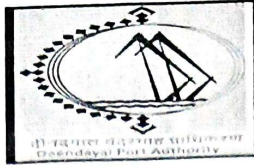


**Deendayal Port Authority
(Erstwhile :Deendayal Port Trust)**

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

ISO 9001 - 2015 &
ISO 14001 - 2015 Certified Port

EG/WK/4751/Part (Revamping - EC onwards) /100 Dated: 29/07/2024

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

Sub: "Augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 3.8 MMTPA Through Modernisation of Existing Pipeline Network at Oil Jetty Area Deendayal Port Trust, Kandla - **Pointwise Compliance of the conditions stipulated in the EC & CRZ Clearance and Monitoring Report in Datasheet r eg.**
(EC Identification No. EC24A033GJ192347 and Proposal No. IA/GJ/NCP/28)634/2018)

Ref.: EC & CRZ Clearance accorded by the SEIAA, Gujarat vide letter no. 10-26/2018-IA.III dated 01/01/2024.

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

In this connection, it is to state that, MoEF&CC, GOI had accorded EC&CRZ Clearance dated 01/01/2024 to the subject project of the DPA **(Copy enclosed as Annexure 1)**. In the said clearance letter, in the Para B STANDARD CONDITIONS, No. XI Miscellaneous (sub para no. iv), the MoEF&CC, GOI has stipulated the condition that, ***"The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the Ministry of Environment, Forest and Climate Change at environment clearance portal"***.

Accordingly, we are submitting herewith compliance report of the stipulated conditions mentioned in the EC & CRZ Clearance granted by the MoEF & CC, GOI dated 01/01/2024 (Period up to May, 2024) in the PARIVESH 2 PORTAL of the MoEF&CC, GoI. Further, we are also submitting herewith Monitoring Report in Data Sheet.

This is for kind information and record, please.

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

Yours faithfully,

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



Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

To,

The Chief Engineer
DEENDAYAL PORT TRUST
A.O. Building ,Annex, P.O.Box No. 50 , Gandhidham- Kutch,,kutch,Gujarat-
370201

Subject: Grant of Environmental Clearance (EC) to the proposed Project Activity
under the provision of EIA Notification 2006-regarding

Sir/Madam,

This is in reference to your application for Environmental Clearance (EC)
in respect of project submitted to the Ministry vide proposal number
IA/GJ/NCP/280634/2018 dated 12 Dec 2022. The particulars of the environmental
clearance granted to the project are as below.

- | | |
|---|--|
| 1. EC Identification No. | EC24A033GJ192347 |
| 2. File No. | 10-26/2018-IA.III |
| 3. Project Type | Expansion |
| 4. Category | A |
| 5. Project/Activity including
Schedule No. | 7(e) Ports, Harbours |
| 6. Name of Project | Augmentation of Liquid Cargo Handling
Capacity from 8 MMTPA to 23.8 MMTPA
Through Modernisation of Existing
Pipeline Network at Oil Jetty Area,
Deendayal Port Trust, Kandla |
| 7. Name of Company/Organization | DEENDAYAL PORT TRUST |
| 8. Location of Project | Gujarat |
| 9. TOR Date | N/A |

The project details along with terms and conditions are appended herewith from page
no 2 onwards.

Date: 01/01/2024

(e-signed)
Amardeep Raju
Scientist E
IA - (INFRA-1 sector)

*Note: A valid environmental clearance shall be one that has EC identification
number & E-Sign generated from PARIVESH. Please quote identification
number in all future correspondence.*

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2. The proposal is for augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA through modernization of existing pipeline network at Oil Jetty Area, Deendayal Port Trust, Kandla, Tal Gandhidam, Dist.Kutch, Gujarat by M/s Kandla Port Trust.

3. Presently Deendayal Port Authority (Erstwhile Deendayal Port Trust) has six oil jetties (OJ no, 1 to 4–DPA & OJ 5 & 6–IFFCO & IOCL respectively) located on western side of Kandla Creek. The five oil jetties presently have a total of 167 nos. pipelines of these, 125 pipelines will be scrapped and the remaining 42 pipelines will be retained 84 new higher capacity pipelines for improving the efficiency and safety over the existing trestle will be laid. The work also envisages replacing inspection of the steel trestles over which the pipelines run and replacing the damaged trestles. Entire project area located within existing Oil Jetty Area of Deendayal Port Authority, Kandla.

4. The Project will be implemented in three phases:

Phase 1: Removal of marine unloading arms, their connected airlines in Oil Jetty 1 & Oil Jetty 4 and Flushing Lines in Oil Jetty and asking M/s HPCL (now taken over by M/s ONGC Ltd.), M/S BPCL, M/S IOCL, M/S IFFCO, M/S Synthetics & Chemicals to remove their redundant pipelines.

Phase 2: Commissioning of Newly Laid Edible Oil Pipelines and subsequently removal of Existing Edible Oil Pipelines by the respective stakeholders. This will be taken up during the final stages of completion of Phase 1.

Phase 3: Removal of Existing Chemical pipelines by the respective stakeholders and laying of New chemical pipelines.

5. The first oil jetty was commissioned during year 1965 & subsequently, other oil jetties were commissioned. DPA has obtained EC and CRZ clearance for the “Development of plots for construction of liquid storage tank farm at Kandla Port Trust at Kandla” vide letter no. F.No. 10-36/2008-IA-III dated 02/02/2010 (for the proposed installation of tanks for storage/handling of the petroleum products and edible oil and laying of inter terminal pipelines) and obtained its extension of validity of EC and CRZ clearance on 18/08/2015 for a period up to 01.02.2020. Out of total 17 plots, DPA allotted 13 plots (3, 4, 5, 6, 7, 10, 12, 13, 14, 15, 17, 18 & 19) to various plot allottees. Further, Ministry of Environment, forest and climate change (CRZ Division) vide letter no. F.No. 19-2/2018-IA.III dated 15/04/2019 clarified on the applicability of CRZ clearance stating that “The need for further CRZ Clearance by the plot holders in the DPT area for which a composite EC & CRZ clearance has been issued therefore does not seem to arise”. All plot allottees (13 No.s) have established their tank farms including interconnecting pipelines from various oil jetties to their terminals. DPA obtained consolidated consent and Authorization from GPCB for the Commercial operation. DPA had obtained the consolidated Consent and Authorization from the GPCB for the said oil jetties and handling of liquid cargo Consent order no. AWH- 43365 Vide



letter no. PC/CCA-Kutch-812/GPCB ID 28494/93560 dated 05/10/2011 valid up to 21/07/2015, Consent order no. AWH- 72820 Vide letter no. GPCB/CCA-Kutch-812(2)/GPCB ID 28494/327172 dated 11/09/2015 valid up to 21/07/2020, Renewal of the Consent order no. AWH-110594 Vide letter no. GPCB/CCA-Kutch-812(5)/GPCB ID 28494/581914 dated 22/01/2021 valid up to 21/07/2025.

6. The proposed project falls under category 'A' of item 7 (e) i.e. 'Ports, harbours, break waters, dredging' of the schedule to the EIA Notification, 2006 and its subsequent amendments. The total project cost is estimated to be Rs. 170.42 Crores.

7. Terms of References (ToR): ToR was recommended by the EAC (infra-2) in its 30th meeting held on 18th -20th April, 2018 and it was granted vide letter No. 10-26/2018-IA.III dated 14th June, 2018. Amendment in ToR was recommended by the EAC (infra-2) in its 51st meeting held on 21st -22nd May, 2020 and it was granted vide letter even no dated 11th June, 2020.

8. Public Hearing: Public Hearing was conducted by Gujarat Pollution Control Board, in district kutch, Gujarat on 10.12.2021. The details of the public hearing is as following:

S.no	Date	Village/Venue	District and State	Chaired by
1	10 th December, 2021	Parking Plot of DPT near Kutch Salt Junction, Kandla Village,	Dist. kutch, Gujarat.	Additional District Magistrate, kutch

9. Land Use Land Cover of the Project site is.

S.no.	Land use/Land cover	Area(ha)	Percentage (%)	Remarks, if any
1	Built-up Area on dry land	8.0	21.16	Entirely within Customs Bonded Area of the port
2	Creek	24.0	63.49	
3	Inter-tidal Zone / Mudflat	3.55	9.39	
4	Mangrove	2.25	5.95	
Total		37.8	100	

10. Terrain and topographical features: The study area is extremely flat. The land is just above the mean sea level. The entire project area is located on the bank of Kandla Creek and is within the Oil Jetty Area of Deendayal Port. No acquisition of additional land will be necessary.

11. Details of water bodies, impact on drainage: The project site is located on the western bank of the Kandla Creek, which joins the Gulf of Kutch ~6.5 km south of oil Jetty 1. Off the project site, the Kandla Creek is more than 1 km wide. The western part of the study area is drained by Kandla Creek, Khori Creek and Nakti Creek, all of which join the Gulf of Kutch. About 3.4 km

north Oil Jetty 5, the Kandla Creek bifurcates into 2 Creeks, Sanu Creek and Phang Creek, which extend further north and north-east through a network of smaller tidal creeks / channels. The eastern half of the study area is dominated by an uninhabited tidal mud-flat called “Sath-Saida Bet”. The western ~1/3 of the Sath-saida Bet drains into the Kandla Creek, whereas the eastern ~2/3 drains into another creek further east.

12. Water Requirement: The domestic water requirement for the existing Oil jetty area is 200 KLD and it will remain unchanged after proposed revamping and replacement of the pipelines. The potable water is supplied mostly by Gujarat Water Supply and Sewerage. Board (GWSSB), an agency of the Government of Gujarat. If there is any shortfall the water is supplied in tankers. Sewage generated at the township is treated in sewage treatment plant. The entire quantity of treated sewage (700 m³ /day) is reused in existing Deendayal Port for miscellaneous purposes. The pipeline revamping and replacement project is not expected to lead to any increase in water demand.

13. Tree cutting: No tree cutting involved in the proposed project. The proposed revamping and replacement of pipelines will be done on already existing Oil Jetty area.

14. Diversion of forest land: There are no forests in the study area. However there are mangroves on the banks of the tidal channels and tidal mud flats in the study area. Beyond the tidal influenced area, the area is semi-arid. The proposed revamping and replacement of pipelines will be done on already existing Oil Jetty area. No new berths will be constructed nor there any proposal to increase the size of the ships presently being handled at the oil jetties. No acquisition of additional land will be required.

15. The proposed project is not located within 10 km of Protected Areas (PA), National Parks, Sanctuaries and Tiger Reserves etc and there are no Eco-Sensitive Zone (ESZ) or Eco-Sensitive Area (ESA) in 10 km radius area.

16. Waste Management: During normal operation of the pipelines no solid wastes will be generated. first a new pipeline should be laid and then only old pipeline should be removed. After detailed deliberations, the sequence for laying of pipelines and removal of old ones has been arrived. This should be strictly followed. Presently, every year about 3600 tonnes of used oil and oily residues are generated at Deendayal Port. These hazardous wastes are packed in labelled plastic drums. Deendayal port has licensed several waste disposal contractors who have necessary authorizations from Central Pollution Control Board (CPCB) and Gujarat Pollution Control Board (GPCB). The wastes are collected by these contractors and taken away for proper disposal with proper documentation. Copies of the documents in the prescribed forms are submitted to DPT as well as GPCB.

17. The oil / sludge removed by Pigging of the revamped pipeline network of the Oil Jetty Area will be considered as Hazardous wastes and disposed off in accordance with the “Hazardous



and Other Wastes (Management and Transboundary Movement) Rules, 2016” & its subsequent amendments. The wastes will be packed in leak-proof containers which will be labelled and temporarily stored in a designated place before being sent to an authorized waste Treatment, Storage & Disposal Facility (TSDF) for proper disposal.

18. The layout on CRZ map of 1:4000 scale prepared by IRS Chennai. MCZMA recommended the project to MoEF& CC vide letter no. ENV-10-2021-41-T dated 25th August, 2022. As per the MCZMA recommendations. The Project Falls in CRZ I(A) (Mangrove), CRZ-I(B), CRZ-III and CRZ-IV. The proposed activities are permissible activities as per the provisions of CRZ Notification 2011.

19. ~130 m - ~220 m offshore. The Jetties are linked to the shore by concrete bridges which also carry power lines and pipelines. The pipelines from the six oil jetties converge at “Y Junction” on the shore from where pipes lead to various storage facilities. The laying of pipeline for the proposed revamping will be entirely on the existing structure like Jetties, Pipelines and Trestles etc and the work involves removal of old pipelines and replacement of the same with the new pipelines. The project does not envisage digging of any foundations. No new berths will be constructed nor there any proposal to increase the size of the ships presently being handled at the oil jetties. Hence no dredging will be required. The new pipelines will be laid on the existing pipe bridges after scrapping some of the existing pipelines. The pipelines are located several feet above the High Tide Line. No land filling will be necessary. There is no proposal to construct any new structure either offshore or on land under the present proposal.

20. The oil jetties were constructed since 1965 i.e much before the EIA notification and CRZ notification therefore, the subject proposal was inspected as per the stipulated condition mentioned in the Consolidated Consent and Authorization order no. AWH-110594 dated 22/01/2021, on 06/09/2022 by the IRO, Gandhinagar. Accordingly detailed monitoring report along with observations had been issued by the IRO, Gandhinagar vide letter no. File No. J-11/77-2022-IROG NR dated 14/11/2022.

21. Land acquisition and R&R issues: No acquisition of additional land will be required for the proposed project.

22. Employment Potential: Deendayal Port Trust employs 2634 persons. It is expected that maximum ~200 workers will be directly engaged at any given time during construction. These will be contractors’ workers. The revamped pipelines will be operated by an external O&M agency hired by DPT.

23. Benefits of the project: Some of existing marine unloading arms and pipelines are no longer in use. They are occupying valuable space. The space freed by scrapping of redundant pipelines can be put to other valuable use. Deendayal Port Trust has decided to revamp the existing pipeline network leading from Oil Jetties, 1, 2, 3 & 4. Some of the existing pipelines along with



allied structures leading from Oil Jetties to the Y-Junction will be scrapped. It has been estimated that-3500 tonnes of pipes and allied structures will be scrapped. These will be replaced by pipelines of higher capacity for improving the efficiency and safety for handling Edible Oils, Chemicals and utilities as Air & Water. This will not only increase cargo-throughput (from 8 to 10 million tonnes per year) but also increase cargo-mix. During the construction period several highly skilled, skilled as well as unskilled workers and other personnel will be employed. As part of its Corporate Environmental Responsibility (CER), DPT shall implement social infrastructure improvement projects in the area in consultation with local people.

24. Details of Court cases: No Court case is pending against the Project.

25. The EAC, after examining the documents submitted by the project proponent and detailed deliberations in its 345th meeting on 09th-10th November, 2023 and **recommended** the proposal for grant of Environmental Clearance and CRZ clearance subject to all specific and standard conditions applicable for such projects.

26. The Ministry of Environment, Forest and Climate Change has considered the proposal based on the recommendations of the Expert Appraisal Committee (Infrastructure, CRZ and other miscellaneous projects) and hereby decided to grant Environmental and CRZ Clearance for the 'augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA through modernization of existing pipeline network at Oil Jetty Area, Deendayal Port Trust, Kandla, Tal Gandhidam, Dist.Kutch, Gujarat by M/s Kandla Port Trust' under the EIA Notification, 2006 as amended and CRZ Notification 2011, subject to strict compliance of the following specific conditions, in addition to all standard conditions applicable for such projects.

SPECIFIC CONDITIONS

- i. Construction activity shall be carried out strictly according to the provisions of the CRZ Notification, 2011. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.
- ii. All the recommendations and conditions specified by the Gujarat State Coastal Zone Management Authority (GCZMA) vide letter No ENV-10-2021-41-T dated 25th August, 2022 shall be complied with.
- iii. Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.
- iv. PP shall ensue while scrapping of 125 old pipeline and laying of 84 new process shall not cause any spillage/leakage.
- v. As proposed by PP Steel scrap will be temporarily stored in designated area before being auctioned off. The storage of steel scrap and any other scrapped material shall be stored temporarily outside the CRZ area.

- vi. Wastes discharged from ships will be handed over to the port's licensed waste disposal contractors.
- vii. No new berths will be constructed nor there any proposal to increase the size of the ships presently being handled at the oil jetties. Hence no dredging shall be carried out.
- viii. The project proponent shall install system carryout to 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.
- ix. 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.
- x. The project proponent shall submit monthly summary report of continuous stack 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.
- xi. Effective safeguard measures, such as regular water sprinkling shall be carried out in critical areas prone to air pollution and having high level of particulate matter such as around loading and unloading point and all transfer points. Extensive water sprinkling shall be carried out on haul roads. It should be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.
- xii. Risk assessment for spill scenarios and Disaster Management Plan as prepared shall be in place in the environment Management cell of Deendayal Port Authority with all SOP's for various scenarios.
- xiii. 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.
- xiv. 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.
- xv. 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.
- xvi. The proponent shall put in place the detailed on site and off site Emergency Management Plan as per the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, as amended to date which may cover the natural disasters also.
- xvii. The company shall develop a contingency plan for H2S release including all necessary aspects from evacuation to resumption of normal operations. The workers shall be provided with personal H2S detectors in locations of high risk of exposure along with self containing breathing apparatus.



- xviii. Emergency Response Plan (ERP) shall be based on the guidelines prepared by OISD, DGMS and Govt. of India.
- xix. Sediment analysis of harbor at identified locations shall be analyzed and records for past and present period shall be maintained.
- xx. 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.
- xxi. No underwater blasting is permitted.
- xxii. Necessary approvals be taken during implementation and commissioning from statutory bodies concerned.
- xxiii. A site specific biodiversity conservation plan including mitigation measures to be developed from competent nationally/internationally recognized institute with appropriate financial allocation for its implementation.
- xxiv. Shoreline should not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary. The details shall be submitted along with the six monthly monitoring report.
- xxv. A continuous monitoring programme covering all the seasons on various aspects of the coastal and marine environs need to be undertaken by a competent organization available in the State or by entrusting to the National Institutes/renowned Universities/accredited Consultant with rich experiences in marine science aspects. Monitoring should include sea weeds, sea grasses, mudflats, sand dunes, fisheries, mangroves and other marine biodiversity components as part of the management plan.
- xxvi. Necessary arrangements for the treatment of the effluents and solid wastes/ facilitation of reception facilities under MARPOL must be made and it must be ensured that they conform to the standards laid down by the competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986. The provisions of Solid Waste Management Rules, 2016. E- Waste Management Rules, 2016, and Plastic Waste Management Rules, 2016 shall be complied with.
- xxvii. All the commitments made to the public during public hearing/public consultation meeting shall be satisfactorily implemented and adequate budget provision shall be made accordingly.
- xxviii. All the recommendations mentioned in the risk assessment report, disaster management plan and safety guidelines shall be implemented.
- xxix. 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 NPV, Compensatory Aforestation 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.



B. STANDARD CONDITIONS:

I. Statutory compliance:

- (i) The project proponent shall prepare a Site-Specific Conservation Plan & Wildlife Management Plan and approved by the Chief Wildlife Warden. The recommendations of the approved Site-Specific Conservation Plan / Wildlife Management Plan shall be implemented in consultation with the State Forest Department. The implementation report shall be furnished along with the six-monthly compliance report (incase of the presence of schedule-I species in the study area).
- (ii) The project proponent shall obtain the necessary permission from the Central Ground Water Authority, in case of drawl of ground water / from the competent authority concerned in case of drawl of surface water required for the project.
- (iii) All excavation related dewatering shall be as duly authorized by the CGWA. A NOC from the CGWA shall be obtained for all dewatering and ground water abstraction.
- (iv) 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.
- (v) 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.

II. Air quality monitoring and preservation:

- (i) 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 PM_{2.5} in reference to PM emission, and SO₂ and NO_x in reference to SO₂ and NO_x emissions) within and outside the project area at least at four locations, covering upwind and downwind directions.
- (ii) 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.
- (iii) Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.
- (iv) 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.
- (v) Diesel power generating sets proposed as source of backup power should be of 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.

- (vi) 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 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.

III. Water quality monitoring and preservation:

- (i) Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission from competent authority shall be obtained for use of fresh water.
- (ii) 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.
- (iii) 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.
- (iv) No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.

IV. Noise monitoring and prevention:

- (i) 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.
- (ii) 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 equipments.
- (iii) 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.
- (iv) 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.

V. Energy Conservation measures:

- (i) Provide solar power generation on roof tops of buildings, for solar light system for all common areas, street lights, parking around project area and maintain the same regularly;
- (ii) Provide LED lights in their offices and residential areas.

VI. Waste management:

- (i) 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 competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986.
- (ii) The solid wastes shall be managed and disposed as per the norms of the Solid Waste Management Rules, 2016.
- (iii) 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.
- (iv) 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.
- (v) Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination.

VII. Green Belt:

- (i) An overall green area of at-least 33% of the Industrial Area should be developed with native species. The green area shall be 40% in case of critically polluted area. The project proponent of the Industrial Area shall comply with the additional commitment made by them in the EIA report regarding the development of green belt.
- (ii) The Industrial Areas are directed to accordingly allocate the area to be developed as green cover to respective individual industrial units so as to achieve the above mentioned condition.
- (iii) The individual industrial unit, at the time of obtaining EC, shall bring a letter from the Industrial Area for the area allocated to them to be developed as green cover as a part of obligation from the Industrial Area.
- (iv) Wherever possible, plantations around the periphery of the Industrial Area, in the downwind direction and along the road sides shall be provided for containment of pollution and for formation of a screen between the industrial area and the outer civil area. The choice of plants should include shrubs of height 1 to 1.5 m and tree of 3 to 5 m height. The intermixing of trees and shrubs should be such that the foliage area density in vertical is almost uniform.
- (v) The parameters like selection of plant species, procedure for plantation, density of tree plantation etc shall be as per the CPCB guidelines.

VIII. Public hearing and human health issues:

- (i) Workers shall be strictly enforced to wear personal protective equipments like dust mask, ear muffs or ear plugs, whenever and wherever necessary/ required. Special visco-elastic gloves will be used by labour exposed to hazards from vibration.
- (ii) 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.
- (iii) Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.
- (iv) 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.
- (v) Occupational health surveillance of the workers shall be done on a regular basis.

X. Environment Responsibility:

- (i) 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 / 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.
- (ii) 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.
- (iii) 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.
- (iv) Self environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.

XI. Miscellaneous:

- (i) 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.
- (ii) 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.
- (iii) 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.
- (iv) The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal.
- (v) 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.
- (vi) The criteria pollutant levels namely; PM_{2.5}, PM₁₀, SO₂, NO_x (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.
- (vii) The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.
- (viii) The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.
- (ix) 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.
- (x) No further expansion or modifications in the Industrial Area shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).
- (xi) 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.
- (xii) The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.



- (xiii) The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.
- (xiv) 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 / information/monitoring reports.
- (xv) 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.
- (xvi) 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.



(Amardeep Raju)
Scientist-E

Copy to:

1. The Secretary, Forest, Environment and Climate Change Department, Govt. of Odisha, KharavelBhavan, Gopabandhu Marg, Keshari Nagar, Bhubaneswar, Odisha 751001.
2. The Deputy Director General of Forests (C), Ministry of Env., Forest and Climate Change, Integrated Regional Office, A/3, Chandersekharpur, Bhubaneswar – 751023.
3. The Chairman, Central Pollution Control Board, PariveshBhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi – 32.
4. The Member Secretary, Odisha State Pollution Control Board, A/118, Unit-Viii, D A V School Main Road, Gopabandhu Nagar, Near Ommeed, Neelkanth Nagar, Bhubaneswar, Odisha 751012.
5. Monitoring Cell, MoEF&CC, Indira ParyavaranBhavan, New Delhi.
6. PARIVESH Portal.
7. Guard File/Record File.



(Amardeep Raju)
Scientist-E

Signature Not Verified

Digitally signed by: Amardeep Raju
Designation: Scientist E
Date and Time: 17/01/2024 5:32:06 PM

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Annexure A

**Compliance Report of GCZMA
Recommendation dated 25/8/2022**

COMPLIANCE REPORT (for the period up to May 2024)

Subject: Status of Compliance with the conditions stipulated By Gujarat State Coastal Zone Management Authority, Gandhinagar, in CRZ Recommendation Letter granted for "**Augmentation of liquid handling capacity from 8 MMTPA to 23.8 MMTPA through modernization of existing pipeline network at oil jetty area of Deendayal Port Trust**".

CRZ Recommendations: Letter No. ENV-I0-2021-41-T dated 25 August 2022, of Director (Environment) & Member Secretary, GCZMA, Forest & Environment Department, GoG.

**Note: Based on the recommendation of the GCZMA, MoEF&CC, GoI had accorded Environmental & CRZ Clearance vide letter dated 01/01/2024*

Sr. No.	Conditions in CRZ Recommendation Letter	Compliance
	Specific Conditions	
1	Project proponent unit shall scrap of existing 125 pipelines and remaining 42 pipelines may be maintain while 84 new pipeline will be laid.	It is assured that due care is being taken while scrapping of existing 125 pipelines.
2	Project proponent shall carry out proposed activities, replacement & revamping of existing pipeline network at oil jetty area and no new land shall be use.	Activities of replacement & revamping is being carried out at the existing oil jetty area and no new land is used.
3	Project proponent shall obtain consent to establish for their proposed expansion from 8 MMTPA to 23.08 MMTPA from GPCB.	The Consent to Establish (CTE) from the GPCB had already been obtained vide CTE amendment (CTE 115467) granted by the GPCB vide letter no. PC/CCA-KUTCH-812(5)/GPCB ID 28494/609592 dated 23/12/2021 with a validity period 11/2/2026 (Copy – Annexure A).
4	Project proponent shall not carry out any construction activities or any activities till obtaining CRZ Clearance from MoEF&CC, new Delhi	DPA has already received CRZ recommendation from GCZMA vide letter no. ENV-10-2021-41-T cell dated 25/08/2022. Additionally, DPA has also received EC and CRZ clearance from MoEF&CC vide file no. letter F. No. 10-26/2018-IA-III dated 01/01/2024.
5	Project Proponent shall adhere to all recommendation given by MECON Ltd. Ranchi, Jharkhand.	It is assured that, recommendation given by MECON Ltd. Ranchi, Jharkhand is being adhered to
6	Project Proponent shall adhere to undertaking dated 25.01.202	It is assured that, undertaking dated 25/01/202 being adhered to.
7	Project Proponent shall carry out Mangrove Plantation in 50 Ha area with consultant of concern District Forest Office of District and Gujarat Ecology commission. Necessary report in this regard may be submitted periodically to this office.	DPA has assigned the work for the "Mangrove Plantation in an area of 50 Ha for the Deendayal Port Authority to GUIDE, bhuj vide work order dated 10/06/2024. A copy is attached herewith as Annexure B Additionally, as per the As per the directions of the GCZMA and MoEF&CC GoI, to date, DPA has undertaken a Mangrove Plantation in an area of 1600 Hectares since the year 2005
8	Project Proponent shall strictly adhere to all conditions of Terms of Reference issued by MoEF&CC, GOI vide F.No. 10-26/2018-IA-III dated 14/06/2018.	DPA has already received the EC and CRZ clearance from MoEF&CC vide file no. letter F. No. 10-26/2018-IA-III dated 01/01/2024.
9	Project Proponent shall strictly adhere to all conditions of Amendment Terms of Reference issued by MoEF&CC, GOI vide F.No. 10-26/2018-IA-III dated 11/06/2020.	A copy of same is attached herewith as Annexure

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Annexure A

Consent to Establish (CTE) from the GPCB



GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN

Sector-10-A, Gandhinagar-382 010

Phone : (079) 23226295

Fax : (079) 23232156

Website : www.gpcb.gov.in

By R.P.A.D.

**"Consent to Establish-Amendment"
(CTE-115467)**

NO: PC/ CCA- KUTCH-812(5)/ GPCB ID: 28494 /

Date: -

To,

M/s. Deendayal Port Trust, (New name),

M/s. Kandla Port Trust, (Old name),

A.O. Building, Kandla,

Tal: Gandhidham,

Dist: Kutch- 370 230

Sub: Consent to Establish (NOC)-Amendment under Section 25 of Water Act 1974 and Section 21 of Air Act 1981

Ref: 1. Your application for CTE-Amendment Inward no. **190237** dated **12/02/2021**.
2. Terms of Reference granted by MoEF & CC vide order dated 10-26/2018-IA-III dated 14/06/2018 & 11/06/2020.

Without prejudice to the powers of this Board under the Water (Prevention and Control of Pollution) Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board grants Consent to Establish-Amendment to set up plant **for augmentation of liquid cargo handling capacity from 8 MMTPA to 23.8 MMTPA through modernization in existing industrial plant located at A.O. Building, Kandla, Ta- Gandhidham, Dist: Kutch** with following condition:

1. This order shall be read as CTE Amendment order No. 115467 dated 27/10/2021 valid up to 11/02/2026.
2. **Industry shall augment of liquid cargo handling capacity from 8 MMTPA to 10 MMTPA & then 10 MMTPA to 23 MMTPA through modernization of liquid cargo handling at oil jetty area, Deendayal Port Trust, Kandla.**

SUBJECT TO THE FOLLOWING CONDITIONS:

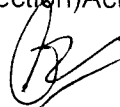
1. Industry shall not start any activities wrt augmentation of liquid cargo handling capacity from 8 MTPA to 23.8 MTPA without prior Environment Clearance & CRZ clearance of the competent authority.
2. Unit shall strictly comply with all conditions of Terms of Reference granted by MoEF & CC vide order dated 10-26/2018-IA-III dated 14/06/2018 & 11/06/2020.
3. Unit shall strictly adhere all conditions of Environmental Clearance vide order no. 11-82/2011-IA-III, dated 19/12/2016.

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Page 1 of 4

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4. There shall be no change in existing water consumption, waste water generation, fuel consumption, flue gases emission & process gases emission & hazardous waste category & quantity, due to proposed CTE-Amendment.
5. Unit shall also strictly adhere to all conditions of Environment and CRZ Clearance issued by MoEF vide letter no. F. no. 11-70/2006-IA-III dated 01/10/2008.
6. Applicant shall comply with Manufacture, Storage and Import of Hazardous Chemicals Rules-1989 (MSIHC) as amended time to time.
7. Applicant shall ensure that all storage terminal located within DPT area shall strictly comply with MSIHC Rules including site notification & submit details periodically to board with relevant details.
8. Applicant shall renew Public Liability Insurance time to time & submit a copy to this Board.
9. Unit shall notify site under MSIHC Rule-1989 from competent authority as mentioned in schedule-5 of MSIHC Notifications.
10. Industry shall not withdraw groundwater without prior NOC from CGWA as per Hon. National Green Tribunal order.
11. Industry shall manage Solid Wastes generated from industrial activities as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46)).
12. Industry shall comply with Plastic Waste Management Rules- 2016 and amendments made therein, if applicable.
13. Industry shall strictly comply with coal handling guideline of this board.
14. Industry shall provide dedicated storage facility for dry cargos & ensure to take adequate measures to prevent dusting.
15. Applicant shall ensure that there shall be no damage to the existing mangrove patches near site and also ensure the free flow of water to avoid damage to the mangroves.
16. Applicant shall ensure compliance of EC condition that no creeks or rivers are blocked due to any activities at the site and free flow of water is maintained.
17. Applicant shall provide proper system for collection, storage & treatment & disposal of waste water generated by vessel as per MARPOL & maintain records & submit periodically to this office.
18. Applicant shall install storm drainage catch basin to avoid directly discharge into surface water.
19. Waste effluent accumulated within port activities including storm water & sewage from port operation including sewage ballast water, bilge water & clean waste water from ships shall be treated as per MARPOL norms.
20. Applicant shall maintain separate records regarding generation, collection, transportation & disposal of waste generation from ship & made available at site.
21. Applicant shall made necessary arrangement for the plastic Waste, Solid Waste or other waste generation due to port activities & for facilitation of reception facilities under MARPOL & Environment (Protection) Act-1986 rules etc.





GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN

Sector-10-A, Gandhinagar-382 010

Phone : (079) 23226295

Fax : (079) 23232156

Website : www.gpcb.gov.in


22. Ports shall obtain approval of their oil spill contingency plan (OSCP) as required under national oil spill disaster contingency plan (NOS-DCP) of coast guard, ministry of defense, govt. of India.
23. Best environmental practices by ports maybe uploaded on "Indian ports Association" as well as the same maybe linked to websites of CPCB and respective SPCBs.
24. Manually handling of cargo should be converted into mechanized system, in time bound manner.
25. Industry shall not carry out any activities, which may attract the applicability of EIA notification-2006 & its amendment.
26. No ground water shall be withdrawal without prior permission from CGWA as per Hon'ble NGT order.
27. Industry shall renew Public Liability Insurance Policy time to time & submit a copy of the same to this office.

3. CONDITIONS UNDER HAZARDOUS WASTE RULES:

- 3.1 The applicant shall have to comply with provisions of Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.
- 3.2 The applicant shall obtain membership of common TSDF site for disposal of Hazardous waste as categorized in Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.
- 3.3 The applicant shall obtain membership of common Hazardous Waste incinerator for disposal of incinerable waste.
- 3.4 The applicant shall provide temporary storage facilities for each type of Hazardous Waste as per Hazardous and other Waste (Management and Trans Boundary Movement) Rules 2016.
- 3.5 The applicant shall obtain registration/authorization for recycling/reprocessing any hazardous waste before procuring material/starting production as per HW Rules 2016.
- 3.6 The applicant shall obtain authorization for recovery/reuses of any hazardous waste material as per HW Rules 2016.

4. GENERAL CONDITION:

- 4.1 Adequate plantation shall be carried out all along the periphery of the industrial premises in such a way that the density of plantation is at east 1000 trees per acre of land and a green belt of 03 meters' width is developed.
- 4.2 The applicant shall have to submit the returns in prescribed form regarding water consumption and shall have to make payment of water cess to the Board under the Water Cess Act- 1977.
- 4.3 In case of change of ownership/management the name and address of the new owners /partners/ directors/ proprietor should immediately be intimated to the Board.
- 4.4 The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emission or sewage waste from the proposed industrial plant. The applicant is required to make

Clean Gujarat Green Gujarat  Page 3 of 4

applications to this Board for this purpose in the prescribed forms under the provisions of the Water Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986.

4.5 The concentration of Noise in ambient air within the premises of industrial unit shall not exceed following levels:

Between 6 A.M. and 10 P.M.: 75 dB(A)

Between 10 P.M. and 6 A.M.: 70 dB(A)

4.6 Applicant is required to comply with the manufacturing, Storage and Import of Hazardous Chemicals Rules-1989 framed under the Environment (Protection) Act-1986.

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

**For and on behalf of
GUJARAT POLLUTION CONTROL BOARD**



**(Smt. U.K. Upadhyay)
Senior Environment Engineer**

Outward No:609592, 23/12/2021

/

Annexure B

Work Order dated 10/06/2024

DEENDAYAL PORT AUTHORITY



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

Website : www.deendayalport.gov.in

NO. EG/WK/4751/Part (Revamping – EC onwards)/69 Dated : 10 /06/2024

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

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

Sub: Mangrove Plantation in an area of 50 Hectares for Deendayal Port Authority reg.

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

Sir,

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

2. Scope of Work:

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

3. The terms of payment:

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

.....Cont.....

Obligation of DPA:

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

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

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

Thanking you.

Yours faithfully,



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

/

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Annexure B

CTE



GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN

Sector-10-A, Gandhinagar-382 010

Phone : (079) 23226295

Fax : (079) 23232156

Website : www.gpcb.gov.in

By R.P.A.D.

**"Consent to Establish-Amendment"
(CTE-115467)**

NO: PC/ CCA- KUTCH-812(5)/ GPCB ID: 28494 /

Date: -

To,

M/s. Deendayal Port Trust, (New name),

M/s. Kandla Port Trust, (Old name),

A.O. Building, Kandla,

Tal: Gandhidham,

Dist: Kutch- 370 230

Sub: Consent to Establish (NOC)-Amendment under Section 25 of Water Act 1974 and Section 21 of Air Act 1981

Ref: 1. Your application for CTE-Amendment Inward no. **190237** dated **12/02/2021**.
2. Terms of Reference granted by MoEF & CC vide order dated 10-26/2018-IA-III dated 14/06/2018 & 11/06/2020.

Without prejudice to the powers of this Board under the Water (Prevention and Control of Pollution) Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board grants Consent to Establish-Amendment to set up plant **for augmentation of liquid cargo handling capacity from 8 MMTPA to 23.8 MMTPA through modernization in existing industrial plant located at A.O. Building, Kandla, Ta- Gandhidham, Dist: Kutch** with following condition:

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2. **Industry shall augment of liquid cargo handling capacity from 8 MMTPA to 10 MMTPA & then 10 MMTPA to 23 MMTPA through modernization of liquid cargo handling at oil jetty area, Deendayal Port Trust, Kandla.**

SUBJECT TO THE FOLLOWING CONDITIONS:

1. Industry shall not start any activities wrt augmentation of liquid cargo handling capacity from 8 MTPA to 23.8 MTPA without prior Environment Clearance & CRZ clearance of the competent authority.
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4. There shall be no change in existing water consumption, waste water generation, fuel consumption, flue gases emission & process gases emission & hazardous waste category & quantity, due to proposed CTE-Amendment.
5. Unit shall also strictly adhere to all conditions of Environment and CRZ Clearance issued by MoEF vide letter no. F. no. 11-70/2006-IA-III dated 01/10/2008.
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GUJARAT POLLUTION CONTROL BOARD

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22. Ports shall obtain approval of their oil spill contingency plan (OSCP) as required under national oil spill disaster contingency plan (NOS-DCP) of coast guard, ministry of defense, govt. of India.
23. Best environmental practices by ports maybe uploaded on "Indian ports Association" as well as the same maybe linked to websites of CPCB and respective SPCBs.
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Clean Gujarat Green Gujarat  Page 3 of 4

applications to this Board for this purpose in the prescribed forms under the provisions of the Water Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986.

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Between 6 A.M. and 10 P.M.: 75 dB(A)

Between 10 P.M. and 6 A.M.: 70 dB(A)

4.6 Applicant is required to comply with the manufacturing, Storage and Import of Hazardous Chemicals Rules-1989 framed under the Environment (Protection) Act-1986.

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

**For and on behalf of
GUJARAT POLLUTION CONTROL BOARD**



**(Smt. U.K. Upadhyay)
Senior Environment Engineer**

Outward No:609592, 23/12/2021

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Annexure C

Annual Monitoring Report

Environmental Monitoring Annual Report
prepared under
“Preparing and monitoring of environmental monitoring and management plan for Deendayal Port Authority at Kandla and Vadinar for a period of 3 years”

Monitoring Period: 15th April 2023 -15th April 2024



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

Submitted to:
Deendayal Port Authority (DPA), Kandla



Gujarat Environment Management Institute (GEMI)

(An Autonomous Institute of Government of Gujarat)

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

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About this Document

Gujarat Environment Management Institute (GEMI) has been assigned with the work of “Preparing and monitoring of Environmental monitoring and Management plan for Deendayal Port Authority (DPA) at Kandla and Vadinar for a period of 3 years” by DPA, Kandla. Under the said project the report titled “*Environment Monitoring Annual Report (Monitoring Period: April 2023 - April 2024)*” is prepared.

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List of Abbreviations

A	Acceptable Limits as per IS: 10500:2012
AAQ	Ambient Air Quality
AWS	Automatic Weather monitoring stations
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BQL	Below Quantification Limit
CCA	Consolidated Consent & Authorization
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DO	Dissolved Oxygen
DPA	Deendayal Port Authority
EC	Electrical Conductivity
EMMP	Environmental monitoring and Management Plan
EMP	Environment Management Plan
FPS	Fine Particulate Sampler
FY	Financial Year
GEMI	Gujarat Environment Management Institute
IFFCO	Indian Farmers Fertiliser Cooperative Limited
IMD	India Meteorological Department
IOCL	Indian Oil Corporation Limited
LNG	Liquefied Natural Gas
MGO	Marine Gas Oil
MMTPA	Million Metric Tonnes Per Annum
MoEF	Ministry of Environment & Forests
MoEF&CC	Ministry of Environment, Forest and Climate Change
NAAQS	National Ambient Air Quality Standards
NO _x	Nitrogen oxides
NTU	Nephelometric Turbidity Unit
OOT	Off Shore Oil Terminal
OSR	Oil Spill Response
P	Permissible Limits as per IS: 10500:2012
PAH	Poly Aromatic Hydrocarbons
PM	Particulate Matter
PTFE	Polytetrafluoroethylene
RCC	Reinforced Concrete Cement
RDS	Respirable Dust Sampler
SAR	Sodium Adsorption Ratio
SBM	Single Bouy Mooring
SO _x	Sulfur oxides
STP	Sewage Treatment Plant
TC	Total Coliforms
TDS	Total Dissolved Solids
TOC	Total organic Carbon
TSS	Total Suspended Solids
VOC	Volatile Organic Compounds



CHAPTER 1: INTRODUCTION

1.1 Introduction

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

1.2 Green Ports Initiative

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

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

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

1.3 Importance of Environmental monitoring and management plan (EMMP)

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

1. Air pollutant emissions due to ship emissions, loading and unloading activities, construction emission and emissions due to vehicular movement.

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

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

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

It is extremely essential that port and harbour projects should have an Environmental Monitoring and Management Plan (EMMP), which incorporates monitoring of Ambient Air, Drinking Water, Noise, Soil, Marine (water, sediment, ecology) quality along with the collection of online meteorological data throughout the duration of the project.

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

This document presents the Environmental Monitoring Report (EMR) for Kandla and Vadinar for the environmental monitoring done during the period from 15th April 2023-15th April 2024.

1.4 Objectives and scope of the Study

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

The scope of work includes not limited to following:

1. To review the locations/stations of Ambient Air, Ambient Noise, drinking water, and Marine Water, Soil and Sediments monitoring within the impacted region in-and-around DPA establishment, in view of the developmental projects.
2. To assess the Ambient Air quality, quality at 6 stations at Kandla and 2 at Vadinar in terms of gases and particulate matter.
3. To assess the DG stack emissions (gases and particulate matter).
4. To assess Drinking water quality at twenty locations (18 at Kandla and 2 at Vadinar) in terms of Physical, Chemical and Biological parameters viz., Color, Odor, turbidity, conductivity, pH, Total Dissolved Solids, chlorides, Hardness, total iron, sulphate, NH₄, PO₄, and bacterial count on a monthly basis.
5. To assess the Marine water quality in terms of aquatic Flora and Fauna and Sediment quality in terms of benthic flora and fauna.
6. To assess Marine Water Quality and sediment in term of physical and chemical parameter.
7. To assess the trends of water quality in terms of Marine ecology by comparing the data collected over a specified time period.
8. Weekly sample collection and analysis of inlet & Outlet points of the Sewage Treatment Plant (STP) to check the water quality being discharged by DPA as per the CC&A.
9. Carrying out monthly Noise monitoring; twice a day at the representative stations for a period of 24 hours.
10. Meteorological parameters are very important from air pollution point of view, hence precise and continuous data collection is of utmost importance. Meteorological data on wind speed, wind direction, temperature, relative humidity, solar radiation and rainfall shall be collected from one permanent station at DPA, Kandla and one permanent station at Vadinar.
11. To suggest mitigation measures, based on the findings of this study and also check compliance with Environmental quality standards, Green Port Initiatives, MIV 2030, and any applicable Statutory Compliance.
12. To recommend Environment Management Plans based on Monitoring programme and findings of the study.



CHAPTER 2: METHODOLOGY

2.1 Study Area

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

a. Kandla

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

- **Climatic conditions of Kandla**

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

b. Vadinar

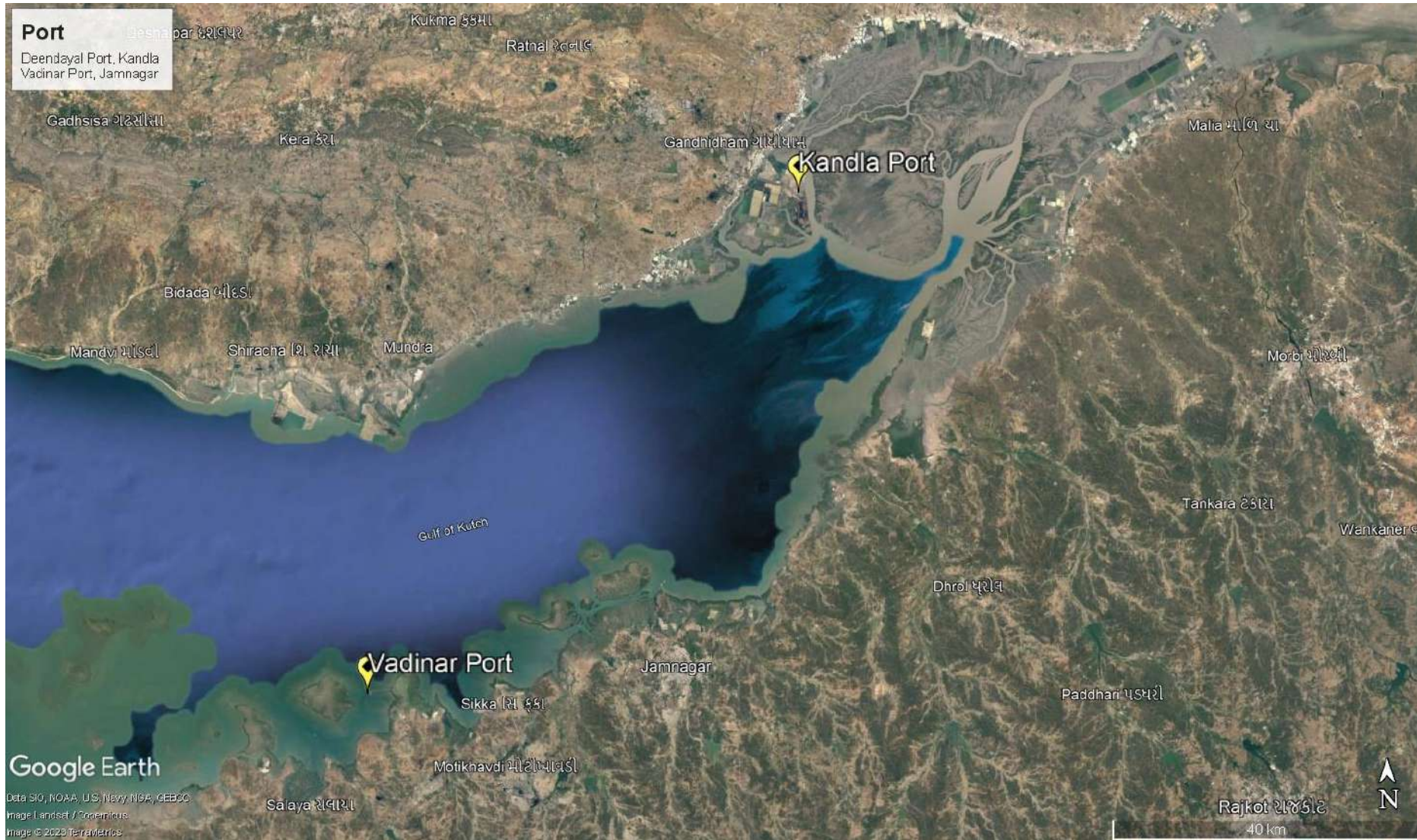
Vadinar is a small coastal town located in Devbhumi Dwarka district of the Gujarat state in India located at coordinates 22° 27' 16.20" N - 069° 40' 30.01". DPA had commissioned the Off Shore Oil Terminal (OOT) facilities at Vadinar in the year 1978, for which M/s. Indian Oil Corporation Limited (IOCL)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

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

- **Climatic conditions of Vadinar**

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

The Kandla and Vadinar port have been depicted in the **Map 1 & 2** as follows:



Map 1: Locations of Kandla and Vadinar Port



Map 2: Locations of Kandla Port



Map 3: Locations of Vadinar Port

2.2 Environmental Monitoring at Kandla and Vadinar

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

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

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

Methodology adopted for the study

Methodology is a strictly defined combination of practices, methods and processes to plan, develop and control a project along the continuous process of its implementation and successful completion. The aim of the project management methodology is to allow the control of whole process of management through effective decision-making and problem solving. The methodology adopted for the present study is shown in **Figure 1** as given below:

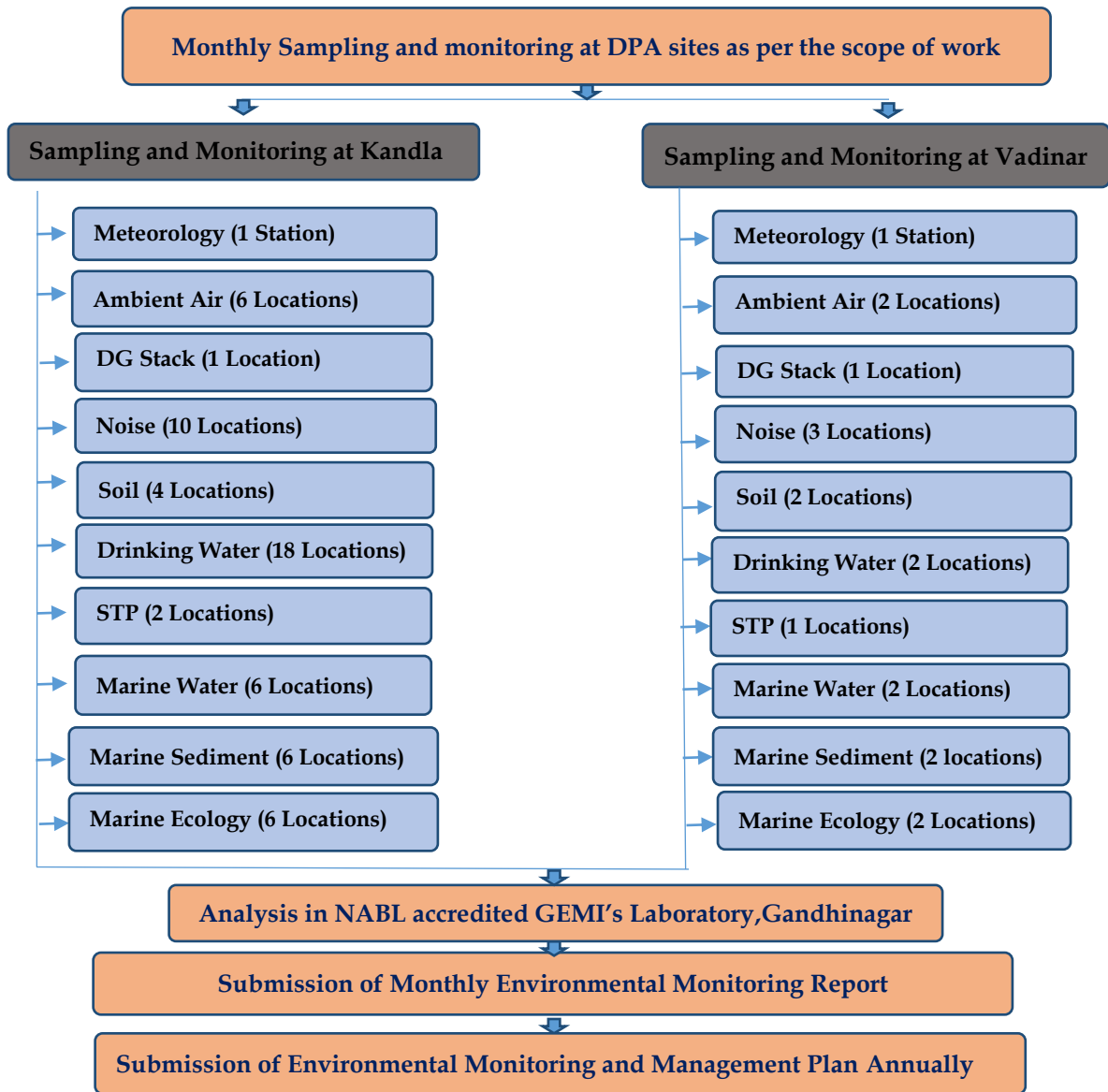


Figure 1: Methodology flow chart

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



CHAPTER 3: METEOROLOGY MONITORING

3.1 Meteorology Monitoring

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

Table 1: Details of Automatic Weather Station

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

Methodology:

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

Table 2: Automatic Weather Monitoring Station details

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

Monitoring Frequency:

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



Figure 2: Photographs of Automatic Weather Monitoring Station at Kandla and Vadinar



3.2 Results and discussion

The summary of hourly climatological observations recorded at Kandla and Vadinar during the monitoring period of **April 2023 to April 2024**, with respect to significant parameters has been mentioned in **Table 3** as follows:

Table 3: Meteorological data for Kandla and Vadinar

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



Details of Micro-meteorological data at Vadinar Observatory

Monitoring Period	Wind Speed (Km/h)			Temperature (°C)			Relative humidity (%)			Solar Radiation (W/m ²)	Wind Direction (°)	Rainfall (mm)
	Max.	Min	Avg.	Max.	Min	Avg.	Mean	Max.	Min			
April-May 23	26.33	7.78	13.24	28.74	28.04	28.17	73.47	70	71.08	110.76	W & South	0.02
May-June 23	34.08	7.63	16.76	29.96	29.22	29.34	71.77	69.03	69.83	102.95	S.S.E	0.19
June- July 23	12.31	1.62	5.19	29.51	28.86	28.94	77.68	75.42	75.95	78.26	South	0.27
July-Aug 23	31.69	5.39	13.12	28.62	27.99	28.06	79.51	77.31	77.77	60.86	South	0.22
Aug-Sep 23	28.07	5.2	12.96	27.75	27.18	27.22	75.13	72.87	73.42	88.14	South & S.W	0
Sep- Oct 23	21.82	4.64	9.59	28.12	27.5	27.56	77.12	74.66	75.32	87.51	South	0.06
Oct- Nov 23	13.8	1.77	4.17	27.89	27.1	27.28	63.61	59.58	61.15	81.61	N.E	0.18
Nov- Dec 23	19.37	3	4.84	24.79	24.11	24.24	64.12	60.47	61.79	70.68	S.S.E	0.03
Dec- Jan 24	16.76	1	4.18	22.94	22.14	22.34	63.13	59.25	60.71	73.37	South	0
Jan- Feb 24	10.62	1.99	3.94	23.24	22.92	22.7	65.66	64.19	64.9	87.29	South	0
Feb- Mar 24	16.92	5.36	8.55	24.16	23.6	23.82	62.34	60.91	61.51	101.99	N.N.W	0
Mar- Apr 24	29.61	0.31	11.63	29.8	24.96	26.5	82.36	57.41	71.08	114.77	N.N.W	0

3.3 Data Interpretation and Conclusion

1) Kandla:

- a. The ambient temperature for the summer season varies in the range of **21.68** to **48.44** °C; in the monsoon season, the temperature varies between **29.32** and **33.38** °C; and in the winter season, the temperature varies between **21.68** and **31.24** °C. The yearly average temperature at Kandla is observed to be around **29.217** °C, with a standard deviation of 4.31.
- b. The relative humidity for the summer season was recorded in the range of **30.59%** to **76.32%**; in the monsoon season, relative humidity was recorded in the range of **66.85%** to **84.57%**; and in the winter season, relative humidity was recorded in the range of **49.02** to **59.69%**; the yearly average humidity at Kandla was **61.75%** with a standard deviation of **10.635**.
- c. The maximum rainfall at Kandla was observed at **21.89** mm for the monitoring period of August to September 2023; the yearly average rainfall was found to be **3.72** mm.
- d. Wind speed and direction play a significant role in transporting pollutants and thus determining the air quality. In the summer season, wind blew from the North and North North West directions; in the monsoon season, wind blew from the West South West; and in the winter season, wind blew from the North direction.
- e. The wind speed recorded ranges from **0.025** to **48.85** km/h in the summer season; in the monsoon season, the wind speed recorded ranges from **0.16** to **37.52** km/h; and in the winter season, the wind speed recorded ranges from **0** to **15.75** km/h. The yearly average wind speed at Kandla is **5.77** km/h, with a standard deviation of 3.55.
- f. The **maximum** solar radiation at Kandla was observed at **105.42** W/m² during the monitoring period **April to May 2023**; the **minimum** solar radiation at Kandla was observed at **54.28** W/m² for the monitoring period **November to December 2023**; **and** the yearly **average** solar radiation was found to be **73.445** W/m² with a standard deviation of 15.19.

2) Vadinar:

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



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



CHAPTER 4: AMBIENT AIR QUALITY MONITORING

4.1 Ambient Air Quality

It is necessary to monitor the ambient air quality of the study area, in order to determine the impact of the shipping activities and port operations on the ambient air quality. The prime objective of ambient air quality monitoring is to assess the present air quality and its conformity to National Ambient Air Quality Standards i.e. NAAQS, 2009⁽¹⁾.

Methodology

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

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

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

Table 4: Details of Ambient Air monitoring locations

Sr. No.	Location Code	Location Name	Latitude Longitude	Significance	
1.	Kandla	A-1	Oil Jetty No. 1	23.029361N 70.22003E	Liquid containers and emission from ship
2.		A-2	Oil Jetty No. 7	23.043538N 70.218617E	
3.		A-3	Kandla Port Colony	23.019797N 70.213536E	Vehicular activity and dust emission
4.		A-4	Marine Bhavan	23.007653N 70.222197E	Construction and vehicular activity, road dust emission,
5.		A-5	Coal Storage Area	23.000190N 70.219757E	Coal Dust, Vehicular activity
6.		A-6	Gopalpuri Hospital	23.081506N 70.135258E	Residential area, dust emission, vehicular activity
7.	Vadinar	A-7	Admin Building	22.441806N 69.677056E	Vehicular activity
8.		A-8	Vadinar Colony	22.401939N 69.716306E	Residential Area, burning waste, vehicular activity

The monitoring locations at Kandla and Vadinar have been depicted in map in **Map 4 and 5** respectively.

Ambient Air monitoring photos

Kandla

A-1: Oil Jetty No. 1



A-2: Oil Jetty No. 7



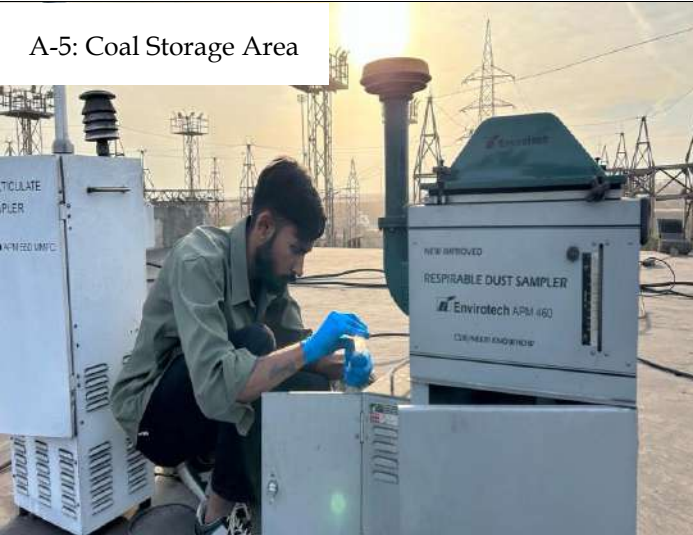
A-3: Kandla Port Colony



A-4: Marine Bhavan



A-5: Coal Storage Area



A-6: Gopalpuri Hospital



Vadinar

A-7: Admin Building

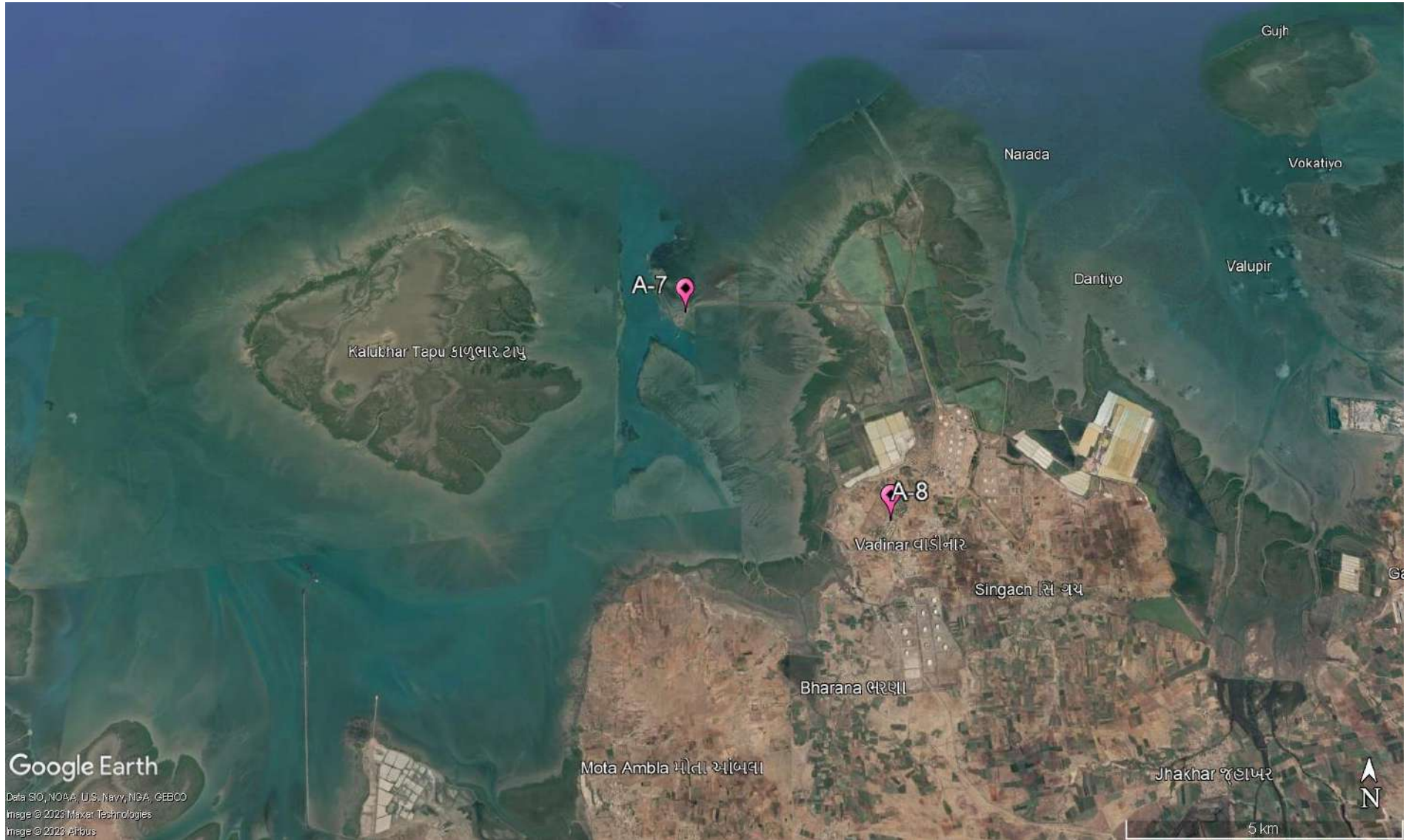


A-8: Vadinar Colony





Map 4: Ambient Air Monitoring locations at Kandla



Map 5: Ambient Air Monitoring locations at Vadinar

Monitoring Frequency

The sampling for Particulate matter, i.e., PM₁₀ and PM_{2.5}, and gaseous components like SO_x, NO_x, and CO, as well as the total VOCs, was monitored twice a week for a period of 24 hours a day. Whereas, the sampling for the components of PAH, benzene, and non-methane VOCs was conducted on a monthly basis. The monitoring period for this study is from April 15, 2023, to April 15, 2024. During this period, 95 air samples were taken from six locations in Kandla, and 97 samples were taken from two locations in Vadinar.

Sampling and Analysis

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

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

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

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

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

Table 5: Parameters for Ambient Air Quality Monitoring

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

4.2 Result and Discussion

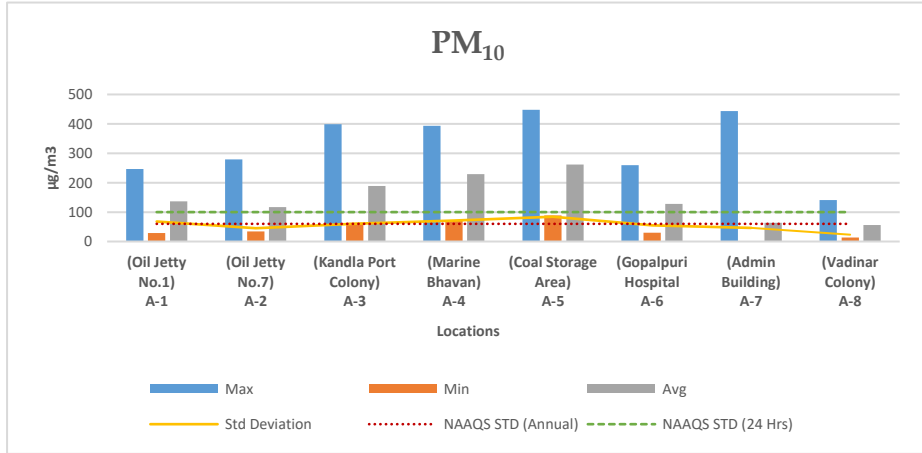
The summarized results of ambient air quality monitoring for the study period are presented in **Table-6 to 9** along with the graphical representation from **Graph 1 to Graph 6**. Various parameters monitored during the study have been presented by their maximum, minimum, average and Standard deviation.



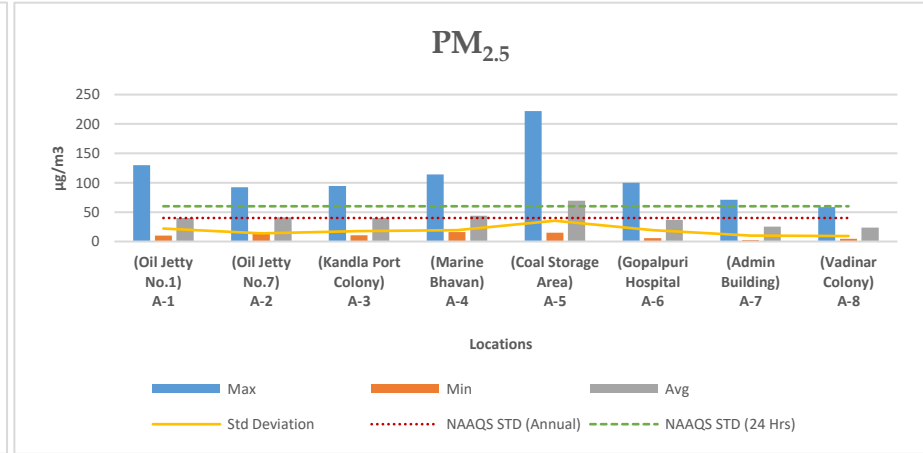
Table 6: Summarized results of PM₁₀, PM_{2.5}, SO₂, NO_x, VOC and CO for Ambient Air quality monitoring

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

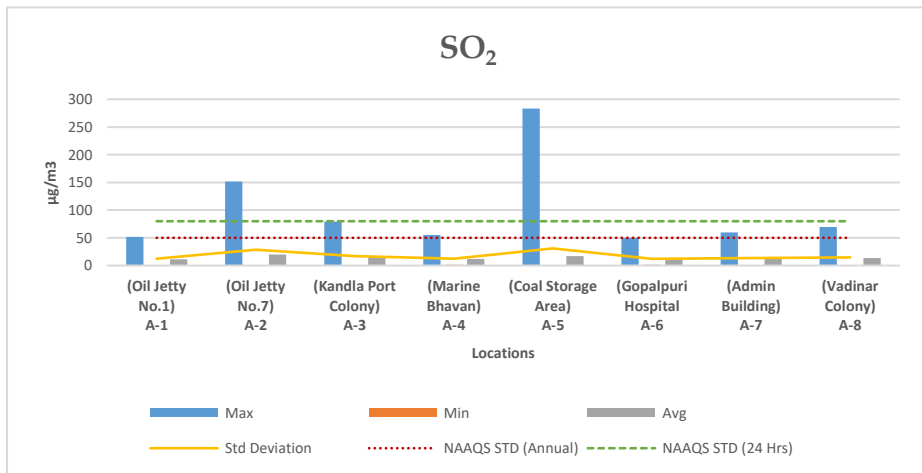
Graphs 1-6 shows spatial trend of ambient air parameter at all the eight-monitoring location (six at Kandla and 2 at Vadinar)



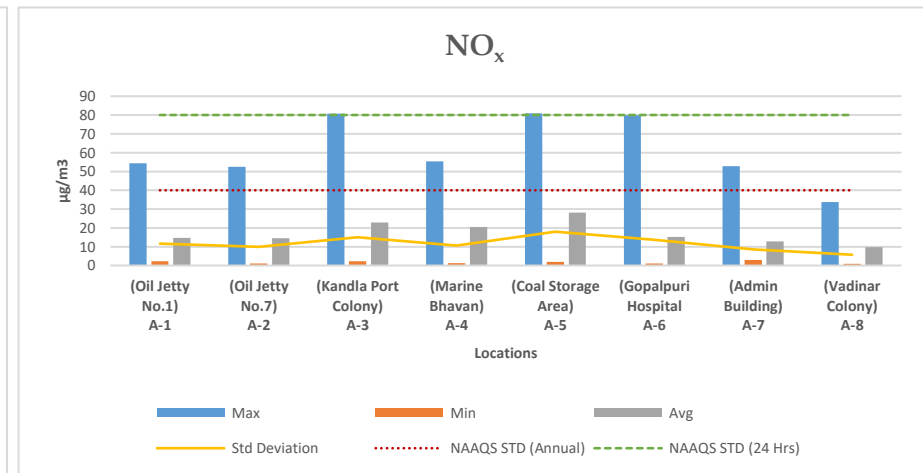
Graph 1 Spatial trend in Ambient PM₁₀ Concentration



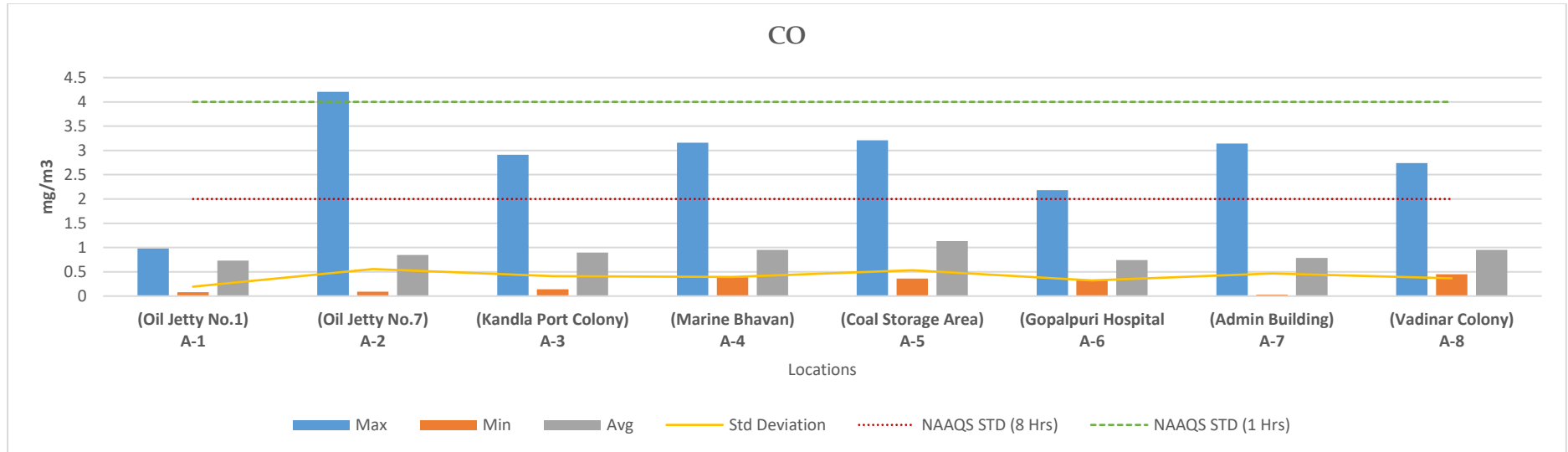
Graph 2 Spatial trend in Ambient PM_{2.5} Concentration



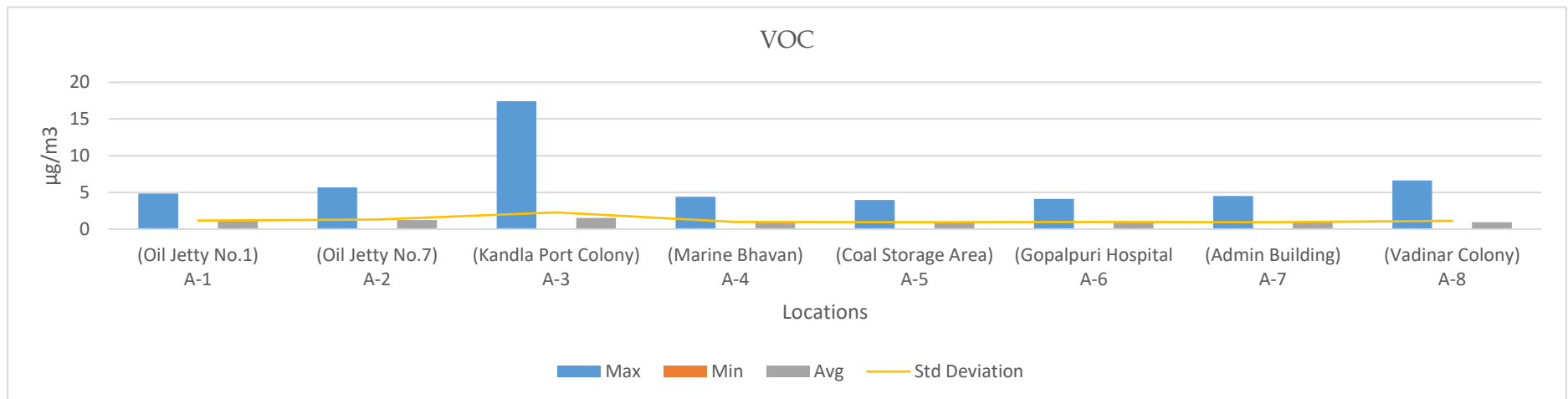
Graph 3 Spatial trend in Ambient SO_x Concentration



Graph 4 Spatial trend in Ambient NO_x Concentration



Graph 5 Spatial trend in Ambient CO Concentration



Graph 6 Spatial trend in Ambient Total VOCs



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

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

Table 8: Summarized results of Polycyclic Aromatic Hydrocarbons

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



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

Table 9: Summarized results of Non-methane VOC

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

4.3 Data Interpretation and Conclusion

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

1) Kandla:

Particulate matter:

- The concentration of PM₁₀ varies very widely and is reported in the range of **28.68** to **448.12** µg/m³, with a yearly average value of **176.83** with standard deviation **64.185** µg/m³. As shown in Graph 1, the highest concentration (value) of PM₁₀ is reported at location A-5 (coal storage area) during the winter. It can be seen that PM₁₀ exceeds the NAAQS annual limit, i.e., 60 µg/m³, in all locations. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-1 (oil jetty No. 1) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 100 µg/m³.
- The concentration of PM_{2.5} varies in the range of 5.51 to 221.9 µg/m³, with a yearly average value of 45.35 with standard deviation 21.16 µg/m³. As shown in Graph 2, the highest concentration of PM_{2.5} is at location A-5 (the coal storage area) in winter. It can be seen that PM_{2.5} exceeds the NAAQS annual limit, i.e., 40 µg/m³, on five locations, and location A-6, i.e., Gopalpuri hospital, falls within the NAAQS annual limit. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-6 (Gopalpuri hospital) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 60 µg/m³.
- The highest concentration of Particulate matter at locations **A-5, (the coal storage area)**, could be attributed to the presence of heavy vehicular traffic in upwind areas, which have a higher impact, causing the dispersion of emitted particulate matter in the ambient air. The activities observed in the surrounding such as The unloading of coal directly into the truck using grabs, construction in the vicinity causes the dust to disperse in the air as well as coal dust to fall and settle on the ground. This settled coal dust again mixes with the air while trucks travel through it. Also, the coal-loaded trucks are generally not always covered with tarpaulin sheets, and this might result in increased suspension of coal from trucks or dumpers during their transit from vessel to yard or storage site. This might increase the PM in and around the coal storage area and Marine Bhavan.

Gaseous Pollutants:

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

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

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

Polycyclic Aromatic Hydrocarbons (PAHs): are ubiquitous pollutants in urban atmospheres. Anthropogenic sources of total PAHs in ambient air emissions are greater than those that come from natural events. These locations are commercial areas where Vehicular activity and dust emission is common. PAHs are a class of chemicals that occur naturally in coal, crude oil, and gasoline. The higher concentration which results from burning coal, oil, gas, road dust, etc. Other outdoor sources of PAHs may be the industrial plants in-and-around the DPA premises.

