and ensure vehicle movement restriction inside terminal.	
Engineering Services	LT Maintenance team reached the site immediately after declaration of emergency	
HR/ Admin	Respond on call and ready for any type of HR/Admin related help	

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

Corporate Affairs	NA	

COMMUNICATION TO MUTUAL AID GROUP
(IF REQUIRED, AS AND WHEN MUTUAL AID IS CALLED) – Not Required.

To	By Whom/ Media	Standard	Performance
IOCL		2 min. after receiving information to Emergency Control Room	
HPCL			
JINDAL SAW			
ADANI POWER			
CGPL			
HMEL			

RESPONSE TIME PERFORMANCE OF ACTION

Agency	Standard Time	Performance	Rating (Max. 9/ Block)	
			+VE Marks	-VE Marks
Ambulance	1-2 Min	2 Min	9	
Safety	4-5 Min	4 Min	9	
Fire Services	4-5 Min	3 Min	9	

A. PERFORMANCE OF OHS & F SERVICES & RESCUE SERVICES

Performance	Performance	Rating (Max. 3 per Block)	
		+VE Marks	-VE Marks
Turn out/ response time of Fire Team	Fire team reached at site within benchmark of response time.	3	
Turn out/ response time of OHC Team	OHC team & Ambulance reached at site within benchmark of response time.	3	
Turn out/ response time of Safety Team and in coordination with incident controller mobilisation of personnel and resources.	Response time of Safety team is within benchmark and will coordinate with incident controller for mobilisation of personnel, resources, PPE's etc.	3	
Firefighting at the site	Fire team reached at site on benchmark timing and rescue the I.P.	3	
Medical attention at the site	Reported to incident Controller and quickly check the condition of IP and transfer IP to OHC for further treatment.	3	
Rescue of person	Person rescued by fire team on time and handover to OHC	3	

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

B. PERFORMANCE OF MAINTENANCE DEPARTMENT

Performance	Performance	Rating (Max. 3 per Block)	
		+VE Marks	-VE Marks
Power shut down/ cut off	Maintenance team reached on time. And ensure no electrical power supply	3	
Immediate arrangements at the site	All arrangement were mobilised.	3	
Mobilizing of personnel and resources	Maintenance team reached at site with tool kit. And all appropriate PPEs.	3	
Maintenance activities being carried out at the site	Maintenance activity was stopped till completion of incident investigation.	3	
Clearing debris	Nor required.	3	
Other arrangement at required to meet emergency	Nor required.	3	

C. PERFORMANCE OF SECURITY SERVICES

Performance	Performance Rating	Rating (Max. 3 per Block)	
		+VE Marks	-VE Marks
Turnout of Security	Security Team reached on time. And area barricading done.	3	
Performance of security guards	Except emergency services vehicle no other vehicles are allowed inside LT during emergency.	3	
Security officer's command & control	Security officers took charge and restricted the entry of unauthorized persons / also ensure that vehicles do not enter the incident site.	3	
Area cordoned off	There was area barricading nearby incident spot by security team.	3	

Prevent unwanted/ unauthorized entry into this area	Security officers restrict the entry of unauthorized persons / also ensure that vehicles do not enter the gate also co-ordinate properly with incident controller.	**3**	
Closer of gates	No vehicles are allowed inside LT and turnstile gate was free for out.	**3**	
Providing security coverage at main gate and directing concern person to the site.	Security guard was guided to emergency vehicle for scene.	**3**	

D. PERFORMANCE OF OPERATION/ CONCERN DEPARTMENT

Performance	Performance Rating	Rating (Max. 3 per Block)	
		+VE Marks	-VE Marks
Immediately pass the communication message through VHF / other available media to subordinates & emergency response team.	Communication / Information on emergency conveyed to all concern by incident controller.	**3**	
Stopping of operation / like critical operations first & on priority basis	All operations of encloser 01 and nearby areas are stopped by incident controller.	**3**	
Emergency response of particular department at site	Response time of concern department found adequate. LT and security Person deputed for guided to emergency vehicle for scene.	**3**	
Support for evacuation of people at site and head count along with HR/ Admin	Evacuation done by Operation team and head count was not taken by Liquid and Security team.	**1**	**-3**
Availability and response of emergency kit / equipment / Other.	Emergency spill kit was immediately mobilized at the incident spot.	**3**	
Audibility of the scenario on PA System by Persons	PA system was not operated for evacuation and stopping the operation of area.		**-3**

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

Observer – Mr. Amit Abdeo is at Incident point, Mr. Abhishek Panda at ECR & Mr. Jatin Mewada at assembly point

Good Observations:

1. All Emergency services are reached at incident location as per benchmark timing.
2. Direction to incident location was provided by LT operation team.
3. CIC confirmed the condition of I.P. from OHC through before leaving the control room.
4.

Observations / Area of Improvement:

1. Siren sound was shut down on 3-5 sec, after breaking the MCP.
2. VHF was clearly not audible during emergency at control room.
3. Ambulance was moved speedily to respond the emergency.
4. Emergency rescue training needs to be provided to all operational and engineering workmen.
5. Coper slag kept in between the passage was blocked the access during emergency response.
6. PA system was not used for announcement of emergency evacuation and stopping the operation at emergency location.

Overall rating - 91

Marks from 96 to 100 - Excellent
Marks from 91 to 95 - Very Good
Marks below 90 - Needs Improvement

VOTE OF THANKS: - Mr. Rama Rao Kondappa

SUPPORTING STAFF:

Drill Organized By	: Mr. Abhishek Panda
Drill guided By	: Mr. Rama Rao Kondappa & Mr. Amit Abdeo
Exercise Performance Assessor	: Mr. Amit Abdeo & Mr. Abhishek Panda
Site incident controller	: Mr. Ganeswara Rao
Chief incident controller	: Mr. Rama Rao Kondappa
Report prepared By	: Mr. Abhishek Panda

ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED
MOCK DRILL REPORT

Observations / Area of Improvement:

Sl No	ATS ID	Recommendations	Corrective action	Responsibility	Target date	Remarks
1	303322	Siren sound was shut down within 3–5 seconds after breaking the MCP.	Siren control panel and hooter to be checked fortnightly during siren testing days.	Mr. Rakesh Patel	19-Sep-25	Open
2	303323	VHF communication was unclear during the emergency at the Control Room.	VHF maintenance and procurement of new VHF sets to be initiated.	Mr. Rama Rao	1-Oct-25	Open
3	303327	Ambulances moved speedily during emergency response.	All emergency services must drive cautiously during emergencies to prevent secondary incidents.	Mr. Abhishek Panda	19-Sep-25	Open
4	303328	Workmen were untrained in emergency response and rescue.	Emergency rescue training to be provided to all operational and engineering personnel.	Mr. Rakesh Patel & Mr. Rama Rao	1-Oct-25	Open
5	303329	Copper slag blocked access during emergency response.	Copper slag must be removed from passages to ensure free movement of emergency vehicles.	Mr. Jatin Anu A Raj	23-Sep-25	Open
6	303330	PA system was not used for emergency announcements and evacuation.	PA system should be operated during emergencies for evacuation and emergency declaration.	Mr. Rama Rao	23-Sep-25	Open

Annexure – 9

ADANI PORTS & SPECIAL ECONOMIC ZONE LTD	HOWE ENGINEERING PROJECTS (INDIA) PVT.LTD.

PROJECT	**Development of VLCC Jetty at Mundra for Handling Crude Imports**		
TITLE OF DOCUMENT	**QRA STUDY REPORT**		
EPC CONTRACTOR	**HOWE Engineering Projects (India) Pvt. Ltd.**		
CONSULTANT	**Valdel Engineers & Constructors Pvt. Ltd.**		
CLIENT DOCUMENT NO.	**HW026-50-E-GN-RP-005**	**Rev. No,**	**A**
CONTRACTOR/ CONSULTANT'S DOCUMENT NO.	**10820-30-2004**		

HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD., AHMEDABAD.
EXTERNAL DRAWING / DOCUMENT REVIEW

- [x] A1 - APPROVED
- [ ] A2 - APPROVED WITH COMMENTS
- [ ] A3 - NOT APPROVED
- [ ] A4 - ADDITIONAL INFORMATION REQUIRED
- [ ] A5 - FOR INFORMATION ONLY

This review and approval does not relieve supplier / contractor / sub-contractor from full compliance with purchase order / contract requirements and also from errors in this drawing / document.

Reviewed By: Team Mechanical Signature :
Date: 03.12.2021 Discipline: Mechanical

REV. NO.	DATE	DESCRIPTION	PREPARED BY		CHECKED BY		APPROVED BY		PROJECT MANAGER	
			Init.	Sign	Init.	Sign	Init.	Sign	Init.	Sign
A	12.10.2021	Issued for Approval	VRD		PLN		BTM		BTM	

Table of contents

List of Tables

List of Figures

1 EXECUTIVE SUMMARY

M/s HPCL Rajasthan Refinery Limited (HRRL) intends to set up a 9.0 MMTPA grass root Refinery and Petrochemical Complex in Pachpadra Tehsil of District Barmer in the state of Rajasthan. There is a plan for expanding the refinery for total capacity of 18 MMTPA in future.

For above, HRRL has decided to install a Crude Oil Terminal (COT) at Mundra (Gulf of Kutch) in Gujarat State for receiving, storage of different type of crude oils and dispatch facility for transporting blended crude oil to Rajasthan Refinery. The facilities of COT is to be setup for 9.0MMPTA Arab Light/Arab Heavy/ Arab mix with 10% owners margin. Ship tanker carrying out crude will be offloaded at APSEZL Jetty and then transport to HRRL COT at Mundra through pipeline. From COT facilities, crude shall be transported to refinery storages located at Barmer (Rajasthan) through cross country pipeline of around 500kms of length. The proposed development for the crude oil import terminal and facilities is located at south port, Mundra, Gujarat.

Mundra Port, one of the largest private ports in India, is located in the North Gulf of Kutch and is presently operated by Adani Port and Special Economic Zone Limited (APSEZL) formerly known as Mundra Port and Special Economic Zone Limited (MPSEZL).

The project to be owned and operated by APSEZL, consists of development of the following.

a) Service Platform 42M*30M with MLA-s, Pig Launchers & Other facilities.

b) 373m approach trestle from land fall point to service platform.

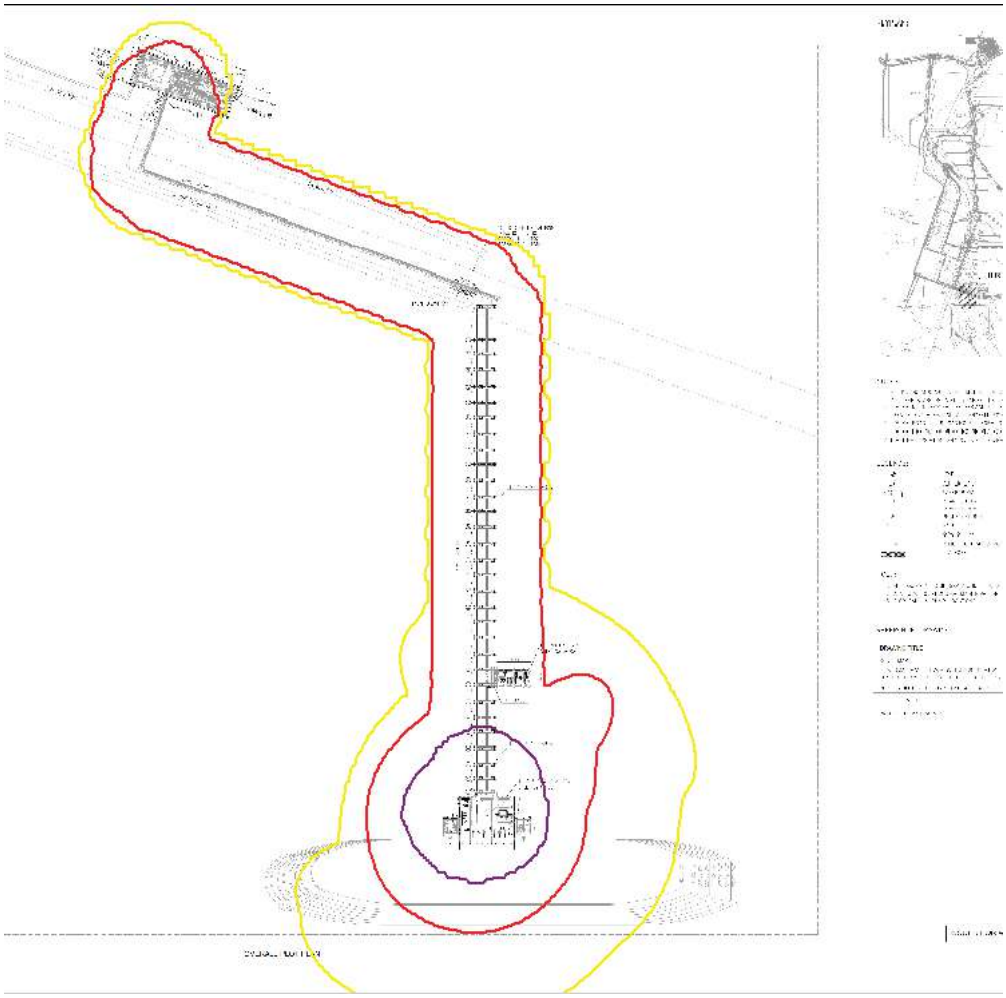
c) About 10km of 48” Cross Country Crude Oil Pipeline up to the Crude Oil Tank (COT) Farm of HRRL @ Mundra

d) Berthing and Mooring Dolphins.

QRA Study has been carried out as per the Methodology provided in Section 2 of this Report. Failure Case Selection, Process Parameters, Leak Size, Release Rate, Detection & Isolation Time, Parts Count & Failure Frequencies, Ignition Probability Data, Meteorological Data, Population Details, Impact Criteria, Individual Risk Criteria, & Societal Risk Criteria are applied as per Assumption Register for QRA Study (Refer Appendix - I). The Software DNV SAFETI 8.4 is used for Consequence Modelling & Risk Modelling respectively. The risk results are detailed in this section below:

Individual Risk contour Topside facilities for crude oil jetty and cross-country pipeline

The following figure shows the risk contours for Topside facilities for crude oil jetty and cross-country pipeline:



ISO- Risk Contour for Topside facilities for crude oil jetty and cross-country pipeline

Based on the result of above figure, the following observations are inferred.

- Individual risk contour of 1E-01, 1E-02,1E-03 and 1E-04 are not realised for overall risk results
- Individual Risk contour of 1E-05 realised and covers entire service platform area and small part of aboveground portion of cross-country pipeline
- Individual Risk contour of 1E-06 and 1E-07 realised and covers entire fire water pump house area and cross-country pipeline (aboveground / underground portion).

Location Specific Individual Risk (LSIR)

The LSIR (Location Specific Individual Risk) is estimated based on hazardous event outcomes of identified loss of containment scenarios, frequencies of loss of containment scenarios, event probability for release scenarios, ignition probabilities together with the directional probability of wind. LSIR levels represent the cumulative risk at a particular location from all the accident events at the project facility for an individual who is assumed to be present at that particular location for 24 hours a day and 365 days a year without any protection. The average risk from individual units and nearby locations provided below:

Sr. No.	Location Description	LSIR (per year)
1	Approach Road	4.15E-05
2	Boom Deploying Station	4.07E-05
3	Loading Arm	4.63E-05
4	Fire Water Pump House	9.18E-06
5	Service Road	8.15E-06

Individual Risk Per Annum (IRPA)

Individual Risk Per Annum (IRPA) is arrived at by combining Location Specific Individual Risk (LSIR) with exposure hours of different worker category. IRPA also calculated based on summation of risk from all failure scenarios at particular location for worker category based on occupancy.

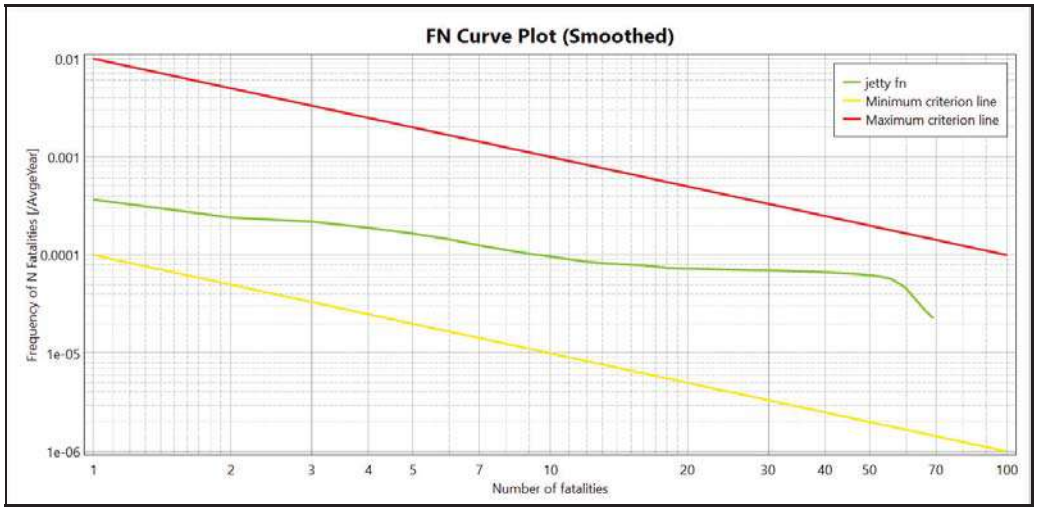
The LSIR is estimated based on hazardous event outcomes of identified loss of containment scenarios, frequencies of loss of containment scenarios, event probability for release scenarios, ignition probabilities together with the directional probability of wind. LSIR levels represent the cumulative risk at a particular location from all the accident events at the project facility for an individual who is assumed to be present at that particular location for 24 hours a day and 365 days a year.

IRPA reflects the risk of an individual spending certain fractions of his/her time at specific locations in the facility. The required IRPA calculations are performed based on hours exposure by a worker in the area. The IRPA for the personnel category are estimated and the same is tabulated below:

Sr. No	Location Description	LSIR Frequency /Avg. Year	Occupancy factor	Incremental IRPA/Avg. Year	Remark
1	Jetty Control personnel	4.02E-05	0.24	9.73E-06	ALARP (Lower ALARP)
2	Jetty Security personnel	4.40E-05	0.24	1.06E-05	ALARP (Lower ALARP)
3	Jetty Unloading Platform Area (Workers)	4.63E-05	0.24	1.12E-05	ALARP (Lower ALARP)
4	Guard	3.38E-05	0.24	8.18E-06	ALARP (Lower ALARP)
5	Maintenance / Instrumentation workers	4.21E-05	0.24	1.02E-05	ALARP (Lower ALARP)
6	Other category of workers - FFS	4.34E-05	0.24	1.05E-05	ALARP (Lower ALARP)

F-N Curve

Societal risk is the risk exposure by a group of people exposed to the hazard. Following F-N curve shows the frequency (F) of there being 'N' of more fatalities due to different failure cases for Topside facilities for crude oil jetty and cross-country pipeline.



FN-Curve for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline Project

From the above figure, it is observed that the F-N curve for the Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline fall under ALARP region. F-N curve falls in ALARP region between 1 to 70 number of fatalities. Maximum number of fatalities observed due to loss of containment events in the terminal and jetty facility is 70 with a frequency of 2.27E-05 per year.

Observation & Recommendations:

Based on the risk results, the following are the observations / recommendation:

1. Personnel at the facility shall be trained regularly on emergency response and preparedness. Ensure that emergency handling and mitigation systems are adequate. Mock drills based on emergency scenario shall be conducted at regular intervals to review emergency preparedness
2. Location specific individual risk of 1.0E-05 and 1.0E-06 per year is realized outside the facility. Therefore, it is recommended to ensure that Emergency Response Disaster Management Plan should be appropriately address the major credible scenarios from the facility for safe escape and evacuation during emergency.
3. Existing Disaster Management Plan (DMP) should be updated including the worst-case scenarios from the project facility.

2 INTRODUCTION

M/s HPCL Rajasthan Refinery Limited (HRRL) intends to set up a 9.0 MMTPA grass root Refinery and Petrochemical Complex in Pachpadra Tehsil of District Barmer in the state of Rajasthan. There is a plan for expanding the refinery for total capacity of 18 MMTPA in future.

For above, HRRL has decided to install a Crude Oil Terminal (COT) at Mundra (Gulf of Kutch) in Gujarat State for receiving, storage of different type of crude oils and dispatch facility for transporting blended crude oil to Rajasthan Refinery. The facilities of COT is to be setup for 9.0MMPTA Arab Light/Arab Heavy/ Arab mix with 10% owners margin. Ship tanker carrying out crude will be offloaded at APSEZL Jetty and then transport to HRRL COT at Mundra through pipeline. From COT facilities, crude shall be transported to refinery storages located at Barmer (Rajasthan) through cross country pipeline of around 500kms of length. The proposed development for the crude oil import terminal and facilities is located at south port, Mundra, Gujarat.

Mundra Port, one of the largest private ports in India, is located in the North Gulf of Kutch and is presently operated by Adani Port and Special Economic Zone Limited (APSEZL) formerly known as Mundra Port and Special Economic Zone Limited (MPSEZL).

The project to be owned and operated by APSEZL, consists of development of the following.

a) Service Platform 42M*30M with MLA-s, Pig Launchers & Other facilities.

b) 373m approach trestle from land fall point to service platform.

c) About 10km of 48” Cross Country Crude Oil Pipeline up to the Crude Oil Tank (COT) Farm of HRRL @ Mundra

d) Berthing and Mooring Dolphins.

2.1 Scope

The scope of work is to carry out Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.

The project consists of development of the following.

- 373m approach trestle from land fall point to service platform.
- About 10km of 48” Cross Country Crude Oil Pipeline up to the Crude Oil Tank (COT) Farm of HRRL @ Mundra
- Berthing and Mooring Dolphins.

2.2 Objectives

The objective of QRA study is as follows:

- Determine the consequences of hydrocarbon releases from process piping and equipment.

- Determine the frequency of hydrocarbon releases.
- Quantify Individual risk.
- Quantify Societal risk.
- Evaluate the acceptability of these risk levels against risk tolerability criteria.
- Identify risk reduction options appropriate for the phase of the development to demonstrate that risks are being managed to a level which is As Low As Reasonably Practicable (ALARP).

2.3 Definitions

ALARP	ALARP, which stands for "as low as reasonably practicable". The ALARP principle is that the residual risk shall be reduced as far as reasonably practicable.
CONSEQUENCE	It is defined as an event or chain of events that result from the release of a hazard. The impact or effect is the degree of harm caused by the event.
EVENT TREE	A logic diagram of success and failure combinations of events used to identify accident sequences leading to all possible consequences of a given initiating event.
F-N CURVE	FN curves are frequency-fatality plots, showing the cumulative frequencies (F) of events involving N or more fatalities. They are derived by sorting the frequency-fatality (FN) pairs from each outcome of each accidental event and summing them to form cumulative frequency-fatality (FN) co-ordinates for the plot.
FREQUENCY	The number of times an outcome is expected to occur in a given period of time.
HAZARD	A state or condition having the potential to cause a deviation from uniform or intended behaviour which, in turn, may result in damage to property, people or environment
INDIVIDUAL RISK	The probability that in one year a person will become a victim of an accident if the person remains permanently and unprotected in a certain location.
LOCATION SPECIFIC INDIVIDUAL RISK	Location specific individual risk for personnel who's exposure to 365 days (Continuous presence at that location). The probability that in one year a person will become a victim to an accident if the person remains permanently and unprotected in a certain location. Often the probability of occurrence in one year is replaced by the frequency of occurrence per year. The individual risk at different locations around a particular plant varies.
RISK	The combination of the likelihood and the consequences of a hazard occurrence resulting in an undesirable event.
RISK CONTOUR	Line on a map connecting points having equal risk
SAFETY	It is the inverse of risk. The higher the risk for an occupation or installation, the lower is its safety. The popular understanding of safety sometimes appears to be "zero risk", but this is impossible in an intrinsically hazardous activity such as oil and gas production
SOCIETAL RISK	The relationship between frequency and the number of people suffering from a

	specified level of harm in a given population from the realization of specified hazards. Societal risk is normally presented in the form of F-N curves, which is a graph of the chance or frequency (F) of events, which can result in N or more fatalities.
JET FIRES	Jet fires are pressurized releases of hydrocarbons that result in impinging flames with significant momentum.
POOL FIRES	Pool fires are liquid pools on fire caused by delayed ignition of releases of flammable liquids and formation of a pool on the floor surface.
LFL	Lower Flammable Limit also called as Lower Explosive Limit (LEL). It is the lower end of the concentration range over which a flammable mixture of gas or vapour in air can be ignited at a given temperature and pressure.
VCE	Vapor cloud explosion is an event resulting from the ignition of a cloud of flammable vapor/ gas in which flame speeds accelerate to sufficiently high velocities to produce significant overpressure.

3 QRA METHODOLOGY

Risk (either health, Safety or economic), is inherent in all activities. To control, prevent or minimize loss of life or injury, damage to property or impact on environment, risk must be analysed and managed. Risk Assessment is a step-by-step process to identify the probability of extent of adverse consequences resulting from a specific activity, quantify risk and compare the same with known risk criteria to prepare and implement appropriate risk reduction measures.

The objectives of this Quantitative Risk Analysis (QRA) study is to identify and quantify all potential failure modes that may lead to hazardous consequences and to evaluate their frequencies and extent. Typical hazardous consequences include fire, explosion, and toxic releases. This study provides an assessment of the risk to plant personnel and demonstrates that individual risk and societal risk are within the acceptable limits.

3.1 Methodology

The initial key step is the identification of the release scenarios, which are based on Hazard Identification process usually carried out by internal review of the Process Flow diagrams and Piping & Instrumentation drawings, and layout configurations. Once the scenarios are defined, then these are evaluated further for their potential frequency of occurrence and consequence hazard zone. The frequency analysis is based on the facility equipment count paired with historical frequency data.

The risk result is estimated by the combination of the scenario frequency and consequence with potential impact to the facility and personnel. A variety of risk metrics may be evaluated depending on the scope, including Individual risk, societal risk. The risk results are compared to relevant criteria to evaluate the tolerability and to offer guidance for risk reduction. The key components are illustrated in below figure:

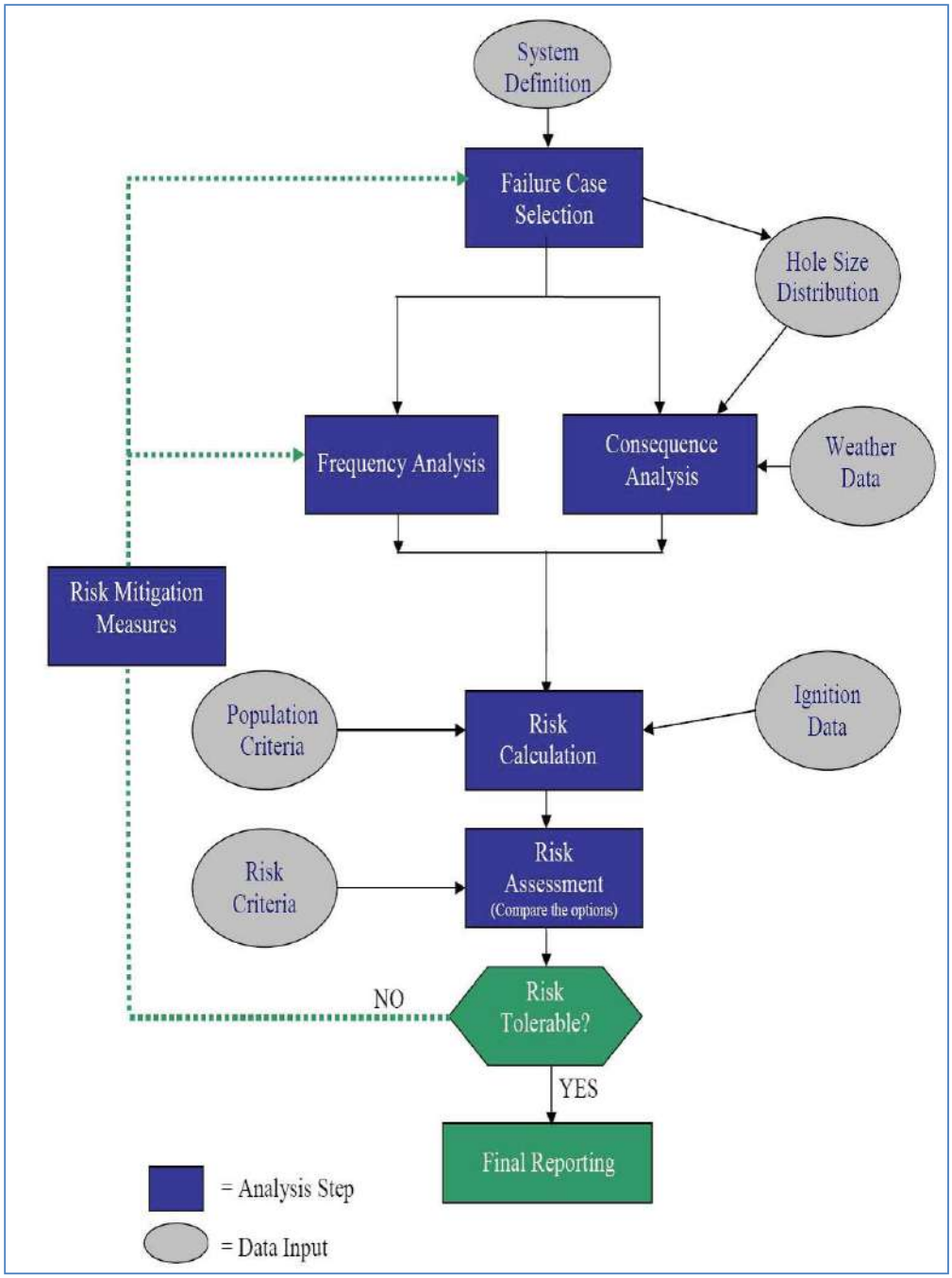


Figure 3-1: QRA Flowchart

3.2 Detailed Approach

3.2.1 Data Review

A review of the following documents for this project has been carried out by DNV. Following latest data has been reviewed in detail:

- Project design basis
- Process flow diagrams (PFD)
- Piping and Instrumentation Diagram (P&ID)
- Project philosophies
- Heat and Mass Balance (HMB)
- Plot plans and layouts

3.2.2 Rule Set and Assumptions

As part of the risk modelling, rule sets and assumptions have been agreed prior to the execution of the risk calculations. These assumptions and rule sets are outlined in the Assumption Register presented in Appendix I.

3.2.3 Hazard Identification & Failure Case Identification

This step involves identification of process hazards to be modelled in the QRA study. All major accident events associated with loss of containment of process streams are considered in this QRA study. Detailed Hazard Identification Table for each isolatable section/failure case is presented in Section 4 of this report.

All facilities normally containing hazardous material have been considered during identification of failure cases. Failure cases and their boundaries are defined based on a study of the PFDs, P&IDs and the Plot plans. Details of failure cases identified for project are presented in Section 4. This description includes failure case identification tag, area name, Isolatable section number and detailed description of isolatable section describing its starting point and end point.

All identified failure cases are defined in terms of location, material released, quantity released, temperature, pressure, leak size, leak direction, leak elevation, leak frequency and ignition probability. This information is provided as input to the QRA model.

3.2.4 Consequence Modelling

The consequence modelling evaluates the resulting effects if the accidents occur and assessing their impacts. Estimation of the consequences of each possible event is performed using DNV Phast software tool.

The events considered for gas and liquid releases consequence are:

- Gas jet fire: due to immediate ignition of gas release
- Flash fire: due to delayed ignition of vapour cloud formed due to the gas releases
- Flammable gas dispersion: due to unignited HC releases
- Liquid pool fire: resulting from release of liquid hydrocarbon from process facility.

3.2.5 Source Term Modelling

Each failure case calculation in SAFETI starts with discharge modelling. Based on release duration and release phase (gas, liquid), SAFETI directs the dispersion and consequence calculations to one of 4 alternate, built-in consequence outcome event trees (continuous vapour release, continuous release with rain-out, instantaneous vapour release, instantaneous release with rain-out), where each event tree branch probability carries default values, which may be re-programmed by the risk analyst. Refer to Appendix I – Assumption Register for event trees.

Process parameters:

The pressure and temperature, composition for streams were taken from the Heat and material Balance.

Release Rates:

The release rate is function of orifice (hole size) area, coefficient of discharge and pressure differential across the orifice. For the given discharge coefficient and pressure differential as the orifice size increases, the release rate estimated by PHAST increases. For the pure liquid or gas streams the release rates are calculated by Phast discharge model.

Inventory and Isolation Time:

An estimate of the inventory that could potentially be released is developed for each isolatable section. The estimate of the total released inventory (IT) is the sum of IS (Static Inventory, Kg) and ID (Dynamic Inventory, Kg). The static inventory is the amount of material within the isolatable section's vessels and piping, prior to leak. The dynamic inventory is calculated based on the pumped or pressurized in-flow rate and the isolation time by:

$I_{(T)} = I_{(S)} + I_{(D)}$

$I_{(T)} = I_{(S)} + MIN(rL,rP) \times t$

Where $I_{(T)}$ = Total potential inventory released (kg)

$I_{(S)}$ = Static Inventory (kg)

$I_{(D)}$ = Dynamic Inventory (kg)

rL = Phast Calculated Leak rate (kg/s)

rP = Process Flow rate (kg/s)

t = Release duration (s)

Release Direction and Location:

The releases from the process equipment and process piping are modelled as horizontal direction. Cross-country pipeline for aboveground portion horizontal release was considered and underground cross-country pipeline vertical, angle horizontal and down impingement was considered for the analysis.

Release sizes:

Following release/leak sizes have been used as representative sizes for small, medium, large, and full-bore rupture (FBR). The defined hole sizes are considered to be fit for the purpose of QRA study as it cover the entire range of leak sizes from minimum to maximum.

Process Equipment:

Small Leak: 7mm

Medium Leak: 22mm

Large Leak: 70mm

Full Bore Rupture (FBR): 150mm

Cross-country Pipeline

Small Leak: 10mm

Medium Leak: 50mm

Large Leak: 100mm

Full Bore Rupture (FBR): 150mm

3.2.6 Weather Parameters

The consequences of released flammable materials into the atmosphere are strongly dependent upon the rate at which the released material is diluted and dispersed to safe concentrations. The local meteorology is therefore important in two respects. First, the wind direction determines whether a release drifts towards or away from vulnerable locations. Second, the actual weather conditions, in terms of wind speed and stability to determine how quickly the plume disperses.

Variation in wind direction defines the apparent orientation of consequences. DNV GL Safeti 8.4 accounts for the different wind directions from the wind distribution probability input and combine the values into the risk calculation. Atmospheric conditions, which include temperature and humidity, are also addressed. Stability classes were finalized as per Pasquill-Gifford stability classes as mentioned in Chemical Process Quantitative Risk Analysis.

Table 3-1: Wind Speed and Pasquil Stability Class

Surface Wind Speed, m/s	Day Time			Night Time		Any Time Heavy Overcast
	Strong	Moderate	Slight	>4/8 Low Cloud	< 4/8 Cloudiness	
<2	A	A-B	B	E	F	D
2-3	A-B	B	C	E	F	D
3-4	B	B-C	C	D	E	D
4-6	C	C-D	D	D	D	D
>6	C	D	D	D	D	D

Data on the distribution of wind speeds and directions as referred from Climatological Normal (1981-2010) The following atmospheric conditions shall be used for the study.

Table 3-2: Meteorological Data

Parameter	Value	Unit	Notes/Justification
Ambient air temperature	35	°C	It has relatively minor influence on the dispersion characteristics (although there will be buoyancy of gas clouds) Maximum temp is 48°C and minimum temperature is 7°C
Relative humidity	95	%	Site Environmental Data (Doc: 10820-1001-Rev.C)
Solar radiation	1 (max) 0 (min)	kW/m^2	Peak solar radiation. Negligible influence on dispersion/consequence.
Atmospheric pressure	1.01	barg	Negligible influence on dispersion/consequence.

Table 3-3: Wind Direction Probability

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Night	8.18	5.91	3.64	2.27	0.91	0.45	0.00	1.82	3.64	13.64	23.64	14.55	5.45	5.00	4.55	6.36
Day	3.91	5.47	7.03	3.91	0.78	0.39	0.00	2.34	4.69	15.23	25.78	15.63	5.47	3.91	2.34	3.13

3.2.7 Physical Effect Modelling

Physical effect of process release, fire and explosion presents danger to personnel, assets, and the environment. The physical effect (flammable/ toxic dispersion, liquid pool evaporation, jet fire, pool fire, flash fire) modelling considers estimating the potential effects using predictive tools in PHAST/SAFETI software.

PHAST calculate all alternate consequence outcomes (e.g. jet fire, explosion) of the event tree selected, in terms of hazard range and event duration (where applicable), for each weather class / wind speed combination. To produce risk results, SAFETI perform impact frequency calculations, using the failure case specified leak frequency as starting point. This section provides a brief overview of the physical effect models within Phast/SAFETI software tool.

Dispersion:

PHAST uses the Unified Dispersion Model (UDM version 2) for dispersion. The UDM contains modelling modules for passive, jet and heavy/ dense gas dispersion.

UDM models the dispersion following ground level or elevated level two phase unpressurised or pressurized release. It allows for continuous, instantaneous, constant finite duration, and general time varying releases. It includes a unified model for jet, heavy, and passive two-phase dispersion including possible droplet rainout, pool spreading and re-evaporation. It calculates the phase distribution and cloud temperature using either a non-equilibrium thermodynamics model, a non-reactive equilibrium model, or an equilibrium model.

Jet fire modelling:

Jet flames can fully develop in an unconfined environment. At first, the influence of wind is disregarded to estimate its shape in idealized conditions. The flame shape is usually defined as the envelope of the visible flame.

PHAST uses surface emitter model for jet fire calculations. For this study, DNVGL recommended correlation (model) was selected for jet fires. DNVGL PHAST decides correlation that is most appropriate for the release conditions. DNVGL PHAST considers Jet Fire model by Cook et. For liquid or two-phase release, Johnson model for horizontal vapour releases and Chamberlain model for non-horizontal vapour release.

Pool fire modelling:

A pool fire can be defined as a turbulent diffusion fire burning above a horizontal pool vaporizing flammable material under conditions where the flammable material has zero or very low initial momentum. A key feature of these fires is that there is a degree of feedback between the fire and the flammable material. To a greater or lesser extent, there is a heat transfer back from the fire to the pool that influences or even controls the rate of evaporation and hence the fire size and other characteristics. The pool with flammable material is not necessarily static. It may be spreading or contracting. Additional flammable material could be fueling the fire from the leak source. Depletion of a local flammable material supply can occur via drainage or overflow to other areas.

3.2.8 Impact Criteria

Closely liaised with the consequence assessment is the impact assessment, i.e., how does the fire, explosion or toxic cloud affect human beings. When the frequencies and consequences / impact of each modelled event have been estimated, they can be combined to produce risk results.

In SAFETI impact/vulnerability criteria is defined, which pre-determines the fraction of fatalities resulting indoor & outdoor from being exposed to specific consequence outcomes for a specified duration, or to one or more specified criteria levels.

The impact criteria used for risk calculations as detailed in Appendix-I: Assumption Register.

3.2.9 Frequency Analysis

The frequency analysis estimates how likely it is for the accidents to occur, based on the type and number of equipment components included in the defined failure cases. The component failure frequencies to be used are usually derived from an analysis of historical accident experience. The approach relate to the Frequency Analysis is presented in this section.

3.2.10 Parts Count

An equipment parts count is carried out for each isolatable section (based on location of ESDV's) for determining appropriate frequencies for the representative failure cases (frequency analysis). The equipment parts count assessment is based on Process Piping and Instrumentation Diagrams (P&IDs). Parts count analysis is supplemented by ''marked P&IDs'' for traceability. Following standard rule set is applied for parts count.

Flange:

A flanged joint comprises two flange faces, a gasket (where fitted) and two welds on the pipe. The failure frequency for flanges refers to a flanged joint.

Valves:

Valves are assigned to one of the following categories:

- Manual Block: all hand operated valves in pipework.
- Manual Bleed: all small hand operated valves connected to the pipework.
- Manual Choke
- Manual Check: all non-return valves.
- Activated ESD: all emergency shutdown valves
- Activated Control: all flow control valves

For valves, the scope includes the valve body, stem, and packer, but excludes flanges, controls, and instrumentation.

Valve Flanges:

The frequencies for flanges refer to a flanged joint, comprising two flange faces, a gasket (where fitted), and two welds to the pipe. Each valve counted has two flanges unless it is welded in place. For valves at the boundary, half of the valve and 1 flange are included in one system and the rest in the adjacent boundary. Spectacle blinds and orifice plates count as 3 flanges. Blinds on bleed valves are counted as 1 flange.

Piping lengths:

The length of the piping is identified from layout.

Vessel:

The frequency function for process vessels includes the vessel itself and any nozzles or inspection openings, but excludes all attached valves, piping, flanges, instruments, and fittings.