- The concentration of Benzene levels was recorded in the range of **0.02** to **3.8** $\mu\text{g}/\text{m}^3$, with a yearly average value of **0.84** with standard deviation **0.64** $\mu\text{g}/\text{m}^3$. The highest concentration of Benzene is at location **A-1, (Oil Jetty No. 1)** in summer. It can be seen that at all locations, Benzene within the NAAQS annual limit, i.e., $5 \mu\text{g}/\text{m}^3$.
- The ambient air monitoring location of Kandla recorded the non-methane VOC (NM-VOC) concentration in the range of **0.08** to **3.54** $\mu\text{g}/\text{m}^3$, with a yearly average value of **0.86** $\mu\text{g}/\text{m}^3$ at Kandla. The highest concentration is at location **A-3, (Kandla Port Colony)** in Winter.

2) Vadinar:

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

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

Gaseous Pollutants:

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

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

Polycyclic Aromatic Hydrocarbons (PAHs):

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

With reference to the Ambient Air Quality monitoring conducted under the study, it may be concluded that the particulate matter PM_{10} , were reported in higher concentration and apparently exceeds the NAAQS particularly at locations of Kandla., whereas $\text{PM}_{2.5}$ complies with the NAAQS at majority of the locations. For both the ambient air monitoring parameters (PM_{10} and $\text{PM}_{2.5}$), the major exceedance was observed at location A-5 i.e. Coal Storage Area. The gaseous pollutants (NO_x , SO_x , CO, VOCs etc.) falls within the permissible limit. The probable reasons contributing to these emissions of pollutants into the atmosphere in-and-around the port area are summarized as follows: -

1. **Port Machinery:** Port activities involve the use of various machinery and equipment, including cranes, for lifts, tugboats, and cargo handling equipment. These machines often rely on diesel engines, which can emit pollutants such as NO_x , Particulate matter, and CO. Older or poorly maintained equipment tends to generate higher emissions.
2. **Port Vehicles:** Trucks and other vehicles operating within port and port area contributes to air pollution. Similar to port machinery, diesel-powered vehicles can emit NO_x , PM, CO, and other pollutants such as PAH, VOCs etc. Vehicle traffic and congestion in and around port areas can exacerbate the air quality issues.
3. **Coal Handling:** Resuspension of dust occurs due to the transportation of coal and the handling of coal.
4. **Construction Activities:** Another reason for the high particulate matter content in this area is due to high construction activities in the surrounding area.

4.4 Remedial Measures:

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

- Practice should be initiated for using mask as preventative measure, to avoid Inhalation of dust particle-Mask advised in sensitive areas. Covering vehicles with tarpaulin during transportation will help to reduce the suspension of pollutants in air.
- Ensuring maintenance of engines and machinery to comply with emission standards.
- Frequent water sprinkling on roads to reduce dust suspension due to vehicular movement, this can be use during transporting coal to avoid suspension of coal dust.
- Use of proper transport methods, such as a conveyor belt, for excavated material and screens around the construction site.
- End to End pavement of roads in construction site could considerably reduce dust emission. Prohibition of use of heavy diesel oil as fuel could be possibly reduce pollutants. Encouraging use of low-sulfur fuels (viz. Marine Gas Oil (MGO)/Liquefied Natural Gas (LNG), can significantly reduce sulfur and PM emissions from ships.
- Retrofitting ships with exhaust gas cleaning systems can help reduce sulfur emissions. Engine upgrades, such as optimizing fuel combustion and improving engine efficiency, can reduce overall emissions.
- Investing in infrastructure for cold ironing allows ships to connect to the electrical grid while docked, reducing the need for auxiliary engines and associated emissions.
- Implementing efficient cargo-handling processes, optimizing logistics to reduce congestion and idling times, and encouraging use of cleaner port machinery and vehicles can all contribute to reducing air pollution in port areas.
- Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.
- Dust collectors shall be deployed in all areas where blasting (surface cleaning) and painting operations are to be carried out, supplemented by stacks for effective dispersion.
- Periodic vacuum-sweeping mechanisms shall be adopted.



CHAPTER 5: DG STACK MONITORING

5.1 DG Stack Monitoring

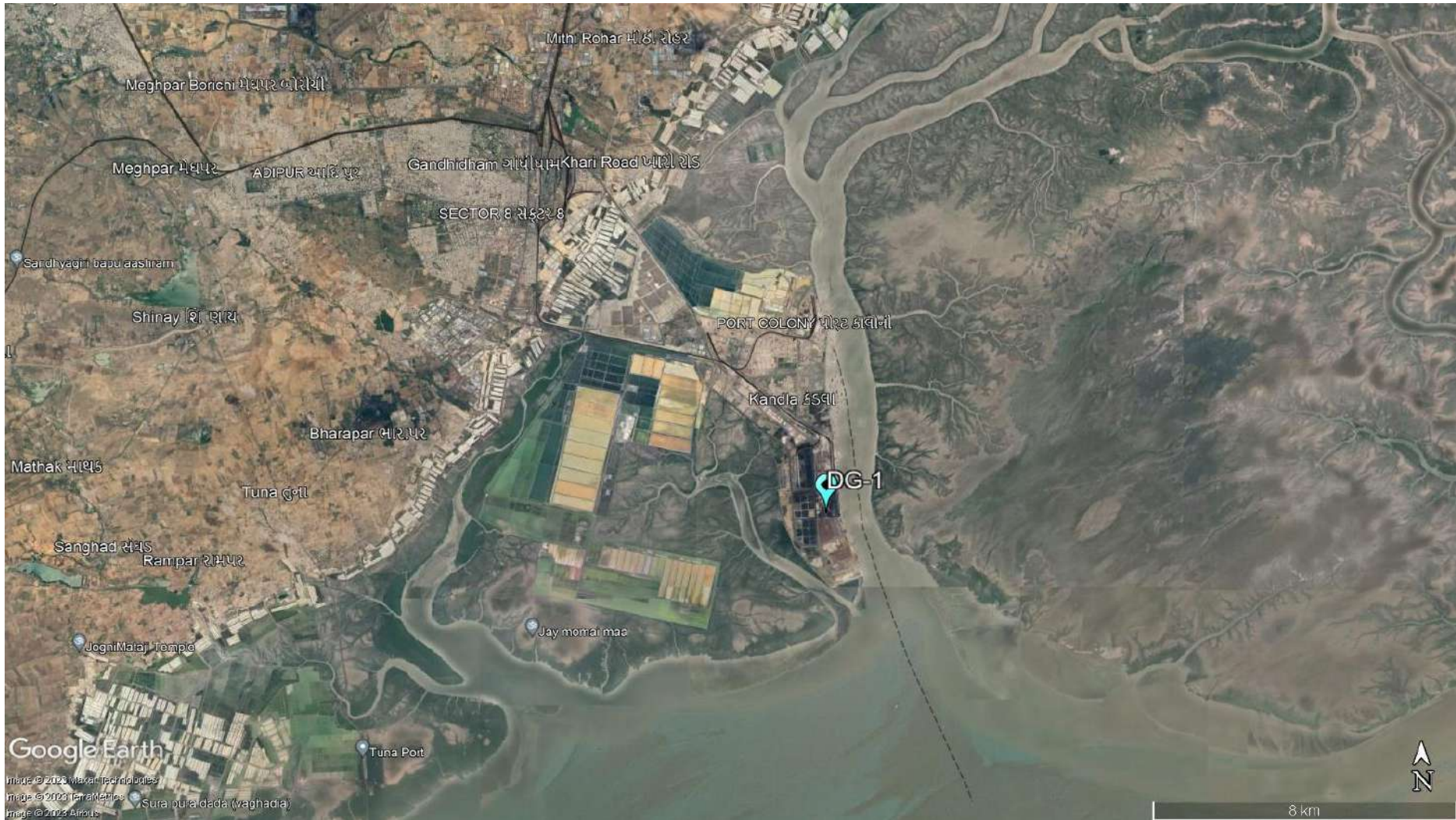
A diesel generator is a mechanical-electrical machine that produces electrical energy (electricity) from diesel fuel. They are used by the residential, commercial, charitable and governmental sectors to provide power in the event of interruption to the main power, or as the main power source. Diesel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

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

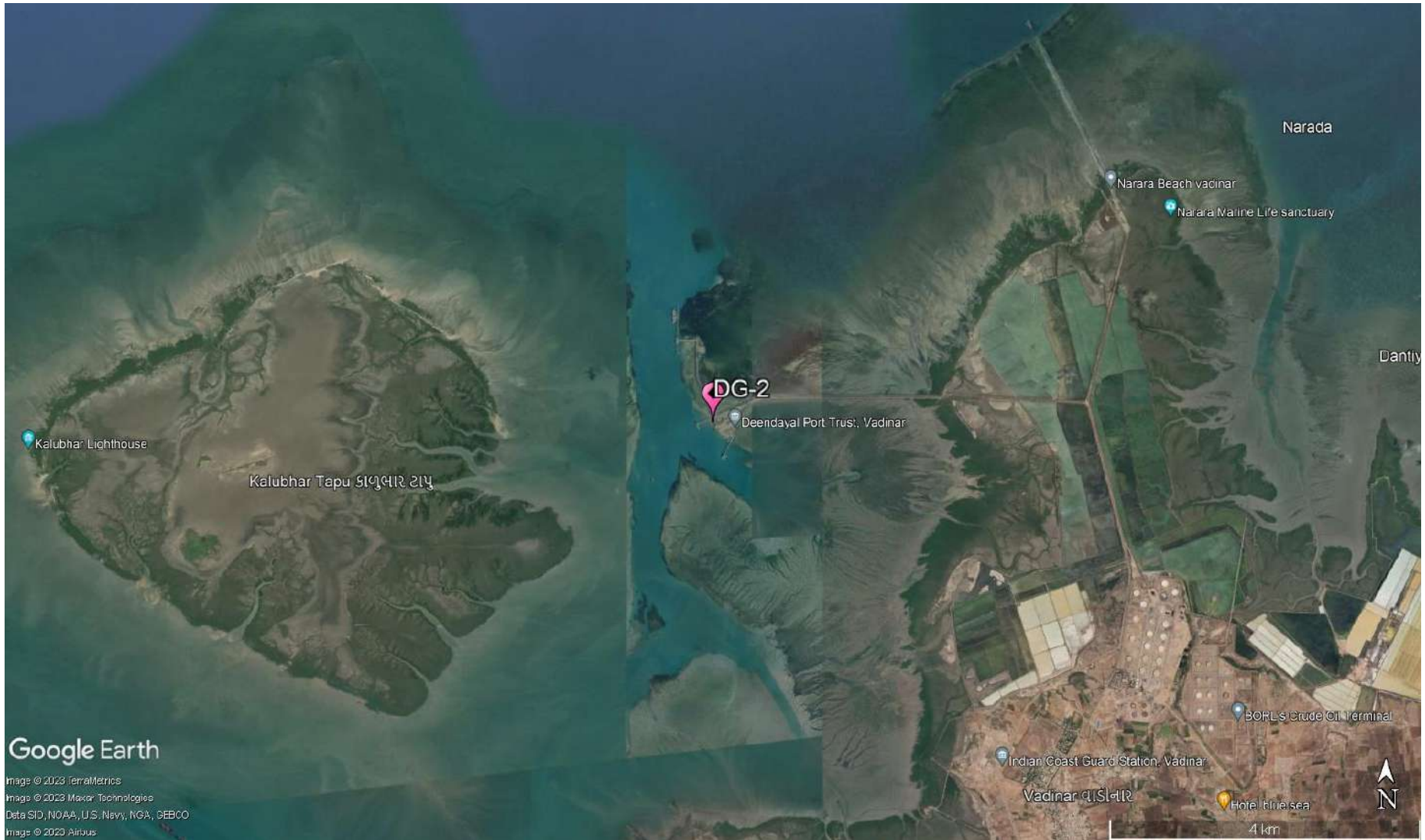
Table 10: Details of DG Stack monitoring locations

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

The map depicting the locations of DG Stack Monitoring to be monitored in Kandla and Vadinar have been mentioned in **Map 6 and 7** as follows:



Map 6: DG Stack monitoring Locations at Kandla



Map 7: DG Stack monitoring Locations at Vadinar

Methodology:

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

Table 11: DG stack parameters

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

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

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

Monitoring Frequency

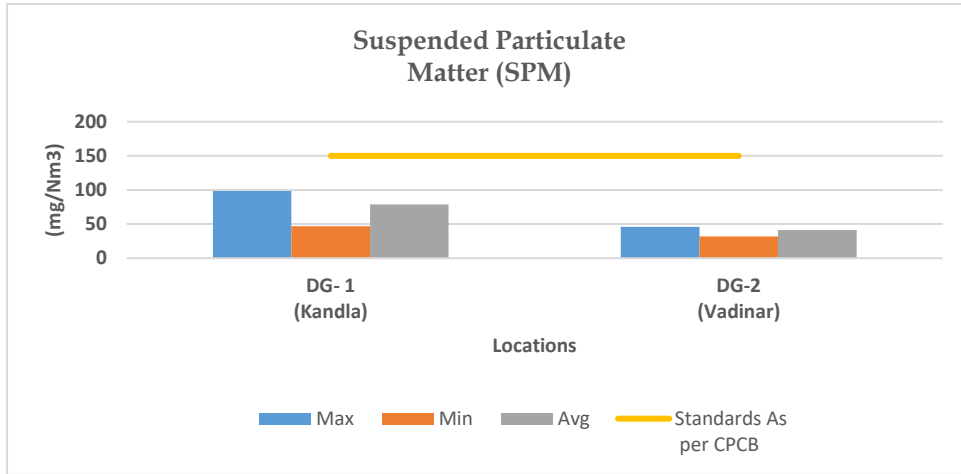
Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar for a period of 15th April 2023 to 15th April 2024.

5.2 Result and Discussion

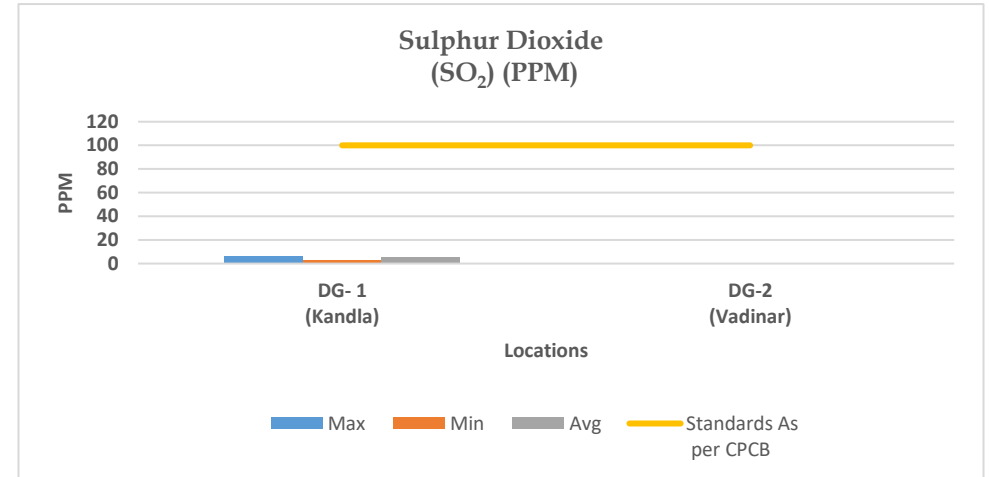
The sampling and monitoring of DG stack emission was carried out for monitoring period at Kandla and Vadinar and its comparison with CPCB or Indian standards for Industrial Stack Monitoring the flue gas emission from DG set has given in **Table 12**.

Table 12: DG monitoring data

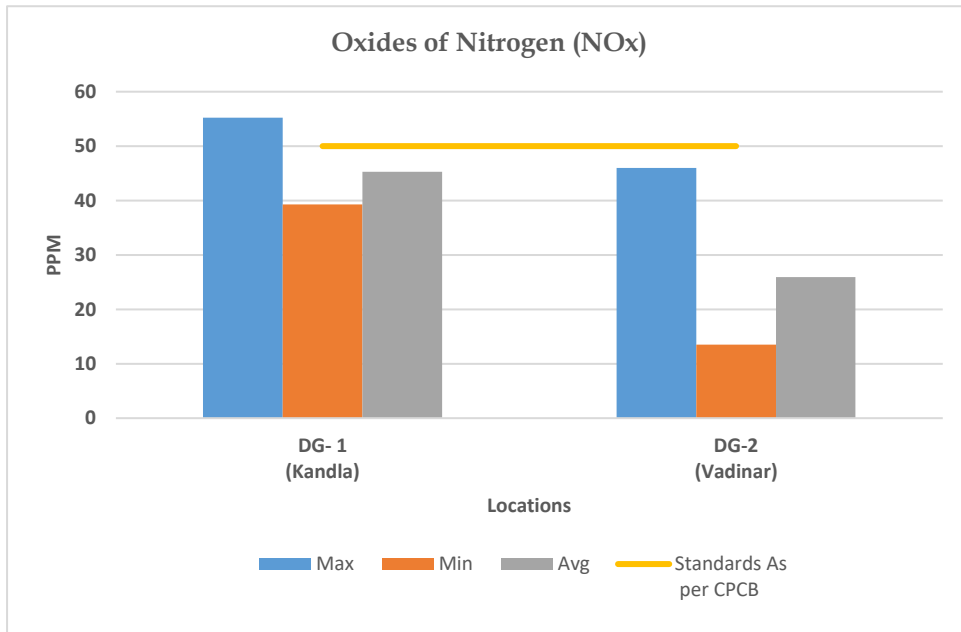
Sr. No.	Stack Monitoring Parameters for DG Sets		DG- 1 (Kandla)	DG-2 (Vadinar)	Stack Monitoring Limits /Standards As per CPCB
1.	Suspended Particulate Matter (SPM) (mg/Nm ³)	Max	98.47	45.32	150
		Min	46.82	31.85	
		Avg.	78.96	41.33	
2.	Sulphur Dioxide (SO ₂) (PPM)	Max	6.45	N.D.	100
		Min	3.25	N.D.	
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



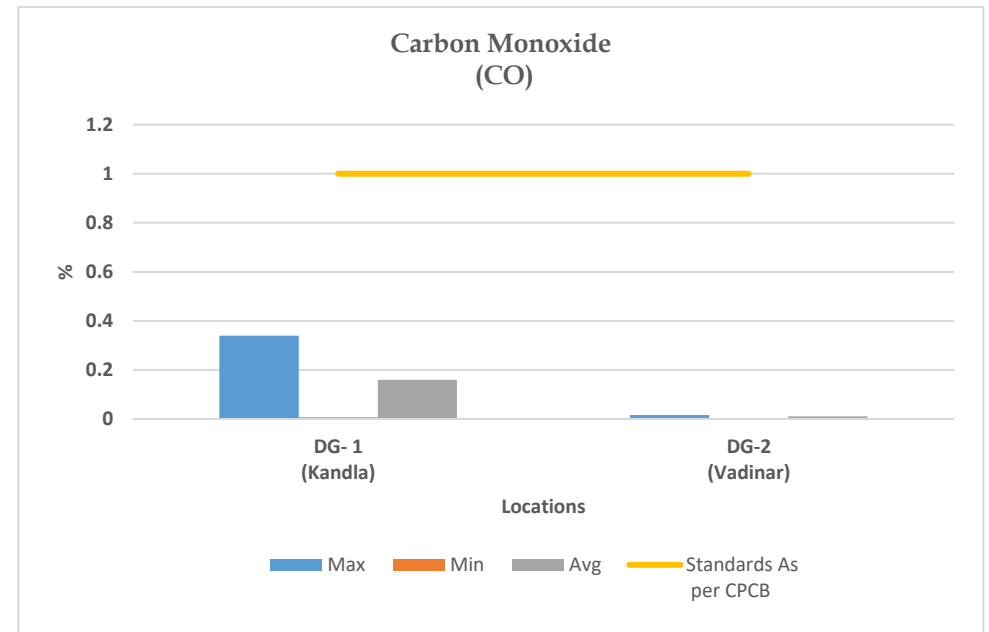
Graph 7 Spatial trend in SPM Concentration



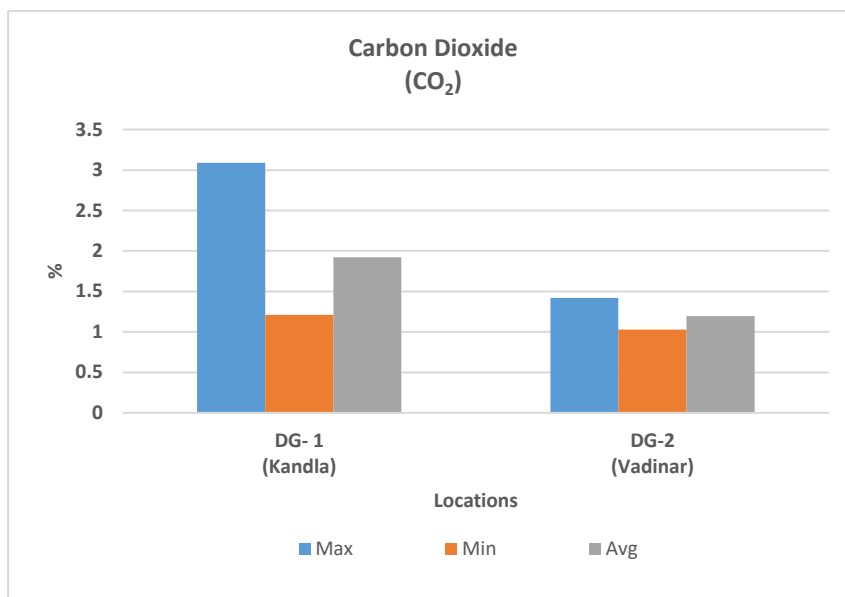
Graph 8 Spatial trend in SO_x Concentration



Graph 9 Spatial trend in NO_x Concentration



Graph 10 Spatial trend in CO Concentration



Graph 11 Spatial trend in CO₂ Concentration

5.3 Data Interpretation and Conclusion

1) Kandla:

The Suspended Particulate Matter (SPM) varies in the range of **46.82** to **98.47** mg/m³. The yearly average SPM of D.G stack-1 is **78.96** mg/m³. The maximum concentration for SPM was observed in the monitoring period of October to November 2023. The Sulphur dioxide (SO_x) varies in the range of **3.25** to **6.45** PPM. The yearly average SO_x of D.G stack-1 is **4.95** PPM. The maximum concentration of SO_x observed in the monitoring period of October to November 2023.

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

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

The CO₂ at Kandla varies in the range of **1.21** to **3.09** %. The yearly average of CO₂ of D.G stack-1 at Kandla is **1.92** %. The maximum concentration of CO₂ observed in the monitoring period of March to April 2024.

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

2) Vadinar:

The Suspended Particulate Matter (SPM) in the range of **31.85** to **45.32** mg/m³. The yearly average SPM of D.G stack-2 at Vadinar is **41.33** mg/m³. The maximum concentration of SPM was observed in the monitoring period of March to April 2024. There is no Sulphur dioxide (SO_x) concentration detected at Vadinar.

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



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

The CO₂ at Vadinar varies in the range of **1.03 to 1.42** %. The yearly average in CO₂ of D.G stack-2 at Vadinar is **1.92** % The maximum concentration of CO₂ observed in the monitoring period of June to July 2024.

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



CHAPTER 6: NOISE MONITORING

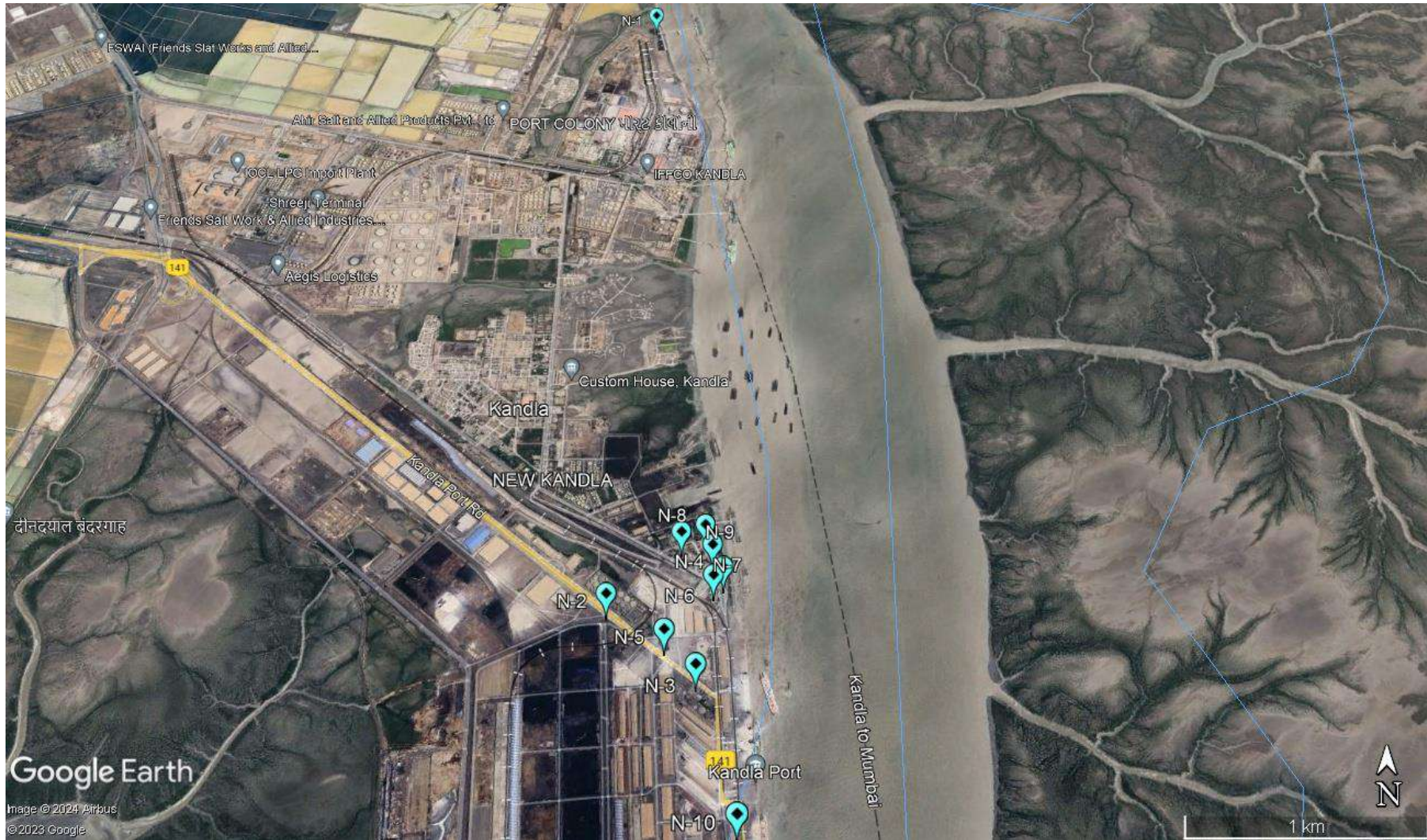
6.1 Noise Monitoring

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

The details of the noise monitoring stations are mentioned in **Table 13** and locations have been depicted in the **Map 8 and 9** as follow:

Table 13: Details of noise monitoring locations

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



Map 8: Locations for Noise Monitoring at Kandla



Map 9: Locations for Noise Monitoring at Vadinar

Methodology:

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

Monitoring Frequency

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

Table 14: Details of the Noise Monitoring

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

Standard for Noise

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

Table 15: Ambient Air Quality norms in respect of Noise⁽²⁾

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

6.2 Result and Discussion

The details of the Noise monitoring conducted during the monitoring period April 2023 to April 2024 have been summarized in the **Table 16** as below:

Table 16: The Results of Ambient Noise Quality

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

6.3 Data Interpretation and Conclusion

- 1) **Kandla:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 10 locations at Kandla ranged from **33.5 dB(A)** to **74.5 dB(A)** while, during Night Time the average Noise Level ranged from **31.9 dB(A)** to **58.9 dB(A)**, of which six locations out of ten locations, noise level were within the permissible limits for the industrial, commercial area and residential zone for Day time and night time. Other Four locations such as i.e., **N-3 (Canteen Area)**, **N-7 (Port & Custom Building)**, **N-8 (Nirman Building)** and **N-9 (ATM building)** which are Commercial areas, slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period of **April to May 2023 and May to June 2023**.
- 2) **Vadinar:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 3 locations at Vadinar ranged from **34 dB(A)** to **77.5 dB(A)** while, during Night Time the average Noise Level ranged from **34.3 dB(A)** to **71.2 dB(A)** at Vadinar, on location **N-11 (Near main gate)** noise level was within the permissible limits for the industrial zone for Day time and night time. On locations of Vadinar such as i.e., **N-12 (Near Vadinar jetty)**, which are considered as industrial area slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period of **June to July 2023**. And on location **N-13 (Port Colony Vadinar)**, most frequently exceed the permissible limit during the day time as well as night time.

6.4 Remedial Measures

The noise levels detected at the locations of Kandla and Vadinar, are found within the prescribed norms. The noise can further be considerably reduced by adoption of low noise equipment or installation of sound insulation fences. Green belt of plants can be a good barrier. If noise exceeds the applicable norms, then the working hours may be altered as a possible means to mitigate the nuisances of construction activities.



CHAPTER 7: SOIL MONITORING

7.1 Soil Quality Monitoring:

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

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

Table 17: Details of the Soil quality monitoring

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

Methodology

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

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

Monitoring Frequency

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

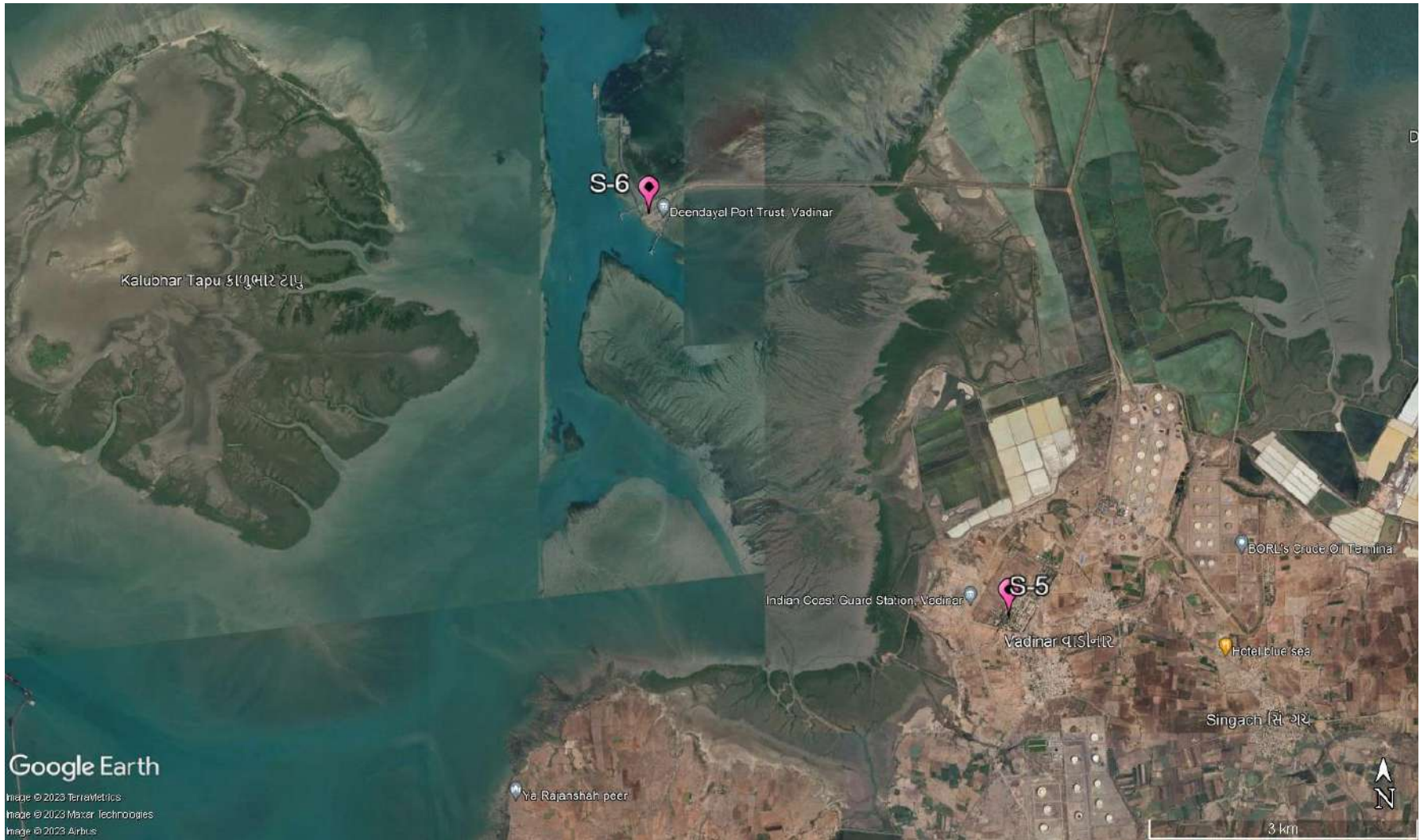
Table 18: Soil parameters

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

The map depicting the locations of Soil Quality Monitoring to be monitored in Kandla and Vadinar have been mentioned in **Map 10 and 11** as follows:



Map 10: Soil Quality Monitoring Locations at Kandla



Map 11: Soil Quality Monitoring Locations at Vadinar

7.2 Result and Discussion

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

Table 19: Soil Quality for the Monitoring period

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

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

7.3 Data Interpretation and Conclusion

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

1) Kandla:

- The value of pH ranges from **6.48** to **9.53**, with the highest at location **S-1 (Oil Jetty 7)** and the lowest at location **S-2 (IFFCO plant)**, while the average pH for Kandla was observed to be **8.23**. The pH in Kandla varies from **Slightly alkaline to strongly alkaline**
- At all monitoring locations, the value of **Electrical Conductivity** ranges from **204** to **75,700 $\mu\text{s}/\text{cm}$** , with the highest at location **S-3 (Khor Creek)** and the lowest at **S-4 (Nakti Creek)**. The average Electrical Conductivity is **16,109.87 $\mu\text{s}/\text{cm}$** .
- The concentration of inorganic phosphate varied from **0.32** to **619.89 kg/ha**, with an average of **17.93 kg/ha**. The highest concentration of inorganic phosphate was found at **S-2 (IFFCO plant)** and the lowest concentration was found at **S-4 (Nakti Creek)**. The availability of phosphorus in the soil solution is influenced by several factors, such as organic matter, clay content, pH, temperature, and more.

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

Heavy Metals

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

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

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

2) Vadinar:

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

Heavy Metals

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

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



CHAPTER 8: DRINKING WATER MONITORING

8.1 Drinking Water Monitoring

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

The details of the drinking water sampling stations have been mentioned in **Table 20** and the locations have been depicted through Google map in **Map 12 and 13**.

Table 20: Details of Drinking Water Sampling Locations

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



Map 12: Drinking Water Monitoring Locations at Kandla



Map 13: Drinking Water Monitoring Locations at Vadinar

Methodology

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

Table 21: List of parameters for Drinking Water Quality monitoring⁽³⁾

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



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

Monitoring Frequency

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



8.2 Result and Discussion

The drinking water quality of the locations at Kandla and Vadinar and its comparison with the to the stipulated standard (Drinking Water Specifications i.e., IS: 10500:2012) ⁽⁴⁾ have been summarized in **Table 22A, 22B, 22C** as follows:

Table 22A: Drinking Water Quality for the Monitoring period

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



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



Table 22B: Drinking Water Quality for the Monitoring period

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



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



Table 22C: Drinking Water Quality for the Monitoring period

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



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

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

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

8.3 Data Interpretation and Conclusion

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

Physico-Chemical Parameters:

- **pH:** The pH values of drinking water samples in Kandla were reported to be in the range of **6.24 to 8.5**, with an average pH of **7.5**. In Vadinar, its values ranged from **7.05 to 8.38**, with an average pH of **7.36**. Notably, the pH levels at both project sites fall within the acceptable range of 6.5 to 8.5, as specified under IS:10500:2012.
- **Colour:** The colour varies from 1 to 10 at the monitoring locations in Kandla. Locations DW-11, DW-14 and DW-10 showed the value of 10 Hazen at Kandla. At Vadinar, the color was observed within the range of 1 to 20 Hazen. the Colour levels at both project sites fall within the acceptable range of 1 to 15, as specified under IS:10500:2012, except of one location DW-20 within the monitoring period of April to May 2023
- **Electrical Conductivity (EC):** It is a measure of the ability of a solution to conduct electric current, and it is often used as an indicator of the concentration of dissolved solids in water. During the monitoring period, the EC values for samples collected in Kandla were observed to range from **12.83 to 7930 $\mu\text{S/cm}$** , with an average value of **708.65 $\mu\text{S/cm}$** . In Vadinar, the EC values showed variation from **30 to 1736 $\mu\text{S/cm}$** , with an average value of **503.14 $\mu\text{S/cm}$** . It's important to regularly monitor EC levels in drinking water as it can provide valuable information about water quality and presence of dissolved substances.
- **Salinity:** Salinity at Kandla varies from **0.02 to 4.39 PSU** with an average of **0.396 PSU**, while at Vadinar, salinity was observed within the range of **0.02 to 0.87 PSU**.
- **Turbidity:** The Turbidity values of drinking water samples in Kandla were reported to be in the range of **0.5 to 13.9 NTU**, with an average of **2.32**. In Vadinar, its values ranged from **0 to 5.3**, with an average **2.21**. Notably, the Turbidity levels at both project sites fall within the acceptable range of 1 to 5 NTU, as specified under IS:10500:2012, except DW-7, in the monitoring period of July to August 2023, DW-13 in the monitoring period of May to June 2023 and DW-14 in the monitoring period of September to October and October to November 2023. On all this location most of the time Turbidity observed Below Quantification Limit
- **Chlorides:** The chloride concentrations in Kandla varied from **3 to 689.78 mg/L**, with an average value of **116.85 mg/L**. At Vadinar the chloride concentration was observed within the range of **9 mg/L to 407.37 mg/L**, with an average value of **99.45 mg/L**. Thus, the chloride levels at both project sites fall within the Permissible limit of 1000 mg/L, as specified under IS:10500:2012.
- **Total Hardness (TH):** The concentration of Total Hardness varies from **1.5 to 480 mg/L**, with an average concentration of **88.68 mg/L**. While at Vadinar, the observed values were within range of **2 to 240 mg/L**. at both study areas Total Hardness found

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

- **Total Dissolved Solids (TDS):** Monitoring TDS is crucial because it provides an indication of overall quality of the water. During the monitoring period, the TDS concentrations in Kandla were observed to vary in a wide range i.e., between 8 to **1522** mg/L, with an average concentration of **264.4** mg/L. which is within the permissible limit. while in Vadinar, it ranged from 6 to **882** mg/L, with an average of **255.75** mg/L. It is important to note that the TDS concentrations in both Kandla and Vadinar fall well within the Permissible limit of 2000 mg/L.
- **Fluoride:** The concentration Fluoride varies from 0 to **1.477** mg/L, with an average concentration of **0.44** mg/L. While at Vadinar Fluoride concentration was varies within range of 0 to **1.06** mg/L, with an average concentration of **0.708** mg/L. The Fluoride concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Fluoride found to be within the Permissible limit norm of 1.5 mg/L as specified by IS:10500:2012
- **Sulphate:** The concentration Sulphate varies from 0 to **141.99** mg/L, with an average concentration of **45.67** mg/L. While at Vadinar Sulphate concentration was varies within range of **13.07** to **102.92** mg/L, with an average concentration of **43.94** mg/L. During monitoring period in Kandla and Vadinar, the sulphate concentrations were found to be within the acceptable limits i.e., 200 mg/L as per the specified norms.
- **Nitrate:** The concentration Nitrate varies from 0 to **25.96** mg/L, with an average concentration of **4.08** mg/L. While at Vadinar Nitrate concentration was varies within range of 0 to **18.54** mg/L, with an average concentration of **8.20** mg/L. The Nitrate concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Nitrate found to be within the Acceptable limit norm of 45 mg/L as specified by IS: 10500:2012.
- **Nitrite:** The concentration Nitrite varies from 0 to **0.2** mg/L. While at Vadinar Nitrite concentration was varies within range of 0 to **1.89** mg/L, with an average concentration of **0.945** mg/L. The Nitrite concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar.
- **Sodium:** During the monitoring period, at Kandla variation in the concentration of Sodium was observed to be in the range of **5.01** to **396.2** mg/L, with the average concentration of **63.71** mg/L. While at Vadinar, the concentration recorded between **6.08** to **204.4** mg/L, with the average concentration of **57.067** mg/L.
- **Odour:** Odour values recorded 1 TON at all monitoring locations of Kandla and Vadinar.

Metals:

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

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

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

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

8.4 Remedial Measures

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

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

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



CHAPTER 9: SEWAGE TREATMENT PLANT MONITORING

9.1 Sewage Treatment Plant (STP) Monitoring:

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

Frequency of monitoring: weekly

Table 22A: Details of the monitoring locations of STP

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

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

Table 23Bs: Discharge norms (as per CC&A of Kandla STP)

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

The detailed process flow diagram of the Kandla and Gopalpuri STP have been mentioned in **Figure 3 and 4** as follows:

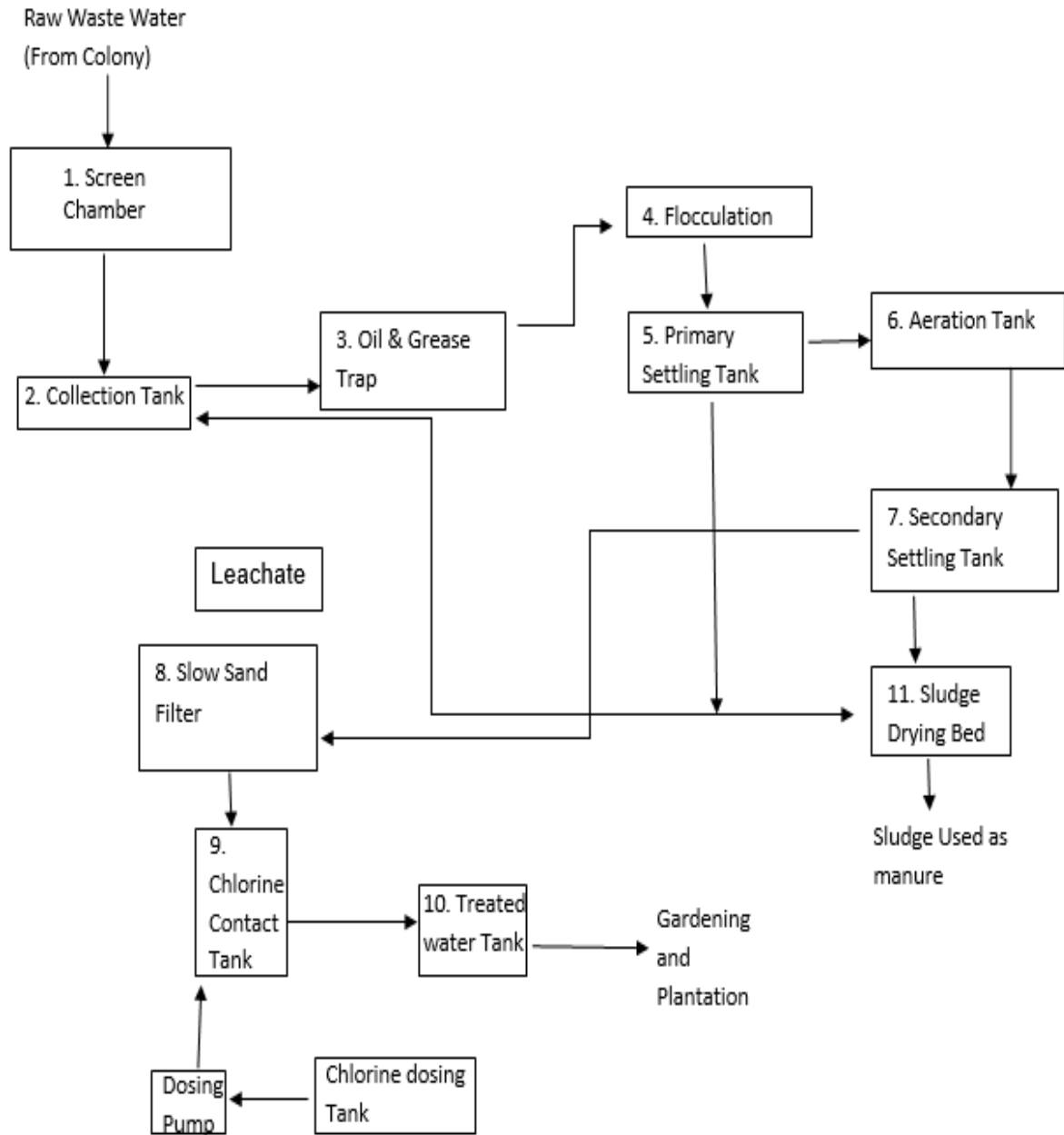


Figure 3: Process flow diagram of STP at Kandla

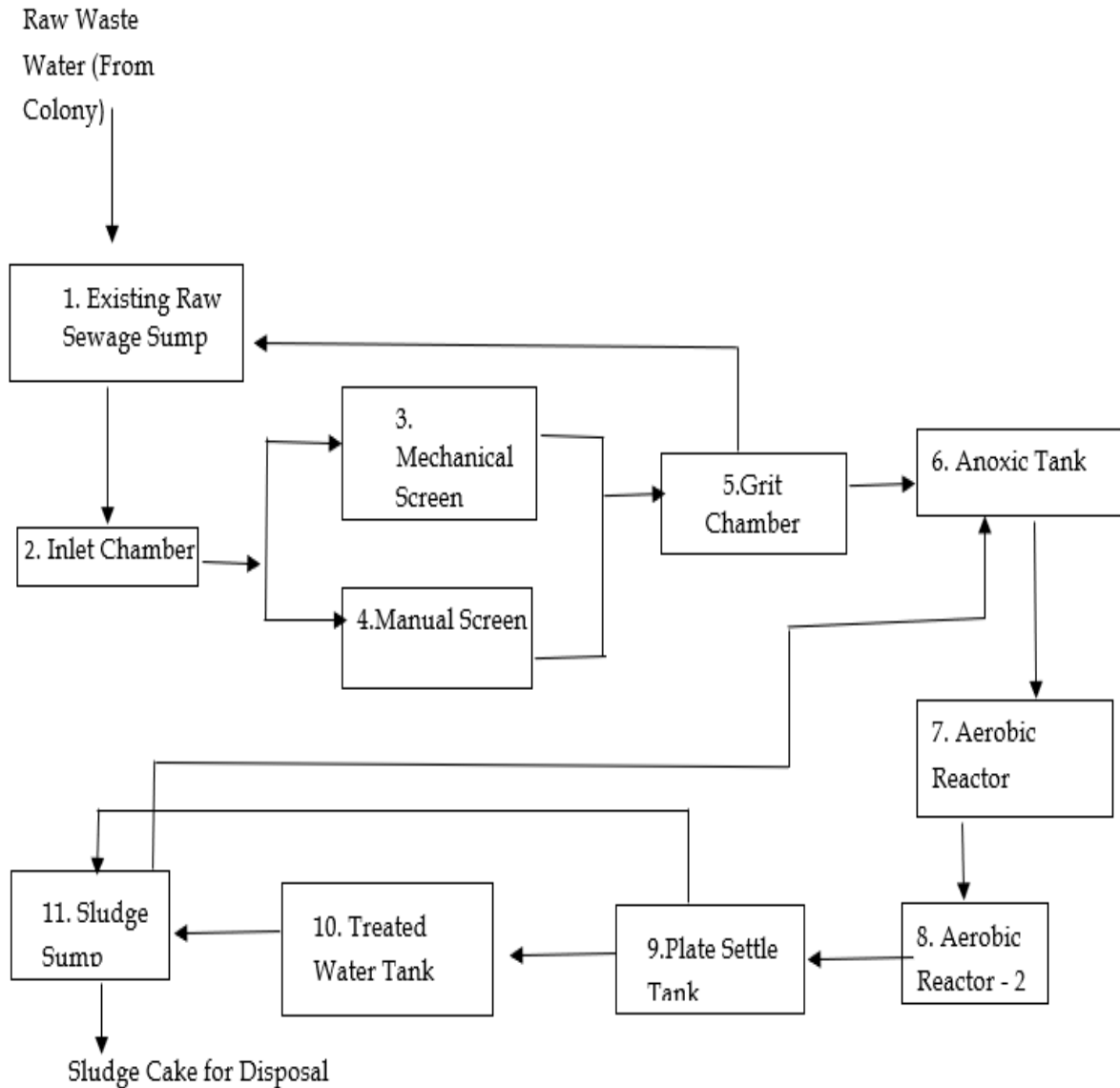


Figure 4: Process flow diagram of STP at Gopalpuri, Kandla

STP at Vadinar

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

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

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

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

The detailed process flow diagram of the Vadinar STP have been mentioned in **Figure 5** as follows:

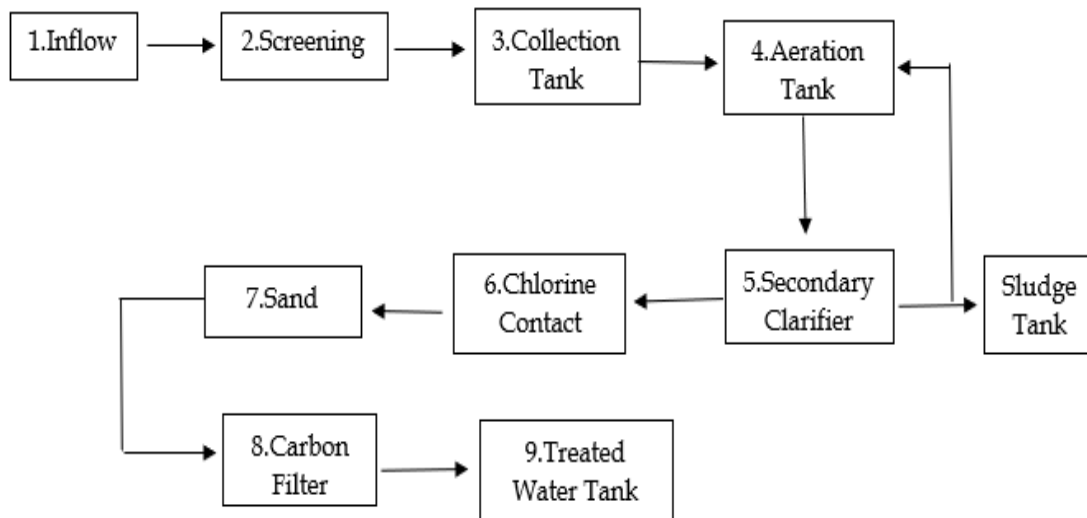
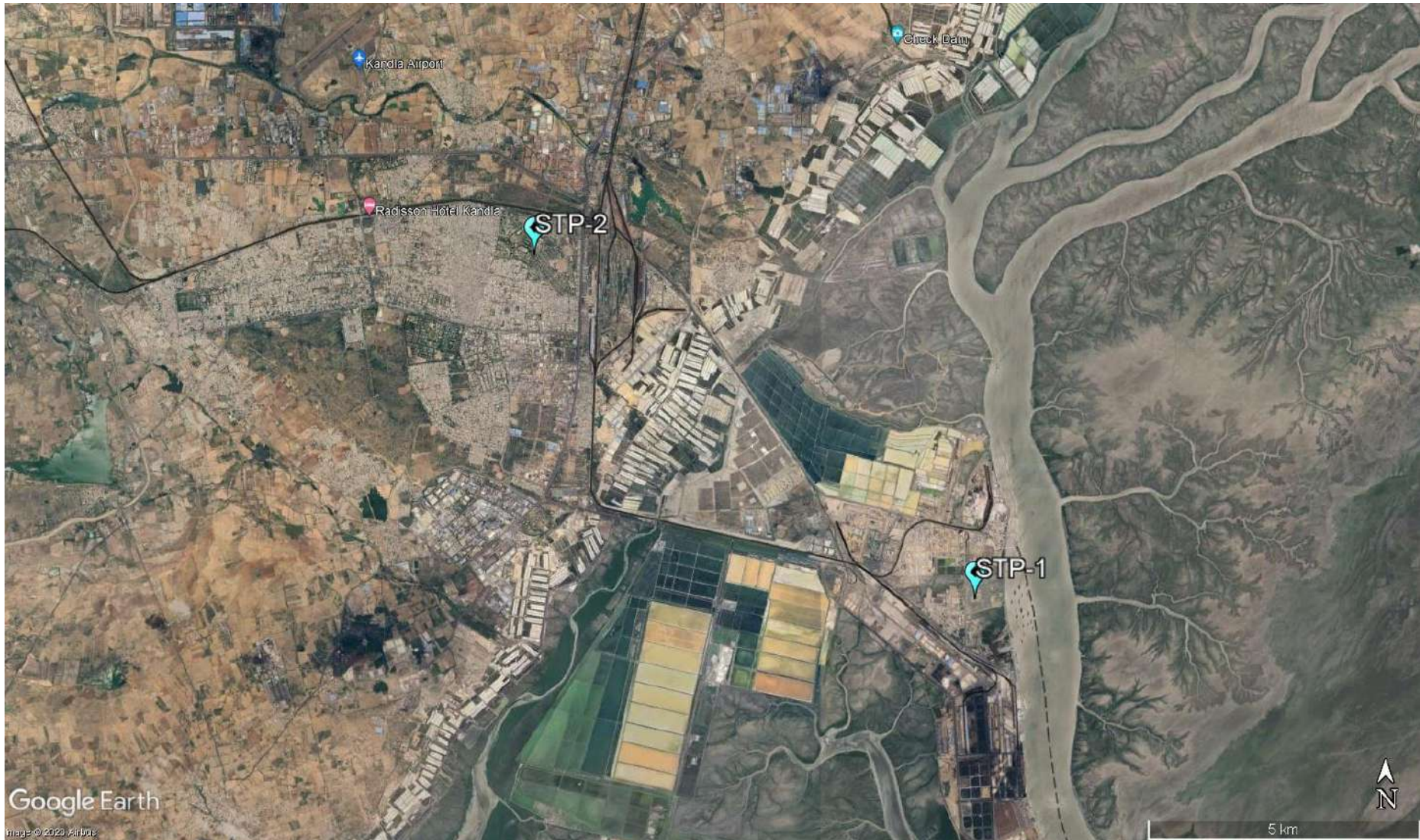
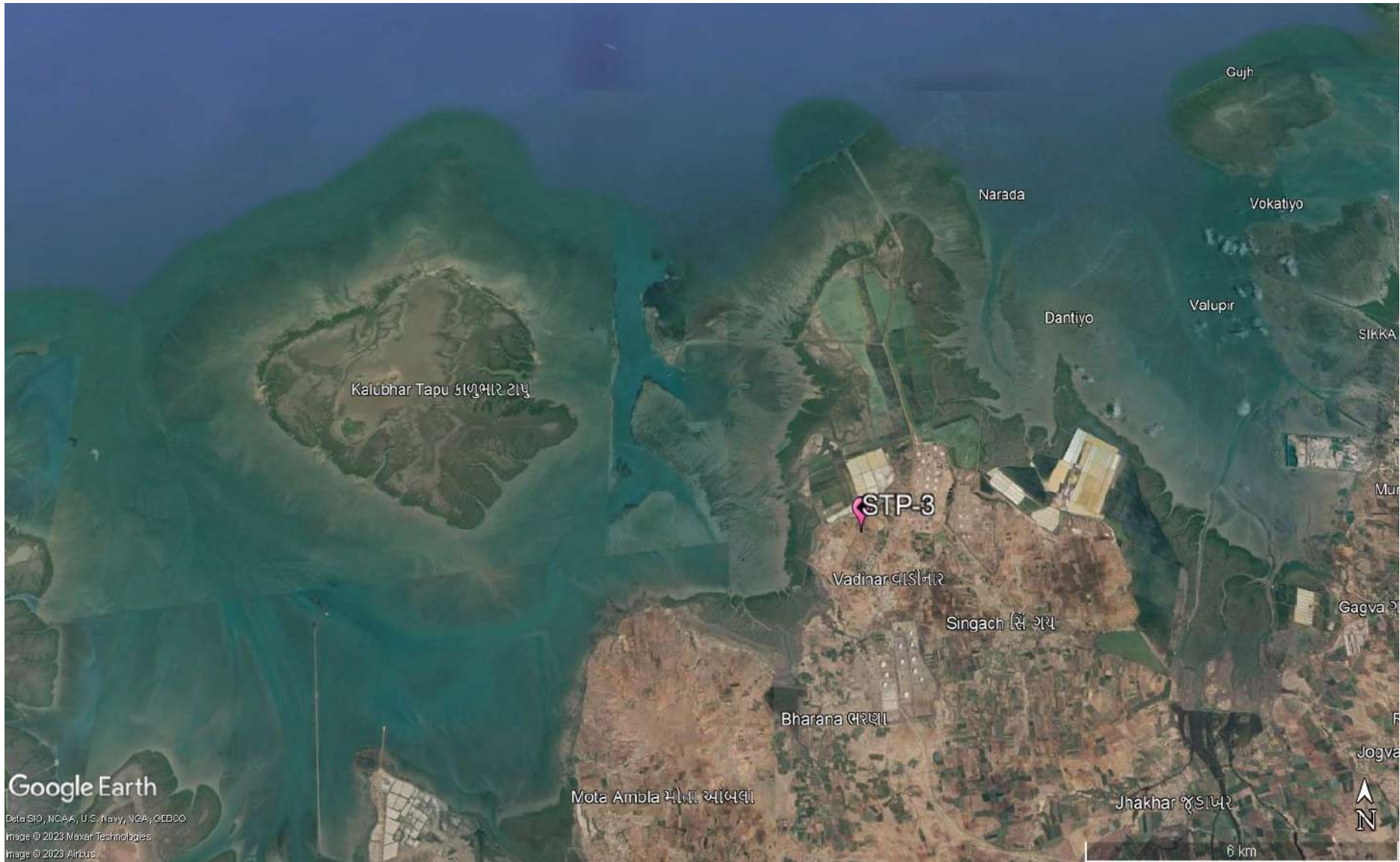


Figure 5: Process flowchart for the STP at Vadinar

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



Map 14: STP Monitoring Locations at Kandla



Map 15: STP Monitoring Locations at Vadinar

Methodology

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

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

Monitoring Frequency

Monitoring is required to be carried out once a week for monitoring location of Kandla and Vadinar i.e., two STP station at Kandla and one STP station at Vadinar. Sample Collected from this location during the monitoring period 15th April 2023 to 15th April 2024.

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

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

9.2 Result and Discussion

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

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

Sr No.	Parameter	Units	Kandla							Vadinar			
			GPCB Norms (Kandla)	STP-1			STP-2			GPCB Norms (Vadinar)	STP-3		
				Inlet	Outlet		Inlet	Outlet			Inlet	Outlet	
					Avg	Avg		Max	Avg			Avg	Max
1.	pH	-	6.5-8.5	7.17	7.302	7.65	6.99	7.48	8.88	5.5-9	7.19	7.41	8.46
2.	TDS	mg/L	-	3065.7	2069.28	6228	1099.40	1003.3	1814	-	471.61	402.67	482
3.	TSS	mg/L	100	183.4	20.97	88	115.17	16.45	46	20	38.78	8.42	36
4.	COD	mg/L	-	184.7	32.57	133.1	213.54	25.98	88.4	50	138.27	16.18	40.2
5.	DO	mg/L	-	145.91	37.780	277.09	162.29	21.98	76.92	-	115.12	18.69	54.5
6.	BOD	mg/L	30	56.82	11.937	52.4	61.75	8.40	18.45	10	44.62	6.053	11
7.	SAR	meq/L	-	12.06	9.318	21.04	5.75	5.43	13.1	-	2.71	2.12	3.2
8.	Total Coliforms	MPN/100ml	<1000	1565.95	1530.66	1600	1537.02	1500.51	1600	100-230	1551	1492.3	1600

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

9.3 Data Interpretation and Conclusion

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

- The average pH at the inlet of STP-1, STP-2, and STP-3 is, respectively, **7.17, 6.99, and 7.19**. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum pH of **7.65, 8.88, and 8.46** and an average pH of **7.302, 7.48, and 7.41**, respectively. Which conform to their respective stipulated norms of 6.5–8.5 at Kandla and 5.5–9 at Vadinar, respectively.
- The average TDS concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **3065.8, 1099.4, and 471.33** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TDS concentration of **6228, 1814, and 482** mg/L, and an average TDS concentration of **2069.3, 1003.3, and 402.67** mg/L, respectively.
- The average TSS at the inlet of STP-1, STP-2, and STP-3 is respectively **183.43, 115.17, and 38.78** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TSS of **88, 46, and 36** mg/L, and an average TSS of **20.974, 16.452, and 8.41** mg/L, respectively. Which conform to their respective stipulated norms of 100 mg/L at Kandla and 20 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average COD at the inlet of STP-1, STP-2, and STP-3 is respectively **184.7, 213.54, and 138.27** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had maximum COD concentrations of **133.1, 88.4, and 40.2** mg/L, and average COD concentrations of **32.576, 25.97, and 16.18** mg/L, respectively. There are no discharge norms for the COD parameter in STP-1 and STP-2 at Kandla, and they conform to their respective stipulated norms of 50 mg/L at Vadinar as mentioned in their respective CCA.
- The average DO concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **145.91, 162.29, and 115.12** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum DO concentration of **277.09, 76.92, and 54.5** mg/L, and an average DO concentration of **37.78, 21.98, and 18.68**, mg/L respectively.
- The average BOD at the inlet of STP-1, STP-2, and STP-3 is respectively **56.82, 61.76, and 44.62** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum BOD of **52.4, 18.45, and 11** mg/L, and an average BOD of **11.93, 8.40, and 6.05** mg/L, respectively. Which conform to their respective stipulated norms of 30 mg/L at Kandla and 10 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average SAR concentrations at the inlet of STP-1, STP-2 and STP-3 are respectively **12.068, 5.75 and 2.71** meq/L. After treatment, the treated effluent from

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

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

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

9.4 Remedial Measures:

- The quantum of raw sewage (influent) entering the STP should be monitored by installation of the flow meter. If the quantity of the sewage exceeds the treatment capacity of the treatment plant, then provision of additional capacity of collection sump should be provided.
- The adequacy and efficacy of the stages of Sewage treatment units shall be conducted.
- The results show the presence of total coliforms; hence the method of disinfection (Chlorination) sodium or calcium Hypochlorite can be used.
- Effectiveness of any technology depends on factors such as the specific pollutants in the wastewater, plant size, local regulations, and available resources. There are several processes that may be implemented such as - Advanced oxidation process involve using strong oxidants to break down complex organic compounds. Methods like Fenton's reagent (hydrogen peroxide and iron catalyst) and UV/H₂O₂ treatment can help in reducing COD through oxidation.
- Electrochemical processes like Electrocoagulation (EC) and Electrooxidation (EO) that involve the application of an electric current to facilitate the removal of pollutants through coagulation, flocculation, and oxidation. These methods can be useful for treating sewage containing various pollutants.



CHAPTER 10: MARINE WATER QUALITY MONITORING

10.1 Marine Water

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

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

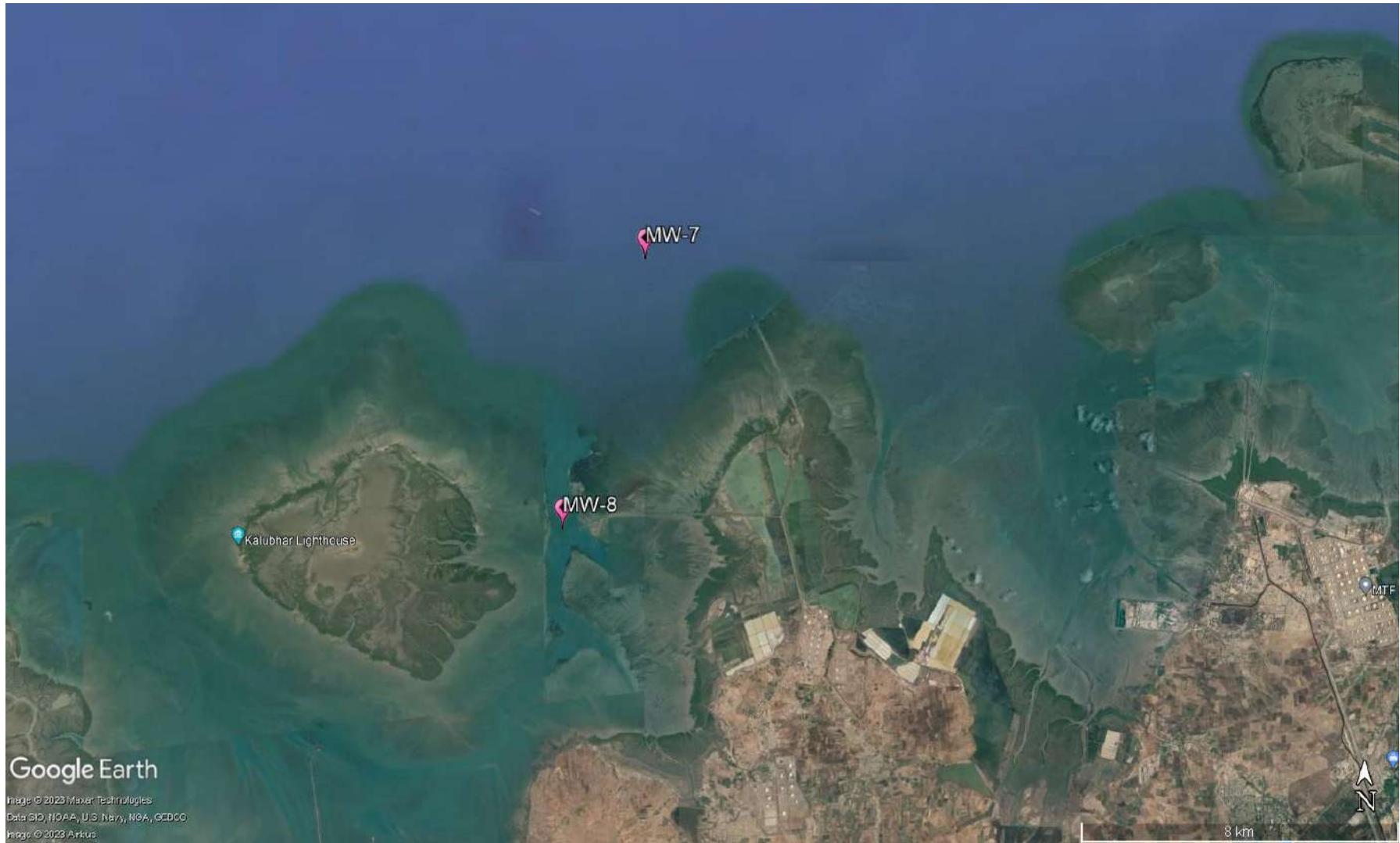
Table 27: Details of the sampling locations for Marine water

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

The map depicting the locations of Marine Water to be sampled and analysed for Kandla and Vadinar have been mentioned in **Map 16 and 17** as follows:



Map 16: Marine Water Monitoring Locations at Kandla



Map 17: Marine Water Monitoring Locations at Vadinar

Methodology

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

Monitoring Frequency

As defined in the scope by DPA, the sampling and analysis of Marine Water has to be carried out once in a month at the eight locations (i.e., six at Kandla and two at Vadinar). For the period 15th April 2023 to 15th April 2024.

Table 28: List of parameters monitored for Marine Water

Sr. No	Parameters	Units	Reference method	Instrument
1.	Electrical Conductivity	µS/cm	APHA, 23 rd Edition (Section-2510 B):2017	Conductivity Meter
2.	Dissolved Oxygen (DO)	mg/L	APHA, 23 rd Edition, 4500 O C, 2017	Titration Apparatus
3.	pH	-	APHA, 23 rd Edition (Section-4500-H+B):2017	pH meter
4.	Color	Hazen	APHA, 23 rd Edition, 2120 B: 2017	Color comparator
5.	Odour	-	IS 3025 Part 5: 2018	Heating mantle & odour bottle
6.	Turbidity	NTU	IS 3025 Part 10: 1984	Nephlo Turbidity Meter
7.	Total Dissolved Solids (TDS)	mg/L	APHA, 23 rd Edition (Section-2540 C):2017	Vaccum Pump with Filtration Assembly and Oven
8.	Total Suspended Solids (TSS)	mg/L	APHA, 23 rd Edition, 2540 D: 2017	
9.	Particulate Organic Carbon	mg/L	APHA, 23 rd Edition, 2540 D and E	TOC analyser
10.	Chemical Oxygen Demand (COD)	mg/L	IS-3025, Part- 58: 2006	Titration Apparatus plus Digester
11.	Biochemical Oxygen Demand (BOD)	mg/L	IS-3025, Part 44,1993,	BOD Incubator plus Titration apparatus
12.	Silica	mg/L	APHA, 23 rd Edition, 4500 C, 2017	UV- Visible Spectrophotometer
13.	Phosphate	mg/L	APHA, 23 rd Edition, 4500 P-D: 2017	
14.	Sulphate	mg/L	APHA, 23 rd Edition, 4500 SO4-2 E: 2017	
15.	Nitrate	mg/L	APHA, 23 rd Edition, 4500 NO3-B: 2017	
16.	Nitrite	mg/L	APHA, 23 rd Edition, 4500 NO2- B: 2017	
17.	Sodium	mg/L	APHA, 23 rd Edition, 3500 Na-B: 2017	Flame photometer

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

10.2 Result and Discussion

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



Table 29: Results of Analysis of Marine Water Sample for the sampling period

Parameters	Primary Water Quality Criteria for Class SW-IV Waters	Kandla																		Vadinar					
		MW-1			MW-2			MW-3			MW-4			MW-5			MW-6			MW-7			MW-8		
		Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Density (kg/m ³)	-	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
pH	6.5-9.0	6.12	8.32	7.89	7.04	8.36	7.99	7.83	8.33	8.11	7.69	8.31	8.05	7.19	8.48	8.03	6.01	8.31	7.94	7.98	8.2	8.11	7.07	8.22	8.06
Colour (Hazen)	No Noticeable	1	10	5.41	1	20	7.83	1	15	7.16	5	20	9	5	15	7.41	5	20	8.27	1	10	5.66	1	10	5.08
EC (µS/cm)	-	49700	63600	54282.5	49800	61700	54490.91	50200	60600	53767.75	50400	75300	55689.91	50100	65100	55115.58	15950	61528	50873.17	52200	56900	54239.2	52.119	57500	50312.6
Turbidity (NTU)	-	56.4	310	188.26	33.9	314	206.76	61.8	317	203.81	69	300	216.66	94.5	379	202.5	70.1	346	209.23	3.15	12.5	5.36	3.42	13.8	6.39
TDS (mg/L)	-	24800	44466	36356.3	24900	41922	36679.5	25100	41624	35690.92	25200	64721	38189.5	25000	47159	36938.58	9970	41436	32927.91	25784	38620	35400.16	26882	41790	35965.75
TSS (mg/L)	-	44	436	342.42	26	563	374.58	52	478	340.75	58	924	402.33	80	682	427.66	58	852	387.72	78	341	255.08	151	346	282.33
COD (mg/L)	-	29.2	79.37	49.62	11.98	79.37	47.81	25.41	81	47.68	22.65	81	52.12	31.56	79.37	53.76	22.97	88.8	49.34	21.28	75	50.98	17.92	75	47.63
DO (mg/L)	3.0 mg/L	4.7	6.4	5.76	5.3	6.4	6.07	4.5	6.7	5.87	3.4	6.5	5.85	5	6.6	6.07	5.6	8.4	6.49	4.3	7.6	6.25	4.4	7.9	6.48
BOD (mg/L)	5.0 mg/L	5.24	8.54	7.56	8.4	8.9	8.57	3.74	8.45	6.81	5	8.78	7.755	9.32	9.87	9.57	3.6	11.1	8.64	3.91	7.5	6.51	4.2	7.16	6.16
Oil & Grease (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphate (mg/L)	-	2056	2937.5	2529.7	2156.32	2897.7	2544.18	2083.7	2925.2	2530.85	2239	3704.9	2879.88	2334.9	2916.8	2652.42	632.62	3612.8	2561.07	1846.3	3225.8	2472.195	2039.9	3236.8	2664.27
Nitrate (mg/L)	-	1.89	5.40	4.28	1.12	5.16	3.75	3.21	5.68	4.17	3.41	5.85	4.64	3.17	6.92	4.21	3.06	6.84	4.06	2.225	5.17	3.56	1.759	5.1	3.39
Nitrite (mg/L)	-	0.12	0.12	0.12	0	0	0	0	0	0	0	0	0	0.11	0.11	0.11	0.13	0.16	0.14	0	0	0	0	0	0!
Phosphate (mg/L)	-	0.25	1.59	0.82	0.09	1.34	0.69	0.57	1.46	0.96	0.61	2.01	0.92	0.29	1.34	0.76	0.54	1.61	0.81	0.64	0.94	0.79	1.43	1.43	1.43
Silica (mg/L)	-	0.29	3.24	2.12	0.22	4.04	2.24	0.2	3.73	2.19	1.12	3.69	2.54	1.26	4	2.64	0.33	3.74	1.92	0.11	0.96	0.56	0.09	1.86	0.76
Sodium (mg/L)	-	7686	10625	9475.57	7811	10341	9242.42	7763	10308	9347.33	9101	10323	9724.14	8789	10278	9403.67	2086	10722	8042.71	2149.6	9485	6743.97	2349.4	9542	7244.66
Potassium (mg/L)	-	68.35	451.9	318.57	69.27	446.5	303.94	68.57	421	290.60	71.73	543.96	342.71	69.63	423.34	324.92	68.34	442.63	272.9	10.86	421.7	259.6	76.31	518	327.43
Hexavalent Chromium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	321	321	321	333	333	333
Odour	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	-	5.13	5.13	5.13	5.25	5.25	5.25	5.4	5.4	5.4	0	0	0	0	0	0	9.44	12.94	11.19	0.11	1	0.41	0.08	1	0.38
Cadmium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper (mg/L)	-	5.1	6.99	5.8175	0.006	10.9	5.79	0.005	7.7	3.85	5.34	12.01	8.224	0.0067	7.6	5.13	8.07	10.2	9.49	3.4	3.4	3.4	0	0	0
Iron (mg/L)	-	0.69	4.11	1.38	0.21	4.07	1.76	0.37	3.92	1.79	1.02	7.93	2.49	0.98	5.45	2.09	0.43	5.3	2.005	0.01	0.25	0.145	0.08	0.66	0.21
Lead (mg/L)	-	0.002	3.44	2.067	0.0029	3.44	2.29	0.0026	3.06	1.98	0.002	9.68	4.32	0.002	4.65	2.39	0.0029	3.65	2.47	0.0023	2.26	1.035	0.002	2.75	0.96
Manganese (mg/L)	-	0.082	129.91	71.47	0.12	159.78	83.88	0.1085	125.66	74.0	0.096	294.91	93.56	0.074	213.14	74.7	0.11	156.41	80.27	2.39	113.93	39.62	1.97	98.8	34.64
Total Chromium (mg/L)	-	0	0	0	5.62	7.8	6.71	5.67	5.67	5.67	5.14	15.99	12.28	5.11	9.65	7.207	0	0	0	0	0	0	45.75	45.75	45.75
Zinc (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Particulate Organic	-	0.51	900	76.22	0.51	35	3.98	0.42	10	1.94	0.58	55	6.03	0.92	30	3.89	0.85	44	5.01	0.47	4.67	1.62	0.32	4.76	1.51



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

10.3 Data Interpretation and Conclusion

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

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

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

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

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

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

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



CHAPTER 11: MARINE SEDIMENT QUALITY MONITORING

11.1 Marine Sediment Monitoring

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

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

Methodology

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

Table 30: Details of the sampling locations for Marine Sediment

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

The map depicting the locations of Marine Sediment sampling at Kandla and Vadinar have been mentioned in **Map 18 and 19** as follows:



Map 18: Marine Sediment Monitoring Location at Kandla



Map 19: Marine Sediment Monitoring Locations at Vadinar

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

Table 31: List of parameters to be monitored for Sediments at Kandla and Vadinar

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

11.2 Result and Discussion

The quality of Marine Sediment samples collected from the locations of Kandla and Vadinar during the monitoring period of April 2023 to April 2024 has been summarized in the **Table 34**.



Table 32: Summarized result of Marine Sediment Quality

Parameters	Kandla																		Vadinar					
	MS-1			MS-2			MS-3			MS-4			MS-5			MS-6			MS-7			MS-8		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Inorganic Phosphate (kg/ha)	16.85	0.86	6.6042	14.37	0.67	8.81	41.2	0.8	16.98	19.44	0.81	9.532	45.1	0.72	14.48	34.6	0.66	15.24	14.5	1.24	5.65	18.51	0.82	5.7325
Phosphate (mg/Kg)	3247.8	290.8	1280.63	2514.7	258.3	1304	3736	226.6	1515	3871	353.7	1287	3741	306.8	1442	14076	578.3	2793.9	3002	152.5	770.24	3477.29	167.93	940.70
Organic Matter (%)	1.42	0.21	0.7875	2.17	0.29	1.13	1.01	0.17	0.593	2.1	0.33	0.975	1.24	0.67	0.911	2.06	0.21	0.915	2.29	0.15	1.04	1.65	0.17	0.89
Sulphate as SO⁴⁻ (mg/Kg)	905.25	110.2	366.8	1022.25	98.2	370.03	571.64	95.33	275.09	650.25	97.45	268.51	768	87.28	294.27	732	96.38	249.1	296	74.07	126.31	213.4	80.06	132.03
Calcium as Ca (mg/Kg)	13800	1612	3464.3	5800	1259	2836	4200	962	2163	4200	1102	2669	10500	1089	3102	3800	1047	2274.6	3700	2200	2930.9	3974.2	2100	2805.45
Magnesium as Mg (mg/Kg)	1952	1225	1538.53	3050	826.46	1810.84	2136	764	1592.59	3172	866.94	1810.6	2440	1032	1622.80	2745	906.98	1581.95	1952	854	1385.18	14640	1167	2920.83
Silica (g/Kg)	671.25	261.3	479.11	612.51	289.4	481.7	571.5	329.1	444.8	555.2	245.7	392.1	597.1	179.2	418.6	580.4	245.3	436.12	529.8	220.9	377.71	546.08	264.92	426.66
Nitrite (mg/Kg)	0.75	0.12	0.41	0.92	0.13	0.50	0.81	0.08	0.41	0.91	0.01	0.43	0.71	0.11	0.375	0.89	0.07	0.489	0.22	0.07	0.159	0.37	0.04	0.23
Nitrate (mg/Kg)	22.34	5.86	16.58	37.12	7.59	18.29	36.47	4.51	15.50	25.94	4.31	13.99	10.34	5.24	13.17	20.38	6.34	14.52	25.33	9.54	15.36	25.21	4.75	10.52
Sodium (mg/Kg)	7860	3194	4512.43	14688	2453	5318	8612	2072	4550	18308	2612	6435	10520	2063	4665	14076	2072	5639.6	11944	3971	7904.6	13660	2719.42	9536.63
Potassium (mg/Kg)	2610.7	241	1525.98	11580	276	2320	3479	260.7	2126	4208	294	2424	3152	205	1790	3479	236.9	2233.4	3372	699	1876.1	4377	1028	2025.66
Aluminium (mg/Kg)	8371.7	2116	3827.74	10641	1237.1	4465.9	10363.1	1278.5	4370.2	12008.4	1971.2	5025.2	10361.1	1264.58	3891.23	12314.1	1273.22	4384.20	14179.7	358.3	4028.56	19356.55	479.16	4883.52
Mercury (mg/Kg)	4.71	4.71	4.71	10.74	10.74	10.74	41.29	41.29	41.29	6.44	6.44	6.44	15.21	15.21	15.21	34.69	34.69	34.69	0	0	0	0	0	0
Texture	Sandy loam	Sand y loam	Silt loam	Sandy loam	Silt loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sand y loam	Sandy loam	Sand y loam	Sand y loam	Sandy loam	Loam	Loam	Loam

11.3 Data Interpretation and Conclusion

The Marine sediment quality at Kandla and Vadinar has been monitored for various physico-chemical parameters during the monitoring April 2023 to April 2024. The detailed interpretation of the parameters is given below:

- **Inorganic Phosphate** for the sampling period was observed in range of **0.66 to 45.12** Kg/ha for Kandla. Whereas for Vadinar the value observed Within range of **0.82 to 18.51** Kg/ha. For Kandla and Vadinar the average value of Inorganic Phosphate was observed **13.77** and **7.74** Kg/ha respectively.
- The concentration of **Phosphate** was observed in range of **226.6 to 3871.15 mg/Kg** for Kandla and for Vadinar the value observed within the range of **152.53 to 3477.29** mg/Kg. For Kandla and Vadinar the average concentration of Phosphate was observed **1616.78** and **1418.5** mg/Kg respectively.
- The **Organic Matter** for the sampling period was observed in the range of **0.17 to 2.17** % for Kandla with the average value of **0.95%** and for Vadinar the value recorded Within range of **0.15 to 2.29%**, with average concentration as **1.03** %.
- The concentration of **Sulphate** was observed in the range of **87.28 to 1022 mg/Kg** for Kandla and for Vadinar the value observed Within range of **74.07 to 296** mg/Kg. For Kandla and Vadinar the average value of Sulphate was observed **392.10** and **153.64** mg/Kg respectively.
- The value of **Calcium** was observed in the range of **962 to 13800 mg/Kg** for Kandla and for Vadinar the value observed within the range of **2100 to 3974.5** mg/Kg. The average value of Calcium for the monitoring period was observed **3660.21** mg/Kg and **2951.76** mg/Kg at Kandla and Vadinar, respectively.
- The value of **Magnesium** for the sampling period was observed in the range of **764 to 3172 mg/Kg** for Kandla and for Vadinar the value observed Within the range of **854 to 1952** mg/Kg. For Kandla and Vadinar the average value of Magnesium was observed **1726.35** mg/Kg and **1440.69** mg/Kg respectively.
- For the sampling period **Silica** was observed in the range of **179.25 to 671.25 mg/Kg** for Kandla with average value **432.83** mg/Kg and for Vadinar the value observed within the range of **220.98** and **546.5** mg/Kg with average **394.35** mg/Kg.
- The value of **Nitrate** was observed in the range of **4.31 to 37.12 mg/Kg** for Kandla with average value **15.47** mg/Kg and for Vadinar the value observed within the range of **4.75 to 25.33** mg/Kg. with average **15.12** mg/Kg.
- The value of **Nitrite** was observed in the range of **0.01 to 0.92 mg/Kg** for Kandla with average value **0.45** mg/Kg and for Vadinar the value observed to be within the range of **0.04 to 0.37** mg/Kg, with average **0.1828** mg/Kg.
- The value of **Sodium** was observed in the range of **2063.3 to 18308 mg/Kg** for Kandla with average value **6647.43** mg/Kg and for Vadinar the value observed within the range of **2719.42** and **13660** mg/Kg, with average **8289** mg/Kg.
- The value of **Potassium** was observed in the range of **205.08 to 11580 mg/Kg** for Kandla with average value **2357.95** mg/Kg and for Vadinar the value observed within range of **699.09 to 4377** mg/Kg, with average **2229.65** mg/Kg.

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

Heavy Metals

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

Table 33: Standard Guidelines applicable for heavy metals in sediments

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

ND = Not Detected

(Source: G Perin et al. 1997)

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

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

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

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

Analysis of the sediments indicates moderate pollution. However, it may be noted that, the sediments are highly dynamic being constantly deposited and carried away by water currents. Hence maintaining the quality of sediments is necessary as it plays a significant role in regulating the quality of the marine water and the marine ecology.

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



CHAPTER 12: MARINE ECOLOGY MONITORING

12.1 Marine Ecological Monitoring

The monitoring of the biological and ecological parameters is important in order to assess the marine environment. A marine sampling is an estimation of the body of information in the population. The theory of the sampling design is depending upon the underlying frequency distribution of the population of interest. The requirement for useful water sampling is to collect a representative sample of suitable volume from the specified depth and retain it free from contamination during retrieval. Deendayal Port and its surroundings have mangroves, mudflats and creek systems as major ecological entities.

As defined in the scope by DPA, the Marine Ecological Monitoring is required to be carried out once a month specifically at eight locations, six at Kandla and two at Vadinar. The sampling of the Benthic Invertebrates has been carried out with the help of D-frame nets, whereas the sampling of zooplankton and phytoplankton has been carried out with the help of Plankton Nets (60 micron and 20 micron). The details of the locations of Marine Ecological Monitoring have been mentioned in **Table 37** as follows:

Table 35: Details of the sampling locations for Marine Ecological

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

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



Map 20 Marine Ecological Monitoring: Locations at Kandla



Map 21: Marine Ecological Monitoring Locations at Vadinar

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

Table 36: List of parameters to be monitored for Marine Ecological Monitoring

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

Methodology

- **Processing for chlorophyll estimation:**

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

- **Phytoplankton Estimation**

Phytoplankton are free floating unicellular, filamentous and colonial eutrophic organisms that grow in aquatic environments whose movement is more or less dependent upon water currents. These micro flora acts as primary producers as well as the basis of food chain, source of protein, bio-purifier and bio-indicators of the aquatic ecosystems of which diverse array of the life depends. They are considered as an important component of aquatic flora, play a key role in maintaining equilibrium between abiotic and biotic components of aquatic ecosystem. The phytoplankton includes a wide range of photosynthetic and phototrophic organisms. Marine phytoplankton is mostly microscopic and unicellular floating flora, which are the primary producers that support the pelagic food-chain. The two most prominent groups of phytoplankton are Diatoms (*Bacillariophyceae*) and Dinoflagellates (*Dinophyceae*). Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro

flagellates (naked flagellates) as well as Cyanophytes (Bluegreen algae). Algae are an ecologically important group in most aquatic ecosystems and have been an important component of biological monitoring programs. Algae are ideally suited for water quality assessment because they have rapid reproduction rates and very short life cycles, making them valuable indicators of short-term impacts. Aquatic populations are impacted by anthropogenic stress, resulting in a variety of alterations in the biological integrity of aquatic systems. Algae can serve as an indicator of the degree of deterioration of water quality, and many algal indicators have been used to assess environmental status.

- **Zooplankton Estimation**

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

- **Diversity Index**

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

1. **Shannon-Wiener's index:**

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

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

Where, \sum = Summation symbol,

p_i = Relative abundance of the species,

\ln = Natural logarithm

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

2. Simpson's index:

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

The formula for calculating D is presented as:

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

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

3. Margalef's diversity index:

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

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

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

Where, N = total number of individuals collected

S = No. of taxa or species or genera

4. Berger-Parker index:

This is a useful tool for tracking the biodiversity of deteriorated ecosystems. Environmental factors have a considerable impact on this index, which accounts for the

dominance of the most abundant species over the total abundance of all species in the assemblage. The preservation of their biodiversity and the identification of the fundamental elements influencing community patterns are thus critical for management and conservation. Successful colonising species will dominate the assemblage, causing the Berger-Parker index to rise, corresponding to well-documented successional processes. The environmental and ecological features of the system after disturbance may therefore simply but significantly determine the identity of the opportunistic and colonising species through niche selection processes.

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

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

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

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

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

5. Evenness index-

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

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

Where, H= Shannon value

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

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

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

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

Monitoring Frequency:

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

12.2 Result and Discussion

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

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

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

- **Biomass:**

With reference to the **Table 39**, the concentration of average **Biomass** reported during monitoring period, from location ME- to ME-6 in range between **95.73-141.73 mg/L** where lowest biomass presents in ME-3 (Near Coal Berth) and highest biomass present in ME-4 (Khorri Creek) during sampling period. In Vadinar, the value of biomass was observed **78 mg/L** at ME-7 (Near SPM) and **110.64 mg/L** in ME-8 (Near Vadinar Jetty) monitoring station.

- **Productivity (Net and Gross)**

Gross primary productivity (GPP) is the rate at which organic matter is synthesised by producers per unit area and time (GPP). The amount of carbon fixed during photosynthesis by all producers in an ecosystem is referred to as gross primary productivity. During the Monitoring Period, the monitoring location of Kandla reported

GPP value in range between **2.44 to 3.73 mg/L/48 Hr** where the highest value recorded for ME-3 (Near Coal Bearth) and lowest recorded at ME-5 (Nakti creek-near tuna port). In Vadinar, the value of **GPP** was observed **3.67** at ME-7 (Near SPM) and **3.09 mg/L/48 Hr** at ME-8 (Near Vadinar Jetty) monitoring station.

Net primary productivity, is the amount of fixed carbon that is not consumed by plants, and it is this remaining fixed carbon that is made available to various consumers in the ecosystem. During the monitoring period of 2023 to 2024 the Net primary productivity of the monitoring location at Kandla from (ME-1 to ME-6) has been estimated to be between **2.49 to 5.47 mg/L/48 Hr**. While in Vadinar, the value of **NPP** was observed **4.16** at ME-7 (Near SPM) and **2.64 mg/L/48 Hr** at ME-8 (Near Vadinar Jetty) monitoring station.

- **Pheophytin**

The level of Pheophytin was detected in the range from **0.8 to 5.81 mg/m³** where the highest value observed at ME-6 (Nakti Creek (Near NH-8A)) and the lowest value observed at ME-3(Near Coral Breth), While in Vadinar, the value of Pheophytin was observed **2.66 mg/m³** at ME-7 and **2.43 mg/m³** at ME-8 monitoring station.

- **Chlorophyll-a**

In the sub surface water, the value of Chlorophyll-a reported in range from **1.61 to 12.43 mg/m³**. The highest value observed at ME-6 (Nakti Creek (Near NH-8A)), while the lowest value observed at ME-2 (Kandla Creek). In Vadinar, the value of chlorophyll-a was observed **2.37 mg/m³** at ME-7 (Near SPM) and **3.24 mg/m³** in ME-8 (Near Vadinar Jetty) monitoring station.

- **Particulate Oxidisable Organic Carbon**

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

- **Secchi Depth**

In monitoring station of Kandla (ME-1 to ME-6) the level of Secchi Depth was observed between **0.56 to 0.63 ft** whereas at Vadinar, the value recorded at ME-7 i.e. Near SPM is **3.93 ft** and in Near Vadinar Jetty is **2.61 ft**.

Ecological Diversity

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

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

Table 38: Phytoplankton variations in abundance and diversity in sub surface sampling stations

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

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

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

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

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

Table 39: Species richness Index and Diversity Index in Phytoplankton

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

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

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

- The Average **Species Evenness** is observed in the range of **0.84 to 0.94** for all the six-monitoring station of Kandla and for the Vadinar the average species evenness is observed in the range of **0.73 to 0.90**.
- During the sampling period, average **Relative Abundance** of phytoplankton communities was in range of **0.37 to 0.44** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative Abundance value **0.40** at ME-7 and **0.41** at ME-8. thus it is concluded that the studied species can be stated as neither highly dominant nor rare.

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

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

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

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

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

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

Table 41: Species richness Index and Diversity Index in Zooplankton

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

- Shannon- Wiener’s Index (H):** During monitoring period 2023 to 2024, Average Shannon- Wiener’s index of zooplankton communities was in the range of **1.62 to 1.80** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener’s index of zooplankton communities recorded to be **1.71** at ME-7 and **1.69** at ME-8. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla and Near SPM (Vadinar).
- Simpson diversity index (1-D):** During the monitoring period **2023 to 2024**, average Simpson diversity index (1-D) of zooplankton communities was ranged between **0.82 to 0.84** at all sampling stations in the Kandla creek and nearby creeks, for Vadinar average Simpson diversity index (1-D) of zooplankton communities was **0.84** at ME-7 and **0.81** at ME-8.
- Margalef’s diversity index (Species Richness):** During the monitoring period **2023 to 2024**, average margalef’s diversity index of zooplankton communities in Kandla and nearby creeks sampling stations was varying from **2.06 to 2.34**, during the sampling period. While for Vadinar, average Margalef’s diversity index (Species Richness) of zooplankton communities observed **2.2** at ME-7 and **2.17** at ME-8.
- Berger-Parker Index (d):** During the monitoring period **2023 to 2024**, average Berger-Parker Index (d) of zooplankton communities was in the range of **0.32 to 0.37** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. Average Berger-Parker Index (d) of zooplankton communities in the sampling stations of Vadinar, was in the range of **0.31 to 0.35**. All the monitoring station signifies a low diversity with an even distribution among the different species.

- The average **Species Evenness** is observed in the range of **0.79 to 0.90** for all the six-monitoring station of Kandla whereas, for the Vadinar the average species evenness was observed in the range of **0.85 to 0.84**, during the monitoring period.
- During the sampling period, **average Relative Abundance** of zooplankton communities was in range of **31.95 to 40.08** between selected sampling stations from ME-1 to ME-6. at Kandla creek and nearby creeks. Whereas for Vadinar the average relative abundance value **39.18** at ME-7 and **37.27** at ME-8, thus it can be concluded that the studied species is stated as neither highly dominant nor rare.

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

Table 42: Benthic Fauna variations in abundance and diversity in sub surface sampling

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khor Creek)	ME-5 (Nakti Creek- near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
<i>Thiaridae</i>	2.20	1.40	2.00	2.00	1.5	2.17	1.25	2.67
<i>Mollusca sp.</i>	2.22	1.33	2.00	1.67	2.5	1.75	2.00	2.50
<i>Odonata sp.</i>	2.50	1.00	1.86	2.33	1.4	2.43	2.20	2.60
<i>Lymnidae</i>	1.67	2.67	5.00	1.75	1.6	1.67	2.40	1.33
<i>Planorbidae</i>	1.00	1.33	1.67	1.00	2.0	2.00	1.50	1.00
<i>Atydae</i>	1.50	2.00	1.50	1.67	1.0	1.60	1.67	1.71
<i>Gammaridae</i>	1.50	2.17	1.25	1.50	1.3	1.50	1.83	2.83
<i>Portunidae</i>	1.00	1.00	1.00	1.00	0	1.00	1.00	1.00
<i>Turbinidae</i>	1.67	1.00	2.33	1.00	1.0	1.33	1.50	1.33
<i>Palaemonidae</i>	1.25	1.00	2.20	2.50	2.4	1.00	1.33	1.67
<i>Diapatra sp.</i>	1.67	2.00	2.50	3.67	2.0	3.50	1.33	2.33
<i>Coleoptera sp.</i>	2.00	1.50	3.00	2.50	0	1.00	2.67	2.00
<i>Crustacea sp.</i>	3.00	1.00	2.33	3.00	2.5	2.50	1.50	1.00
<i>Hemiptera sp.</i>	2.33	3.33	0	2.00	1.7	1.50	2.50	1.50
<i>Tricoptera sp.</i>	1.33	4.00	2.33	4.00	2.5	4.50	1.50	1.00
<i>Hydrobidae</i>	1.00	2.50	1.00	2.00	1.0	2.50	0	2.50
<i>Viviparidae</i>	3.00	1.00	0	1.00	2.0	1.50	3.00	3.00
<i>Neridae</i>	1.50	1.00	1.50	0	4.0	2.00	1.00	2.00
Density-m³	10.18	8.82	9.64	10.09	8.5	9.73	9.73	9.55
No of genera	5.45	4.82	4.82	5.00	4.8	4.91	4.91	4.73

Few Benthic organisms were observed in the collected sample by using the Van-Veen grabs during the sampling conducted for DPA Kandla and Vadinar. Majority of the species were found under the Macro-benthic organisms during the sampling period were represented by *Atyde*, *Palaemonidae*, *Mollusca sp.*, etc. The average density of benthic fauna was varying from **8.55 to 10.18 m³**.

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

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

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

- Shannon- Wiener’s Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wiener’s index of benthic organism was in the range of **1.35 to 1.48** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener’s index of benthic organism recorded to be **1.29** at ME-7 and **1.35** at ME-8. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla and Vadinar.
- Simpson diversity index (1-D):** During the monitoring period **2023 to 2024**, average Simpson diversity index (1-D) of benthic organism was ranged between **0.84 to 0.86** at all sampling stations in the Kandla creek and nearby creeks, Similarly, for Vadinar average Simpson diversity index (1-D) of benthic organism was **0.87** at ME-7 and **0.83** at ME-8.
- Margalef’s diversity index (Species Richness):** During the monitoring period **2023 to 2024**, average margalef’s diversity index of benthic organism in Kandla and nearby creeks sampling stations was varying from **1.73 to 1.92**. While for Vadinar, average Margalef’s diversity index (Species Richness) of benthic organism observed to be **1.79** at ME-7 and **1.68** at ME-8.
- Berger-Parker Index (d):** During the monitoring period **2023 to 2024**, average Berger-Parker Index (d) of benthic organism was in the range of **0.33 to 0.37** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. average Berger-Parker Index (d) of benthic organism in the sampling stations of Vadinar, was in the range of **0.36 to 0.37**. All the monitoring station signifies a low diversity with an even distribution among the different species.

- The average **Species Evenness** is observed in the range of **0.87 to 0.89** for all the six-monitoring station of Kandla and for the Vadinar the species evenness is observed in the range of **0.82 to 0.88**.
- During the sampling period, **average Relative Abundance** of Benthic organisms was in range of **53.67 to 60.63** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative abundance value **57.46** at ME-7 and **51.58** at ME-8, thus it is concluded that the studied species can be stated as neither highly dominant nor rare.



CHAPTER 13: SUMMARY AND CONCLUSION

13.1 Summary and Conclusion

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

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

Methodology

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

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

- **Ambient Air Quality Monitoring**

Particulate matter (PM₁₀ and PM_{2.5}) levels exceeded the national ambient air quality standards (NAAQS) at most monitoring locations, especially at the coal storage area. The high particulate matter levels were attributed to heavy vehicular traffic, loading/unloading of cargo, and dust from unpaved roads. For Gaseous monitoring, sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) were generally within the NAAQS limits.

- **DG Stack Monitoring**

Monitoring of the diesel generator (DG) stacks was conducted at one location each in Kandla and Vadinar. Parameters like suspended particulate matter, SO₂, NO_x, CO, and CO₂ were measured and found to be within the prescribed emission limits.

- **Drinking Water Quality Monitoring**

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

- **Marine Water and Sediment Quality Monitoring**

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



- **Marine Ecology Monitoring**

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

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

Annexure 1: Photographs of the Environmental Monitoring conducted at Kandla



Annexure 2: Photographs of the Environmental Monitoring conducted at Vadinar



Source: GEMI



CHAPTER 14: REFERENCES



References:

- (1) National ambient air quality standards central pollution control board, 2009
- (2) Ambient Air Quality Standards in respect of Noise,2000.
- (3) American Public Health Association 23rd Addition, Standard Methods for Water and Waste water analysis, 2017.s
- (4) Indian Standard DRINKING WATER – SPECIFICATION (Second Revision), 2012.



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Annexure D

Disaster Management Plan

Disaster Management Plan (UPDATED MAY 2019)

for

DEENDAYAL PORT TRUST

ISO 9001:2008 & ISO 14001:2004 Certified Port

Post Box No: 50

Gandhidham (Kutch) – 370201



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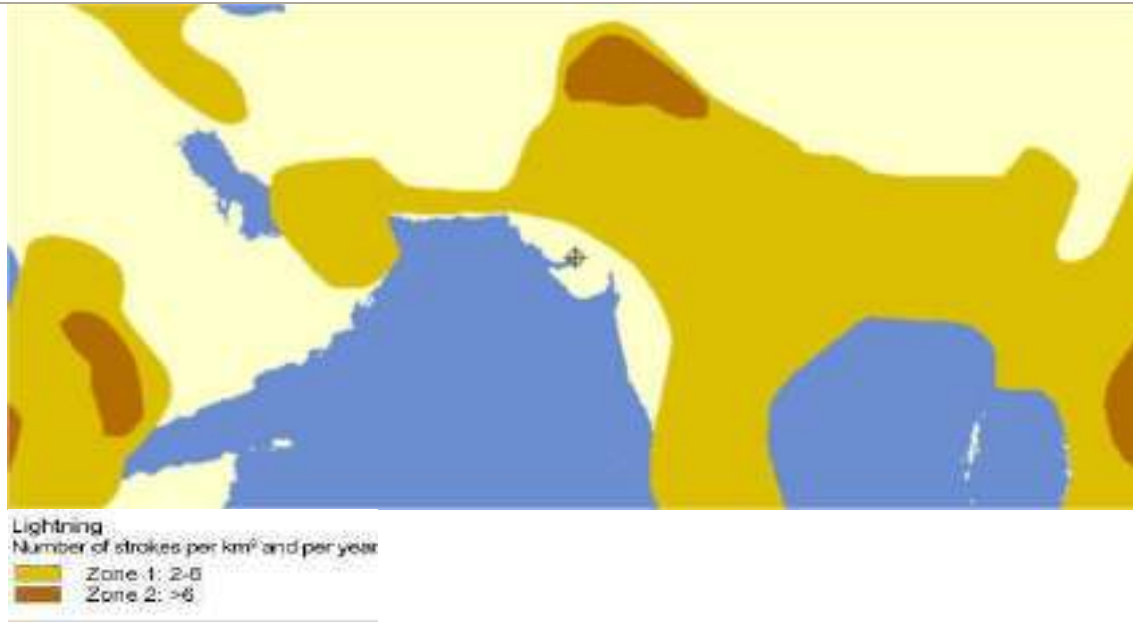
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As per Munich Re World Map for Natural hazards, Gandhidham region is in Zone – I which means on an average there are 2 - 6 lightning strikes per km area per year which signifies moderate risk exposure.

2

Thus risk exposure can be considered as moderate.



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1 PREFACE

The Disaster Management Plan (DMP) for Kandla Port has been developed to provide procedures for the implementation and continual development of the Internal Action Plan.

The Internal Action Plan is an interactive document which will be continuously refined and updated every year.

This plan has been formulated to fulfil the requirements of the relevant standards and guidelines set forth by the National Disaster Plan 2016.

It should be noted that the findings and recommendations of the study are based on the data provided and discussions held during the site visit with the port personnel at the time of the site visit on 18th & 19th August 2010 and updated in the Month of July 2016. FOLLOWED BY MAY 2019

National Disaster Management Plan, 2016. A publication of the National Disaster Management Authority, Government of India. May 2016, New Delhi

Documents provided by DEENDAYAL PORT TRUST for reference are:-

1. DEENDAYAL PORT TRUST– Internal action plan up dated July 2018.
2. DMP – DEENDAYAL PORT TRUST– Originally Prepared by Tata AIG Risk Management in the year 1999. Updated by A R Jadeja, Signal Supdt. KPT 2016
3. Copies of DMP of chemical / POL Terminals on Kandla Port Property.
 - a) JRE tank terminal (P) Ltd.
 - b) CRL
 - c) BPCL

- d) United storage and tank terminals Ltd – Liquid Terminal
 - e) United storage and tank terminals Ltd – Liquefied Gas Storage and handling terminals.
 - f) Indo Nippon chemical Company Ltd.
 - g) Rishi Kiran Logistics (P) Ltd,
 - h) INEOS ABS (India) Ltd
 - i) Friends oil and chemical terminals (P) Ltd
 - j) Indian oil (LPG)
 - k) Indian Oil
 - l) IOC Marketing Division
 - m) HPCL
 - n) Friends salt works and allied industries
 - o) IFFCO
4. Layout Map of DEENDAYAL PORT TRUST– DRG. NO: KPH/09
 5. Layout of Fire fighting line at DEENDAYAL PORT TRUST
 6. Layout of proposed oil pipe line at oil jetty DEENDAYAL PORT TRUST

We have exercised all reasonable skill, care and diligence in carrying out the study. This report / document is

not deemed to be any undertaking, warranty or certificate.

2 INTRODUCTION

The important aspect in emergency management is to prevent by Technical & Organizational measures, the unintentional escape of hazardous materials out of the facility and minimize accidents and losses.

Emergency planning also demonstrates the organizations commitment to the safety of employees and public and increases the organizations safety awareness.

The format and contents of the Disaster Management Plan (DMP) have been developed taking into consideration the guidelines of National Disaster Management Authority & Plan, and other accepted industry good practice principles formulated as a result of lessons learned in actual emergencies requiring extensive emergency response.

This master document is to be studied in advance and used for training purpose also. This master document will be upgraded once in every three years by reviewed annually.

2.1 Objectives of DMP

The objective of DMP is to describe the facility emergency response organization, the resources available and response actions applicable to deal with various types of emergencies that could occur at the facility with the response organization structure being developed in the shortest time possible during an emergency. Thus, the objectives of emergency response plan can be summarized

- ③ Rapid control and containment of the hazardous situation.
- ③ Minimizing the risk and impact of event / accident.
- ③ Effective rehabilitation of the affected persons and preventing of damage to property.

In order to effectively achieve the objectives of the emergency planning, the critical elements that form the backbone of the DMP are

- ③ Reliable and early detection of an emergency and careful planning.
- ③ The command co – ordination and response organization structure along with efficient trained personnel.
- ③ The availability of resources for handling emergencies.
- ③ Appropriate emergency response actions.
- ③ Effective notification and communication facilities ③ Regular review and updating of the DMP ③ Proper training of the concerned personnel.

FOREWORD

"The document On-site Disaster Management Plan is prepared with the objective of defining the functions and responsibilities of all concerned managerial, operational and supporting services department personnel with respect to detection and effective implementation of action plan. The ultimate goal is the effective containment of the emergency situation by proper mitigative action at the place of occurrence, cautioning people in adjoining affected locations, prompt rescue and medical aid to affected persons and communication to civil authorities for rushing in help from outside. All concerned are hereby requested to carefully study and thoroughly familiarize themselves with it in order to ensure its effectiveness in times of emergency"

Chairman

DEENDAYAL PORT TRUST

Date: ___/___/2019

2.2 Responsibility Nodal officer

Responsibility for establishing and maintaining a state of emergency preparedness belongs to the DC. He is responsible for maintaining distribution control of the plan, and for ensuring that the plan and applicable implementing procedures are reviewed annually. The Fire Safety In charge is responsible for the training of personnel to ensure that adequate emergency response capabilities are maintained in accordance with the plan. He is also responsible for ensuring the adequacy of the conduct of drills, as outlined in the On-site Disaster Management Plan. All employees of various departments are responsible for carrying out their responsibilities, as defined in this Plan.

Contact details of Deputy Conservator as a NODAL OFFICER for any port related contingencies/ incidents are as under

Name Capt T Srinivas

Phone : 02836-233585

Fax : 02836-233585

Cell : 9825232982

E mails : dyconservator@deendayalport.gov.in , srini_takes@yahoo.com , signalkpt@gmail.com

3 FACILITY DESCRIPTION PORT PROFILE

3.1 Introduction

3.1.1 Unique Location

The Major Port of Kandla situated about 90 km off the mouth of Gulf of Kachchh in the Kandla Creek at Latitude 23 degree 1minute North and Longitude 70 degree 13 minutes east, is the lone Major Port on the Gujarat coast line along the West Coast of the country. Amongst the 12 Major Ports in the country, Kandla occupies an enviable position, both in terms of international maritime trade tonnage handled and financial stability and self-sufficiency attained year after year. A gateway to the north-western part of India consisting of a vast hinterland of 1 million sq. km stretched throughout 9 states from Gujarat to Jammu & Kashmir, the Port has a unique location advantage. The Port's hinterland is well connected with infrastructural network of broad gauge and railway system as well as State and National Highways

3.1.2 The Evolution

January 20, 1952, Pandit Jawaharlal Nehru, the then Prime Minister of India, laid the foundation stone at Kandla for the new port on the western coast of India. It was declared as a Major Port on April 8, 1955 by Late Lal Bahadur Shastri, the then Union Minister for Transport. The DEENDAYAL PORT TRUST was constituted in 1964 under the Major Port Trusts Act, 1963. Since then, this Major Port of Kandla has come a long way in becoming the 'Port of the New Millennium'.

3.1.3 The Strengths to Anchor On

Excellent infrastructural facilities, well-connectivity with the rest of the country by road and rail networks, all-round services provided with efficiency and transparency, lowest port tariff and the envious cost-effectiveness are the major strengths of Kandla Port.

3.1.4 Vision

"To be Asia's Supreme Global Logistic Hub"

3.1.5 Mission

To transform the Port of Kandla into a most globally competitive logistics hub with international excellence leaving imprints in the international maritime arena by exploring its fathomless growth potentialities.

HAZARD RISK VULERNABILITIES

3.2 Business Horizon

As the portal to the West and North India and due to its unique location advantage, a vast hinterland of 1 million sq. km can be assured for from Kandla.

The hinterland of the Kandla Port consists of the states of J &K, Punjab, Himachal Pradesh, Haryana, Rajasthan, Delhi, Gujarat and parts of Madhya Pradesh, Uttaranchal and Uttar Pradesh.

Kandla Port is the gateway port for the vast granaries of Punjab and Haryana and the rich industrial belt of West and North India.



3.2.1 Advantage Deendayal Port

ISO 9001 – 2008& ISO 14001:2004 Certified Port.

All weather port – 365 days, 24 hours.

Protected and safe harbor.

16 berths stretching 2.55 km in a straight line

Facilities for liquid cargo, POL products, chemicals and edible oil.

Storage facility for LPG to the tune of 30,000 cu.m.

Port with highest liquid storage capacity in the country.

Excellent road and rail connectivity.

High capacity cranes for dry cargo.


Transparent and notified tariff.


13 meter draught.

Security by CISF. ISPS Compliant

3.3 Port Logistics


3.3.1 Navigation Facilities

 Round-the-clock navigation.


 Permissible draught 13 meters.

Ships with 330 meters length overall and 75,000 DWT are accommodated presently.

 Safe, protected and vast anchorage at outer harbour for waiting and lighter age purpose.

 22 lighted navigational buoys with solar lights, as per IALA system, are provided in the navigational channel.

 VTS PMS & Pilot Personal Unit as an aid for night navigation.

 Fully equipped signal stations operational round-the-clock. With VTS GOK Port Monitoring Stations

3.3.2 Flotilla

10 Harbor tugs of various sizes. (inclusive Vadinar

2 high speed pilot launches.

One state of the art fully computerized survey launch

FRP mooring launches.

Four general service launches.

One heave up barge for maintenance of navigational aids.

3.4 Strategic & Climatic Advantage

- ✚ All-weather port.
- ✚ Tropical and dry climatic conditions to handle any type of cargo throughout the year.
- ✚ Temperature varying from 25 degree Celsius to 47 degree Celsius.
- ✚ Scanty rainfall facilitates round-the-year operations.
- ✚ Uninterrupted and smooth port operations on 365 days a year.
- ✚ No adverse wave effect, being a protected and sheltered harbour situated in the Creek.
- ✚ The only Indian Major Port nearest to the Middle East and Europe.

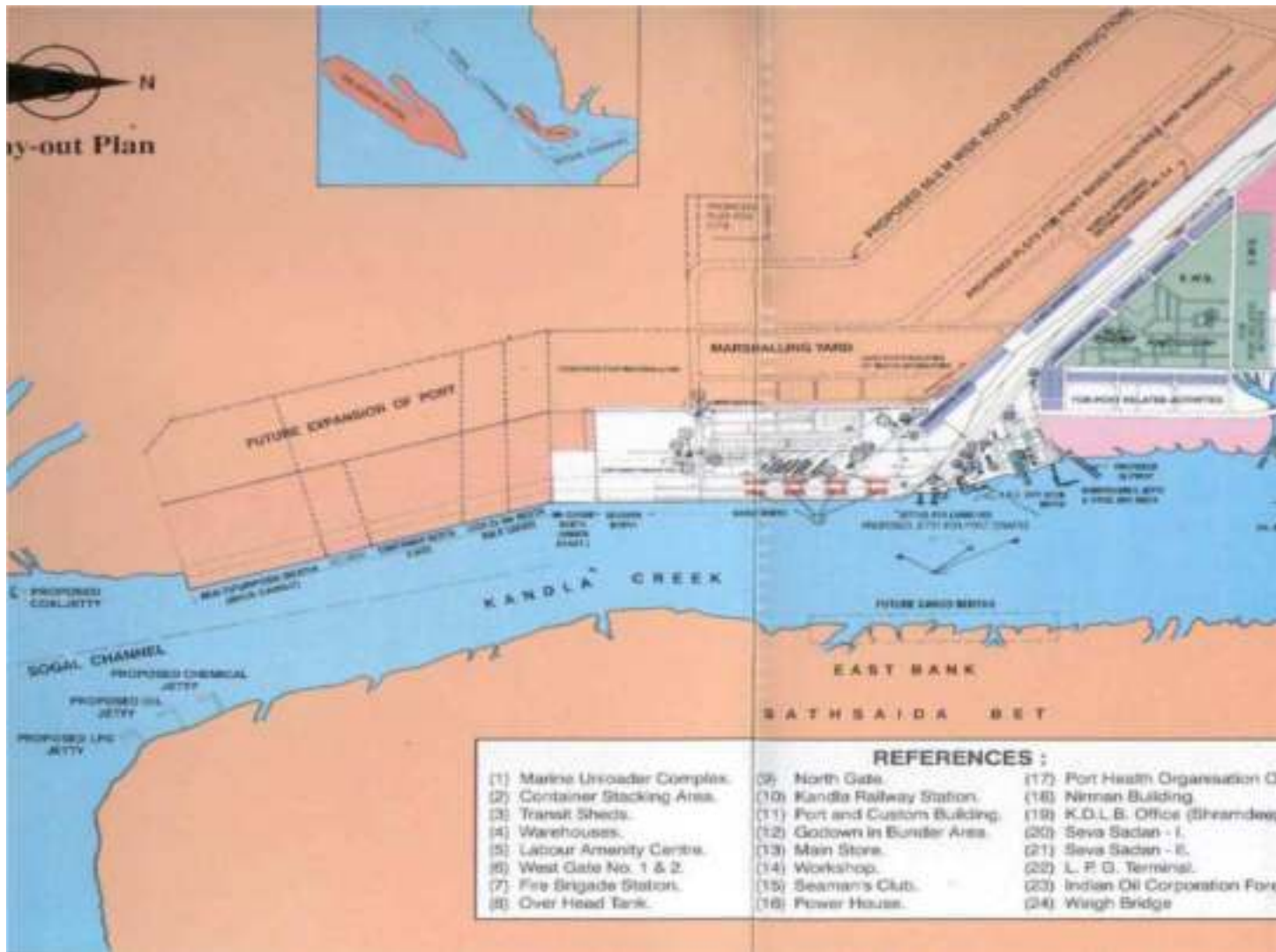
3.5 Port Location

- ✚ Latitude: 23°01"N
- ✚ Longitude: 70°13"E

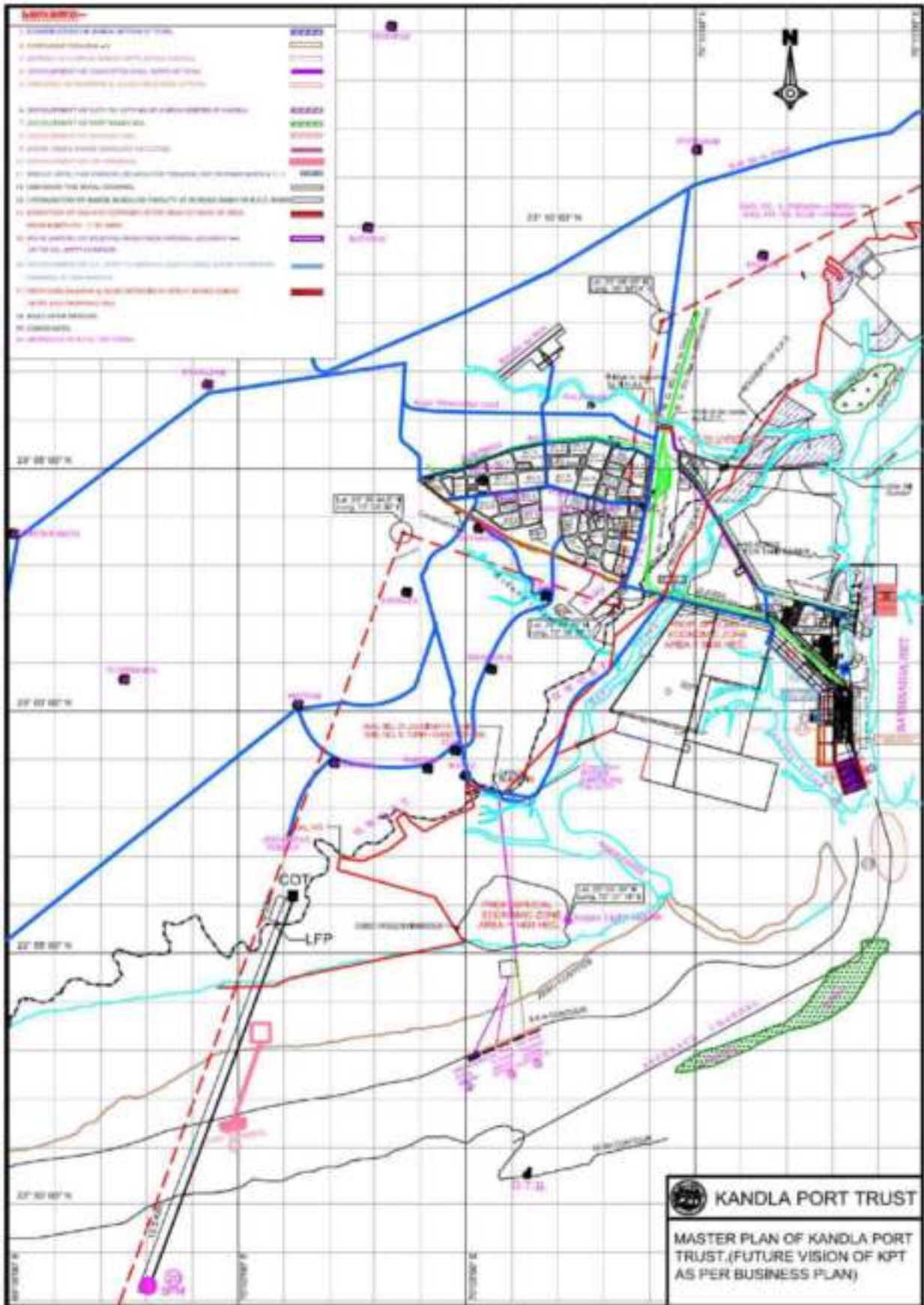
Kandla Port is situated in the Kandla Creek and is 90km from the mouth of the Gulf of Kutch.

3.5.1 Location - Latitude : 23° 1' N, Longitude : 70° 13' E

Figure 1 – Over view of DEENDAYAL PORT TRUST






3.6 Future Vision of KPT as per Business Plan






3.7 Steel Floating Dry Dock

The existing steel floating dry dock caters to the need of Port crafts as well as outside organizations and has capacity to accommodate vessels of following parameters.

-  LOA maximum up to 95 meters.
-  Breadth maximum up to 20 meters.
-  Draught maximum up to 4.5 meters.


Lift displacement maximum up to 2700 tones.

3.8 Infrastructure Advantages at Kandla Port







-  16 dry cargo berths are available, with quay length of 2532 meter.
-  Six oil jetties.
-  Total custom bonded port area inside the custom fencing is 253 hectares.

THREE cargo moorings in the inner harbor area for stream handling.

3.8.1 Chemical & Liquid handling Complex



 Total storage capacity : 21.89 Lakh KL

- Private sector storage terminals – 9.81 Lakh KL.
- Public sector and cooperative undertaking – 12.08 Lakh KL.



-  Loading arms for simultaneous loading and unloading.
-  Near zero waiting period for vessels.
-  Capacity utilization at international levels ensuring demurrage free handling.
-  Excellent discharge rates and faster turnaround.
-  Lowest vessel related charges and wharfage charges.
-  Suitable for A, B, C, LG, NH, EO classes of liquid and chemicals.

Chemical storage tank farms in the vicinity of liquid jetties.

Tanks for storage of all categories of liquid cargoes like chemicals LPG, cryogenic cargoes, ammonia, acids, petroleum products, edible oils. Etc.

-  Efficient handling ensuring minimum losses.
-  Sophisticated pipeline network (including stainless steel pipes) Sufficient parking space inside and outside the storage facilities.

3.9 Road Network

-  Four lane National Highway No: 8-A extended right up to the Ports main gates.
-  Fully developed road network, both in and around the Port area to facilitate faster movement of cargo.
 - Inside Cargo Jetty Area – 30 km.
 - Outside Cargo Jetty Area – 31 km.
 - Railway Inside Cargo Jetty Area – 13 km.

3.10 Storage Facilities

Kandla Port offers excellent and vast dry cargo storage facilities inside the custom bonded area for storage of import and export cargoes.

The existing storage facilities at the dry cargo jetty area are:

Sr No	Description	No	Area (Sq MTRS)	Capacity in (Tones)
01	Warehouses	35	2.03 Lakhs	6.47 Lakh
02	Open storage space	67	16.63 Lakhs	36.27 Lakh

3.10.1 Private Sector Liquid Storage Facilities

Sr No	Name of the Terminal Operator	No of Tanks	Capacity in (KL)
-------	-------------------------------	-------------	------------------

01	CRL (Chemicals & Resins Ltd)	112	247000
02	FSWAI (Friend Salt Works & Allied Industries)	132	271650
03	Kesar Enterprise	44	90081
04	N P Patel Pvt Ltd	09	38497
05	FOCT (Friend Oil & Chemicals Terminal	21	39263
06	USTTL – Liquid Terminal	22	63038
07	Agencies & Cargo Care Limited	27	50000
08	J K Synthetics	14	25176
09	IMC Limited	04	25288
10	J R Enterprises	15	25320
11	Indo Nippon Chemicals Ltd	10	17200
12	Liberty Investment	06	16016
13	Bayer ABS Ltd	11	13310
14	Deepak Estate Agency	09	13212
15	Tejmalbhai & Company	08	12577
16	Avean International Care Ltd	11	12160
17	USTTL Gas Terminal	04	5720
18	Parker Agrochem Export Ltd	06	15000
Total Capacity		465	980508

3.10.2 Public Sector Liquid Storage Facilities


Sr No	Name of the Terminal Operator	No of Tanks	Capacity in (KL)
01	Indian Oil Corporation	38	575838
02	Bharat Petroleum Corporation	21	230000
03	Hindustan Petroleum Corporation	28	204000
04	IOC – LPG	02	30000
05	IFFCO	11	110000
06	NDDB	09	58530
Total Capacity		109	1208360

3.11 Container Handling Facilities HAS BEEN AWARDED TO KANDLA INTERNATIONAL CONTAINER TERMINAL : OPERATIONAL

Fully operational Container Terminal Operated by KICT

3.12 Port Equipments

3.12.1 Wharf Cranes

 12 wharf cranes of the following capacities:

- Two of 12 tones.
- Four of 16 tones.
- Six of 25 tones.

- 2 MOBILE CRANES OF 63 TONNES EACH
- ✚ The rated capacity of the 16 ton crane is 400 tones / hour.
- ✚ The rated capacity of the 25 ton crane is 400 tones / hour.

3.12.2 Weighbridges

- ✚ Nine weighbridges inside the port, which includes:
 - Two Weighbridge of 40 MT capacities.
 - ○ One Weighbridge of 50 MT capacity
 - ○ Two Weighbridge of 60 MT capacity
 - ○ Two Weighbridge of 80 MT capacity
 - ○ Three Weighbridge of 100 MT capacities.

3.12.3 Other Support Equipment

- ✚ Easy availability of other support loading equipments such as Forklifts, Tractor - Trailers, Pay-loaders of various capacities.
- ✚ Private handling, equipments like Mobile Cranes, Top lifters, pay-loaders, Forklifts, Heavy-duty Trailers etc. available on hire at competitive rates.

3.13 Berths at Kandla Port

3.13.1 Details of Draught

Sr No	Name of Berth	Draught (in Meters)	DWT (In Metric Tons)
1	Cargo Berth No.1	10.0	45000

2	Cargo Berth No.2	9.80	45000
3	Cargo Berth No.3	9.80	45000
4	Cargo Berth No.4	9.80	45000
5	Cargo Berth No.5	10.0	35000
6	Cargo Berth No.6	12.0	35000
7	Cargo Berth No.7	12.00	55000
8	Cargo Berth No.8	12.00	55000
9	Cargo Berth No.9	12.00	55000
10	Cargo Berth No.10	12.00	55000
11	Cargo Berth No.11	13.00	65000
12	Cargo Berth No.12	13.0	65000
13	Cargo Berth No.13	13.0	75000
14	Cargo Berth No. 14	13.0	75000
15	Cargo Berth No.15	13.0	75000
16	Cargo Berth No. 16	13	75000
15	Oil Jetty No. 1 (Nehru Jetty)	10.0	40000
16	Oil Jetty No. 2 (Shastri Jetty)	09.00	52000
17	Oil Jetty No. 3 (Indira Jetty)	09.80	40000
18	Oil Jetty No. 4 (Rajiv Jetty)	10.70	56000
19	Oil Jetty No. 5 (IFFCO)	10.10	45000
18	Oil Jetty No. 6 (IOCL)	10.10	45000

3.13.2 Details of Berths

No of Berth	No of Bollard		No of Panels	Length of Each Panel	Length of Berth (m)	Draught (in Meters)	DWT (In Metric Tons)
1	1 to 8	08	08	22.866	182.93	9.80	45000
2	8 to 16	08	08	22.866	182.93	9.80	45000
3	17 to 24	08	08	22.866	182.93	9.80	45000
4	25 to 32	08	08	22.866	182.93	9.80	45000
5	33 to 41	09	09	22.866	205.79	9.10	35000
6	42 to 50	09	09	22.866	205.79	9.10	35000
7	51 to 58	08	08	(30.440 x 7) + 22.56 + (3.00)	238.64	12.00	55000
8	59 to 68	10	06	(45.72 x 3) + 30.44 + 27.44 + (18.00)	213.04	12.00	55000
9	69 to 76	08	05	(45.72 x 3) + 25.72 + (18.05)	182.93	12.00	55000
10	77 to 85	09	05	(59.10 x 2) + (43.20 x 2) + (4.81)	209.41	12.00	55000
11	86 to 98	13	05	(59.00 x 4) + (45.00)	281.00	12.50	65000
12	-----	---	---		264.00	12.50	65000
13						13.0	75000
14						13.0	75000
15						13.0	75000
16						13.0	75000

3.13.3 Details of Existing Godown

Sr No	Godown No	Size of Godown (in M)	Area in Sq Meters	Capacity in (Tons)
1	Godown – 1 (WH-A)	152.44 x 36.59	5578	9817
2	Godown – 2 (WH-B)	152.44 x 36.59	5578	10500
3	Godown – 3 (W.H -C)	152.44 x 36.59	5578	10500
4	Godown – 4 (W.H.D)	152.44 x 36.59	5578	10500
5	Godown – 6 (C.F.S. - II)	90.00 x 36.00	3240	12400
6	Godown – 7 (C.F.S. – I)	90.00 x 36.00	3240	12400
7	Godown – 8 (F.B.S.S)	236.00 x 30.00	7080	13300
8	Godown – 9 (Bagging Plant)	287.00 x 19.20	5510	10400
9	Godown – 10	132.00 x 22.50	2970	11400
10	Godown – 11	186.00 x 22.50	4185	7900
11	Godown – 12	170.00 x 22.50	3825	7200
12	Godown – 13	162.00 x 22.50	3645	6900
13	Godown – 14	192.00 x 22.50	4320	8100
14	Godown – 15	162.00 x 22.50	3645	6900
15	Godown – 16	192.00 x 22.50	4320	9100
16	Godown – 17	174.00 x 22.50	3915	15000
17	Godown – 18	138.00 x 45.00	6210	23800
18	Godown – 19	192.00 x 22.50	4320	8100
19	Godown – 20	192.00 x 22.50	4320	8100
20	Godown – 21	192.00 x 22.50	4320	8100

21	Godown – 22	192.00 x 22.50	4320	8100
22	Godown – 23	174.00 x 22.50	3915	7400
23	Godown – 24	156.00 x 45.00	7020	26900
24	Godown – 25	132.00 x 22.50	2970	5600
25	Godown – 26	99.06 x 36.55	3621	13900
26	Godown – 27		1943	6995
27	Godown – 28	173.88 x 30.50	5503	19092
28	Godown – 29	137.55 x 50.00	6888	24797
29	Godown – 30	126.00 x 49.00	6174	22226
30	Godown – 31	140.00 x 50.00	7000	25200
31	Godown – 32	307.45 x 40.00	12298	44273
32	Godown – 33	133.00 x 40.00	5320	19152
	Total Available Presently		158349	434052

3.14 Various Private Terminal Storages at Kandla & the chemicals POL products handled.




3.14.1 Bharat Petroleum Corporation Ltd

-  Motor Spirit (MS)
-  HSD – High Speed Diesel
-  SKO – Superior Kerosene Oil
-  Ethanol (Ethyl Alcohol)
- Naphtha
- LDO – Light Diesel Oil

3.14.2 CRL

-  Benzene
-  Toluene
-  Aniline
-  Butanol (Butyl Alcohol)
-  H Phenol
-  CTC – Carbon Tetra Chloride
-  Caster Oil
-  CPS
-  Phenol
-  De Alcohol (Denatured Alcohol)
-  IPA – Iso Propyl Alcohol
-  Butyl Acetate
-  MEK (Methyl Ethyl Ketone)
-  Methyl Alcohol / Methanol
-  Hexane
-  Vinyl Acetate
-  MIBK
-  BAM
-  Propylene
-  Cyclo Hexane
-  Caustic Soda (Sodium Hydroxide)
-  Acetic Acid
-  Nonene
-  EDC (Ethylene Di Chloride)

3.14.3 United Storage & Tank Terminals Ltd

-  LPG – Liquefied Gas Storage & Handling terminal
-  1:3 Butadiene
-  Crude C 4 Mix
- Butane – 1

3.14.4 Indo Nippon Chemicals Co Ltd




-  ISO Butanol
-  A – Olefin
-  Waksol (Parafin)
-  VAM – Vinyl Acetate Monomer
-  MDC – (Methyle Metacrylate)
- Toluene
- Naphtha
- IPA

3.14.5 Rishi Kiran Logistics (P) Ltd




















-  Butyl Cellsolve
-  Chloroform
-  DO Wanol
-  HNP
-  N – Parafin
-  Methanol
-  Polyether Polyol
- Papi 27 Polymeric
- Tri chloric ethylene Vinyl
chloride monomer.

3.14.6 Ineos ABS (India) Ltd

Chemicals Stored

-  Styrene
-  ACN
-  Chloroform
- Parafin

Chemicals Proposed

-  Methyl Ethyl Ketone (MEK)
-  Benzene
-  Methanol
-  HNP
-  Acetone
-  Butyl Acrylate
-  Butanol
-  1 – Butanol
-  CTC (Carbon Tetra Chloride)
-  Cyclo Hexanol
-  Cyclo Hexanone
-  Cumene
-  Di Octylphthalate
-  Ethanol – IPA (Mix)
-  Ethanol
-  Ethyl Hexanol
-  Ethyl Benzene
-  Hexane
-  Heptane
- Iso Propanol

P – Xylene

Propylene Trimer

C – 9 – Hydrocarbons

Toluene


Vinyl Acetate

Mixed xylene

N – Tetra Decane

Polvoal




3.14.7 Friends Oil & Chemical Terminal (P) Ltd

-  Furnace Oil
-  Styrene
-  C – Palm Oil
-  Mix – HSD & Naphtha
-  CPO (NEG) – Crude Palm Oil
-  Acrylate Bam
-  Butyle Glycol
-  Mosstanoll
-  Butyl Glycol
- Cubutol
- Methyl Methacr
- ISO Nanano
- CDSBO

3.14.8 Indian Oil (LPG)






 LPG

3.14.9 Indian Oil FST

-  Motor Spirit (MS)
-  High Speed Diesel (HSD)
-  SKO (Superior Kerosene Oil)

LAN

3.14.10 Hindustan Petroleum Company Limited

-  Furnace Oil (FO)
-  High Speed Diesel (HSD)
-  Light Diesel Oil (LDO)
-  SKO (Superior Kerosene Oil)
-  Motor Spirit (MS)

3.14.11 Friends Salt Works & Allied Industries

-  Naptha
-  Toluene
-  N – Proanol
-  HNP
-  Mixed Parafin
-  Solvent – CS
-  Iso Propyl Alcohol (IPA)
-  Methenol
-  N – Parafin C9 – C
-  M – xylene
-  High Speed Diesel (HSD)

Mosstanol

Methylene Chloride

Ethyl Acetate

Vinyl Acetate

HA – 100

MEK

Acetone

Crude Benzene

Heavy Aromatics

Butyl Acrylate

Shell Sarasol – 4

Carbon Tetra Chloride (CTC)

HA – 170

MBK

De Natured Spirit

Nonene

Condensate

Caradol SC- 56 – 0

N – Parafin

Butyl Acetate



LAB



Naptha



Hexane



ISO – Decyl Alcohol



Sodium Hydroxide (Caustic Soda)



Methyl Met



Butyl Arylate





MIBK

DHSO – But

Crude PEG

CPKO Crude
PNEG

3.14.12 IFFCO

-  Anhydrous Liquid Ammonia
-  Phosphoric Acid
-  Potash
-  Urea
-  Hydrochloric Acid
-  Sulphuric Acid
- LSHS Furnace Oil

3.14.13 IOC (Marketing)

No list of chemicals is provided

3.14.14 JRE Tank Terminal (P) Ltd (Liquid Storage Terminal)

No list of chemicals is provided

3.14.15 United Storage & Tank Terminals Ltd (Liquid Terminal)

No list of chemicals is provided

3.15 Offshore Oil Terminal (OOT) Vadinar

KPT had commissioned off shore oil terminal facilities at Vadinar in 1978, jointly with Indian Oil Corporation, by providing single bouy mooring (SBM) system having capacity of 54 MMTPA, which was the first of its kind in India. A significant quantum of infrastructural up gradation has since been effected and excellent maritime infrastructure created for the 32 MMTPA Essar Oil Refinery at Vadinar.

- ✚ A draught of up to 33 meters at SBMs and lighterage point operations (LPO) Three SBMs available.
- ✚ 2 Oil Handling Berths of 1,00,000 DWT draft of 20 mtrs
- ✚ Handling VLCCs of 300000 DWT and more.

Providing crude oil for the refineries of Koyali (Gujarat), Mathura (UttarPradesh), Panipat (Haryana) and Essar Refinery, Jamnagar (Gujarat) ✚ 2nd SBM was commissioned in the year 1998.

- ✚ 3rd SBM at Vadinar is for importing crude for the oil refinery of Essar Oil.
- ✚ Simultaneous handling of three VLCCs possible at the SBMs. 3 SBMs interconnected by sub-sea pipeline
- ✚ Vast crude tankage facility.

Two 35 tone and four 50 tone state of art BP SRP pull back tugs are available for smooth and simultaneous shipping operations on the SBMs and product jetty.

- ✚ Excellent infrastructure and tranquil waters facilitate transshipment operations even during the monsoon.

4 IDENTIFICATION OF EMERGENCIES

4.1 Overall Methodology

In order to undertake this study DPT has used ALOHA (Aerial Locations of Hazardous Atmospheres) a computer program designed especially for use by people responding to chemical releases, as well as for emergency planning and training. ALOHA models key hazards — toxicity, flammability, thermal radiation (heat), and overpressure (explosion blast force) — related to chemical releases that result in toxic gas dispersions, fires, and /or explosions.

4.1.1 Dispersion Modeling

ALOHA air dispersion model is intended to be used to estimate the areas near a short-duration chemical release where key hazards—toxicity, flammability, thermal radiation, or overpressure—may exceed user-specified Levels of Concern (LOCs).

(Note: If the released chemical is not flammable, toxicity is the only air dispersion hazard modeled in ALOHA.)

ALOHA is not intended for use with radioactive chemical releases, nor is ALOHA intended to be used for permitting of stack gas or modeling chronic, low-level ("fugitive") emissions. Other models are designed to address larger scale and/or air quality issues (Turner and Bender 1986). Since most first responders do not have dispersion modeling backgrounds, ALOHA has been designed to require input data that are either easily obtained or estimated at the scene of an accident. ALOHA's on-screen help can assist you in choosing inputs.

4.1.1.1 What is Dispersion

Dispersion is a term used by modelers to include advection (moving) and diffusion (spreading). A dispersing vapor cloud will generally move (advent) in a downwind direction and spread (diffuse) in a crosswind and vertical direction (crosswind is the direction perpendicular to the wind). A cloud of gas that is denser or heavier than air (called a heavy gas) can also spread upwind to a small extent.

ALOHA can model the dispersion of a cloud of pollutant gas in the atmosphere and display a diagram that shows an overhead view of the regions, or threat zones, in which it predicts that key hazard levels (LOCs) will be exceeded. This diagram is called a threat zone plot. To obtain a threat zone estimate, you must first choose at least one LOC. (ALOHA will suggest default LOCs, and you may keep those or choose up to three other LOCs.) For toxic gas dispersion scenarios, an LOC is a threshold concentration of the gas at ground level—usually the concentration above which a hazard is believed to exist. The type of LOC will depend on the scenario. For each LOC you choose, ALOHA estimates a threat zone where the hazard is predicted to exceed that LOC at some time after a release begins. These zones are displayed on a single threat zone plot. If three LOCs are chosen, ALOHA will display the threat zones in red, orange, and yellow. When you

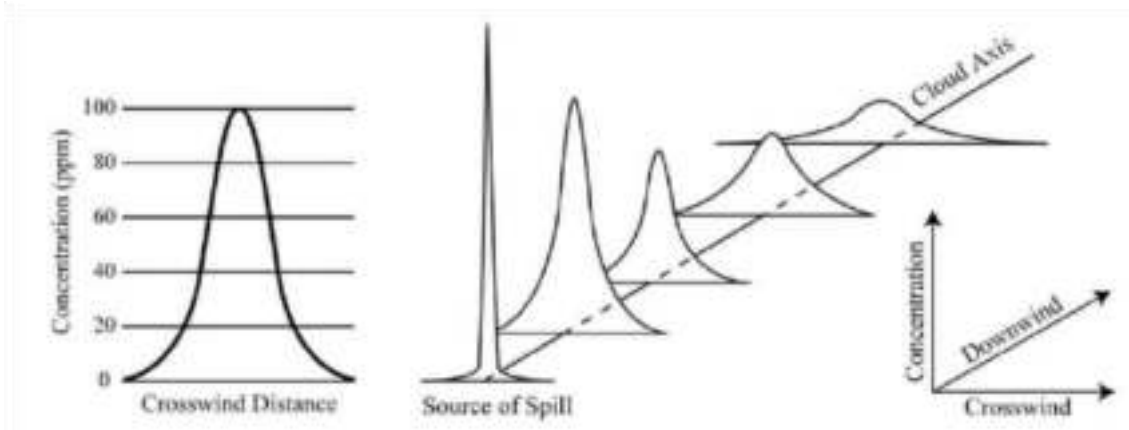
use ALOHA's default LOCs, the red zone represents the worst hazard.

There are two separate dispersion models in ALOHA: Gaussian & Heavy Gas.

4.1.1.2 Gaussian Model:

ALOHA uses the Gaussian model to predict how gases that are about as buoyant as air will disperse in the atmosphere. Such neutrally buoyant gases have about the same density as air. According to this model, wind and atmospheric turbulence are the forces that move the molecules of a released gas through the air, so as an escaped cloud is blown downwind, "turbulent mixing" causes it to spread out in the crosswind and upward directions. According to the Gaussian model, a graph of gas concentration within any crosswind slice of a moving pollutant cloud looks like a bell-shaped curve, high in the center (where concentration is highest) and lower on the sides (where concentration is lower). At the point of a release, the pollutant gas concentration is very high, and the gas has not diffused very far in the crosswind and upward directions, so a graph of concentration in a crosswind slice of the cloud close to the source looks like a spike. As the pollutant cloud drifts farther downwind, it spreads out and the "bell shape" becomes wider and flatter.

Gaussian distribution (left) & Gaussian Spread (right)



4.1.1.3 Heavy gases:

When a gas that is heavier than air is released, it initially behaves very differently from a neutrally buoyant gas. The heavy gas will first "slump," or sink, because it is heavier than the surrounding air. As the gas cloud moves downwind, gravity makes it spread; this can cause some of the vapor to travel upwind of its release point. Farther downwind, as the cloud becomes more diluted and its density approaches that of air, it begins behaving like a neutrally buoyant gas. This takes place when the concentration of heavy gas in the surrounding air drops below about 1 percent (10,000 parts per million). For many small releases, this will occur in the first few yards (meters). For large releases, this may happen much further downwind.

Cloud spread as a result of gravity.



The heavy gas dispersion calculations that are used in ALOHA are based on those used in the DEGADIS model (Spicer and Havens 1989), one of several well-known heavy gas models. This model was selected because of its general acceptance and the extensive testing that was carried out by its authors.

4.1.1.4 Classification of Heavy Gases:

A gas that has a molecular weight greater than that of air (the average molecular weight of air is about 29 kilograms per kilomole) will form a heavy gas cloud if enough gas is released. Gases that are lighter than air at room temperature, but that are stored in a cryogenic (low temperature) state, can also form heavy gas clouds. If the density of a gas cloud is substantially greater than the density of the air (the density of air is about 1.1 kilograms per cubic meter), ALOHA considers the gas to be heavy.

4.1.2 Fires & Explosions

ALOHA version 5.4, can model fire and explosion scenarios as well as toxic gas dispersion scenarios. This section provides information about fires and explosions, and then explains how to model fires and explosions in ALOHA.

ALOHA allows to model chemical releases from four types of sources: Direct, Puddle, Tank, and Gas Pipeline.

- ③ Direct: chemical release directly into the atmosphere (bypassing ALOHA's source calculations).
- ③ Puddle: chemical has formed a liquid pool.
- ③ Tank: chemical is escaping from a storage tank.
- ③ Gas Pipeline: chemical is escaping from a ruptured gas pipeline.

ALOHA Sources & Scenarios

Source	Toxic Scenarios	Fire Scenarios	Explosion Scenarios
Direct			
Direct Release	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Puddle			
Evaporating	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Burning (Pool Fire)		Pool Fire	
Tank			
Not Burning	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Burning		Jet Fire or Pool Fire	
BLEVE		BLEVE (Fireball and Pool Fire)	
Gas Pipeline			
Not Burning	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Burning (Jet Fire)		Jet Fire	

4.1.2.1 Fire

A fire is a complex chain reaction where a fuel combines with oxygen to generate heat, smoke, and light. Most chemical fires will be triggered by one of the following ignition sources: sparks, static electricity, heat, or flames from another fire. Additionally, if a chemical is above its auto ignition temperature it will spontaneously catch on fire without an external ignition source.

There are several properties that measure how readily—that is, how easily—a chemical will catch on fire. Here we'll discuss three of these properties: volatility, flash point, and flammability limits. Volatility is a measure of how easily a chemical evaporates. A flammable liquid must begin to evaporate—forming a vapor above the liquid—before it can burn. The more volatile a chemical, the faster it evaporates and the quicker a flammable vapor cloud is formed. The flash point is the lowest temperature where a flammable liquid will evaporate enough to catch on fire if an ignition source is present. The lower the flash point, the easier it is for a fire to start. Flammability limits, called the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL), are the boundaries of the flammable region of a vapor cloud. These limits are percentages that represent the concentration of the fuel—that is, the chemical—vapor in the air. If the chemical vapor comes into contact with an ignition source, it will burn only if its fuel-air concentration is between the LEL and the UEL. To some extent, these properties are interrelated—chemicals that are highly volatile and have a low flash point will usually also have a low LEL.

Once the chemical catches on fire, three things need to be present to keep the fire going: fuel (the chemical), oxygen, and heat. This is often referred to as the fuel triangle. If any one of those components is eliminated, then the fire will stop burning.

Like other reactions, a fire can also generate byproducts—smoke, soot, ash, and new chemicals formed in the reaction. Some of these reaction byproducts can be hazardous themselves. While ALOHA cannot model all the complex processes that happen in a fire (like the generation and distribution of byproducts), it can predict the area where the heat radiated by the fire—called thermal radiation—could be harmful.

Thermal radiation is the primary hazard associated with fires. However, it is also important to consider the hazards associated with any secondary fires and explosions that may occur.

4.1.2.2 Thermal Radiation Levels of Concern:

A Thermal Radiation Level of Concern (LOC) is a threshold level of thermal radiation, usually the level above which a hazard may exist. When you run a fire scenario, ALOHA will suggest three default LOC values. ALOHA uses three threshold values (measured in kilowatts per square meter and denoted as kW/m²) to create the default threat zones:

- ③ Red: 10 kW/m² (potentially lethal within 60 sec);

- ③ Orange: 5 kW/m² (second-degree burns within 60 sec); and

- ③ Yellow: 2 kW/m² (pain within 60 sec).

The thermal radiation effects that people experience depend upon the length of time they are exposed to a specific thermal radiation level. Longer exposure durations, even at a lower thermal radiation level, can produce serious physiological effects. The threat zones displayed by ALOHA represent thermal radiation levels; the accompanying text indicates the effects on people who are exposed to those thermal radiation levels but are able to seek shelter within one minute.

ALOHA's default thermal radiation values are based on a review of several widely accepted sources for this topic (e.g., American Institute of Chemical Engineers 1994, Federal Emergency Management Agency et al. 1988, and Lees 2001).

Thermal Radiation Burn Injury Criteria.

Radiation (kW/m ²)	Intensity	Time for Severe Pain (S)	Time for 2 nd Degree Burns (S)
1		115	663
2		45	187
3		27	92
4		18	57
5		13	40
6		11	30
8		7	20
10		5	14
12		4	11

Note: The durations that correspond to effects like pain or second-degree burns can vary considerably, depending on circumstances. The effects above were observed on bare skin that was exposed directly to the thermal radiation. Some types of clothing can serve as a protective barrier against thermal radiation and can affect the exposure duration. However, exposure duration should be kept to a minimum, even at low levels of thermal radiation.

4.1.3 Overpressure

A major hazard associated with any explosion is overpressure. Overpressure, also called a blast wave, refers to the sudden onset of a pressure wave after an explosion. This pressure wave is caused by the energy released in the initial explosion—the bigger the initial explosion, the more damaging the pressure wave. Pressure waves are nearly instantaneous, traveling at the speed of sound.

Although a pressure wave may sound less dangerous than a fire or hazardous fragments, it can be just as damaging and just as deadly. The pressure wave radiates outward like a giant burst of air, crashing into anything in its path (generating hazardous fragments). If the pressure wave has enough power behind it, it can lift people off the ground and throw them up against nearby buildings or trees. Additionally, blast waves can damage buildings or even knock them flat— often injuring or killing the people inside them. The sudden change in pressure can also affect pressure-sensitive organs like the ears and lungs. The damaging effects of the overpressure will be greatest near the source of the explosion and lessen as you move farther from the source.

ALOHA predicts an explosion's effects, assess the surroundings at the explosion site as you interpret ALOHA's threat zone plot. Large objects (like trees and buildings) in the path of the pressure wave can affect its strength and direction of travel. For example, if many buildings surround the explosion site, expect the actual overpressure threat zone to be somewhat smaller than ALOHA predicts. But at the same time, more hazardous fragments could be generated as the blast causes structural damage to those buildings.

4.1.3.1 Overpressure Levels of Concern

An Overpressure Level of Concern (LOC) is a threshold level of pressure from a blast wave, usually the pressure above which a hazard may exist. When you run a vapor cloud explosion scenario, ALOHA will suggest three default LOC values. ALOHA uses three threshold values to create the default threat zones:

- ③ Red: 8.0 psi (destruction of buildings);

- ③ Orange: 3.5 psi (serious injury likely); and

- ③ Yellow: 1.0 psi (shatters glass).

ALOHA's default overpressure values are based on a review of several widely accepted sources for this topic (e.g., American Institute of Chemical Engineers 1994, Federal Emergency Management Agency et al. 1988, and Lees 2001).

Explosion Overpressure Damage Estimates

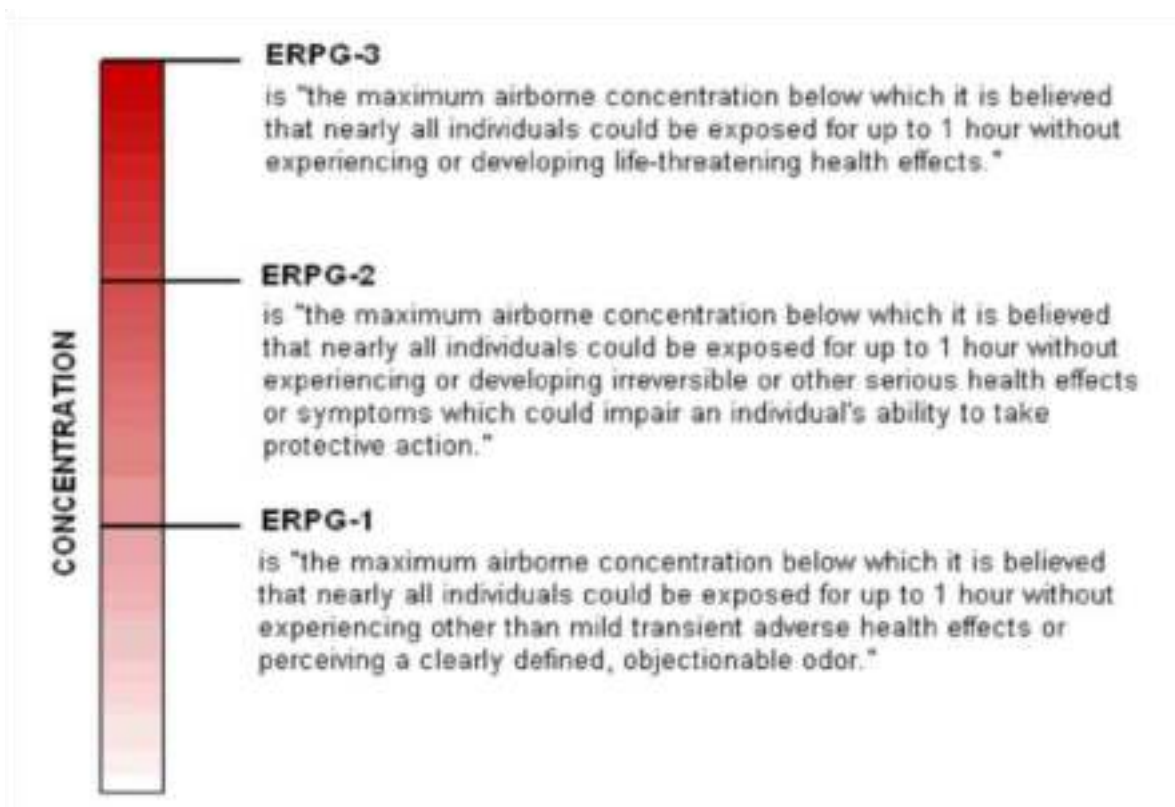
Overpressure* (psig)	Expected Damage
0.04	Loud noise (143 dB); sonic boom glass failure.
0.15	Typical pressure for glass failure.
0.40	Limited minor structural damage.
0.50-1.0	Windows usually shattered; some window frame damage.
0.70	Minor damage to house structures.
1.0	Partial demolition of houses; made uninhabitable.
1.0-2.0	Corrugated metal panels fail and buckle. Housing wood panels blown in.
1.0-8.0	Range for slight to serious laceration injuries from flying glass and other missiles.
2.0	Partial collapse of walls and roofs of houses.
2.0-3.0	Non-reinforced concrete or cinder block walls shattered.
2.4-12.2	Range for 1-90% eardrum rupture among exposed populations.
2.5	50% destruction of home brickwork.
3.0	Steel frame building distorted and pulled away from foundation.
5.0	Wooden utility poles snapped.
5.0-7.0	Nearly complete destruction of houses.
7.0	Loaded train cars overturned.
9.0	Loaded train box cars demolished.
10.0	Probable total building destruction.
14.5-29.0	Range for the 1-99% fatalities among exposed populations due to direct blast effects.
* These are peak pressures formed in excess of normal atmospheric pressure by blast and shock waves.	

4.2 Effect at different Heat Radiations & Overpressure

4.2.1 Emergency Response Planning Guidelines (ERPGs)

ERPGs were developed as planning guidelines, to anticipate human adverse health effects caused by exposure to toxic chemicals.

The ERPGs are three-tiered guidelines with one common denominator: a 1-hour exposure period. The tiers are defined as follows:



Interpreting ERPG:

The ERPG guidelines do not protect everyone. Hypersensitive individuals would suffer adverse reactions to concentrations far below those suggested in the guidelines.