3.2.11 Generic Failure Frequencies

Generic failure frequencies for base elements (valves, piping, flanges etc.) are taken from OGP (431-1). DNVGL Leak software LEAK V3.3 is used for calculation of failure frequencies using (1992-2006) 2006 database. Prior to using LEAK software all the base element failure frequencies for hole sizes given in OGP have been verified to ensure consistency of results provided by software with OGP leak frequency data. Subsequently leak frequencies for hole sizes specific to study was calculated.

For this study “full release frequencies” category from OGP has been used which takes into account of the contribution from the three types of releases (i.e., Full release, Limited Release and Zero Pressure release). The details of generic failure frequency data for “full release frequencies” is provided in Assumption register.

Frequency aspects of the risk calculations relate to the:

- Failure case leak frequencies, unique to each failure case.
- Weather class, wind speed and wind directional probability, for each of the wind directions.
- Specified immediate ignition probabilities and delayed ignition probabilities.
- SAFETI selected event tree and branch probabilities, for each alternate consequence outcome.
- Fatal Impact probability for each alternate consequence outcome. This is based on the SAFETI calculated magnitude of each consequence and the SAFETI default impact probability criteria or risk analyst specified impact criteria for that type of consequence.
- For cross-country pipeline CONCAWE oil pipeline database was considered for the analysis.

3.2.12 Manning Data

Wherever applicable, population data is defined separately for risk calculation. For individual risk calculation, people expected to be affected by the hazard are grouped based on their work which reflects a particular pattern of exposure to major accident hazards. The defined population data accounts the day and night pattern in risk calculation. The fraction of time spent inside and outside a building by an individual within each working group at each specific location is also determined in order to differentiate the indoor and outdoor effect of consequences.

For societal risk calculation, specific population areas are determined and the average numbers of inhabitants at each population area throughout the year are set. The average fraction of time spent inside and outside a building by the inhabitants in each population area is also determined to differentiate the indoor and outdoor effect of consequences.

Refer Appendix-I: Assumption Register for Manning details.

3.2.13 Risk Calculations

Brief description on how risk calculations are performed by SAFETI is provided below.

All identified failure cases, which are defined in terms of: location, material released, quantity released (or release duration), temperature, pressure, leak size, leak direction (horizontal), leak elevation, leak frequency and immediate ignition probability

Each failure case calculation in SAFETI starts with discharge modelling. Based on release duration and release phase (gas, liquid, 2-phase), SAFETI directs the dispersion and consequence calculations to one of 4 alternate, built-in consequence outcome event trees.

For each release case, SAFETI takes the failure case release frequency as initial input, multiplies this by the first weather class/ wind speed probability, for the first of total wind directions considered in the study. SAFETI takes this result and multiplies it by the immediate ignition probability, while also separately multiplying this result by the defined/calculated delayed ignition probability. These two results are multiplied by the first of the event tree consequence branch probabilities, relating to immediate or delayed ignition branch path.

SAFETI takes the calculated consequence hazard range and verifies which grid points are within the consequence hazard area. For each grid point within range SAFETI then calculates the magnitude of the consequence at each grid point.

The calculated consequence magnitude at each grid point is then compared to the SAFETI programmed impact criteria levels. The likelihood of fatality is calculated, based on the impact probability criteria specified in SAFETI, for the type of consequence and the magnitude of the consequence.

This calculation is repeated for each event tree alternate consequence outcome at each grid point, for that weather class/ wind speed and wind direction, and the result added to the previous risk level, at each grid point.

Once all risk calculations at all grid points have been completed for the first failure case, the next failure case will be calculated, again adding all results cumulatively at each grid point. This is repeated until all failure cases have been calculated, while SAFETI also tracks the risk contribution made by each failure case at each grid point.

Once completed, SAFETI produces individual risk contour results by linking points of equal risk, based on the pre-specified levels of individual fatality risk to be plotted, and using linear interpolation between relevant grid points. The risk contour results are super imposed on the electronic site map, entered in the SAFETI software. Similar calculations are performed for calculation of societal risk using defined vulnerability parameters however the persons inside each grid are equally distributed in the grid cell instead of at the centre of the grid cell as considered in individual risk calculations.

4 FAILURE CASE SCENARIOS

The failure case scenarios for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline Project are identified as per the location of equipment. In the event of a release, only the material in the section is released. Based on the process information the following failure case scenarios are identified for the analysis.

Table 4-1: Failure Case Scenarios

ISO Section	Isolatable Section Description	Representative Leak Location	Leak Size (mm)
ISO -1	Marine Loading Arm (2 Nos) to 026-MOV-1001/ 026-MOV-1002	Marine Loading Arm (2 Nos)	10
			150
ISO 2	From 026-MOV-1001/ 026-MOV-1002 to 026-ROV-1001/026-ROV-1002	2x30" Transfer P/L from loading arm to 48" crude pipeline header	7
			22
			70
			150
ISO 3	026-ROV-1001/026-ROV-1002 to (pig L/R at jetty) 026-V-1001 (MOV 1007)	pig launcher/receiver at Jetty	7
			22
			70
			150
ISO 4	Aboveground 48" crude P/L From ROV-1003 to till UG portion (trestle)	48" cross country pipeline.	10
			50
			100
			150
ISO 5	Underground 48" crude P/L from AG PL portion to COT terminal B/L	48" cross country pipeline.	10
			50
			100
			150

4.1 Process Conditions

Identified failure cases are defined in terms of material released, quantity released, temperature, pressure, leak size, leak frequency and ignition probability and the same are provided as input to the model. Operating pressure, temperature and leak size play a vital role in estimating the release rates and subsequent consequence of the failure scenario. Input data required for estimation of release rates and inventory data are taken from enquiry document at the time of study.

Table 4-2: Failure Case Scenarios

ISO Section	Isolatable Section Description	Representative Leak Location	Leak Size (mm)	Maximum line size in the section (inch)	Release Phase (Liquid-L / Gas-G)	Operating Pressure bar g	Operating Temperature Deg C
ISO -1	Marine Loading Arm (2 Nos) to 026-MOV-1001/ 026-MOV-1002	Marine Loading Arm (2 Nos)	10	20	L	10.13	48
			150				
ISO 2	From 026-MOV-1001/ 026-MOV-1002 to 026-ROV-1001/026-ROV-1002	2x30" Transfer P/L from loading arm to 48" crude pipeline header	7	30	L	8.13	48
			22				
			70				
			150				
ISO 3	026-ROV-1001/026-ROV-1002 to (pig L/R at jetty) 026-V-1001 (MOV 1007)	pig launcher/receiver at Jetty	7	48	L	7.34	48
			22				
			70				
			150				
ISO 4	Aboveground 48" crude P/L From ROV-1003 to till UG portion (trestle)	48" cross country pipeline.	10	48	L	7.34	48
			50				
			100				
			150				
ISO 5	Underground 48" crude P/L from AG PL portion to COT terminal B/L	48" cross country pipeline.	10	48	L	7.34	48
			50				
			100				
			150				

4.2 Failure Frequencies

This section estimates the failure frequency for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline Project. The generic failure data used as the basis for the frequency analysis through LEAK software (v 3.3) is based on the IOGP, Risk assessment data directory, Sep 2019 has been used in this QRA study to estimate failure frequency for this facility. Cross-country pipeline failure frequency is considered from CONCAWE oil pipeline database.

Table 4-3: Failure Frequencies

ISO Section	Isolatable Section Description	Representative Leak Location	Leak Size (mm)	Failure Frequency (per year)
ISO -1	Marine Loading Arm (2 Nos) to 026-MOV-1001/ 026-MOV-1002	Marine Loading Arm (2 Nos)	10	4.00E-07
			150	2.00E-07
ISO 2	From 026-MOV-1001/ 026-MOV-1002 to 026-ROV-1001/026-	2x30" Transfer P/L from loading arm to 48" crude	7	1.64E-03
			22	2.19E-04

ISO Section	Isolatable Section Description	Representative Leak Location	Leak Size (mm)	Failure Frequency (per year)
	ROV-1002	pipeline header	70	5.62E-05
			150	5.21E-05
ISO 3	026-ROV-1001/026-ROV-1002 to (pig L/R at jetty) 026-V-1001 (MOV 1007)	pig launcher/receiver at Jetty	7	3.30E-03
			22	5.35E-04
			70	1.17E-04
			150	1.18E-04
ISO 4	Aboveground 48" crude P/L From ROV-1003 to till UG portion (trestle)	48" cross country pipeline.	10	1.80E-04
			50	1.80E-04
			100	1.80E-04
			150	1.80E-04
ISO 5	Underground 48" crude P/L from AG PL portion to COT terminal B/L	48" cross country pipeline.	10	1.80E-04
			50	1.80E-04
			100	1.80E-04
			150	1.80E-04

4.3 Inventory Calculations

ISO Section	Isolatable Section Description	Representative Leak Location	Leak Size (mm)	Failure Case ID	Section Flowrate (kg/sec)	Release rate for analysis (kg/sec)	Isolatable Time (sec)	Static Inventory (kg)	Dynamic Inventory (kg)	Total inventory (Kg)
ISO -1	Marine Loading Arm (2 Nos) to 26-MOV-1001/ 026-MOV-1002	Marine Loading Arm (2 Nos)	10	ISO -1 /L/10	1478.35	1.02	120	1796.89	122.81	1919.69
			150	ISO -1 /L/150	1478.35	469.90	120	1796.89	56388.00	58184.89
ISO 2	From 026-MOV-1001/ 026-MOV-1002 to 026-ROV-1001/026-ROV-1002	2x30" Transfer P/L from loading arm to 48" crude pipeline header	7	ISO 2/L/7	1478.35	0.92	120	8085.99	110.02	8196.01
			22	ISO 2/L/22	1478.35	9.06	120	8085.99	1086.72	9172.71
			70	ISO 2/L/70	1478.35	91.68	120	8085.99	11001.60	19087.59
			150	ISO 2/L/150	1478.35	421.00	120	8085.99	50520.00	58605.99
ISO 3	026-ROV-1001/026-ROV-1002 to (pig L/R at jetty) 026-V-1001 (MOV1007)	pig launcher/receiver at Jetty	7	ISO 3/L/7	2956.69	0.87	120	15525.10	104.53	15629.63
			22	ISO 3/L/22	2956.69	8.60	120	15525.10	1032.00	16557.10
			70	ISO 3/L/70	2956.69	87.11	120	15525.10	10453.20	25978.30
			150	ISO 3/L/150	2956.69	400.03	120	15525.10	48003.84	63528.94
ISO 4	Aboveground 48" crude P/L From ROV-1003 to till UG portion (trestle)	48" cross country pipeline.	7	ISO 4/L/10	2956.69	0.87	120	385022.51	104.53	385127.05
			22	ISO 4/L/50	2956.69	8.60	120	385022.51	1032.00	386054.51
			70	ISO 4/L/100	2956.69	87.11	120	385022.51	10453.20	395475.71
			150	ISO 4/L/150	2956.69	400.03	120	385022.51	48003.84	433026.35
ISO 5	Underground 48" crude P/L from AG PL portion to COT terminal B/L	48" cross country pipeline.	7	ISO 5/L/10	2956.69	0.87	120	9965045.04	104.53	9965149.58
			22	ISO 5/L/50	2956.69	8.60	120	9965045.04	1032.00	9966077.04
			70	ISO 5/L/100	2956.69	87.11	120	9965045.04	10453.20	9975498.24
			150	ISO 5/L/150	2956.69	400.03	120	9965045.04	48003.84	10013048.88

5 CONSEQUENCE ASSESSMENT

This section presents the consequence modelling results for all leak sizes for accident scenarios associated with each process unit for all alternate consequences. The consequence results have been produced for all failure cases considered. The consequence results mainly include effect distances for following physical effects for 2F and 5D weather conditions:

5.1 Consequence Analysis Results

5.1.1 Flash Fire

Scenario	Release orientation	Weather	Distance downwind to LFL [m]
HOWE/ISO -1 /L/710	Horizontal	Category 2/F	4.01
		Category 5/D	3.48
HOWE/ISO -1 /L/150	Horizontal	Category 2/F	164.40
		Category 5/D	186.81
HOWE/ISO -2 /L/7	Horizontal	Category 2/F	3.89
		Category 5/D	3.38
HOWE/ISO -2 /L/22	Horizontal	Category 2/F	13.49
		Category 5/D	10.15
HOWE/ISO -2 /L/70	Horizontal	Category 2/F	65.03
		Category 5/D	65.44
HOWE/ISO -2 /L/150	Horizontal	Category 2/F	156.63
		Category 5/D	176.35
HOWE/ISO 3/L/7	Horizontal	Category 2/F	3.75
		Category 5/D	3.27
HOWE/ISO 3/L/22	Horizontal	Category 2/F	13.01
		Category 5/D	9.75
HOWE/ISO 3/L/70	Horizontal	Category 2/F	63.19
		Category 5/D	63.39
HOWE/ISO 3/L/150	Horizontal	Category 2/F	153.05
		Category 5/D	171.47
HOWE/ISO 4/L/10	Horizontal	Category 2/F	3.75
		Category 5/D	3.27
HOWE/ISO 4/L/50	Horizontal	Category 2/F	13.01
		Category 5/D	9.75
HOWE/ISO 4/L/100	Horizontal	Category 2/F	63.19
		Category 5/D	63.39
HOWE/ISO 4/L/150	Horizontal	Category 2/F	153.05
		Category 5/D	171.47
HOWE/ISO 5/L/10	Vertical	Category 2/F	n/a

Scenario	Release orientation	Weather	Distance downwind to LFL [m]
		Category 5/D	n/a
HOWE/ISO 5/L/50	45deg. Horizontal	Category 2/F	1.82
		Category 5/D	1.85
HOWE/ISO 5/L/50	Vertical	Category 2/F	0.17
		Category 5/D	0.25
HOWE/ISO 5/L/50	Down Impingement	Category 2/F	n/a
		Category 5/D	n/a
HOWE/ISO 5/L/100	45deg. Horizontal	Category 2/F	2.21
		Category 5/D	2.02
HOWE/ISO 5/L/100	Vertical	Category 2/F	0.28
		Category 5/D	0.35
HOWE/ISO 5/L/100	Down Impingement	Category 2/F	2.28
		Category 5/D	53.95
HOWE/ISO 5/L/150	Horizontal	Category 2/F	264.46
		Category 5/D	200.79

5.1.2 Jet Fire

Scenario	Release orientation	Weather	Flame length [m]	Distance downwind to (4 kW/m2) [m]	Distance downwind to (12.5 kW/m2) [m]	Distance downwind to (37.5 kW/m2) [m]
HOWE/ISO -1 /L/10	Horizontal	Category 2/F	5.88	10.60	8.49	7.21
		Category 5/D	4.57	9.62	7.39	6.07
HOWE/ISO -1 /L/150	Horizontal	Category 2/F	83.79	167.80	129.35	105.20
		Category 5/D	5.70	10.27	8.23	6.99
HOWE/ISO -2 /L/7	Horizontal	Category 2/F	5.70	10.27	8.23	6.99
		Category 5/D	4.43	9.32	7.17	5.89
HOWE/ISO -2 /L/22	Horizontal	Category 2/F	15.41	28.69	22.61	18.93
		Category 5/D	11.98	26.21	19.82	16.02
HOWE/ISO -2 /L/70	Horizontal	Category 2/F	41.78	81.01	62.84	51.39
		Category 5/D	32.48	74.35	55.40	43.77
HOWE/ISO -2 /L/150	Horizontal	Category 2/F	80.12	160.12	123.45	100.41
		Category 5/D	62.28	145.35	107.94	84.90
HOWE/ISO 3/L/7	Horizontal	Category 2/F	5.51	9.92	7.95	6.75
		Category 5/D	4.29	8.99	6.92	5.69
HOWE/ISO 3/L/22	Horizontal	Category 2/F	15.06	28.00	22.07	18.49
		Category 5/D	11.70	25.57	19.35	15.65
HOWE/ISO 3/L/70	Horizontal	Category 2/F	40.91	79.25	61.49	50.29

Scenario	Release orientation	Weather	Flame length [m]	Distance downwind to (4 kW/m2) [m]	Distance downwind to (12.5 kW/m2) [m]	Distance downwind to (37.5 kW/m2) [m]
		Category 5/D	31.80	72.73	54.20	42.83
HOWE/ISO 3/L/150	Horizontal	Category 2/F	78.45	156.65	120.79	98.25
		Category 5/D	60.98	142.55	105.82	83.21
HOWE/ISO 4/L/10	Horizontal	Category 2/F	5.51	9.92	7.95	6.75
		Category 5/D	4.29	8.99	6.92	5.69
HOWE/ISO 4/L/50	Horizontal	Category 2/F	15.06	28.00	22.07	18.49
		Category 5/D	11.70	25.57	19.35	15.65
HOWE/ISO 4/L/100	Horizontal	Category 2/F	40.91	79.25	61.49	50.29
		Category 5/D	31.80	72.73	54.20	42.83
HOWE/ISO 4/L/150	Horizontal	Category 2/F	78.45	156.65	120.79	98.25
		Category 5/D	60.98	142.55	105.82	83.21
HOWE/ISO 5/L/10	Vertical	Category 2/F	8.17	12.90	10.48	8.95
		Category 5/D	6.35	11.14	8.94	7.58
HOWE/ISO 5/L/50	45deg. Horizontal	Category 2/F	13.85	25.32	16.04	8.94
		Category 5/D	10.77	25.23	17.29	11.76
HOWE/ISO 5/L/50	Vertical	Category 2/F	9.74	19.14	10.88	3.89
		Category 5/D	7.57	18.44	11.38	7.53
HOWE/ISO 5/L/50	Down Impingement	Category 2/F	21.07	19.83	14.06	11.74
		Category 5/D	16.38	19.98	12.39	9.82
HOWE/ISO 5/L/100	45deg. Horizontal	Category 2/F	37.04	73.62	45.95	26.78
		Category 5/D	28.79	71.91	46.15	30.57
HOWE/ISO 5/L/100	Vertical	Category 2/F	26.46	48.46	25.11	4.72
		Category 5/D	20.57	45.65	27.86	15.36
HOWE/ISO 5/L/100	Down Impingement	Category 2/F	54.48	58.60	38.75	30.50
		Category 5/D	42.35	59.65	35.00	26.79
HOWE/ISO 5/L/150	Horizontal	Category 2/F	78.45	156.47	120.64	98.14
		Category 5/D	60.98	142.43	105.72	83.13

5.1.3 Pool Fire

Scenario	Release orientation	Weather	Pool diameter [m]	Distance downwind to 4 kW/m2 [m]	Distance downwind to 12.5 kW/m2 [m]	Distance downwind to 37.5 kW/m2 [m]
HOWE/ISO -1 /L/10	Horizontal	Category 2/F	15.99	32.22	17.99	10.73
		Category 5/D	15.99	33.41	19.09	11.05
HOWE/ISO -1 /L/150	Horizontal	Category 2/F	109.05	117.39	74.15	60.79
		Category 5/D	109.05	124.80	75.51	61.73
HOWE/ISO -2 /L/7	Horizontal	Category 2/F	4.82	17.83	11.49	5.74
		Category 5/D	4.82	18.29	12.47	6.88
HOWE/ISO -2 /L/22	Horizontal	Category 2/F	15.14	31.53	17.74	10.25
		Category 5/D	15.14	32.60	19.19	10.55
HOWE/ISO -2 /L/70	Horizontal	Category 2/F	48.17	60.15	36.66	28.53
		Category 5/D	48.17	62.94	37.37	29.15
HOWE/ISO -2 /L/150	Horizontal	Category 2/F	103.21	112.17	70.67	57.71
		Category 5/D	103.21	119.15	71.97	58.65
HOWE/ISO -3 /L/7	Horizontal	Category 2/F	4.70	17.55	11.32	5.68
		Category 5/D	4.70	18.00	12.29	6.85
HOWE/ISO -3 /L/22	Horizontal	Category 2/F	14.76	31.21	17.64	10.03
		Category 5/D	14.76	32.31	19.23	10.33
HOWE/ISO -3 /L/70	Horizontal	Category 2/F	46.95	58.95	35.88	27.87
		Category 5/D	46.95	61.66	36.57	28.48
HOWE/ISO -3 /L/150	Horizontal	Category 2/F	100.61	109.83	69.12	56.35
		Category 5/D	100.61	116.62	70.39	57.27
HOWE/ISO -4 /L/10	Horizontal	Category 2/F	5.20	18.66	12.00	5.89
		Category 5/D	5.20	19.21	13.10	6.95
HOWE/ISO -4 /L/50	Horizontal	Category 2/F	25.99	39.79	22.73	16.36
		Category 5/D	25.99	41.69	22.92	16.80
HOWE/ISO -4 /L/100	Horizontal	Category 2/F	51.97	63.88	39.09	30.58
		Category 5/D	51.97	66.94	39.84	31.23
HOWE/ISO -4 /L/150	Horizontal	Category 2/F	77.98	88.98	55.40	44.47
		Category 5/D	77.98	94.06	56.43	45.25
HOWE/ISO 5/L/10	Horizontal	Category 2/F	5.20	18.66	12.00	5.89
		Category 5/D	5.20	19.21	13.10	6.95
HOWE/ISO 5/L/50	45deg. Horizontal	Category 2/F	25.99	39.79	22.73	16.36
		Category 5/D	25.99	41.69	22.92	16.80
HOWE/ISO 5/L/50	Vertical	Category 2/F	25.99	39.79	22.73	16.36
		Category 5/D	25.99	41.69	22.92	16.80

Scenario	Release orientation	Weather	Pool diameter [m]	Distance downwind to 4 kW/m2 [m]	Distance downwind to 12.5 kW/m2 [m]	Distance downwind to 37.5 kW/m2 [m]
HOWE/ISO 5/L/50	down impingement	Category 2/F	25.99	39.79	22.73	16.36
		Category 5/D	25.99	41.69	22.92	16.80
HOWE/ISO 5/L/100	45deg. Horizontal	Category 2/F	51.99	63.90	39.10	30.59
		Category 5/D	51.99	66.97	39.85	31.24
HOWE/ISO 5/L/100	Vertical	Category 2/F	51.99	63.90	39.10	30.59
		Category 5/D	51.99	66.97	39.85	31.24
HOWE/ISO 5/L/100	down impingement	Category 2/F	51.99	63.90	39.10	30.59
		Category 5/D	51.99	66.97	39.85	31.24
HOWE/ISO 5/L/150	Horizontal	Category 2/F	77.98	88.98	55.40	44.47
		Category 5/D	77.98	94.06	56.43	45.25

6 RISK INTEGRATION

The risk associated with a hazardous event is assessed based on both the damage caused and probability of its occurrence. Risk is function of Consequence and Frequency. The risks are defined in terms of risks to an individual and risk to a group of population.

All identified failure cases are defined in terms of location, material released, release duration, temperature, pressure, leak size, release orientation and leak frequency.

Each failure case calculation in DNV GL Safeti 8.4 starts with discharge modelling. Based on release duration and type of material being released, it directs the dispersion and consequence calculations to one of 4 alternate, built-in consequence outcome event trees.

For each release case, Safeti takes the failure case release frequency, multiplies this by the weather class/ wind speed probability, for the wind directions considered in the study. DNV GL Safeti takes this result and multiplies it by the immediate ignition probability or delayed ignition probability. These results are multiplied by the event tree consequence branch probabilities, relating to immediate or delayed ignition branch path.

Safeti takes the calculated consequence hazard range over equal sized grids and verifies which grid points are within the consequence hazard area and calculates the magnitude of the consequence at those grid points. The calculated consequence magnitude at each grid point is then compared to the Safeti programmed impact criteria levels. The likelihood of fatality is calculated, based on the impact probability criteria in Safeti, for the type of consequence and the magnitude of the consequence.

This calculation is repeated for each event tree alternate consequence outcome at each grid point, for all weather classes/ wind speeds and wind direction, and the result added to the previous risk level, at each grid point.

Once all risk calculations at all grid points have been completed for the first failure case, the next failure case will be calculated, again adding all results cumulatively at each grid point. This is repeated until all failure cases have been calculated, while Safeti also tracks the risk contribution made by each failure case at each grid point.

Once completed, Safeti produces individual risk contour results by linking points of equal risk using linear interpolation between relevant grid points. The risk contour results are super imposed on the electronic site map, entered in the Safeti software. Similar calculations are performed for calculation of societal risk using Population details at each location of the facility. The persons inside each grid are equally distributed in the grid cell instead of at the centre of the grid cell as considered in individual risk calculations. Refer Appendix I – Assumption Register for population data used for the analysis.

6.1 Ignition Probabilities

DNV GL will use the Institute of Petroleum (IP) data (UKOOA correlation, also available in OGP database) ignition probability database for execution of the QRA study.

The OGP database consists of a total of 28 different mathematical functions and lookup correlations to define the ignition probability for all types of facilities and surrounds, based on data drawn from UKOOA.

The values presented in OGP relate to "total" ignition probability, which can be considered as the sum of the probability of early ignition and delayed ignition. The IP review of ignition and explosion probabilities concludes that, there are too little data to draw any firm conclusions but that "risk assessment approaches based on 30:70 to 50:50 split delayed ignition or jet / pool fire: flash fire / explosion is reasonable". Furthermore, it also identifies that, on average, approximately 20% of ignited gas releases result in explosions.

The proposed explosion probability rule set is therefore:

- 50% of all ignitions are immediate resulting in jet/pool fires (F).
- 20% of all ignitions result in explosion (PEX).
- The remainder (30%) of ignitions result in flash fires (1-F-PEX).

Based on the above, the ratio between P(immediate ignition) and P(delayed ignition) is estimated as 50:50. This estimate is supported by the joint industry Ignition Probability Review, which shows that approximately 50% of ignitions occur within a minute or so of the leak commencing.

Hence, the split immediate: delayed ignition used will be 50:50, will be used as ignition and explosion probabilities.

The immediate ignition probability can be calculated as,

$P_{immediate} = P_{total} \times 0.50$, for plant areas where P_{total} is calculated from UKOOA look-up table

Refer Appendix I – Assumption Register for Ignition Probabilities used for the analysis.

6.2 Individual Risk Acceptance Criteria

Individual Risk

The term "Individual Risk" is used for the calculations of the risk of fatality for someone at a specific location, if the person is always present at the location, i.e. is continuously exposed to the risk at that location. This is sometimes referred to as Location-Specific Individual Risk (LSIR).

The process for calculating the levels of risk associated with the facility is:

- Calculate the Location Specific Individual Risk (LSIR) from Major Accident Hazard events using the QRA model
- Define the worker groups and groups of the public (if any) by their location and movements within the effects zone of the facility
- Use the QRA model to calculate societal risk, F-N curve

In order to determine acceptability, the risk results are assessed against a set of risk criteria. The individual risk criteria adopted for this study is based on HSE UK Guideline and is presented below.

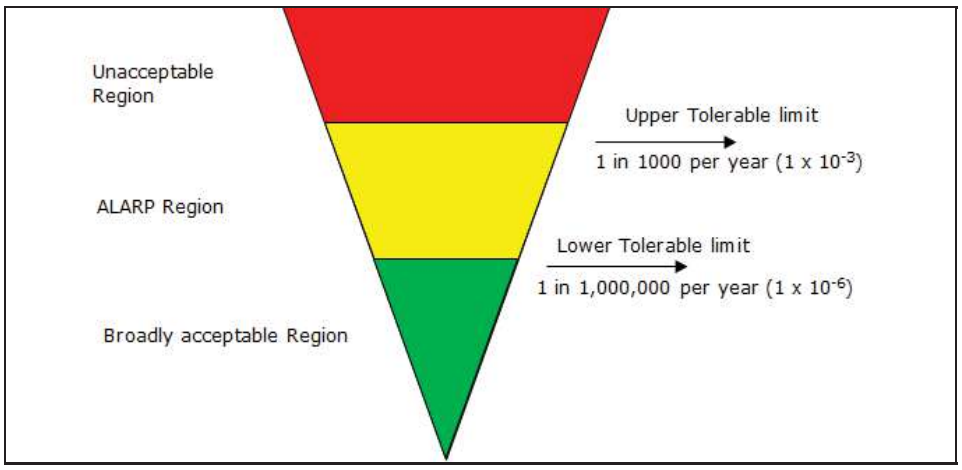


Figure 6-1: Individual Risk Criteria for Workers

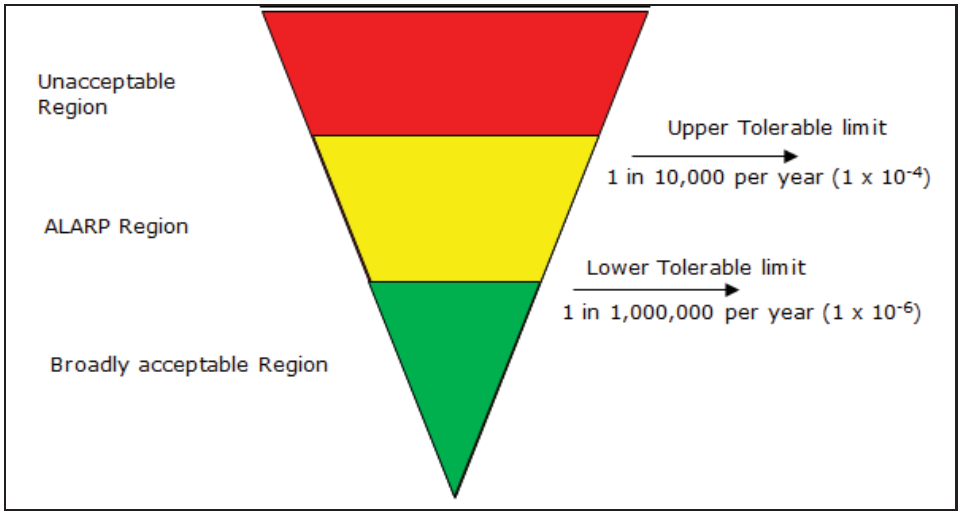


Figure 6-2: Individual Risk Criteria for Public

Risk criteria for Location Specific Individual Risk **LSIR** are as follows:

- Individual risk levels above 1 x 10^{-3} per year will be considered unacceptable and will be reduced, irrespective of cost.
- Individual risk levels below 1 x 10^{-6} per year will be deemed acceptable.
- Risk levels between 1 x 10^{-3} and 1 x 10^{-6} per year will be treated to levels as low as reasonably practicable (ALARP).

Risk criteria for **Individual Risk for Public** are as follows:

- Individual risk levels above 1 x 10^{-4} per year will be considered unacceptable and will be reduced, irrespective of cost
- Individual risk levels below 1 x 10^{-6} per year will be deemed acceptable
- Individual risk between 1 x 10^{-4} per year to 1 x 10^{-6} per year will be in the ALARP region

Interpretation of the figure and the table presented above is that if the calculated risk of fatality for any individual within the specific group of workers is greater than $1x10^{-3}$ per year then the risk is unacceptably high and requires immediate action. If the calculated figure is less than $1x10^{-6}$ per year, then it is deemed acceptable with no further action. The benchmark figures are an aid as to where the risk of fatality per person per year is anticipated to be, given experience of risk assessments throughout the industry. The tolerable risk level lies between the acceptable and unacceptable levels then it is in ALARP.

6.3 Societal Risk Acceptance Criteria

Societal Risk is the risk experience in a given time period by the whole group of personnel exposed, reflecting the severity of the hazard and the number of people in proximity to it. It is defined as the relationship between the frequency and the number of people suffering a given level of harm (normally taken to refer to risk of death) from the realization of the specified hazards. It is expressed in the form of F-N curve using UK HSE F-N curve criteria. The UK HSE F-N Curve societal risk criterion is shown in following Figure.

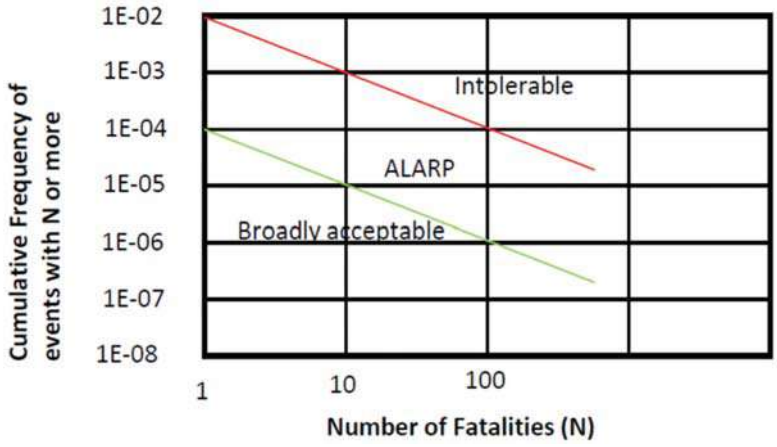


Figure 6-3: F-N Curve Acceptance Criteria

Table 6-1: Societal Risk Criteria for Workers and Public

Group	Maximum Tolerable Intercept With N=1	Negligible Intercept With N=1	Maximum Tolerable Intercept With N=100	Negligible Intercept With N=100
Workers	10^{-2}	10^{-4}	10^{-4}	10^{-6}
Public	10^{-3}	10^{-5}	10^{-5}	10^{-7}

7 RISK ASSESSMENT & RISK RESULTS

Risk assessment is the process of comparing the level of risk against a set of criteria as well as the identification of major risk contributors. The purpose of risk assessment is to develop mitigation measures for unacceptable generators of risk, as well as to reduce the overall level of risk to ALARP. The results of all Topside Facilities for Crude Oil Jetty and Cross-Country Project are illustrated in this section.

7.1 Individual Risk Contour

The following figure shows the risk contours for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline:

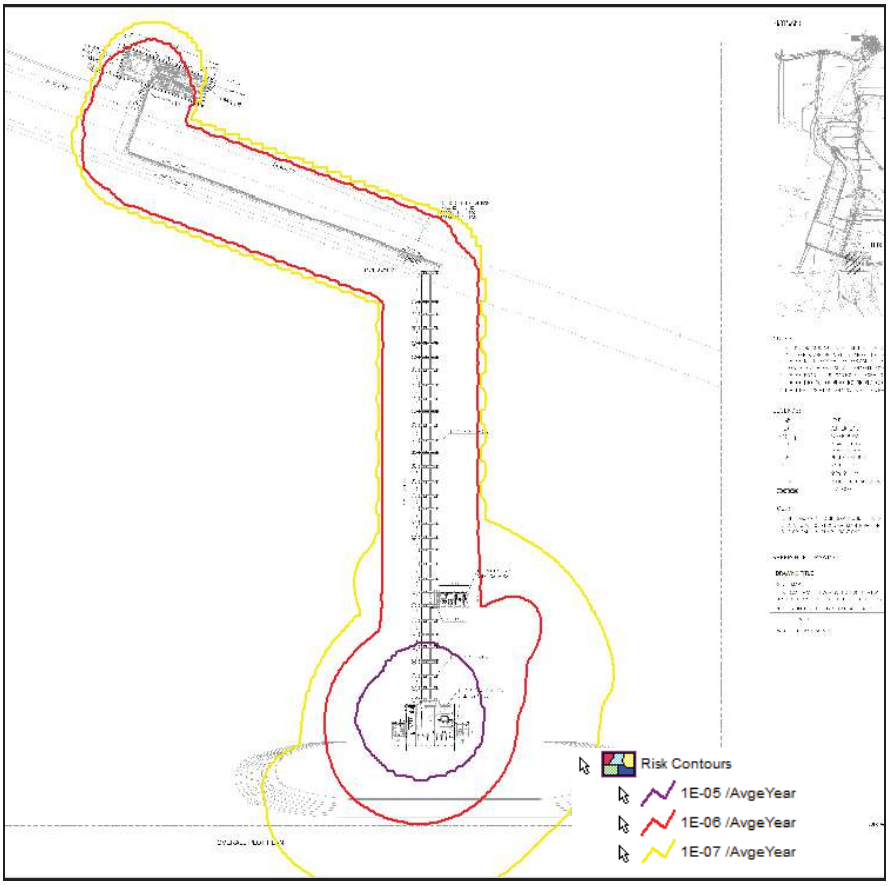


Figure 7-1: Individual Risk Contour-Overall

Based on the result of above figure, the following observations are inferred.

- Individual risk contour of 1E-01, 1E-02,1E-03 and 1E-04 are not realised for overall risk results

- Individual Risk contour of 1E-05 realised and covers entire service platform area and small part of aboveground portion of cross-country pipeline
- Individual Risk contour of 1E-06 and 1E-07 realised and covers entire fire water pump house area and cross-country pipeline (aboveground / underground portion)

7.2 Location Specific Individual Risk (LSIR)

The following The LSIR (Location Specific Individual Risk) is estimated based on hazardous event outcomes of identified loss of containment scenarios, frequencies of loss of containment scenarios, event probability for release scenarios, ignition probabilities together with the directional probability of wind. LSIR levels represent the cumulative risk at a particular location from all the accident events at the project facility for an individual who is assumed to be present at that particular location for 24 hours a day and 365 days a year without any protection.

LSIR at various critical locations in the facility is shown in below table:

Table 7-1: Location Specific Risk Assessment (LSIR)

Sr. No.	Location Description	LSIR (per year)
1	Approach Road	4.15E-05
2	Boom Deploying Station	4.07E-05
3	Loading Arm	4.63E-05
4	Fire Water Pump House	9.18E-06
5	Service Road	8.15E-06

7.3 Individual Risk Per Annum (IRPA)

Individual Risk Per Annum (IRPA) is arrived at by combining Location Specific Individual Risk (LSIR) with exposure hours of different worker category. IRPA also calculated based on summation of risk from all failure scenarios at particular location for worker category based on occupancy.

The LSIR is estimated based on hazardous event outcomes of identified loss of containment scenarios, frequencies of loss of containment scenarios, event probability for release scenarios, ignition probabilities together with the directional probability of wind. LSIR levels represent the cumulative risk at a particular location from all the accident events at the project facility for an individual who is assumed to be present at that particular location for 24 hours a day and 365 days a year.

IRPA reflects the risk of an individual spending certain fractions of his/her time at specific locations in the facility. The required IRPA calculations are performed based on 8 hours a worker spending in the area as a conservative approach. The calculated IRPA for the worker categories are given below:

Table 7-2: Individual Risk Per Annum (IRPA)

Sr. No	Location Description	LSIR Frequency /Avg. Year	Occupancy factor	Incremental IRPA/Avg. Year	Remark
1	Jetty Control personnel	4.02E-05	0.24	9.73E-06	ALARP (Lower ALARP)
2	Jetty Security personnel	4.40E-05	0.24	1.06E-05	ALARP (Lower ALARP)
3	Jetty Unloading Platform Area (Workers)	4.63E-05	0.24	1.12E-05	ALARP (Lower ALARP)
4	Guard	3.38E-05	0.24	8.18E-06	ALARP (Lower ALARP)
5	Maintenance / Instrumentation workers	4.21E-05	0.24	1.02E-05	ALARP (Lower ALARP)
6	Other category of workers - FFS	4.34E-05	0.24	1.05E-05	ALARP (Lower ALARP)

7.4 F-N Curve

Societal risk is the risk exposure by a group of people exposed to the hazard. Following F-N curve shows the frequency (F) of there being 'N' of more fatalities due to different failure cases Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline Project.

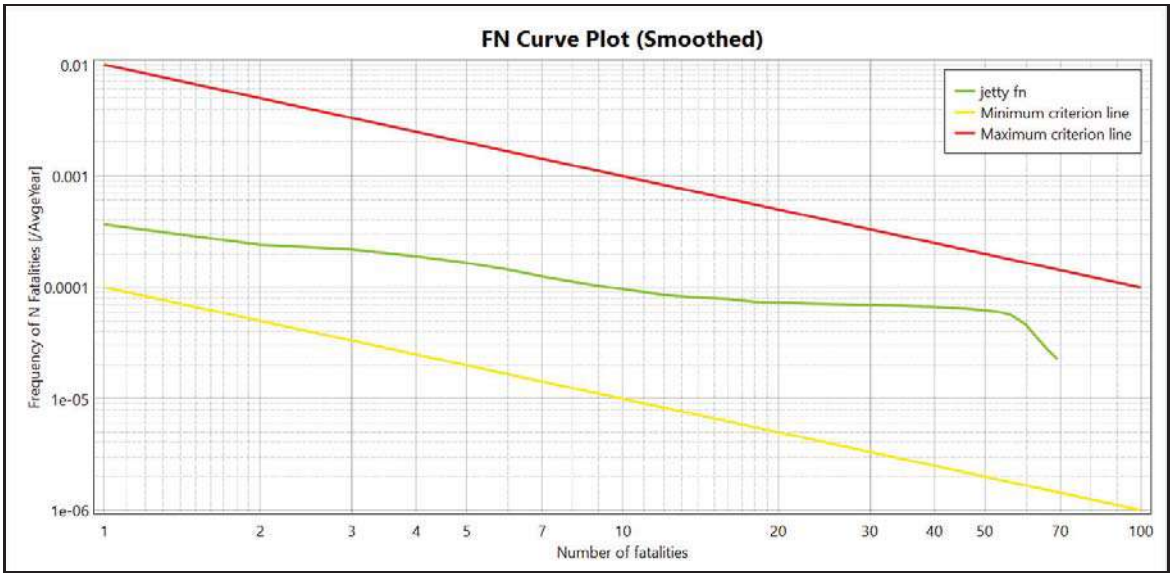


Figure 7-2: FN-Curve for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline Project

From the above figure, it is observed that the F-N curve for the Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline fall under ALARP region. F-N curve falls in ALARP region between 1 to 70 number of fatalities. Maximum number of fatalities observed due to loss of containment events in the terminal and jetty facility is 70 with a frequency of 2.27E-05 per year.