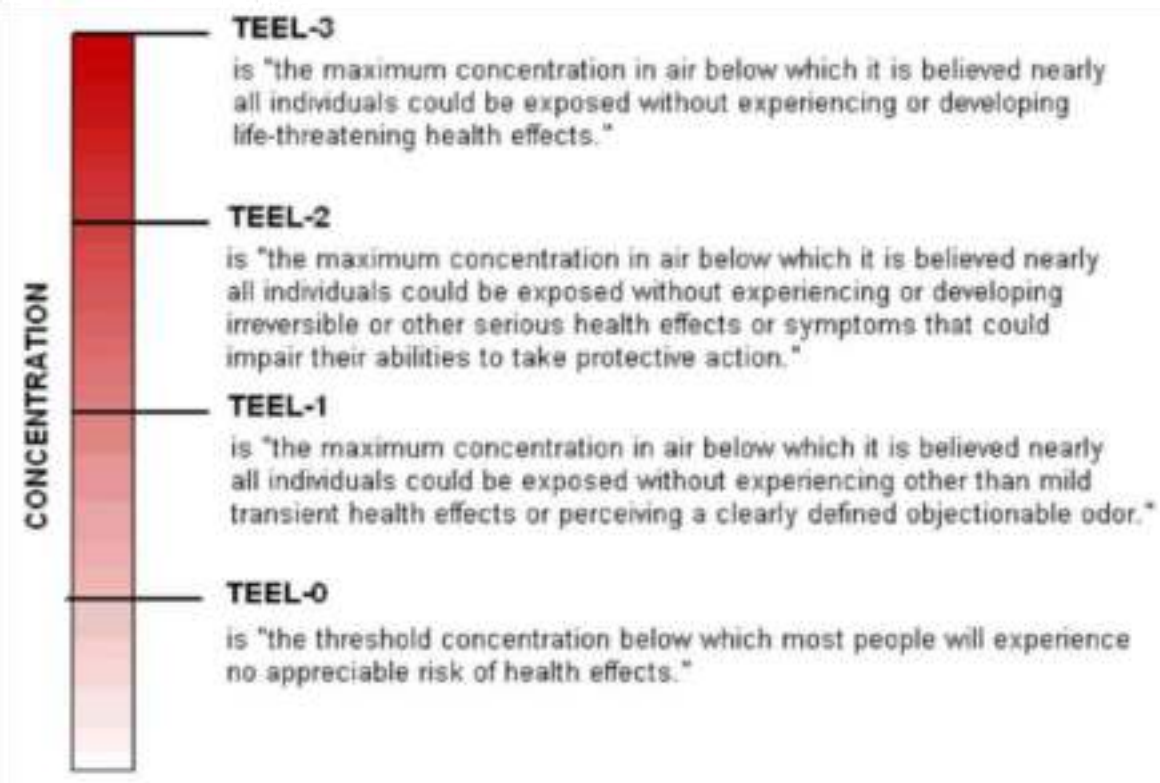
The guidelines are focused on one period of time: 1 hour. Exposure in the field may be longer or shorter. However, the ERPG committee strongly advises against trying to extrapolate ERPG values to longer periods of time.

ERPGs do not contain safety factors usually incorporated into exposure guidelines such as the TLV. Rather, they estimate how the general public would react to chemical exposure. Just below the ERPG-1, for example, most people would detect the chemical and may experience temporary mild effects. Just below the ERPG-3, on the other hand, it is estimated that the effects would be severe, although not lifethreatening. The TLV, on the other hand, incorporates a safety factor to prevent ill effects to exposed workers.







4.2.2 Temporary Emergency Exposure Limit (TEEL)

TEELs are temporary levels of concern designed to be used as toxic exposure limits for chemicals for which Acute Exposure Guideline Levels (AEGLs) or Emergency Response Planning Guidelines (ERPGs) have not yet been defined. Like AEGLs and ERPGs, they are designed to represent the predicted response of members of the general public to different concentrations of a chemical during an incident.

Each TEEL includes four tiers, defined as follows:



4.3 Various emergencies that may be expected at the port area

-  Leak / Spill and fire and explosion at the chemical jetties of hazardous chemicals. Fire at Berth/Storage area/warehouse/goodowns
-  Medical Injury
-  Terrorism/Sabotage
-  Civil disturbance
-  Hostage situation
-  Severe Weather
- Earthquake
- Tsunami
- Ships Accidents in the channel.

4.4 Leak / Spill and Fire & Explosion of Hazardous Chemicals at the Jetties

✚ Consequence analysis of impact distances for selected maximum credible loss scenarios of some selected chemicals handled at the chemical berths. ✚ The distance worked are indicative and to be used as a guide line.

4.5 Important assumptions considered for the Study

1. Representative chemicals have been chosen at each jetty. The distance shown in the table / map are applicable to any jetty (1 to 6) where the same chemical could be handled.

If the port is ready to handle the indicated distances for the chosen chemicals, then it can handle any other chemical emergency also under any weather conditions except storm / cyclone etc.

2. Wind speed 10m/sec from SW at 3 meter height.
3. Ground roughness – Open / Concrete
4. Cloud cover – Partial (5 Tenths)
5. Ambient Temperature – 40 degree C Average
6. Atmospheric stability Class “C”
7. Relative Humidity – 50%
8. Leak of 1000 litres of chemical
9. State of chemical at the time of leak – Liquid
10. Source: Direct Source
11. Source: Evaporating Puddle
 - Downwind toxic effects
 - Vapour cloud flash fire
 - Overpressure from vapour cloud explosion
12. Source: Burning Puddle
 - Thermal Radiation

13. Puddle diameter Average – 10 M

14. Puddle volume 1000 Litres.

4.6 Maximum Credible Loss Scenarios

The Maximum Credible Loss Scenarios (MCLS) give the possible failure scenarios, which takes into account the maximum inventory that can get released at the time of such a failure considering the intervention time based on safety systems provided at the facility.

The most hazardous chemicals taken into consideration for the study are:

Berth No: 1 – LPG & Toluene

Berth No: 2 – Benzene, ACN & Aniline

Berth No: 3 – Methanol, 1,3 Butadiene & Acetone

Berth No: 4 – VCM & Propylene

Berth No: 5 – Ammonia & HSD

Berth No: 6 – Motor Spirit & SKO

4.7 Impact Distances for MCLS under study

4.7.1 Jetty No – 1 Instantaneous Release / Evaporation Puddle / Burning Puddle for LPG

Chemical		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance for		
		TEEL - 3 33000 ppm	TEEL - 2 17000 ppm	TEEL - 1 5500 ppm	60%	10%	8 psi	3.5 psi	1.0 psi	10.0kW/m ²	5.0kW/m ²	2.0kW/m ²
		m	m	m	m	m	m	m	m	m	m	m
Jetty One	LPG (Instantaneous Release)	31	46	88	68	204	LOC not exceeded	48	61	-----	-----	-----
	LPG (Evaporation Puddle)	13	24	54	35	130	LOC not exceeded	21	42	-----	-----	-----
	LPG (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	34	42	57

Jet ty On e	TOLUENE (Instantaneous Release)	208	395	1.0Km	71	233	LOC not exceeded	52	72	-----	-----	-----
	TOLUENE (Evaporation Puddle)	< 10	21	73	< 10	< 10	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	-----	-----	-----
	TOLUENE (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	29	35	47

- All emergency equipment should be placed more than 72 meters away from the source of leak.
- Fire fighting should be carried out from a distance of more than 47 meter unless fire suits / fire proximity suits are worn by the fire fighting personnel.
- All persons not directly connected with the emergency operation should be moved more than 1 km away from the source of leak.
- All other fire fighting precautions should be adhered to.

4.7.3 ACRYLONITRILE (ACN)

Chemical		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
		ERPG - 3 75 ppm	ERPG - 2 35 ppm	ERPG - 1 10 ppm	60%	10%	8 psi	3.5 psi	1.0 psi	10.0kW/m ²	5.0kW/m ²	2.0kW/m ²
		m	m	m	m	m	m	m	m	m	m	m
Jet ty Two	ACN (Instantaneous Release)	1.0 Km	1.5 Km	2.8 Km	62	211	LOC not exceeded	41	61	----	-----	-----
	ACN (Evaporation Puddle)	49	76	148	< 10	< 10	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	----	-----	-----
	ACN (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	19	23	30

- In case of an emergency involving Acrylonitrile in the form of a major leak with or without a fire, all fire fighters handling the emergency must wear Breathing apparatus, in addition to the usual fire suits.
- All persons not connected with the emergency operation should move beyond 2.8Km distance.

- All supporting personnel must be ready with BA sets.
- The nearby shanty should be evacuated.
- All security staff must have respiratory protection.
- All persons handling the emergency should be sent to the Kandla Port Hospital for checking for CAN poisoning.

4.7.4 ANILINE

		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
		TEEL	TEEL	TEEL	60%	10%	8 psi	3.5 psi	1.0 psi	10.0kW/m ²	5.0kW/m ²	2.0kW/m ²
		- 3 20 ppm m	- 2 12 ppm m	- 1 8 ppm m	m	m	m	m	m	m	m	m
Jet ty Two	ANILINE (Instantaneous Release)	1.8 Km	2.3 Km	2.7 Km	72	237	LOC not exceeded	53	73	-----	-----	-----
	ANILINE (Evaporation Puddle)	12	20	29	< 10	< 10	No part of the cloud was above the LEL	No part of the cloud was above the	No part of the cloud was above the	-----	-----	-----

							LEL	LEL			
ANILINE (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	20	23	31

- All persons handling the emergency must wear full protection suits to avoid skin contact. BA should be worn by the persons handling the emergency.
- The adjoining shanty should be evacuated.
- Persons handling the emergency should check up if their nails, lips, earlobes have turned blue. If so, immediately move them to Kandla Port hospital.

4.7.5 BENZENE

Chemical	Dispersion Distances	LEL Distances	Overpressure Distances	Pool Fire Heat Radiation Distance For
----------	----------------------	---------------	------------------------	--

		ERPG - 3 1000 ppm m	ERPG - 2 150 ppm m	ERPG -1 50 ppm m	60% m	10% m	8 psi m	3.5 psi m	1.0 psi m	10.0kW/m ² m	5.0kW/m ² m	2.0kW/m ² m
Jet ty Tw o	BENZENE (Instantaneous Release)	228	625	1.1 Km	80	265	LOC not exceeded	61	76	----	-----	----
	BENZENE (Evaporation Puddle)	23	81	145	< 10	20	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	----	-----	----
	BENZENE (Burning Puddle)	----	-----	----	----	-----	----	----	-----	29	35	47

- A Benzene fire gives out dense black smoke which could reduce the visibility. All fire fighters must wear a chemical protection suit while handling the emergency, wear BA.

- All those not connected with the emergency handling should move beyond 1.1 km up wind.
- Initial fire fighting should be from a distance of 47 meter, unless fire suits, proximity suits are worn. All security staff must have respiratory protection.
- All persons handling the emergency should be sent to the Kandla Port hospital for urine test to check for Benzene poisoning.

4.7.6 1:3, BUTADIENE

Chemical		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
		ERPG - 3 5000 ppm	ERPG - 2 200 ppm	ERPG - 1 10 ppm	60%	10%	8 psi	3.5 psi	1.0 psi	10.0kW/m ²	5.0kW/m ²	2.0kW/m ²
		m	m	m	m	m	m	m	m	m	m	m
Jetty Thre e	1:3, BUTADIENE (Instantaneous Release)	92	524	2.4 Km	62	206	LOC not exceeded	48	63	-----	-----	-----

1:3, BUTADIENE (Evaporation Puddle)	22	157	736	13	53	LOC not exceeded	< 10	21	----	-----	----
1:3, BUTADIENE (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	34	42	57

- Initial fire fighting should be from a distance of more than 57 meters. The fire fighters should wear BA sets and chemical protection suits.
- The shanty should be evacuated beyond 2.4 Km distance.

4.7.7 ACETONE

Chemical		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
		TEEL - 3	TEEL - 2	TEEL - 1	60%	10%	8 psi	3.5 psi	1.0 psi	10.0kW/m ²	5.0kW/m ²	2.0kW/m ²
		5700 ppm	3200 ppm	200 ppm	m	m	m	m	m	m	m	m
Jetty There	ACETONE (Instantaneous Release)	97	134	591	56	190	LOC not exceeded	40	56	-----	-----	-----
	ACETONE (Evaporation Puddle)	10	17	111	< 10	22	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	-----	-----	-----

		m	m	m	m	m	m	m	m	m	m	m
Jet ty Th re e	METHANOL (Instantaneous Release)	178	431	1.0 Km	49	190	LOC not exceeded	LOC not exceeded	33	----	-----	----
	METHANOL (Evaporation Puddle)	< 10	33	89	< 10	< 10	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	----	-----	----
	METHANOL (Burning Puddle)	----	-----	----	----	-----	----	----	-----	11	12	15

- Fire fighters should note that acetone and methanol fires are non luminescent and there could be a tendency to go nearer to the puddle /pool on fire. This should be done by fire fighters fully equipped with fire suits / proximity suits. Acetone / Methanol are water soluble, which is advantageous for fire fighting.

4.7.9 Jetty No – 4 Instantaneous Release / Ev PROPYLENE

Chemical		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
		TEEL - 3 20000 ppm m	TEEL- 2 10000 ppm m	TEEL -1 1500 ppm m	60% m	10% m	8 psi m	3.5 psi m	1.0 psi m	10.0kW/m ² m	5.0kW/m ² m	2.0kW/m ² m
Jetty Four	PROPYLENE (Instantaneous Release)	51	80	233	74	253	LOC not exceeded	52	66	-----	-----	-----
	PROPYLENE (Evaporation Puddle)	30	53	163	51	194	LOC not exceeded	29	52	-----	-----	-----
	PROPYLENE (Burning)	-----	-----	-----	-----	-----	-----	-----	-----	33	41	55

Puddle)												
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- All emergency handling should be from a distance of more than 66 meters unless full fire suits / proximity suit is worn.
- **All personnel not directly connected with the emergency should be moved beyond 233 meters from the leak area.**

4.7.10 Jetty No – 4 Instantaneous Release / Ev VINYL CHLORIDE (VCM)

Chemical		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance		
		ERPG - 3	ERPG - 2	ERPG - 1	60%	10%	8 psi	3.5 psi	1.0 psi	10.0kW/m ²	5.0kW/m ²	2.0kW/m ²
		5000 ppm	1000 ppm	200 ppm								
		m	m	m	m	m	m	m	m	m	m	m
Jetty Four	VCM (Instantaneous Release)	47	108	376	45	152	LOC not exceeded	30	48	-----	-----	-----
	VCM (Evaporation Puddle)	< 10	15	52	< 10	23	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	-----	-----	-----

		m	m	m	m	m	m	m	m	m	m	m
Jet ty Fiv e	AMMONIA (Instantaneous Release)	219	589	1.4 Km	33	80	LOC not exceeded	LOC not exceeded	26	-----	-----	-----
	AMMONIA (Evaporation Puddle)	96	260	617	< 10	16	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	-----	-----	-----
	AMMONIA (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	< 10	11	13

- Emergencies involving Ammonia will be mostly leakage / spillage.
- Ammonia is flammable with difficulty.
- Ammonia emergencies should be handled by wearing BA sets.
- Ammonia is soluble in water, which will make it easier to handle the emergency.
- Do not direct water jet onto the liquid ammonia puddle, this could cause spurting of the liquid. Let the ammonia vapours come into the water spray / fog.

AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. AEGL-2 and AEGL-3, and AEGL-1 values as appropriate will be developed for each of five exposure periods (10 and 30 minutes, 1 hour, 4 hours, and 8 hours) and will be distinguished by varying degrees of severity of toxic effects. It is believed that the recommended exposure levels are applicable to the general population including infants and children, and other individuals who may be susceptible.

The three AEGLs have been defined as follows:

AEGL-1 is the airborne concentration, expressed as parts per million or milligrams per cubic meter (ppm or mg/m³) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL-2 is the airborne concentration (expressed as ppm or mg/m³) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3 is the airborne concentration (expressed as ppm or mg/m³) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Airborne concentrations below the AEGL-1 represent exposure levels that can produce mild and progressively increasing but transient and nondisabling odor, taste, and sensory irritation or certain asymptomatic, nonsensory effects. With increasing airborne concentrations above each AEGL, there is a progressive increase in the likelihood of occurrence and the severity of effects described for each corresponding AEGL. Although the AEGL values represent threshold levels for the general public, including susceptible subpopulations, such as infants, children, the elderly, persons with asthma, and those with other illnesses, it is recognized that individuals, subject to unique or idiosyncratic responses, could experience the effects described at concentrations below the corresponding AEGL.

4.7.12 Jetty No – 5 Instantaneous Release / Evaporation Puddle / Burning Puddle for HSD

		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
		TEEL 8600 ppm	TEEL 3300 ppm	TEEL 400 ppm	60%	10%	8 psi	3.5 psi	1.0 psi	10.0kW/m ²	5.0kW/m ²	2.0kW/m ²
		3	2	1								
		m	m	m	m	m	m	m	m	m	m	m
Jetty Five	HSD (Instantaneous Release)	59	112	370	73	240	LOC not exceeded	53	71	-----	-----	-----
	HSD (Evaporation Puddle)	<10	15	85	14	48	LOC not exceeded	10	19	-----	-----	-----

HSD (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	35	42	58
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- High Speed Diesel fires should be handled with care, by wearing fire suits / proximity suits.
- Foam should be used for fire fighting.

4.7.13 Jetty No – 6 Instantaneous Release / Evaporation Puddle / Burning Puddle for MOTOR SPIRIT

Chemical	Dispersion Distances	LEL Distances	Overpressure Distances	Pool Fire Heat Radiation Distance
----------	----------------------	---------------	------------------------	-----------------------------------

		TEEL - 3 1500 ppm m	TEEL - 2 610 ppm m	TEEL - 1 610 ppm m	60% m	10% m	8 psi m	3.5 psi m	1.0 psi m	10.0kW/m ² m	5.0kW/m ² m	2.0kW/m ² m
Jet ty Six	MOTOR SPIRIT (Instantaneous Release)	159	258	258	68	227	LOC not exceeded	51	66	----	-----	----
	MOTOR SPIRIT (Evaporation Puddle)	51	85	85	16	70	LOC not exceeded	11	24	----	-----	----
	MOTOR SPIRIT (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	37	45	61

- Motor spirit fires should be handled with care, by wearing fire suits / proximity suits.
- Foam should be used for fire fighting.

Jet ty Six	SKO (Instantaneous Release)	141	159	209	74	239	LOC not exceeded	54	73	-----	-----	-----
	SKO (Evaporation Puddle)	< 10	< 10	< 10	< 10	< 10	No part of the cloud was above the LEL	No part of the cloud was above the LEL	No part of the cloud was above the LEL	-----	-----	-----
	SKO (Burning Puddle)	-----	-----	-----	-----	-----	-----	-----	-----	28	35	48

- SKO fires should be handled with care, by wearing fire suits / proximity suits.
- Foam should be used for fire fighting.

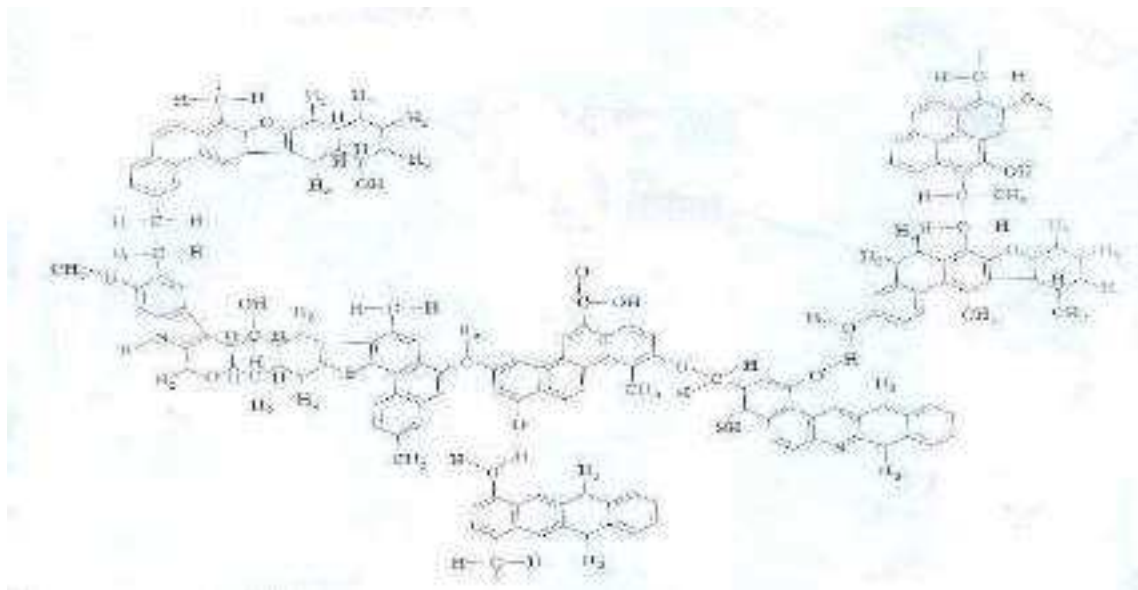
4.8 Coal Storage at Open Yard

4.8.1 General Characteristics of Coal

Coal is a fossil fuel extracted from the ground by underground mining or open pit mining. It is a readily combustible, black or brownish – black sedimentary rock. It is composed primarily of carbon along with assorted other elements.

Carbon forms more than 50% by weight and more than 70% by volume of coal.

Coal usually contains a considerable amount of incidental moisture, which is the water trapped within the coal in between the coal particles. The structure of a coal molecule is represented as follows:



Methane gas is another component of coal. Methane in coal is dangerous as it can cause explosion and may cause the coal to spontaneously combust.

4.8.2 Effects of Coal Burning

Combustion of coal, like any other compound containing carbon, produces CO_2 , along with minor amount of SO_2 .

Coal can be set on fire by spontaneous combustion

4.8.3 Spontaneous Combustion in Coal

The risk from fire exists where significant amounts of coal are in use or storage. Coal is a combustible material, making it susceptible to a variety of ignition scenarios. One of the most frequent and serious causes of coal fires is spontaneous combustion, which has been responsible for a number of incidents within the department in recent years.

Preventing spontaneous combustion coal fires involves attention to many different factors. Among the most critical are the type, age and composition of coal, how it is stored and how it is used. Given the right kind of coal, oxygen, and a certain temperature and moisture content, coal will burn by itself.

Spontaneous combustion has long been recognized as a fire hazard in stored coal. Spontaneous combustion fires usually begin as “hot spots” deep within the reserve of coal. The hot spots appear when coal absorbs oxygen from the air. Heat generated by the oxidation can initiate the fire.

Such fires can be very stubborn to extinguish because of the amount of coal involved (often hundreds of tons) and the difficulty of getting to the seat of the problem. Moreover, coal in either the smouldering or flaming stage may produce copious amounts of methane and carbon monoxide gases. In addition to their toxicity, these gases are highly explosive in certain concentrations, and can further complicate efforts to fight this type of coal fire.

Even the most universal fire fighting substance, water, cannot be used indiscriminately, because of the remote possibility of a steam explosion; it is advisable that water be applied carefully and from a safe distance. Certain chemicals such as carbon dioxide or nitrogen may mitigate fire effects, but their use has had mixed success from a DOE (Department of Energy) perspective. The above information suggests that coal fires require awareness and prior planning to extinguish efficiently, completely, and safely.

4.8.4 Causes of Spontaneous Coal Fires

The following general factors have been mentioned as contributing causes:

- ③ Coal handling procedures allowed for long-time retention of coal, which increases the possibility of heating

- ③ New coal added on top of old coal created segregation of particle sizes, which is a major cause of heating
- ③ Too few temperature probes installed in the coal bunker resulted in an excessive period of time before the fire was detected.
- ③ Failure of equipment needed to fight the fire
- ③ Ineffective capability and use of carbon dioxide fire suppression system
- ③ Delay in the application of water

4.8.4.1 Preventing Spontaneous Combustion in Stored Coal

High quantities of coal are stored in bunkers, silos, hoppers and open air stockpiles. How susceptible such stocks of coal are to fire from spontaneous combustion depends on a number of factors, from how new the coal is to how it is piled.

4.8.5 Recommendations for Coal Storage

- ③ Storing coal with low sulphur content is helpful. Sulphur compounds in coal liberate considerable heat as they oxidize.
- ③ Air circulating within a coal pile should be restricted as it contributes to heating; compacting helps seal air out.
- ③ Moisture in coal contributes to spontaneous heating because it assists the oxidation process. Moisture content should be limited to 3 %; sulphur content should be limited to 1 %, “as mined.” Coal having high moisture content should be segregated and used as quickly as possible. Efforts should be made to keep stored coal from being exposed to moisture.
- ③ Following the “First in, First out” rule of using stock reduces the chance for hot spots by helping preclude heat build up for portions of stock which remain undisturbed for a long term. The design of coal storage bins is important in this regard.

- ③ A high ambient temperature aids the spontaneous heating process. Remove coal as quickly as possible. The longer large coal piles are allowed to sit, the more time the spontaneous process has, to work.

- ③ The shape and composition of open stock piles can help prevent fires. Dumping coal into a big pile can lead to problems. Rather, coal should be packed in horizontal layers (opinions range from 1 ½' to 3' high) which are then levelled by scraping and compacted by rolling. This method helps distribute the coal evenly and thus avoids breakage and segregation of fine coal. Segregation of coal particles by size should be avoided, as it may allow more air to enter the pile and subsequent heating of finer sizes.

- ③ The height of the coal pile/stock is also important; limit un-layered, un-compacted high grade coal to a height of 15' maximum height.

- ③ Properly inspect, test and maintain installed fire protection equipment.

- ③ Maintain an updated pre-fire plan and encourage regular visits to coal facilities by the site or local emergency response force.

4.8.6 Roll Packing

Roll packing helps to exclude O₂ and thus to prevent fires by discouraging spontaneous combustion. Coal is distributed by a grab bucket or by other means in a uniform layer. The layer is then levelled by scraping and compacted by rolling. Distributing the coal evenly avoids breakage and segregation of the coal. The firm packing helps shed water.

4.8.7 Checking Temperature

Steam rising from a pile or the odour of burning coal is an indication of spontaneous heating, but an earlier or more reliable indication is obtained by checking the temperature/ hot spots/CO detection.

Rise of temperature can be noted by use of thermocouples. Hot spots can be detected by use of IR coal fire monitors. CO detectors can indicate that coal combustion has started.

4.9 Risk Analysis for Coal Fires in Storage Yard Berth 14

Data used for calculation of impact distance for coal fires. Type of coal – Bituminous (Medium Volatile)

Emissivity Constant (ϵ)	=	0.9 for Bituminous Coal
Stefan Boatmen constant	=	$5.6 \times 10^{-8} \text{ kW/m}^2 \text{ K}^4$

FQ 47K 4.9.1 Formula used for Calculation of Impact Distance (D) ✓ /

Where D	=	Distance from flame centre to receiving point.
Where F	=	Fraction of heat radiation = 0.15 (Conservative)
Where Q	=	Total Heat Generated /Emitted by Coal
Where K	=	Thermal Radiation level

Maximum temperature attained by flame of Coal $T_f = 900\text{DegC} = 1173\text{K}$

Ambient surrounding temperature $T_a = 27\text{DegC}$ to $35\text{DegC} = 300\text{K} - 308\text{K}$

$$Q = \sigma A \epsilon (T_f^4 - T_a^4)$$

$$\sigma = 5.68 \times 10^{-8} \text{ kW/m}^2 \text{ K}^4$$

$$T_f^4 = (1173)^4 \text{ K}$$

$$T_a^4 = (300)^4 \text{ K}$$

For active coal burning area = 10m^2

$$Q = 5.6 \times 10^{-8} \times 0.9 \times 10 (1173^4 - 300^4)$$

$$Q = 950 \text{ kW}$$

For Heat radiation 4 kW/m^2 impact distance D

$$D = \sqrt{(950 \times 0.15) / (4 \times 3.14 \times 4)} = 1.68 = 1.7\text{m}$$

For Heat radiation 12.5 kW/m^2 impact distance D

$$D = \sqrt{(950 \times 0.15) / (4 \times 3.14 \times 12.5)} = 0.9527 = 1 \text{ m}$$

For Heat radiation 37.5 kW/m^2 impact distance D

$$D = \sqrt{(950 \times 0.15) / (4 \times 3.14 \times 37.5)} = 0.55\text{m}$$

For active coal burning area – 100 m^2

$$Q = 5.6 \times 10^{-8} \times 0.9 \times 100 (1173^4 - 300^4)$$

$$= 9500 \text{ kW/m}^2$$

For Heat radiation 4 kW/m^2 impact distance D

$$D = \sqrt{(9500 \times 0.15) / (4 \times 3.14 \times 4)} = 5.32 \text{ m}$$

For Heat radiation 12.5 KW/m^2 impact distance D

$$D = \sqrt{(9500 \times 0.15) / (4 \times 3.14 \times 12.5)} = 3.012 \text{ m}$$

For Heat radiations 37.5 KW/m² impact distance D

$$D = \sqrt{(9500 \times 0.15) / (4 \times 3.14 \times 37.5)} = 1.74 \text{ m}$$

The Damage Effects Due to Thermal Radiation of Varying Intensity

Incident Radiation Intensity (kW/m ²)	Type of Damage
37.5	Sufficient to cause damage to process equipment unless the equipment is fully thermally fire protected (Insulation, fire proofing, sprinkler protection etc)
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing, etc.
4.5	Sufficient to cause pain to personnel if unable to reach within 20 seconds, blistering of skin (1st degree burns) is likely.

4.9.2 Summary:

Heat Radiation Impact distance for	Active Burning Coal Area	
	10 m ²	100 m ²
4 kW/m ²	1.7 m	5.3 m
12.5 kW/m ²	1.0 m	3.0 m

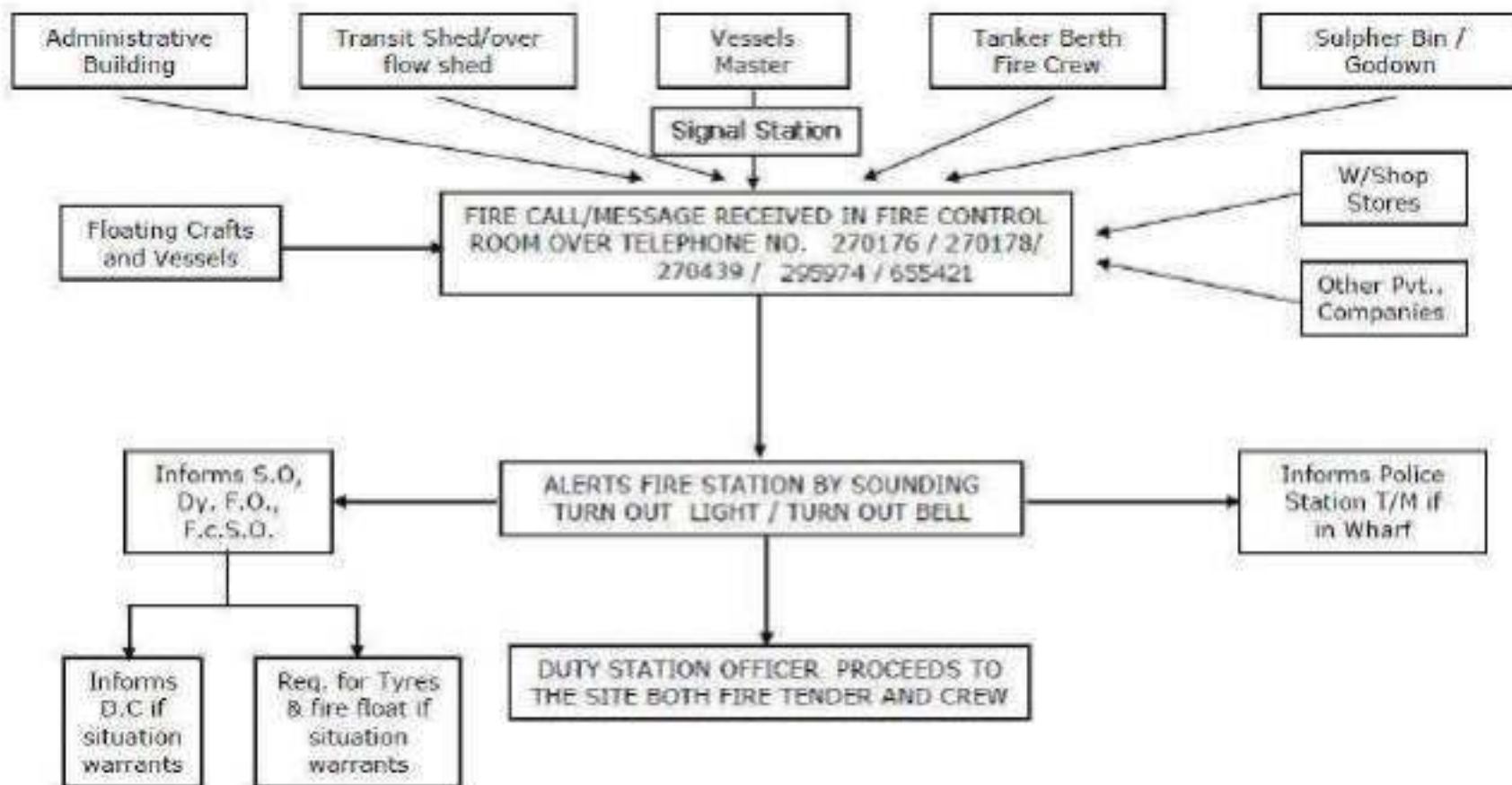
37.5 kW/m ²	0.5 m	1.74 m

Assuming that 100m² surface area of the coal stack is smouldering no person should approach the stock within 6 m distance.

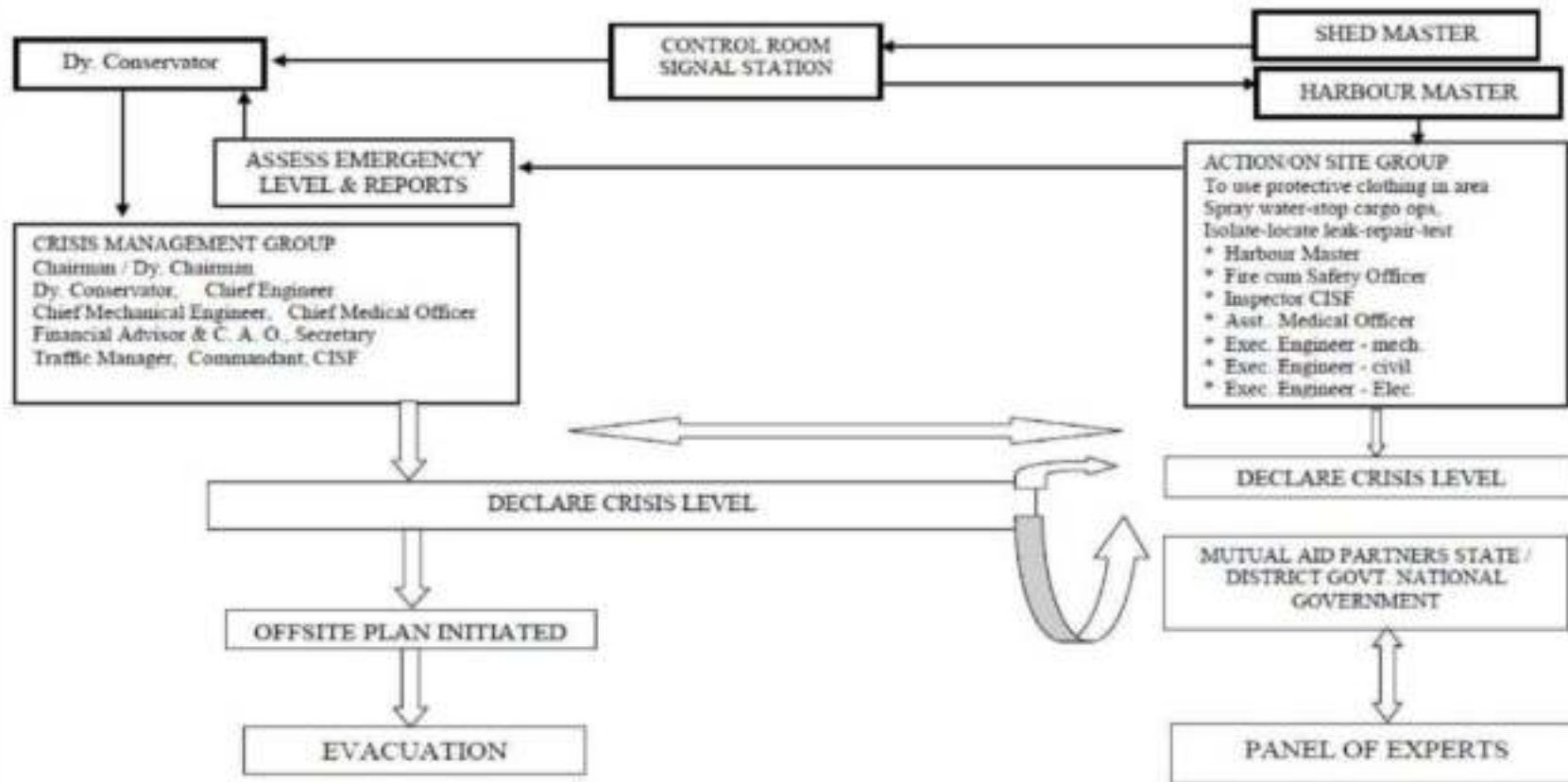
All fire fighting should be done from more than 5.3 m away from the affected coal stack unless the fire fighter is fully clothed with fire protective clothing and respiratory protection

Please note that CO could also be emitted during a coal fire due to incomplete combustion. Hence adequate respiratory protection should be used like canister gas mask or Self Contained Breathing Apparatus –SCBA

4.10 Fire & Explosion Response Plan



4.11 Fire & Toxic Leakage



PROCESS

- | | |
|--|--|
| (1) Master or informer raises alarm | (2) Inform control room at the Fire Station |
| (3) Advises D.C. and H.M and Action Group | (4) Action group commences to use protective clothing in area
-Spray water-stop cargoes/Isolate – locate leak-repair test |
| (5) Declare crisis level | (6) Crisis level endorsement by crisis management group |
| (7) If crisis level declared is greater | (8) Mutual aid partners contacted and district emergency plan initiated |
| (9) If necessary evacuation commenced partial or full. | |

4.12 Details of Fire Fighting Equipment available at Kandla Port

4.12.1 Fire Water Tender – 6 Nos

Water Tank Capacity: 6000 liters. (Discharge Capacity 2250 liters/PER MIN at 7.5kg/cm² & 300 liters at 40kg/cm²).

Fire Monitor Discharge capacity 2750 lpm at 7kg/cm² with effective throw/Jet of minimum 45 meters.

Fire Fighting Equipments:

- RRL Hose 15mtrs X 63mm (ID)
- Foam AFFF 3%
- Various type of Branches
- Hose Fittings
- Small Gears
- Personnel Protective equipment (PPE)
- Additional Foam Fighting System
- Communication System
- Public Address system
- Extension Ladder

4.12.2 Foam Fire Tender – 3 Nos

Water Tank Capacity: 5000 liters. (Discharge Capacity 2250 liters at 7.5kg/cm² & 300 liters at 3.5kg/cm²).

Foam Tank Capacity: 1000 liters.

Fire Monitor Discharge capacity 2750 lpm at 7kg/cm² with effective throw/Jet of minimum 45 meters.

Additional CO₂ Extinguishing System.

Fire Fighting Equipments:

- RRL Hose 15mtrs X 63mm (ID)
- Foam AFFF 3%
- Various type of Branches
- Hose Fittings
- Small Gears
- Personnel Protective equipment (PPE)
- Additional Foam Fighting System
- Communication System
- Public Address system
- Extension Ladder

4.12.3 Multi Purpose Fire Tender – 1 No

Water Tank Capacity: 5000 liters. (Discharge Capacity 2000 liters at 10kg/cm² & 300 liters at 3.5kg/cm²).

Foam Tank Capacity: 1000 liters.

Fire Monitor Discharge capacity 2750 lpm at 7kg/cm² with effective throw /Jet of minimum 45 meters.

Additional CO₂ Extinguishing System.

Additional Dry Chemical Powder Extinguishing System.

Fire Equipments:

- RRL Hose 15mtrs X 63mm (ID)
- Foam AFFF 3%
- Various type Branches
- Hose Fittings
- Small Gears
- Personnel Protective equipment (PPE)
- Addition Foam Fighting System
- Communication System
- Public Address system
- Extension Ladder

4.12.4 SURVEYED OFF NEW PROCUREMENT IN PROCESS

4.12.5 Tank Lorry - 01 No.

- Tank Capacity 12,000 liters.
- Anti Pollution Scheme.

4.12.6 Fire Jeep – 01 No.

Pump Discharge Capacity 1800 liters at 7kg/cm².

Fire Fighting Equipments:

- RRL Hose 15mtrs X 63mm (ID)
- Various type of Branches
- Hose Fittings
- Small Gears
- Personnel Protective equipment (PPE)
- Communication System
- Public Address system
- Extension Ladder

4.12.7 Safety Jeep – 01 No.

For proper Coordination, Inspection, in around the Port (Oil & Chemical Tank Farm & Administrative Works).

Fire Fighting Equipments:

- Small Gears
- Personnel Protective equipment (PPE)
- Communication System
- Public Address system

4.12.8 Ambulance – 01 No.

For Transportation of Injured Ship Official, Ship Crews and Victims.

4.13 Station wise Manpower Break Up (Manned Round The Clock)

4.13.1 Emergency Response Centre / Old Kandla Fire Station (Liquid Cargo Jetty)

- Fire cum Safety Officer – 01
- Deputy Fire Officer – 01
- Station Officers – 02 Nos
- Leading Fireman– 02 Nos
- Pump Operator cum Driver – 03 Nos
- Fireman – 08 Nos

Oil Jetty No. 1 (LPG Jetty)

- Leading Fireman – 01
- Pump Operator cum Driver – 01
- Fireman– 04 Nos

Oil Jetty No. 2

- Leading Fireman– 01
- Fireman– 04 Nos
- Pump Operator cum Driver – 01

Oil Jetty No. 3

- Leading Fireman – 01
- Fireman– 04 Nos

Oil Jetty No. 4

- Leading Fireman – 01

- Pump Operator cum Driver – 01
- Fireman– 04 Nos

Oil Jetty No. 5 (IFFCO Jetty)

- Leading Fireman – 01
- Pump Operator cum Driver – 01
- Fireman– 04 Nos

While LPG Tanker is discharging the LPG at Oil Jetty No.1, a Station Officer shall be in charge till the unberthing of LPG Vessel.

Above Fire Crews will be posted at Oil Jetties depending upon the Nature of Risk Cargo Handled.

4.13.2 Tilak Fire Station (Dry Cargo Jetty).

- Station Officers– 01 No
- Leading Fireman– 01 No
- Pump Operator cum Driver– 02 Nos
- Fireman – 04 Nos

For Running & Maintenance of First Aid, Fire Equipments installed at various work places of Kandla Port.

- Leading Fireman– 01 No
- Fireman – 02 Nos

4.13.3 Azad Fire Station (Dry Cargo Jetty).

- Station Officers– 01 Nos

- Leading Fireman– 01 No
- Pump Operator cum Driver– 02 Nos
- Fireman – 04 Nos

4.14 Fire fighting facility at Chemical / Oil Handling Berths

4.14.1 Oil Jetty No: 1

Fixed 2 nos water/foam monitors mounted on towers at each end of each berth.

There are three vertical turbine pumps each of 500m³/hr capacity. One each of Electrical Fire Water Pumps, Diesel Engine Fire water pumps, Electrical flushing pumps.

Jetty one LPG side – 12 DCP – 5Kg Fire Extinguishers, 2 DCP – 150 Kg Trolley mounted fire extinguishers.

4 Fire suits, 2 BA sets with 2 spare respirable air cylinders.

Fire equipment Room:

- Foam / DCP – 15 Nos fire extinguishers
- Helmets – 6 Nos
- Hose length (15 meters) 10 Nos
- Manual Siren – 1No
- Gum Boots – 6 Pairs
- Ropes
- Foam compound 1000 Liters
- Hose fittings
- Branch Pipes
- Fire Axe

- Safety shower – 1 No
- Water curtains
- Fire suits – 2 Nos
- Canister gas mask – 1 No
- Telephone
- Mobile foam trolley – 100 Liters

4.14.2 Oil Jetty No: 2

Fixed foam / water remote controlled monitors mounted on towers at each end of each berth.

There are two vertical turbine pumps each of 800m³/hr capacity, two jockey pumps of 25m³/hr capacity, two foam pumps each of 22m³/hr capacity, two foam /water remote controlled tower monitors, and six jumbo curtains installed at the jetty face.

Fire equipment Room:

- Foam /DCP – 10 Nos each fire extinguishers
- Helmets – 6 Nos
- Fire Hoses - 10 Nos
- BA set – 1No
- Gum Boots – 6 Pairs
- Foam making branch pipes – 2 Nos
- Female coupling –8 Nos
- Jet branch pipes –5 Nos
- Fire suits -2 Nos
- Foam compound - 50 x 30 Liters
- Chemical Suits- 2 Nos
- Fire Axe- 1No
- DCP Fire extinguishers – 10 Nos

- Foam Fire extinguishers – 10 Nos
- Fire Buckets – 10 Nos
- Oil Dispersant – 10 x 20 Liters
- Rubber hand gloves – 6 Nos
- Hose length – 15 meters (10 Nos)

4.14.3 Oil Jetty No: 3, 4 & 5

In Oil Jetty No: 3, there are two foam pumps, with foam tank, 2 remote controlled tower monitors for foam / water spray, 2 sets of jumbo curtains at jetty face, one flame detection system, one 50KW DG set and control console.

Oil Jetty No: 4, there are three vertical turbine pumps each of 500m³/hr capacity, 2 foam pumps with foam tank, 2 remote control tower monitors of capacity 3000 liters per minute of water, 3 jumbo curtains at jetty face, 50 KW DG set and control console.

Oil Jetty No: 5, there are two fire water pumps each of 270m³/hr capacity, (One electrical driven pump, and one diesel engine pump each).

Fire equipment Room:

- Fire buckets – 8 Nos
- Manual Fire Sirens – 1 No
- Foam branch pipes – 4 Nos
- Mechanical foam generator – 2Nos
- Foam compound – 1000 Liters
- BA set – 1 No
- Gum Boots – 6 Pairs
- Helmets – 6 Nos
- Hose length (15 Meters) – 10 Nos
- DCP fire extinguishers – 10 Nos

- Foam fire extinguishers – 5 Nos
- Fire suits – 2 Nos
- Dispersant chemicals - 6 x 20 Lets
- Double female couplings – 8 Nos
- Male coupling – 2 Nos
- Diffuser – 2 Nos
- Water Curtain – 1 No
- Jet Branch Pipe – 2Nos
- Canister Gas Masks – 1 No
- Portable foam / water monitor – 1 No
- Mobile foam generator
- Safety Shower – 1No

4.14.4 Oil Jetty No: 6

- 2 – Nos Diesel engine fire water pumps 820m³/hour each.
- 1 – HP Jockey pump electrical 80m³/hour
- Fire blankets (water jel)
- Smoke detectors in fire pump house
- Hand tool set
- Water curtains nozzles – 2 Nos • AFFF foam
- DCP fire extinguishers – 6 Nos
- Trolley mounted DCP fire extinguishers – 4 Nos
- CO₂ fire extinguishers – 6 Nos
- Foam fire extinguishers – 6 Nos

4.15 General Fire fighting guidelines at the Oil Jetty

1. Stop all loading / unloading operations and close valves.
2. All fire fighters will be apprised of the chemicals and POL products normally handled at the jetties. A set of MSDS is available at the fire station.
3. As a general rule all fire fighting will be carried out from a distance of 60 meter (Average heat radiation experience of $2\text{kw}/\text{m}^2$). If the fire fighters are required to go closer to the fire then fire suits / close proximity suit must be worn. If necessary, water cover could be provided to the fire fighters going closer to the fire.
4. The water curtain along the edge of the berth will be activated for fire / leak / spill emergency at the berth.

and any available tug should be immediately put on s/by.
5. All emergency equipment should be placed beyond the over pressure distance of about 60 meters (Average overpressure distance for 1.0 psi experience) to avoid damage to them.
6. The remote water / foam monitor should be operated to control the fire at the jetty. If properly used the fire will be immediately controlled.
7. All persons not connected with handling the emergency should be moved beyond the TEEL – 1 / ERPG – 1 level distance which is an average distance of 1 Km. But if toxic chemical release takes place then the people from the shanty should be moved beyond 3 Km distance of the fire.
8. All security staff (CISF) should also have access to respiratory protection as they may not be able to leave their post.
9. External help should be obtained as soon as it is felt that the emergency is grave.

10. CISF guards will keep note of all incoming aid equipment.
11. After the emergency is over the Deputy Conservator / Harbour Master will assign a senior management team to verify that there is no longer a threat of further fire / leak / spill, to assess damage and initiate repairs

as needed.
12. Any emergency at the chemical jetties or at the dry cargo berths will be informed to the Deputy Conservator / Harbour Master, who will activate the DMP if necessary.

4.16 General guidelines in case of Toxic Chemical spill / leak

1. Stop all loading / unloading operations and close valves.
2. All emergency operation should be carried out from up wind direction. This may always not be possible. All persons handling a chemical leak / spill should wear chemical protection suit and respiratory protection like gas mask / BA sets.
3. any available tug should be put on alert or pressed into operation.
4. Deputy Conservator / Harbour Master should be informed of a chemical spill however small it may be.
5. CISF should have access to respiratory protection as they may not be able to leave their post.
6. In case of a major chemical leak / spill the neighbouring shanty should be evacuated especially if chemicals like, Acrylonitrile, Benzene, Aniline, 1:3 Butadiene, Vinyl Chloride, Styrene has spilled.
7. Attempts could be made to salvage the spilled chemical or dispersant could be applied to the spill.

8. The chief fire officer should be kept informed of the chemicals being loaded / unloaded at the port chemical berths on a daily basis.

Important fire fighting methods and spill handling methods of the concerned chemicals should be then informed to the fire fighters. They should also be apprised of the health effects and water solubility of the concerned chemicals.

IDENTIFICATION OF EMERGENCIES AT THE OIL & CHEMICAL FACILITIES AROUND THE KANDLA PORT

5.1 Impact Distances

Under the Risk Assessment Study for the DEENDAYAL PORT TRUST carried out by Tata AIG Risk Management Services Ltd in the year 1999, various failure scenarios have been identified for different facilities around the port and these have been simulated using Phast / Safeti software. These failure scenarios have been categorized into Maximum Credible Loss Scenarios (MCLS) and Worst Case Scenarios (WCS).

These failures can be due to number of reasons like material failure, human error. The failures could also be on account of natural disasters like earthquake, flood etc or they could be due to external factors like missile attack or terrorist attack. On failure due to any account mentioned above and depending on the extent of damage, there can be partial or total loss of confinement of hazardous materials handled in the port.

5.2 Maximum Credible Loss Scenarios (MCLS) considered for the study

5.2.1 Scenario 1 – Butadiene Sphere of United Storage and Tank Terminals Ltd.

There are 4 Butadiene Spheres in the terminal. We have considered the 1000 M.T. sphere for the study. Butadiene is stored at 3 to 4 Degree C and pressure in the sphere is maintained at 0.8 bar. The temperature of Butadiene is controlled by brine chillers cooled by Freon refrigeration system. The probability of BLEVE is very remote, considering there are two compressors and DG set is provided to take care of full power load of terminal in case of power failure. However, for Consequence Analysis study, we have considered BLEVE of 1000 M.T. Butadiene Sphere. It is assumed that the catastrophic rupture of the sphere takes place at a pressure of 25 bar.

Initial temperature (K) : 395. Initial pressure (bar (g))
 : 25.0

5.2.1.1 Radiation Effects: Bleeve / Fire Ball

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5m/s C	2m/s D
1.	4	1558	1558
2.	12.5	919	919
3.	37.5	526	526

5.2.1.2 Explosion Effects

Sr. No.	Over pressure		Distance in meters	
	BAR(g)	PSI (g)	5.0m/s;C	2.0m/s; D
1.	0.0207	0.3	3246	3246
2.	0.1379	2	841	841
3.	0.2068	3	650	650

Comments:

1. In case of BLEVE a radius of 526 m. could be subjected to heat radiation, intensity of 37.5 kw/m². This would affect the facilities of Synthetics and chemicals, Indo Nippon, Kesar Enterprises, Bayer ABS & Chemicals and Resins. A portion of IFFCO facility (boundary) would also be subject to 37.5 KW per m² radiation intensity. This could cause fires in the neighbouring areas and this is likely to lead to domino effect. Employees within a radius of 1.5 km. from the sphere would suffer burn injuries.
2. Structural damage is likely within a radius of 650 m. from the sphere. This would damage nearby tanks, buildings and is likely to lead to domino effect which could aggravate the emergency. Upto a distance of 3.2 k.m there would be window glass breakage.

3. The possibility of BLEVE is less likely as the Horton spheres are maintained at low temperatures and at low temperature. There is also a standby DG set to take care of 100% electrical load of the terminal. The spheres are protected by water spray ring system along with a hydrant system.

5.2.2 Scenario 2 - Phenol storage of United Storage and Tank Terminals Ltd.

In the United storage terminal there is a phenol storage tank. In the event of bottom nozzle rupture or a large overflow from the tank, phenol would spill out and the contents would be within the dyke.

5.2.2.1 Dispersion Distance for PHe nol

Sr. No.	Concentration of interest ppm	Dispersion Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	100	103	90

5.2.2.2 Radiation Effects – Pool Fire

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	32	32
2.	12.5	25	22
3.	37.5	12	12

Comments:

Phenol has IDLH of 100 ppm concentration and the vapours are toxic. Toxic vapour of 100 ppm. Concentration would disperse upto 90 to 103 meters in the downward direction. This scenario may have a moderate off site implication due to toxic vapours.

5.2.3 Scenario 3 - Toluene storage of United Storage and Tank Terminals Ltd.

It is assumed that the tank has a diameter of 15 m. and dyke dia of 30 meters. In case of bottom nozzle failure of large overflow toluene would accumulate in the dyke. In case, the pool encounters the source of ignition, a pool fire would result.

5.2.3.1 Dispersion Distance for Toluene

Sr. No.	Concentration of interest Vol %	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	1.2 (LEL)	63	72

5.2.3.2 Radiation Effects – Pool Fire

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	59	44
2.	12.5	25	22
3.	37.5	20	19

5.2.3.3 Flash Fire

Sr. No.	Distance (m)	Distance in meters (1/2 LEL Distance)	
		5.0m/s;C	2.0m/s; D

1.	Furthest extent (m) for flash fire	111	121
----	------------------------------------	-----	-----

Comments:

In case of a pool fire, the radiation effect is likely to be contained within the site. A flash fire distance is approximately 120 m. This means that a flammable cloud could cause a flash fire due to source of ignition within 120 m. in the downward direction. The flash fire would result in a pool fire.

The terminal has its own independent fire protection and fire fighting system which can reduce the affected distance by immediate actions like spray of foam compound over the pool formed in the dyke to prevent ignition and reduce the rate of evaporation.

5.2.4 Scenario 4 – Acrylonitrile storage of Bayer ABS

Acrylonitrile polymerises in the presence of light and at high temperature. If polymerization takes place in the tank, it could explode resulting in large release of Acrylonitrile. Acrylonitrile could also be released in the event of bottom nozzle failure of tank or overflow into the dyke.

5.2.4.1 Dispersion Distance for Acrylonitrile

Sr. No.	Concentration of interest ppm	Dispersion distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4 (IDLH)	4026	12000

5.2.4.2 Radiation Effects – Pool Fire

Sr. No.	Radiation levels (kW/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	80	85

2.	12.5	57	53
3.	37.5	42	32

5.2.4.3 Flash Fire

Sr. No.	Distance (m)	Distance in meters (1/2 LEL Distance)	
		5.0m/s; C	2.0m/s; D
1.	Furthest extent (m) for flash fire	118	125

Comments:

1. Acrylonitrile has boiling point of 77Degree C and IDLH 4 ppm concentration. However, it should be noted that on polymerization and in fire condition, Acrylonitrile would decompose to release hydrogen cyanide and NOx.
2. The dispersion distance for 4 ppm concentration of Acrylonitrile vapours could be 12 kms if the wind speed is 2 m/sec and atmospheric stability D. However, this distance could be reduced if timely action is taken.
3. Bayer ABS maintains a good safety code of practice. They have conducted various safety studies and have a good maintenance system. Moreover the emergency management plan is well prepared and rehearsed in house. The standard of housekeeping in the terminal is good. The personnel working in the terminal have a good knowledge of the actions to be taken in the event of an emergency.

5.2.5 Scenario 5 - Styrene storage of Bayer ABS

Bayer ABS has a 1210 KL styrene tank. Styrene can undergo violent polymerization above 65 degree C, which could be explosive. It is assumed that the tank diameter is 12.5 m. and bund is 22.5 x 22.5 m². In case of bottom nozzle failure, overflow, shell rupture, the material would accumulate in the dyke and if it would encounter the source of ignition, a pool fire would result.

5.2.5.1 Radiation Effects

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	52	43
2.	12.5	26	21
3.	37.5	23	17

Comments:

1. The radiation effect would be restricted to the site and is not likely to have off site implication. However, on polymerization and fire condition, styrene generates enormous quantity of soot and splinter could fly off. This could affect neighboring areas.
2. The high safety standards maintained and observed at site would go a long way in preventing catastrophic scenarios.

5.2.6 Scenario 6 - Benzene storage of Indo Nippon

In Indo Nippon terminal Benzene is stored in an 1800 KL tank. Pool fire scenario has been considered for the tank assuming tank diameter as 12 m. and dyke dia as 25 m.

5.2.6.1 Dispersion Distance for Benzene

Sr. No.	Concentration of interest Vol%	Dispersion Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	1.3	119	120

5.2.6.2 Radiation Effects: Pool Fire

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D

1.	4	55	42
2.	12.5	23	20
3.	37.5	20	16

5.2.6.3 Flash Fire

Sr. No.	Distance (m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	Furthest extent (m) for flash fire	175	175

Comments

In case of pool fire radiation effect would be restricted to site.

5.2.7 Scenario 7 - Methanol storage of Indo Nippon

Methanol is stored in 2500 KL tank, dyke dia is assumed as 30 m. And tank dia as 15 m.

5.2.7.1 Dispersion Distance for Methanol

Sr. No.	Concentration of interest Vol%	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	6	36	47

5.2.7.2 Radiation Effects: Pool Fire

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	66	73

2.	12.5	48	48
3.	37.5	37	34

5.2.7.3 Flash Fire

Sr. No.	Dispersion (m)	Dispersion Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	Furthest extent (m) for flash fire	172	83

5.2.7.4 Explosion Effects – Late Ignition

Sr. No.	Over pressure		Distance in meters	
	BAR(g)	PSI (g)	5.0m/s;C	2.0m/s; D
1.	0.0207	0.3	110	137
2.	0.1379	2	80	95
3.	0.2068	3	78	91

Comments:

1. In case of pool fire, the radiation effect would be restricted to the site.
2. Methanol has a low boiling point i.e. (65oC.), hence if timely action is not taken, a large amount of Methanol would vaporize and unconfined vapour cloud would be formed which if it encounters a source of ignition would explode.
3. In case of unconfined vapour cloud explosion there may be a moderate implication on the surrounding facilities (Synthetics & chemicals and J R Enterprises).

5.2.8 Scenario 8 - Refrigerated Butadiene storage tank of Synthetics and chemicals

There are two atmospheric storage tanks of Butadiene having capacity of 2000 MT each. The storage temperature is maintained at minimum 8oC. Ammonia is used as refrigerant. The tank is double walled

tank, catastrophic rupture of the tank is improbable. It is assumed that if the roof of the tank fails and a pool fire has taken place whose diameter equals the diameter of the tank.

5.2.8.1 Radiation Effects: Pool Fire

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	46	74
2.	12.5	41	41
3.	37.5	33	19

5.2.8.2 Flash Fire

Sr. No.	Distance (m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	Furthest extent (m) for flash fire	97	4

Comments:

The radiation distance would be contained within the site.

5.2.9 Scenario 9 - IFFCO Ammonia Sphere

IFFCO has refrigerant ammonia storage tanks. There are two 1500 m/tons Horton Spheres. In case of external fire, the sphere would be heated up. The external fire would cause the shell above the liquid level to get weakened.

5.2.9.1 Dispersion Distance for Ammonia

Sr. No.	Concentration of interest ppm	Distance in meters	
		5.0m/s;C	2.0m/s; D

1.	500 (IDLH)	10440	9908
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Comments:

1. A toxic ammonia cloud of IDLH concentration (500 ppm) would disperse up to 10 km. in the downward direction.
2. Considering that ammonia is highly soluble in water and it is a light gas, the severity of the scenario could be greatly reduced by timely action. I.e. application of water spray to ammonia cloud.
3. The ammonia storages are well protected. The company has its own fire and safety department with fire engines and fire fighting personnel on duty round the clock. The company has a good preventive maintenance programme. Safety training is given to all employees.

5.2.10 Scenario 10- Phenol storage of Kesar Enterprises

Kesar Enterprises terminal phenol is stored in a 566 KL steam jacketed tank. In case of overflow or bottom nozzle failure, phenol would accumulate in the dyke.

5.2.10.1 Dispersion Distance for Phenol

Sr. No.	Concentration of interest ppm.	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	100 (IDLH)	103	90

5.2.10.2 Radiation Effects: Pool Fire

Sr. No.	Radiation levels (kW/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	32	32
2.	12.5	25	22
3.	37.5	12	12

Comments:

1. Phenol vapour of IDLH 100 ppm would disburse upto 131 to 197 m. in downward direction. This may have a moderate off-site implication.

5.2.11 Scenario 11 - Acrylonitrile storage of Kesar enterprises.

In Kesar terminal, Acrylonitrile is stored in a 2526 KL tank. Acrylonitrile polymerises in the presence of light and at high temperature. In case of polymerization, the distances affected could be as follows.

5.2.11.1 Dispersion Distance for Acrylonitrile

Sr. No.	Concentration of interest ppm	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	4075	12150

5.2.11.2 Radiation Effects: Pool Fire

Sr. No.	Radiation levels (kW/sq m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	4	91	96
2.	12.5	65	58
3.	37.5	46	35

5.2.11.3 Flash Fire

Sr. No.	Distance (m)	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	Furthest extent (m) for flash fire	119	126

Comments

1. The dispersion distance for Acrylonitrile for a cloud of 4 ppm concentration is approximately 12 km in the downwind direction, if the wind speed is 2 m/s at atmospheric stability is D. However, this would be greatly reduced if timely action is taken.
2. The polymerization products include Hydrogen Cyanide and Nox.

5.2.12 Scenario 12 - Aniline storage - JK Synthetics Terminal

Aniline is stored in the JK Terminal. The tank diameter is considered 12m and dyke diameter as 25m.

5.2.12.1 Dispersion Distance for Aniline

Sr. No.	Concentration of interest ppm	Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	100	92	177

Comments:

1. In case of overflow of tank or bottom nozzle rupture aniline would accumulate in the dyke.
2. Aniline has an IDLH value of 100 ppm. Toxic vapour of aniline would disperse upto 177 m. in the downwind direction, if the wind speed is 2m/sec.
an atmospheric stability D.
3. The rate of evaporation could be reduced by blanketing with water.

5.2.13 Scenario 13 - BLEVE of LPG road tanker

LPG Road Tankers are filled up at the IOCL terminal. In case of over pressurization of the bullets a BLEVE could take place. Over pressurization could take place because of external fire. In case of an accident of the road tanker on the road, LPG would spill out and could result in an unconfined vapour cloud explosion. One 10 ton LPG road tanker has been considered for the study.

5.2.13.1 Radiation Effects – Bleeve / Fireball

Sr. No.	Radiation levels (Kw/sq m)	Distance in meters	
		5m/sC	2m/s D
1.	4	345	345
2.	12.5	196	196
3.	37.5	108	108

5.2.13.2 Explosion Effects

Sr. No.	Over pressure		Distance in meters	
	BAR(g)	PSI (g)	5.0m/s;C	2.0m/s; D
1.	0.0207	0.3	707	707
2.	0.1379	2	183	183
3.	0.2068	3	141	141

5.2.14 Scenario 14 - Naphtha storage of BPCL

In case of a dyke fire or tank roof fire of a naphtha storage tank in BPCL terminal the damage distances would be as follows.

Sr No	Commodity	Scenario	Wind Speed (M/S)	Damage Distance for Pool fire(Meters)		
				4 kW/m ²	12.5 kW/m ²	37.5 kW/m ²
1.	Naphtha	Dyke fire	3	205	71	31
2.	Naphtha	Tank Roof	3	188	65	29

		Fire				
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5.2.15 Scenario 15 - Catastrophic rupture of 15000 MT cryogenic LPG tank of IOCL

The possibility of catastrophic rupture of the cryogenic LPG tank is very remote. However in case of such a scenario the damage distances would be as follows.

5.2.15.1 Explosion Effects

Sr. No.	Over pressure		Distance in meters	
	BAR(g)	PSI (g)	5.0m/s;C	2.0m/s; D
1.	0.0207	0.3	316	302
2.	0.1379	2	169	176
3.	0.2068	3	157	166

5.2.16 Scenario 16 - Catastrophic rupture of ammonia road tanker

In case of catastrophic rupture of ammonia road tanker the damage distances would be as follows.

5.2.16.1 Dispersion Distance for Ammonia

Sr. No.	Concentration of interest ppm	Dispersion Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	500	1866	1592

5.2.17 Scenario 17 - Leak from Acrylonitrile road tanker

In case of leak from one compartment (Capacity 3 tons) from an Acrylonitrile road tanker, the affected distances would be as follows.

5.2.17.1 Dispersion Distance for Acrylonitrile

Sr. No.	Concentration of interest ppm	Dispersion Distance in meters	
		5.0m/s;C	2.0m/s; D
1.	400	574	1508

6 TOXIC HAZARD RANKING FOR HAZARDOUS CHEMICALS HANDLED AT PORT PREMISES

6.1 Hazard Ranking

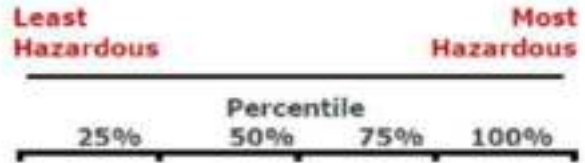
6.1.1 Propane



6.1.2 Butane

CHEMICAL PROFILES | Hazard Rankings

Chemical: [BUTANE](#)
CAS Number: 106-97-8



Human Health Rankings

[Toxicity and exposure potential](#)

[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

[Toxicity and persistence](#)

[Environmental Hazard Value Score \(IRCH\)](#)



Integrated Environmental Rankings

[Combined human and ecological scores](#)

[Total Hazard Value Score \(IRCH\)](#)

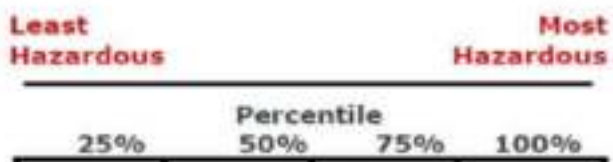


6.1.3 Toluene

CHEMICAL PROFILES | Hazard Rankings

Chemical: [TOLUENE](#)

CAS Number: 108-88-3



Human Health Rankings

Toxicity only

[Ingestion Toxicity Weight \(RSEI\)](#)



[Inhalation Toxicity Weight \(RSEI\)](#)



[Human Health Effects Score \(UTN\)](#)



Toxicity and exposure potential

[Noncancer Risk Score - Air Releases \(EDF\)](#)



[Noncancer Risk Score - Water Releases](#)



(EDF)

[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

Toxicity only

[Ecological Effects Score \(UTN\)](#)



Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#)



Integrated Environmental Rankings

Combined human and ecological scores

[Total Hazard Value Score \(IRCH\)](#)



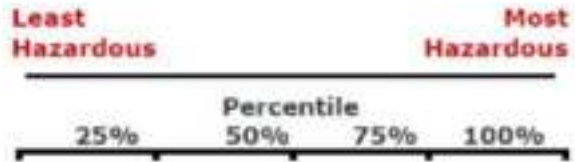
[Total Hazard Value Score \(UTN\)](#)



6.1.4 Acrylonitrile

CHEMICAL PROFILES | Hazard Rankings

Chemical: [ACRYLONITRILE](#)
CAS Number: 107-13-1

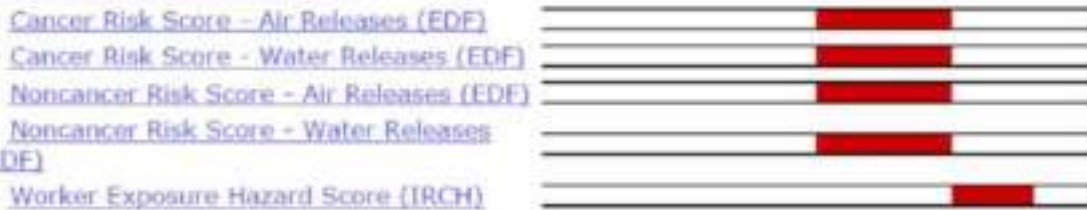


Human Health Rankings

Toxicity only



Toxicity and exposure potential



Ecological Health Rankings

Toxicity only



Toxicity and persistence



Integrated Environmental Rankings

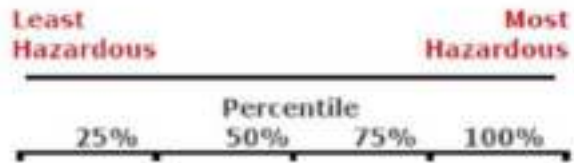
Combined human and ecological scores



6.1.5 Aniline

CHEMICAL PROFILES | Hazard Rankings

Chemical: [ANILINE](#)
CAS Number: 62-53-3



Human Health Rankings

Toxicity only

[Ingestion Toxicity Weight \(RSEI\)](#)



[Inhalation Toxicity Weight \(RSEI\)](#)



[Human Health Effects Score \(UTN\)](#)



Toxicity and persistence

[Human Health Risk Screening Score \(WMPT\)](#)



Toxicity and exposure potential

[Cancer Risk Score - Air Releases \(EDF\)](#)



[Cancer Risk Score - Water Releases \(EDF\)](#)



[Noncancer Risk Score - Air Releases \(EDF\)](#)



[Noncancer Risk Score - Water Releases \(EDF\)](#)



[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

Toxicity only

[Ecological Effects Score \(UTN\)](#)



Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#)



[Ecological Risk Screening Score \(WMPT\)](#)



Integrated Environmental Rankings

Combined human and ecological scores

[Total Hazard Value Score \(IRCH\)](#)



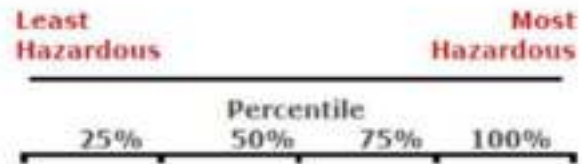
[Total Hazard Value Score \(UTN\)](#)



CHEMICAL PROFILES | Hazard Rankings

Chemical: [BENZENE](#)

CAS Number: 71-43-2



Human Health Rankings

Toxicity only

[Ingestion Toxicity Weight \(RSEI\)](#)



[Inhalation Toxicity Weight \(RSEI\)](#)



[Human Health Effects Score \(UTN\)](#)



Toxicity and persistence

[Human Health Risk Screening Score \(WMPT\)](#)



Toxicity and exposure potential

[Cancer Risk Score - Air Releases \(EDF\)](#)



[Cancer Risk Score - Water Releases \(EDF\)](#)



[Noncancer Risk Score - Air Releases \(EDF\)](#)



[Noncancer Risk Score - Water Releases \(EDF\)](#)



[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

Toxicity only

[Ecological Effects Score \(UTN\)](#)



Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#)



[Ecological Risk Screening Score \(WMPT\)](#)



Integrated Environmental Rankings

Combined human and ecological scores

[Total Hazard Value Score \(IRCH\)](#)



[Total Hazard Value Score \(UTN\)](#)

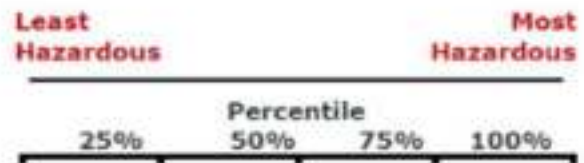


6.1.7 1: 3, Butadiene

CHEMICAL PROFILES | Hazard Rankings

Chemical: [1,3-BUTADIENE](#)

CAS Number: 106-99-0



Human Health Rankings

Toxicity only

[Ingestion Toxicity Weight \(RSEI\)](#)



[Inhalation Toxicity Weight \(RSEI\)](#)



[Human Health Effects Score \(UTN\)](#)



Toxicity and exposure potential

[Cancer Risk Score - Air Releases \(EDF\)](#)



[Cancer Risk Score - Water Releases \(EDF\)](#)



[Noncancer Risk Score - Air Releases \(EDF\)](#)



[Noncancer Risk Score - Water Releases \(EDF\)](#)



[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

Toxicity only

[Ecological Effects Score \(UTN\)](#)



Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#)



Integrated Environmental Rankings

Combined human and ecological scores

[Total Hazard Value Score \(IRCH\)](#)



[Total Hazard Value Score \(UTN\)](#)

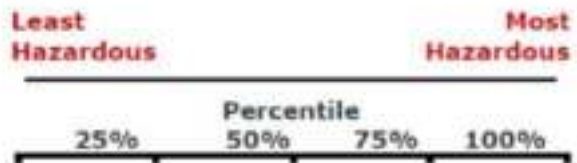


6.1.8 Acetone

CHEMICAL PROFILES | Hazard Rankings

Chemical: [ACETONE](#)

CAS Number: 67-64-1



Human Health Rankings

Toxicity only

Human Health Effects Score (UTN)



Toxicity and persistence

Human Health Risk Screening Score (WMPT)



Toxicity and exposure potential

Noncancer Risk Score - Air Releases (EDF)



Noncancer Risk Score - Water Releases (EDF)



Worker Exposure Hazard Score (IRCH)



Ecological Health Rankings

Toxicity only

Ecological Effects Score (UTN)



Toxicity and persistence

Environmental Hazard Value Score (IRCH)



Ecological Risk Screening Score (WMPT)



Integrated Environmental Rankings

Combined human and ecological scores

Total Hazard Value Score (IRCH)



Total Hazard Value Score (UTN)

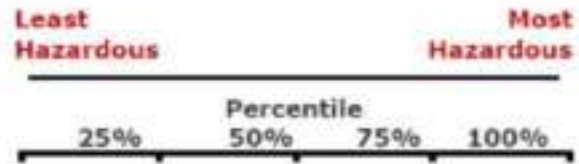


6.1.9 Methanol

CHEMICAL PROFILES | Hazard Rankings

Chemical: [METHANOL](#)

CAS Number: 67-56-1



Human Health Rankings

Toxicity only



Toxicity and exposure potential



Ecological Health Rankings

Toxicity only



Toxicity and persistence



Integrated Environmental Rankings

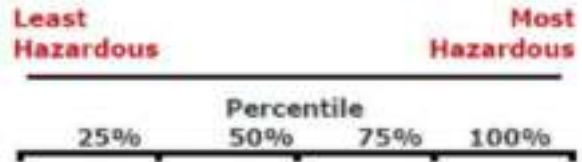
Combined human and ecological scores



6.1.10 Propylene

CHEMICAL PROFILES | Hazard Rankings

Chemical: [PROPYLENE](#)
CAS Number: 115-07-1



Human Health Rankings

Toxicity only



Toxicity and exposure potential



Ecological Health Rankings

Toxicity only



Toxicity and persistence



Integrated Environmental Rankings

Combined human and ecological scores

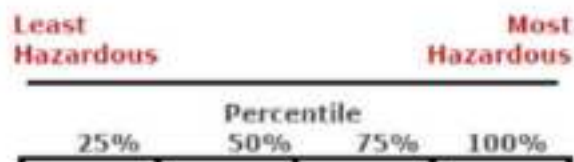


6.1.11 Vinyl Chloride

CHEMICAL PROFILES | Hazard Rankings

Chemical: [VINYL CHLORIDE](#)

CAS Number: 75-01-4



Human Health Rankings

Toxicity only

[Ingestion Toxicity Weight \(RSEI\)](#)



[Inhalation Toxicity Weight \(RSEI\)](#)



[Human Health Effects Score \(UTN\)](#)



Toxicity and persistence

[Human Health Risk Screening Score \(WMPT\)](#)



Toxicity and exposure potential

[Cancer Risk Score - Air Releases \(EDF\)](#)



[Cancer Risk Score - Water Releases \(EDF\)](#)



[Noncancer Risk Score - Air Releases \(EDF\)](#)



[Noncancer Risk Score - Water Releases \(EDF\)](#)



[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

Toxicity only

[Ecological Effects Score \(UTN\)](#)



Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#)



[Ecological Risk Screening Score \(WMPT\)](#)



Integrated Environmental Rankings

Combined human and ecological scores

[Total Hazard Value Score \(IRCH\)](#)



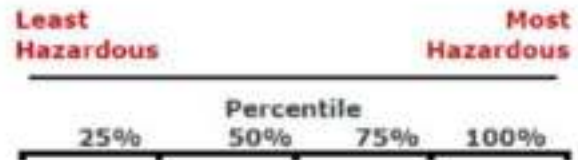
[Total Hazard Value Score \(UTN\)](#)



6.1.12 Ammonia

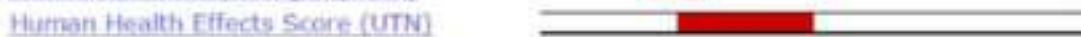
CHEMICAL PROFILES | Hazard Rankings

Chemical: [AMMONIA](#)
CAS Number: 7664-41-7



Human Health Rankings

Toxicity only



Toxicity and exposure potential



Ecological Health Rankings

Toxicity only

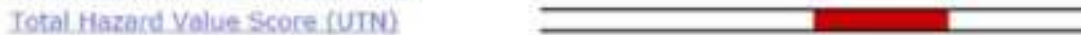


Toxicity and persistence



Integrated Environmental Rankings

Combined human and ecological scores

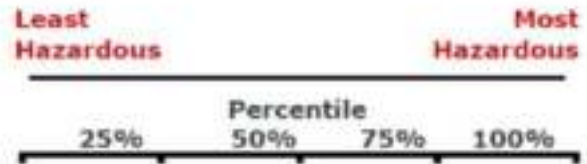


6.1.13 Ethanol

CHEMICAL PROFILES | Hazard Rankings

Chemical: [ETHANOL](#)

CAS Number: 64-17-5



Human Health Rankings

Toxicity and exposure potential

[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#)



[Ecological Risk Screening Score \(WMPT\)](#)



Integrated Environmental Rankings

Combined human and ecological scores

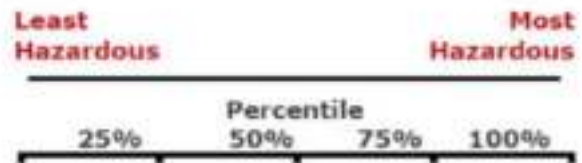
[Total Hazard Value Score \(IRCH\)](#)



6.1.14 Phenol

CHEMICAL PROFILES | Hazard Rankings

Chemical: [PHENOL](#)
CAS Number: 108-95-2



Human Health Rankings

Toxicity only

[Ingestion Toxicity Weight \(RSEI\)](#) 

[Inhalation Toxicity Weight \(RSEI\)](#) 

[Human Health Effects Score \(UTN\)](#) 

Toxicity and persistence

[Human Health Risk Screening Score \(WMPT\)](#) 

Toxicity and exposure potential


[Noncancer Risk Score - Air Releases \(EDF\)](#) 

[Noncancer Risk Score - Water Releases \(EDF\)](#) 

[Worker Exposure Hazard Score \(IRCH\)](#) 

Ecological Health Rankings

Toxicity only

[Ecological Effects Score \(UTN\)](#) 

Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#) 

[Ecological Risk Screening Score \(WMPT\)](#) 

Integrated Environmental Rankings

Combined human and ecological scores

[Total Hazard Value Score \(IRCH\)](#) 

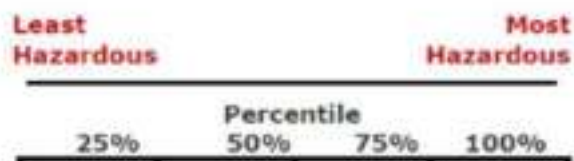
[Total Hazard Value Score \(UTN\)](#) 

6.1.15 Methyl Ethyl Ketone

CHEMICAL PROFILES | Hazard Rankings

Chemical: [METHYL ETHYL KETONE](#)

CAS Number: 78-93-3

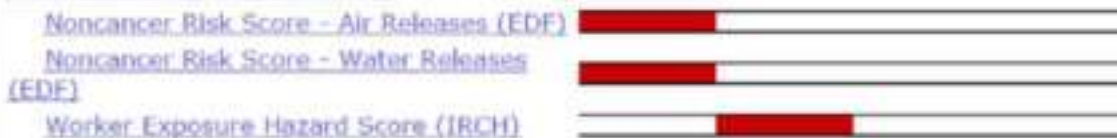


Human Health Rankings

Toxicity only



Toxicity and exposure potential



Ecological Health Rankings

Toxicity only



Toxicity and persistence



Integrated Environmental Rankings

Combined human and ecological scores

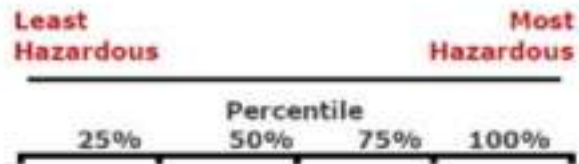


6.1.16 Vinyl Acetate

CHEMICAL PROFILES | Hazard Rankings

Chemical: [VINYL ACETATE](#)

CAS Number: 108-05-4



Human Health Rankings

Toxicity only

[Ingestion Toxicity Weight \(RSEI\)](#)



[Inhalation Toxicity Weight \(RSEI\)](#)



[Human Health Effects Score \(UTN\)](#)



Toxicity and exposure potential

[Noncancer Risk Score - Air Releases \(EDF\)](#)



[Noncancer Risk Score - Water Releases \(EDF\)](#)



[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

Toxicity only

[Ecological Effects Score \(UTN\)](#)



Toxicity and persistence

[Environmental Hazard Value Score \(IRCH\)](#)



Integrated Environmental Rankings

Combined human and ecological scores

[Total Hazard Value Score \(IRCH\)](#)



[Total Hazard Value Score \(UTN\)](#)

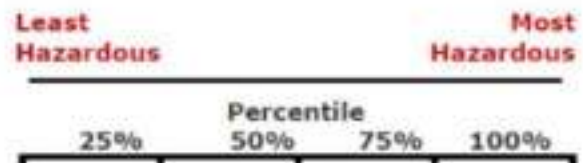


6.1.17 Caustic Soda

CHEMICAL PROFILES | Hazard Rankings

Chemical: [CAUSTIC SODA](#)

CAS Number: 1310-73-2



Human Health Rankings

[Toxicity and exposure potential](#)

[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

[Toxicity and persistence](#)

[Environmental Hazard Value Score \(IRCH\)](#)



Integrated Environmental Rankings

[Combined human and ecological scores](#)

[Total Hazard Value Score \(IRCH\)](#)

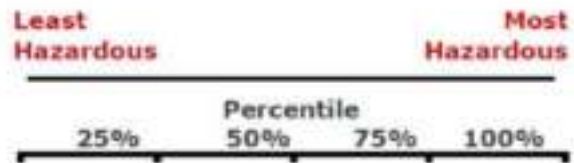


6.1.18 Acetic Acid

CHEMICAL PROFILES | Hazard Rankings

Chemical: [ACETIC ACID](#)

CAS Number: 64-19-7



Human Health Rankings

[Toxicity and exposure potential](#)

[Worker Exposure Hazard Score \(IRCH\)](#)



Ecological Health Rankings

[Toxicity and persistence](#)

[Environmental Hazard Value Score \(IRCH\)](#)



Integrated Environmental Rankings

[Combined human and ecological scores](#)

[Total Hazard Value Score \(IRCH\)](#)

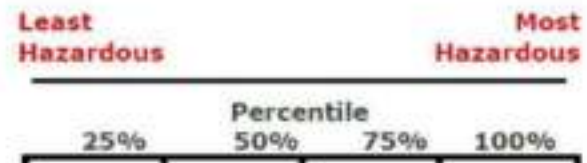


6.1.19 Nonene

CHEMICAL PROFILES | Hazard Rankings

Chemical: [NONENE](#)

CAS Number: 27215-95-8



Ecological Health Rankings

[Toxicity and persistence](#)

[Ecological Risk Screening Score \(WMPT\)](#)

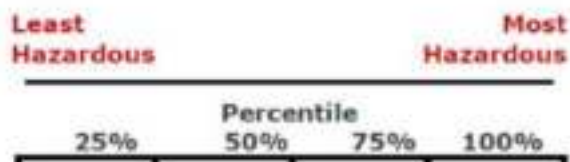


6.1.20 Ethyl Di Chloride (EDC)

CHEMICAL PROFILES | Hazard Rankings

Chemical: 1,2-DICHLOROETHANE

CAS Number: 107-06-2



Human Health Rankings

Toxicity only

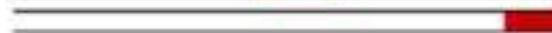
Ingestion Toxicity Weight (RSEI)



Inhalation Toxicity Weight (RSEI)



Human Health Effects Score (UTN)



Toxicity and persistence

Human Health Risk Screening Score (WMPT)



Toxicity and exposure potential

Cancer Risk Score - Air Releases (EDF)



Cancer Risk Score - Water Releases (EDF)



Noncancer Risk Score - Air Releases (EDF)



Noncancer Risk Score - Water Releases (EDF)



Worker Exposure Hazard Score (IRCH)



Ecological Health Rankings

Toxicity only

Ecological Effects Score (UTN)



Toxicity and persistence

Environmental Hazard Value Score (IRCH)



Ecological Risk Screening Score (WMPT)



Integrated Environmental Rankings

Combined human and ecological scores

Total Hazard Value Score (IRCH)



Total Hazard Value Score (UTN)



7 SABOTAGE & CIVIL DISTURBANCE

Access to the Kandla Port is controlled by walls / fence. The entrances are manned by CISF guards.

If a civil disturbance or sabotage threatens or actually damages the port property – the Harbour Master will communicate with local civil authorities or will request immediate assistance from police, coast guard, navy / air force.

7.1 Bomb Emergency Management

In the event of receiving a bomb threat by telephone call, the following should be asked and noted for relaying it to the army/air force/navy:

In view of the high priority given to Ports, they have high risk of becoming targets of the terrorist groups. Therefore the possibility of receiving bomb threats cannot be ruled out. The golden rule is consider all bomb threats as genuine and act accordingly keeping in mind the safety of the people in the Port and the property.

The objective is:

- a) To avoid/minimize any loss or damage to lives and property
- b) To eliminate panic and build up confidence.
- c) To be prepared for proper handling of any critical situation.

7.2 Immediate actions:

- a) Bomb threats may be received in writing email, SMS or may be received on phone.
- b) When the call is received on phone, keep the caller on the line as long as possible. Request him to repeat the message, listen carefully as every word spoken by the person has to be recorded mentally and penned down.

- c) If the caller does not indicate the location of the bomb or the time of possible detonation, it is advisable to try to ask him for this information.
- d) Inform the caller that the port area is occupied and the detonation of a bomb would result in death or serious injury to many innocent persons.
- e) Pay particular attention to peculiar background noises such as motors running, background music and any other noise which may give a clue as to from where the call is being made.
- f) Listen closely to the voice (male, female), voice quality (calm, excited), accents and speech impediments. Immediately after the caller hangs up report should be made to the security officer on duty about all the above details.
- g) Fill up the bomb threat call details in the format as given below.
- h) Call all identified personnel (As indicated for any emergency)
- i) As soon as an emergency is envisaged /occurs the Emergency chief or his alternate shall promptly communicate the information by a telephone or any other quickest mode of communication to the Inspector of Police, highest administrative officer, fire brigade and the nearby installations. The

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information should include the location of the installation and the degree of emergency (anticipated, eminent or actual).

7.3 Bomb Threat Report Form

7.3.1 Actions on Receiving Bomb Threat Call

1. Do not put down receiver or cut off caller
2. Put on tape-recorder /USE CELL PHONE RECORDING
3. Alert nearest colleague
4. Keep Form and pen ready to fill
5. Note time and duration correctly
6. Obtain as much information as possible
7. Keep caller engaged in conversation as long as possible

(Apologise for bad line, ask him to speak up etc.)

Time of call..... Date..... Exact words of caller.....

Was any one called for by name or designation () Yes () No. If so, who?

7.3.2 Questions to Ask Caller

1. Who is calling from where?
2. When is the bomb set to go off?
3. Where is the bomb placed?
4. What kind of bomb is it?
5. How does it look like?
6. Why are you doing this?
7. Whom do you represent?
8. How do you know so much about the bomb?
9. How can we get rid of the bomb?
10. Do you know that the bomb will kill innocent people?

7.3.3 Details of Caller

- Sex: () Male () Female Approximate age:years.
- Origin of call: () inside plant, () outside local, () outside long distance.
- Voice characteristic: () fast, () slow, () stutter, () distinct, () disguised, () educated, () uneducated, () loud, () soft.
- Language used, accent, manner: ()calm, ()angry, ()emotional, ()laughing, ()deliberate, ()normal, ()abnormal, ()other
- Is voice familiar? () yes, () no.
- Background sound: ()street, ()telephone booth, ()airport, () railway station, ()residence, ()cannot identify, ()others

CISF Commandant/Officer informed at: Name of the person receiving call signature.....

(Keep these forms with all Telephone Operators/All designations having direct line?)

7.4 Responsibility of the CISF Commandant / Officer of Kandla port

- a) Advise the Emergency chief (Chairman/Dy. Chairman/Dy. Conservator/Harbour Master) and keep him apprised of the actions being taken.
- b) Immediately make elaborate preparations near the threatened area for
 - ③ Fire fighting
 - ③ Casualty handling
 - ③ Rescue operations
 - ③ Search operations
- c) Prepare for partial/total evacuation if required. Emergency chief or his alternate will authorize these activities.
- d) Designate the team for bomb search. Initiate search operations with Fire and safety/security officers if time is available.

7.5 Action Plan

Two situations are possible.

- a) When no time limit is given.
- b) When bomb threat call has time limit specified.

As soon as the call is received the concerned area-in-charge will make fire fighting/first aid preparations immediately.

1. In the first case if there is no time limit specified for bomb explosion, as soon as the Emergency chief gives a clearance the following action should be initiated.
 - ③ Emergency shutdown of the Port sections likely to be affected.
 - ③ Evacuation of the employees and visitors to safer locations.
 - ③ Bomb search taking all the precautions.

7.5.1 Action plan when time limit is specified:

In such case the concerned officers should search the area along with safety and security officers.

7.5.2 Search procedures:

- Search must be conducted by employees of the concerned department since they are familiar with the area and would be in a better position to notice a foreign object faster.
- Two teams could be formed to search various parts of the area. Stand quietly for some moments to listen for any clockwork device before starting the search.
- As far as practical do not cause any disturbance in the environment till the search is over.
- Do not go into dark rooms and turn on lights. Use a flashlight instead.
- If any foreign or suspicious object is located, do not move or touch it. The removal/disarming of a bomb must be left to professionals. Report the location and description of the object immediately to the emergency control centre/Security gate.
- If possible place sand bags or mattresses around the bomb. Do not cover it.
- Identify the danger area and block it off with clear zone of at least 100 meter.

7.6 Important Telephone Nos of Police Authorities

Name and Designation of Officer	Fax	Telephone Nos. (Office)	Telephone Nos. (Residence)
District Collector, Bhuj. 9978406212	250430	(02832) 250020	02832- 250350
Resident Add. Collector, Bhuj Mob.9978405099	250430	250650	
Parixita Rathore (IPS) S. P.-(East),9978405690		280233	
Mr. Dy. SP (Anjar)9825304239	243254		
Mr. Dy. SP(HQ)9825225071			
Mr.) Dy. SP.9824543004	0837- 224040		
Control Room(DC-5)Purab	280287		

Mr. Vinod Chawda, M.P.,Kachchh		(m)	
Dy.Collector, Anjar Mob. 9825228049		243345	243363
Mamlatdar, Anjar Mob. 9879278174		242588	243362
Mamlatdar, Gandhidham 7567003975		250475 250270	222875 250475
Collector, Jamnagar		2555869	2554059
Collector's Control Room, Bhuj.		2252347 2231733	-
Dy. Mamlatdar, Gandhidham		250475 250270	9427719800
Civil Defence, Gandhidham		220221	
PGVCL, Gandhidham		221728 222809	
GW&SB, Gandhidham		220975	
GSRTC, Gandhidham		220198	
Duty Officer, All India Radio, Bhuj		221412	
State Information Dept. (Shri Sony) (m) 9879012714		224859 250954	253034 252855
Air Force,Duty Officer, Bhuj		252501 252502	
Air Force, Bhuj		223450	
Air Port, Bhuj		254550	
Aerodrome Officer, Kandla		238370	223247
Indian Navy, Jamnagar		550263 to 5	550825
Airforce, Jamnagar		550245 to 7	550247

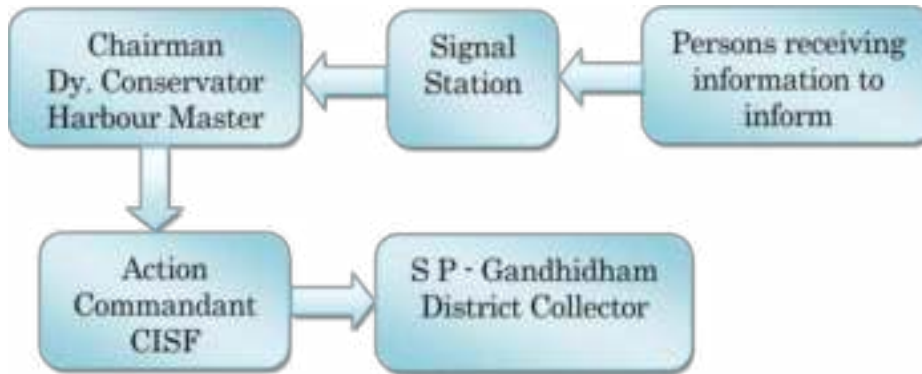
S. No	Designation	Present incumbent	Contact Telephone Numbers
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			Office	Res	Mobile
01	CISF Commandant		271037	229140	9825227282
02	CISF Dy. Commandant		271036	220192	9825227045
03	Asst. Commandant		270440	271041	8000954482
04	Control Room		271040		
05	North Gate		270440		
06.	West Gate – I		271039		
07.	West Gate II		270876		

7.6 Contact Telephone Nos of Bomb Detection & Disposal Squad

Sr. No	Area	Telephone
01	GNADHIDHAM	9979928800
02	Rajkot	0281 – 245777
03	Ahmadabad	079 – 2210019

8 HOSTAGE SITUATION



8.1 Commandant CISF Responsibilities

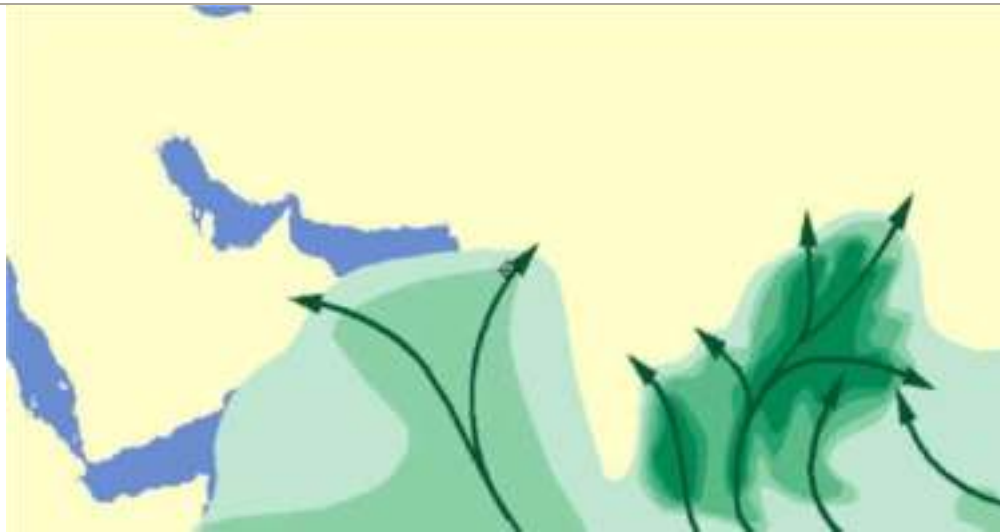
- Apprise - Chairman, Deputy Chairman, Deputy Conservator, Harbour Master of contemplated action.
- Prepare threatened area for fire fighting, casualty handling, search and rescue operations
- Inform Police and requisition help with regard to negotiators/snipers, etc.
- CISF to cordon off area and deny access to persons hampering operations especially media and onlookers.
- Buy time for negotiators to arrive or for formalizing proper plan of action.
- Police/CISF shall assess the situation and based on the assessment, Chairman may permit operation deemed fit to free hostages.

9 SEVERE WEATHER SITUATION

9.1 Act of God Perils (Cyclones Tsunami)


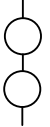














9.1.1 Storms / Cyclone







Even though Kandla is within the cyclone area of storms originating in the Arabian Sea and those that enter across the Indian Peninsula from the Bay of Bengal, cyclones are not as severe or frequent as in the Bay of Bengal. Historically, there has been major cyclone in the region in the year 1998. Hence the exposure to this peril is High.



9.1.1.1

Signal No.	Symbol Day	Symbol Night	Type of Warning	Description

I			Cautionary	There is a region of squally weather in which a storm may be forming.
II			Warning	A storm has formed.
III			Cautionary	Port is threatened by squally weather.
IV			Warning	The Port is threatened by storm, but it does not appear that the danger is as yet sufficiently great justifying extreme measures of precautions.
V			Danger	The Port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the south of the port.
VI			Danger	The Port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the north of the port.
VII			Danger	The Port will experience severe weather from a storm of slight or moderate intensity that is expected to cross over or near to the port.
VIII			Great danger	The Port will experience severe weather from a storm of great intensity that is expected to cross to the south of the port.

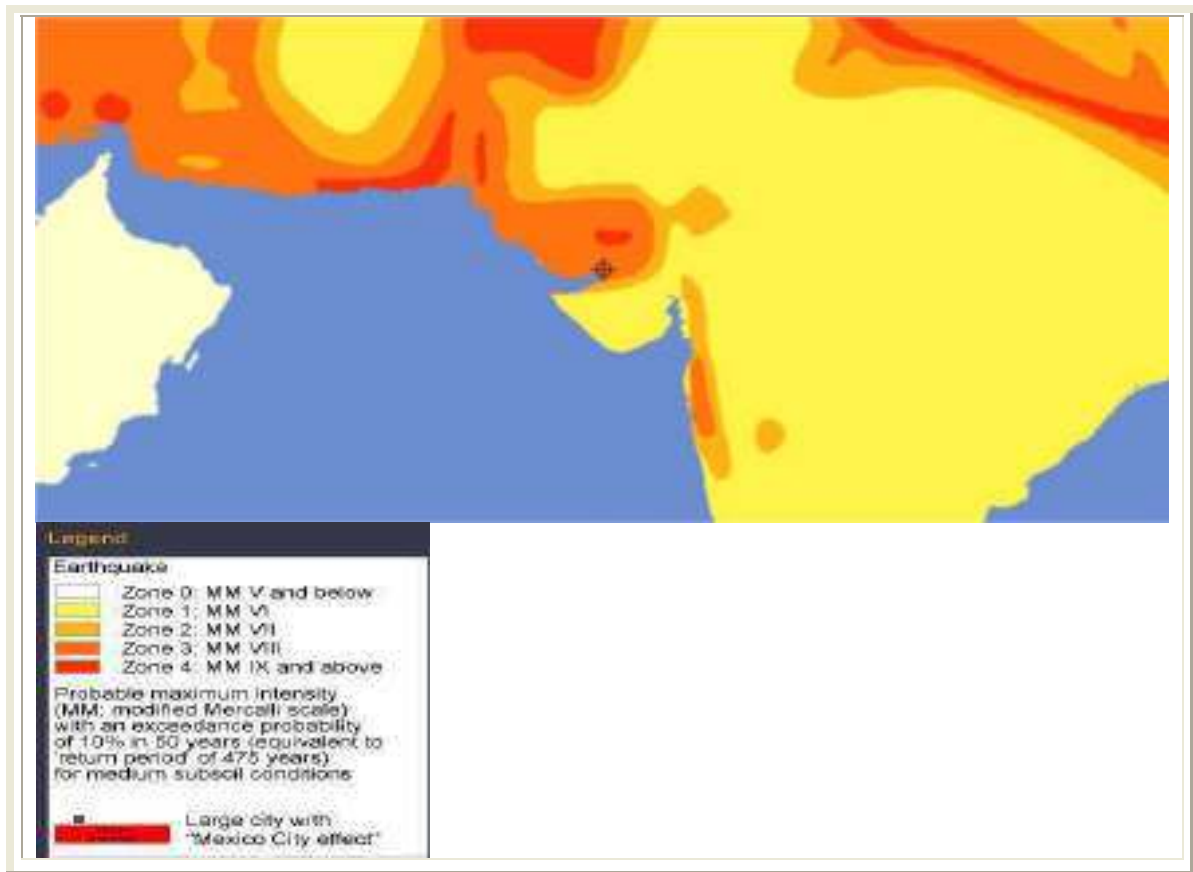
IX			Great danger	The Port will experience severe weather from a storm of great intensity that is expected to cross the coast to the north of the port.
X			Great danger	The Port will experience severe weather from a storm of great intensity that is expected to cross over or near to the port.
XI			Failure of communication	Failure of Communication with Meteorological head quarters has broken down and the local officer considers that there is danger of bad weather.

 Red Light,
 White Light

9.1.2 Earthquake

As per Munich Re world map for Natural hazards the Gandhidham region comes under the Zone III of the earthquake classification as per Indian Standards which is relatively high. However, seismic experts have opined that the Indian land mass is being constantly compressed between the sea and Himalayas and thus the developed stresses are being released in the form of earthquakes in the least expected areas.

Thus taking the dynamic seismic scenario in to consideration risk exposure can be considered as High.

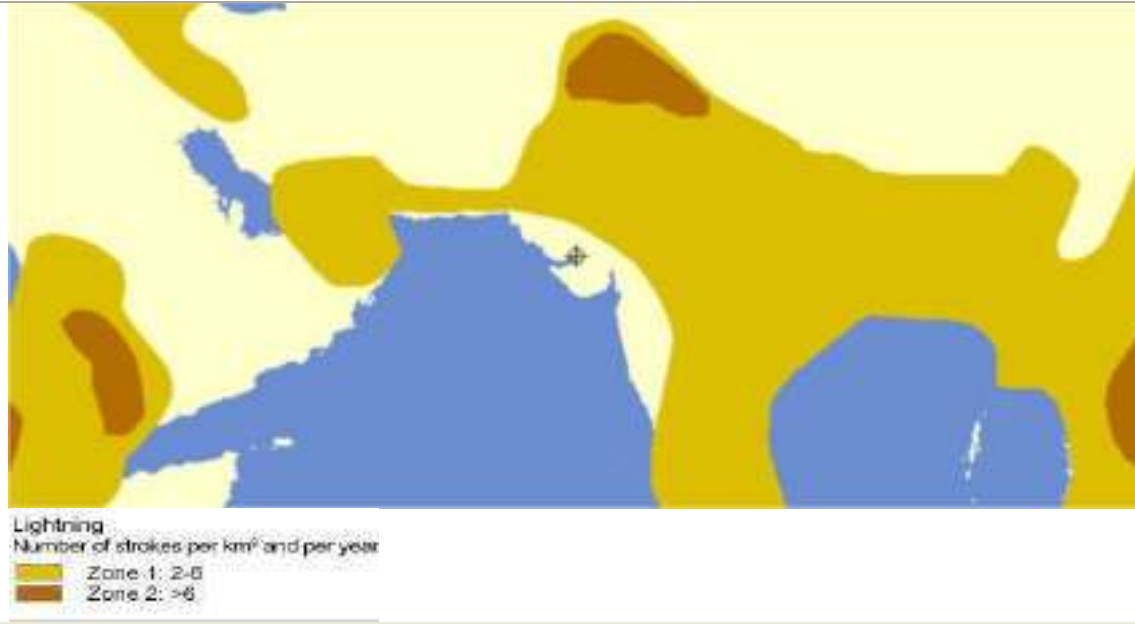


9.1.3 Lightning

As per Munich Re World Map for Natural hazards, Gandhidham region is in Zone – I which means on an average there are 2 - 6 lightning strikes per km area per year which signifies moderate risk exposure.

2

Thus risk exposure can be considered as moderate.



9.1.4 Tsunami

Tsunami is large submarine earthquake or large submarine landslides, which are often triggered by earthquakes, and volcanic eruption in the sea or on the coast. The waves spread out in all directions and at great speed, which increases with the depth of water. In great ocean basins the average speed is about 700km/h.

Thus risk exposure can be considered as moderate.



Gujarat is prone to tsunami risk due to its long coastline and probability of occurrence of near and offshore submarine earthquakes in the Arabian Sea. Makran Subduction Zone (MSZ) - South West of Karachi is an active fault area which may cause a high magnitude earthquake under the sea leading to a tsunami. In past, Kandla coast was hit by a Tsunami of 12 mtrs height in 1945, due to an earthquake in the Makran fault line. Tsunami prone areas in the State include coastal villages of Kutch, Jamnagar, Rajkot, Porbandar, Bhavnagar, Anand, Ahmedabad, Bharuch, Surat, Navsari and Valsad districts.

When severe weather is predicated or threatened preparation is made by site personnel.

The most probable severe weather events at the Kandla Port will involve High winds, Heavy rains, Cyclone, Storm, Tsunami, and Lightning & Earthquake.

There is a possibility of surface water accumulation and ingress into buildings and equipment. In addition the above severe hazard conditions can create significant personnel hazards loss of power.

PREPAREDNESS & RESPONSE

9.2 Internal Action Plan in case of Cyclone / Flood & Any other Natural Calamity

As soon as the message on anticipated cyclone/flood/natural calamity is received from the State Government Authority/Indian Meteorological Department/Cyclone Warning Centre/Indian Navy, etc. by any official of the Port Trust, the same shall immediately be informed to the Deputy Conservator (Nodal Officer), who in turn shall get such message confirmed from the above sources and apprise the Chairman and Dy. Chairman accordingly. On approval of Chairman, the Action Plan as stipulated hereunder shall be put into operation for which the Deputy Conservator shall inform all the officers-in-charge of the Control Rooms as well as the Heads of Departments, including Chief Operation Manager, OOT, and Vadinar about the decision of the Chairman as per Point No: 9.2.1.

9.2.1 Particulars of the Action Plan Committee Members

Sl No	Name	Designation	Telephone Nos.			
			Office	Residence.	Fax	Mobile
1	Mr. SANJAY MEHTA, IFS	Chairman	02836-233001 234601	02836-233002	235982	
2	Mr.	Dy. Chairman	234121 236323	234218 236346	236323	

3	Capt. T Srinivas	Deputy Conservator	233585 220235	232806	233585	9825232982
4	Mr. A Krishnan	Deputy FA&CAO	220214	223854		9825227036
5	Mr. Ajay Gupta	Sr. DD(EDP)	239623	234116		9825227095
6	Mr Bimal Kumar Jha	Secretary	220167	231939	233172	8141084794
7	Mr. Suresh Balan	Sr.Dy. Secy (G)	221375	236086		9825227044
8	Mr. Rajendra Singh	Dy. Secy	220033			9422056830
9	Mr. Deepak Rane	Sr. Asst. Secy	221679	234691		8238057380
10	Mr. N M Parmar	SE(C-I)		252624		9825227046
11	Mr. Y K Singh	PO.	223828	228584		9825227079
12	Mr.	Traffic Manager	270625 270246	263006	270475	
13	Mr. Krupananda Swami	Sr. Dy Traffic Manager	270270	235100		9825227049
14	Mr. D N Sondhi	FA&CAO	233174		220047	9825214726
15	Capt. S K Pathak	Harbour Master I/C	270201	231310		9825503499
16	Mr	Dy.Hydl. Engr	270277	225389		9825227201
17	Mr. Sunil Kumar	Flotilla Supdt.	270280	226121		7874627756
18	Mr. K Varughese	FCSO	270176 270178	227512	270176	9825227041

19	Mr. SSP PATIL	Chief Engineer	233192	228777	220050	9825227243
20	Mr. MANOJ MISHRA	Dy. CE	233569			7420027171
21	Mr. K J Todarmal	Exe Eng (R)	236165	220670		8980049099
22	Mr. N M Parmar	SE (PL)	222535	252624		9825227046
23	Mr. V R Reddy	DY.CE (G)	270429	228869		9825227038
24	Mr.B. Rajendra Prasad	Exe Eng (D), ENVIRONMENT	220038	232880		9725338260
25	Mr.	CME	270632 270184	231043	270184	9825226944
26	Shri S C NAHAK	Dy CME	270426	226067		9825235196
27	Mr. P Srinivasu	SE (E)	271010			9825204316
28	Mr. B J Solanki	SE (M)	270352			9726188222
29	Dr. Kalindi Gandhi	CMO	225767 220072	234598		9825505795
30	Dr CHELLANI	Sr Dy CMO	236346	220558		9825505796
31	Dr S B Suryavanshi	AMO	220072	233099		9687606995
32	Dr. Mahesh Bapat	A.M.O	220072	228167		9687607528
33	Mr.	Comdt. CISF	271037	229140		9825227282

Based on the past experience, after detailed discussions and experience sharing process, the actions suggested in the plan have to be taken immediately by the concerned staff members/officials as shown against their names/Designations as soon as the warning of cyclone or any other natural calamity is issued. All staff members/officials should know that they shall come into action on their own as soon as the warning is issued, without waiting for any further instructions. Failure on the part of any employees/officials to carry out the earmarked action plan shall attract severe consequences, which all must note.

9.3 Control Room

There shall be three control rooms, one at Kandla at Signal Station Seva-Sadan-III, and second one at AO Building, Gandhidham and third at A O Building Off Shore Oil Terminal, and Vadinar. The Control Room at Kandla shall be under the direct supervision Harbour Master, whereas Dy. Secy. (G) will be the overall in charge of the control room at A O Building, Gandhidham. XEN (M&E) will be the overall in charge of control room at Vadinar. They shall rush to the respective control rooms as soon as the action plan is put into force. The officials named in the duty roster of various departments elsewhere in this Action Plan shall also report to the respective HODs for coordination and to perform duties as may be assigned by the higher authorities. The overall in charge should draw up roster of the said employees and assign duties for the coming five days. The staff should report to the respective control rooms. The Radio Radar Technician will remain in control room to attend all communication equipments.

9.3.1 Duty Roster for Staff of General Administrative Department

01	Mr. Kamalesh S Bajaj, Senior Clerk	220416		
02	Assistant	220010		
03	Assistant	220010		
04	Senior Clerk	220010		
05	Sr. Clerk	220010		
06	Junior Clerk	220010		
07	Messenger	220010		
08	. Junior Clerk	220010		
09	, LWA	270872		

List of Duty Roster of Marine Department (Ministerial Staff)

Sr No	Name	Office	Residence / Mobile
01	PA to DC	220235	9428032483
02	Mr. AR Jadeja, Signal Supdt	270549	9825427400
03	Office Supdt.	221971	
04	Assistant	221971	
05	Sr. Clerk	221971	
06	Messenger	221971	

9.3.2 Pilots

Sr No	Name	Residence	Mobile
01	Shri. S. K. Pathak	231310	9825803499
02	Capt V Tyagi		7065965924
03	Capt. A K Sharma	238154	9879603642
04	Capt. Vipul M. Madaan	221478	9879603643

9.3.3 List of Telephone Nos & Address of DC, HM & Pilots

Sr No	Name of Officer / Pilots	Address of Gandhidham Res	Tel Nos: Cell / Landline
-------	--------------------------	---------------------------	--------------------------

01	Capt T Srinivas DC	A – 7, Gopalpuri	9825232982 232806
02	Shri S K Pathak HM	C – 32, Gopalpuri	9825803499 231310
03	Capt S K Pathak Pilot		
04	Capt D C Bhatt. Pilot	C – 38, Gopalpuri	9879603641 235653
05	Capt A K Sharma Pilot	C – 40, Gopalpuri	9879603642 238154
06	Capt V Madaan, Pilot	C – 31, Gopalpuri	9879603643 221478
07	AVAILABLE CONTRACT PILOTS WILL BE CONTACTED BY THE SIGNAL STATION.		
08			
09			
10			

9.3.4 Contract / Empanelled Pilots

Sr No	Name	Mobile
01	AVAILABLE CONTRACT PILOTS WILL BE CONTACTED BY SIGNAL STATION	

9.3.5 List of Duty Roster of Mechanical Engineering Department

Designation	Office
CME	270632

Addl. CME	270426
PA to CME	270184
SE(Electrical)	270209
SE (M)	270354
Dy M M	234114
XEN(E)	270469
XEN(DD) I/C	270285
AXEN(M)	270285
Asstt. Engr (M)	234199
AXEN	270165
AXEN (E)	
AE(E)	270322
Office Supdt	270245
Div. Accountant	270245
Div. Accountant	270342
Steno	270184
Junior Clerk	270245
AE(E)	270469
AE(E)	270458
AE(M)	270010
AE(M)	270370
JE(M)	270127
Head Clerk	270342
Head Clerk	270498

Div. Accountant	270498
Head Clerk	270484
Div. Accountant	270484

9.3.6 List of Duty Roster of Civil Engineering Department

Designation	Office	Mobile
Chief Engr	233192	9825227243
Supdt. Engr.(P)	233569	9825325390
Supdt. Engr.(C)	270787	9825227038
Supdt. Engineer (Const)	270419	9825227203
PA To CE (T)	220016	--
P.A. To CE	220050	9426737553
Supdt Engineer (Harbour)	270429	9825227046
Exe. Engr (R)	236165	9825706255
Exe. Engineer (Design)	220038	9725338260
Ex.Engr (TD)	223912	9427205610
Dy.Secretary(E)	221758	9825227044

Asst.Estate Manager	221598	
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9.4Kandla Control Room

Designation	Office	Residence	Fax No	Mobile
Harbour Master	270201	231310	270624	9825232982
Signal Supdt	270549, 270194	232551	270624	9825427400
Signalman at Signal Station	270549, 270194		270624	9825227246

9.5 A.O. Building, Control Room (Gandhidham)

Designation	Office	Residence	Fax No	Mobile
Dy. Secretary (G)	221375	236990	-----	9825505969
Accounts Officer	220908	226199	-----	-----
DMM	231362			

9.4 Vadinar Control Room

Designation	Office	Residence	Fax No	Mobile
Signalman	0288- 2573026			9825212359
Exe. Engineer	0288-			

(E&M)	2573005			
A. F. S.	0288			9712824782
Pilot in Station				

The overall in charge of the Control Rooms shall ensure the presence of the staff, to which various duties have been assigned. They should attend the meetings as and when called. In case of absence of the staff, the matter should be informed to the disciplinary authority, who shall take disciplinary action against the erring employees.

9.5 The Control Room shall have the following Facilities

Control Room	Telephone Nos	Fax No	VHF
Kandla	02836 – 270549/270194, Cell 9825227246	02836- 270624	8,10,12,16
Gandhidham	02836 – 238055/239055	02836- 239055	-----
Vadinar	0288-2573026, 9825212359		12, 16, 8, 10

The above facilities will remain as permanent assets of the Control Rooms. The overall in charge for setting up of Control Room at Kandla will be Dy. Conservator and Secretary for A. O. Building, Gandhidham. They should ensure setting up the Control Rooms at the respective places within two hours of warning and the matter reported to Chairman/Deputy Chairman.

Commandant, CISF to remain in contact with In charge of Control Room at Kandla regarding the positions of the Cyclone.

9.6 Functions of the Control Room

1. It shall remain in touch with the Indian Meteorological Department (Telephone numbers given at Point No: 11.8.1) and also offices and officials as at Point No: 9.8.2, 9.8.3, 9.8.4, 9.8.5 & 9.8.6 on need basis.

9.8.1 Important Telephone Numbers of Indian Meteorological Department

Designation	Address	Office	Resi.	Fax
Director (ACWC)	-do-	022- 22150405	022- 22150452	
Director (I/c)	Met Center Ahmadabad	07922865012 22865165		07922865449 22865012 22861413
Met I/C	MET Centre, Ahmadabad	22861413		
Duty Officer		22865012		
Meteorologist	Ahmadabad	22861413		

Websites

www.imd.gov.in

9.8.2 The Telephone Numbers of Some of the VIP S

Sr. No.	Name and Designation	Fax	Telephone (Office)	Telephone (Resi)
1	District Collector, Bhuj	02832-250430	250020	250350
2	Dy. Collector, Mob. Bhuj 9825300729	02832-252704	250650	
3	Add. Collector, Bhuj Mob. 9825049360	02832-252704	252704	251348
4	Superintendent Police, of Gandhidham,	9978405690	227934	
5	Asstt. Supdt. Of Police		253405	250850
6	Dy. Collector, Anjar		243345	243363
7	Dy. S. P., Anjar		243254	242596
8	Mamlatdar, Gandhidham	9879278174	242588	243362
9	Mamlatdar, Gandhidham		250475 250270	222875 250475
10	Port Co-coordinator, OCC		234313	232808
11	Terminal Manager, IOC	234396	231871	236442
12	Air Force Commander, Jamnagar		2550245	-
13	Collector, Jamnagar		555869	554059
14	Station Commander, Air Force, Bhuj		244005 to 244010	
15	Commandant, Gandhidham	B	223845	

9.8.6 Gujarat State Disaster Management Authority Telephone Numbers of Senior Officials

24 hrs 079- 23251900 - 20

Sr.No	Name of Officers	Designation	Contact No
1	Anuradha Mall, IAS	CEO	079-23259502
2	Shri L.G.Ambujakshan	PS to CEO	079-23259276
3	Shri G. C. Brahmhatt, IAS	Addl. CEO	079-23259451
4	Shri P.B.Thakar, IAS	Addl. CEO	079-23259292
5	Shri G B Mungalpura, GAS	Director (Admin)	079-23259292
6	Shri J. J. Shelat	Director Finance	079-23259278
7	Shri H.K.Chauhan	Controller of Account	079-23259219
8	Shri Nisarg Dave	Deputy Director	079-23259501
9	Shri Sumedh Patil	Deputy Director	079-23259279
10	Shri Piyush Ramteke	Sector Manager	079-23259283
11	Shri Santosh Kumar	Sector Manager	079-23259220
12	Shri Ankit Jaiswal	Sector Manager	079-23259246
13	Shri Anil Kumar	Sector Manager	079-23259220
14	Ms. Akanksha Jain	Sector Manager	079-23259306
15	Ms. Ambika Dabral	Sector Manager	079-23259246
16	Mr. Bhushan Rauisinghani	Sector Manager	079-23259283
17	Ms. Disha Dwivedi	Sector Manager	079-23259283
18	Shri Nehal Desai	Asst. Manager (Admin)& Asst. Director- H & L (i/c)	079-23259286

2. Information from the above Offices/Officers will be collected and transmitted to the overall in charge of Control Rooms/ Dy. Conservator/Harbour Master/ Traffic Manager/Senior Commandant, CISF/Chief Mechanical Engineer on hourly basis. The information should also be passed on to Secretary/Dy. Chairman/Chairman on every 03 hours.
3. Two telephones should be kept in the Control Rooms, one for receiving and the other for outward calls.

4. Each control room will enter messages in Log Books continuously and simultaneously report to the overall in charge after every one-hour. The information shall be passed on to Chairman/Deputy Chairman directly depending upon the importance. It shall be the responsibility of the Control Room Staff to ensure that timely information is passed on and timely proper monitoring done.

9.9 Continuous Monitoring Process

Immediately after the initial signal for Cyclone storm is received, the following officials shall continuously monitor the movement of Cyclone on hourly basis.

Sr. No.	Designation	Office	Mobile
1	Dy. Conservator	233585 / 220235	9825232982
2	Harbour Master	270201	9825803499
3	Pilot	270549	
4	Signal Supdt	270194, 9825227246	9825427400

These officials shall obtain the information from the following sources and The Telephone Numbers of I.M.D. is given in (Point No: 9.8.1)

1. State Meteorological Control Room, Ahmadabad,.
2. Meteorological Control Room, Delhi.

The information so collected shall be maintained by making hourly log entry in a register.

9.10 Monitoring Through Internet

1. As soon as the cyclone warning Signal No. 5 or above is hoisted, the HM nd Pilot should monitor it through internet and give two hourly print out to Dy. Conservator, Secretary, Chief Engineer, FA & CAO, Dy. Chairman and Chairman. Dy. Director (EDP) along with Junior Engineer (PMC) and Mr. B. Rajendra Prasad Exe. Engineer (Design) will monitor the website in the A. O. Building, Gandhidham.

The following are the website codes, through which the required information regarding the position of the Cyclone can be ascertained:

1. www.imd.gov.in

9.11 Inmarsat Mini – M – Terminal Kandla - 00873762092789

9.11.1 Control Room, Gandhidham

1	IDS No	762092789	-	VOICE
		762092790	-	FAX
		762092791	-	DATA

9.11.2 Control Room, Vadinar

1	IDS No	762092777	-	VOICE
		762092778	-	FAX
		762092779	-	DATA

9.12 Plotting of Information on Map

The following officers shall be deputed in the Control Room immediately on starting of the control room with relevant charts.

Sr. No.	Designation	Office	Residence	Mobile
1	Harbour Master	270201	231310	9825803499
2	Pilot			
4	Signal Supdt.	270549 / 270194	232551	9825427400 / 9825227246

The above persons shall immediately reach the Control Room and stay there till the emergency is called off. They shall plot the movement of cyclone on hourly basis and bring the position to the notice of Traffic Manager, Chief Mechanical Engineer, Dy. Conservator and Dy. Chairman/Chairman.

After scrutinizing the movement of Cyclone on the Charts, Dy. Conservator shall, in consultation with Chairman / Dy. Chairman, if required, take a decision for evacuation of ships immediately as soon as the Cyclone is in close proximity to the danger line as defined above.

All pilots should remain stand by as soon as the warning of Cyclone No. 5 level and above is received. All pilots shall be stationed at Kandla and shall not leave the port without prior permission.

Dy. Conservator shall station himself at Control Room at Kandla and remain continuously in touch with the pilots. The pilots should be in a position to mobilize themselves for evacuation of vessels and securing all Port crafts at shortest possible time.

All Class-I & Class-II Officers, the Technical Staff, the essential staff and other persons assigned with specific functions under this plan who want to avail leave in the month of May, June and July should invariably submit their leave program in April every year. Secretary shall issue a circular in the first week of April every year to all the Class-I and Class-II Officers and ascertain the period for which officers would like to proceed on leave during the months of May, June and July of that year.

9.13.2 Immediate stopping of operations at the Port

All the Pilots of the Port should reach Kandla immediately in case of emergency. Any Pilot not traceable in emergency shall be liable for disciplinary action.

Dy. Conservator/Harbour Master/Pilots should be available at Kandla during emergency. (i) Removal of vessels whenever the Cyclone is located in close proximity to the danger line plotted between 65 degree E Longitude 18.2 degree N Longitude and 73 degree E Longitude 18.2 degree N Longitude. Map showing the above position is given at (Annexure XXX (to be inserted by KPT)).

- i. Under such a situation, the ships shall be removed during the first/next available tide. It will be the duty of Harbour Master and Dy. Conservator to ensure that the ships are removed during the first/next available tide as soon as the storm approaches in the close proximity to the danger line as defined above without seeking any further instructions from higher authorities. This action shall be taken automatically and suo-motto without any confusion and for this purpose Traffic Manager shall stop all loading and unloading operations immediately upon instructions from Dy. Conservator so as to enable him to remove the vessels in time. The removal shall be done with the help of all the available pilots plus all contract/empanelled pilots together at one go in the shortest possible time so as to ensure that all the vessels cross the bar before

the tide restriction sets in.
- ii. Dy. Conservator shall ensure that all ships are moved out of the Harbour at the earliest. All pilots shall immediately report at Kandla and stay there till the Action Plan is in operation. Dy. Conservator/Harbour Master shall immediately plan removal of vessels to the OTB as soon as the Action Plan is put into operation irrespective of the signal number, which must be hoisted. If it is impossible to remove them, then all other steps should be taken to ensure safety of the vessels at the Port, as also it would not cause any damage to the Port.
- iii. S E (M) shall enlist the Engine side staff of the Floating crafts to be kept stand by for shifting of crafts to safer places. He will be the in charge of manning these crafts as per the requirement.

For shipping tugs, Marine Engineer / Engineer In charge (Tugs) / will be the in charge for manning the engine side staff for operation of the shipping tugs as per the requirement. Assistant Engineer (DT) and, Assistant Executive Engineer (FC) shall co-ordinate with Marine Engineer / Engineer In charge (Tugs).

- iv. After the Cyclone warning Signal No. 5 or above is hoisted at the Port Traffic Manager shall ensure that the loading/unloading operations at the Port are stopped immediately, hatches closed, ships' derricks properly secured and all labourers evacuated from the port area. Public address system shall be installed at the cargo jetty area, which shall be under the charge of TM. He shall use it for necessary arrangements relating to the evacuation. Senior Commandant, CISF shall ensure that Public Address System is fitted on jeeps provided to CISF.

Traffic Manager should ensure that responsible persons make announcements in a proper way so as not to create any misunderstanding / panic.

9.14 Securing of Cranes

Chief Mechanical Engineer shall ensure that immediately the cranes are secured and properly locked after closing of loading and unloading operations from ships as per procedure and report submitted to Chairman/Dy. Chairman after the operation of this action plan.

The following officers shall constantly monitor the safety of Cranes:

Sr. No.	Designation	Office	Residence	Mobile
1	S E (M)	270354	222771	9825227255
2	S E (E)	271010	229038	9427205563

The above officials and, Assistant Engineer (Elec.) shall arrange to secure all the cranes and keep them properly locked as per the procedure and send a report to the Chief Mechanical Engineer.

Executive Engineer (Dry Dock) and, AE (Mech) shall arrange to secure the cranes at maintenance Jetty as well as Bunder Area.

9.14.1 Securing of all Crafts

Dy. Conservator/Harbour Master shall immediately arrange for securing all the Port Crafts at safer places so that there is no loss to the port and send a report to the Chairman/Dy. Chairman as early as possible after operation of this action plan. Flotilla Superintendent shall be overall in charge of each craft for ensuring their safety.

For parking of crafts in emergency, there places are mainly identified, viz. Bunder Basin, Launch Jetty and maintenance Jetty (As per):

1. Maximum number of crafts such as Mooring Launches, G. S. Launches, and Pilot Launches will be placed in Bunder Basin.
2. In the inner side of Passenger Jetty, one Pilot Launch and one G.S. Launch will be kept.
3. Three Tugs will be kept in the inner side of Maintenance Jetty.

Priority will be given to the Port Crafts for parking in the Bunder Basin and other areas. Rest of the places available in the northern side of Bunder basin area will be allotted to the self propelled barges and private crafts. Dumb barges will be allowed on the beach between maintenance jetty and oil jetty area.

Berthing Supervisor will render all possible assistance to FS, being the overall in charge of the crafts. The following flotilla staff will take care of;

1	Mr. T. Sunil Kumar	F.S
2	Mr JAYDEEPSINH GOHIL	B.S
3	Mr. R B Chauhan	AFS
4	Mr. KENIYA	AFS

9.15 Private Barges / Crafts

The parties who have been given license by the Dy. Conservator to keep their barges and crafts inside the Port limit are given below:

9.15.1 **ALL** HARBOUR CRAFT License Holders to keep their Crafts inside the Port Area

Necessary instructions shall be issued to all those people have valid license immediately. The work of informing these parties will be carried out by Office Superintendent of Dy. Conservator's Office and will personally ensure that the instructions are carried out and report to HM within two hours of the Action Plan coming into operation. The representatives of the above parties shall reach Kandla at once, failing which Dy. Conservator shall cancel the license granted to them and take over the barges/crafts of the party who violate the instructions.

9.16 Evacuation of People from Kandla Area during Emergency – Action Plan

In Kandla Area, there is Residential Habitation in the following areas:

9.16.1 Places of Habitation

9.16.1.1 Saltpan Units

Considerable numbers of Salt Workers are engaged in the following Salt Manufacturing Units.

1. Kutch Salt Works.
2. New Kandla Salt Works.
3. Vijay Salt Works.
4. Friends Salt Works.

5. United Salt Works on KPT Land.
6. United Salt Works on State Government Land.
7. Small Salt Works of State Government, Near Nakti Creek.

The approximate number of Salt Workers that are being engaged/ residing in these Salt Works will be around 2575.

9.16.1.2 Sirva Labour Camp

Plots in Shirva Labour Camps (Near Mosque) have been allotted by DEENDAYAL PORT TRUST on L&L Basis. Population: 450 (approx). There are also some un-authorized hutments in the area.

9.16.1.3 Sirva Railway Hutments

The Shirva Railway Hutments (alongside Main Road) is a cluster of un-authorized Hutments erected on the Railway Land: Population 700 (approx).

9.16.1.4 G – Type Quarters & Housing Societies

The G-Type Quarters are constructed by DEENDAYAL PORT TRUST in early 1950s and were allotted to some persons who were engaged in Port related activities in those days.

DEENDAYAL PORT TRUST has allotted land to Two Housing Societies known as Kandla Port Workers Co-operative Society and Dr. Jaynat Khatri Co-operative Housing Society in Kandla area. Population: 1000 (approx).

9.16.1.5 New Kandla Port Colony P & T & Customs Colonies

The KPT employees, Customs employees etc are residing in these areas.

9.16.1.6 Hutments in the Land of PGVCL

There is a cluster of unauthorized Hutments to the Northern side of wahiya creek and southern side of M/s ABS Bayers Limited and this land belongs to PGVCL. Population: 100 (approx).

9.16.1.7 Banna Fishermen Hutments

There are unauthorized Fisherman hutments situated on the Bank of Kandla Creek towards Southern side of NDDDB Colony. Population: 800 (approx).

9.16.1.8 Hutments near IFFCO Plant

There is a cluster of unauthorized hutments near IFFCO Plant. Population: 500 (approx).

9.17 Population of Kandla

The population of Kandla Area is basically a mixture of people from various places and they can be generally divided in the following three groups;

People belonging to nearby villages like (i) Tuna (ii) Kharirohar (iii) Mithirohar (iv) Chirai and (v) Gandhidham City.

People belonging to other States like (i) Andhra Pradesh (ii) Rajasthan (iii) Uttar Pradesh and (iv) Bihar.

People working in Government establishments residing in the colonies of their organizations.

Most of the people residing in Shirva Labour Camp, Shirva Railway Hutments and Thermal Hutments etc are engaged as Private Labours in the Port and Port related ancillary activities and petty business.

9.17.1 People of Nearby Villages

People of the Port and nearby lease areas belonging to nearby villages like (i) Tuna (ii) Kharirohar (iii) Mithirohar (iv) Chirai and (v) Gandhidham City will have to be sent back to their respective village by providing them Trucks and/or ST Bus facilities in consultation with State Govt. Agencies.

9.17.2 People of Other States

People belonging to other States like (i) Andhra Pradesh (ii) Rajasthan (iii) Uttar Pradesh and (iv) Bihar may not have any relatives or other accommodations facilities in the nearby places like Gandhidham, Adipur.

Hence, they will have to be provided Temporary Shelter in the Schools/community centres as may declared as Temporary Rehabilitation Centre/ Temporary shelters by the State Govt. Authorities.

9.17.3 Action Plan for Evacuation of People from Kandla

On Hoisting of No. 5 Signal or above in Kandla Port, immediately action shall have to be initiated for evacuation of people in the following areas by the persons responsible as mentioned hereunder:-

The evacuation of the inhabitants of the following areas at Kandla is to be done as these areas are sensitive and prone to natural calamities like cyclone, high-tide and other disaster like Gas Leak, etc.

OSD(Estate) and Mr. Bhatia, Asst. Engineer (C) shall ring up all salt lease holders directing them to evacuate their people from their Kandla sites and a report thereof submitted to the Chairman/ Dy Chairman. The Dy Secretary (Estate) will be overall in-charge of the proposed action.

9.17.3.1 List of Salt Lessees

Sr. No	Name of Salt Works	Contact Person	Tel. No. Office	Tel. No. Residence
1	Asstt. Salt Commissioner, Gandhidham	Mr. Jagdish Tripathi	233670	263690
2	M/s. Kanoria Chemicals and Ind. Ltd., Plot No.220, Sector -4, Gandhidham	Mr. B. N. Singh, Mr. J. Singh Factory -	229470	283325 9825225841
3	Shree Krishna Salt Industries, Central Bank	Mr. Kantibhai Thakkar Mr. Vikash Patel	234727 233990	235315 234089

	Compound, Gandhidham	Mb: 9825206214		
4	M/s. Chirai Salt Works, DBZ-S-46, Jawahar Chock, Gandhidham.	Mr.Sureshbhai Mr.Parasbhai Mb: 9825225181 Mr.Mayajar	221109 221267 9826214709	234386 233081
5	M/s. Bhuvneshwari Salt Works, TCX-S-62, Gandhidham	Mr.Sreechandji Jain 9825222269	237114 235203	233605 236860
6	M/s. Dungershee Salt Works, Shop No. D-93, P.B.No.9, Gandhidham	Mr.Hiralal Parekh Mb: 9825019661 Mr. R.B.Agrawal Mb: 9825019662 Mr. Bhikhabhai (Salt Area)	222765 223440 9825225667	232767
7	M/s. Shree Laxmi Salt Allied Ind., "Shree Sadan", 207 / 12-B, Gandhidham	Mr. Rajubhai Rathi Mr. Rameshbhai Rathi Mob.: 9824214901	232167	232167 235482
8	M/s. Jyoti Salt Industries, "Sukh Sadan", Opp. Hotel President, Gandhidham	Mr.Acharya Sukhdevbhai Mr. Sukhdevbhai Acharya Mb: 9825226075	223776 221082 221089 223094	221876

9	M/s. New Kandla Salt and Chemical Co., "Maitri Bhavan", Plot No.18, Sector 8, Gandhidham	Mr. Babulalji Sanghvi 9825226091 Mr. Sukhrajbhai 98252 26011	232227 231588 234087	234325 231814 232122
10	M/s. Kutch Salt Works, New Kandla	Mr. Mitenbhai Mb: 9825225990 Mr. S.P.Giria, Works Manager, Mb: 9825228085	234659 02222040561 22041598 270371	238633

11	M/s. Vijay Salt Works and Allied Industries, "Friends House", P.No. 50, Sector -1A, P.B.No.106, Gandhidham	Mr. Harishbhai Chaturani Mb: 9825064241 Mr. Babulal Nahata	231119 252247 223743	234856 9825228398
12	M/s. Rajesh Salt Works, "Chandan Chambers" National Highway, Plot No.18, 12/A, Gandhidham.	Mr. Kishorbhai Thakkar Mob: 9825177081 Mr. Rameshbhai Mb: 9825226026	220586 221048 222301	234387
13	M/s. Western Chemical, DBZ-S-151, Gandhidham	Mr. Naranbhai Mb: 9825226092	233185 230913	230141
14	M/s. Urvakunj Nicotine Ltd., Central Bank Compound, Plot No.31, Sector No.9, Gandhidham	Mr. Mahendrabhai Patel 9825206214	234727	234480

		Mr. Vikash Patel Mb: 9825226214		
15	M/. Friends Salt Works, "Maitri Bhavan", Plot No.18, Sector No.8, Gandhidham	Mr. Babulalji Mb: 9825226015 Mr. Ashokbhai Mb: 9825226091 Mr. Sukhrajbhai Mb: 9825226011	232227 231588 234087	231646 231814
16	Smt. Savitri H.Pandya, DBZ-N-21/A, GIM	Mr. Jagdihbhai	220212 238112	255612
17	Smt. Vimlaben.H. Pandya, DBZ-N-21/A, Gandhidham	Mr. Jadishbhai Mr.Amritlal Pandya Mb: 9825225212	220212/238 112 238212 255612	- / /
18	M/s. Rajendra Salt Works, D-125, Jawahar Chowk, Gandhidham	Mr. Tarachand	-	-
19	Mr. Natwarlal Agrawal, TCX-S-75, Gandhidham	Mr. Natwarlal Mb: 9825393555	222672	231564
20	Mr. Indrumal Khubchand, C/o Gulab Salt Works, D-125, Jawahar Chowk, Gandhidham.	Mr. Tarachand	233041 234388	234937
21	Mr. Virji Khimji C/o Ajit Salt works, D-75, Gandhidham	Mr. Kirtibhai	220310	-

22	Mr. Girdharilal.S. Agrawal, Plot No.126, Ward – 12/B, Gandhidham	Mr. Girdharilal	232862	234755
23	Mr. Vijay Kumar.D. Palan & Mri Jagdish Kumar.D.	Mr. Navrotambhai Palan	220310	-
24	M/s. Satya Salt Works, DBZ-S-183, Gandhidham	Mr. Candubhai Mb: 9825225911	224055 221445	234739 234469
25	Shri Premji Gangji Soni, DBZ-S-183, Gandhidham	Mr. Mahes Soni	221263	-
26	Smt. Geetadevi Chaturani Plot No.13, Sector 1, Gandhidham	Mr. Romesh / Ashwin Mr. Dayalbhai Chaturani, Mb:9825064245	221048 256713 220586 256706 Fax: 222930	-
27	Shri Rashmin A.Pandya DBZ-N-21/A, Gandhidham	Mr. Jagdish Pandya	220212 238112 238212	-
28	M/s. Neelkant Enterprise, DBZ-S-60, Gandhidham	Mr. Shamjibhai Mb: 9825 25711	220421 220103 Fax: 223560	231485
29	Dayalal G.Chaturani Shop No.1 to 4, "Chandan Chamber" Plot No.18, Ward No.12, Gandhidham	Mr. Dayal	221048 220588	-

30	Shri Punamchand, DBZ-N-197, Gandhidham	Chaganla	Mr. Chaganlal	220545	-
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Safety Officer & Librarian shall inform the Public/Private Sector Tank Farms in Kandla about the situation and advise them to shift their people out of the respective areas to safe places.

9.17.3.2 List of Private / Public Tank Farm Owners

Sr. No.	Tank Farm Owners	Persons to be contacted in case of emergency		
		Name and Position	Telephone No.	Mobile No.
1	Kesar Enterprises Ltd., Near Oil Jetty, Old Kandla (Kutch)- 370210	Mr. R.K. Gupta Gen. Manager	270435 (O) 295676 (R)	9375349181
2	Kessar Enterprises Ltd, Terminal II, Plot No. 5 &6 Old Kandla	Mr. R.K. Gupta G.M	270435 (O) 270177 (O)	9375349181

3	Chemical & Resins Pvt. Ltd Terminal –I, Near Oil Jetty, Old Kandla, Kutch Terminal – II, Near West Gate, New Kandla – Kutch	Lt. Col. Pramod Kumar (Retd), GM,	270505(O) 236831(R) 270916 (O)	9825225676
4	Indo-Nippon Co. Ltd., Plot No.2, K.K.Road, Old Kandla,	Mr. R.N. Pathak Asst. Terminal Manager	270795(O) 235818(R) 270295(O)	9879571295
5	J. R. Enterprise, Plot No.3, Old Kandla,	Mr. Devendra Dadhich, Terminal In-charge	653528 (O) 257152 ®	9898238380
6	Friends Oil & Chemical Terminals Pvt. Ltd., Near Booster Pump Station, Old Kandla, Kutch	Mr.S.Ramakrishnan Terminal Manager	270987 (O) 257249 ®	9879572107

7	<p>Indian Oil Corporation Ltd.,</p> <p>Main Terminal, GIM</p> <p>Foreshore Terminal, Kandla</p> <p>KBPL</p> <p>LPG Import Plant</p>	<p>Mr. AK. Khanna</p> <p>Sr. Term. Manager</p> <p>Mr. KS Rao, Sr.TM</p> <p>Mr. PS Negi</p> <p>Plant Manager</p>	<p>233274</p> <p>(O)</p> <p>229002 (R)</p> <p>270394</p> <p>(O)</p> <p>270628</p> <p>(O)</p> <p>270477</p> <p>(O)</p> <p>233359[®]</p> <p>270978</p> <p>(O)</p> <p>236944</p>	<p>9427216637</p> <p>9426416108</p> <p>9426725342</p>
8	<p>United Storage & Tank Ltd</p> <p>Near IOC Foreshore Terminals, New Kandla</p> <p>Gas Terminal, Plot No. 4</p> <p>Old Kandla</p>	<p>Mr. Manoj Gor</p> <p>Terminal Manager</p> <p>Mr. G. Chudasama</p>	<p>270609</p> <p>(O)</p> <p>653525</p> <p>(O)</p> <p>651238[®]</p> <p>653529</p> <p>(O)</p>	<p>989850029</p> <p>9904366855</p>
9	<p>IFFCO Kandla Unit, Kandla, Kutch</p>	<p>Mr. L. Murugappan,</p> <p>G.M.(NPK-I)</p> <p>Mr. Brahmbatt</p> <p>Manager (F & S)</p>	<p>270711</p> <p>270352(O)</p> <p>270381</p> <p>(O)</p>	<p>982506922</p> <p>9099019861</p>

10	BPCL, KK Road, GIM	Mr. RG. Dekate Sr. Manager Operations	234313 (O) 223235 (R)	9099929634
11	HPCL KK Road, GIM	Mr. Murthy Manager (Installation)	230936 (O) 220084 (O) 233078 Ext	
12	INEOS ABS (I) Ltd Plot No. 8 Old Kandla	Mr. Vineeth Nair Dy. Manager	270087 (O) 234409 (R)	9825237029

13	Liberty Investments Pvt. Ltd., Plot No. 1 & 2, Block 'H', New Kandla	Mr. Jitendra Vaidya Terminal Manager	270151 (O) 270464 (O) 270468 (R)	9825025645
14	Avean International Pvt. Ltd., Liquid Storage Tank Terminal, Plot No. B-1, New Kandla	Mr. Bharat Rathod Terminal Manager	270537 (O)	9375310260

15	Rishi Kiran Logistics Pvt Limited, Plot No. 7, Link Road Old Kandla	Mr. RH. Pandya GM (Terminal)	270223 (O) 270443 (O)	9879104556
16	N.P.P. Pvt. Ltd., Old Kandla	Mr. MD.Nagvekar	270347 (O) 257807 ®	9825227649
17	Friends Salt Works and Allied Industries, KK Road, Old Kandla	Mr. NJ.Zinduwadia Sr. Manager Mr. HA. Mehta,S.M	270814 (O) 262698 (R) 271260 (O)	9825506361 9825506360
18	IMC Ltd, Cargo Jetty New Kandla	Mr. Anil Brahmbhat	270369(O) 653524 (O) 296079 (R)	9898126243
19	Agencies & Cargo Care Ltd., Plot No.3, New Kandla.	Mr.Shivkumar Menon, Terminal Manager	270714 (O)	9825226765

20	Dipak Estate Agency Plot No. 5-6, Block – A New Kandla	Mr. Narendra Thacker	270375 (O)	9879611243
21	Parker Agrochem Exports Ltd, Plot No. 3 –4,Block- H New Kandla	Mr. Bharat Thacker	270486 (O) 270528 (O) 231876 (R)	9825238260
22	Tejmalbhai & Co New Kandla	Mr. Ankitbhai Chandan	271330 (O) 230090 (R)	9825225101
23	Parker Agrochem Product Pvt. Ltd, Plot 7-9/A,N.Kandla	Mr. Raja Babu Dy Manager	270528 (O) 231876 (R)	9979158543
24	Mother Dairy Fruit & Vegetable Pvt. Ltd, Near Oil Jetty, Old Kandla	Mr. Saju Therattu	270654 (O) 270655 (O) 230979(R)	9974022681

Traffic Manager/ Additional Traffic Manager shall arrange to inform all the Stevedores / Agents and other Stakeholders to remove their workers from the operational areas at Kandla.

9.17.3.3 List of Stevedores in the Port

Sr. No.	Name	Address	Fax No.	Telephone Nos.	
				Office	Resi.

1	M/s. Cargo Movers	"Cargo House" BBZS-32A, Gandhidham	231687	220453 231365	261280
2	M/s. DBC & Sons (P) Ltd.	Seva Sadan-II, Room No. 303 / 304, New Kandla	270631	270503 270263 270348	-
3	M/s. A.V.Joshi & Co.	Plot No. 18, Sector-8, Maitry Bhavan, Nr. Post Office, Gandhidham – Kutch	233924	231070 232227 231588	234909
4	M/s. ACT Shipping P. Ltd	Seva Sadan-II, Room No. 206/207, New Kandla	232175	270111 270112 270015 229967	261308 231416
5	M/s. Cargo Carriers	214/215, Rishab Corner, Plot 93, Sector- 8, GIM	230030	220816 231649 230030	231694
6	M/s. Cargo Clearing Agency (Gujarat)	Plot No. 271, Ward 12- B, Gandhidham	233034	221721 220655	231452
7	M/s. Chotalal Premji Stevedores Pvt. Ltd	C-8, Shaktinagar, GIM	231509	270009	-
8	M/s. Hiralal Maganlal & Co.	C-11, GIDC Area, Gandhidham – Kutch	223914	223914 231832	223878 232430

9	M/s. New Dholera Shipping Company	Goyal Commerce Centre Building - 1, Plot No.259, Ward 12B, Gandhidham - Kutch	-	222637 232267	237284
10	M/s. J.M. Baxi & Co.	Seva Sadan – II, Room No. 301 / 306, New Kandla	270646	270630 270550 270448	260427
11	M/s. Pestonjee Bhicajee (Kutch)	Seva Sadan-II, 203, New Kandla	270650 270556	270257 270367	262914
12	M/s. OTA Kandla Pvt. Ltd.	BBZ-N-324, Gandhidham	223241	220145 270560	223241
13	M/s. Purshotamdas Jeramdas & Co.	5, Vaswani Chamber, 16, Sector-8, GIM	222850	238242 222598	220598
14	M/s. R. Tulsidas & Co.	Ahit Building , Plot No.323, Gandhidham - Kutch	232308	222717 221943	-
15	Rishi Shipping	Plot 50, Sector 1/A GIM	238943	229830 229831	
16	M/s. Vinsons	BBZ-S-25, Gandhidham - Kutch	231948	220466	222395 239460
17	Sical Logistics Ltd	403, 4th Floor, Madhuban Compex, OSLO, GIM	234416	234646 234194	

18	Parekh Marine Agency	C-8, Shaktinagar GIM	231509	229297 221158	
19	Krishna Shipping and Allied Services	Transport Nagar, NH GIM	233135	230501 223814 229085	
20	Kevar Handling & Transport	Carrier & Shop 24, Tolani Chamber, Sector -8, GIM	228298	228298	
21	Trinity Shipping & Allied Industries	Trinity House, Plot 46 Sec 1/A, GIM	232060	230911 230910	
22	Velji P & Sons(P)Ltd	2nd Floor, Deepak Complex, 315, 12/B GIM	236168	231545 231546 225466	
23	Asean Marine Services	Ashit Bldg, Plot 33 Sector 1/A, GIM	232308	222717 221943 222145	
24	Rishikiran Roadlines	Kiran House, Plot 8 Sector 8, GIM	231422	231894 234108	
25	Universal Shipping Services	Hotel Sea Bird, Plot 173, Sector 1/A, GIM	235251	230663 226050 226037	
26	Seaways Shipping (P) Ltd	2nd Floor, Plot 351 Ward 12/B, GIM		226183 237147	

27	Seacrest Shipping Services Pvt. Ltd	216, 2nd Floor Om Corner, Plot 336 Ward 12/B, GIM	227028	233325	
28	Shree Maruti Shipping Services	18/21, Swaminarayan Bldg, Sector 9, GIM	234107 250690	233245 237247 250690	
29	Liladhar Pasoo Forwarders P.Ltd	Plot 4, Sector -1 KASEZ, GIM	252383 253506	252286 252297 252612	
30	Shree Radhey Shipping Company	14-16/C, GF Green Park, GIM	232967	222919 228919 238883	
31	Pearl Shipping	220, Rishab Corner, Plot 93, Sector 8 GIM	235570	225283 225284	
32	Patel Shipping Agency	Patel Avenue, Floor 2,Plot 170, Sector 1/A, GIM	231143	224024	
33	Ashirvad Shipping	18-21, Swaminarayan Bldg, Sector- 9, GIM	250690	233245 237247 222822	
34	M/s. Swaminarayan Vijay Trade	1st Floor, H-6, Op. Tejas Society, Ghatlodia,	079- 231983	231981, 231982	

	Carriar	Ahmadabad			
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9.17.3.4 List of Liner & Steamer Agents at Kandla Port

Sr. No.	Name	Fax No.	Tele. No.	Mobile
01	M/s ACT Shipping Ltd Mr. Harshad Gandhi	232175/ 270597	270111 270115-6 229967 231734	9825226141
02	M/s Admiral Shipping Ltd	233596	230552 232823	
03	M/s Areadia Shipping Ltd	232542	234254 223486	
04	M/s Ambica Maritime Ltd Mr. Amit Vyas	252447	252479 252349	9825225210
05	M/s APL (India) Pvt Ltd., Mr. Murli Krishnan	236361	224601/2 236357 236355	9825225753
06	M/s Arebee Star Maritime Agencies Pvt Ltd. Mr. Anil Talwar	235831	220465 235832	9824229109
07	M/s Ashit Shipping Ser. Pvt Ltd. Mr. Sanjay Thakkar	232308	221943 222717 222145	9825225698
08	M/s Atlantic Shipping Pvt Ltd	223372	230552	
09	M/s Asia Shipping Services. Mr. Mohan Karia239326	231285	234526 230954	

10	M/s Bayland Freight Systems Pvt Ltd., Mr. Danendran Gopalan	239326	225522/ 23	9825230880
11	M/s B D Vithlani Shipping Services Pvt Ltd.	234104	232220 221081	
12	M/s Cargo Conveyors Mr. Shekhar Ayachi Mob. 9825226102	233034	221460 220655	
13	M/s CCA Shipping Services Mr. K C Varghese	233034	221721 220655	9825225217
14	M/s Chowgule Brothers Mr. C R Soman	229227	278521 225051 232365	9825361782
15	M/s Coastline Services (India) Pvt Ltd.	221137	232095 222853	
16	M/s Container Marine Agency Pvt Ltd	234541	230026 220416	
17	M/s Conftreight Shipping Agency (India) Pvt Ltd. Mr. K T R Nair	-	233615 236157	
18	M/s Cresent Shipping Agency (India) Pvt Ltd Mr. Sanjay Salve.	224506	221290 221957	9825227311
19	M/s DBC Freight International	230832	230832 230639	

20	M/s DBC Sons (Gujarat) Pvt Ltd. Mr. R C Vazirani	270631	270263 270503	
21	M/s Depe Global Shipping Agency Pvt Ltd. Mr. Jaydeep Roy	232079	231528 233608 234582	9825228121

22	M/s Evershine Shipping Services. Mr. Kishan Motwani	234083	221588 237408	
23	M/s Forbes Gokak Ltd	231464	222634 235004	
24	M/s Freight Connection (India) Pvt Ltd	231357 270726	222247 222545 270727	
25	M/s GAC Shipping (India) Pvt Ltd. Mr. V C Rao	231429	231427 237244	9825225136
26	M/s Ganges Liners Pvt Ltd	233437	231608 233436	
27	M/s German Exp. Shipping Agency Pvt Ltd	236040	223269 236040	
28	M/s Goodrich Maritime Pvt Ltd	222875	222882 222883	
29	M/s G P Dave & Sons (Shipping)	234382	234288 234382	
30	M/s Greenways Shipping Agencies Pvt Ltd	232079	233608 234585	
31	M/s K. Shipping Services Pvt Ltd	233632	231933	
32	M/s Halar Ship & Freight Forwarders. Mr. Tejas Shrma	270224	270192 270568	9825212646
33	M/s Hind Shipping Agencies. Mr. Mahesh Vyas	234795	232710 235375	
34	M/s Hindustan Shipping Services. Mr. M D Sorathiya	239110	239110 222821	9824214994

35	M/s Interocean Shipping India Pvt Ltd. Mr. Suresh Tripathy	232579	235201 230589	9825225583
36	M/s Intra Trade Pvt Ltd. Mr. B P Vasavda	233295	233313 231255	9825226129
37	M/s Trades Shipping Pvt Ltd	231463	235572 233606	
38	M/s James Mackintosh Marine (A) Pvt Ltd. Mr. Satish Nair	270793	270792 270846	9825226077

39	M/s J MBaxi & Co. Mr. D P Mitra	270646	270630 270635 270525	9825225107
40	M/s Kutch Shipping Agency Pvt Ltd. Mr. Azad Khan	233339	221148 250226/ 7/8	
41	M/s Liladhar Passop Forwarders Pvt Ltd. Mr. S. Chakraborty	252383	252297 252402 252288	9825020523
42	M/s Maersk (India) Ltd. Mr. Dinesh Joshi	231388	231387 236192 233963	9825270419
43	M/s Maheshwari Handling Agency Pvt Ltd. Mr. Chaggan Maheshwary	230575 234633	223228 230393	9825227111
44	M/s Maltrans Shipping Agencies India Pv Ltd.	230606	220147 230336 235022	
45	M/s Mathurdas N. & Sons Forwarders Ltd.	252221	252224 252350	

46	M/s Meridian Shipping Agency Pvt Ltd	230212	220305 230220	
47	M/s Mitsutor Shipping Agency Pvt Ltd	230411	220110	
48	M/s M M Shipping Services	235255	231385 238385	
49	M/s Modest Shipping Agency Pvt Ltd	-	230576	
50	M/s NLS Agency India Pvt Ltd. Mr. Sanjay Salve	232413	231318 220305	9825237311
51	M/s Orient Express Lines Ltd	230359	232186 232805	
52	M/s Orient Ship Agency Pvt Ltd. Mr. H G Digrani	233518	223430 223487	9824214801
53	M/s Oscar Shipping Agencies.	231812	226959/6 0 232123	
54	M/s Parekh Marine Agencies Pvt Ltd. Mr. Mitesh Dharamshi	231509	221409 235341	9825226557
55	M/s Patel Handling Agency (Capt. Kalra)- 9825062912	231143	224024 231004 221718	
56	M/s Patvolk (Mr. Shreekumar Nair)	231464	222624 235004	

57	M/s Pearl Shipping Agency. Capt. Kalra	231143	224024 221718	9825062912
58	M/s Penguin Shipping Agencies Pvt Ltd.	230606	230336 220147	

59	M/s Pestonjee Bhieajee (Kutch) Mr. R K Kewalramani	270650 270556	270221 270257 270367	9825226962
60	M/s Prudential Shipping Agencies Pvt Ltd. Mr. Siddharth Mishra	232911	230479 233982	9825226477
61	M/s P&R Nedlloyd India Pvt Ltd	232207	224906/7 232128	
62	M/s R T Bhojwani & Sons Mr. Gopichand Bhijwani	232423	223831 220839	9825225639
63	M/s Sahasu Shipping Services Pvt Ltd	236358	225224 237854	
64	M/s Sai Shipping Co. (P) Ltd Mr. S T Hingorani	231972	221369 231739	9825228681
65	M/s Samrat Shipping Co Pvt Ltd	232890	231983 222939	
66	M/s Samsara Shipping Pvt Ltd. Mr. Pranesh Rathod	233165	228602	9825225755
67	M/s Scorpio Shipping Agency	-	223085	
68	M/s SDS Shipping Pvt Ltd	231542	221326 221087	
69	M/s Seanay Shipping Pvt Ltd	270026	270788	
70	M/s Seabridge Maritime Agencies Pvt Ltd	231509	221409 221158	
71	M/s Seafreight Pvt Ltd	222850	233530 222393	

72	M/s Sealand Agencies India Pvt Ltd	230584	231179 230584	
73	M/s Seamar Shipping India	255563	-	
74	M/s Seatrade Shipping	234171	233810	
75	M/s Sentrans Maritime Pvt Ltd	236129	230002 220702	
76	M/s South India Corporation (Agencies) Ltd Mr. Antony	234416	221276 234646 231494	9825226256
77	M/s Spoonbill Maritime Agencies Pvt Ltd	234167	221049 222058 234454	
78	M/s Star International	231395	233948 232402	
79	M/s Taipan Shipping Pvt Ltd	236040	223269 227010	
80	M/s Taurus Shipping Services. Mr. Sukhveersingh	231266	221334 223074	9825227325
81	M/s Oceanic Shipping Agency Pvt Ltd	270631	270263 270503	
82	M/s TICC Container Line (Kandla) Pvt Ltd	237854	237854	
83	M/s Total Transport Systems Pvt Ltd	231463	222634	
84	M/s Transocean Shipping Agency Pvt Ltd	-	230832	
85	M/s Transworld Shipping Services India Pvt Ltd Mr. Sandeep Rajvanshi	231913	229824 221290	9825225733
86	M/s Trinity Shipping & All. Services Pvt Ltd Mr. Soly	222060	230911 223703	9825225245

87	M/s Unimarine Agencies (Gujarat). Mr. Jaikumar Ramdasani	224633	224631/ 32 223113	9825225216
88	M/s Unique Shipping Services Pvt Ltd	-	232729 232730	
89	M/s United Liner Agencies of India Pvt Ltd Capt Rakesh Kumar	236040	227779 223269	9825225741
90	M/s Universal Freight Systems	252383	252288 252297	
91	M/s Universal Shipping Services Mr. Anil Pillai	235251	230663 231708	9824215168
92	M/s Velhi P. Sons (Agencies) Pvt Ltd	255328	255327 231545	
93	M/s Vibhuti Shipping Pvt Ltd Mr. Vinod	236219	236719 230035 232424	9825226536
94	M/s Worldwide Cargo Care Pvt Ltd	231913	221290 221479	

9.18 Core Team

Asstt. Commandant-CISF, OSD (Estate), Ex. Engineer (Roads)-KPT, Executive Magistrate of State Govt. of Gujarat i.e. the Mamlatdar, Gandhidham and Police Inspector, Kandla shall jointly ensure evacuation of people from Kandla areas. The persons entrusted with the evacuation programme as indicated here below will have to report the progress in evacuation to the Dy. Secretary (E) who shall appraise all developments in this regard to Chairman and Dy. Chairman, KPT over telephone from time to time.