7.5 Impairment ISO Risk Fire Events

7.5.1 Pool Fire Iso Risk Contour

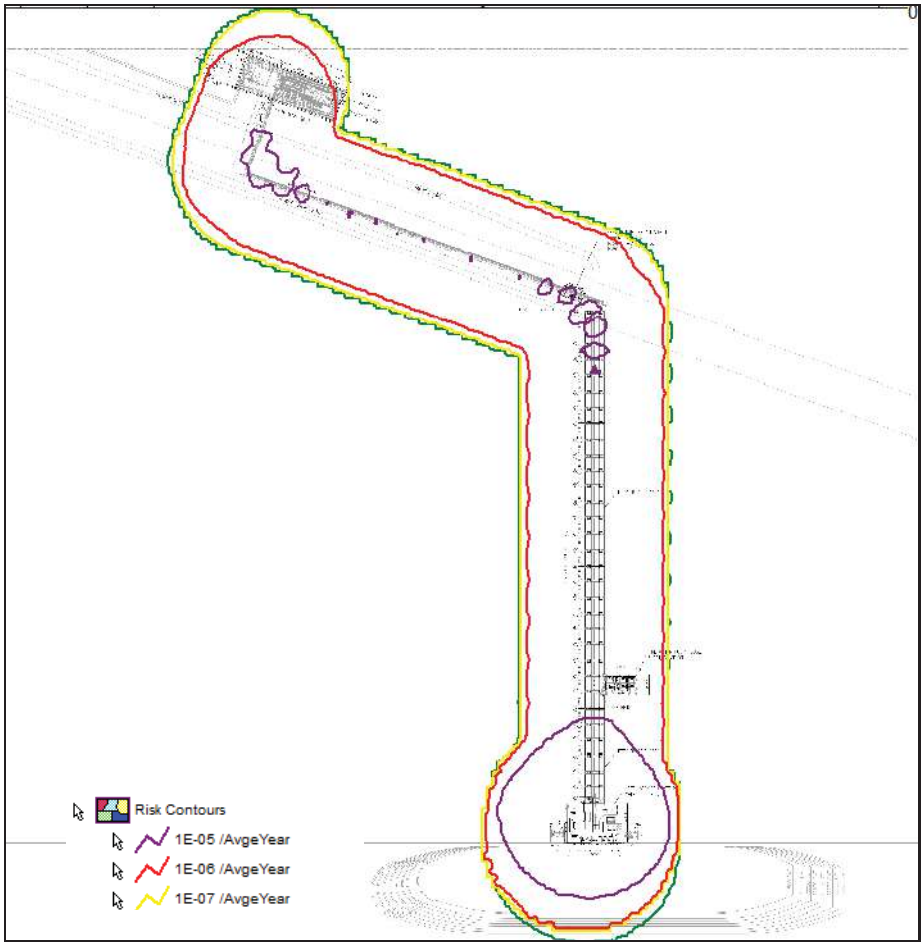


Figure 7-3: ISO- Risk contour for pool fire for 12.5kW/m2 radiation

From the Figure 7-3, it is observed that 1E-05 per year frequency (purple colour) contour 12.5kW/m2 radiation level overlap entire service platform and not reaching to fire water pump house area. 1E-06 per year frequency (red color) and 1E-07 per year frequency (yellow colour) contour overlapping to the entire cross-country pipeline and service platform.

7.5.2 Jet Fire ISO- Risk Contour

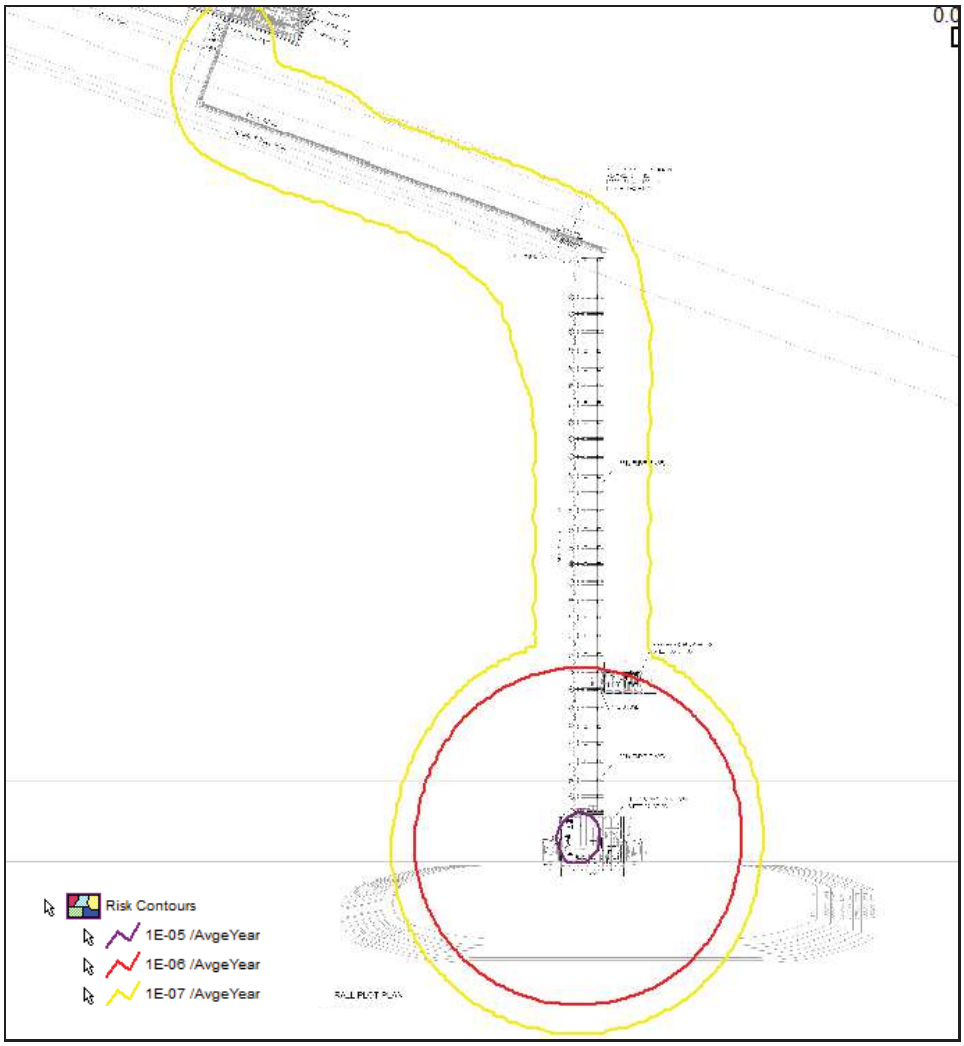


Figure 7-4: ISO- Risk contour for jet fire for 12.5kW/m2 radiation

From the Figure 7-4, it is observed that 1E-05 per year frequency (purple colour) contour 12.5kW/m2 radiation level overlap pig L/R, air compressor area, boom deploying station, unloading arm and slope oil tank at service platform. 1E-06 per year frequency (red colour) contour was overlapping to the service platform and part of the aboveground pipeline area. 1E-07 per year frequency (yellow colour) contour overlapping to the entire cross-country pipeline (aboveground/underground portion).

7.5.3 Flash Fire ISO- Risk Contour

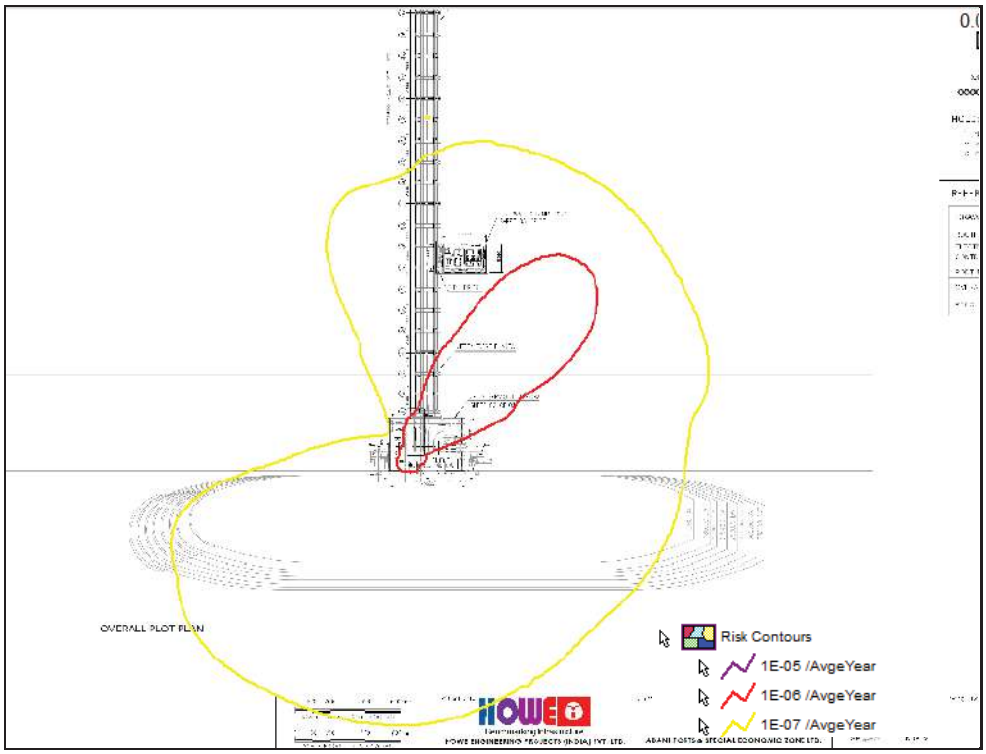


Figure 7-5: ISO- Risk contour for flash fire for 12.5kW/m2 radiation

From the Figure 7-5, it is observed that 1E-06 (Red) per year frequency contour 12.5kW/m2 radiation level overlap service platform. 1E-07 (Yellow Colour) per year frequency contour overlapping to the service platform and part of the aboveground pipeline area.

8 CONCLUSIONS & RECOMMENDATIONS

QRA Study has been carried out as per the Methodology provided in Section 3 of this Report. Failure Case Selection, Process Parameters, Leak Size, Release Rate, Detection & Isolation Time, Parts Count & Failure Frequencies, Ignition Probability Data, Meteorological Data, Population Details, Impact Criteria, Individual Risk Criteria, & Societal Risk Criteria are applied as per Assumption Register for QRA Study. The Software DNV SAFETI 8.4 is used for Consequence Modelling & Risk Modelling respectively. The risk results are detailed in section 7.

1. Summary of ISO- Risk Contour Results

ISO risk contour is illustrated in section 7.1, based on the contour, below observations are made.

- Individual risk contour of 1E-01, 1E-02,1E-03 and 1E-04 are not realised for overall risk results
- Individual Risk contour of 1E-05 realised and covers entire service platform area and small part of aboveground portion of cross-country pipeline
- Individual Risk contour of 1E-06 and 1E-07 realised and covers entire fire water pump house area and cross-country pipeline (aboveground / underground portion)

2. Summary of LSIR Results

Sr. No.	Location Description	LSIR (per year)
1	Approach Road	4.15E-05
2	Boom Deploying Station	4.07E-05
3	Loading Arm	4.63E-05
4	Fire Water Pump House	9.18E-06
5	Service Road	8.15E-06

3. Summary of IRPA Results

Sr. No	Location Description	LSIR Frequency /Avg. Year	Occupancy factor	Incremental IRPA/Avg. Year	Remark
1	Jetty Control personnel	4.02E-05	0.24	9.73E-06	ALARP (Lower ALARP)
2	Jetty Security personnel	4.40E-05	0.24	1.06E-05	ALARP (Lower ALARP)
3	Jetty Unloading Platform Area (Workers)	4.63E-05	0.24	1.12E-05	ALARP (Lower ALARP)
4	Guard	3.38E-05	0.24	8.18E-06	ALARP (Lower ALARP)
5	Maintenance / Instrumentation workers	4.21E-05	0.24	1.02E-05	ALARP (Lower ALARP)
6	Other category of workers - FFS	4.34E-05	0.24	1.05E-05	ALARP (Lower ALARP)

4. Summary of FN curve Results

ISO risk contour is illustrated in section 7.4, based on the FN curve, below observations are made. From the FN curve, it is observed that the F-N curve for the Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline fall under ALARP region. F-N curve falls in ALARP region between 1 to 70 number of fatalities. Maximum number of fatalities observed due to loss of containment events in the terminal and jetty facility is 70 with a frequency of 2.27E-05 per year.

8.1 Observation/ Recommendations

Based on the risk results, the following are the observations / recommendation:

1. Personnel at the facility shall be trained regularly on emergency response and preparedness. Ensure that emergency handling and mitigation systems are adequate. Mock drills based on emergency scenario shall be conducted at regular intervals to review emergency preparedness
2. Location specific individual risk of 1.0E-05 and 1.0E-06 per year is realized outside the facility. Therefore, it is recommended to ensure that Emergency Response Disaster Management Plan should be appropriately address the major credible scenarios from the facility for safe escape and evacuation during emergency.
3. Existing Disaster Management Plan (DMP) should be updated including the worst-case scenarios from the project facility

9 REFERENCES

/1/ Piping and Instrumentation Diagram (P&IDs)

/2/ Guidelines for Quantitative Risk Assessment CPR 18 E (Purple book), Committee for the Prevention of Disasters, Netherlands (Edition: PGS 3, 2005)

/3/ Guidelines for Developing Quantitative Safety Risk Criteria, CCPS, 2009

/4/ OGP 434-01 Process release frequencies, 2019

APPENDIX I – Assumption Register

ADANI PORTS & SPECIAL ECONOMIC ZONE LTD	HOWE ENGINEERING PROJECTS (INDIA) PVT.LTD.

PROJECT	**Development of VLCC Jetty at Mundra for Handling Crude Imports**		
TITLE OF DOCUMENT	**QRA ASSUMPTION REGISTER**		
EPC CONTRACTOR	**HOWE Engineering Projects (India) Pvt. Ltd.**		
CONSULTANT	**Valdel Engineers & Constructors Pvt. Ltd.**		
CLIENT DOCUMENT NO.	**HW026-50-E-GN-RP-005**	**Rev. No,**	**A**
CONTRACTOR/ CONSULTANT'S DOCUMENT NO.	**10820-30-2004**		

REV. NO.	DATE	DESCRIPTION	PREPARED BY		CHECKED BY		APPROVED BY		PROJECT MANAGER	
			Init.	Sign	Init.	Sign	Init.	Sign	Init.	Sign
A	12.10.2021	Issued for Approval	VRD		PLN		BTM		BTM	

Table of contents

1 INTRODUCTION

M/s HPCL Rajasthan Refinery Limited (HRRL) intends to set up a 9.0 MMTPA grass root Refinery and Petrochemical Complex in Pachpadra Tehsil of District Barmer in the state of Rajasthan. There is a plan for expanding the refinery for total capacity of 18 MMTPA in future.

For above, HRRL has decided to install a Crude Oil Terminal (COT) at Mundra (Gulf of Kutch) in Gujarat State for receiving, storage of different type of crude oils and dispatch facility for transporting blended crude oil to Rajasthan Refinery. The facilities of COT is to be setup for 9.0MMPTA Arab Light/Arab Heavy/ Arab mix with 10% owners margin. Ship tanker carrying out crude will be offloaded at APSEZL Jetty and then transport to HRRL COT at Mundra through pipeline. From COT facilities, crude shall be transported to refinery storages located at Barmer (Rajasthan) through cross country pipeline of around 500kms of length. The proposed development for the crude oil import terminal and facilities is located at south port, Mundra, Gujarat.

Mundra Port, one of the largest private ports in India, is located in the North Gulf of Kutch and is presently operated by Adani Port and Special Economic Zone Limited (APSEZL) formerly known as Mundra Port and Special Economic Zone Limited (MPSEZL).

The project to be owned and operated by APSEZL, consists of development of the following.

a) Service Platform 42M*30M with MLA-s, Pig Launchers & Other facilities.

b) 373m approach trestle from land fall point to service platform.

c) About 10km of 48” Cross Country Crude Oil Pipeline up to the Crude Oil Tank (COT) Farm of HRRL @ Mundra

d) Berthing and Mooring Dolphins.

1.1 Scope

The scope of work is to carry out Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.

The project consists of development of the following.

- 373m approach trestle from land fall point to service platform.
- About 10km of 48” Cross Country Crude Oil Pipeline up to the Crude Oil Tank (COT) Farm of HRRL @ Mundra
- Berthing and Mooring Dolphins.

1.2 Objectives

The objective of QRA study is as follows:

- Determine the consequences of hydrocarbon releases from process piping and equipment.

- Determine the frequency of hydrocarbon releases.
- Quantify Individual risk.
- Quantify Societal risk.
- Evaluate the acceptability of these risk levels against risk tolerability criteria.
- Identify risk reduction options appropriate for the phase of the development to demonstrate that risks are being managed to a level which is As Low As Reasonably Practicable (ALARP).

1.3 Abbreviations

ALARP	As Low As Reasonably Practicable
CR	Catastrophic Rupture
ESD	Emergency Shut-Down
ESDV	Emergency Shut-Down Valve
F&G	Fire & Gas (Detection)
FBR	Full Bore Rupture
HAZID	Hazards Identification
HSE (UK)	Health and Safety Executive (UK)
HSE	Health, Safety & Environment
HMB	Heat & Mass Balance
HC	Hydrocarbon
HCRD	Hydrocarbon Release Database
H2S	Hydrogen Sulphide
IR	Individual Risk
IRPA	Individual Risk Per Annum
IP	Intermediate Pressure / Institute of Petroleum
KTA	Kilo-Tonnes Per Annum
LPG	Liquefied Petroleum Gas
LSIR	Location Specific Individual Risk
F-N Curve	Logarithmic Plot of Frequency of fatalities (F) versus cumulative number of fatalities (N), a measure of offsite societal risk (to the public)
LoC	Loss of Containment
LP	Low Pressure
LFL	Lower Flammable Limit
MAH	Major Accident Hazards
MMT	Million Metric Tonne
ME	Multi Energy
NNF	Normally No Flow
OGP	Oil & Gas Producers
P&ID	Piping and Instrument Diagram
PLL	Potential Loss of Life

PFD	Process Flow Diagram
PHAST	Process Hazard Analysis Software Tools
QRA	Quantitative Risk Assessment
SR	Societal Risk
UKHSE	United Kingdom Health & Safety Executive
UKOOA	United Kingdom Offshore Operators Association
UFL	Upper Flammable Limit
VCE	Vapour Cloud Explosion

2 QRA METHODOLOGY

The initial key step is the identification of the release scenarios, which are based on Hazard Identification process usually carried out by internal review of the Process Flow diagrams and Piping & Instrumentation drawings, and layout configurations. Once the scenarios are defined, then these are evaluated further for their potential frequency of occurrence and consequence hazard zone. The frequency analysis is based on the facility equipment count paired with historical frequency data.

The risk result is estimated by the combination of the scenario frequency and consequence with potential impact to the facility and personnel. A variety of risk metrics may be evaluated depending on the scope, including Individual risk, societal risk. The risk results are compared to relevant criteria to evaluate the tolerability and to offer guidance for risk reduction. The key components are illustrated in below figure:

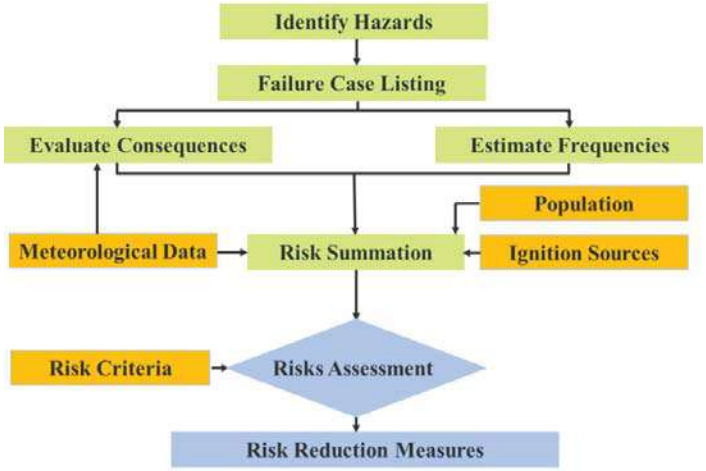


Figure 2-1: QRA Flowchart

2.1 Data Review

A review of the documents for this project shall be carried out to assess the process conditions and the potential release and hazard scenarios. Process conditions such as operating pressure, temperature, density, molecular weight and stream compositions shall be taken from Heat and Material Balance sheet. List of documents required are given below:

2.2 Failure Case Listing

Identify the possible potential loss of containment scenarios from the facility based on potential leak sources.