The Evacuation of People from different areas at Kandla shall be looked after by the officers named below.

9.18.1 Banna Fishermen Hutments

ACTION BY, Junior Engineer, and CISF

9.18.2 Saltpans (Including Major & Minor)

ACTION BY: Asstt. Estate Manager, Mr. AB Pradhan, Labour Officer and CISF.

9.18.3 Sirva Camp & Sirva Railway Hutments

ACTION BY: OSD (Estate), Estate Inspector and CISF

9.18.4 G Type Quarters of DEENDAYAL PORT TRUST

ACTION BY: Assistant Engineer and CISF

9.18.5 New Kandla KPT Colonies, Customs & Hutments in PGVCL Land

ACTION BY: Assistant Engineer/InspectorVigilance with CISF

9.18.6 Hutments near IFFCO Plant

ACTION BY: Junior Engineer and CISF

9.18.7 Cargo Jetty & Oil Jetty Areas

ACTION BY: Traffic Manager – Private Workers/ Shore Workers

AAO, CHD - CHD Workers

HOD/Dos - The Employees of their respective deptt.

The Traffic Manager/ Commandant CISF shall ensure that the Cargo/ Oil Jetties are completely evacuated and there is no fresh entry into the operational areas.

9.19 Public Announcement

The Public Announcement for faster evacuation is to be made by (a) CISF on behalf of DEENDAYAL PORT TRUST and (b) Police Inspector, Kandla Police Station in consultation with KPT officials.

9.20 Temporary Shelters

The Temporary Evacuation Centres (TEC) will be set up in the Gandhidham area in places like Schools/ Community centres etc as may be decided in consultation with the State Govt. Officials.

Executive Engineer (TD) will have to ensure the following;

Opening cleaning and providing water facility in the Temporary Shelters at Gandhidham in premises coming under the administrative jurisdiction of Kandla Port that may be identified for the purpose by the Collector/Mamalatdar/concerned state govt. authority. The toilet blocks attached to these buildings are to be kept in usable condition.

Executive Engineer (Electrical) shall ensure providing of lights and continuous electric supply in the Temporary Shelters as mentioned above.

Mr. A B Pradhan, Labour Officer and the Head Master of BVM School will have to ensure opening of the School and shifting of school furniture as may be directed.

The requirement of amenities/ medical aid etc in the Temporary Evacuation Centres will be taken care of by the Executive Engineer(TD)/ (R), Senior Engineer (PL), updt Engineer (E) and Doctors of Medical Department.

9.21 Transport Facility

The Traffic Manager shall provide sufficient number of Trucks and Dumpers as may be requested by Dy. Secretary (E) for evacuation purpose.

The hired buses of KPT shall be deployed for evacuation. In case of additional requirement the Dy. Secretary (G) will co-ordinate with Mamlatdar, Gandhidham for obtaining sufficient number of ST Buses for evacuation purpose.

Secretary shall co-ordinate the above activities.

Ensuring the functioning of TELEPHONES

The name and telephone No. of the Officer Telephone Department to be contacted in case of any problem:

1. General Manager, Bhuj(O) 231201/231648 (R)

2. District Engineer, Bhuj(O) 525410

3. SDO (P), Gandhidham(O) 232453/229666 (R)

Dy. Secretary (Personnel) shall ensure that the telephone of all the Head of Departments and other responsible officers of different Departments are functioning properly by ringing personally. In case any of the telephones does not function or give satisfactory service, he shall take up the matter with the higher authorities immediately.

9.22 Traffic Movement

Commandant, CISF with the help of Police shall ensure that all incoming traffic to the Port is stopped except those which are coming for rescue operations and essential services at three places i.e. KASEZ Junction, Railway crossing and Kharirohar Road. He shall immediately erect two temporary tents and post sufficient number of personnel of CISF in coordination with Police, who shall identify which person has to be allowed. Commandant, CISF shall also ensure that those allowed do not cause any hindrance for those who are supposed to function as per the Internal Action Plan.

Staff Attendance

From experience it is observed that several times many officials do not turn up for work under one or the other pretext. This would be viewed very seriously. Immediately on operationalising this Action Plan, even if, it is a Public Holiday, the following staff shall report for duty.

All Operational Staff particularly those of Floating craft Section and Power Supply Section.

All Head of Departments and all Class-I & Class-II Officers shall be present in their office timings. Besides, a list of very essential officers, who will be required to be present even beyond the normal duty hours, as and when required, shall be prepared.

All P.A.s/Stenographers/Peons of Head of Departments and Deputies.

All Office Superintendents/Superintendents (Accounts)

All Head Clerks and Divisional Accountants.

The above officials shall be present in the office, unless otherwise directed.

The Staff attendance on days when the Action Plan is in the operation shall be collected from P.A. to HODs and compiled by Asstt. Secretary (G). The daily position will be reported to Chairman/Dy. Chairman every day with separate list of absentees. Assistant Secretary (G) should ensure presence of staff by following the required action.

All Head of Departments may hold a meeting with Class-I, & Class-II and staffs and explain their functions as per the provisions of Action Plan during the Natural Calamity and submit a Compliance Report to Chairman/Dy. Chairman on priority basis.

The following officers will ensure timely supply of Drinking Water/Food Packets to the staff during the operation of the Action PLAN:

Asstt. Executive Engineer- For the staff of Traffic/Mech./Civil

Engineering Department

AFS- For the Flotilla Staff /SIGNAL STATION

Company Commander, CISF- CISF

FcSO- For Fire Brigade Staff

The above officers shall be responsible for placing order for procurement of Food Packets. They should ensure that there is no shortage on this account. They shall come in to action on their own. They are also responsible for placing advance order, preparation of food packets, transportation, and distribution in time and report compliance to Secretary for the previous day.

9.24 Sanction of Advance

All Head of Departments would make a judicious assessment regarding the requirement of funds by them to meet the different exigencies, which they may have to handle on account of the Natural Calamity situation. The HoDs would inform the FA&CAO on telephone or in writing or through a messenger regarding their requirement of advances. The FA&CAO in turn would examine the advances sought by the Head of Departments and sanction the advances early without any delay. The FA&CAO would keep the Chairman and Dy. Chairman informed about the amount released by him and seeks approval.

9.25 Vehicle Pool

As soon as this Action Plan comes into force, the vehicle pool stands formed; the vehicle pool shall be controlled by Senior Engineer (Pipeline) and Senior Labour Officer. The following vehicles will be there in the Pool:

All Ambulances Under CMO

9.26 Private Vehicles Buses { To be arranged by Labour Section}

9.26.1

List of Civil, Electrical & Mechanical Contractors

Sr. No	Name & Address of Contractor			
		Office	Resi	
1	Mr. Dilip Bhandbe, M/ Mukund Ltd.	223412		
2	M/s. Maheshwari Const. Co., SDX-N-5, Gandhidham-Kutch Mr. Rameshbhai	232134		
3	M/s. Apex Engineers, Bajaj Chambers, 12/B, Gandhidham – Kutch (Mr. Vishal)	222002 222223	—	9898226666
4	M/s. Gadhvi Constructions, Plot No.524, Sector – 5, Gandhidham – Kutch	235772	—	9426215258
5	M/s. Advance Builders Contractors, B-23, Apanagar, Gandhidham – Kutch.		232864 234242	9825255934
6	M/s. Mohan Construction Co., 415, 2/B, Adipur (Mr. Mohan)	—	264140	9825174351
7	M/s. Star Decorators, 17, Plot No.5, 12/A, National Highway, Gandhidham – Kutch (Mr. Vinod Bajaj)	221450	—	—

8	M/s. Kamal P. Chellani, DBZ-S-81-A, GandhidhamKutch (Mr. Kamal)	_____	_____	9825221542
9	M/s. K.K.Construction, E-71, Gujarat Housing Society, Devi Krupa, Sector –5, Gandhidham (Mr. Milanbhai)			230064
10	M/s. Mepabhai Madan, Plot No. 21/22, Sector-9, Opp. KPT Office, Gandhidham Mr. Rajubhai	222209 222210		233627
11	M/s. S. B. Singh, B-110, Sapna Naga Gandhidham – Kutch	239351	_____	_____
12	M/s. Dipesh Construction Co., 11, Apurva Chambers, Ganga Gate, Anjar – Kutch. (Mr. Parth) (Mr. Sukhdevbhai)	242997	243319	9824294260 9825179040
13	M/s. Raj Construction Co., Deepak Complex, Plot No.315, Ward 12/B, Gandhidham-Kutch Mr. Rajesh Makhijani	220911		
14	M/s. M. V. Rajani,444, 2/B, Matruchhaya,Rambaugh Road, Adipur – Kutch (Mr. Narayan)	260800 262920	_____	9825225690

15	M/s. Bhimji Velji Sorathia, 21, Nilesh Park, Plot No.80, Sector – 8, Near New Court Building, Gandhidham – Kutch (Mr. Bhimji Velji)	231383	_____	9825225948
16	M/s. Sollone & Parco Engg. Co., CCX-165, Adipur – Kutch (Mr. Ravi Solanki)	261298 263248		9825222919
17	M/s. Mahesh Construction, Plot No. 415, 2/B, Adipur- Kutch (Mr. Mahesh)	_____	264140	9825091599
18	M/s. Patel Construction Co. Zanda Chowk, Gandhidham (Mr. Tejabhai Kangad)	220421	_____	9825227199
19	M/s. M. G. Bhavnani, Plot No.102, Sector 1/A, Gandhidham – Kutch	_____	_____	9825191636
20	M/s. Patel Engineering Works, Gandhidham	231832		
21	M/s. H.M.G. Gandhidham	235710 234609		
22	M/s. Mukund Limited Mumbai	022- 25347373		
23	M/s. Bajaj Electric Mumbai	022- 23724192		
24	M/s. Mishra Brothers Gandhidham			

		221172		
25	M/s. Sonu Electricals 18, K.P.Shopping Centre, Near Jivan Bharati School, Karelibaug, Vadodara-390018 Shri Jayendrasingh.B. Thakker	02652464108	2647886	
26	M/s. Ravi Electronics, "Prashant", 20, New Jagnath Rajkot – 360 001 Mr. G.K.Patel	465256 460 253		
27	M/s Megha Technicals, CCX - 165, Adipur - Kutch (Mr. Ravi Solanki)	261298 263248	_____	9375320232
28	M/s Maruti Construction, Gandhidham – Kutch	_____	_____	9824893851
29	M/s Ramesh Meghji Sorathia, Anjar – Kutch	_____	_____	9825225948
30	M/s Mohit Construction, B-168, Shaktinagar, Gandhidham - Kutch	_____	_____	9825227072

Senior Engineer (Pipeline) should ensure the availability of the Drivers and the Vehicles and report to the Secretary. All Vehicles whether it is of KPT or hired should be parked in the location as decided by the Senior Engineer (PL) and Senior Labour Officer(PO), from where it can be taken for immediate use as soon as the people move into action. The list of travel agencies is given below:

9.26.2 The list of Travel Agencies

Sr. No.	Name of Agency	Phone No.	
01	M/s. Rathod Tours and Travels, Gandhidham	222444	222959
02	M/s. Gayatri Tourist, plot No. 720/721, Valmikinagar, Bharatnagar, Gandhidham.		231715 230252
03	M/s. Panch Tirth Tours, BBZ-S12, Gandhidham	232215 230760	9825234455
04	M/s. Maheshwari Travels, Plaza Centre, Shop No. 110, 1st floor, Plot No. 110, Sector No.8, Gandhidham	232211 234455	252120 253433
05	M/s. Titan Travels, Behind Shyam Electric Stores, Jhanda Chowk, Gandhidham	222832	236911
06	M/s. Rohit Enterprises, Plot No. 99, Sector No. 4, Near IOB, Gandhidham	228550 237538 237547	234140 9825225121
07	M/s. Jai Somnath Travels, Mr. Mishra		9727304414
08	M/s. Agrawal Tourists, Gandhidham	221311 220068	
09	M/s. Ashirwad Travels Gandhidham. Shri Laxma Singh	225608 225609	9825225608
10	M/s. Krishna Travels Gandhidham	220683 234838	
11	M/s. Shiv Tourists, Gandhidham	221454	

12	M/s. Thakker Gandhidham Travels,	225097	9825271072
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9.27 Contact with Railway & GSRTC

Secretary, Dy. Secretary (G) & Dy. Secretary (P) should ensure for the smooth movement of workers/employees for which he may get in touch with the following officers of Western Railway/GSRTC and apprise them about the situation so that the movement of Staff is not suffered.

Transport	Contact Person	Telephone Nos.	
		Office	Residence
Western Railway	Area Manager	221340	236237
	Control Room	232578	
	Enquiry	131/220011	
GSRTC, Anjar	Depot Manager	241192	243746
GSRTC, Bhuj	Depot Manager	220002/220102	
GSRTC, G'dham	Depot Manager	220198	

9.28 Generator Sets

Generators of following capacities have been installed at Kandla, Gandhidham, and Gopalpuri to supply power to various installations in case of power failure:

1. Cargo Jetty Area - 2 Nos of 1000 KVA EACH:

These Generators can cater power inside Cargo Jetty Area, Seva Sadan-III, Nirman Building, and Old C.D.C. Building restricted up to 2000 KVA.

2. Kandla Hospital - 25 KVA
3. A O Building- 200 KVA
4. Gopalpuri Hospital- 45 KVA
5. Guest House- 25 KVA
6. Old Kandla Fire Brigade- 5 KVA

In addition to above, if any additional Generator Sets are required at Kandla or Gopalpuri, the following officers shall be contacted who shall immediately hire/procure or provide in whatever manner the D.G. Sets giving preference to the operational area.

- (i) Deputy Chief Mechanical Engineer
- (ii) S E (Electrical)
- (iii) Executive Engineer (Mechanical)
- (iv) Asstt. Executive Engineer (Electrical) Shri AK Sharma

The above officers shall also be responsible for operation and maintenance of Generators provided at various locations and submits daily report to the Chief Mechanical Engineer about the working of Generators.

Additional requirement will be assessed by Dy CME/S.E (Electrical) and submitted to Chief Mechanical Engineer for approval. Necessary Fuel (POL) shall be procured and stored in advance by the concerned officials of Mechanical Engineering department.

9.29 Fire Dewatering Pumps

There are 10 Nos. of Dewatering Fire Pumps available with Fire-Cum-Safety Officer at various points. The details of which are as under:-

Dewatering Pump	Old Kandla Fire Station	Tilak Fire Station (West Gate-I)	Azad Fire Station (West Gate -II)
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Portable Fire Pump Capacity:270 LPM	04	01	01
Trailer Fire Pump Capacity:1800 LPM	-	01	01
Trailer Fire Pump Capacity:2250 LPM	02	-	-

The Portable Fire Pump single delivery having capacity of 270 litre per minute are useful for dewatering the congested places like ship holds, barges and other intricate areas.

All the above Fire Pumps will be operated by the Fire-Cum-Safety-Officer. The maintenance of major nature and breakdown will be attended by Executive Engineer (Mechanical).

Fire cum Safety Officer(O) 270176 Mob: 98252-27041

Dy. Fire Officer (O) 270176/270178 (R) 226478

9.30 Shipping Navigational Aid Section

Executive Engineer (Dry -dock) shall ensure that heave-up barge "Bhimsen" is shifted to Bunder area and secured properly; Assistant Engineer (Mechanical) shall attend the above work.

Steel Floating Dry Dock

Executive Engineer (Dry Dock) and AE(DD) shall ensure that the Steel Floating Dry Dock and the Electric Wharf Cranes at the maintenance jetty are properly secured as per procedure and compliance reported to Chief Mechanical Engineer and Dy. Chief Mechanical Engineer shall monitor the safety of the Steel Floating Dry Dock.

9.31 Periodical Reporting by all HODS

All Head of Departments shall have to send Action Taken Report to the Secretary / Control Rooms in writing by Fax or through telephone with regard to the action taken by them as per the Action Plan. If the report is not received from the Head of Departments, the Officer In-charge, Control Room shall obtain the

information, compile it and submit the same to the Chairman / Dy. Chairman on 12 hourly basis i.e. twice a day.

9.31.1 Chief Engineer

The Chief Engineer shall ensure through Superintending Engineers that all Road Blockades are not cleared as also he should ensure that blockades caused in Port quarters due to the falling of trees, walls, sheds, etc. are got removed immediately. He will ensure that the colonies are got cleared and wherever logging of water is found, the water is pumped out and disinfected. A report shall be submitted to the Chairman / Dy. Chairman every day.

9.31.2 Chief Mechanical Engineer

Chief Mechanical Engineer, Dy. CME/S.E (E) shall ensure that all Generator Sets are properly functioning at A.O. Building, Seva Sadan-III, P&C Building, Hospitals, and Guest House. They will ensure quick restoration of Power supply arrangements by keeping close liaison with the officials of Pachim Gujarat Vija Co. Ltd. They will report to the Chairman / Dy. Chairman every day.

9.31.3 Action Plan – Land Fire Station

The Port Fire Brigade has its Head Quarter at Old Kandla Oil Jetty area with two Sub- Stations at Dry Cargo Jetty at New Kandla.

The contact Numbers are as under:

Main Station (Emergency Response Centre) - 270176, 270178, 271377

Cargo Jetty – West Gate No. 1- 270439

Cargo Jetty – West Gate No. II - 295974

Fire cum Safety Officer - 270176 (O))/ 98252 27041(M)

Dy. FcSO- 270178(O) / 226478 (R)

9.31.4 Resources Available

Refer 4.12 to 4.14.4

In case of any fire, or other crisis an information is received through telephone - or VHF channel - Fire Station Control Room, the Duty telephone attendant raises the fire alarm bell and lights the vehicle indicating light (turn-out bell and Turn out light)

The Duty Station Officer proceeds to the scene of fire with fire Tenders and crew. Station Telephone Attendant should inform other officers like Fire-cum-Safety Officer, Dy. Conservator and Port Control. Telephone Attendant should inform hospital and if fire is in wharf should inform Traffic Manager. Fire cum Safety Officer after apprising the situation should inform Deputy Conservator directly or through the Telephone Attendant immediately.

9.31.5 Ensuring the Functioning of Telephones

The name and telephone No. of the Officer Telephone Department to be contacted in case of any problem:

1. General Manager, Bhuj(O) 231201/231648 (R)
2. District Engineer, Bhuj(O) 525410
3. SDO(P), Gandhidham(O) 232453/229666 (R)

Dy. Secretary (Personnel) shall ensure that the telephone of all the Head of Departments and other responsible officers of different Departments are functioning properly by ringing personally. In case any of the telephones does not function or give satisfactory service, he shall take up the matter with the higher authorities immediately.

9.32 Accidents in the Channel

9.32.1 Fire on Board Tanker / Anchor / OTB

The Ship Master - Pilot should raise & alarm and inform Kandla Tower/SIGNAL STATION on VHF Channel 8 or 16 about the intensity and location of fire.

Kandla Tower will inform the Dy. Conservator, Harbour Master and FCSO. & TM

Master should immediately ensure that the loading/discharging operation is suspended and all the connected valves are closed.

Master of the vessel should immediately gear up his firefighting equipment and post his staff for extinguishing the fire. CO₂ should be injected in the affected compartments.

Dy. Conservator after contacting the ship will inform Chairman and Dy. Chairman about the situation.

Harbour Master, will arrange for availability of chemical dispersant and its equipments and keep them in readiness in case of any oil spillage.

TUGS, with personnel and equipments should immediately start for tanker. Harbour Master on board Tug also to reach the tanker.

Dy. Conservator to remain in constant touch with the Master/Pilot of the Tanker to assess the situation.

In case no power is available on deck, the floating hoses connected on board can be disconnected by means of mechanical puller. Hose can be heated up slightly and the weight can be taken off. The Special Clamps on the flange can be removed. This operation takes about 20 Meters for each hose.

If it found necessary to safeguard jetty and the tanker is required to be removed from the jetty, one tug should remain near to tow the tanker and when given orders should pick up the fire spring and take the weight off the moorings. Master and the Pilot should take due precautions and safety measures and by using Fireman's suits to send the personnel to forward of the vessel for unmooring the tanker. Two lines to be

passed on to the Tug for towing to a safe anchorage. In case, the magnitude of fire is more and beyond the control, other agencies such as Indian Coast Guard, ONGC to be called for assistance.

9.32.2 Grounding of a Tanker

Master or Pilot of the vessel should immediately contact Kandla Tower on VHF Channel 8 or 16 and give the detailed information and the seriousness of grounding. Kandla Tower Signal Station will in turn inform Traffic Manager, Dy. Conservator and Harbour Master, Kandla Port Trust. Dy. Conservator will inform Chairman/Dy. Chairman.

Harbour Master will immediately proceed to site and will immediately board the vessel and after assessing the situation will inform Dy. Conservator about the seriousness of the crisis.

Dy. Conservator in the meantime will remain at Kandla Tower and will be in constant touch with the vessel and if required give necessary guidance to Master/Pilot.

Dy. Conservator to direct Sr. Hydrographic Surveyor to proceed to grounded vessel and check the exact position of the ship and also the grounding around.

Tugs and Launches available at Kandla should remain in readiness and wait for the order of action from Dy. Conservator /Harbour Master.

Fire-Cum-Safety-Officer along with staff and equipment salvage pumps etc to remain on board fire float.

Master of vessel to obtain soundings of all the tanks and to maintain a record of the same to ensure any leakage. He should also take hand lead surroundings around the ship and plot them on the chart.

Master should inform his Chief Engineer to change over to high sea suction for cooling water.

If found necessary, Dy. Conservator can decide and ask for a small tanker/salvage tug which can be brought alongside of the grounded ship and part of cargo can be discharged to this daughter ship. This will help to lighten the grounded ship.

Master should instruct his staff to prepare all her ropes including insurance wire for towing, pulling operation.

Tug to immediately to proceed to grounded vessel and take towlines and start pulling the vessel under the instruction of Harbour Master. If required, Dy. Conservator can decide and send more than one Tug also to the grounded ship for assistance. In case the vessel cannot be re-floated within a day, a navigational warning should be sent to the Chief Hydrographer, Dehradun and the same will be transmitted through Mumbai Radio and Navtex.

9.32.3 Breaking / Ground of a Ship outside Kandla Port Limit

Kandla Port has not had any major incident of grounding/sinking or breaking of a ship in recent past. However, minor incidence of grounding could be tackled by Port's own personnel and equipments.

If there is any major breaking or grounding of a ship outside the limits of Kandla Port, the Port can activate its own crisis management plan to deal with the situation. On receiving message from the Master of the Vessel/ or from Principal Officer, MMD or Coast Guard, Mumbai, Dy. Conservator/Harbour Master, KPT will immediately inform Chairman/Dy. Chairman, Kandla Port Trust.

Harbour Master will instruct Flotilla Superintendent/Tug Master, Fire-Cum-Safety Officer to keep the tugs, launches in readiness. Crafts with chemical dispersant spraying system at Kandla and Vadinar should rig the booms etc, Store enough stock of chemical dispersant and stay in readiness. In case, there is any major oil spillage port to activate its oil spill crisis management plan.

Port Signal Station to be made Control Room and to remain in constant touch with the Ship. Master should immediately send messages and inform nearest Port or Coast Guard about the latest situation of the Ship.

Port command team headed by Dy. Conservator will mobilize the resources available with Port to help the Ship.

Indian Coast Guard, to utilize the services of Helicopter and indicate the location and magnitude of the oil spill. They should keep the nearest port informed about the oil spill/sleek.

If the oil slick is dangerous/approaching the limits of Kandla Port Trust, the Harbour Master along with one Senior Pilot and Safety Inspector (antipollution Scheme) to proceed on chemical dispersant Spraying craft and to reach oil slick and under his guidance all available port crafts can spray chemical dispersant. They can go up & down and try to stop/minimize the oil slick danger to port, Harbour Master to keep Dy. Conservator informed about the situation.

Indian Coast Guard, IOC, ONGC and other agencies who have the system to recover the floating oil should be directed with oil recovery vessel to the area.

If it is necessary, Dy. Conservator can requisition a privately owned small tanker or tank barge, which can recover the oil, store it for eventual disposal ashore. If the oil slick is very large and beyond the control of the Port, the Chairman should inform the Ministry and seek their guidance for mobilizing equipments from outside Parties.

STRENGTHENING DISASTER RISK GOVERNANCE

9.33 Contingency plans in grave situation

Immediately on the occurrence of a crisis, the local Internal Action Plan under the Disaster Management Act, 2005 would be put into effect by the local/District and the state authorities. If the situation has wider ramifications and warrants response at the State/National level, the Chairman/ Deputy Chairman will contact the Nodal Ministry of the State / Central Government and seek the required help. The concerned authorities would activate its control room, call for a meeting of the Crisis Management Group and put into operation its contingency Plan.

9.33.1 First Information

As and when a critical crisis situation develops, the first information would be sent by the Chairman/Deputy Chairman to the State/Central Nodal Ministry through Wireless/Cellular Mobile Phone/Fax/e-mail or any other quickest possible means.

Security measures at Vital Installations are inspected by I.B. periodically. The Deputy Conservator and Traffic Manager shall implement the recommendations of I.B. with the help of CISF, made from time to time for beefing up/strengthening the security at important vital installations.

9.33.2 Authorities responsible for sending of First Information

Crisis	Authorities responsible for reporting	Remarks
Natural Disasters	District Magistrate or District Collector Indian Meteorological Department State/Central Water Commission	Information relating to forecasting/warning of the natural calamity will be sent by the IMD, State/Central Water Commission to the Relief Commissioner as laid down in the contingency Action Plan of the State/Central Ministry.
Chemical/Biological/RADIO ACTIVE Disasters	Chairman / Deputy Chairman	The Chief of the Public Sector/Undertakings would be equally responsible to send the first information through his channel to the Nodal Ministry.
Major Disaster having off-site implications	Chairman/Deputy Chairman	
Break-down in Power Generation/Supply	Chief Mechanical Engineer and Executive Engineer (Electrical) through Gujarat Electricity Board Authority.	

An Installation	Oil	Chief or In-charge of the Oil Installation through his channel to the Nodal Ministry.	
Hijack of an Indian Merchant ship or Indian Crew in a Foreign ship		Chairman/Deputy Chairman	Commandant of CISF, Traffic Manager, Deputy Conservator would inform to Chairman/Deputy Chairman immediately.

9.33.3 List of Members NDMA

Contact Details of NDMA Officers

Name	Office	Fax	Mob.	E.mail id
Shri R K Jain, IAS (Retd), Member	011-26701710	011-26701716		secretary@ndma.gov.in

Sh. S K Gulati, PPS	011-26701711,	011-26701716		
Mr. D S Butola PA	011-26701713			-
Lt Gen (Retd) N C Marwah, PVSM, AVSM, Member	011-26701775	011-26701783		marwahnc.ndma@nic.in
Smt Seetha Mahesh, PS to Member	011-26701721	011-26701783		seetham.ndma@nic.in
Shri Vijaya Kumaran, PA to Member	011-26701782	011-26701783		
Dr. D N Sharma, Member	011-26701738	011-26701767		dnsharma@ndma.gov.in
Smt. Shashi A Kumar PSO to Member	011-26701761	011-26701767		
Shri Kamal Kishore, Member	011-26701740	011-26701754	9818143429	kkishore@ndma.gov.in
Shri Harish Kumar Arora PPS to Member	011-26701751	011-26701754	9910226153	
Shri Basudev Rajbhar PA to Member	011-26701753		8285642447	

JOINT SECRETARIES

Name	Office	Fax	Mob.	E.mail id
Shri B Pradhan, IAS, JS (Admin & Capacity Building and Training)	011-26701780	011-26701795		jsadm@ndma.gov.in b.pradhan@nic.in
M.Mushtaq, PPS	011-26701876			
Shri A.K.Sanghi,ITS JS (Mitigation, IT& Comn)	011-26701718	011-26701864		mitigation@ndma.gov.in
Shri Munendar Kumar, PA	011-26701720			
Maj Gen Anurag Gupta, Advisor (Ops)	011-26701886	011-26701742	8527892258	advopscomn@ndma.gov.in

Ms Archana, PA	011-26701267			
Ms. Mamta Kundra, Joint Secretary (Policy & Plan)(Additional Charge)	011-26701777	011- 26701816	09599946299	jspp@ndma.gov.in
Ms Indira, PA	011-26701747			
M.Sanjay Singh, PA	011-26701816		9899403773	

FINANCIAL ADVISOR

Name	Office	Fax	Mob.	E.mail id
Smt. Aastha S Khatwani, FA,	011-26701709	011-26701715		fa@ndma.gov.in
Sh. Bharat Bhushan, PPS	011-26701712			

JOINT ADVISORS

Name	Office	Resi	Mob.	E.mail id
Lt Col Vikrant Lakhanpal, JA (IT & Comn)	011- 26701743			jaitcomn@ndma.gov.in , vikrant.lakhanpal@ndma.gov.in
Col Ranbir Singh, JA (CBT)	011- 26701823			ranbir@ndma.gov.in
Vinay Kajla, JA (RR & NDRF)	011- 26701815			vinay.kajla@ndma.gov.in ,
Dhirendra Singh Sindhu, JA (OPS)	011- 26701218			dssindhu@ndma.gov.in
Sachida Nand Singh, JA(MP & P)	011- 26701798			jampp@ndma.gov.in
Alice Kujur, DIR (PP)	011- 26701722			-
S K Singh, Dir (Finance)	011- 26701778			
Yogeshwar Lal,	011- 26701833			

DS (Admin)				
Bhupinder Singh, DS (PR & AG)	011-26701878			

NCRMP

Name	Office	Fax	Mob.	E.mail id
Ms. Mamta Kundra Project Director	011-26701777 011-26714321			pd.ncrmp@gov.in
Shri S.S. Jain Dy. Project Director	011-26701792			dpd.ncrmp@gov.in
Shri Ashok Kumar Sarkar, Project Accountant cum Admn. Officer	011-26701744			adm.ncrmp@gov.in

NDMA CONTROL ROOM

Name	Office	Fax	Mob.	E.mail id
Control Room	011-26701728 011-1078	011-26701729	9868891801 9868101885	controlroom@ndma.gov.in , ndmacontrolroom@gmail.com ,

Librarian shall ring up all the private/public sector companies of the area and inform them about their situation and tell them to evacuate their people and take necessary steps. List of private/public sector companies is as shown in Point No:

9.17.3.2

Senior Labour Officer, Labour Officer along with Executive Engineer (R) and Headmasters of BVM School shall ensure that temporary evacuation centers are established in the school/community center of Gandhidham-Kandla area.

11.1.1 List of Schools in Gandhidham – Kandla Complex

Sr. No.	Name of School	Contact Person	Telephone No.
1	Dr. C. G. High School	Principal	220271
2	SVP Gujarat Vidhyalaya	Principal	220242
3	M.P. Patel Kanya Vidhyalaya	Principal	220705
4	Adarsh Maha Vidhyalaya	Principal	234172
5	Adarsh Kanya Vidhyalaya	Principal	220175
6	Bhartiya Vidhya Mandir, Kandla Bhartiya Vidhya Mandir, Gopalpuri	Head Master Head Master	271049 233684
7	Central School, (IFFCO)	Principal	221288
8	Central School (Railway)	Principal	220657
9	Modern School	Principal	220284
10	Mount Carmel School	Principal	234262
11	Aum Vidhyalaya, IFFCO	Principal	221104
12	Saint Xavier's School, Adipur	Principal	260265
13	Maitri Maha Vidhyala, Adipur	Principal	260445
14	Maitri Kanya Vidhyalaya, Adipur	Principal	260612

15	Model Excelsior High School, Adipur	Principal	260707
16	Gujarat Vidhyalaya, Adipur	Principal	261312
17	Nagarpalika High School, Anjar	Principal	242510
18	Adarsh Nivasi School, Gandhidham	Principal	223246
19	P.N.Amersey School	Principal	223646
20	Shree Gurunanak English School	Principal	238421
21	Swaminarayan Gurukul	Principal	228098
22	Kairali English School	Principal	221050
23	Sarvodaya Pradhamic Shala Near Oslo Cinema, Gandhidham	Mr. Kangodia	227958
24	Ganeshnagar Pr.Shala, G'nagar	Mr. Kangodia	
25	Jagjivan Pra. Shala, Sapnanagar, Gandhidham	Mr. Kangodia	
26	Cargo Pra. Shala, Sapnanagar, Gandhidham	Mr. Kangodia	
27	Old & New Sunderpuri Schools	Mr. Srimali, HM	224867
28	G'dham Pr. Shala, Near Shivaji Park, Gandhidham	Mrs. Arunaben.	229255
29	Adipur Prathmic Shala, Adipur	Mr.C.M.Rami	264525 264181
30	Kandla Pr. Shala, Shirva Camp & Thermal Colony & United Salt Works	Mrs. Shantaben	253198

Dy. Secretary (P) shall ensure that the telephone of all the Head of Departments and other responsible officers of different Department are functioning properly by ringing personally. In case of any of the telephone does not function or gives satisfactory service; he shall take up the matter with the Higher Authority of Telephone Department.

The staff attendance on days when the Action Plan is in operation shall be collected from PA to HoDs and complied by Asstt. Secretary and reported to Chairman/Dy. Chairman every day with separate list of

absentees. Secretary will do the overall supervision of the work and report compliance to the Chairman/Dy. Chairman within two hours of the warning received.

Secretary will be the overall in charge for liaison work with central/state government officials/IMD, Ahmadabad/Pune Laboratory/ Delhi Laboratory in which he can take the help of Dy. Secretary (P) and Dy. Hydraulic Engineer and report the matter to the Chairman/Dy. Chairman immediately. They shall remain present in all the meetings relating to the Action Plan and report the proceedings of the meetings to the Chairman/Dy. Chairman. They shall also communicate the action to be taken to the concerned Head of Departments. List of IMD telephone numbers is shown below:

11.1.2 List of Important Telephone Nos of Indian Meteorological Department

Websites – www.imd.gov.in, <http://www.imdahm.gov.in/index.html>

All Head of Department shall have to send Action taken report to the Secretary/Control rooms in writing by fax or on telephone with regard to the action required of them as per the Action Plan. If the report is not received from any of the HoDs, the Officer In charge, Control Room shall obtain the information, compile it and submit the same to the Chairman/Dy. Chairman on 12 hourly bases i.e. twice a day.

11.2 Contacts of Officials of GAD following nodal officer will form a team

Sr. No.	Designation	Present incumbent	Contact Telephone Numbers		
	Mr Bimal Kumar Jha	Secretary	220167	231939	233172
01	Mr. Suresh Balan	Dy. Secy (G)	221375	236086	
02	Mr. DEEPAK RANE	Sr. Dy. Secy	220033	234730	

11.3 Duty Roster for Staff of General Administrative Department

AS ABOVE

11.4 Central Industrial Security Force (CIF)

The Sr. Commandant shall remain in contact with in charge of control room at Kandla (HARBOUR Master) regarding the position of the cyclone / calamity.

The Sr. Commandant shall ensure that Public Address System is fitted on Jeeps provided to CISF. He will make arrangements for announcements, with the coordination of police through Public Address System mounted on at least 03 vehicles. The CISF personnel will procure truck with the help of TM. The list of fleet owners and major lift operators are given below:

11.4.1 List of Major Heavy Lift Operators at KPT

Name of Party	Name of Contact Person	Phone Number
Swastik Heavy Lifters	Mr. Jigneshbhai Mr. Aslambhai	9825758151 9825228421
Kutch Carrier Transport Co	Mr. C. R. Thackar	9825225591
Agarwal Handling Agency	Mr. Rakesh Thackar	9426928728
Active Cargo Movers	Mr. Narendra	9825220411
Raghuvirsingh & Sons	Mr. Harcharan	9879104853
Thacker Brothers	Mr. Kamleshbhai	9825296107
Kiran Roadlines	Mr. Pankaj Gadvi	9879104552
Regal Shipping	Mr. Ashok Dudi	9825326328
Rathore Freight Carriers		220759/ 220380

11.4.1.1 Additional list of firms for pay loaders / cranes

M/s Mahalaxmi Transport Co., Plot No. 35, Sector No. 8, Behind Hotel Fun & Food, Gandhidham	Mr. H K Rathod	(O)222387 (R)233500
M/s Kandla Earth Mover, DBZ-S-151, Gandhidham	Mr. Sanjay Goyal	(O)221759 (R)222338 (M) 9825020550

Mr. Lalji Bhavanji Sathwara, Laljibhai Sathwara, Plot No. 27, Shop No.5, Sector9/A, Gandhidham	(O)234118 (R)232566 (M) 9825225957
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11.4.1.2 Equipments available with ABGKCTL TABE REMOVED

11.4.2 List of Fleet Owners at KPT

Sl. No.	Name of Company	Contact Person	Tel. Office	Tel. Resi.	Mobile
01	M/s A V Joshi & Company	Mr. Ramesh Singhvi Mr. Thacker MR. Harshandhu	231386 232605 233147	234176 221451 234325	98251 91325 98252 26105 98252 26013
02	M/s Rishi Shipping	Mr. B. K. Manshukhani Mr. Manoj Manshukhani	220843 229830 238943	234889 235587	98252 25170
03	M/s Maheshwari Handling Agency	Mr. C. P. Maheshwari Mr. Chandan Maheshwari	223228 230393	222339	98252 27111
04	M/s ABC	Mr. Latif Mr. Mithu Mr. Kasam	220483 221390 270190	234163 231477 251684	98252 26707
05	M/s Ganesh Transport	Mr. Hira Rabari Mr. Visa Rabari	223638 223915	260425	
06	M/s Kewar Carrier		220483 227553	234163	

07	M/s Krishna	Mr. K. M. Thakker	223814	220998	98250 19699
	Transport Service	Mr. Pankaj Thacker	224938	234988	98252 25228
08	M/s Gautam Freight Ltd	Mr. Ramesh Singhvi	220163	230328	98251 91325
			230345	234176	

11.5 Contact Nos of CISF Officials

S. No	Designation	Contact Telephone Numbers		
		Office	Res	Mobile
01	Commandant	271037	229140	9825227282
02	Dy. Commandant	271036	220192	9825227045
03	INSPECTORS			8500495813, 9045696584
04	Control Room	271040		
05	North Gate	270440		
06.	West Gate – I	271039		
07.	West Gate II	270876		

11.6 Finance Department

As soon as the Calamity/Cyclone warning Signal No. 5 is hoisted the Dy. Director (EDP) should monitor it through Internet and give two hourly printouts to Dy. Conservator, Secretary, Chief Engineer, FA&CAO, Dy. Chairman and Chairman. And Dy. Director (EDP) will monitor the website in the A O Building, Gandhidham.

All Head of Departments would make a judicious assessment regarding the requirement of funds by them to meet with the different exigencies, which they may have to handle on account of the Cyclone/Calamity situation. The Head of Departments would inform the FA&CAO on telephone or in writing or through a Messenger regarding the requirement of advances. The FA&CAO in turn would examine the advances

sought by the Head of Departments and sanction the advances early without any further delay. The FA&CAO would keep the Chairman and Dy. Chairman informed about the amount released by him and seeks approval.

11.7 Medical Department

Two Casualty Emergency Wards, one at Gopalpuri and other at Kandla Hospital shall start functioning as soon as warning of Cyclone is received. Chief Medical Officer will ensure that no Doctor is given leave during the emergency period. These casualty emergency wards will function round the clock with posting of Doctors and Staff round the clock. Chief Medical Officer will ensure the functioning of casualty emergency wards at Gopalpuri and Kandla. A Register shall be maintained at both the places where in the record of patients attended would be maintained. Adequate number of chlorine pills should be distributed after Cyclone to avoid epidemic from spreading. Chief Medical Officer shall submit a report every evening to Chairman/Dy. Chairman.

11.8 During Disaster

1. Maximum alertness of staff members for their safety.
2. Ambulances/vehicles with Drivers to be kept standby awaiting further orders.
3. Liaison with: - Control Room, Disaster Site/Spot, P.A.s to all HoDs, New Kandla Hospital.

(Action: P.A. to CMO)

11.9 Post Disaster Phase

11.9.1 Tackling of Patients

1. Use of ambulance will be purely on priority basis. The A.C. Ambulance can be used as an Emergency Mobile Van for carrying medicines along with a doctor and other essential Para-medical staff, to the site of crisis.

(Action: Dr. Sunil Suryavanshi)

2. Line of treatment to be decided by attending Doctors, such as Indoor/Outdoor/Under observation etc.

(Action: All Doctors)

3. Cases will be attended depending upon the gravity of injury/condition of case, i.e. very serious, stable. (Action: All Doctors)
4. To ensure supply of adequate medicines and any other items. (Action: AMO Stores / S P S K)
5. Dead bodies to be shifted to Govt. Hospital, Rambaug promptly for identification, disposal, and issue of death certificate etc.

(Action: Mamlatdar/PSI/Medical Supdt. Rambaug Hospital/PA to CMO)

6. If needed be, liaison with local Medical Practitioners, Local Hospitals, etc. (Action: P. A. to CMO.)
7. If need be, to arrange for outside ambulance, in consultation with FA&CAO to whom details have been submitted earlier.

(Action: P. A. to CMO.)

8. Transfer of serious patients to Govt. Hospital/Private hospitals , Bhuj/ Rajkot/ Jamnagar be made but such transfer to be restricted.

(Action: All Doctors on approval by CMO)

9. To mobilize additional nursing /Para-medical staff to cope with additional workload.

(Action: CMO PA tto CMO)

10. Re-deployment of Manpower from Gopalpuri Port Hospital to Kandla Hospital and vice versa.

(Action: C.M.O.)

11.10 Prevention of Epidemics

1. Chlorination of drinking water at source. (Action: Sr. Engr. (P/L) & Estate office In-charge)
2. Mass Survey of residents of Port Colonies at Kandla and adjoining areas. (Action: Dr. Malik & Volunteers)

3. To get chlorine tablets from DHO-Bhuj and arrange for distribution thereof. (Action: Dr. S. B. Suryavanshi and Volunteers)

4. To educate residents/public to promote hygienic condition in and around their dwelling place, use boiled water

(Action: C.M.O. and Volunteers)

5. To shift cases afflicted by contagious or infectious diseases to Govt. Hospital / Private hospitals and notify such cases to the notice of State Authorities.

(Action: C.M.O.)

6. To ensure hygienic condition/cleanliness in both hospitals and colony in coordination with concerned staff of respective Estate Office.

(Action: Dr. Suryavanshi & Dr. Malik with in charges of respective Estate Officers)

7. In Rehabilitation Centre, Medical care will be looked after by Dr. Mahesh P Bapat & AMO besides supply of Chlorine Tablets.

8. To provide on the spot medical-aid at New/Old Kandla Port colonies. (Action: SMO In

9. Antidotes of all the poisonous gases to be kept ready. (M.O. (P)/Safety Officers/AMO)

10. Any further actions depending upon the conditions and restoration in the matter being decided by Administration.

11. Re-deployment on services as mentioned before.

12. In life threatening condition of Staff members - their evacuation.

11.11 Marine Department

As soon as warning of Cyclone Signal No. 5 or above is received, following measures shall be taken:

- Setting up of Control Room at Signal Station.
- Pilots and other Supervisory personnel in Flotilla Section should reach Kandla even if they are on leave, to tackle emergency, if any.
- Evacuation of Ships and securing all Port Crafts at Shortest possible time.
- Essential Staff (Fire Brigade) will not be given any kind of leave.
- The following personnel of Marine Department will not be granted any leave and they shall report for duty including holidays, during such time when Action Plan is put into operation.

⇒ All Operational Staff in Flotilla Section and Signal Station.

⇒ Ministerial Personnel at Point No: 11.11.1

11.11.1 Particulars of the Action Plan Committee Members

- For dewatering, if required, Fire-Cum-Safety-Officer will make arrangements by operating the dewatering Fire Pumps available with him.

11.12 Ships

- All the Pilots of the Port should reach Kandla immediately in case of emergency.
- Dy. Conservator/Harbour Master/Pilots should be available at Kandla during emergency.
- Removal of vessels whenever the cyclone is located in close proximity to the danger line plotted between 65 degree E longitude 18.2 degree N latitude and 73 degree E longitude 18.2 degree N latitude. Map showing the above position is given at Annexure-XXX.

Under such a situation the ships shall be removed during 1st/next available tide. It will be the duty of Harbour Master and DC to ensure that the ships are removed during 1st/next available tide as soon as the storm reaches to close proximity to the danger line as defined above without seeking any further instruction from the higher authorities. This action shall be taken automatically and suo-moto without any confusion and for which purpose Traffic Manager shall stop all loading and unloading operations immediately upon instructions from Dy. Conservator, so as to enable him to remove the vessels in time. The removal shall be done with the help of all the available Pilots plus all empanelled Pilots together at one go in the shortest possible time, so as to ensure that all the vessels cross the bar before the tide restriction sets in.

Dy. Conservator shall ensure that all ships are moved out of the Harbour at the earliest. All pilots shall immediately report at Kandla and stay there till the Action Plan is in operation. Dy. Conservator/Harbour Master shall immediately plan removal of vessels to the OTB as soon as the Action Plan is put into operation irrespective of the Single number, which must be hoisted. If, it is impossible to remove them, all other steps should be taken to ensure safety of the vessels at the Port as also it would not cause any damage to the Port. Dy. Conservator shall also ensure adequate stock of fuel for all crafts.

11.13 Securing of all Crafts

Dy. Conservator /Harbour Master shall immediately arrange for securing all the Port Crafts at safer places, so that there is no loss to the Port and send a report to the Chairman/Dy. Chairman as early as possible after operation of this Action Plan. Flotilla Supdt. (Mr. I. D. Bhagchandani) shall be overall in charge of each craft for ensuring their safety.

For parking of crafts in emergency, three places are mainly identified, viz. Bunder Basin, Launch Jetty and Maintenance Jetty as per:

11.13.1 Placement of Port Crafts on Cyclone Warning

(A)	Shipping Tugs	All 35 BP tugs and Hired tugs	Bunder Area
			Maintenance Jetty (West side)
(B)	Pilot Launches & Survey Launches	All Launches	Floating Crafts Jetty Inside area
			Bunder Basin
			Inside Bunder Area North

			Side.
(C)	G.S. Launches & Mooring Launches	M. L. Mrinal	Inside Bunder Area North Side on Pilot Launches
		M.L. Vaishali M L Alli M L Thamrai	Inner Side of Floating Craft Jetty
		M. L. Vijay M. L. Priyadashani PL Prahari, Rakshak	Inside Bunder Area North on G. S. and Pilot Launches.

Maximum number of crafts such as mooring launches, GS launches and pilot launches will be placed in Bunder Basin.

In the inner side of Passenger Jetty, one pilot launch and one G S launch will be kept.

Three tugs will be kept in the inner side of maintenance jetty.

Priority will be given to the Port crafts for parking in the bunder basin and other areas. Rest of the places available in the Northern side of bunder basin area will be allowed to the self propelled barges and private crafts. Dumb barges will be allowed on the beach between maintenance jetty and oil jetty area.

BS will render all possible assistance to FS, being the overall in charge of the crafts. The following flotilla staff will take care of the crafts.

11.13.2 Flotilla Staff Will be decided by FS as per available team with mooring crew

11.14 Private Barges / Crafts

The parties who have been Harbour Crafts License by the DC have to keep their barges and crafts inside the port limits being earmarked for the purpose.

Necessary instructions shall be issued to all these people having valid license immediately. The work of informing these parties will be carried out by the Office Supdt. of Dy. Conservator's office and will personally ensure that the instructions are carried out and reported to Harbour Master within two hours of the Action Plan coming into operation. The representatives of the above parties shall reach Kandla at once, failing which the Dy. Conservator will cancel the license granted to them and take over the barges/crafts of the party who violates the instructions.

The position shall be appraised to Chairman / Dy. Chairman within two hours of the receipt of warning and at frequent intervals.

11.14.1 List of Duty Roster of Marine Department (Ministerial Staff)

Sr No	Name	Office	Residence / Mobile
01	PA to DC	220235	9428032483
02	Mr. AR Jadeja, Signal Supdt	270549	9825427400
03	Office Supdt.	221971	
04	Assistant	221971	
05	Sr. Clerk	221971	
06	Messenger	221971	

11.14.2 List of Telephone Nos & Addresses of DC, HM & Pilots

Sr No	Name of Officer / Pilots	Address of Gandhidham Res	Tel Nos: Cell / Landline
01	Capt T Srinivas DC	A – 7, Gopalpuri	9825232982 232806
02	Shri S K Pathak HM	C – 32, Gopalpuri	9825803499 231310
04			
05	Capt A K Sharma Pilot	C – 40, Gopalpuri	9879603642 238154
06	Capt V Madaan, Pilot	C – 31, Gopalpuri	9879603643 221478
07	ALL AVAILABLE CONTRACT PILOTS WILL BE CONTACTED THROUGH SIGNAL STATION		
08			
09			
10			
11			
12			
13			
14			
15			
16			

11.14.3 Contract / Empanelled Pilots WILL BE CONTACTED BY SIGNAL STATION

11.14.4 Sections

1. Flotilla Section 270280

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Mr. Sunil Kumar	Flotilla Supdt.	270280	226121		7874627756
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2. Signal Station 270549/270194/9825227246 Fax 270624

3. Fire Station 270176/270178/270439/550421/271244/271377

In case of Natural Calamity, first start with rescue operations, restoration activities on war footing on the advice of Chairman/Dy. Chairman, Dy. Conservator/ Harbour Master/Fire-Cum-Safety-Officer/Flotilla Supdt as the case may be.

11.15 Traffic Department

After, the warning of Cyclone or any other Natural calamity is issued at the Port, Traffic Manager shall ensure that the loading/unloading operations at the Port are stopped immediately, hatches closed, ships derricks properly secured and all labourers evacuated from the Port Area. Public Address System shall be installed at the Cargo Jetty Area, which shall be under the charge of Traffic Manager. He shall use it for necessary arrangements relating to evacuation. Traffic Manager should also ensure that responsible persons make announcements in a proper way, so as not to create any misunderstanding/panic.

Notwithstanding above, Traffic Manager shall stop all loading and unloading operations immediately upon instructions from Dy. Conservator, so as to enable the latter to remove the vessels in time.

The responsibility of evacuating the Port Shore Workers and Private Shore Labourers rest with Traffic Manager. He along with, Dy. Traffic Manager, Mr. Gulrajani, Safety Officer and Dy. Commandant, CISF should ensure that the Port is completely evacuated and there is no fresh entry in the Custom bounded area. Dy. Traffic Manager should get in touch with the Main Contractors in the regard.

Traffic Manager shall render necessary help to procure requisite number of Trucks for Public Announcement and evacuation.

Traffic Manager shall inform all the Stevedores List given below:

11.15.1 List of Stevedores

Sr. No.	Name	Address	Fax No.	Telephone Nos.	
				Office	Resi.
1	M/s. Cargo Movers	"Cargo House" BBZS-32A, Gandhidham	231687	220453 231365	261280
2	M/s. DBC & Sons (P) Ltd.	Seva Sadan-II, Room No. 303 / 304, New Kandla	270631	270503 270263 270348	-
3	M/s. A.V.Joshi & Co.	Plot No. 18, Sector-8, Maitry Bhavan, Nr. Post Office, Gandhidham – Kutch	233924	231070 232227 231588	234909
4	M/s. Agarwal Handling Agencies	DBZ-N-47, Gandhidham – Kutch	232749	220282 233187	232749
5	M/s. ACT Shipping P. Ltd	Seva Sadan-II, Room No. 206/207, New	232175	270111 270112 270015 229967	261308 231416

		Kandla			
6	M/s. Cargo Carriers	214/215, Rishab Corner, Plot 93, Sector- 8, GIM	230030	220816 231649 230030	231694
7	M/s. Cargo Clearing Agency (Gujarat)	Plot No. 271, Ward 12-B, Gandhidham	233034	221721 220655	231452
8	M/s. Chotalal Premji Stevedores Pvt. Ltd	C-8, Shaktinagar, GIM	231509	270009	-
9	M/s. Hiralal Maganlal & Co.	C-11, GIDC Area, Gandhidham – Kutch	223914	223914 231832	223878 232430
10	M/s. New Dholera Shipping Company	Goyal Commerce Centre Building - 1, Plot No.259, Ward 12B, Gandhidham - Kutch	-	222637 232267	237284
11	M/s. J.M. Baxi & Co.	Seva Sadan – II, Room No. 301 / 306, New Kandla	270646	270630 270550 270448	260427
12	M/s. Pestonjee Bhicajee (Kutch)	Seva Sadan-II, 203, New Kandla	270650 270556	270257 270367	262914

13	M/s. OTA Kandla Pvt. Ltd.	BBZ-N-324, Gandhidham	223241	220145 270560	223241
14	M/s. Purshotam das Jeramdas & Co.	5, Vaswani Chamber, 16, Sector-8, GIM	222850	238242 222598	220598
15	M/s. R. Tulsidas & Co.	Ahit Building , Plot No.323, Gandhidham – Kutch	232308	222717 221943	-
16	M/s. Robinsons	101 / 102, Maritime House, Plot No.45, Sector – 9A, Gandhidham – Kutch	234394	221578 223836	231767
17	Rishi Shipping	Plot 50, Sector 1/A GIM	238943	229830 229831	
18	M/s. Vinsons	BBZ-S-25, Gandhidham – Kutch	231948	220466	222395 239460
19.	Sical Logistics Ltd	403, 4th Floor, Madhuban Compex, OSLO, GIM	234416	234646 234194	
20	Parekh Marine Agency	C-8, Shaktinagar GIM	231509	229297 221158	

21	Krishna Shipping and Allied Services	Transport Nagar, NH GIM	233135	230501 223814 229085	
22	Kevar Carrier Handling & Transport	Shop 24, Tolani Chamber, Sector -8, GIM	228298	228298	
23	Trinity Shipping & Allied Industries	Trinity House, Plot 46 Sec 1/A, GIM	232060	230911 230910	

24	Velji P & Sons(P) Ltd	2nd Floor, Deepak Complex, 315, 12/B GIM	236168	231545 231546 225466	
25	Asean Marine Services	Ashit Bldg, Plot 33 Sector 1/A, GIM	232308	222717 221943 222145	
26	Rishikiran Roadlines	Kiran House, Plot 8 Sector 8, GIM	231422	231894 234108	
27	Universal Shipping Services	Hotel Sea Bird, Plot 173, Sector 1/A, GIM	235251	230663 226050 226037	
28	R.T.Bhojwa ni & Sons	DBZ -S- 146, GIM	232423	222211 221831	
29	Logistic Enterprises (P) Ltd	C-8, Shaktinagar, GIM	231509	235341 230587	

30	Seaways Shipping (P) Ltd	2nd Floor, Plot 351 Ward 12/B, GIM		226183 237147	
31	Seacrest Shipping Services Pvt. Ltd	216, 2nd Floor Om Corner, Plot 336 Ward 12/B, GIM	227028	233325	
32	Shree Maruti Shipping Services	18/21, Swaminarayan Bldg, Sector 9, GIM	234107 250690	233245 237247 250690	
33	Liladhar Pasoo Forwarders P.Ltd	Plot 4, Sector -1 KASEZ, GIM	252383 253506	252286 252297 252612	
34	Shree Radhey Shipping Company	14-16/C, GF Green Park, GIM	232967	222919 228919 238883	
35	Pearl Shipping	220, Rishab Corner, Plot 93, Sector 8 GIM	235570	225283 225284	
36	Patel Shipping Agency	Patel Avenue, Floor 2, Plot 170, Sector 1/A, GIM	231143	224024	
37	Ashirvad Shipping	18-21, Swaminarayan Bldg, Sector- 9, GIM	250690	233245 237247 222822	

38.	M/s. Swaminara yan Vijay Trade Carriar	1st Floor, H-6, Op. Tejas Society, Ghatlodia, Ahmadabad	079- 231983	231981, 231982	
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11.16 Mechanical Engineering Department

- Marine Engineer/Engineer In charge should be available in emergency cell and remain in constant touch with Chief Mechanical Engineer/Signal Station and Assistant Engineers posted on Shipping Tugs.
- All Assistant Engineers (D/T &F/C) should be available on operational tugs irrespective of their duties. They should keep main engines and associated equipment in readiness all the times.
- Assistant Engineers posted in tugs should contact Superintending Engineer (Mech)/ Engineer In-charge for all technical & personal problems.
- Assistant Engineer (F/C) will be responsible for timely supply of food packets and drinking water to officers and staff of tugs.
- SE (Electrical) will be responsible for Securing Cranes at Cargo Jetty. He may, if need be inform about requirement of advance and to draw accordingly. He will be responsible to run 2 X 1000 KVA Generator Sets at Cargo Jetty Area in case of Power failure and also maintain additional Generator sets required at Kandla/Gopalpuri and Attending work of maintenance of major nature and breakdown.
- Asstt. Executive Engineer (Mech.) and JE (Mech) will be responsible for timely supply of Drinking Water/Food Packets to the staff of Mechanical Engineering Department during operation of the action plan.
- Assistant Engineer (Mech.) will be responsible to attend breakdown of Fire Fighting Pumps and DG Sets of 2 X 1000 KVA at Kandla.
- Steel Floating Dry Dock and one Electric Wharf Crane at maintenance jetty and one crane at bunder area are to be properly secured by Executive Engineer (Dry Dock) with help of his team mentioned below, as per prescribed procedure and concerned officers shall constantly monitor the safety of the

Steel Floating Dry Dock and Electric Wharf Cranes in side Bunder Area. He shall ensure all the required wedges, wire ropes, shackles etc.. and other fixtures as required to be kept ready so that the same can be fixed without loss of time & to check the site for the requirement, from time to time.

Action: XEN (DD) and Asstt. Engineer (FC) will lead the team of JE(Mech) and will be in contact with Executive Engineer (Mech) and Chief Mechanical Engineer/Deputy Chief Mechanical Engineer.

- All the V.H.F. and other Wireless Sets, and other required equipments of VHF Unit, including the sets kept at S.F.D.D. should be kept in perfectly working condition and the batteries are fully charged and to be kept in ready position and staff will remain in touch with control room till the emergency is called off to attend all communication equipments. It shall be responsibility of the Control Room Staff to ensure that timely information is passed on and timely and proper monitoring is done.

Action:, Assistant Engineer (DD) and R./R. Technician will render all possible assistance to Ex. Engineer(DD) during the course of calamity period.

- All the vehicles belonging to the Mechanical Engineering Department to be kept in perfectly working condition and sufficient stock of fuel and lubricant to be kept in ready position.

Action: Assistant Engineer (Mech.) with the help of Junior Engineer (Mech.) Garage

- During the course of calamity all the vehicles lying inside the premises of Auto Workshop should be kept in the parking ways meant for parking the individual vehicles and inside the shed. No vehicle is to be parked under any tree or under any such structure where there is possibility of falling such structure or tree over the vehicles. All the concerned drivers to be informed accordingly well advance to avoid such possible damage to vehicles and to remain present at duty place in consultation, Vehicle –in-charge of Pipeline Division.

Action: Assistant Engineer (Mech) with the help of Junior Engineer (Mech) Garage.

- Record of attendance of the employees during these periods to be kept ready and to be fed to the Control Room or any official responsible for such duties.

Action: Assistant Executive Engineer (Mech), Assistant Engineer (Mech) with the help of Head Clerk (Mechanical Division) and Divisional Accountant for all sections.

- Assistant Engineer (DD) to remain in Control Room at New Kandla to attend the communications with help of R/R Technician.

- Assistant Executive Engineer (Mech) and, Assistant Engineer (Mech) are to be associated with Executive Engineer (M) to constantly monitor the safety of the Port Crafts.
- The heave up water barge "BHIMSEN" is shifted to Bunder Area and secured properly in Naval Aid Salvage Section and Floating Craft. Absent/Present report of the above staff will be reported to the concerned section immediately on

starting of each shift and maintenance of major and breakdown etc... Action: Mr. Manohar Dana, Assistant Engineer (Mech)

- All the telephones and intercom telephones and their allied communication systems and equipments should be kept in perfect working condition to ensure that timely information is passed on and timely and proper monitoring done till the emergency is called off. He will ensure quick restoration of telephones by keeping close liaison with the concerned personnel. He will report to the Executive Engineer (Electrical) every day and to carry out all work assigned by the Executive Engineer (E) in case of emergency.

Action: Assistant Engineer (Instru).

- SE (E) and Executive Engineer (E) shall be responsible for liaison with the PGVCL for receiving power in case of power failure. In the event of disturbance in the distribution network necessary arrangements shall be made by them as per the requirement depending upon the situation.
- If any additional Generator Sets are required at Kandla or Gopalpuri, the following officers shall be contacted who shall immediately hire/procure or provide in whatever manner the DG Sets giving preference to the operational area.

1. Superintending Engineer(E)

2. Executive Engineer (Electrical)

3. Executive Engineer (Mechanical)

4. AXEN(E)

The above officers shall also be responsible for operation and maintenance of Generators provided at various locations and submits daily report to the Chief Mechanical Engineer about the working of Generators.

Additional requirements, if any, will be assessed by Dy. CME and the same shall be submitted to Chief Mechanical Engineer for hiring, well in advance so that XEN (E) can take necessary action for hiring, installation etc...

- After the warning of Cyclone or any other Natural Calamity is issued at the Port, Chief Mechanical Engineer shall ensure immediately that the cranes are secured and properly locked as per procedure and report submitted to the Chairman/Deputy Chairman after the operation of the Action Plan.

The following officers shall constantly monitor the safety of the cranes;

1. Executive Engineer (Electrical)

2. Executive Engineer (Mechanical)

The responsibility of evacuating all Mechanical/Electrical and Civil workers rests with Chief Mechanical Engineer with the assistance of respective Executive Engineers.

The maintenance of major nature and de-watering fire pumps operated by FireCum-Safety-Officer will be attended by Executive Engineer (Mech).

Executive Engineer (Dry Dock) and, AE(DD) shall ensure that the Steel Floating Dry Dock and Electric Wharf Cranes at the maintenance jetty are properly secured as per the procedure and compliance reported to the Chief Mechanical Engineer immediately. SE (Mech) shall monitor the safety of Steel Floating Dry Dock.

The following staffs have to report for duty even if it is a public holiday to actively participate in the Action Plan and they shall be responsible for record keeping of attendance, preparation, and submission of reports etc.

1. P A to CME

2. Office Superintendent

3. Superintendent Accounts

4. Sr. Clerk

5. Junior Clerk

11.16.1 List of Duty Roster of Mechanical Engineering Department As formed by CME on available officers

Name of Officer	Designation	Office	Resi.	Fax
Mr. SAROJ DAS	CME	270632 270184	231043	270184
Shri A Ramaswami	Dy CME	270426	226067	
Mr. P Srinivasu	SE (E)	271010		
Mr. B J Solanki	SE (M)	270352		
ABOVE OFFICERS WILL BE FORMULATING A TEAM				

11.17 Civil Department

Based on the practical experience and seriousness of the two Natural Calamities - the devastating Cyclone in 9th June 1998 and the Earthquake on 26th January 2001, the following Action Plan for Civil Engineering Department, is proposed to be implemented.

As soon as the message on anticipated Cyclone/Natural Calamity is received from concerned authorities, the same will be intimated to all the concerned under the Civil Engineering Department and will be instructed to be alert. All the staff members/officers should note that they will come into action on their

own as soon as the Warning is issued without waiting for any further instructions. Failure on the part of any employee/officer to carry out the earmarked Action Plan shall attract severe consequences.

Immediately after receiving the information on the Natural Calamity, nobody will be granted any kind of leave and the persons who are already on leave will be called back after canceling the leave.

Absent/Present report of the staff and the officers will be reported to the concerned Section immediately on starting of each shift for this purpose, Sectional Heads of all Divisions will be responsible to report the matter to P. A. to Chief Engineer for compilation of the information and onward transmission to General Administration Department.

The Engineering Department will assist in shifting of the persons to safe places in the event of such action is required.

Water Supply arrangements will be made to various colonies/sites of work/camps where the workers are shifted, etc. The Senior Engineer (Pipeline) will be the in charge for supply of water to various destinations.

Sufficient number of vehicles will be arranged for transportation workers/staff/officers. This arrangement will also be made by the Senior Engineer (Pipeline).

The Engineering Department will ensure that all Road blockades are got cleared as also blockades caused in Port Quarters due to failing of trees, walls, shed, etc. are got removed immediately. Further, it will be ensured that the colonies are got cleared and whatever logging of water is found is pumped out and disinfected. A report will also be submitted to Chairman/Dy. Chairman.

11.17.1 The following officers are to be contacted in the event of any such problems

Area	Designation	Office	Resi.	Mobile
New Kandla	XEN(R)	236165	222056	9913949700
Gopalpuri	XEN (TD)	223912	235683	9427205610
Old Kandla	Senior Engineer (Pipe Line)	220013	232880	9825225962

Cargo Jetty	Executive Engineer (Harbour)	270429	252624	9825227046
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11.17.2 List of Duty Roster of Civil Engineering Department CE will form a team as per

Mr. SSP PATIL	Chief Engineer	233192	228777	220050	9825227243
Mr. . V R Reddy	Dy. CE	270429	228869		9825227038
Mr. K J Todarmal	Exe Eng (R)	236165	220670		8980049099
Mr.	SE (PL)	220013	229164		9825225962
Mr	SE (H)				
Mr.B. Rajendra Prasad	Exe Eng (D)	220038	232880		9725338260

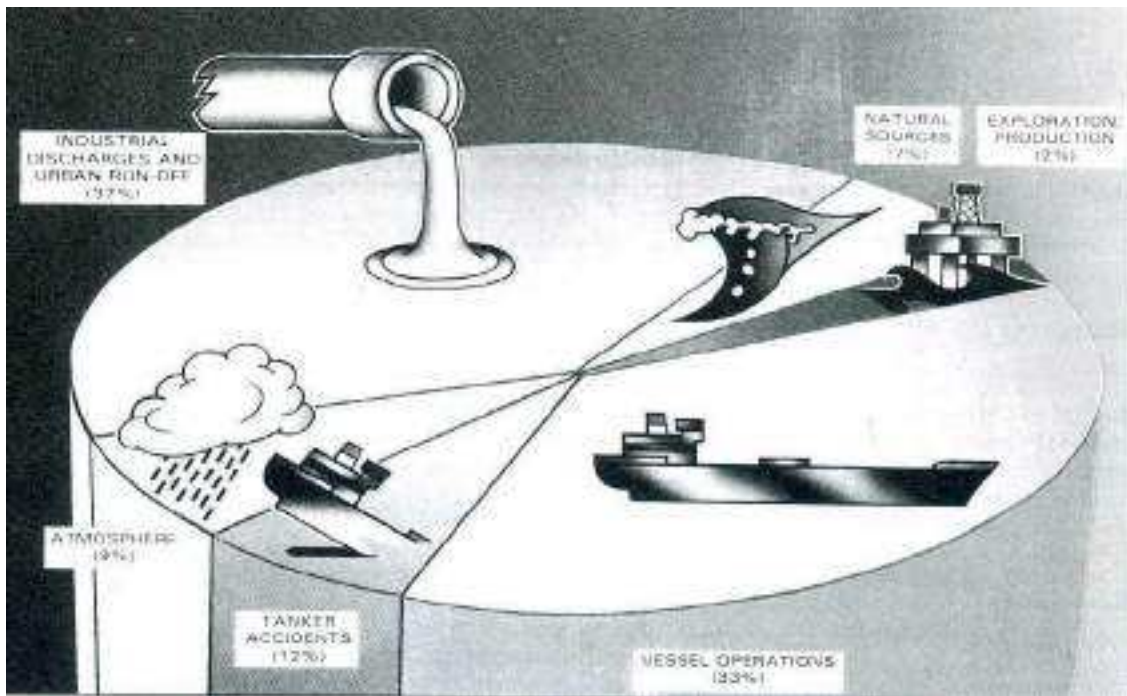
Periodical Meetings will be conducted with the Executive Engineer's/ DSOs/Staff Member to assess the progress made during the day and to instruct further course of action in the matter.

12 RESPONSE TO MARINE OIL SPILLS

12.1 Sources of Petroleum Hydrocarbons

The best estimate for the total input of petroleum to marine environment from all sources is some 3.2 million metric tons per year. By far the biggest contribution comes from terrestrial sources, mainly in the form of municipal and industrial wastes. Accidental spills from ships, together with offshore exploration and production activities, account for about 0.47 million metric tons which is a relatively small amount considering the world's current production of three million metric tons, half of which is transported by sea.

Major Inputs of Petroleum to the Marine Environment. (Figure)



12.1.1 Accident Spills from Tankers

Accidental spills from tankers contribute an estimated 4,000,000 tonnes annually. Analysis of tanker spills occurring throughout the world shows that the majority (some 75%) occur in port during routine ship operations such as loading, discharging and bunkering. Most of these spills are, however, relatively small: over 92% are less than 7 tonnes given in the table below and probably, in total, contribute less than 20,000 tons annually. In comparison, accidents such as collisions and groundings give rise to less than 10% of all spills from tankers, but a quarter of these are larger than 700 tonnes given in the table below. In fact, a few large accidents give rise to the majority of the oil spilled and hence there is considerable annual variation in this figure below:

Comparison of Incidence of World Oil Spills from Tankers, 1974 – 1985, resulting from Routine Operations & Major Accidents

	< 7 Tones)	7 – 700 (Tones)	> 700 (Tones)	Total
Loading / Discharging	2236 (90%)	227 (9%)	11 (1%)	2474 (100%)
Bunkering	442 (95%)	22 (5%)	-----	464 (100%)
Collision	39 (17%)	134 (59%)	54 (24%)	227 (100%)
Grounding	69 (25%)	134 (49%)	70 (26%)	273 (100%)
Total	2786 (81%)	517 (15%)	135 (4%)	3438 (100%)

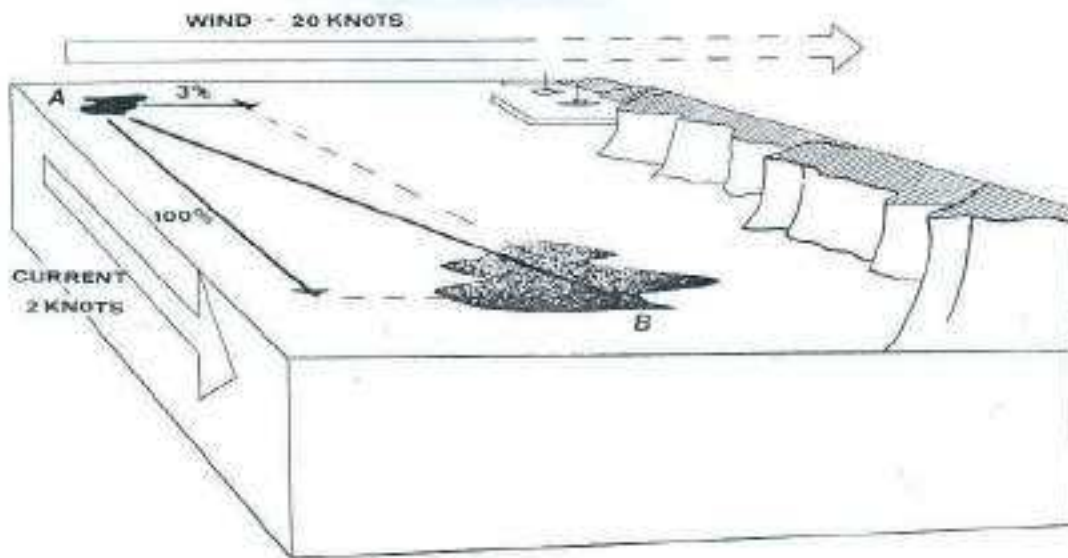
12.2 Forecasting Slick Movement

It is equally important to be able to forecast the probable movement of a slick as well as the likely changes in the properties of oil after it has been spilled. This allows sensitive resources in the path of the slick to be identified and, if appropriate, response measures to be put into effect. The task of forecasting the position of the oil can only be accomplished if data on winds and currents are available since both contribute to the movement of floating oil.

12.2.1 Effect of wind, Tidal currents

It has been found empirically that floating oil will move downwind at about 3% of the wind speed. In the presence of surface water currents, an additional movement of the oil equivalent to the current strength will be superimposed on any winddriven motion. Close to land, the strength and direction of any tidal currents must be taken into account but further out to sea their contribution is usually less significant because they are cyclic and so tend to cancel out over time. Thus, with knowledge of the prevailing winds and currents, it is possible to predict the rate and direction of movement of floating oil from a known position, as shown in Figure given below, overleaf.

The influence of 3% of the wind speed combined with 100% of the current speed results in the movement of oil from A to B



12.2.1.1 Computer Models

This simple calculation can be easily done by hand but becomes very timeconsuming if tidal currents have to be taken into account since it must be recalculated at regular intervals as currents change. Computers can be used to speed up such calculations by storing information on water movement and coastal outline for a specific geographic area. Wind data and the spill location are then the only additional information required at the time of a spill. The reliability of such models depends upon the accuracy of water movement and wind data. Often they are combined with mathematical models simulating weathering processes to provide a forecast of the overall fate of a spill.

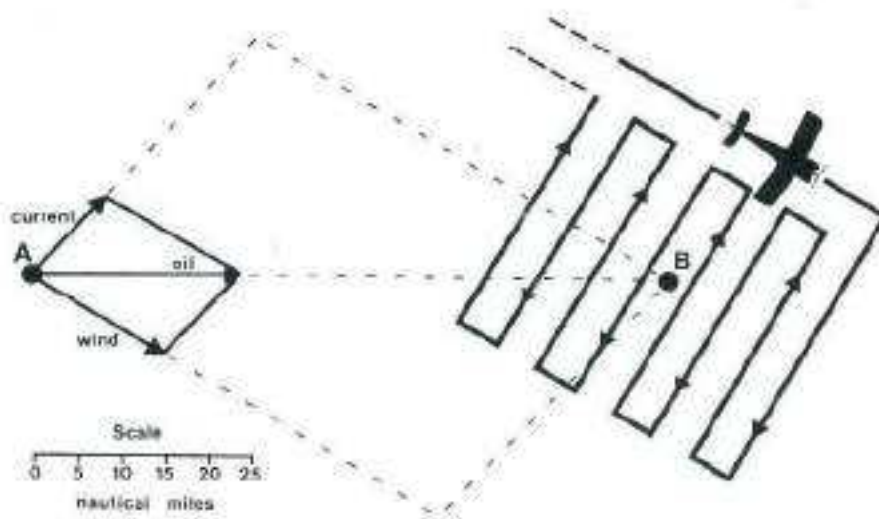
12.3 Aerial Surveillance at Sea

However reliable an oil spill model may be predictions of the fate and movement of oil slicks at sea should be verified through regular surveillance of the oil. This should be conducted from the air since observation from a vessel is highly inefficient.

12.3.1 Search Pattern

12.3.1.1 Ladder Search

A 'ladder search' is frequently the most economical method of surveying a large sea area. Since floating oil has a tendency to become aligned in long narrow windrows parallel to the direction of the wind, a ladder search across the wind will increase the chances of oil detection.



Movement of oil from A to position B three days later, predicted by combining 100% of the current speed and 3% of the wind speed as shown. The arrows from A represent current, wind and oil movement for one day. A cross-wind ladder search pattern is shown over position B.

12.4 Effect of Sunlight, Search Altitude

Haze and dazzle off the sea often affects visibility and the position of the sun may dictate the best direction to fly a search pattern. Sun glasses can give some relief from eye strain caused by strong light. Polarizing lenses can assist the detection of oil at sea under certain light conditions due to the differences in light reflected from oil and water. The search altitude is generally determined by the visibility. In clear weather 500 meters (1600 feet) frequently proves to be optimum for maximizing the scanning area without losing detail.

12.4.1 Navigation

However, it is necessary to drop to half this height or lower in order to confirm any sightings of floating oil or to examine its appearance. Over the open sea, away from any obvious reference points, it is easy to become disoriented. Ideally an observer will be able to consult the aircraft instrumentation for speed, direction and position, but it is worth ensuring beforehand that the instruments can be read without difficulty. In the absence of such aids, an observer with a suitable chart can keep track of course changes and positions by communicating with the pilot using the aircraft intercom.

12.5 Visual Quantification of Floating Oil

It is important that the port personnel estimate the amount of release for planning mitigating measures and allocating resources effectively. An accurate assessment of the quantity of floating oil is virtually impossible due to the difficulty of gauging its thickness. At best, the correct order of magnitude can be estimated by considering certain factors. Oil spreads rapidly and most liquid oils will soon reach an average thickness of about 0.1 mm, characterized by a black or dark brown appearance. Similarly, the color of sheen roughly indicates its thickness.

12.5.1 Appearance versus thickness, Cold water effects

A reliable estimate of water content in a 'mousse' is not possible without laboratory analysis but accepting that figures of 50% to 80% are typical, approximate calculations of oil quantities can be made, given that most typical floating 'mousses' are 1 mm or more thick. However, it should be emphasized that the thickness of 'mousse' and other viscous oils is particularly difficult to gauge because of their limited spreading. Indeed in cold waters some oils with high pour points will solidify into unpredictable shapes and the appearance of the floating portions will belie the total volume of oil present.

12.5.1.1 A Guide to the Relation between Appearance, Thickness and Volume of Floating Oil

Oil Type	Appearance	Approximate Thickness (mm)	Approximate Volume (m ³ /km ²)
Oil sheen	Silvery	0.0001	0.1
Oil sheen	Irridescent	0.0003	0.3
Crude and fuel oil	Black/dark brown	0.1	100
Water-in-oil emulsions ('mousse')	Brown/orange	>1	>1000

12.5.2 Surface area, Percentage cover

In order to estimate the amount of floating oil it is necessary not only to gauge thickness, but also to determine the percentage area of the sea surface covered by oil, water-in-oil emulsion and sheen. Again, accurate estimates are complicated by the patchy incidence of floating oil. To avoid distorted views, it is necessary to look vertically down on the oil when assessing its distribution. By estimating the percentage coverage of each form of oil, the area covered relative to the total sea area affected can be calculated from timed overflights at constant speed or from position fixing equipment.

12.6 Spill Control Management

12.6.1 Contingency Planning

12.6.1.1 Tankers

Plans covering areas where a wide range of oil types are handled or where tankers pass in transit, cannot anticipate the impact of a spill. It is therefore important that the type of oil spilled is established at the earliest opportunity so that its fate can be predicted and the appropriate clean-up techniques employed.

12.6.2 Fixed Installations

For oil terminals where a limited number of oil types are involved, an appreciation of the likely fate of potential spills is valuable when drawing up contingency plans. Information on the prevailing winds and currents throughout the year will indicate the resources where oil spill impact is most likely. Data on the types of oil handled can enable predictions to be made regarding the lifetime of slicks and the quantity and nature of the residue, which may require a clean-up response. It will also assist in the selection of appropriate clean-up equipment to be held in readiness for spills.

12.6.3 Priorities for protection, Sensitivity maps

Because of the difficult decisions that will be required during an oil spill in order to mitigate damage and to resolve conflicts of interest, much can be done at the contingency planning stage to identify sensitive areas and to determine priorities for protection. The mapping of sensitive areas can be a useful starting point. Detailed consideration should be given to the likely impact that a spill would have on each habitat or activity, taking into account any seasonal variability. Attention should then be given to identifying areas to be protected and their order of priority. This will never be easy since the value of each resource to the community will depend upon the weight given to environmental, recreational, economic and political considerations. This may require a wide range of data to be gathered and evaluated.

If properly conducted, such studies of the resources at risk in an area can also form a basis for quantifying any damage caused by a spill at risk in an area can also form a basis for quantifying any damage caused by a spill.

12.6.4 Response decisions

Having determined priorities for protection, attention can be given to designating appropriate clean-up measures. It is necessary to make a realistic assessment of the feasibility of employing various techniques since a recommendation to avoid the more ecologically damaging response options may result in the adoption of ineffective techniques and greater damage to other habitats or activities.

12.6.5 Containment

The containment of floating oil for subsequent recovery or its diversion away from sensitive areas calls for the use of some form of barrier. Many different types of oil barriers have been developed. These include commercially available floating booms, netting systems, sorbent booms, improvised booms and barriers, bubble barriers and chemical barriers. Selection of the most appropriate barrier will depend upon the particular conditions as well as availability. Since commercially available booms are the most common form of barrier used in oil spill control they are described in greatest detail in this section.

12.7 Commercially Available Booms

Design features

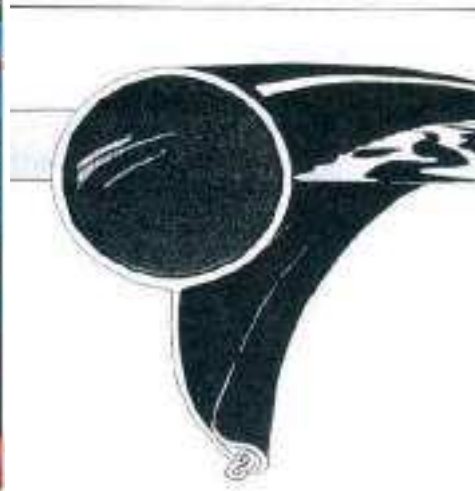
Designs vary considerably but all normally incorporate the following features:

1. Freeboard to prevent or reduce splash over;
2. Sub-surface portion (skirt) to prevent or reduce escape of oil under the boom;
3. Floatation by air or some buoyant material;
4. Longitudinal tension component (chain, wire or boom fabric itself) to withstand effects of winds, waves and currents.

Boom designs fall into two broad categories:

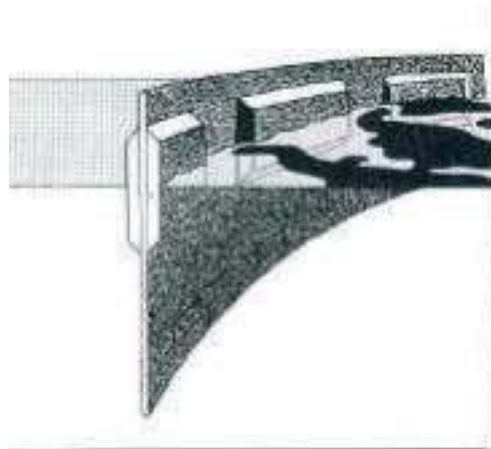
12.7.1 Curtain Booms

Curtain Booms provide a continuous sub-surface skirt or flexible screen supported by a solid or air floatation chamber usually of circular cross-section. Air floatation booms take up only a small storage area when deflated, whereas solid floatation booms, although more resistant to damage, are bulky in storage. Curtain booms generally have good wave-following capabilities, moderate escape velocities and are reasonably easy to clean.



12.7.2 Fence Booms

Fence Booms with a flatter cross-section are held vertically in the water by integral or external buoyancy. Solid floatation is most frequently used for fence booms but if external floats are used, turbulence may be generated leading to escape of oil at low water velocities. Such designs are bulky in storage and difficult to clean. In general, fence booms are more suitable for calmer waters where current velocities are low.



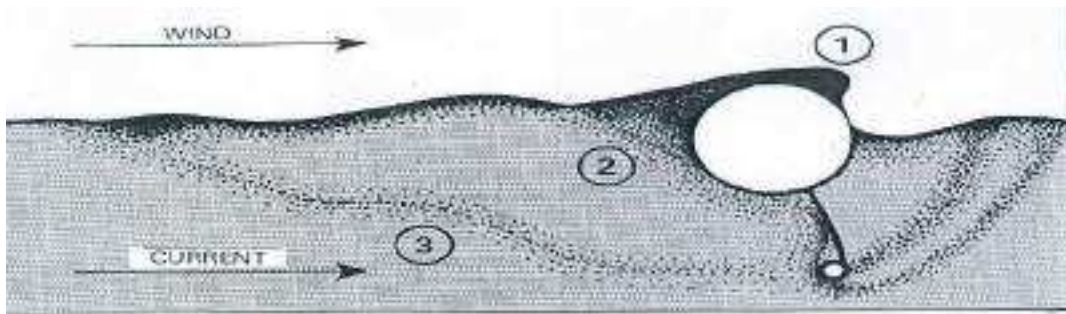
12.7.2.1 Common features

Many curtain and fence booms have similar features including bracing struts and/or integral ballast to keep them upright in the water, connectors for joining sections together as well as towing and anchoring points.

12.7.3 Performance/Limitations

12.7.3.1 Currents, Wind, Waves, Turbulence

The most important characteristic of a boom is its oil containment or deflection capability, determined by its behavior in relation to water movement. It should be flexible to conform to waves yet be sufficiently rigid to retain as much oil as possible. No boom can contain oil against water velocities much above 1 knot (0.5 meters per second) acting at right angles to it. The way in which oil escapes, and its relation with water velocity is as much a function of oil type as boom design. Low viscosity oils escape at lower velocities than more viscous materials. With the latter, the oil tends to accumulate at the boom face and to flow vertically down and under the skirt whereas low viscosity oils are carried under the boom as droplets sheared from the underside of the oil layer. Besides river and tidal currents, wind and waves can generate water velocities in excess of the escape velocity as well as causing splash over of contained oil. Oil escape can also result from turbulence along a boom and therefore a uniform profile without projections is desirable.



Escape of oil from a boom:

1. Splash over by wave action
2. Flow down the face of the boom
3. Droplets sheared from the underside of the contained slick

12.7.3.2 Boom size

The size and length of boom sections are also important considerations. The optimum size of a boom is largely related to the sea state in which it is to be used. As a general rule, the minimum freeboard to prevent oil splash over should be selected. The depth of skirt should be of similar dimensions to the freeboard. While short section lengths can make booms easier to handle and can protect the integrity of the boom as a whole should one section fail, these advantages must be weighed against the difficulty and time taken to connect sections effectively. Connections interrupt the boom profile and, wherever possible, should not coincide with the point of heaviest oil concentrations. The design of connectors should allow easy fastening and unfastening during deployment and whilst the boom is in the water.

12.7.3.3 Strength, Ease of deployment

Other important characteristics are strength, ease and speed of deployment, reliability, weight and cost. A boom must be sufficiently robust for its intended purpose and it must tolerate inexperienced handling, since

trained personnel are not always available. Structural strength and durability are required particularly to withstand the forces of water and wind on a boom when it is either towed or moored. Ease and speed of deployment combined with reliability are clearly very important in a rapidly changing situation and may strongly influence the choice made.

12.8 Netting Systems

12.8.1 Advantages

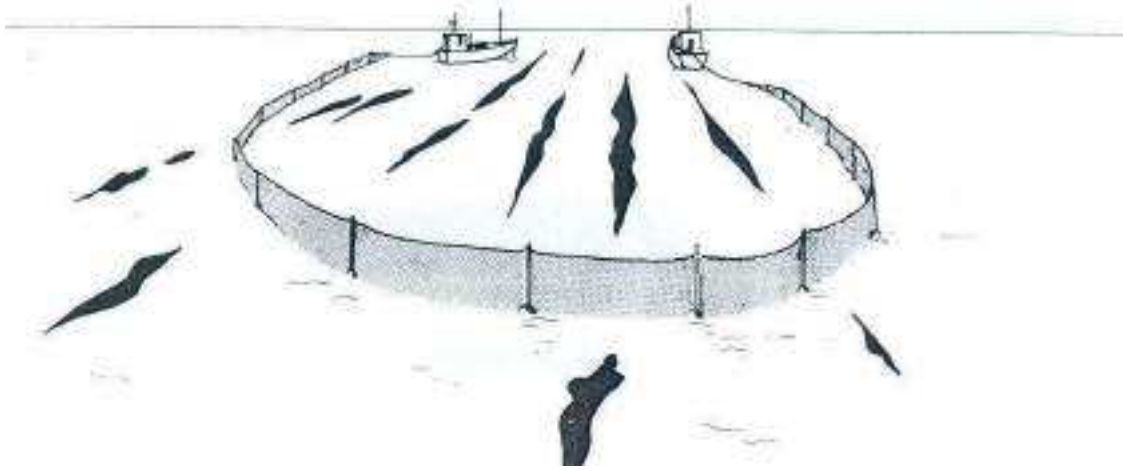
The use of nets to recover solid tar balls is an obvious application and the extension of their use to contain viscous oils theoretically presents a number of advantages over the use of conventional booms. In particular, the open structure should offer less resistance to water movement so that light but strong sections could be manufactured which might realistically be long enough to enclose oil scattered over a wide area of sea. As a result of the lower resistance of nets to movement through the water, it should also be possible to operate in faster currents or to sweep or trawl the sea surface at higher speeds than can be achieved with conventional booms.

12.8.2 Designs

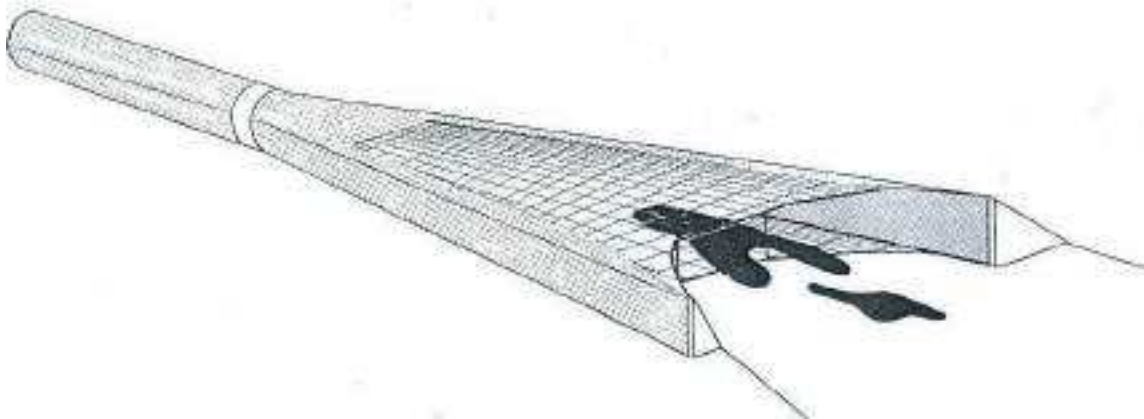
Two basic designs of net have so far been developed which draw on experience from the fishing industry a long double net based on the purse seine method of fishing which can be used to corral or collect floating oil or which can be moored to protect sensitive areas; and a trawl net with a detachable 'cod-end' which can be towed along the sea surface.

12.8.3 Experience

Although neither design has yet been fully evaluated during an actual oil spill, large scale field trials show some promise, especially in the case of the purse seine type when used to corral and retain floating oil. However, once oil has been adsorbed onto the net the mesh becomes blocked and the oil retention capabilities are similar to conventional booms.



Netting system of the purse seine type for oil containment and recovery using two vessels to corral floating oil.



Oil trawl for collecting floating solid oil into a detachable cod-end.

12.9 Sorbent Booms

12.9.1 Construction, Uses

Sorbent booms usually consist of a tube of netting or some other fabric filled with a synthetic or natural sorbent material. Booms constructed of sorbent material have little inherent strength and, in some application, may require additional support. Some also need extra floatation to prevent them sinking when they become saturated with oil and water. They are normally only used in areas of low current velocity to collect thin films of oil, since their recovery efficiency decreases rapidly once the outer layers of the sorbent material become saturated with oil. The handling and disposal of oil-soaked sorbent booms can also cause considerable problems. The use of sorbents is further discussed in the section on Recovery.



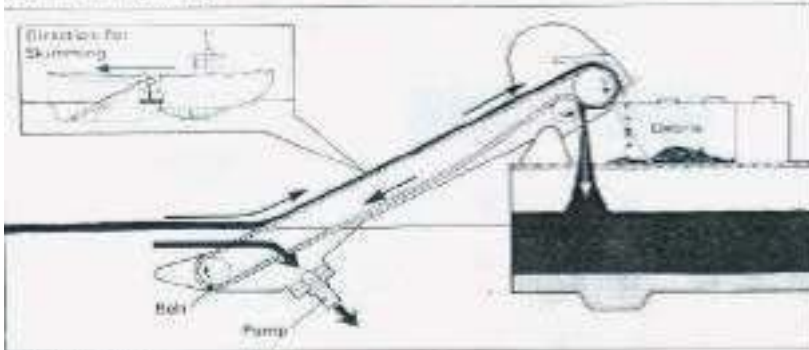
Fixed oil barrier constructed with straw bales and wire netting nailed to wooden stakes.

12.9.1.1 Recovery

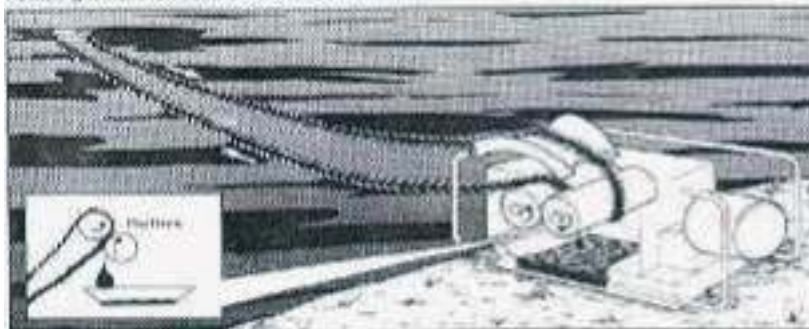
The rapid recovery of contained oil is vital to prevent its escape and the contamination of other areas. Recovery can be achieved using skimmers, pumps, sorbents, manual techniques and non-specialized mechanical equipment, such as vacuum trucks.

12.10 Skimmers

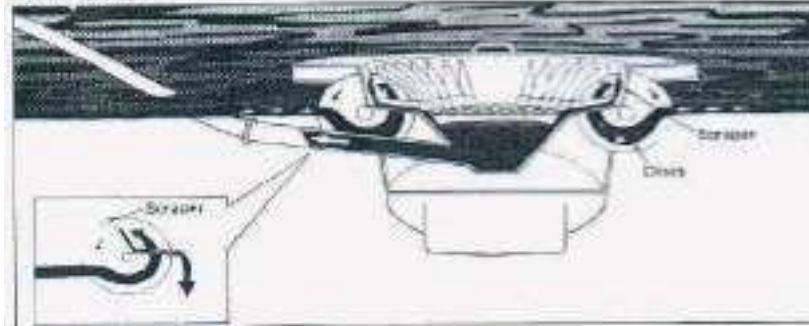
ADHESION DEVICES



Belt skimmers
 A belt conveys the oil from the water surface by adhesion. Upward rotating belts carry the oil to their top limit where it is scraped or squeezed off into a storage tank. Universally, downward rotating belts first submerge the oil which then surfaces behind the belt, due to its buoyancy, into a defined area within the vessel.
 Operational limit – for upward rotating belts 0.5 knots, sea state 1; for downward rotating belts 2 knots, sea state 2. Preference – medium viscosity oils but upward rotating belts also tolerate heavier material.



Oleophilic rope skimmers
 A central tension core rope, through which is interwoven oleophilic strands forming a long continuous mat. The floating mat is pulled by powered rollers around a return pulley. The rollers squeeze the oil into a storage tank.
 Operational limit – sea state 3. Sensitive to increasing viscosity. Preference medium viscosity oils.



Disc skimmers
 Discs rotate through the oil/water interface. Oil adheres to the disc surface, is removed by scraper to a central collection point and is pumped to storage.
 Operational limit – sea state 2. Sensitive to emulsified oils, waves, debris.
 Preference – medium viscosity oils.

SUCTION DEVICES



Weir skimmers
 Oil flows over a self-leveling weir into the well of the skimmer and is pumped to storage.
 Operational limit – sea state 1. Sensitive to higher viscosity oils, emulsified oils, waves and debris. Preference – free-flowing oils.



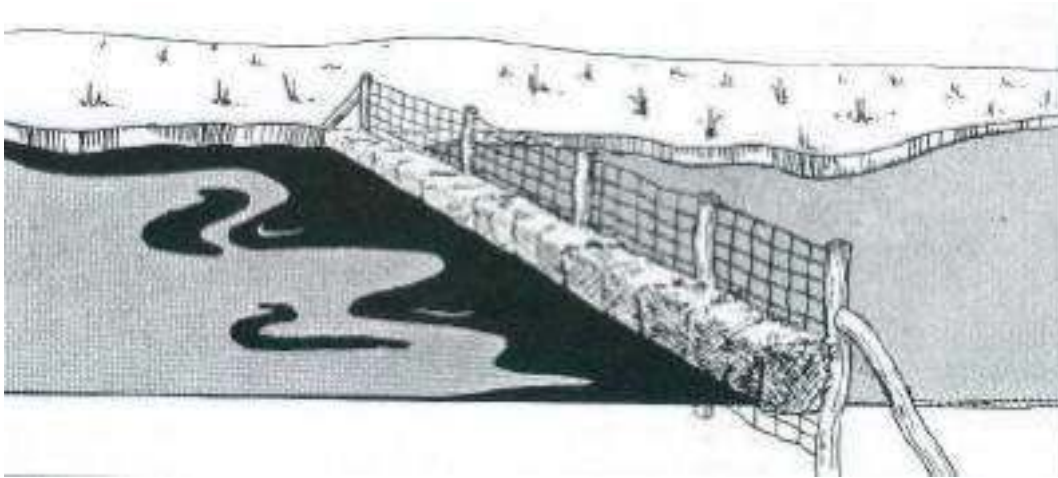
Vortex skimmers
 A vortex induced by an impeller causes the oil to concentrate at the ends of the vortex due to centrifugal effects. The collected oil is pumped from the top and the free water released from the bottom.
 Operational limit – sea state 3 and 0.5 kt water movement. Sensitive to debris. Preference – free-flowing oils.



Air suction skimmers
 Vacuum system or an air conveyor attached to a hose which may be fitted with specially designed skimmer heads. The pumping of more viscous materials is possible by increasing the water content.
 Operational limit – sea state 3. Vacuum systems more sensitive to debris. Preference – light to medium viscosity oils but air conveyors can tolerate high viscosity oils.

12.10.1 Design features

All skimmers incorporate an oil recovery element, some form of floatation or support arrangement and a pump to transfer collected material to storage. More complicated designs may be self-propelled and may have several recovery elements, integral storage tanks or oil/water separation facilities.



12.10.2 Suction skimmers

Two basic approaches can be recognized: SUCTION and ADHESION. The simplest concept is a suction device whereby oil is collected by a pump or air suction system from the water surface directly or via a weir. These designs tend to collect large volumes of water together with the oil. This can be an advantage when recovering viscous oils since the presence of excess water helps to maintain the flow of oils which would otherwise tend to block hoses and pipe work. Large storage is required to receive and separate the water which frequently represents more than 90% of the collected material. For oil spill control purposes, simple gravity separation in settling tanks is adequate.

12.10.3 Adhesion skimmers, Oil types

In contrast, skimmers which incorporate oleophilic materials into belts, drums, discs or synthetic ropes often achieve a higher ratio of recovered oil in relation to water. In general, they work best with medium viscosity oils between 100 and 2000 centistokes although skimmers with toothed discs or chain link belts have been designed specifically for the recovery of heavy oils. These high viscosity oils, such as heavy bunker oil, are extremely sticky and can prove difficult to remove from the adhesion surfaces, whereas, in contrast, viscous water-in-oil emulsions can be almost non-adhesive. Although low viscosity oils like diesel and kerosene can be collected, they do not accumulate on the oleophilic surfaces of skimmers in sufficiently thick layers for high recovery rates to be obtained.

12.10.4 Waves /swell, Currents

Skimmers are designed so that the oil recovery element is positioned at the oil/water interface. This is usually achieved by a self-levelling arrangement and although swell alone does not generally affect performance, none is effective in steep waves.

Small units are easily swamped and pitched around, whilst larger skimmers have greater inertia and cannot follow the wave profiles. The performance of skimmers is also adversely affected by currents in much the same way as for booms. This limitation is partly overcome in some self-propelled skimmers where a

sorbent mop array or belt is rotated so that its velocity relative to the floating oil effectively reduced when the vessel is underway.

12.10.5 Self-propelled skimmers

Other designs of self-propelled skimmers can be effective in the calmer waters of ports and harbours. Because they are comparatively expensive they often combine some secondary function such as debris or waste oil collection. Such vessels are often an integral part of response arrangements for oil terminals and refineries where the pollution risk is more predictable.

12.10.6 Power source

Skimmers require power for the recovery element or for transferring the collected oil to a storage tank. Many systems are designed with an integral power pack. Diesel power can be used directly or to drive electric, hydraulic or pneumatic systems. All except petrol engines can be built to conform with safety regulations imposed in refineries, tank farms and other restricted areas where there may be a risk of fire and explosion. When used in potentially dangerous atmospheres, regular tests should be carried out with explosion meters to ensure safe operating conditions, since spark sources can never be completely eliminated.

13 ROLE OF INDUSTRIAL TERMINALS ON KPT LAND

13.1 Roles & Responsibility

Sr. No.	Tank Farm Owners	Persons to be contacted in case of emergency		
		Name and Position	Telephone No.	Mobile No.
1	Kesar Enterprises Ltd., Near Oil Jetty, Old Kandla (Kutch)370210	Mr. R.K. Gupta Gen. Manager	270435 (O) 295676 (R)	9375349181
2	Kessar Enterprises Ltd, Terminal II, Plot No. 5 &6 Old Kandla	Mr. R.K. Gupta G.M	270435 (O) 270177 (O)	9375349181
3	Chemical & Resins Pvt.Ltd Terminal –I, Near Oil Jetty, Old Kandla, Kutch Terminal – II, Near West Gate, New Kandla – Kutch	Lt. Col. Pramod Kumar (Retd), GM,	270505(O) 236831(R) 270916 (O)	9825225676
4	Indo-Nippon Co. Ltd., Plot No.2, K.K.Road, Old Kandla,	Mr. R.N. Pathak Asst. Terminal Manager	270795(O) 235818(R) 270295(O)	9879571295
5	J. R. Enterprise, Plot No.3, Old	Mr. Devendra Dadhich,	653528 (O) 257152 ®	9898238380

	Kandla,	Terminal In-charge		
6	Friends Oil & Chemical Terminals Pvt. Ltd., Near Booster Pump Station, Kandla, Kutch	Mr.S.Ramakrishnan Terminal Manager	270987 (O) 257249 ®	9879572107

7	Indian Oil Corporation Ltd., Main Terminal, GIM	Mr. AK. Khanna Sr. Term. Manager Mr. KS Rao, Sr.TM	233274 (O) 229002 (R) 270394 (O)	9427216637 9426416108
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Upgraded Emergency Plan / DMP for Kandla Port Gandhidham (Kutch)

	Foreshore Terminal, Kandla KBPL LPG Import Plant	Mr. PS Negi Plant Manager	270628 (O) 270477 (O) 233359 ® 270978 (O) 236944 ®	9426725342
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8	United Storage & Tank Ltd Near IOC Foreshore Terminals, New Kandla	Mr. Manoj Gor Terminal Manager	270609 (O) 653525 (O) 651238 ®	989850029
	Gas Terminal, Plot No. 4 Old Kandla	Mr. G. Chudasama	653529 (O)	9904366855
9	IFFCO Kandla Unit, Kandla, Kutch	Mr. L. Murugappan, G.M.(NPK-I) Mr. Brahmbatt Manager (F & S)	270711 270352(O) 270381 (O)	982506922 9099019861
10	BPCL, KK Road, GIM	Mr. RG. Dekate Sr. Manager Operations	234313 (O) 223235 (R)	9099929634
11	HPCL KK Road, GIM	Mr. Murthy Manager (Installation)	230936 (O) 220084 (O) 233078 Ext	
12	INEOS ABS (I) Ltd Plot No. 8 Old Kandla	Mr. Vineeth Nair Dy. Manager	270087 (O) 234409 (R)	9825237029
13	Liberty Investments Pvt. Ltd., Plot No. 1 & 2, Block 'H', New Kandla	Mr. Jitendra Vaidya Terminal Manager	270151 (O) 270464 (O) 270468 (R)	9825025645

14	Avean International Pvt. Ltd., Liquid Storage Tank Terminal, Plot No. B-1, New Kandla	Mr. Bharat Rathod Terminal Manager	270537 (O)	9375310260
15	Rishi Kiran Logistics Pvt Limited, Plot No. 7, Link Road Old Kandla	Mr. RH. Pandya GM (Terminal)	270223 (O) 270443 (O)	9879104556
16	N.P.P. Pvt. Ltd., Old Kandla	Mr. MD.Nagvekar	270347 (O) 257807 ®	9825227649
17	Friends Salt Works and Allied Industries, KK Road, Old Kandla	Mr. NJ.Zinduwadia Sr. Manager Mr. HA. Mehta,S.M	270814 (O) 262698 (R) 271260 (O)	9825506361 9825506360
18	IMC Ltd, Cargo Jetty New Kandla	Mr. Anil Brahmbhat	270369(O) 653524 (O) 296079 (R)	9898126243
19	Agencies & Cargo Care Ltd., Plot No.3, New Kandla.	Mr.Shivkumar Menon, Terminal Manager	270714 (O)	9825226765
20	Dipak Estate Agency Plot No. 5-6, Block – A New Kandla	Mr. Narendra Thacker	270375 (O)	9879611243

21	Parker Agrochem Exports Ltd, Plot No. 3 –4,Block- H New Kandla	Mr. Bharat Thacker	270486 (O) 270528 (O) 231876 (R)	9825238260
22	Tejmalbhai & Co New Kandla	Mr. Ankitbhai Chandan	271330 (O) 230090 (R)	9825225101
23	Parker Agrochem Product Pvt. Ltd, Plot 7-9/A,N.Kandla	Mr. Raja Babu Dy Manager	270528 (O) 231876 (R)	9979158543
24	Mother Dairy Fruit & Vegetable Pvt. Ltd, Near Oil Jetty, Old Kandla	Mr. Saju Therattu	270654 (O) 270655 (O) 230979(R)	9974022681

The individual terminal will have to ensure the following in the event of emergencies arising out of:

- a) Natural disaster
- b) Toxic release
- c) Flammable vapour release
- d) Road tanker / Rail tank truck transportation accident
- e) Fire
- f) Flooding

13.1.1 Natural Disasters

- Ensure that adequate staff are posted at the terminal to meet any eventuality
- Ensure all operations are shut down
- If possible, ensure disconnecting pipelines
- Provide 48 hours food supply as well as portable water supply at the terminal

13.1.2 Toxic Release

- Ensure that the staff is evacuated in the direction opposite or as far as possible at 90 degree to the direction of the wind
- The staff located at the site to ensure safe operation, should be provided with gas masks
- Do's and Don'ts should be posted outside the control room to ensure minimum loss to life

13.1.3 Flammable Vapour Release

- It should be ensured that all possible help is rendered to the affected site / terminal
- The fire and safety officer at Kandla Port fire station should be informed
- Information pertaining to fire should be relayed to Main Emergency Control room at Gandhidham
- Information regarding fire incident should also be relayed to Kandla Free Trade Zone fire station
- Security personnel of the individual terminals should also be on standby to assist in fire fighting if the need be
- Mutual Aid Agreement should be signed between all the terminals as well as the KPT
- IOC LPG terminal should assist the affected terminal by way of sharing their experience in terms of plugging a chemical/gas leak
- The terminal Manager of the terminal next to the affected terminal should also inform the CISF

13.1.4 Road Tanker / Rail Tank truck transportation accident

- The dispatch terminal to whom the cargo belongs is responsible for attending to the mishap
- The dispatcher has to inform the exact location of the accident to the Main Emergency Control Centre as well as to the local emergency control room at Kandla
- CISF Commandant has to be informed by the dispatcher of the site of accident
- The Fire and Safety Officer stationed at Kandla Port should also be informed with specific name of the chemical
- In case the road tanker involved happens to be containing POL products then HPCL, BPCL and IOCL should be contacted immediately
- Accident involving rail tank truck i.e. LPG should be informed to the IOCL LPG Terminal Manager immediately
- In case of any leakage reported from LPG road tanker or rail tank truck the same should be arrested by the IOCL team

13.1.5 Fire

- Inform the Kandla Port Fire and Safety Officer
- Ensure that information pertaining to the Chemical involved in fire is passed to the Main Emergency Control Centre at Gandhidham as well as Kandla
- Information should be relayed to CISF regarding the fire
- In case it is a fire related to POL product then the oil majors i.e. HPCL, BPCL and IOCL should be contacted
- In the event of chemical fire it would be the collective responsibility of the DEENDAYAL PORT TRUST as well as the dispatcher to ensure that the spill is controlled and collected

13.1.6 Flooding

- Terminal should have trolley mounted pumps preferably of flame proof type to ensure dewatering of the site
- Gum boots should be supplied to the staff at the terminal
- The electricity supply to the terminals should be shut off to avoid short circuit
- The trolley mounted pump should have DC supply in order to ensure continuous operation
- It should be ensured that all the drains should be cemented and free of any debris which could hamper the flow of water

The following occupiers shall be a part of the emergency team for rendering expert advice. (This composition may be changed once in three years on rotation basis.)

13.2 Toxic Team

- IFFCO
- Chemical & Resins Ltd.
- United Storage & Tank Terminals Ltd.
- Bayer ABS

13.3 Fire Team

- Kesar Terminal I
- Indo Nippon

- Friends Oil & Chemicals Ltd. (FOCL)
- Friends Salt Works & Allied Industries Ltd. (FSWAI)

13.4 Transportation Team

- IOCL POL TERMINAL
- HPCL
- BPCL

13.5 Natural Disaster Team

- J. R. Enterprise
- J. K. Synthetics
- Synthetic Chemicals

Individual terminals shall be responsible for ensuring that safe shut down has been affected aftermath of a disaster in the neighborhood.

In case of dry docks KPT shall assume the charge of the emergency controller along with P&O to ensure that all the staff is evacuated from the area barring the security and the emergency team.

The emergency team would be drawn essentially from CISF and Marine Department i.e. at the behest of Harbour Master as well as P&O. In the event of an impending natural disaster like cyclone only CISF personnel to be stationed at the wharf. For the ships berth at the dock please refer to the cyclone disaster plan as annexed.

The emergency team should have the following:

- a) Chemical data sheet
- b) Protective clothing
- c) Breathing Apparatus
- d) Safety Harness

- e) General tools and flash light
- f) Leak plugging equipment like wood plugs
- g) Analytical equipment like explosivemeter
- h) Flood light with generator
- i) First Aid kit
- j) Portable diesel operated fire water pump

The responsibility of the various teams mentioned above would be to follow the following procedure:

- a) Keep people away
- b) Inform incident Controller i.e. at Main Control Room
- c) Contain the chemicals
- d) Avoid igniting the chemicals by ensuring muffler on the exhaust
- e) Obtain chemical data sheet

The communication parameters which need to be relayed to the Emergency Control Centre

- a) Place and time of the incident
- b) Chemicals involved
- c) Condition of the container
- d) Injuries or deaths
- e) Area surrounding (open country, town)
- f) Weather conditions
- g) Assistance available (police, fire services)
- h) Means of maintaining contact

Logistic Team

The function of Logistic Team is to ensure necessary supplies are available to Response Team during the emergency. In addition to above mentioned, the function is also responsible for organising and maintaining the staging area where emergency material and equipment is to be temporarily stored and assembled

before rapid deployment. The Logistic Coordinator will be reporting to the Emergency Chief Incident Controller and keep him updated on the availability of supplies and equipment or of any anticipated need.

Typical list of emergency equipment and material is given below:

- Fire extinguishers
- Fire fighting agents
- Fire hoses and nozzles
- Personal protection apparatus like fire suit (proximity suit)
- Chemical resistance protective clothing
- Self contained breathing apparatus
- Respirators
- Emergency lights
- Power generators
- Portable radios and cellular mobile phones
- Spill control agents for decontamination of toxic spills
- Plastic containers and lining material for diking and damming
- Earth moving machinery
- Fuel and gasoline for operation of vehicles and machinery

14 LINKS BETWEEN THE ARMY, COAST GUARD & AIR FORCE

Aftermath of any disaster the recovery and relief operations are conducted on a war footing.

The task involved usually demands rough and tough and dedicated personnel who are trained professionals to meet any challenge be it evacuating people marooned due to flood or making shelters or transporting relief to inaccessible areas. It is for this purpose that the army, air force and the coast guard would be required to assist the Kandla Port Administration.

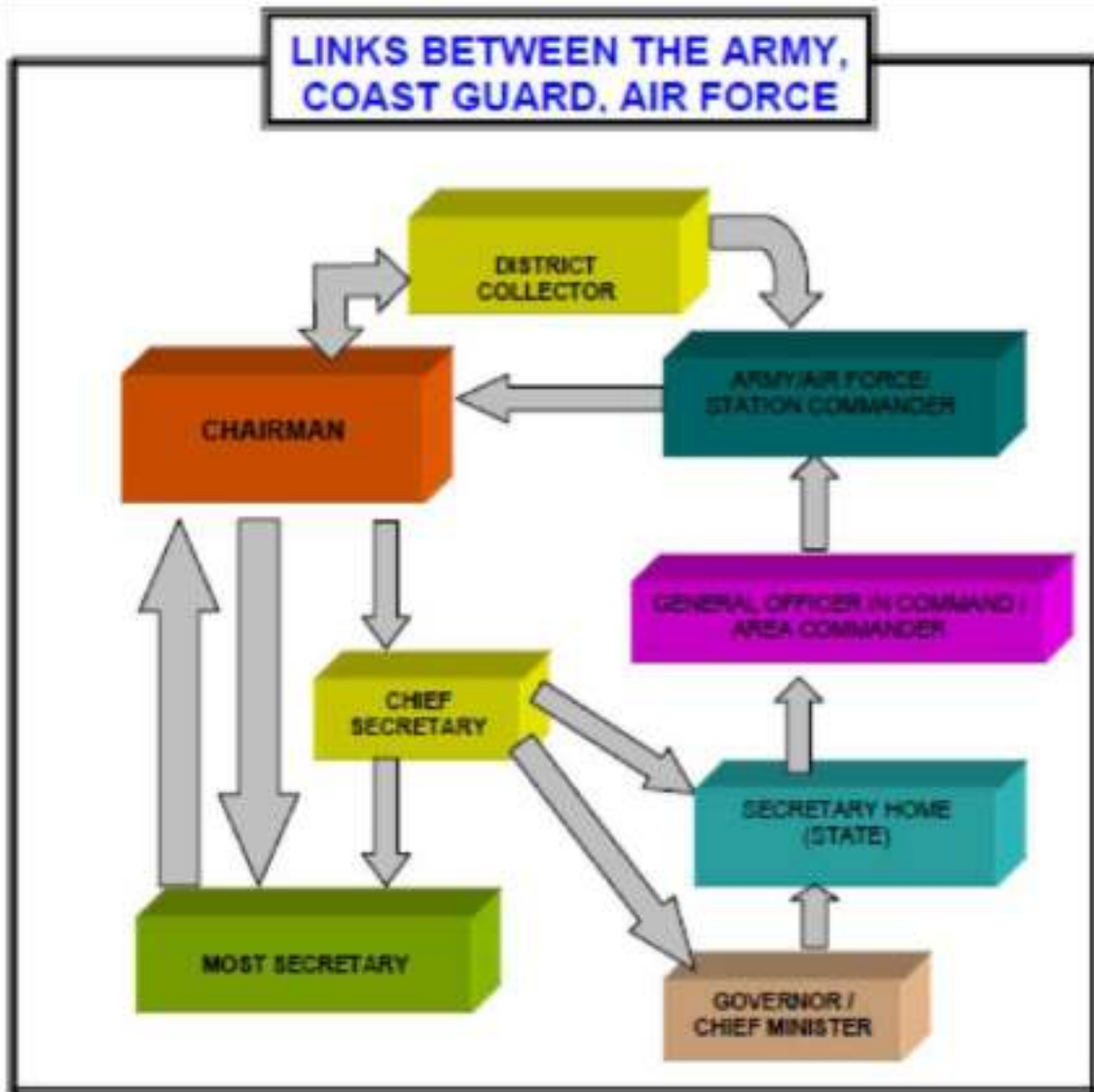
The Chairman / Deputy Chairman would be the coordinating officials for liaising with the Station Commander (army, navy as well as air force) after consulting the District Administration.

While seeking assistance from the army, air force or the coast guard the following documents should be kept ready for reference:

- ③ Overall plot plan of the Kandla Port
- ③ Clear demarcation of the affected area on the plot plan
- ③ VHF link frequency for establishing contacts with the signal room as well as CISF commandant.
- ③ List of all the important telephone numbers.
- ③ In the event of Cyclone, keep the task force updated on the weather condition.
- ③ Ensure that the emergency team is extending their full co-ordination to the task force.
- ③ For ready reference the Secretary should nominate a person who should be made responsible to taking notes on what is happening and what sequence.
- ③ The areas, which could be used as temporary shelters should be indicated to them.
- ③ Open space which can be used as staging area should be indicated to them.
- ③ All the medical staff should be kept on standby and they should be asked to act after consulting the Army or the Air force teams.
- ③ In the event of air evacuation requirement it should be ensured that the people being evacuated are listed and the number of sorties required is noted.
- ③ In the event of a cyclone and an resultant Ammonia Gas leak it should be noted that the Army and the Air force should be provided with gas mask (if the need be).
- ③ Data pertaining to the number people in the affected areas (an approximate) should be made available to the Army / Air force.

The flow of information for co-ordination:

Chairman District Collector Chief Secretary Secretary - Ministry of Surface Transport Governor / Chief Minister of the state ARMY/AIRFORCE.



15 PROCEDURE FOR CO-ORDINATION

The overall responsibility of the Emergency management lies with the Chairman, Kandla Port. He assumes the responsibility of Chief Site Controller on receipt of the information of an emergency or an impending emergency.

Some of the critical functions are:

- ③ Activation of the emergency response organization
- ③ An ongoing emergency assessment, including upgrading or downgrading of the emergency alarm level
- ③ Notification of outside governmental agencies
- ③ The decision to ask for outside help and resources
- ③ The decision to evacuate the people
- ③ Decisions involving the safety of off-site vulnerable points (e.g. recommendations to evacuate or take shelter, in the case of a toxic vapour release).
- ③ Decisions to shut down/restart the Port.

The Chairman i.e. the Chief Site Controller shall be responsible for designating the Incident Controller, the Field Controller as well as the Liaison Officer as well as Public Relations Officer.

Functions like

- ③ Communication
- ③ Fire, Safety and Rescue
- ③ Special hazard
- ③ Utilities
- ③ Engineering / technical function
- ③ Medical function
- ③ Logistic function
- ③ Security function

③ Administrative function

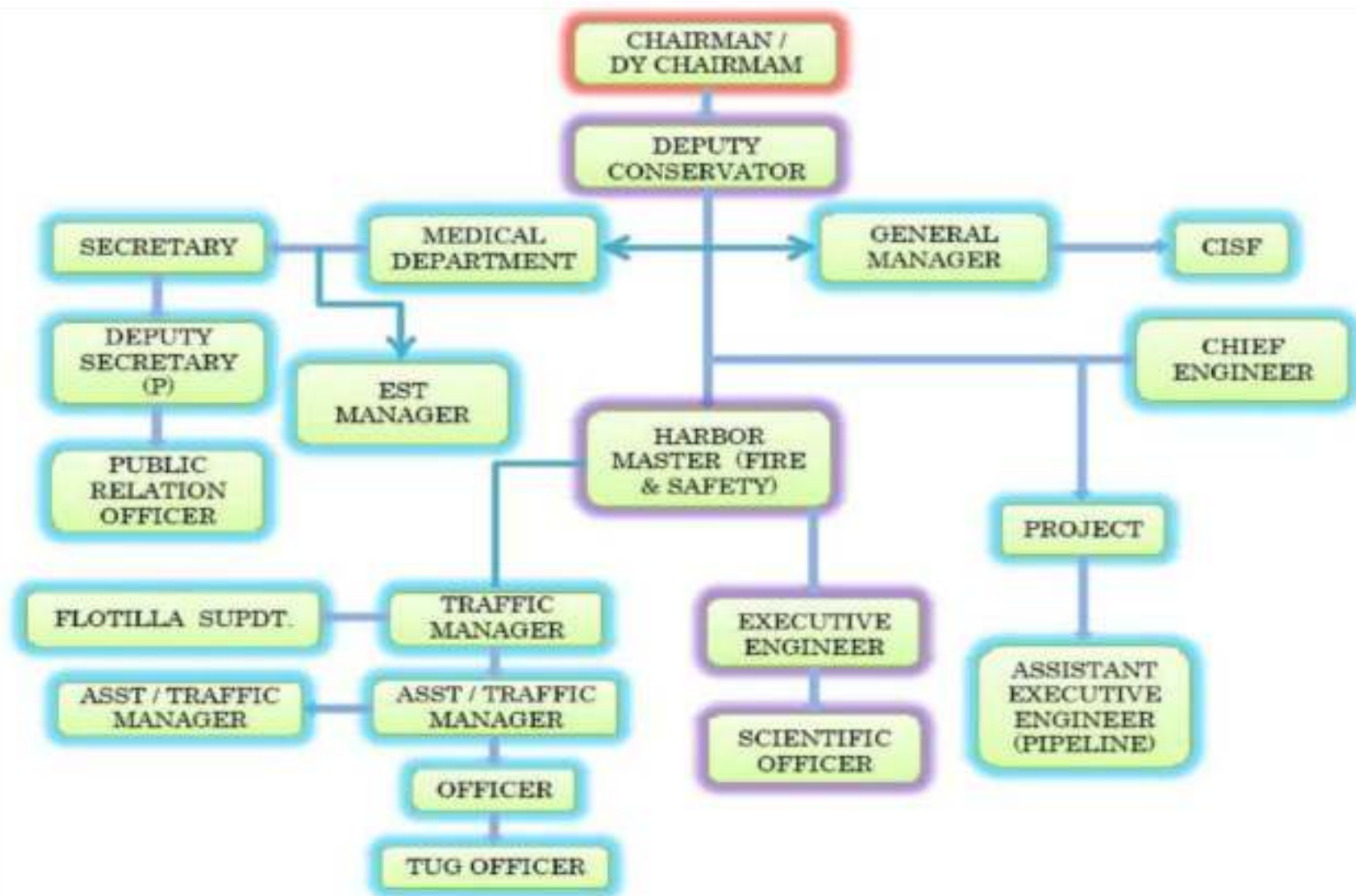
EMERGENCY NOTIFICATION SHEET	
1.	Plant / Location Name _____ Unit _____ Address of Plant / Site _____
2.	Date _____ Time of Call _____
3.	Caller's Name _____ Caller's Position _____ Caller's Telephone Number _____
4.	Time (or Anticipated Time) of Accident / Emission _____ Projected Duration of Accident / Emission _____

5.	Type of Accident / Emission _____
6.	Emergency Alert Level (EAL) : Check One ALERT <input type="checkbox"/> [] SITE EMERGENCY <input type="checkbox"/> [] GENERAL EMERGENCY <input type="checkbox"/> []
7.	In case of Toxic Release :
	Chemical Name of Substance Released _____ Amount and/or Rate of Release _____ Estimated Duration of Release _____ Type of Release (Gas, Liquid or Solid) _____ Toxicity / Flammability _____ Potential Impact on Offsite Area _____ Estimated Area Affected by the Release _____



8.	Weather Condition _____ Wind Speed _____
9.	Casualties / Damages _____
10.	Brief Description of the Accident _____ _____ _____
11.	Assistance Requested _____ _____ _____ _____
12.	Signature _____ Date _____ Time _____

15.1 Procedure for Co – ordination





16 ASSEMBLY POINTS & ESCAPE ROUTES

1. There are two main escape routes from the port side i.e. by land:
 -  Kharirohar road.
 -  Main NH 8 i.e. leading to Gandhidham.
 2. The sea route would be the Kandla creek and other creeks i.e. Phang creek, Sara Creek or Rohar Creek or Nakti Creek connecting the same.
 3. Air evacuation can be undertaken by Helicopter or from Kandla Aerodrome.
 4. KPT to prepare list of all the personnel in their port colony and have it posted at the assembly area.
 5. The assembly points in the Cargo Dock for the workers in the area between the North Gate and the plot number five would be the area in front of the Railway Station.
 6. The assembly point for the port township could be between block E&D and at the intersection of Block 'B'.
 7. The assembly point for each of the adjoining berth would be on the road i.e. used for moving between the warehouse A,B,C,D and the berthing area.
 8. However for the workers working in the warehouses as mentioned above the assembly point would be the central road between the two streams of warehouses.
 9. The workers working in the bins i.e. open storage the assembly point would be the area in front of the West Gate # 2.
 10. For bins closer to the West Gate #2 fire brigade station the staging area for the fire station would be used as assembly point.
-

11. Computer should be installed in the rooms next to the assembly point connected to the time office for a list of people inside the port and the same should be made available at the railway station.
12. Railway station should have emergency evacuation counter all the personnel being evacuated from the area should be asked to check-in at the counter before they board the train.
13. The PA system at the assembly area should be used to announce “do not carry any luggage or belongings just carry as much as is bare essential in clothing”.
14. The point of departure from the Dry cargo area would be West Gate 1 & 2 as well as North Gate and in an extreme case one would have to use the jetty being used by the pilots for evacuation by sea.

RECOVERY AND BUILDING BACK

17 RECOVERY FACILITY RE-ENTRY RESTORATION OF SERVICES

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The recovery and re-entry phase will begin after the declaration of termination of emergency situation. This determination would be made by the Chief Incident Controller. The recovery plan would be flexible enough to adapt to existing conditions. All of the conditions that may be encountered in an emergency situation cannot be anticipated in advance. Detailed plans and procedures for recovery operations would be prepared at the time they are needed.

Re-entry operations would be performed by the Re-entry Team, which would be same as that of green team under the leadership of the Chief Incident Controller.

The team shall consist of personnel knowledgeable in procedures and facility layout. In the Re-entry planning process, the team will gather available information on the nature of the emergency and its present status by methods such as discussions with the operations personnel on-shift. Necessary protective clothing and equipment would be available for the team before re-entry is authorized.

Specific procedures for recovering from an emergency and re-entering the facility can hardly be provided, since they will have to be determined on a case by case basis, depending on the type of accident and the severity of the damage suffered. However, provision would be made for the following:

- Organising a re-entry team
- Inspecting the damaged area
- Declaring the emergency concluded and making the "all clear" known to the facility employees and the community
- Deciding which employees would report to work and notifying them
- Beginning an investigation into the causes of the emergency
- Assessing the damage to the facility
- Transferring necessary operations to alternative locations
- Decontaminating the damaged area
- Restoring services to the damaged area
- Clearing up the debris
- Salvaging material and equipment affected by the emergency
- Restoring the parts of the facility affected by the emergency
- Determining responsibilities and instituting possible insurance and damage claims

In case of an aftermath of a toxic release, it should be ensured that Chief Incident Controller and the party carrying out the re-entries to ascertain the termination of emergency, should be carrying self-contained breathing apparatus as well respiratory masks.

Please note in the event of a natural disaster the recovery team would involve the usage of ARMY or other paramilitary forces the same would be under the control of the station commander and the overall Controller shall be the District Collector.

CAPACITY DEVELOPMENT

18 MAINTAINING

CAPABILITIES

EMERGENCY

RESPONSE

In order to ensure a prompt and professional emergency response capability, port personnel are required to be knowledgeable of the possibility of various emergencies and emergency actions. General safety training should be provided to all employees to familiarize them with alarms, evacuation routes, safe assembly points, etc. In addition, personnel who are a part of the Emergency Response Organization are required to have additional training and should participate in periodic drills and exercises.

18.1 Training & Education

Regular training should be provided to all personnel who have a role in planning and operational response to an emergency. The main goal of training for emergencies is to enable the participants to understand their roles in the response organization, the tasks associated with each position and the procedures for maintaining effective communications with other response functions and individuals.

The training objectives are:

1. To familiarize personnel with the contents and manner of implementation of the Plan and its procedures.
2. To train personnel in the performance of the specific duties assigned to them in the plan and in the applicable implementing procedures.
3. To keep personnel informed of any changes in the plan and the implementing procedures.
4. To maintain a high degree of preparedness at all levels of the Emergency Response Organization.
5. Train new personnel who may have moved within the organization.

6. Test the validity, effectiveness, timing and content of the plan.

7. Update and modify the plan on the basis of experience acquired through exercises and drills.

Selected port personnel should receive instruction in the use of the fire fighting and emergency equipment available at the site. All personnel working at the site should receive instructions in fire prevention and in basic fire fighting techniques. Periodic refresher training should be provided and supplemented by fire drills.

Crews of tugs, which can be used for fire fighting, should receive instruction and training in fighting petroleum fires in co-operation with land based fire-fighting services. In order to utilize fully the tugs firefighting equipment and capability during an emergency, it may be necessary to supplement the crew with trained shore personnel. Opportunities should be provided at frequent intervals for combined practices involving the tugs and shore fire fighting services. Opportunities may arise whereby a combined fire practice or conference can be arranged between shore personnel and crew members of tanker at berth without imposing an operational delay on either the berth or the tanker. This should help make the tanker personnel familiar with the firefighting equipment ashore. Shore personnel should also have the opportunity of becoming familiar with the types and locations of firefighting equipment on and of being instructed in any design features on tankers which may require special attention in case of fire.

18.2 Drills & Exercises

Emergency drills and integrated exercises have the following objectives. These constitute another important component of emergency preparedness. They refer to the re-enactment, under the assumption of a mock scenario, of the implementation of response actions to be taken during an emergency.

1. To test the adequacy of the effectiveness, timing, and content of the plan and implementing procedures.
2. To ensure that the emergency organization personnel are familiar with their duties and responsibilities by demonstration.
3. Provide hands-on experience with the procedures to be implemented during emergency.
4. Maintain emergency preparedness.

The frequency of the drills should vary depending on the severity of the hazard. However, drills should be conducted once in a year. Scenarios may be developed in such a manner as to accomplish more than one event objective.

Drills and exercises will be conducted as realistically as is reasonably practicable.

Planning for drills and exercises should include:

- ③ The basic objectives
- ③ The dates, times and places
- ③ The participating organizations
- ③ The events to be simulated
- ③ An approximate schedule of event
- ③ Arrangements for qualified observers
- ③ An appropriate critique of drills/exercises with participants

Evaluation of drills and exercises should be carried out which should include comments from the participants and observers. Discrepancies noted by the drill observers during the drill shall be pointed out during the drill. A written evaluation of the drill or exercise should be prepared by the individual responsible for conducting the drill or exercise. The evaluation should include assessments and recommendations on:

- ③ Areas that require immediate correction.
- ③ Areas where additional training is needed.
- ③ Suggested modifications to the plan or procedures.
- ③ Deficiencies in equipment, training, and facilities.

The evaluation of a drill or exercise shall be submitted to the Main Controller for review and acceptance who shall then determine the corrective actions to be taken and assign the responsibility to appropriate personnel.

The Chief Fire Officer should track all approved drill and exercise corrective actions as a means of assuring that corrections are made in a reasonable amount of time, and shall advise Main Controller of the status of implementation of corrective actions.

Records of drills, exercises, evaluations, and corrective actions should be duly maintained.

18.3 Review of the plan

The Plan and associated implementing procedures should be reviewed to ensure compliance with relevant regulations and applicable state and local emergency plans and written agreements with mutual aid companies also.

The plan should be reviewed under the direction of the Chairman who should encompass the plan, response procedures, equipment, training, drills and interfaces with local emergency management agencies. The need for changes is based upon the following aspects:

- ③ Written evaluations of drills and exercises which identify deficiencies or more desirable methods, procedures, or organizations.

- ③ Changes in key personnel involved in the organization.

- ③ Changes in the facility organization structure.

- ③ Changes in state regulations.

- ③ Modifications to the facility which could affect emergency planning.

- ③ Recommendations received from other organizations and state agencies.

18.4 Emergency Control Center

The Emergency Control Centre is located in the Board Room of Administrative Office Annexure Building at First Floor.

This room will have seating arrangements for all members of Disaster Management Group.

It will have the following:

1. Adequate number of telephones. One of these telephones shall be used for outgoing telephone calls only.
2. Internal telephones, telex, fax.
3. VHF transceiver having marine band capable of being operated by mains or battery.
4. Hot line linking deputy commissioner of the district.
5. Internal and external telephone directories.
6. Emergency manuals.
7. Emergency light.
8. Wind direction and speed indicator.
9. Plan of the port showing:
 - ③ Berths/Areas where hazardous materials are handled
 - ③ Sources of safety equipment's
 - ③ Personal protective equipment such as aprons, gloves, gum boots, etc. ③ The fire fighting system
 - ③ Stocks of other fire-extinguishing materials
 - ③ Site entrance and roadways, updated at the time of the emergency to indicate roads which are to be used and which are not to be used.
 - ③ Assembly points and routing ③ Medical centers.
 - ③ Layout of pipelines in the Port area

③ Lorry parks and rail sidings

③ Port location in relation to the surrounding community (5 km map)

19 DEENDAYAL PORT TRUST OFF SHORE OIL TERMINAL – VADINAR PORT

19.1 Vadinar Port Information

Vadinar Port is an important port in DEENDAYAL PORT TRUST Group of ports under the control of Kandla Port Trust, Kandla. The port is just 55 Kms from Jamnagar city.

Latitude: 22 Degree 26'25' North

Longitude: 69 Degree 40' 15' East

Charts – Gulf of Kutch Chart No: 203

19.1.1 Metrological Data

1. Temperature: Summer Maximum 38Degree C, Minimum 19Degree C
2. Temperature: Winter Maximum 36Degree C, Minimum 14Degree C
3. Annual rainfall: Average 241.2 mm
4. Average Wave Height: 30 Centimeter (Summer)
5. Average Wave Height: 25 Centimeter (Winter)
6. Maximum Wave Height: 45 Centimeter
7. Maximum Tide – 6.12 Meter
8. Minimum Tide – 0.02 Meter
9. Wind Speed – Average Wind Speed – 16 knots/hour
 - Summer – 25 knots / hour
 - Winter – 18 knots /hour

10. Anchorage: Anchorage areas are about 4.5 miles from shore.

19.1.2 Off Shore Oil Terminal (O O T) Vadinar

The DEENDAYAL PORT TRUST has commissioned the off shore oil terminal facilities in 1978 jointly with Indian Oil Corporation by providing Single Buoy Mooring (SBM) system having a capacity of 10MMTPA was first of its kind in India. The following are the salient features of the operations at OOT Vadinar.

- A draft of upto 30 meters at SBMs and Lighterage Point Operations (LPO) • The Single Buoy Moorings can handle vessels having length of 335 meters. 2 NOS OF OIL BERTHS OF NAYRA(EX ESSAR)
- Handling VLCCs upto 3,00,000 DWT
- Providing crude oil intake for the refineries of M/s. IOCL at Koyali (Gujarat), Mathura (UttraPradesh), and Panipat (Haryana). & VADINAR OIL REFINERY OF NAYRA (EX ESSAR)
- Commissioned the first SBM on 27th August 1978.
- M/s. IOCL Commissioned the second SBM on 25th October 1997.
- Commissioned the third SBM (Essar) on 29th December 2006.
- Simultaneous handling of 3 vessels at three of SBMs
- Vast crude tankage facility of M/s. IOCL having capacity of 11, 44,000 KL.
- 4 High powered Tug of 50 Ton BP.
- Two Tugs of 35 ton BP &
- Two 50 Ton BP tugs for smooth operation is being acquired.

19.1.3 Export Jetty (Essar)

- One Ro - Ro / Lo - Lo Jetty for handling of project cargo / construction material / spare parts.
- Product Jetties (Private Berths at the Port)
- Essar Jetties are used for tankers Loading of POL product cargo by alongside.
- The Jetty No 1 – commissioned on 6th December 2006.
- The Jetty No 2 – commissioned on 29th December 2009.

19.2 Control Room –Vadinar Port

There is one control room at A.O. Building, Vadinar Jetty under the direct supervision of Pilot, stationed at Vadinar. In absence of Pilot, the other Pilot posted at Vadinar and XEN (M&E) shall be responsible for the direct supervision of the Control room at Vadinar, in association with Marine Engineers Grade - II. They shall rush to the Control room as soon as the Action plan is put into force. Two persons viz. one Assistant, Flotilla Supervisor and one Signaller shall report for duty to the In-Charge of Control Room immediately, as soon as the Control room comes into operation. The In-Charge should draw-up rosters of the said employees shift-wise and assign duties to them. The In-Charge shall ensure the presence of the staff as to whom various duties have been assigned. They should attend the meetings as and when called. In case of absence of the staff, the matter should be informed to the C.O.M. (OOT), who shall take disciplinary action against the erring employees.

The Control room has the following assets

Telephone	Fax	VHF Signal
0288-2573026		Marine Channel 12,16,8,10
Mobile Phone Nos. 9825212359 / 9825212360 /		
Xerox Machine / STD telephone		

Inmarsat Mini M. Terminal and / or V.Sat Terminal Antenna are required to be set up and installed at Vadinar.

Manning at Vadinar Control Room Jetty

Any one of the AVAILABLE Contract Pilots is available at Vadinar

Designation
XEN(M&E)
M.E. Grade-II
Office Supdt
A.F.S

A.F.S
Signalman
Signalman
Signalman
Signalman

19.2.1 Obtain Information from following Sources

1. State Meteorological Control Room, Ahmadabad
2. Control Room, KPT, Kandla / Gandhidham 9. Meteorological Section, New Kandla,
3. signal station, New Kandla.

The information so collected shall be maintained by making hourly log entry in a register.

19.2.3 Control Room Assets

1. Xerox machine
2. STD telephone
3. Fax machine
4. Inmarsat Mini M. Terminal / and or V. Sat Terminal antenna, are required to be set up at Vadinar jetty

The In-Charge of Control room should ensure setting up of the Control room at Vadinar jetty immediately on receiving warning and matter be reported to C.O.M. who in turn apprise the Dy. Chairman and Chairman, KPT.

The control room shall remain in touch with various authorities / agencies like State Govt. / Distt. Authorities / and local authorities. Besides, Naval Authority OkhaPorbandar should also be contacted on VHF/UHF frequency, round the clock. In the prevailing set up of CISF Security control staff at Vadinar, Officer-in-charge of C.I.S.F. Unit of KPT Vadinar along with his entire CISF Security Personnel will remain in contact with In-charge of Control Room for posting of CISF Security Personnel at various locations as per the requirements and they will carry out the duties and responsibilities as required & assigned under this Action Plan.

In case the Marine Signal No.8 is issued, the Vadinar jetty area will be evacuated including the Control Room, which shall be shifted to Room No.5 of Port Guest house at Vadinar colony. In this regard, XEN (E&M) shall pre-plan installation of VHF Antenna and drawing extension line of there available Telephone Nos. (02833)-256533 / 256714 at Port Guest House at Colony and ensure laying of cable with suitable connectors with the Wireless Sets duly tested and thereafter to be set up there at Guest House.

19.3 Functions of Control Room –Vadinar Port

Control room shall remain in touch with State level / District level Meteorological Department / Masters of ships at Vadinar, Navy / Coast Guard at Porbandar / Vadinar and also with the Control Room of KPT at Kandla/Gandhidham.

Telephone numbers of concerned contact persons are as under:

STD code: Jamnagar (0288), Vadinar (0288)

Sr. No	Name of Organization / Contact person	Office	Residence
01	Chairman, Mutual Aid District Collector, Jamnagar	2555869	2554059
02	Joint Chair Person, Mutual Aid Commissioner, JMC, Jamnagar	Fax No.2554454 2552321	2552372
03	Distt. Supdt. of Police, Jamnagar	2554203	2555868
04	Police Control Room, Jamnagar	2550200	
05	Police Control Room, Sikka	2344249	
06	The Dy. Chief Controller, Civil Defense, Jamnagar	2540371 2674758	2671828
07	Control Room, Collector Office Jamnagar	2553404	
08	Port Officer, GMB, Jamnagar.	2712815 Mobile:9426239289	2554942

09	Commandant, Home Guard, Jamnagar	2553862	
10	Mamlatdar, Khambhalia	234788	234736
11	Dy. Collector, Khambhalia	234577	
12	Police Station, Khambhalia	234735	
13	Fire Officer, Fire Station, Jamnagar	2662690 Mobile:9879531101	2550340
14	DEAN, Irwin Group Hospital, Jamnagar (Now Guru Gobind Singh Hospital)	2553515	2553676
15	Indian Air Force, Jamnagar Extension: 222/257 Wing Commander	2720003 to 009 2720004-2720005	
16	Duty Officer, INS, Valsura Jamnagar	2550263-222 extn.	
17	CISF, Coast Guard, Vadinar		
18	DGM, IOC, Vadinar	02833-256527	02833- 256567
19	Chief Operation Manager, IOC, Vadinar	02833-256984	02833- 256559
20	Dy. Manager (operation), IOC, Vadinar	02833-256545	02833- 256530
21	Fire Brigade, IOC, Vadinar	02833-256542	02833- 256559
22	Main Board of M/s Essar Oil Limited, Vadinar	02833-241444	
23	Security Control Room, Essar, Vadinar.	02833-241917	02833- 241191

24	Vice President, (P&Admr ESSAR Vadinar Refinery.	02833-241107 02833-241167	028332550976 028332662856
25	M/s. Reliance Petro. Ltd., Moti Khavdi	0288-6610101	

Information from the above officers will be collected and transmitted to the C.O.M. (OOT) on hourly basis between 0800 to 2000 hours & 2000 hours to 0800 hours respectively. The said information shall be passed on to Dy. Chairman / Chairman on three hourly basis.

The Vadinar control room shall maintain logbook of messages received from and to Control Room at Gandhidham continuously and report to the COM (OOT) every hour. The information shall be passed on to Dy. Chairman / Chairman depending upon the importance. It shall be the responsibility of the Control Room staff to ensure that the information is passed on timely and proper monitoring is done.

The following are the Website addresses through which the required information regarding the position of the Cyclone can be ascertained.

<http://www.imd.gov.in/> <http://www.supertyphoon.com/indian.html>
<http://www.npmoc.navy.mil/products>
<http://www.solar.ifa.hawaii.edu/tropical/tropical.html>
<http://www.wunderground.com/tropical>

19.4 Stopping of Port Operations

In case of emergency situation, local port authorities like COM (OOT) will decide about the stoppage of the port operations which will be stopped after consulting DGM, IOC / Essar, and ordered by Dy. Chairman / Chairman. In case COM (OOT) is not available in the emergency situation, senior most Executive Engineer is authorized to take such decisions in consultation with Gandhidham officials. Under such situation COM (OOT) in co-ordination with officials of Indian Oil Corporation Ltd. and M/s. Essar, shall get the operation at all three SBMs stopped and also get the hoses dis-connected from the tanker berthed at SBMs and un-berth tanker from Product jetty of Essar. Pilot of KPT on board the tankers will immediately take action to castoff the tanker from SBMs/Product berths and tankers will be directed to go to suitable safer place in that situation. All the ships waiting at own anchorage or working at anchorage will be asked by Vadinar control to go off in open sea at least 5 Nautical miles away from SBM. The tankers carrying out transshipment operation at LPO (Lighterage point), will be asked to stop the operation immediately and be on their own power to be away from other ships in the vicinity.

19.5 Securing of Ships / Crafts / Tugs etc

Pilot / M.E. Grade-II / both the AFS, should be available at Vadinar in case of Action Plan is in operation and situation like emergency. Immediate action for stopping the shipping operation should be taken by informing concerned agencies like IOC, ESSAR, and Shipping Agencies and also to KPT Tug / Craft working for the shipping operations at SBMs / LPO point and Product berth of Essar at Vadinar.

Both the AFS and AXEN (Mech.) should ensure that all the big crafts are moved out of Pathfinder Creek and all Port crafts & small crafts of private parties are placed at inner and outer side of the Vadinar Berthing Jetty or any other suitable location pre-decided and notified. If it is impossible to remove them, then all other steps should be taken to ensure safety of vessel / crafts at the Vadinar port, as also it would not cause any damage to the port. For the purpose of securing of ships / all crafts, pilots assisted by Marine Engineers Grade-II and XEN (E&M) will jointly assess the situation and get the crafts/tugs secured accordingly. The Pull Back tugs shall be secured safely at the Berthing Jetty and Crafts/dumb barge of outside agencies will be placed at safer places in this area. Both AFSs, will ensure while directing all the flotilla staff to take care of the safety of Floatilla. They will look after Pull back tugs and all other Masters will look after the Port flotilla with the help of team of Lascars, Serangs, Quarter Masters and Engine staff. The private Tugs & dump barges engaged by M/s. Essar and M/s. IOC and placed at approach jetty or RO-RO LO-LO jetty shall be ensured to secure at a place decided well in advance by XEN (E&M) and AFS after consulting authority of M/s. Essar and M/s. IOC. A compliance report of securing all crafts at safe places should be furnished to Control Room immediately on issuance of Cyclone Signal No.5.

Both the AFS should ensure the sufficient stock of mooring ropes and heaving lines, etc. to meet operational requirements during the emergent situation and sufficient number of life buoy, life jackets, etc. kept in easily accessible places in each crafts and at various other places on shore too.

19.6 Communication

XEN(E&M) and XEN (Civil-II) shall ensure on hourly basis by ringing personally that the telephones of signal station, AO Building, Estate Office, Hospital, Electric and Water supply are functioning, failing which they shall take up the matter with concerned BSNL authorities. In case of any difficulty in communication system, COM (OOT) should be contacted.

The satellite phone or V-Sat communication network should be established and put into operation at the earliest, by the following Signalmen:

1. Shri P.C. Kothari.
2. Shri Krishna Prajapati.

They will ensure the charging of walkie-talkie, Mobile telephones, as well as satellite phone available at the Signal Station, Vadinar.

The staff at Jamnagar Liaison office shall remain present on 12 hourly shift basis round the clock; to carry out the liaison work during the Action Plan is in operation and any other work as may be assigned during the period of Calamity. S/Shri V.M. Mehta, Assistant shall communicate with the Gandhidham/Kandla officials in case Vadinar communication is cut off from that of Gandhidham/Kandla

Traffic Movement & Security

XEN(C-II) and In-charge of CISF (KPT) Vadinar unit shall ensure that all incoming traffic to the Port jetty of Vadinar is stopped except those which are coming for rescue operations and essential services. They shall ensure posting of adequate security personnel, at various security points in co-ordination with the local police authority. XEN (Civil-II) and S.I. (W&W) should ensure safety of essential service premises like water overhead tanks / Main Store / Electric Station at colony. In addition, the in-charge of CISF Unit (KPT) Vadinar in co-ordination with XEN (Civil-II) shall ensure the posting of Security personnel with arms at all strategic locations, such as Control Station room at Jetty & Port Colony, Water supply tower, etc.

Medical Aid at Vadinar Port Health Center

Medical Officer (O.O.T.) being Officer in-charge at Health Center, Vadinar & other complete Health Center staff will remain in state of readiness to deal with any casualty by setting up a Casualty Emergency Room at the Health center, Port Colony, Vadinar. The Casualty Emergency Room shall start functioning as soon as Action Plan is put in operation and warning of the calamity is received. No staff of the Health center will be given leave during the period and Casualty Emergency room will function round the clock with posting of Doctor and staff round the clock. Medical Officer shall remain present and, apart from attending the patients, will allocate various duties to the available medical & Para-medical staff, such as maintaining records of patients attended and preparing a report thereof. Adequate number of chlorine pills should be distributed after the calamity is over, to avoid epidemic from spreading. M.O. (OOT), being Officer in-charge shall pre-plan for assessment & urgent requirements of all kind of the medicines to meet with the situation which may arise in case of any Natural Calamity. He should arrange to obtain the advance approval for immediate procuring of such medicines and the same should be procured & stocked readily available in advance.

Action to be taken by Pilots

In case of receiving cyclonic weather warning i.e. on declaration Weather Warning signal No.5 at Port, Pilot on the Board at SBM should un-moor the tankers and direct the Master of vessel to move the vessels to safer places i.e. away from the SBM. While returning to the Jetty by the Port craft, the Pilot should ensure that all the Port crafts are secured properly and safely at both inner and outer sides of the jetty. He should also ensure that ropes are doubled up and the tugs are manned at all times and engines are kept in readiness to move out in case of emergency.

Meanwhile, till the time the Pilot returns to the Jetty, the AFS on duty will not waste time and initiate action to secure the smaller crafts, which will further be inspected by the Pilots. Masters of all the smaller crafts should also be directed to ensure proper fendering arrangements are provided and if required extra fendering to the crafts may be provided. AFS shall ensure that the proper fendering arrangements are provided to all crafts before on set of inclement weather. Port crafts will get the priority over the private crafts to come alongside jetty. If any space is available, the private crafts can be allowed to come alongside the jetty.

After observing/monitoring weather conditions, intensity, speed and direction of propagation of Cyclone, necessary arrangement for abandoning the crafts may be made and on declaration of weather warning Signal No.8, the Vadinar jetty area will be evacuated including jetty Control Room, which shall be shifted to Room No.5 at Port Guest House at Vadinar Colony. In the month of April every year, Signalmen under guidance of XEN (M&E), shall inspect & ensure working of all the equipments meant for Control Room of Jetty as also readiness of all the electric connections / charging points at the above alternate location of Control Room at Colony.

Generator Set

Wherever Generator sets are required due to power failure at Port Jetty and colony, AXEN (Electrical), JE (Electrical) shall be contacted who shall immediately arrange to provide the DG set already procured & available with Electrical section, giving preference to the operational area. However COM (OOT) shall be free to hire additionally required DG sets for a suitable period, if the same is not found adequate available in store.

AXEN (E), JE (Elect.) shall prepare a roster of staff of Electrical section for putting the D.G. sets installed & commissioned at the following destinations in operation and attending faults, if any occurs, during the operation of Action Plan and ensure readiness for meeting with emergency situation in case of power failure. Diesel oil drums, connecting cables with lugs etc. and any other such materials are to be kept readily available/accessible for use.