The event outcomes of flammable materials shall be further analysed with respect to jet fire, Flash fire explosion and pool fire based on their flash point.

2.3 Consequence Analysis

Consequence modelling evaluates the resulting effects if the accident occurs, and their impact on equipment and structures. Once the scenario is defined, a source model is selected to describe how materials are discharged from the process. The source model describes the rate of discharge, the total discharged quantity and the state of discharge – that is, liquid, vapor or a combination of both. Typically, a dispersion model is subsequently used to describe how the material moves downwind and mixes with air. For flammable releases, fire and explosion models consider concentration, mass of material present in the flammable cloud, heat of combustion of material and weather parameters such as wind velocity, atmospheric stability.

Consequence analysis will be carried out for the following event outcomes as minimum.

Jet fire/Flash Fire: Jet fires can occur due to immediate ignition of the released flammable gas or delayed ignition of the HC vapor cloud flashing back leading to a jet fire scenario at the release location. Jet fire can also result from release of two-phase liquid or liquid containing light HC. Upon release, light HC starts flashing immediately forming a flammable mixture. If ignited, this will result in a flash fire followed by a jet fire at the source of release.

Pool fire: Upon release of heavy HC or 2-Phase HC fluid, HC pool can form. Ignition of the pool can lead to a pool fire scenario.

Vapour Cloud Explosion: Upon release in the absence of immediate ignition sources, flammable gas forms a flammable vapor cloud. Upon finding a credible ignition source, delayed ignition of the flammable gas cloud can lead to vapor cloud explosion if the gas is accumulated in a congested area. The degree of explosion will depend upon the congestion and the confined volume.

2.4 Frequency Analysis

In risk assessment, frequency is estimated based on knowledge and expert judgment, historical experience, and analytical methods. These factors combine to support judgments made by risk assessment teams. Historical experience is expressed in terms of statistical data gathered from existing operations, generally in the form of incidents, base failure rates and failure probabilities.

a. Process equipment leak frequency database: At the end of 1996, the E&P Forum (the previous name of IOGP) completed and issued the Risk Assessment Data Directory. Incidents typically analysed in E&P risk assessments were identified and divided into four major categories, within which twenty-six individual datasheets were developed. These datasheets were made available to OGP members and other interested parties. In 2006, IOGP Safety Committee formed a task force to consider the future of the data directory. The objective of the Risk assessment data directory is to provide data and information that can be used to improve the quality and consistency of risk assessments with readily available benchmark data. The directory includes references for common incidents analysed in upstream production operations. The original 1996 data directory included 26 individual datasheets. Version 2 (2009) included 20 datasheets, although the scope of the material presented was similar to the original with some reorganisation. In 2019 IOGP published Version 3 starting with an update to 5 datasheets (published as reports 434-01, 434-02, 434-04, 434-06 and 434-20). Version 3 of the remaining datasheets is forthcoming.

b. Parts count: Parts count will be undertaken based on P&IDs. The parts count will be used as the basis for identifying the release sources corresponding to small, medium, large and full-bore rupture events. Parts count will be performed for clearly identified isolatable sections based on the location of ESDVs and thereafter based on failure cases. In case of unloading hoses/arms, purple book (CPR 18E) shall be referred considering the time of unloading operation.

c. Leak frequency assessment: The release frequency for each isolatable section is calculated as the sum of the products of the number of components and the generic component failure rate. It is evident from the frequency databases that smaller leaks are more dominant and larger releases are very rare and therefore it is necessary that various hole size ranges are considered. The output of this is a frequency of potential releases for small, medium, large and catastrophic hole sizes for process equipment releases. The hole size ranges are characterized by a representative hole size within each range. The hole size distribution, representative hole size and associated assumptions are detailed in Assumptions Register developed for assessment purpose.

d. Ignition probabilities: Ignition characteristics and associated probabilities determine which event tree branch will be followed and what will be the potential event for a given release scenario. The ignition probabilities play a major role in determining fire and toxic scenario contribution and therefore selecting the correct ignition probabilities plays an important role in risk calculation. Ignition probabilities provided in IOGP risk assessment data directory will be adopted.

2.5 Risk Analysis

Risk assessment is the process of comparing the level of risk against a set of criteria as well as identifying major risk contributors. In the risk assessment stage, the quantified risk results are compared to pre-established risk criteria (from governmental regulatory requirements, recommended guidelines, or corporate guidelines) to indicate whether the risks are tolerable or to make some other judgment about their significance.

Risk assessment identifies the level of risk associated with credible failure scenarios and evaluates against risk acceptance criteria. It also can be used to identify recommendations that may further reduce the risk to tolerable levels, if risks are found to be intolerable, or to reduce the overall level of risk to a level As Low As Reasonably Practicable (ALARP)

2.6 Risk Reducing Measures

A risk assessment can identify risks that exceed the tolerable criteria. In such cases, risk reducing measures are identified to reduce the risk / hazard.

2.7 Software Database

Our Software Solutions are founded on the latest regulatory requirements and the deep-seated technical expertise of our safety, software and risk specialists. They are validated at our world-leading laboratories and test sites.

PHAST and SAFETI (PHASTRISK) are the market leaders in the oil and gas, petrochemicals, chemicals and pharmaceutical industries. DNV sets the industry standard for carrying out quantitative risk assessments (e.g. our QRA software Safeti-NL is mandated by the Dutch Government).

- DNV PHAST v8.4 will be used for the Consequence Modelling
- DNV SAFETI (PHAST RISK) v8.4 will be used for Risk Modelling
- Leak v3.3 will be used to estimate Failure Frequency

3 ASSUMPTION & INPUT DATA

As part of the study process, rule sets / assumptions have to be agreed prior to the execution of the critical steps. The rule sets and assumptions that will be applied for QRA study as applicable, are outlined in Table 4 1.

If any of the values applied in this document are altered, the risk results presented in the report may no longer be valid. Consequently, alteration of any of these assumptions may generate a need for update of the respective study. The table below gives an overview of the assumptions made for QRA study, as applicable. A detailed description of the assumptions is found in the subsequent forms in this section.

Table 3-1: List of Assumptions

Assumption No.	Description
1.	Failure Cases Selection
2.	Process Parameters
3.	Leak Size, Release Rate, Release Direction & Release Types
4.	Detection & Isolation Time
5.	Parts Count & Failure Frequencies
6.	Ignition Probability Data
7.	Manning Level
8.	Meteorological Data
9.	Event Trees
10.	Event Outcomes
11.	Impact Criteria
12.	Individual Risk Criteria
13.	Societal Risk Criteria
14.	Vulnerability Assessment
15.	Report Structure

3.1 Failure Case Selection

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**01**
Assumption / Rule Set: Failure Case Selection	

All facilities normally containing hazardous material shall be considered during identification of failure cases. All identified failure cases shall be defined in terms of location, material released, quantity released, released condition including inventory flow/ pumped flow, temperature, pressure, leak size, leak direction, leak elevation, leak frequency and ignition probability.

Identification of isolatable sections is required to determine the inventory available for release upon loss of containment. Following assumptions are made for determining isolatable sections.

- An isolatable section is defined as section between ESDVs and BDVs. Isolatable inventory will be considered for modelling purpose.
- QRA study inputs like isolatable sections, process parameters etc. will be based on the P&ID, PFD, Plot Plan etc. available at the start of the study.
- Normally No Flow (NNF) lines are not considered for inventory analysis.
- Open and closed drains are generally low pressure and NNF type and will not be considered in inventory analysis or for the purpose of identifying isolatable sections.
- Representative release sizes will be considered to determine the frequencies and release rates.
- Release location, in most cases, the defined scenarios will include equipment items that are located in the same part of each unit.
- Start-up line and other normally closed valves are not considered for QRA Study.
- Flare is not continuously operation and will not be considered for analysis.

The event outcomes of all flammable chemicals shall be further analysed with respect to jet fire, explosion and pool fire based on their flash point.

DNV shall use systematic naming convention to detail the various failure cases.

Failure case Id structure: Area/Segment #/Phase/Leak size

For e.g., Compressor /ISO1/G/S

Where,

Area of Isolatable Segment is Compressor

ISO1 is a Leaking Isolatable Segment between two SDV valves

G is the phase of the release, typically “G” for gas, “L” for Liquid

S is the Leak size, typically “S” for Small, “M” for Medium, “L” for Large and “FBR” for Full Bore Rupture.

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**01**
Assumption / Rule Set: Failure Case Selection	
Reference:	1. QRA Standard Practice 2. Guidelines for QRA 'Purple Book', CPR-18E (Section 2)

3.2 Process Parameters

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**02**
Assumption / Rule Set: Process Parameters	

For each failure case, the key inputs to the derivation of release parameters will be the material, phase, process conditions (temperature and pressure), flow rate and isolatable section volume / inventory, as described below:

Material: The releases shall be represented by a single equivalent material, based on the average molecular weight - for example, the majority of releases would be expected to be methane. Where a mixture that would have different release / dispersion behaviour to the equivalent material (or where it is uncertain) – a mixture should be defined and input to the discharge modelling. Stream Composition shall be taken from the PFDs and Heat & Mass Balances.

Process conditions (operating temperature and pressure) shall be taken from the PFDs and Heat & Mass Balances. Where the conditions vary within a section, those associated with the main inventory will be used, and where there is no 'main' inventory the stream with the highest pressure will be taken as representative.

Flow Rate: Design flowrate shall be taken from the PFDs and Heat & Mass Balances.

Inventory Calculation:

- Process P&IDs / PFDs will be divided into a number of isolatable sections. Based on the isolatable sections developed, inventory assessment will be carried out for the given isolatable section by adding the following.
- Inventory is identified considering static inventory available in the isolatable section and dynamic inventory identified considering release rate from identified hole size with ESD action assuming to activate within the time mentioned in Assumption sheet no. 4.
- The length of pipe work will be estimated from the layouts. An additional 10% will be added to the piping inventory for allocating pipe bends along the pipe work routing. This assumption is usually considered to give an adequate estimation of the pipe length from which to determine the source term of hydrocarbon which is to be dispersed.
- The inventory calculation will be calculated based on static and dynamic volume. This will be estimated from process design information.
- Static inventory – will be based on the process equipment (vessels, drums etc.) and piping in that defined isolatable section Assumption sheet no. 4.

Project:	Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.
Client:	Valdel Engineers & Constructors Pvt. Ltd.
Assumption No:	02
Assumption / Rule Set: Process Parameters	

- The following assumptions will be made:
  - In the event of F&G activation, the time to detect and time taken by SDV to completely close are assumed to be as per the time mentioned in Assumption sheet no. 4.
  - For heat exchangers, pumps, compressors - the volume will be assumed to be that of the piping since they do not hold significant inventory.
  - For gas system vessel - gas volume will be assumed 100% occupying entire vessel.

For liquid system vessel – liquid volume will be taken up to the Normal Liquid Level (NLL). If in case no data is available, 50% of total vessel volume will be assumed, which is considered typical.

Reference:	1. QRA Standard Practice

3.3 Leak Size, Release Rate, Release Direction & Release Types

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**03**
Assumption / Rule Set: Leak Size, Release Rate, Release Direction & Release Types	

The representative leak hole sizes to be modelled are selected to ensure that the entire range of potential hole size is represented in the modelling. The leak hole size in reality can range from a pinhole leak on one side to a full-bore rupture on the other extreme.

1. Release Size:

The following representative leak sizes will be modelled:

Process Equipment and inter connection lines release hole size band

Leak Category	Representative Hole Size (mm) for Piping	Hole Size Range (mm)
Small	7	0 – 10
Medium	22	10 – 50
Large	70	50 – 150
FBR	150	>150

Release Rate:

The representative release rate, Q (kg/s), selected in each case is generally taken as the initial maximum release rate, Qo (kg/s), which is calculated within the PHAST discharge model.

However, certain key scenarios are considered where the representative release rate is adjusted from the initial maximum Qo:

- For gas release, if the initial maximum release rate, Qo, is very large (greater than NFR- normal flow rate) the initial peak release rate will be of very short duration, the model will consider as instantaneous release instead of continuous release.
- For liquid release, if the initial maximum release rate, Qo, is very large (greater than NFR-normal flow rate) the initial peak release rate will be of very short duration and the representative release rate (to be considered in PHAST) will be restricted to the normal flow rate.

2. Release direction:

For Aboveground equipment release will be modelled as oriented horizontally at a height of 1 meter from the ground level to ensure conservatism. This height is based on most conservative approach as per general QRA practice.

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**03**
Assumption / Rule Set: Leak Size, Release Rate, Release Direction & Release Types	

For underground pipeline release will be modelled as oriented vertically at height of 0 meter. This height is based on most conservative approach as per general QRA practice.

3. Release Types:

- Vapour releases: These are relatively straightforward scenarios where the process fluid is gas, and hence the discharge parameters applied to the model are based on the gas properties. Immediate ignition events are treated as jet fires/flash fires, while delayed ignition events are assumed to be flash fire/ explosions. Both the fire and explosion calculations are based on the full isolatable inventory, and full release rate, of the vapour failure case.
- Flashing liquid releases. These are releases where the process fluid is 2-phase or liquid, where a significant flash will occur upon release (i.e. 80%, by mass, or greater). These releases are treated as fully flashing and, hence, the subsequent consequences are based on the resulting vapour. Immediate ignition events are treated as jet fires (or equivalent*1), while delayed ignition events are assumed to be flash fire/ explosions. Both the fire and explosion calculations are based on the full isolatable inventory, and full release rate, of the liquid / 2-phase failure case.
- Liquid releases. These are defined as all releases where the vapour fraction is less than 20% (by mass) and where the flash fraction upon release remains below 20%. Hence, these are release scenarios where the credible immediate ignition outcomes are pool fires. Any potential for vapour clouds will be, primarily, through vaporisation of the pool, rather than the initial flash. Immediate ignition events are treated as pool fires, while delayed ignition events are assumed to be explosions. The pool fire calculations are based on the full liquid inventory and release rate, while explosion calculations are based on the rate / mass adjusted for the vaporisation fraction. Separator liquid outlets and liquid handling system will be modelled as liquid phase.

  Note: Modelling liquids with the full spectrum of stated HMB components in Safeti 8.4 suppresses rain-out, if mixture components include any gas, N2, CO2, H2S, C1, C2 etc., leading to wrong rain-out and hence consequence results. It is therefore suggested as under:

- **Water Content:** The modelling will fully take into account water to limit the potential release rate. However, only the hydro-carbons will be physically modelled in the failure cases, as water in hydro-carbon mixtures is not compatible in PHASTRISK and leads to wrong results. The reduced mixtures modelled will reflect the correct molecular weight (MWT) of the full mixture minus the water. The flow rate of stream will be reduced in proportion to water percentage (based on the weight percentage) and total inventory in KG (static and dynamic inventory) will be calculated.

4. Dispersion

- Flammable gas dispersion averaging times – 18.75s (flammable averaging time as default setting in the software).

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**03**
Assumption / Rule Set: Leak Size, Release Rate, Release Direction & Release Types	
• Software default value of 0.1 m for surface roughness will be used for the facility (typical value for industrial areas).	
Reference:	1. DNV expert judgment – using Phast Risk defaults and DNV Technical Data 2. OGP Risk Assessment Data Directory (Section 2) 3. CPR 18E, Purple Book. Section 4.4.1 4. CMPT, A Guide to Quantitative Risk Assessment for Offshore Installation. (Centre of Maritime and Petroleum Technology)

3.4 Detection and Isolation Time

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**04**
Assumption / Rule Set: Detection and Isolation Time	

The total inventory includes static as well as dynamic inventories. The dynamic inventory is calculated as the product of the representative release rate and the duration for which it is applied. Static inventory is the hold-up volume in the isolatable section. Thus, the inventory released is the mass released prior to isolation plus the isolatable static inventory.

- Detection Time is the time required by the Leak Detection System to detect a leak.
- Response Time is the time taken by the operator to validate the leak and respond.
- Shutdown Time is the time for the SDVs to close down.
- Total isolation time includes sum of detection time, response time and shutdown time.

Intervention time of protective system considered for assessing time dependant process parameters includes the following:

- F&G detection time;
- Actuation time;
- SDVs closing time.

The following intervention time shall be considered in the study for release scenarios identified in the terminal: Three different types of blocking systems are distinguished, namely the automatic blocking system, the semi-automatic blocking system and the manual blocking system.

An automatic blocking system is a system where the detection of the leakage and closure of the blocking valves is fully automatic. There is no action of an operator required. The closing time of the blocking valves is two minutes.

A semi-automatic blocking system is a system where the detection of the leakage is fully automatic. The detection results in a signal in the control room. The operator validates the signal and closes the blocking valves using a switch in the control room. The closing time of the blocking valves is ten minutes.

A Manual blocking system is a system where the detection of the leakage is fully automatic. The detection results in a signal in the control room. The operator validates the signal, goes to the location of the blocking valves and closes the valves by hand. The closing time of the blocking valves is 30 minutes.

Based on the detection and blocking system envisaged in engineering, the detection and isolation time of 2 minutes is be selected and shall be used for risk assessment as default unless required due to different isolation philosophy as per PIDs.

Reference:	1 . Guidelines for QRA 'Purple Book', CPR-18E (Section 4)

3.5 Parts Count & Failure Frequencies

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**05**
Assumption / Rule Set: Parts count & Failure Frequencies	

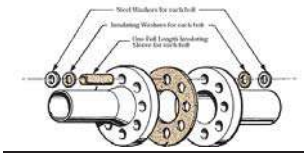
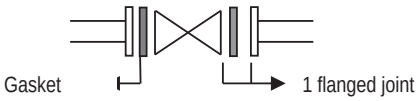
Failure Frequency data used as in the study is presented in this section.

Process Piping / Equipment for Installations

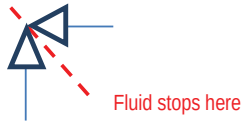
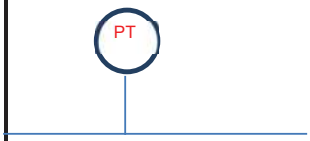
Failure Frequency Estimation within the Process Installation involves counting the number of components (valves, flanges, blinds, instrument tapping, etc.) within a particular section boundary.

In part count, the scope of valve includes the valve body, stem, and packing but excludes flanges. These flanges shall be counted separately. Normally opened valve assembly may be counted as one valve and two flanged joints; whereas normally closed valve assembly (where only leaks from one side of valve would cause the consequence) may be counted as 0.5 times of the valve and one flange joint. Sample parts count methodology is detailed in Table below.

Parts Count Methodology

Symbols	Parts Count
	1 Manual Valve & 2 flanged joints 
	**Valves (Manual Valve, Control Valve, NRV, BDV)** 1 valve (if valve has flanged joints and normally open) is counted as: 1 Valve 2 flanged joints 1 valve (if valve has flanged joints and normally close) is counted as: 0.5 valve 1 flanged joint
Isolatable Section 1  Isolatable Section 2	**Actuated Valve (SDV)** For Isolatable Section 1 0.5 Valve

Project:	Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.
Client:	Valdel Engineers & Constructors Pvt. Ltd.
Assumption No:	05
Assumption / Rule Set: Parts count & Failure Frequencies	

	1 flanged joint <u>For Isolatable Section 2</u> 0.5 Valve 1 flanged joint
	<u>PSV</u> 0.5 Actuated Valve 1 flanged joint
	<u>1 Instrument Connection is counted as:</u> 1 instrument connection <u>In case of flow orifice instrument is counted as</u>: 1 instrument connection. 1.5 flanged joint Includes the instrument itself plus up to 2 instrument valves, 4 flanges, 1 fitting and associated small-bore piping.
	Spectacle Blind = 1.5 flanged joint

<u>Process Equipment and Piping</u>

For all process equipment and piping, the failure frequencies will be based on the OGP, Risk assessment data directory, 2019.

The generic failure data used as the basis for the frequency analysis through LEAK software (v3.3) is based on the OGP, Risk assessment data directory, 2019.

For this analysis, DNV GL will only apply the frequencies based on full leaks. The release scenarios will be modelled with four different hole sizes (small, medium, large and very large releases).

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**05**
Assumption / Rule Set: Parts count & Failure Frequencies	

Underground Pipelines

For gas underground cross-country pipelines "11th Report of the European Gas Pipeline Incident Data Group

(period 1970 – 2019)" database will be considered for the analysis.

For Oil underground cross-country pipelines "CONCAWE Performance of European cross-country oil pipelines Statistical summary of reported spillages in 2019 and since 1971" Database will be considered for the analysis.

Leak Software:

DNV's proprietary leak frequency software model, LEAK v 3.3, is used to estimate the expected leak frequencies.

Leak software version 3.3 is inbuilt with HCRD failure data 2015 and is a simplified tool used to calculate failure frequencies for various isolatable segments.

For each failure case or isolatable section identified, a 'parts count' is required which is a count of every equipment item from as large as pumps and filters to as small as flanges and instrument connections. Parts count shall be done using P&IDs. The parts count shall be then combined with the generic failure rates to obtain the required failure frequencies per failure case.

Each of the failure frequencies (for full piping releases) shall be calculated from Leak software (Leak v 3.3. Frequency analysis shall consider all valves to be welded. No flange joints shall be considered. However separate flanges shall be included for analysis, wherever present in the P&ID.

Reference:	1. OGP 434-01 Process release frequencies, 2019 2. 11th Report of the European Gas Pipeline Incident Data Group (period 1970 – 2019)" 3. CONCAWE Performance of European cross-country oil pipelines Statistical summary of reported spillages in 2019 and since 1971 4. Guidelines for QRA 'Purple Book', CPR-18E (Section 3.2.9.2)

3.6 Ignition Probability

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**06**
Assumption / Rule Set: Ignition Probability	

DNV will use the Institute of Petroleum (IP) data (UKOOA correlation, also available in OGP database) ignition probability database for execution of the QRA study.

The OGP database consists of a total of 28 different mathematical functions and lookup correlations to define the ignition probability for all types of facilities and surrounds, based on data drawn from UKOOA.

The following UKOOA look-up correlations will be used for determining the ignition probabilities:

1. Pipe Liquid Industrial (Liquid Releases from onshore pipeline in industrial area)
2. Small Plant Liquid (Liquid release from small onshore plant)

1 – Pipe Liquid Industrial

Releases of flammable liquids that do not have any significant flash fraction (10% o less) if released from onshore cross-country pipelines running through industrial or urban areas.

Release Rate (kg/s)	Ignition Probability
0.1	0.0010
0.2	0.0016
0.5	0.0028
1	0.0045
2	0.0070
5	0.0126
10	0.0198
20	0.0311
50	0.0563
100	0.0700
200	0.0700
500	0.0700
1000	0.0700

6 – Small Plant Liquid

Releases of flammable liquids that do not have any significant flash fraction (10% or less) if released from small onshore plants (plant area up to 1200 m2, site area up to 35,000 m2) and which are not bunded or otherwise contained.

Release Rate (kg/s)	Ignition Probability
0.1	0.0010
0.2	0.0013
0.5	0.0018
1	0.0024
2	0.0042
5	0.0088
10	0.0155
20	0.0272
50	0.0570
100	0.1000
200	0.1000
500	0.1000
1000	0.1000

The IP review of ignition and explosion probabilities concludes that, there are too little data to draw any firm conclusions but that “risk assessment approaches based on 30:70 to 50:50 split delayed ignition or jet / pool fire: flash fire / explosion are reasonable”. Furthermore, it also identifies that, on average, approximately 20% of ignited gas releases result in explosions.

Project:	Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.
Client:	Valdel Engineers & Constructors Pvt. Ltd.
Assumption No:	06
Assumption / Rule Set: Ignition Probability	

The proposed explosion probability rule set is therefore:

- 50% of all ignitions are immediate resulting in jet/pool fires (F);
- 20% of all ignitions result in explosion (PEX);
- The remainder (30%) of ignitions result in flash fires (1-F-PEX).

Based on the above, the ratio between P(immediate ignition) and P(delayed ignition) is estimated as 50:50. This estimate is supported by the joint industry Ignition Probability Review, which shows that approximately 50% of ignitions occur within a minute or so of the leak commencing.

Hence, the split immediate: delayed ignition used will be 50:50, will be used as ignition and explosion probabilities.

The immediate ignition probability can be calculated as,

$P_{immediate} = P_{total} \times 0.50$, for plant areas where P_{total} is calculated from UKOOA look-up table

Reference:

1. IP Research Report – Ignition Probability Review, Model Development and Look-Up Correlations, January 2006, Energy Institute, London
2. UKOOA/HSE/EI Look-up Correlation Workbook (Version D1), ESR Technology (formerly the Engineering Safety and Risk Business of AEA Technology).
3. Ignition probabilities, OGP Risk Assessment Data Directory, Report No. 434-6.1, 2019

3.7 Manning Level

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**07**

Assumption / Rule Set: Manning Level

For individual risk calculation, people expected to be affected by the hazard are grouped based on their work which reflects a particular pattern of exposure to major accident hazards. The defined population data accounts the shift pattern in risk calculation. The fraction of time spent inside and outside a building by an individual within each working group at each specific location is also determined in order to differentiate the indoor and outdoor effect of consequences.

For societal risk calculation, specific population areas are determined and the average numbers of inhabitants at each population area throughout the year are set. The average fraction of time spent inside and outside a building by the inhabitants in each population area is also determined to differentiate the indoor and outdoor effect of consequences.

Manning details will be used to calculate IRPA and F-N Curve.

Location	Jetty				
	Shift 1	Shift 2	Shift 3	General Shift	Subtotal (A)
Jetty Control personnel	*2*	*2*	*2*	*2*	8
Jetty Security personnel	*2*	*2*	*2*	-	8
Jetty Unloading Platform Area (Workers)	*6*	*6*	*6*	-	18
Guard (If any)	*4*	*4*	*4*	-	12
Maintenance / Instrumentation workers	*2*	*2*	*2*	-	6
Other category of workers (if any) - FFS	*6*	*6*	*6*		18
TOTAL					0

1. Number of shifts	3 Shift		
2. Shift timings	07-15	15-23	23-07

Reference:	Population Data provide by Client/ Contractor

3.8 Meteorological Data

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**08**
Assumption / Rule Set: Meteorological Data	

The consequences of releases of flammable materials into the atmosphere are strongly dependent upon the rate at which the released material is diluted and dispersed to safe concentrations. The local meteorology is therefore important in two respects. First, the wind direction determines whether a release drifts towards or away from vulnerable locations. Second, the actual weather conditions, in terms of wind speed and stability, determines how quickly the plume disperses. Variation in wind direction defines the apparent orientation of consequences. Stability classes were finalized as per Pasquill-Gifford Stability Classes as mentioned in CPQRA.

Table: Wind Speed and Pasquill Stability Class (as per CPQRA)

Surface Wind Speed, m/s	Day Time			Night Time		Any Time Heavy Overcast
	Strong	Moderate	Slight	≥4/8 Low Cloud	< 4/8 Cloudiness	
<2	A	A-B	B	E	F	D
2-3	A-B	B	C	E	F	D
3-4	B	B-C	C	D	E	D
4-6	C	C-D	D	D	D	D
>6	C	D	D	D	D	D

Stability Classes:

A - Very unstable; sunny light winds

A/B – unstable; as with A only less sunny or more windy

B – unstable; as with A/B only less sunny or more windy

B/C – Moderately unstable; moderate sun and moderate wind

C - Moderately unstable; very windy / sunny or overcast /light wind

C/D - Moderately unstable – moderate sun and moderate wind

D – Neutral; little sun and high wind or overcast windy night

E – moderately stable; less overcast and less windy night than D

F – stable; night with moderate clouds and light/moderate windy

G – very stable; possibly fog

The following atmospheric conditions in line with IMD (Barmer) shall be used for the study.

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**08**

Assumption / Rule Set: Meteorological Data

Meteorological Data for Barmer (IMD Data)

Parameter	Value	Unit	Notes/Justification
Ambient air temperature	35	°C	It has relatively minor influence on the dispersion characteristics (although there will be buoyancy of gas clouds) Maximum temp is 48°C and minimum temperature is 7°C
Relative humidity	95	%	Site Environmental Data (Doc: 10820-1001-Rev.C)
Solar radiation	1 (max) 0 (min)	kW/m^2	Peak solar radiation. Negligible influence on dispersion/consequence.
Atmospheric pressure	1.01	barg	Negligible influence on dispersion/consequence.

Wind Direction Probability (Normalize to 100%)

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Night	8.18	5.91	3.64	2.27	0.91	0.45	0.00	1.82	3.64	13.64	23.64	14.55	5.45	5.00	4.55	6.36
Day	3.91	5.47	7.03	3.91	0.78	0.39	0.00	2.34	4.69	15.23	25.78	15.63	5.47	3.91	2.34	3.13

Reference:	1. Climatological Normals (1981 – 2010)

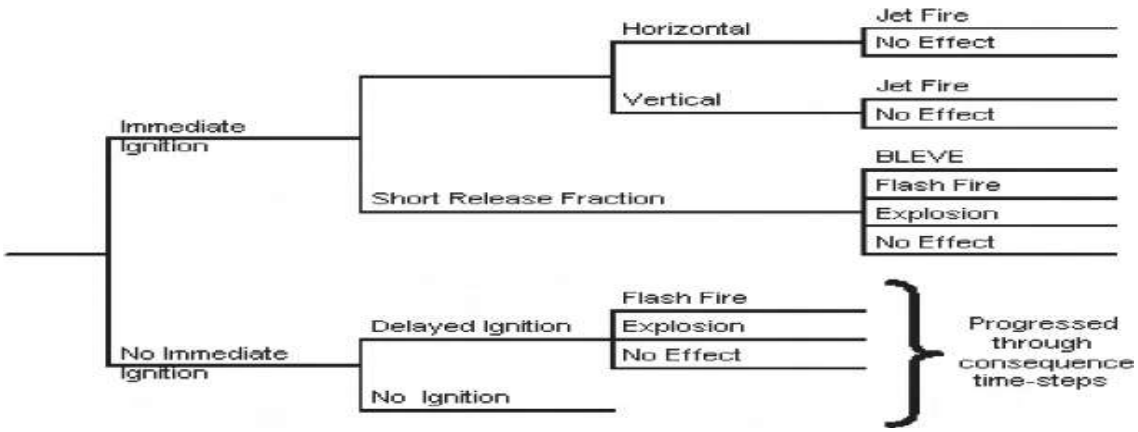
3.9 Event Tree

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**09**
Assumption / Rule Set: Event Trees	

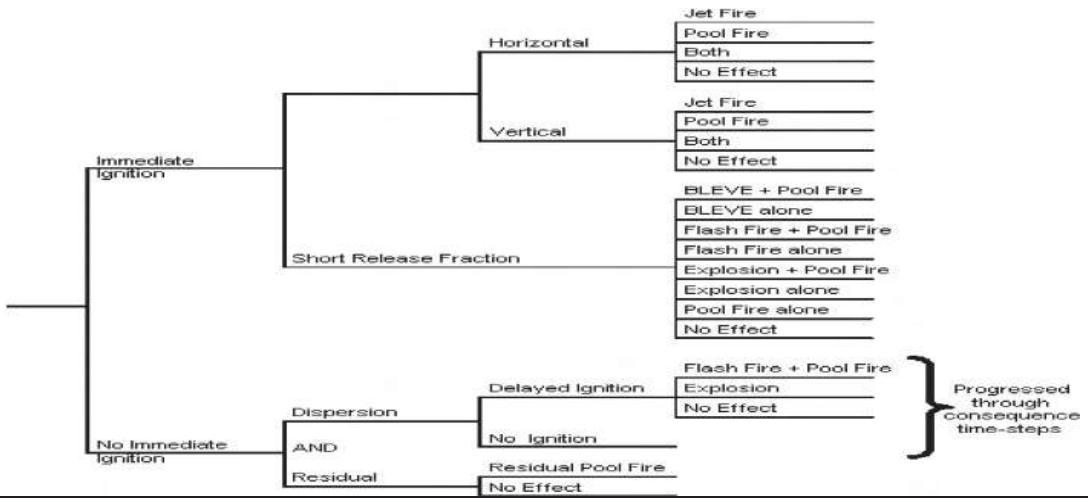
An event tree is used to develop the consequences of an event. An event tree is constructed by defining an initial event and the possible consequences that flow from this. The initial event is usually placed on the left and the branches are drawn to the right, each branch representing a different sequence of events and terminating in an outcome.

Following Event Trees will be considered for the Project:

1. **Continuous, No Rainout**

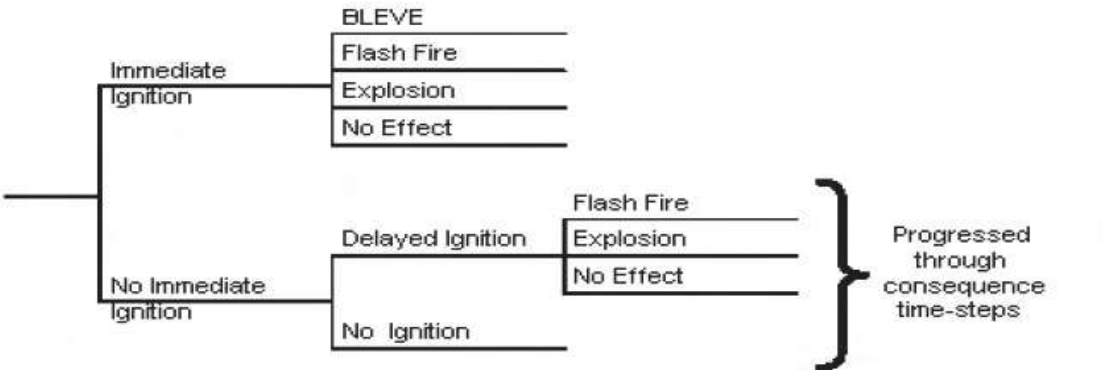


2. **Continuous, with Rainout**

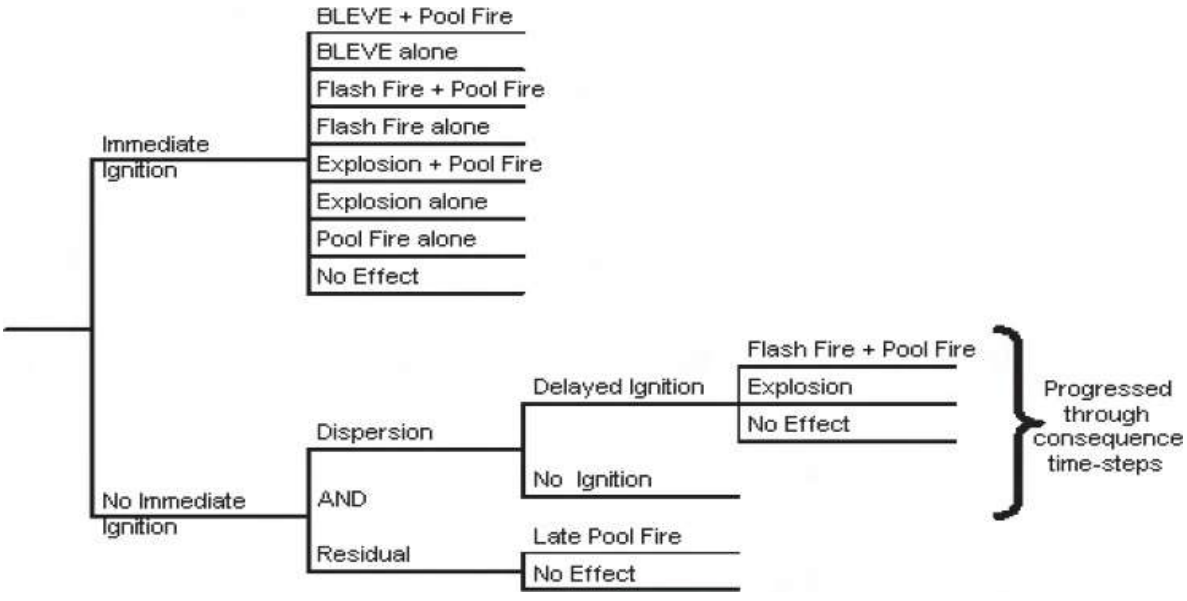


Project:	Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.
Client:	Valdel Engineers & Constructors Pvt. Ltd.
Assumption No:	09
Assumption / Rule Set: Event Trees	

3. **Instantaneous, No Rainout**



4. **Instantaneous, with Rainout**



Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**09**
Assumption / Rule Set: Event Trees	
Reference:	1. DNV Explosion Methodology Definition RiskNet Guideline G14

3.10 Event Outcomes

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**10**
Assumption / Rule Set: Event Outcomes and Congestion	

This section details the possible consequences which may emanate upon loss of containment.

The incidental scenarios which can cause injury to human health and potential loss of life are the following:

- Jet fire;
- Flash fire;
- Pool fire;
- Explosion:

Jet Fire

Jet fires are burning jets of gas or atomized liquid whose shape is dominated by the momentum of the release. The jet flame stabilizes on or close to the point of release and continues until the release is stopped. Jet fire can be realized, if the leakage is immediately ignited. The effect of jet flame impingement is severe as it may cut through equipment, pipeline or structure. The damage effect of thermal radiation is depended on both the level of thermal radiation and duration of exposure.

Flash Fire

A flash fire occurs when a cloud of vapours/gas burns without generating any significant overpressure. The combustion zone moves through the cloud away from the ignition point. The duration of flash fire is relatively short but it may stabilize as a continuous jet fire from the leak source. An approximate estimate for the extent of the total effect zone is the area over which the cloud is above the LFL.

Pool Fire

Pool-fire calculations are then carried out as part of an accidental scenario, e.g. in case a hydrocarbon liquid leak from a vessel leads to the formation of an ignitable liquid pool. First no ignition is assumed, and pool evaporation and dispersion calculations are being carried out. Subsequently late pool fires (ignition following spreading of liquid pool) are considered. If the release is bunded, the diameter is given by the size of the bund. If there is no bund, then the diameter is that which corresponds with a minimum pool thickness, set by the type of surface on which the pool is spreading.

Vapour Cloud Explosion (VCE)

VCE results from the delayed ignition of a flammable cloud formed due to the release of a large quantity of flammable vaporising liquid or gas which burns sufficiently quickly to generate high overpressures (i.e. pressures more than ambient). The flame accelerates to sufficiently high velocities to produce significant overpressure. The overpressure resulting from an explosion of hydrocarbon gases is estimated considering

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**10**
Assumption / Rule Set: Event Outcomes and Congestion	

the explosive mass available to be the mass of hydrocarbon vapour between its lower and upper explosive limit.

Congestion modelling:

Within the process areas, obstructed regions are defined as areas with the potential for confinement and congestion of a flammable cloud, which may promote explosion hazards. The flammable cloud size is estimated based on the overlapping area of an unobstructed/ undisturbed dispersion cloud and the congested area.

- Explosion will be modelled using TNO Multi-Energy method.
- Dimensions of obstructed regions;
- Based in the plot plan, Curve number 7 (conservative approach) will be used; and
- Blockage ratio 0.2 will be considered for the QRA study.

Reference:	1. DNV Technical Note on Human Impact Criteria T15, Rev 03 2. Guidelines for Developing Quantitative Safety Risk Criteria, CCPS, Second Edition, 2000

3.11 Impact Criteria

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**11**
Assumption / Rule Set: Impact Criteria	

The Damage Criteria give the relation between extent of the physical effects (exposure) and the percentage of the people who will be killed or injured due to those effects. The knowledge about these relations depends strongly on the nature of the exposure. Physiological/physical effects of the thermal radiation for jet fire or pool fire scenarios and overpressure impact for vapour cloud explosion is discussed below in order to appreciate the damage effect produced.

Thermal Radiation Level Impact Criteria

Radiation Intensity (kW/m2)	Description
37.5	100% Fatality and Severe damage to plant
12.5	Minimum energy to ignite wood with a flame; Melts plastic tubing. Extreme pain within 20s. Fatality if escape is not possible. Outdoor: 70% Lethality Indoors: 30% Lethality
4	Maximum radiant heat intensity in areas where emergency actions lasting 2 min to 3 min can be required by personnel without shielding but with appropriate clothing. If unprotected pain after 16 seconds and 1% lethality

Flash fires:

Flash fires are represented by LFL contour. Based on the UDM dispersion method adopted by PHAST, 100% LFL consequence hazard distances will be reported.

Explosions:

Explosion overpressure contours for side-on overpressure levels of 0.3, 0.1 and 0.03 bar will be included in the report.

Overpressure Impact Criteria

Overpressure Level (bar)	Observed Effect
0.3	Heavy damage to plant and structures. There is a 50% chance of a fatality for a person in a building and 15% chance of a fatality for a person in the open. Eardrum damage.
0.1	Lower limit of serious structural damage, Control House or Substation concrete roof can collapse
0.03	Limited minor structural damage (Crack in glass)

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**11**
Assumption / Rule Set: Impact Criteria	
Reference:	1. OGP Risk Assessment Data Directory, Report No. 434-14, "Vulnerability of Humans". 2. A Guide to Quantitative Risk Assessment for Offshore Installation (CMPT, Appendix V.3)

3.12 Individual Risk Criteria

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**12**
Assumption / Rule Set: Individual Risk criteria	

The level of risk calculated for employees and the general public is studied in two principal areas. Firstly, Individual Risk, which is the level of risk of fatality for specific people, usually defined as individuals within specific groups. The groups are defined by their activities in or around the facilities.

The second area is risk to society, which is a measure of the risk of fatality within the general public.

The process for calculating the levels of risk associated with the facility is:

- Calculate the Location Specific Individual Risk (LSIR) from Major Accident Hazard events using the QRA model
- Define the worker groups and groups of the general public (if any) by their location and movements within the effects zone of the facility
- Calculate Individual Risk figures as LSIR data
- Use the QRA model to calculate societal risk, F-N curve

In order to determine acceptability, the risk results are assessed against a set of risk criteria. The individual risk criteria adopted for this study is based on HSE UK Guideline and is presented below.

Individual Risk Criteria

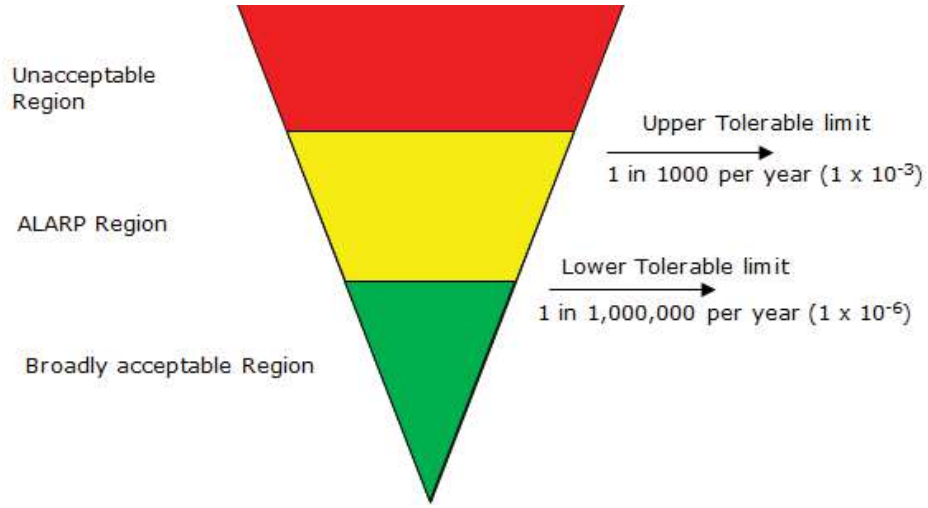


Figure: Individual Risk Criteria for Workers

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**12**
Assumption / Rule Set: Individual Risk criteria	

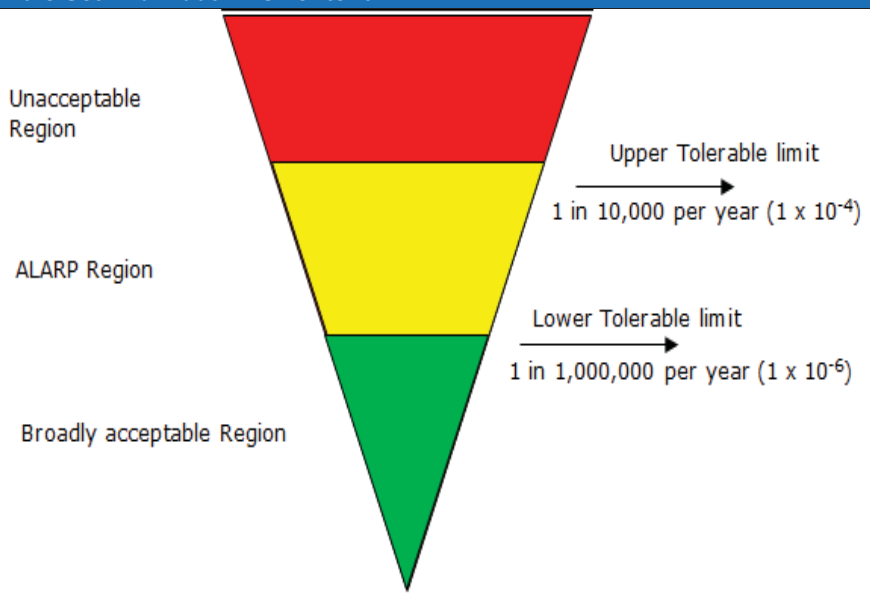


Figure: Individual Risk Criteria for Public

Reference:	1. DNV Technical Note on Risk Criteria, T17 Rev 01

3.13 Societal Risk Criteria

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**13**
Assumption / Rule Set: Societal Risk criteria	

The acceptance criteria for F-N curve based on HSE UK Guideline are presented below:

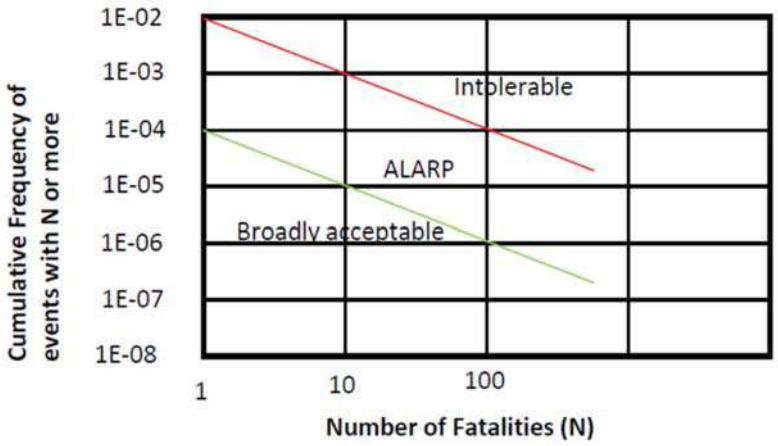


Figure: FN Curve Acceptance Criteria for Workers

Table: Societal Risk Criteria

Group	Maximum Tolerable Intercept With N=1	Negligible Intercept With N=1	Maximum Tolerable Intercept With N=100	Negligible Intercept With N=100
Workers	10^{-2}	10^{-4}	10^{-4}	10^{-6}
Public	10^{-3}	10^{-5}	10^{-5}	10^{-7}

Reference:	1. DNV Technical Note on Risk Criteria, T17 Rev 01

3.14 Vulnerability Assessment

Project:	**Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.**
Client:	**Valdel Engineers & Constructors Pvt. Ltd.**
Assumption No:	**14**
Assumption / Rule Set: Vulnerability Assessment	

Fires (jet and Pool):

Based on thermal dose from minimum of a 20-seconds exposure, fatality rates of 1%, 50% and 100% are calculated to occur at radiation levels of 4kW/m2, 12.5kW/m2 and 37.5kW/m2 respectively on the basis of the TNO Probit [Pr=-36.38 + 2.56× ln(Q4/3×t)], where Q is radiation in W/m2 and t is the exposure time in seconds]. If the exposure time is demonstrated to be significantly longer than 20 seconds then values can be revised accordingly.

Flash fires:

For flash fires occurring outdoors, it is assumed that personnel located inside the footprint to the LFL have a 100% probability of fatality to people outdoor.

Explosions:

Explosions will be modelled using TNO ME method. SAFETI 8.4 default impact criteria of 0.3 bar for outdoor vulnerability and 0.3 bar and 0.1 bar for indoor vulnerability will be used for risk assessment.

For calculating the outdoor risk due to explosion events, the following default probability of fatality in Safeti 8.4 is considered.

Explosion	Overpressure (bar)	Probability of Fatality (%)
Light Explosion Damage	0.1	0
Heavy Explosion Damage	0.3	100

Vulnerability to the building occupant from explosion events is detailed in Building Risk Assessment assumption section.

Curve number 7 (1 barg max overpressure) will be used to characterize all confined areas, in line with DNV in-house QRA guidance.

Reference:	1. DNV Explosion Methodology Definition RiskNet Guideline G14

3.15 Report Structure

Project:	Quantitative Risk Assessment (QRA) study for Topside Facilities for Crude Oil Jetty and Cross-Country Pipeline.
Client:	Valdel Engineers & Constructors Pvt. Ltd.
Assumption No:	15
Assumption / Rule Set: Report Structure	

The Structure of Main Report and Appendices is as below:

Main Report: Main report will contain following information as a minimum:

1. QRA Executive Summary
2. Brief Facility Description
3. QRA Methodology
4. Hazard Identification
5. Failure Frequency Assessment
6. Consequence Assessment
7. Risk Acceptance Criteria
8. Risk Assessment
9. Conclusion, Summary and Recommendations
10. References

Following **Appendices** will be provided as a part of QRA Study Report as a minimum:

1. QRA Assumption Register

Reference:	1. DNV General Practice

Annexure – 10

adani
Ports and Logistics

Cost of Environmental Protection Measures

Sr. No.	Activity	Cost incurred (INR in Lacs)			Budgeted Cost (INR in Lacs)
		2023 – 24	2024 – 25	2025 – 26 (till Sept.'25)	2025 – 26
1.	Environmental Study / Audit and Consultancy	22.67	40.46	37.39	45.2
2.	Legal & Statutory Expenses	8.60	17.37	10.55	13
3.	Environmental Monitoring Services	13.37	17.27	8.73	20.46
4.	Hazardous / Non-Hazardous Waste Management & Disposal	130.11	122.46	70.95	156.13
5.	Environment Days Celebration and Advertisement / Business development	3.42	1.85	1.76	4.5
6.	Treatment and Disposal of Bio-Medical Waste	2.28	2.39	1.26	2.4
7.	Mangrove Plantation, Monitoring & Conservation	15	0	---	---
8.	Other Horticulture Expenses	904	570	175	655
9.	O&M of Sewage Treatment Plant and Effluent Treatment Plant (including STP, ETP of Port & SEZ & Common Effluent Treatment Plant)	186.94	164.31	117.47	227.69
10.	Expenditure of Environment Dept. (Apart from above head)	80.39	93.40	40.32	49.41
	Total	**1366.78**	**1029.51**	**463.43**	**1173.79**

Annexure – 11

Details of Greenbelt Development at APSEZ, Mundra

	Total Green Zone Detail till Up to September 2025				
LOCATION	**Area (In Ha.)**	**Trees (Nos.)**	**Palm (Nos.)**	**Shrubs (SQM)**	**Lawn (SQM)**
SV COLONY	72.29	34920.00	7962.00	69696.00	100646.00
PORT & NON SEZ	81.61	149359.00	19220.00	75061.78	62966.38
SEZ	115.70	226120.00	20489.00	220583.60	28162.03
MITAP	2.47	8113.00	33.00	3340.00	4036.00
WEST PORT	104.29	248074.00	66816.00	24112.00	16369.00
AGRI PARK	8.94	17244.00	1332.00	5400.00	2121.44
SOUTH PORT	14.45	27530.00	3470.00	3882.00	3327.26
Samundra Township	58.26	63722.00	11834.00	23908.89	47520.07
Productive Farming (Vadala Farm)	0.00	0.00	0.00	0.00	0.00
TOTAL (APSEZL)	**457.99**	**775082**	**131156**	**425984.27**	**265148.18**
		906238.00			

Details of Mangrove Afforestation done by APSEZ

Sl. no.	Location	District	Area (Ha)	Duration	Species	Implementation agency
1	Mundra Port	Kutch	24	-	Avicennia marina	Dr. Maity, Mangrove consultant of India
2	Mundra Port	Kutch	25	-	Avicennia marina	Dr. Maity, Mangrove consultant of India
3	Luni/Hamirmora (Mundra,)	Kutch	160.8	2007 - 2015	Avicennia marina, Rhizophora mucronata, Ceriops tagal	GUIDE, Bhuj
4	Kukadsar (Mundra)	Kutch	66.5	2012 - 2014	Avicennia marina	GUIDE, Bhuj
5	Forest Area (Mundra)	Kutch	298	2011 - 2013	Avicennia marina	Forest Dept, Bhuj
6	Jangi Village (Bhachau)	Kutch	50	2012 - 2014	Avicennia marina	GUIDE, Bhuj
7	Jakhau Village (Abdasa)	Kutch	310.6	2007-08 & 2011-13	Avicennia marina, Rhizophora mucronata, Ceriops tagal	GUIDE, Bhuj
8	Sat Saida Bet	Kutch	255	2014-15 & 2016-17	Avicennia marina & Biodiversity	GUIDE, Bhuj
9	Dandi Village	Navsari	800	2006 - 2011	Avicennia marina, Rhizophora mucronata, Ceriops tagal	GEC, Gandhinagar
10	Talaja Village	Bhavnagar	50	2011-12	Avicennia marina	Forest Dept, Talaja
11	Narmada Village	Bhavnagar	250	2014 - 2015	Avicennia marina	GEC, Gandhinagar
12	Malpur Village	Bharuch	200	2012-14	Avicennia marina	SAVE, Ahmedabad
13	Kantiyajal Village	Bharuch	50	2014-15	Avicennia marina	SAVE, Ahmedabad
14	Devla Village	Bharuch	150	210-16	Avicennia marina	SAVE, Ahmedabad
15	Village Tala Talav (Khambhat)	Anand	100	2015 - 2016	Avicennia marina	SAVE, Ahmedabad
16	Village Tala Talav (Khambhat)	Anand	38	2015 - 2016	Avicennia marina	GEC, Gandhinagar
17	Aliya Bet, Village Katpor (Hansot)	Bharuch	62	2017-18	Avicennia marina & Rhizophora spp.	GEC, Gandhinagar
18	Kukadsar-(Bhadeswar-Mundra)	Kutch	250	2021-22	Avicennia marina	Shreeji Enterprise, Amreli
19	Kukadsar-(Bhadeswar-Mundra)	Kutch	750	2022-23	Avicennia marina	Shreeji Enterprise, Amreli
20	Kukadsar-(Bhadeswar-Mundra)	Kutch	250	2023-24	Avicennia marina	Shreeji Enterprise, Amreli
Total			**4140**			

Annexure – 12

Certificate of Approval

Issued by Indian Register Quality Systems

IRCLASS SYSTEMS AND SOLUTIONS PRIVATE LIMITED

Certificate No.
IRQS/250400271

To certify that the Occupational Health and Safety Management Systems of

Adani Port and Special Economic Zone Limited

ADDRESS
P.O. Box No. 1, Navinal Island,
Mundra, Kutch - 370 421, Gujarat

has been assessed and found conforming to the requirement of **ISO 45001: 2018**

INITIAL CERTIFICATION DATE	CURRENT DATE OF GRANTING	EXPIRY DATE
MARCH 02, 2010	FEBRUARY 24, 2025	FEBRUARY 27, 2028

CERTIFICATION SCOPE

Providing Port Facilities for Import & Export of Bulk, Break Bulk, Liquid and Containerized Cargo, its Storage and Transportation by Road, Rail, Pipeline and Single Point Mooring (SPM) and RORO Operation for Export of Vehicle

Indian Register Quality Systems

NABCB OH 007

IAF

AUTHORISED CERTIFICATION BODY SIGNATURE

Shashi Nath Mishra
Chief Operating Officer (COO)

This approval is subject to continued satisfactory maintenance of the Occupational Health and Safety Management Systems of the organization to the above requirements which will be monitored by IRQS during annual Surveillance audits. Validity of the Certificate is subject to successful completion of annual surveillance audits. The use of the Accreditation Mark indicates accreditation with respect to activities covered by the certificate with NABCB accreditation no. OH 007.

Condition Overleaf.

Indian Register Quality Systems (A Division of IRCLASS Systems and Solutions Private Limited)
Head Office: 52A, Adi Shankaracharya Marg, Opp. Powai Lake, Powai, Mumbai - 400 072, India. Website: www.irqs.co.in, www.irclass.org

Annexure – 13

adani
Ports and Logistics

O/C

PCB ID: 35427

Ref No. APSEZL/EnvCell/2025-26/067 **Date: 08.09.2025**

To,

Member Secretary

Gujarat Pollution Control Board

Paryavaran Bhavan,

Sector-10-A, Gandhinagar-382010

Dear Sir,

Sub: Environmental Statement for the financial year ending 31st March, 2025 for **M/s Adani Ports and Special Economic Zone Limited (WFDP-West Port).**

Ref: **1.** Consent Order No. AWH – 113458 issues dated 28.06.2021 Valid till 01.02.2027.

With reference to the above-mentioned subject and reference, please find enclosed Environmental Statement in Form V prescribed under Rule 14 of the Environment (Protection) Rules 1986, for M/s **Adani Ports and Special Economic Zone Limited (WFDP-West Port), Village: Tunda, Taluka: Mundra, Dist. Kutch - 370421** for the financial year ending 31st March 2025.

Thank you,

Yours faithfully,
For **Adani Ports and Special Economic Zone Limited**

Authorized Signatory

11/09/25
Gujarat Pollution Control Board
Head Office
Sector No.-10-A,
Gandhinagar-382010

Encl: As above.
Copy to: The Regional Officer, Gujarat Pollution Control Board, Gandhidham

Adani Ports and Special Economic Zone Ltd
Adani House,
PO Box No. 1
Mundra, Kutch 370 421
Gujarat, India
CIN: L63090GJ1998PLC034182

Tel +91 2838 25 5000
Fax +91 2838 25 51110
info@adani.com
www.adani.com

Registered Office: Adani Corporate House, Shantigram, Nr. Vaishno Devi Circle, S.G. Highway, Khodiyar, Ahmedabad – 382421, Gujarat, India

Annexure – 14

Expense Details for Fisherfolk Amenitites work in different core areas													
Sr. No.	Details	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	TOTAL	AMT IN LACS
Expenditure Details (Amount in Rs.)													
1	Vidya Deep Yojana	2,069,300	193,000	2,087,000	1,771,000	110,225	580,103	969,660	-	-	-	7,780,288	77.80
2	Vidya Sahay Yojana	552,580	495,000	691,000	708,000	504,336	659,709	847,013	563,000	644,000	482,000	6,146,638	61.47
3	Adani Vidya Mandir – Shaping Lives	4,200,000	4,030,000	3,472,000	6,434,020	1,593,805	3,737,700	5,950,854	7,452,390	7,815,023	3,903,900	48,589,692	485.90
4	Senio Citizen Health Card	--	8,430,000	1,750,000	2,975,000	1,750,000	-	-	-	-		14,905,000	149.05
5	Financial Support to Poor Patients	4,439,507	1,275,000	813,000	1,296,063	763,800	1,255,000	1,691,410	1,620,000	1,666,000	895,000	15,714,780	157.15
6	Machhimar Kaushalya Vardhan Yojana	188,708	200,000	397,000	73,000	--	226,000	134,070	-	-	-	1,218,778	12.19
7	Machhimar Sadhan Sahay Yojana	--	--	315,000	522,000	--	-	-	-	-	-	837,000	8.37
8	Machhimar Awas Yojana	4,592,106	1,165,000	--	2,311,000	2,424,016	2,480,000	712,000	1,227,000	-	-	14,911,122	149.11
9	Machhimar Shudhh Jal Yojana	2,236,050	2,700,000	2,038,000	1,773,000	2,348,300	1,936,575	2,096,050	1,370,000	1,264,000	316,000	18,077,975	180.78
10	Sughad Yojana	1,367,300	170,000	--	192,000	30,000	-	-	-	-	-	1,759,300	17.59
11	Machhimar Akshay kiran Yojana	860,850	100,000	68,000	--	--	-	-	-	-	-	1,028,850	10.29
12	Machhimar Ajivika Uparjan Yojana-Mangroves plantation	1,558,800	500,000	1,382,000	1,400,000	1,900,272	2,069,432	1,914,432	-	270,000	286,000	11,280,936	112.81
13	Bandar Svachhata Yojana	106,400	50,000	--	--	367,000	145,000	25,000	-	-	-	693,400	6.93
14	Cricket league and Cycle Marathon	432,000	657,119	638,000	610,800	--	-	-	-	-	-	2,337,919	23.38
15	Sports Material For Children & Youth at Vasahats	197,797	--	--	--	--	-	-	-	-	-	197,797	1.98
16	New Pilot Initiative for Polyculture	398,240	160,000	--	--	--	-	-	-	-	-	558,240	5.58
17	New Pilot Initiative for Cage farming Asian Seabass & Lobster	864,000	660,000	--	--	--	-	-	-	-	-	1,524,000	15.24
18	Sea Weed Culture Project	--	--	--	200,000	--	-	-	-	-	-	200,000	2.00
19	Mangrove Biodiversity Project	--	--	1,890,000	684,000	499,210	997,642	1,135,000	-	191,000	-	5,396,852	53.97
20	Approach Road restoration at 9 vasahat	--	--	--	--	599,000	942,780	1,011,000	-	-	519,000	3,071,780	30.72
21	Community trening Centor & Maintenance work						6,022,000	2,051,000	-	-	-	8,073,000	80.73
	TOTAL	24,063,638	20,785,119	15,541,000	20,949,883	12,889,964	21,051,941	18,537,489	12,232,390	11,850,023	6,401,900	164,303,347	1,643.03