1. Jetty
2. Colony
3. Guest House
4. Health Center
5. Water supply complex at colony

Provision of sufficient emergency spares and cables, terminals, portable lights (Handle torch, emergency lights), tools, tackles, etc. should be ensured well in advance in planned manner to combat the situation. All precautionary measures should be taken to protect the D.G. sets from detrimental effect of thunderstorm, heavy rain showers and such cyclonic conditions. Sufficient stock of waterproof spread sheets, tarpaulins, canvas, etc. to protect the electrical gear from water showers/moistures, etc. should be planned, procured and kept at easily accessible place for instant use.

Power supply staff should be well equipped with jigs and fixtures, such as portable tower ladders, insulated axe, gumboots, hand gloves, shockproof accessories. All the above urgent items should be got procured & kept readily available, well in advance in association with Assistant Executive Engineer (Mech), to cater for emergent situations. XEN (E&M) shall take advance action for procurement of one No. DeWatering Pump (Diesel Driven) and the same should be kept stand-by along with its suction & discharge hoses connected for use

Vehicle Pool

As soon as the Action plan comes into force, the vehicle pool shall be formed and vehicles as allocated as per ([List of Vehicles available with Chief Operations Manager \(OOT\) Vadinar](#)) shall remain stationed at the said places along with operating staff. The pool shall be controlled by Assistant Executive Engineer (M) / AXEN (E) to be assisted by Junior Engineer (Mech) / (Elect), and following staff will render their services for posting of drivers and allocating of vehicles as per ([List of Vehicles available with Chief Operations Manager \(OOT\) Vadinar](#))

Apart from the above, XEN (E&M) / XEN (Civil-II), shall hire vehicles, if needed for emergency work, from the private vehicle contractors. The list of private vehicles contractors is shown as Annexure – VII. Assistant Executive Engineer (M) / AXEN (E) should ensure the availability of drivers and vehicles and submit compliance report to the COM (OOT). All hired vehicles should be stationed at the location as decided by XEN (E&M) / AXEN (M), from where it can be taken for immediate use at the required places.

Temporary Evacuation Centre

The temporary evacuation center shall be looked after by XEN (Civil-II) and Assistant Executive Engineer (Civil) who will be assisted by the Principal of St. Ann's School & his staff and the following KPT staff members assisted by the volunteer's employees as mentioned in the Annexure-III, for setting up temporary evacuation centers and rendering required services for the same. They shall ensure that temporary evacuation centers are established immediately, in the school and staff club of Vadinar Port colony. Port vehicles such as Trucks, Buses, Ambulances, etc. will be put into operation for immediate evacuation of people from Port Jetty as well as colony, as the need be.

1. Sr. Clerk
2. Assistant
3. Junior Clerk
4. Junior Engineer (Civil)
5. Junior Engineer (Civil)
6. Junior Engineer (Civil)
7. Junior Engineer (Civil)

Assistant Engineer (Water Supply sub division, Vadinar) shall ensure for providing adequate quantity of water supply at all the temporary evacuation centers.

Medical Officer (O.O.T) with the help of internees and staff of Health Centre shall ensure to provide necessary medicines / medical assistance to affected persons and ensure about the hygienic conditions at the temporary evacuation centers.

XEN(Civil-II) being Officer-in-Charge of Temporary Evacuation Centre, with the assistance of following staff members and volunteers employees mentioned in the Annexure-III, shall take care of the requirements of food/water etc. and supply the same for the evacuees in the temporary evacuation centers.

1. Senior Clerk.
2. Electrician.
3. Junior Clerk.

4. Lascar.
5. Chowkidar.

The Officer-in-charge of C.I.S.F. Unit of O.O.T. Vadinar and SI(W/W) should arrange to make announcements regarding cyclone warnings with the co-ordination of local police, by vehicles mounted with public address systems and also should arrange for requisitioning and providing trucks for shifting peoples, as soon as Internal Action Plan comes in action.

Spray of Dis-infecticides / BHC powder etc will be looked after by Assistant Engineer (Civil) Building Sub. Division along with staff of Estate office i.e. Jr. Engineers and other staff.

19.13 Press & Media Management

There will be a Press cell headed by C.O.M. (OOT). The following officers/employees shall remain in the Press cell.

1	XEN (M&E), as Officer-in-Charge
2	PA to COM
	Signalman

The press cell shall come into operation in the chamber of COM (OOT). The press cell shall issue daily press note with the knowledge and approval of Chairman / Dy. Chairman. If needed, a photographer be engaged, who will take photograph / video shooting everyday, which will depict the situation as well as the relief work undertaken by the officers. All media people of press, journalist etc. shall be taken care of by XEN (Civil-II).

As regards to their transportation, lodging / boarding and other hospitality, he shall take required advance amount from Accounts Officer (O.O.T.) and submit the bills thereof subsequently. Accounts Officer (O.O.T.) along with Superintendent of Accounts / D.A. will be the custodian of cash drawn and kept in their custody for the disbursement for various emergency payments to the designated Officers and the record of such advances to such individual Officers.

XEN (Civil-II), Vadinar and Pilot posted at Vadinar, shall remain present in all KPT meetings relating to the Action Plan. XEN (Civil-II) and Pilot in-charge shall remain in touch with State Governments / District Authority and Mutual aid scheme members, on daily basis, for sorting out the difficulty / problems of cyclone/calamity relief work in consultation with COM (OOT).

19.14 Action to be taken by Accounts Officer (OOT)

As soon as the Cyclonic Weather warning Signal No. 5 is declared, Accounts Officer (OOT) shall arrange for the cash amount to be disbursed as advances to various officers. All Officers-in-charge, should make a judicious assessment regarding requirement of funds by them to meet with different exigencies which they may have to handle on account of the situation arises due to Cyclone / natural calamity. A.O. (OOT) in turn, would examine the advances sought by the officers and disburse the advances immediately without delay and intimate C.O.M (OOT) and F.A & C.A.O about amount released by him and obtain sanction thereof.

19.15 Advance Planning

19.15.1 For stocking required equipments / machinery / material & medicines

Assistant Engineer (Civil) in association with Store Keeper, should ensure the advance stocking of Diesel, Petrol, Kerosene, Lubricant Oil, Emergency lights as well as Torches & Cell, required tools & tackles, jigs and fixtures etc. in sufficient quantity to meet with the emergency requirements of Vehicles, Generators as stipulated under action at Sr. No.8 & 10 above and all such other services. All the Officers-in-Charge, must list out the materials required well in advance, to facilitate procurement & stocking in, sufficient quantity of the same by Assistant Engineer

(Civil).

19.15.2 For securing of ships / crafts / tugs etc

A safe place to secure ships/crafts/tugs etc. on issuance of Cyclone Signal No. 5, should be decided & notified well in advance (By April end) by XEN (E&M), in association with both Assistant Flotilla Supervisors. The sequences of operations for shifting of all crafts shall be planned in advance by all the Masters along with related Marine staff, under the guidance & instructions of above officials.

19.15.3 Post Calamity Operations

19.15.3.1.1 Marine Operations

Immediately after the Calamity subsides, Marine Engineers Grade-II along with both the Assistant Flotilla Supervisors & related Marine staff shall carry out the inspection of all the Floating Crafts and check if the crafts can be put into operation for checking the condition of SBMs and hoses. Accordingly, a report to that effect, shall be submitted by both Marine Engineers Grade-II, to the Control Room at Vadinar, who in turn, after taking approval of C.O.M., will transmit the same to the Dy. Chairman/Chairman at Gandhidham/Kandla. C.O.M. shall co-ordinate with officials of M/s. IOC/Essar Vadinar, for their all Okey reports or otherwise, as regard to SBMs/Product Berth, Pipelines and their clearance for resumption of shipping operation & project works at Vadinar.

19.15.3.1.2 Other than Marine Operations

XEN (Civil-II), after taking the stock of situations, arrange for all relief/restoration measures for the damages caused during the Calamity. An advance planning of work-force (Work team/Volunteers by name), list of materials required and the arrangement of effecting the relief/restoration, shall be checked out & notified to all the connected persons in this operations.

For coping up with the immediate restoration work in Post-calamity period, an advance approval of Chairman, KPT, shall be obtained by XEN (Civil-II) by processing the case file, for authorizing the Chief Operations Manager (OOT) to engage Daily rated labour of various discipline in Un-Skilled, Semi-Skilled and Skilled category, at the fixed daily wage for each category personnel.

Further, to hire equipments such as Vehicles/Mobile cranes / Dumpers / JCBs / Pay Loaders etc. for immediate relief/restoration work at the required places at Vadinar, XEN (Civil-II) shall also process case file in advance, for obtaining approval of Chairman, KPT, to hire such equipments, for immediate restoration work in PostCalamity period at Vadinar.

19.16 Action Plan – Land Fire Station

In case of any fire, the Control Room shall immediately establish a communication with C.I.S.F., Fire Brigade of M/s. IOCL and M/s. Essar Oil Ltd., Vadinar and immediately summon CISF In-charge of OOT to directly reach the site of the fire along with his Security Personnel & co-ordinate with fire fighters, for cordoning the site of fire and take actions to provide rescue and containment of fire.

CISF In-charge of KPT (OOT) Dept., Vadinar should keep informing the Control Room and C.O.M (OOT) from time to time about the gravity of situation and extent of control over the situation.

19.16.1 List of all the officers in charge & designated officers & employees covered

Sr. No.	Name & Designation	Tele. No. at Office	Tele. No. Residence
1.	C.O.M.	0288-2573001 0288-2573031 FAX	
2.	, XEN(M&E)	0288-2573005	
3.			
4.	XEN(Civil)	0288-257006	
5.	AXEN(E)	0288-2573011	
6.	Shri NAYAK, M.E. Gr.II	0288-2573007	
7.	A.O.(OOT)	0288-257008	
8.	Dr Medical Officer.	256313 (Vadinar)	
9.	AXEN (Civil)		
10.	A.E.©		
11.	A.E.©		-----
12.	Shri A.XEN.(Mech)		2915231 (Jamnagar)
13.	PA to COM		
14.	O.Supt.		256483 (Vadinar)

15.	Supdt. A/cs.		
16.	(Store Keeper)		
17.	A.F.S.		256517 (Vadinar)
18.	, AFS		256817 (Vadinar)
19	Signalman		
20.			
21.	Signalman		
22.	Signalman		
23.	J.E.©		
24.	J.E. © Gr-1.		
25.	J.E.©		
26.	KPT Guest House at colony.		
27.	Shed Master		
28.	Assistant,KPT Liaison office at Jamnagar		
29.	Time Keeper		
30.	(Clerkcum-Time keeper).		
31.	, Maistry		

19.16.2 List of Press Reporters & News Services at Jamnagar

Sr.No	News Service	Name and address	Telephone nos.
01	District Information Officer, Jamnagar.	Shri K. A. Karamata, District Information Center, Jamnagar.	2556827 2672939
02	Times of India, PTI	Shri Darshan Thakar, Journalist society, Jamnagar	2555731 9824232632
03	Indian Express, Jansatta & Financial Express	Shri Bipin Sukhpariya Limda lane, Jamnagar	2553717
04	Phulchaab	Shri Dinesh Vora, Nr. Old Railway station, Jamnagar	2550320
05	Sandesh	Smt. Bhavnaben Soni, Opp. Apsara Talkies, Jamnagar	2553106 9825280456
06	Jay Hind	Shri Bharatbhai Raval, Nr. Old Railway station, Jamnagar	2557447
07	Sanj Samachar	Shri Mukeshbhai Joiser, Near Old Rly. Station, Jamnagar	2554109 9824219999
08	Bhoomi	Shri Dolarbhai Raval, Limda lane, Jamnagar	2679080
09	Nobat	Shri Pradeep Madhwani, Pancheshwar tower road, Jamnagar	2555924 2670924 2553752 (Fax)

10	Gujarat Samachar	Shri Vipul Hindocha Opp. Madras hotel, Teen batti Jamnagar	2670634
11	Ajkal	Shri Praful Tankaria, City Point, Near Town Hall, Jamnagar	2665602 2665603
12	Lokvat	Shri Jay C. Chauhan, New Super Market, Jamnagar	3092114
13	Sahara Samay	Shri Darshan Thakar, Journalist Society, Jamnagar	2555731
14.	Divya Bhaskar	Shri Mukesh Joiser, Near Old Rly. station, Jamnagar	9824219999

19.16.3 List of School & Buildings available at Vadinar for Shelter purpose

1. St. Ann's School, Vadinar Port colony Telephone No. 256568 / 256514
2. Staff club, Vadinar Port Colony.

19.16.4 List of volunteers employees at Vadinar (Dist Jamnagar) To be formed by COM

19.16.5 List of Vehicles available with Chief Operations Manager (OOT) Vadinar : To be arranged by XEN (M&E) as per availability

Name of Driver (Motor) & their Residence Telephone No : To be arranged by XEN (M&E) as per availability

19.16.6 Names of local contractors working at OOT Vadinar

1. Rajlaxmi Construction, P.O. Vadinar. Phone No. 02833-256789/256505 - Contact person: Shri C.R. Jadeja.
2. Shree Shakti Construction, P.O. Meghpar (Padana) Ph. No. 246314 / 246411 Contact Person: Shri Pradumansinh G. Zala.
3. M/s Jai Chamunda Enterprises, Vadinar 361010 Contact person: Ranmal Vira, Ph. No. 02833-256719
4. Shri Kama Mala, Vadinar 361010.
5. Shri M. B. Jadeja, Vadinar 361010.
6. Shri Ganesh Construction, Village-Kajurda, Tal. Khambhalia Contact person: Shri Kherajbhai
7. Shri Hira Punja Rathod, Vadinar 361010
8. M/s. Shiraji Construction, Vadinar.
9. Shree Ashapura & Co Vadinar 361010 Ph No. 02833-256711
10. M/s. Bariya & Co., Near KPT colony, Vadinar.


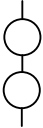
19.16.7 Important Telephone Nos of IMD <http://www.imdahm.gov.in/index.html>


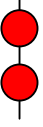
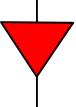
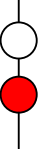
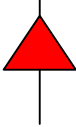

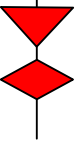

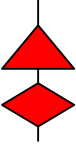
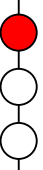
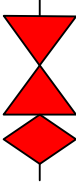

19.16.8 List of Vehicle Hire / Transport Travel Contractors at Jamnagar









Sr.No	Name and address of Transport / traveler	Telephone
1	Pavan Travels, Pancheshwar tower, Jamnagar	2552002
2	Patel Travels, Pancheshwar tower. Jamnagar	2552419 /

		2660243
3	Ashwamegh Travels, Jamnagar	2670613
4	Sheenath Travels, Jamnagar	2663315 / 2662215
5	Royal Travels, Opp. Town Hall, Jamnagar	2553333 / 2553636
6	Pruthvi Travels, Sikka Patia, SIKKA (Jamnagar.)	244466
7	Shree Divya Travels, Jamnagar	2677601
8	Payal Travels, Jamnagar	2551514 / 2551415
9	Gujarat Travels, Jamnagar	2664315
10	Abhishek Travels, Jamnagar	2564380
11	Shiv Shakti Travels, Jamnagar	2566611
12	Sapan Travels, Jamnagar	2558558
13	Tulshi Travels, Jamnagar	2541054
14	Samay Travels, Jamnagar	2551925

19.16.9 Chart of Weather Warnings

Signal No.	Symbol Day	Symbol Night	Type of Warning	Description
I			Cautionary	There is a region of squally weather in which a storm may be forming.

II			Warning	A storm has formed.
III			Cautionary	Port is threatened by squally weather.
IV			Warning	The Port is threatened by storm, but it does not appear that the danger is as yet sufficiently great justifying extreme measures of precautions.
V			Danger	The Port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the south of the port.
VI			Danger	The Port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the north of the port.
VII			Danger	The Port will experience severe weather from a storm of slight or moderate intensity that is expected to cross over or near to the port.

VIII			Great danger	The Port will experience severe weather from a storm of great intensity that is expected to cross to the south of the port.
IX			Great danger	The Port will experience severe weather from a storm of great intensity that is expected to cross the coast to the north of the port.
X			Great danger	The Port will experience severe weather from a storm of great intensity that is expected to cross over or near to the port.
XI			Failure of communication	Failure of Communication with Meteorological head quarters has broken down and the local officer considers that there is danger of bad weather.

 Red Light,
 White Light

19.17 Vadinar Oil Terminal Limited (VOTL) of Essar

19.17.1 Facility Description

Vadinar Oil Terminal Limited (VOTL) is a wholly owned subsidiary of Essar Shipping & Logistics (ESLL) with a focus on investment in crude and product terminals. VOTL has set up a 32 Million tone terminal with crude reception and crude and product storage facility at Vadinar, Gujarat, India.

The VOTL facilities serve the following functions:

- Receiving crude oil from tankers at an SPM located in the Gulf of Kutch, with transfer of crude oil via pipeline to the VOTL crude storage facility, located within the fence – line of the EOL refinery;

- Receiving product from the refinery into a product tank farm, also located inside the Refinery fence-line for loading into tankers at the marine terminal jetty;
- Receiving seawater from the intake well that is pumped via pipeline to the EOL refinery, and then discharging seawater via the seawater outfall located near the location of the SPM.

The crude oil tank and product tank farms, which are located inside the fence - line of the EOL refinery, while owned by VOTL, are actually operated and maintained by the Refinery, and were not covered by this HAZID or the ERA. (These tanks farms have been risk assessed separately).

The areas where the Marine Terminal and the SPM are located in the Gulf of Kutch are part of a designated and controlled marine park and represent a sensitive marine environment. The on-land pipelines pass through low lying areas which consist of some farming land and are adjacent to several villages.

The VOTL marine terminal facility consists of the following systems for supporting the aforementioned functions:

- A Single Point Mooring (SPM) and Subsea Line for loading crude:

The SPM buoy is the gateway for crude oil input to the EOL refinery. The SPM is anchored to the seabed in the Gulf of Kutch, in around 35 m of water. Tankers are secured to the buoy via mooring hawsers. The tanker is held off the SPM by a pull-back tug. The offloaded crude oil is pumped by the crude tanker pumps through the floating hose(s), through the SPM, and then via flexible catenary hoses into the 48" rigid subsea pipeline, through a PLEM and then flows directly to the crude oil tank farm located within the EOL refinery. The SPM is located roughly 4Km from the Marine Terminal and 8Km from the crude oil pipeline landfall.

- Seawater Intake Unit and Outfall system:

Seawater is pumped from the seawater intake facility (located at pathfinder Creek, adjacent to the jetty) and delivered to meet the water needs of the refinery. Seawater flows through two filter packages in the seawater intake well and is then pumped to a seawater storage reservoir located in the Refinery via a 48" GRP pipeline. Chlorine is added to the seawater downstream of the pumps at the intake facility for prevention of marine growth in the pipeline and the Refinery seawater reservoir.

The seawater outfall dispose of waste brine (high salinity water) generated from different Refinery units through a diffuser located on the seabed close to the location of SPM. The seawater outfall flow is pumped from a seawater return reservoir at the Refinery through an on-land 48" GRP pipeline and then via an 8Km subsea pipeline.

- A jetty including three (3) Loading Arms:

The jetty is located at the inlet to pathfinder Creek, and is situated between two coral reefs which are part of a declared "Marine National Park". The jetty is used for shipping of refined white and black products to vessels. The jetty is connected with the refinery through 3 x 32" diameter pipelines which bifurcate into 7 x 24" lines on the trestle and finally culminate into three (3) loading arms. Each of the 7 x 24" lines are allocated to each of the seven (7) products handled at the jetty, namely: ATF (aviation turbine fuel), kerosene, MS 87 (motor spirit), MS 95 (motor spirit), naphtha, diesel and VGO / FO (vacuum gas oil and fuel oil). Tanker at the jetty is located via pipelines connected through three sets of loading arms with Quick Connector Disconnecting Coupling.

- A pig station with three (3) Pig Receivers / Launchers and Terminal Area Slop Tank:

Pigging is carried out for clearing any previous pipeline content, separation of cargoes, cleaning inside pipeline coating and assessing any leak- buckle or damage- deformation in the internal section of pipelines (intelligent pigging). Products for export are pumped from the refinery to the jetty through 3 x 32" diameter cross- country pipelines. There are two (2) pipelines for white products (naphtha, MS, ATF, Kerosene, and diesel), and other is for black products (VGO / FO). To enable the flexibility of these pipelines to carry different products, pigging is carried out between the Refinery and the Marine Terminal Pigging station, where each line has its own pig receiving and launching facilities (total of 3 pig receivers / Launchers).

A slop tank is also provided for the pig stations to contain / collect liquid product drained from the pig station, and it is also used for transfer of products drained into the jetty Slop Tank (which are transferred by pump). Products drained into the slop tank are removed as required by an educator truck and taken back to the EOL Refinery where they are reprocessed.

- Pipelines between Terminal and Refinery (including crude oil and seawater lines) include the following:
 - 3x 32" diameter cross- country pipelines (two (2) pipelines for white products, and one for black products) between refinery and marine terminal (around 18 km in length)
 - Crude oil pipeline (48") between refinery and landfall (13 Km), and then a further 8Km of 48" subsea pipeline to the PLEM on the seabed below the SPM
 - Seawater intake (48") between marine terminal and refinery (17Km), and seawater outfall (48") between refinery and landfall (13 Km) plus 8Km of subsea line to the outfall diffuser.

All pipelines are buried on land within an earthen berm. Steel lines are wrapped and cathodic protected (crude / product lines). The seawater lines are GRP. There are no flanges or connections on crude / product lines on –land (other than at marine terminal for product), and only air vents are provided along the seawater lines. The subsea crude oil pipeline is concrete encased, with the only flanges at the point of landfall and at the subsea PLEM.

- Buildings including the Main Terminal Control Building (MTCB) and two substations (main substation located near the seawater intake station, and jetty substation).

The response strategy for the VOTL plan has been developed taking into account the spill risks, and possible sources of spillage associated with Marine Terminal operations including those at the SPM and Jetty berths and facilities within the Port.

The geographical area of operations is bound by, but not limited to, one mile either side of the line joining following coordinates.

SPM	:	690 39' 35'' E
		220 30' 14''N
LFP	:	690 43' 26''E
		220 27' 59''N
Berth B (North End)	:	690 40' 10.26''E
		220 27' 15.25''N
Berth A (South End)	:	690 40' 11''E
		220 26' 54''N
Sea Water Intake	:	690 40' 32''E
		220 26' 11'' N

19.17.2 Oil Spill Risks

19.17.2.1 Identification of activities and risks

Oil spills will be categorized in accordance with the internationally recognized three tier classification system

Tier One	100 - 700 T
Operational spillages which can be dealt with using the resources immediately available	
Tier Two	700 – 10000 T
Medium size spillages which exceed VOTL resources and which require District and/or Regional assistance	
Tier Three	10000 > T
Large spillages which exceed the full resources of the District/Region and which may require National assistance and/or the implementation of the NOS - DCP	

19.17.2.2 Types of Oil likely to be spilled

No.	Oil Type	Strategy Figure	Specific Gravity	Genre	Characteristics	Examples
1	Light Oil	5.1	< 0.84	White oils	Non-persistent, Volatile	Aviation fuel, Kerosene, Motor spirit, Naphtha, HSD
2	Crude Oil	5.2	> 0.84	Black oils	Persistent, Viscous, Emulsion. Fresh oil amenable to dispersants	Arabian Light, Arabian Heavy, etc.
3	Heavy Oil	5.3	> 0.95	Black oils	Persistent, Viscous, Emulsion. Generally not amenable to dispersants	Fuel Oils, LSWR

Probable fate of spilled Oil

19.17.3 Preliminary Assessment

The ICG Coordinator will make a preliminary assessment of the incident by contacting the person reporting the spill, governmental officials, and the responsible party.

- 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;
- Determining whether the spill has been stopped or is ongoing, and if ongoing, how quickly it can be controlled;
- Assessing the need for state assistance; and
- Assessing the feasibility of removal and determining the equipment needed to remove the oil.

19.17.4 Containment & Control

Clean-up actions must begin as soon as possible to minimize the effect on natural and economic resources. These actions may 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.

19.17.5 Development of Oil Spill scenarios

VOTL is operating 02 Nos. Berths (A & B) for product evacuation & 01 No SPM for crude intake.

The VOTL is capable of accepting vessels ranging from 25000 to 100,000 DWT each at berth A & B and Vessels ranging from 87,000 to 325,000 DWT at SPM.

The Marine Terminal is located within an area which has been declared as a Marine National Park / Marine Sanctuary.

The mean tidal range is approximate 6 meters and current speed in excess of 2 knots may be experienced alongside jetty.

19.17.6 Port Operations

19.17.6.1 Pilotage

Pilotage is compulsory for all vessels. Pilotage and auxiliary support craft services are provided by Kandla Port Trust (KTP).

19.17.6.2 Main Approach Channel

The least depth in the main approach channel to the tanker jetty is 13 meters; the maximum acceptable draft alongside jetty berths is 15 meters. A minimum under keel clearance of 6% of vessel's maximum sea going draft plus 0.60 meters is applied to all vessels under way.

While the risk of grounding is low, it cannot be wholly eliminated. The most likely cause is steering or propulsion system failure which could result in grounding on the channel margins with consequent damage to the bottom and/of the mid body plating. The potential spill quantities depend upon the size / type of tanker and the area of impact damage.

The vessels calling the product terminal, in bound and out bound will be escorted by minimum two tugs in fair weather condition. This considerably reduces the risk of the vessel running aground in the channel.

19.17.6.3 Approach to SPM Berth

Tankers bound for SPM will follow the deep water route. Berthing and un-berthing of the Tankers on the SPM will be done by KPT Pilots. Charted depth at SPM location is 34.5 meters. Grounding of Tankers in the SPM area is considered as very remote.

19.17.7 Oil Spill scenarios

19.17.7.1 Collision between Vessels Underway

The control which will be imposed on ship movements within terminal are designed to ensure that any risk or collision is minimized. For example, inward / outward bound ships will have sole occupancy of the approach channel to the jetty berth; additionally all departing vessels will remain under Pilotage up to the western limit of the terminal area. It is thus considered that the likelihood of collision between vessels underway within the terminal is remote. There is perhaps a greater risk of collision between vessels maneuvering to the SPM and the jetty anchorage position without Pilotage assistance.

19.17.7.2 Berthing incident (Jetty)

Oil spills can occur as a result of hull contact with the corners of breasting dolphins during ship berthing or un-berthing maneuvers. Such incidents are generally due to failure of a vessel's main propulsion or steering systems, loss of control onboard an attendant tug or pilot error or misjudgment. The potential spill quantities involved depend on the vessel type and the location and extent of the impact damage.

19.17.7.3 Tug impact

There are well documented incidents where cargo or bunker oil has been released as a result of hull impact damage by tugs. This can occur when tugs are approaching a vessel underway prior to berthing, or when coming alongside a moored vessel prior to un-berthing. The potential spill quantities again depend on the location and the extent of the impact.

Adequate fenders shall reduce the level of risk.

19.17.7.4 Cargo Transfer Operations (SPM Berth)

This section considers the potential sources of oil spills during the discharge of crude oil cargoes and is based on oil industry data and ITOPF statistics. It should be noted that the ITOPF statistics demonstrate that most oil spill incidents occur during routine cargo handling operations and that some 91% of these incidents resulted in spillages of less than 7 tones.

19.17.7.5 Connection of Floating Hose String

After the floating hoses have been lifted on board, blank flanges are unbolted from the ends of the hoses prior to connecting them to the ship's presentation flanges. Small spillages frequently occur during the removal of the blank flanges; these are caused by surging of the line contents as the floating hose sections

follow the wave pattern. While in most cases such spillages are contained within the ship's manifold drip tray, there are recorded incidents where oil has escaped overboard via scuppers, which have not been effectively plugged. Spillages of this nature should not exceed 1 m3.

19.17.7.6 Snapping of 24'' diameter Floating Hose

Spillage of crude oil due to snapping of a floating hose, during crude oil unloading operations @ 10000 m3/hr. estimated time taken for response is two minutes. Snapping of hose may occur due to accidental drifting of tanker, collision with SPM, the hose getting entangled due to movement of a tug boat very near to the SPM / Tanker, due to rough weather condition. Theoretically the quantity spilled would be 142 tons. Chances of a full bore snapping of the hose are classified as a rare phenomenon.

19.17.7.7 Sea and Overboard Discharge Valves

Oil can escape to the sea via sea or overboard discharge valves which are directly connected to the cargo pipeline system due to either incorrect line setting or defective valves. The likelihood of this occurring is considerably less on SBT vessels.

19.17.7.8 Slop Tank Overflow

Crude Oil Washing (COW) of cargo tanks will be undertaken during bulk cargo discharge; this operation entails the transfer of tank bottoms and washing oil back to back to the vessel's slop tank(s). The overflow of slop tanks as a result of instrumentation failure or operator error during this process is not uncommon. Checks on the system and operation, pre, during and post COW will considerably lower the associated risk.

19.17.7.9 Vessel Breakout

Other than a sudden and catastrophic failure of the mooring hawser leading to rupture of the floating hose string, it can be reasonably assumed that cargo discharge will have been suspended in weather conditions which approach the established environmental limits. It would also be normal practice to station a crewmember on the forecastle head to maintain a mooring watch. Under most circumstances, therefore, early warning of a potential breakout situation can be anticipated.

In any event, an emergency stop button for the main cargo pumps will be located at the ship's manifold and the deck watch keeper would initiate an ESD immediately the hose string parts.

A vessel breakout and loss of integrity of the floating hose string could result in a spill quantity of some 142 m³. This quantity is based on the following assumptions:

- Bulk flow rate
- Reaction time
- ESD activation time
- Hose contents

In case of undue stresses experienced by the floating hose string, the breakaway couplings will get activated. These are designed to seal both ends on activation.

19.17.7.10 Hull Failure

The incidence of oil pollution due to hull failure is low and some 84% of the incidents attributed to this cause by ITOPF involved spill quantities of less than 7 tones; these spills were caused mainly by minor hull fractures and weld failures. The potential for more serious incidents with spill quantities in excess of 700 tones must, however, be acknowledged.

19.17.7.11 Fire and Explosion

Fires and explosions onboard ship represent a safety hazard with the risk of oil pollution as a secondary impact. All tankers engaged for trading to the SPM facility will be equipped with inert gas systems; gives the control which will be imposed and enforced by VOTL in respect of the oxygen content of cargo tanks, the risk of fire and / or explosion in the cargo spaces must be regarded as minimal.

Strict monitoring and control of the main cargo pump room atmosphere will minimize the fire and explosion risks associated with this space.

Fires resulting from uncontrolled smoking in the accommodation, organization hot work such as welding and engine room fires can spread rapidly if not dealt with swiftly and give rise to incidents of a very serious nature.

While the likelihood of fire or explosion occurring onboard vessels berthed at the SPMs is low, the risk is nevertheless acknowledged. Such an incident could give rise to a spillage of 700 tons or more.

19.17.7.12 Spillages of Fuel Oil

Fuel oil bunkers will not be supplied to tankers moored to the SPM. It may, therefore, be necessary for vessels to undertake the internal transfer of fuel oil for trim or other operational reasons. A bunker tank overflow during such operations could result in spillages of < 1 ton.

Cargo Transfer Operation (Jetty Berth)

19.17.7.13 Ballast Discharge

Only fully SBT (Segregated Ballast Tank) vessels shall be chartered for trading to the Marine terminal; those ships which load refined products will also discharge their segregated ballast water concurrent with the loading operation.

Under fair weather and operational conditions, tankers at SPM will not engage in de-ballasting activity.

On some older designs of SBT tankers, the ballast pipelines pass through the cargo tanks and vice versa, any loss of ballast line integrity can result in the entrainment of cargo oil in the ballast water discharge. Industry records indicate that the spill quantity from this cause on board product carriers should not exceed 25 tones.

19.17.7.14 Loading Arms

The operation of loading arms can lead to minor releases of oil. Common sources are vent valves, swivel joints and hydraulic lines. Loading lines are equipped with PERC (Powered Emergency Release Coupling) and with DDV (Double Disk Valve)

19.17.7.15 Cargo Tank Overflow

Cargo tank overflows can occur on board loading vessels; spills of this nature can be due to instrumentation failure or human error. The spill quantity is a function of the flow rate and also the number of tanks being loaded at the time of the incident. Some of the oil will be retained on deck but in a worst case scenario, some oil could go overboard.

19.17.7.16 Hull Failure - Fire and Explosion

The risks of hull failure - fire and explosion are also similar to those for SPM vessels with the attendant spill quantities being proportional to the tanker size.

19.17.7.17 Effluent Discharges

Treated effluent from the refinery is discharged into the sea area. The discharge consent levels are set and monitored by the State Pollution Control Board and VOTL regularly tests for effluent quality.

Instrumentation malfunction, failure of in-line samplers or operator error can result in the entrainment of oil in the final discharge to harbor waters. Most spillages of this nature are not substantial, and based on industry experience elsewhere, are unlikely to exceed 5m³ in volume.

19.17.7.18 Special Equipment which may be used

- 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

19.18 Fire Fighting Facilities at Vadinar Oil Terminal Limited (VOTL) of Essar

19.18.1 Fire water supply pumps at Sea Water Intake

Fire pumps are vertical turbine type as per IS 1710

Dedicated fire pumps are provided for:

1. Fire Tower monitor system
2. Fire Hydrant System (There is no interconnection between two header)

19.18.2 Fire water Pump for Tower Monitor – 4 Nos

- a. Main Motor Driven Pump – 1 No (Discharge capacity 792m³/hr at 15 kg/cm²).
- b. Engine driven – 1 No (Discharge capacity 822m³/hr (standby)).
- c. Jockey Pump (Discharge capacity 33m³/hr at 10.5 kg/cm²).

19.18.3 Fire water Pump for Hydrant System – 4 Nos

- a. Main Motor Driven Pump – 1 No (Discharge capacity 792m³/hr at 15 kg/cm²).
- b. Engine driven – 1 No (Discharge capacity 822m³/hr (standby)).
- c. Jockey Pump (Discharge capacity 33m³/hr at 10.5 kg/cm²).

19.18.4 Fire Hydrant & Jumbo Curtain

Fire Hydrants is located at different section of premises to be protected depending upon nature of fire hazard, fire hydrants are double outlet type.

Each outlet capacity is 900 lpm at 7.5 kg/cm²

The flow rate of hydrant is 1800 lpm at 7.5 kg/cm²

19.18.5 Fire Hydrant Point – 31 Nos

- a. Berth A - 4 Nos
- b. Berth B – 4 Nos
- c. Pig area / cross country / MTCB – 16 Nos
- d. SWI – 03 Nos
- e. Between Berth A & B – 4 Nos

19.18.6 Jumbo Curtain at Berth A

The Jumbo curtains nozzle shall have discharge capacity of 3000 lpm of sea water at 7.5 kg/cm².

Total – 6 Nos of Jumbo Water Curtain

The nozzle shall be able to produce 14 meters. Vertical plane & 20 meters horizontal radius dense water curtain through 160 degree angle – 04Nos at jetty to protect loading arms and – 2 Nos one each at the breasting dolphin to protect tower monitors from the radiant heat in case of fire on tankers.

19.18.7 Jumbo Curtain at Berth B

The Jumbo curtains nozzle shall have discharge capacity of 3000 lpm of sea water at 7.5 kg/cm².

Total – 02 Nos of Jumbo Water Curtain

The nozzle shall be able to produce 13.5 meters. Vertical plane & 22 meters horizontal radius dense water curtain through 180 degree angle – 02Nos at jetty to protect loading arms.

19.18.8 Water / Foam Tower Monitor at Berth A

The monitor shall be suitable for both sea water and foam, each monitor shall be capable of discharging 6000 lpm of sea water and 36000 lpm of expanded foam at 10 Kg.cm² over a range of 100 meters in horizontal direction and 40 meters range in vertical direction. The monitor shall be capable of producing good quality of finished foam.

Horizontal range with water – 100 meters Horizontal
range with foam - 90 meters

The monitor shall be capable of 360 degree rotation in either direction in horizontal plane and 60 degree elevation 70 degree depressions in vertical plane. The monitors shall be achieved by remote control from control room.

Two nos of positive displacement pump have been provided. At a time one pump will be running and other will be acting as stand by. The Capacity of each pump 21.6 m³/hr at 16kg/cm²

19.18.9 Foam Compound Induction

Foam compound induction system is in line with balanced pressure proportioning type to ensure proper mixing of foam concentrate and right proportion and supply the same to the monitor line depending upon the water flow rate necessary automatic valve, spool valve and duplex pressure gauge have been provided to ensure 0 to 6% of foam compound induction.

Induction rate is set at 3% foam compound induction.

19.18.10 Water / Foam Tower Monitor at Berth B

The monitor shall be suitable for both sea water and foam, each monitor shall be capable of discharging 6000 lpm of sea water and 36000 lpm of expanded foam at 7 Kg.cm² over a range of 75 meters in horizontal direction and 35 meters range in vertical direction. The monitor shall be capable of producing good quality of finished foam.

Horizontal range of monitor – 75 meters

The monitor shall be capable of 360 degree rotation in either direction in horizontal plane Elevation – (+) 85 and (-) 45. The monitors shall be achieved by remote control panel near pantry in open area.

19.18.11 Foam supply system at Berth B

Foam supply system shall be operated by manually, located near Foam Tank, Foam supply system located at approximately 50 meters away from Berth B central platform. Since the pipeline will always be under pressure for throwing water / foam through the monitor:

One No foam solution storage tank is provided at south side of berth B with capacity of 16KL.

Foam pumps – 2 Nos (01 No stand by)
Each pump discharge capacity is – 37m³/hr

Two nos of positive displacement pump have been provided. At a time one pump will be running and other will be acting as stand by. The Capacity of each pump 37 m³/hr at 16kg/cm²

19.18.12 Foam Compound Induction

Foam compound induction system is in line with balanced pressure proportioning type to ensure proper mixing of foam concentrate and right proportion and supply the same to the monitor line depending upon the water flow rate necessary automatic valve, spool valve and duplex pressure gauge have been provided to ensure 0 to 6% of foam compound induction.

Induction rate is set at 3% foam compound induction.

19.18.13 Foam Trolley

Foam trolley is firefighting equipment ready to use initial level in case of fire, oil spillage in dyke.

Foam trolley capacity – 200 liters Discharge capacity – 225 lpm

Total – 8Nos of foam trolley available in field.

- Berth A – 2 Nos
- Berth B – 2 Nos
- Pig Area – 3 Nos
- SWI - 1 No

19.18.14 Ground Fixed Water cum Foam Monitors

Fixed foam monitors are ready for instant use in case of emergency and are able to discharge dense foam from orifice type foam nozzle. The discharge capacity of monitor is 2850 lpm

Monitor having facility to discharge water for cooling purpose, all fixed foam monitors are having 200 liters foam drum ready to use by monitor pick up tube.

Total – 4 Nos

- Pig Area – 2 Nos
- Berth B – 2 Nos

19.18.15 Fire Extinguisher

Portable Fire Extinguishers are the first aid of fire fighting equipments. All fire extinguishers installed in the jetty premises are clearly visible and accessible.

At Berth A

- DCP 75 Kg –4 Nos • DCP 50 Kg –2 Nos • DCP 10 Kg –6 Nos

At Berth B

- DCP 75 Kg –4 Nos
- DCP 10 Kg –6 Nos
- CO2 6.5 Kg –2 Nos

Other jetty area locations are also equipped with fire extinguishers

19.18.16 Innergen Total Flooding System

Innergen Total Flooding System has been designed for protection of MTCB floor underneath cabling and DCS instrument panels. It is automatic fire extinguishing flooding system. The contents of gas are (52% nitrogen gas, 40% argon gas, 8% CO₂ gas)

The system is kept in both auto / manual mode operation. There are 12 Innergen gas cylinders which are pressurized to 200 bar at 20 Degree Centigrade for fire protection system.

Innergen Total Flooding system is divided in five different Zones.

Zone 01 & 02: is instrumentation room, Ground Floor MTCB (There are 6 Nos discharge nozzle of Innergen System)

Zone 3: is panel room right side (There is 1 No discharge nozzle of Innergen System)

Zone 4: is panel room left side (There is 1 No discharge nozzle of Innergen System)

Zone 5: is Battery Room Ground Floor MTCB (There is 1 No discharge nozzle of Innergen System)

The system has been put in manual mode.

19.18.17 Manual Call Point (MCP)

MCPs have been installed in premises in different accessible & visible locations like:

- Berth A
- Pig Station
- Around MTCB Building
- SIW & Berth
- All MCP are indentified with Zebra cross red and yellow

In case of Emergency Alarm to be raised MCP glass should be used.

Total 69 Nos of MCPs are in premises connected to DCS panel. On activation of any one MCP alarm will be blow on DCS

- Berth A – 13 Nos
- Berth B – 6 Nos
- Pig Area – 7 Nos
- MTCB – 6 Nos
- SWI / SS – 12 Nos
- Road / Tresle / KPT – 25 Nos

19.18.18 Smoke Detectors

Smoke detectors have been provided inside building (MTCB) cable cellar room, electrical panel room, instrument panel room.

Due to availability smoke particles detector will get activated. Fed Red Becon & hooter will start and on DCS alarm will be sounded repeatedly.

Total No of Smoke Detectors – 68 Nos

19.18.19 Fixed Gas Detectors

Fixed gas detectors have been installed in the jetty premises where most critical hazardous zone is identified.

Fixed hydrocarbon detector detects the hydrocarbon vapours available in the atmosphere and it gives pre explosion alarm. The alarm is set at 10% of LEL.

Total No of Gas detectors – 25 Nos

- Berth A – 6 Nos
- Berth B – 6 Nos
- Pig Area – 5 Nos
- SWI / (H₂) / MTCB – 8 Nos

19.18.20 Life Saving Appliances

1. Life Buoy Ring – Life buoy ring with 30 meters 8 Inch Nylon rope have been installed in entire jetty premises. Total No of Life Buoy – 29 Nos
2. Life Work Vest – Life work vest have been installed in emergency almirah at berth A and Berth B and also installed at central platform of berth and SWI. Total No of Life Work Vest – 18 Nos
3. Life Jacket – Life jacket is available with the terminal whenever persons go to the SPM / Sea shore side life jacket has to be worn. Total No of Life jacket – 12 Nos

19.18.21 Emergency Escape Breathing Device (EEBD)

Emergency Escape Breathing Device is used to escape from place where emergency arises and it is difficult to reach a muster point / safe place, same shall be used in such emergency.

EEBD is ready to use for 15 minutes to see the person can be reached to safest place with normal breath.

Total Nos of EEBD – 5 Nos

- Berth A – 1 No
- Berth B – 1 No
- Pig Area – 1 No
- SWI – 1 No
- Store – 1 No

19.18.22 Breathing Apparatus Set (BA Set)

B A set is to be used in such emergency where it is difficult to breath during rescue operation. Fire Fighting, Toxic gas release, and Flammable gas in atmosphere.

B A set has been installed in jetty premises where it is most hazardous so it can be used immediately whenever necessary.

Total No of B A set – 6 Nos & 2 Nos Spare Air Cylinder

Emergency Almirah Berth A – 2 Nos

- SWI – 2 Nos
- MTCB – 1 No
- Store – 1 No

19.18.23 First Aid Box

First Aid Box is distinctively marked with a red cross on a white background. First aid box is kept in prominent place. Custodians of the first aid boxes are qualified first abiders only.

The names of the first aiders are displayed at the notice board of the control room.

The first aiders are available in each shift.

First aid box available at site – 8 Nos

First box location available in jetty premises and their locations are:

- MTCB – 1 No
- Berth A – 1 No
- Berth B – 2 Nos
- SWI – 1 No
- Security Gate – 1 No
- 70 – 1 – 1 No • 76 – 2 – 1 No

19.18.24 Portable Safety Instrument

1. Area Monitor – Area monitor is available in control room. It is used for continuous monitoring of hydrocarbon vapors in atmosphere. The area monitor lowest alarm is set at 5% of LEL on reaching this range area monitor will be sounding with high volume.

Area monitor is used in hot work area where the most critical hazardous area are identified such as Berth A / Berth B

2. Portable Multi Gas Detector – Multi gas detector is always available in control room and in the field with the fire men. Whenever any hot work permit is issued by SIC, Safety team checks the area and residual hazardous of concerned location and ensures that no hydrocarbon vapor is in the atmosphere. Stand by fire man continuously monitors and makes sure that the LEL always is 0%.
3. Chlorine Meter – The device is widely used for check the work environment before entering the chlorination room / area.
4. H₂S Meter – Very useful device for working crew for confined space work. I.e. Vessel, Tank & nearby hazardous area for continuous monitoring work environment.
5. Oxygen Resuscitator – It is a medical equipment and to give oxygen to casualty by trained person.

19.18.25 Chlorination System at SWI

Chlorine gas is most toxic and corrosive gas. In case of leak and in coming in contact with the skin irritation starts, inhalation is most dangerous if more than 15ppm it will be IDLH (Immediate Danger Life & Health)

Chlorine tonners have been laid down at chlorination system for chlorine injection in sea water line which is going to refinery.

3 Nos of fixed chlorine detectors have been provided at three different locations.

1 No Caustic Soda Tank capacity 8000 Liters with blower and hood

Hood provided on running cylinder, the detector laid would sense 0.5ppm in case of a leak. The blower starts automatically.

Chlorine containment kit & 2 Nos BA set is available in the SWI store.

19.18.26 Chlorine Kit

It is used for containment of chlorine gas in case chlorine leakage from the tonner valve assembly, plug or from body.

Work Permit System

Any routine work, testing of equipment, inspection, schedule maintenance, concern has to take work permit for particular job. SIC will make sure that before issuing work permit receiver must have completed TBRA & TBEA and also tool box talk.

- Hot work permit
- Cold work permit
- Electrical Isolation & restoration
- Confined space entry permit
- Vehicle entry check sheet
- Photography permit check sheet
- Isolation of fire fighting network
- Radiography check sheet.

19.19 Off Shore DMP of Indian Oil Corporation (Vadinar)

19.19.1 Introduction of Facility

Indian Oil Corporation (IOC) Ltd (Pipelines Division) owns and operates two offshore oil terminals in the Gulf of Kutch at Vadinar. The terminals are intended to handle the combined throughput requirement of its three refineries at Koyali, Mathura and Panipat. The oil terminal facilities comprise of two nos. Single Point Mooring (SPM) systems for moorings of tankers, off-shore /on-shore pipelines, the shore terminal comprising of 13 nos. of floating roof tanks with the total storage capacity of about one million tone and originating pumping station through which crude is pumped to the refineries at Koyali, Mathura and Panipat through the Salaya -Virangam, Virangam - Koyali, Virangam-Chaksu, Chaksu-Mathura and Chaksu-Panipat pipeline system.

The offshore oil facilities are connected to the shore tanks by means of 1067 mm (42") dia. submarine pipeline of about 5.3 KM for SPM-I and 6.3 Km for SPM-II followed by twin 1067 mm (42") dia. onshore pipelines of 5.7 KM length each. Another 2.1 Km loop line of 1067 mm (42") dia. is also laid to interconnect the Pipe Line End Manifolds (PLEM) of both SPMs to facilitate shore based pigging operation of both offshore and onshore pipeline. A sketch showing the above is enclosed as Annexure-I. For operational flexibility, sub-sea isolation valves are provided at suitable locations. The tankers berthed at SPMs discharge the crude oil through two strings of floating hoses connected between the tanker manifold and SPMs, and two strings of submarine hoses connected between SPMs and the PLEM located at the end of the submarine pipeline at the seabed.

This off shore oil terminal in Gulf of Kutch near Vadinar together with its cross-country pipeline system to the refineries can be termed as a vital energy artery of the Western Region catering to the energy requirement of the entire Northwest region of the country.

19.19.2 Location of the SPM Terminal

The SPM facilities are situated within the territorial water of DEENDAYAL PORT TRUST(KPT). SPM-I is situated at Latitude 20o 30' 34" N and Longitude 69o 42' 04" E and SPM-II is situated at Latitude 22o 30' 14.36" N and longitude 69o 40' 53.60" E.

The drafts available at SPMs are 34.9 meters and 32.5 meters for SPM-I & SPM-II respectively. The KPT provides the infra structure as well as Pilotage facility for operating this terminal. The entry channel of approximately 126 km (70 Nautical miles) in the Gulf of Kutch is identified for the navigation of vessels by KPT.

A zone of 3.6 Km (2 nautical miles) around each SPM has been declared as the "No Anchorage Zone" and no vessel is allowed to anchor in this area to prevent fouling of their anchors with our SPM anchor chains or sub-sea hoses and the pipeline.

Hardware Details of SPM System at Vadinar

Sr No	Parameters	SPM - 1	SPM - 1
1	Capacity of Tankers to be handled	3,00,000 DWT	3,15,000 DWT
2	Mean Sea Level	34.9 MTR	32.5 MTR
3	Geographical Co - ordinates	LAT: 20° 30' 34 " N LONG: 69° 42' 04 " E	LAT: 22° 30' 14.36 " N LONG: 69° 40' 53.6 " E
4	Year of Commissioning	August - 1978	March - 1997
5	Off - Shore Line	5.3 KM	6.3 KM
	Loop Line Between SPM-I & SPM-II Is 2.1 Kms		
Hose Configuration			
(A) Floating Hose			
1	24" X 40' Half Float Hose	01 No in each String	01 No in each String
2	24" X 40' Decreasing Stiffness Hose	01 No in each String	01 No in each String
3	24" X 40' Standard Full Float Hose	21 Nos in STBD String & 22 Nos in Port String	20 Nos in STBD String & 21 Nos in Port String
4	Metallic Reducer	01 No in each String	01 No in each String
5	20" X 40' Full Float Hose	01 No in each String	01 No in each String
6	20"-16" X 40' Tapered Hose	01 No in each String	01 No in each String
7	16" X 35' Full Float Hose	02 Nos in each String	02 Nos in each String
8	16" X 30' Tanker Rail Hose	01 No in each String	01 No in each String

	Total Length in Meters in each string	Port STR: 331.83 STBD STR: 324.11	Port STR: 336.32 STBD STR: 324.13
(B) Submarine Hoses			
1	20" X 40' Carcass Double Submarine Hose	-----	04 Nos in each String
2	20" X 37.5' Carcass Double Submarine Hose	04 Nos in each String	-----
3	20" X 35' Carcass Double Submarine Hose	04 Nos in each String	04 Nos in each String
	Total Length in Meters in each String	OFF.SH : 44.20 ON. SH : 44.20	OFF.SH : 45.72 ON. SH : 45.72
	Type of Plem Valve Actuator	Rotary Vane	Spring Loaded

19.19.3 Tanker Operation

Tankers can be unloaded simultaneously from both the SPMs and any one SPM. The details of tanker operation are described below:

Pilots of KPT bring the tanker near SPM. There are two strings of floating hoses of 610 mm (24") dia for each SPM which are lifted by the crane of the tanker for connecting to tanker manifold. When the tankers are not there, these floating hoses are floating on sea and at the ends of the strings, butterfly valves are used to close/ blind the line and additionally blinds are fitted to avoid spillage of oil. Once the floating hose strings are connected to the tanker, the system is ready for discharge of cargo through SPM system.

Before commencement of discharge of the tankers, ullaging of the tanker is done and in the meanwhile shore tanks are also aligned and tank valves are operated for receipt of cargo into shore tanks. The inlet and outlet valves of the shore tanks are motor operated and can be closed within five minutes in case of any emergency or after the discharge of the tanker is over. KPT provides the tug for pull back operation to avoid tankers overriding the SPM buoy, under buoy hoses etc. to prevent damage to the buoy and oil pollution.

Further during the operation of the tanker, there is a constant watch on the SPM system and the hoses for any leakage or burst and the operating parameters are kept well within the designed limits besides observing all safety aspects for the safety of the tanker, buoy and its accessories. The work of connecting and disconnecting hoses and repair of lines has been given on contract. During discharge operations technical personnel from following agencies are always available:

- DEENDAYAL PORT TRUST
- IOC Salaya Mathura Pipeline (SMPL), Vadinar.

- M/S Underwater Services, Mumbai
- Crude Oil Tanker

There are isolating valves provided for isolation of the floating strings and under buoy hose strings for use in any emergency arising out of failure of hose or burst of hose during operation to prevent oil loss, pollution and to sustain operation through the other string. Thus by meticulously following the international marine standards of operations and maintenance the entire tanker discharge operation is kept totally spill proof.

Further the entire off-shore facilities are subjected to stringent inspection checks as per Oil Companies International Marine Forum (OCIMF) guidelines and rigorous preventive and schedule maintenance for the upkeep of the facilities/ equipment is done in order to avoid any unforeseen instances of hose burst, leaks or any other eventualities which may result in either small or large scale oil spills in the ocean.

19.19.4 Definition of Oil Spill Management

Accidental and unwanted discharge of crude oil in the sea during the operation of SPM system including accidental spillage, if any, from the oil tankers may be termed as an oil spill resulting into pollution of marine environment.

The oil spill may be minor, intermediate or major in nature depending upon the source and duration of the oil spill.

19.19.5 Oil Spill Classification

Oil spill can be broadly categorized into three categories depending upon the volume and area of oil spill, which has taken place. These three categories of oil spill are generally classified as Tier one, two and three and each Tier will require response strategies to suit its magnitude and manifestations as mentioned below:

TIER ONE

This would be a spill of a magnitude the local resources could respond to, successfully without assistance from other agencies.

TIER TWO

This would be a spill of a magnitude that would outstrip the local resources and would require assistance on a regional basis. This would either come from local/central Government or Local Industries Mutual Aid arrangement.

TIER THREE

This would be a spill of a magnitude that would surpass the capabilities of Tier one and Tier two. Additional resources would be required on a national and international level.

Clearly Tier one and Tier two levels of response equipment and manpower resources are governed by a number of criteria. These criteria are such as location, logistics for national and international assistance, nearby sensitivities and many others.

The following classification has been made as per OISD norms:

Tier Level	Volume
Tier –1	Up to 100 MT
Tier – 2	100 MT – 1000 MT
Tier – 3	More than 1000 MT

19.19.6 Risk Analysis & Causes of Spill

Accidental spill from tankers contribute an estimated 0.4 million tons annually globally. Analysis of tanker spills occurring throughout world shows that the majority occurs in port during routine ship operations such as loading, discharge and bunkering. The most of these spills are, however, relatively small. Over 92% are less than 7 tones and probably in total, contribute less than 20000 ton annually. In comparison, accidents, such as collisions and grounding give rise to less than 10% of oil spills from tankers, but a quarter of these are larger than 700 tons.

19.19.7 Spills Due to Collision

The statistical data shows that as a percentage of the total no. of incident, collision account for 5% of oil spill regardless of the quantity of oil released. The classification based on size of the spill shows more alarming statistics with 29% of all large spills (> 700 tons) being due to a collision. Almost 21% of the sizable spills involving the release of between 7 and 700 tons are due to collisions. Small spills of less than 50 barrel (7 tons) from a collision account for less than 2% of total.

19.19.8 Spills Due to Grounding

A similar analysis of statistical data shows that although as a percentage of the total incidence spills due to grounding are rather small, accounting for only 5.2 %. A different picture emerges when the quantities involved are scrutinized. Large spills of more than 700 tones caused by grounding account for 33% of all releases of that magnitude. Off the sizable spill between 7 - 700 tones about 18 % are a direct result of grounding. The small spills of up to 7 tones are fairly insignificant and are 2.7 % of the total spills in that category.

It is prudent to assume that in any collision or grounding, spill quantity may be more than 700 tones.

19.19.9 Most Likely Spills

The most likely maximum spill can result from a central compartment of a tanker being ruptured at the bottom of the hull releasing most of its contents. Quantities in the order of 7000 tones are therefore more probable due to the release of an assumed 90 % of the contents of a center tank of a typical 175,000 DWT single skin fully laden tanker ruptured due to grounding.

19.19.10 Collision with another Vessel

A collision with another vessel causing a tank to rupture will release only the contents of the tank above the water line. The ensuing spill caused by a gash in the tank resulting from a surface collision will release near about 1750 tones. Therefore the spill quantities in both the above scenarios pertaining to rupture due to collision and a bottom gash resulting from grounding are to be 1750 - 7000 tones when a single tank has been damaged.

19.19.11 Oil Spilled into Sea

Oil spilled into the sea undergoes a number of physical and chemical changes, some of which lead to its disappearances from the sea surface whilst others cause it to persist. The time taken depends primarily upon the physical and chemical characteristics of the oil, as well as the quantity involved, the prevailing climate and sea conditions and whether the oil remains at sea or is washed ashore.

In considering the fate of spilled oil at sea, a distinction is frequently made between nonpersistent oil, which tend to disappear rapidly from the sea surface, and persistent oil, which in contrast, dissipates more slowly and usually requires a clean-up response. Most crude oils and refined residual oils have varying degree of persistent depending upon their physical properties and size of the spill. The main physical properties, which affect the behavior of oil spilled at sea, are specific gravity, distillation characteristics, viscosity and pour point.

19.19.12 Most Small Oil Spills

Most spills will in fact be small, involving less than two tones and will occur mostly when the hose system failed at the terminal. This can usually be dealt with swiftly and efficiently by the terminal operator. Major spills are fortunately considered rare with estimated probabilities between one in 100 years to One in 220 years. In the event of such a large spill at the Gulf of Kutch efforts can be made either to contain and collect the oil using booms and skimmers, or to disperse it using chemical dispersant which are spread either from marine craft using side booms or aircraft (similar to crop spraying).

If oil is washed ashore on a hard sand beach, for instance, it can be quickly and effectively cleared by manual labour with the aid of trucks and bulldozers.

In some cases, bio-degradation method may be applied using bacteria to digest the oil which can halve the time that natural forces would take to achieve the same result. However, natural forces usually degrade any oil, which cannot be cleaned up, and such forces are exceptionally strong at the Gulf of Kutch and the effects of a pollution incident are rarely long term.

19.19.13 Impact of Second SPM at Vadinar

The second SPM was commissioned during March'97 at Vadinar location. Obviously this has an impact on the requirement for pollution preparedness.

It is felt that there will be an increase in the likelihood of a spill rather than the possible volume of oil spill. This position comes from the facts mentioned below:

Increase in vessel traffic.

Doubling of hoses, joints and other possible points of failure and Increases in connections and disconnection of hoses etc.

19.20 Responsibility during Emergency

The basic responsibility of combating oil spill disaster and marine pollution lies with the local port authority within its port jurisdiction and the defaulter companies/ organizations.

19.21 Chief Coordinator (Location Head, WRPL Vadinar)

- a. On getting information of oil spill, he will report to KPT authority and other resource agencies.
- b. He will co-ordinate all activities through Chief Operation Manager and Maintenance Manager (Marine).
- c. He will ensure that appropriate response and techniques are in action to clean up pollutants.
- d. He will ensure that all the resource agencies have been duly reported about incident.
- e. He will apprise Head of WRPL about the incident and actions undertaken.

- f. He will make arrangements for disposal of oil as per the directive of Regional Commander (West).
- g. He will be responsible for the resumption of Operations at SPM terminal.
- h. He will contact IOC (Shipping) and seek assistance required to meet the emergency.

19.22 Roles of IOC in Controlling Oil Spill Disaster

19.22.1 IOC Vadinar

- a. To assist KPT off shore oil terminal, and Coast Guard Vadinar action group, in implementation of local action plan.
- b. To assist KPT, Vadinar and Coast Guard Vadinar in obtaining additional available equipment and chemicals from identified resources if and when required.
- c. To assist in chartering/hiring of tankers to undertake transportation/ transshipment operation if so required by KPT.
- d. To arrange for storage of oil transshipped as above.
- e. To make assessment of the value of the oil transshipped.

19.22.2 IOC Shipping New Delhi

- a. To arrange for chartering tankers for Vadinar as required.

19.22.3 Indian Coast Guard – Central Coordinating Authority

- a. To receive the report of significant spillage of oil at sea.
- b. To keep the Ministry of Defense apprised of the development on receipt of information about oil spill.
- c. To decide upon the nature and extent of actions required and to advise the Regional Headquarters/Local Action Groups/authorities concerned regarding the action to be taken by the latter in consultation with Apex Committee on Control of Marine Pollution/Task Force on oil spills.

- d. To arrange for chartering of any tankers for oil transshipment operations, if required.
- e. If the resources available with the Regional Headquarters / Port authorities/other agencies, Local Action Group/authorities are inadequate, to mobilize all available and necessary resources and direct the same towards the concerned Regional Headquarters/Local Action Groups/authorities.

Regional Coast Guard Commanders (RCC)

- a. Receiving reports of oil pollution at sea.
- b. Coordinating the activities of RCC when activated.
- c. Keeping the Director General, Coast Guard apprised of developments.
- d. Processing and coordinating claims of the affected parties and participating agencies with a view to compilation for processing by Director General Shipping.
- e. Mobilizing Coast Guard resources to support On Scene Commander (OSC) action at spill area.
- f. Maintaining the Regional Contingency Plan (RCP) and forward revised plans to members as may be required by RCC.
- g. Receiving periodic reports from resource agencies on account of Pollution Equipment and material with a view to have an upto date inventory list in the Coast Guard western Region, Eastern Region and Andaman and Nicobar Region.
- h. Providing the administrative infrastructure to the RCC for conduct of routine and operational tasks.
- i. Providing additional sampling effort during spills when requested by OSC.
- j. Maintaining a list of national and international agencies that may be called upon to assist for pollution response at the discretion of RCC.
- k. Arranging for periodical exercise in pollution response.
- l. Providing sensor data to RCC/OSC as required.
- m. Pre-designating a Coast Guard OSC.

19.22.4 Responsibility of Port Authority

The port authorities will be responsible for response to accident / oil spill within Port Limits keeping the coast guard regional commander informed and request for any additional assistance through the Regional Communication/Operations Centers. The detailed responsibilities are as follows:

- a. To arrange for the preparation of a local contingency plan in consultation with Regional Head Quarter/Central Coordinating Authority.
- b. To identify a suitable sea going tug when required for operations
- c. To identify surface crafts
 - On which dispersant spraying equipment can be mounted and
 - Which can be used for rigging the booms
- d. To ensure that the purpose of part-XIII of Merchant Shipping Act, 1958, actions are taken by the various authorities under the overall legal receiver of the wrecks and dock concerned.
- e. To ensure that at least following minimum equipment is kept available locally at all time:

Inflatable booms

Dispersant spraying equipments capable of being mounted on surface craft.

Suitable dispersant chemicals of the nature and quantity estimated as requirement of Local Action Group as part of the local contingency plan.

Oil skimmer equipment

- a. Surface crafts on which above dispersant equipment can be mounted and which can be used for rigging booms etc.
- b. To arrange for training of personnel expected to be engaged in above operation.
- c. To arrange for periodic exercise under the guidance of the RCC to keep equipment and personnel on continuous readiness for oil spill response operation.
- d. To consult the Coast Guard or Director General Shipping or any other authority, when further advice/assistance is required.

- e. To keep the Coast Guard appraised of actions being taken.

19.22.5 Responsibility of Boarding Officer

- a. Inform Chief Crisis Coordinator / Alternate Chief Crisis Coordinator, Maintenance Manager (Marine), IOC Control room, Marine Department about the oil spill incident.
- b. Stop the cargo or slow down the cargo as may be the case and accordingly isolate the affected portion causing the oil spill.
- c. Instruct the O&M contractor to fight the oil spill & locate the source of oil spill and coordinate with various agencies for oil spill containment.
- d. To carry out the water flushing of the SPM system as per the requirement in coordination with IOC control room.

19.22.6 Reporting & Alerting Procedure

After knowing major oil spill, Chief Coordinator, IOCL is to report the same immediately to KPT authority who in turn will inform Commander Coast Guard Region (West). Besides informing KPT, Chief Coordinator, IOCL should inform DC, Jamnagar, Forest Department Jamnagar and Gujarat Pollution Control Board Jamnagar, Gandhinagar regarding the incident.

19.22.7 Handling SPM Emergency

In case of any burst or leakage in floating / under buoy hoses or in any system of SPM, is noticed by the master or Deputy Officer or Our Boarding officer or any other person, the above incident should be immediately brought to the notice of Master/ Deputy Officer of the Ship. On getting the information, the discharging operation should be immediately stopped and the IOC control room at Vadinar should be informed through VHF channel 12 and 07 (US) about the stoppage of oil discharge. The master of the ship/ IOC Boarding officer with the help of crew members of ship and supporting contract vessel of IOC should try to assess where the spill is coming from and try to contain the spill by means of deploying booms available with the ship/contract vessels of IOC. Procedure to be adopted in case of leakage from following is as detailed below:

19.22.8 Floating Hose

- Stop discharge.
- Close the butterfly valve near tanker manifold and isolation valve near SPM.
- Contain the leak
- Further operation can be done only after replacement of burst/leaked hose or hoses

19.22.9 Under Bouy Hose

- Stop discharge.
- Close the PLEM valve of the leaking line.
- Contain the leak
- Further operation can be done only after replacement of burst/leaked hose or hoses.

19.22.10 Central Swivel Leak

If the leak is not controllable then

- Cast-off the vessel.
- Contain the leak.
- Arrest the leak.
- Re-berth the vessel.
- Restart operation.

19.22.11 Central Swivel Leak

The officer on board of the vessel can decide in consultation with pilot/master of the vessel whether the ship can continue at berth. If necessary, arrangement should be made to replace the damaged mooring rope.

19.22.12 Damage to Buoy

It is due to overriding of tanker. The officer on board of the vessel can decide in consultation with the pilot/master of the vessel whether the ship can continue at berth.

19.22.13 Pollution Control near SPM

- a. The master of the vessel will be informed about the oil spillage by boarding officer. The master in turn will contact the port signal station, which is provided with VHF channels 16, 12, 10 and 07 (US) and give a detailed report of the incidence to KPT.
- b. The signal station in turn will inform the Chief Operation Manager (COM) Offshore Oil Terminal (OOT) KPT.
- c. Boarding officer will also inform IOC shore control room/ marine department through VHF and IOC control room in turn will inform the incident to CMNM / Chief Coordinator, IOCL, Vadinar.

- d. Upon receipt of information from port signal station, COM, KPT will direct all the crafts presently posted at Vadinar to combat the oil spill within port limit.
- e. The tug / launches of KPT should carry sufficient quantity of dispersant before leaving Vadinar jetty.
- f. Since the flow of underwater current around Vadinar coast is very high, usage of oil skimmer to recover oil from any leakage from SPM and other floating hoses is not much effective, hence the pollution control near SPM done presently is limited to spray of dispersant.

19.22.14 Typical Case of Oil Spill Combating at Vadinar

In case of any accidental oil spill in and around SPM following action plan is to be brought to effect immediately in line with the disaster plan in association with KPT.

1. Reporting:

- a. On getting any information about oil spill noticed by the Master or the Duty Officer of the vessel, or Boarding Officer of IOC on board, working SPM Maintenance Contractor, Coast Guard patrol party, KPT pilot or any other person, the above incident should be brought to the notice of the Master / Duty Officer of the ship. On getting any such information, the discharging operation should immediately be suspended and the IOC tank farm which is also available on VHF channel 12 and 07 (US) should be immediately informed about the stoppage of discharge.
- b. On getting such information from Boarding Officers, the shift in charge in IOC shore control room shall inform the incident to Chief Coordinator, IOCL, Vadinar and the necessary line isolation from ship to shore tank farm should be ensured by closing necessary valves.
- c. The master or the Boarding Officer of the vessel should contact the Port Signal Station which is provided with VHF channel 16,12,10 and 07 (US) and give a detailed first hand information report of the incident.
- d. The Signal Station, in turn, should inform the COM, KPT. COM, KPT may in turn pass on the information to their authorities and Coast Guard etc.
- e. IOC officer on board should also pass on the information to location head Vadinar through IOC control room on VHF channel and check back with COM, KPT for confirmation of the message receipt through Port Signal Station.
- f. Chief Coordinator, IOCL, Vadinar will immediately establish contact with ED WRPL Gauridad and pass on the first hand information report besides informing the incident to statutory bodies like Gujarat Pollution Control Board (GPCB) and Forest Department / National Marine Park authorities.

2. Alerting: 1

- a. COM, KPT will direct the crafts posted at Vadinar to proceed to SPM and during the passage rig-up the dispersant spraying booms.
- b. IOC, Vadinar should ask its maintenance contract vessel to be ready for deployment of spill combating facilities on board at short notice on demand from COM, KPT.
- c. Small tug available with SPM maintenance contractor should also be put on alert for deployment, if so demanded by KPT for replenishment of oil dispersant and other support services.

3. Operational Requirements:

- a. In view of the strong current experienced at Vadinar only dispersant may be sprayed by 3 tugs of KPT while the fourth craft would be busy in replenishing her stock of dispersant chemicals from the storage provided at Vadinar jetty.
- b. The Master of harbour tugs / launches should ensure that sufficient quantity of dispersant chemical is carried out on board prior to leaving the jetty.
- c. In view of the strong currents experienced at Vadinar and the location of the SPM, Commander TMS Hayes, Advisor on Marine Pollution, International Maritime Organization in his Mission Report has indicated that it will not be possible to contain the oil spill and use a skimmer to collect oil. He therefore has recommended that the KPT should equip at least three crafts with dispersant spraying units. Accordingly, the Port had provided only the dispersant spraying equipments for use at Vadinar.

4. Execution:

The craft should move downstream of the oil spill and then start streaming up against the current while carrying out spray of dispersant chemicals with a systematic run over the oil spill, till the total spill gets dispersed.

5. Support Services:

IOC shall assist KPT and Coast Guard in

- a. Implementing the local action plan.
- b. In obtaining additional equipments and chemicals from HQs of KPT and Coast Guard, if and when required.
- c. Chartering of tankers to undertake transportation / transshipment operation if so required by KPT.
- d. Arranging for the storage of oil transported at shore and
- e. Making assessment of the value of the oil transshipped.

6. Claims:

In case the oil spill in and around SPM terminal is due to any problem of tanker or any negligence from tanker operation crew, following steps should be taken for claim, which will be done by DC / COM, KPT.

COM, KPT should inform the Master of the Vessel holding him responsible for the spillage/pollution and also steps taken by the Port to combat the oil spill and for cleaning operations and the charges thereof as per rules.

Record of all expenditures towards the use of port craft / tugs / dispersant chemicals / port vehicles and any other material should be maintained by the DC / COM, KPT for subsequent recovery from the Master/Agent of the ship, prior to her departure.

7. Final Report :

The detailed report of the oil spill in chronological order supported with available data/records will be prepared by KPT and sent to respective Organizations including IOC. However necessary reports for informing IOC official should be prepared by Chief Coordinator, IOCL, and Vadinar. He will also submit necessary reports to statutory bodies like Gujarat Pollution Control Board, Forest Department/National Marine Park authorities.

19.22.15 Relationship with Coast Guard & Port Trust

The Indian Coast Guard and Port Trust along with IOC would be among the main organization involved in the more practical aspects of oil spill response at Vadinar terminal.

It has been therefore, the endeavor of KPT / IOCL / ESSAR / Indian coast Guard to ensure that good working relationship, understanding of individuals, operating procedure are developed and understood before the high pressure environment of spill response prevents the building of such ties.

All relationship with the Indian Coast Guard has been undertaken with the knowledge that in the National Disaster Plan it states that ICG is the controlling body for all oil spill response activities.

19.23 Oil Spill Equipment Available with IOCL Vadinar

Sr.No	Item Description	Qty
01	Inter Tidal Boom	600 mm
02	Coastal Boom	600 mm
03	Disc Skimmer	1No
04	Mop Skimmer	1No

05	Dispersant Spray Sets	2 Sets
06	On Shore Cleaning System	1 No
07	Floating Tank 25m ³	2 Nos
08	Floating Tank 12.5m ³	4 Nos
09	Off Loading Pump	1 No

19.24 Oil Spill Consumables Available with IOCL Vadinar

Sr.No	Item Description	Qty
01	Oil Spill Dispersant	9800 Liter
02	Oil absorbent pillow (1.5'x1'x5")	72 Nos
03	Oil absorbent boom (length-10'x dia-7")	120 Nos
04	Oil absorbent sheet (1.5'x1.5')	760 Nos

19.25 Imp Telephone Nos of Govt Officials related to Oil Spill Combating

Sr No	Description	Telephone No		Fax Number
		Office	Residence	
1	District Collector Jamnagar (0288)	2555869	2554059 09427306210	
2	Collector Office Jamnagar (0288)	2557601 – 5	-----	2555899
3	Superintendent of Police Jamnagar (0288)	2554203	2555868 09427305071	2556382
4	Municipal Fire Station Jamnagar (0288)	2550101	-----	-----
5	Regional Officer Gujarat Pollution Control Board Jamnagar (0288)	2752366	2540741	2753540
6	Conservator of Forest Jamnagar (0288)	2552077	2553327 09425049064	2679371

7	Police outpost Vadinar (02833)	256541	-----	-----
8	KPT Control Tower Vadinar (02833)		-----	-----
9	Deputy Superintendent of Police, Khambalia (02833)	234262	234726	234262
10	Deputy Collector, Khambalia (02833)	234577	234714	234577
11	Commander Coast Guard, Porbandar (0286)	2241794 /2240958	2244234	2244056
12	Gujarat Pollution Control Board, Gandhinagar, (079)	23222756 /23222095	-----	23232156
13	Chief Conservator of Forest Gandhinagar, (079)	23254123	-----	23229917
14	Director Environment, Govt. of Gujarat. Gandhinagar, (079)	23251062	-----	23252156
15	CG, Station Vadinar	256560 /256579	256534	256560
16	COM, KPT, Vadinar	256749	256522	256540
17	Head (Environment), RIL, (Mr. Kannan)	95288- 3012152		952833- 3012199
18	RPL, Port Operation Center			
19	Mundra (Port operation Center)	0283828820 1 to 288207, 0283822003 3		95288- 288270

19.26 Important Telephone Nos of VOTL Marine Operations

Sr No	NAME	DESIG	TEL (OFF)	MOBILE NO.
1.	Capt Deepak Sachdeva	Chief Operations Officer	02833-241777	9925153618
2.	Capt. Alok Kumar	Port Captain		9909908611
3.	Commandt. Raghuvanam	Head- Port Facility Security	02833-241780	9909021183
4.	V. Gopalakrishnan	Admin Officer	02833-241779	9979891335
5.	Control room	Shift -in charge	02833-241775	9979868460
6.	Control room fax		02833-241779	

19.27 Emergency Telephone Nos of outside agencies including District Authorities

19.27.1 Fire Station

SL No	Dept. Name / Officer's Name	Office	Resident
1	Inspector CISF (02833)	256542	-

2	Municipal Jamnagar (0288)	2550340	2550340
		2550101	
		2675091	
		101	

19.27.2 SHO (Police)

SL No	Dept. Name / Officer's Name	Office	Resident
1	District Superintendant of Police	2554203	2555868
2	Deputy Superintendant of Police	2552940	2542970
3	Police Control Room	100 2550200	-
4	Police Inspector, City 'A' Division	2550243	2676667
5	Police Inspector, City 'B' Division	2550244	2550315
6	Police Inspector, Panchkoshi 'A' Division	2550359	-
7	Police Inspector, Panchkoshi 'B' Division	2676556	-
8	Dhrol	02897- 222033	-
7	Dy. SP Khambhaliya Police Inspector Circle	234726	
8	Office, Khambhaliya	234744	

19.27.3 Collectorate

SL No	Dept. Name / Officer's Name	Office	Resident
1	Collector Shree & District Magistrate Shree	2555869	2554059
2	Additional Collector Shree	2550284	2672131
3	Resident Deputy Collector Shree	2553183	2556102

4	Sub divisional Magistrate Shree	2552130	2552807
5	Mamlatdar Shree (City)	2674575	2660950
6	Collector Control Room	2553404	-
7	Circuit House, Lal Bungalow	2550237-38	-
8	Deputy Collector, Khambhaliya	234577	

19.27.4 District Authority

SL No	Dept. Name / Officer's Name	Office	Resident
1	District Development Officer	2553901	2552402
2	Deputy District Development Officer	2550221	2755070
3	District Health Officer	2671097	2756252

19.27.5 Forest Department

SL No	Dept. Name / Officer's Name	Office	Resident
1	Conservator of Forest Marine National Park	2552077	2552327
2	Deputy Conservator of Forest Marine National Park	2552077	2679374
3	Deputy Conservator of Forest (Distribution)	2553664	2559787
4	Deputy Conservator of Forest (Common)	2553026	2554387

19.27.6 Port Department

SL No	Dept. Name / Officer's Name	Office	Resident
1	Port Officer - Bedi Port	2670207	2556106
2	Port Office - Okha	262001	262010

19.27.7 Railway Station

SL No	Dept. Name / Officer's Name	Office	Resident
1	Railway Inquiry - Jamnagar	2755222	-
2	Railway Inquiry - Hapa	2570410	-
3	Officer, Railway Station - Jamnagar	2755169	-
4	Officer, Railway Station - Hapa	2570410	-

19.27.8 Airport Office

SL No	Dept. Name / Officer's Name	Office	Resident
1	Airport Officer	2712187	2560252
		2712413	2560262
2	Indian Airlines - Jamnagar	2550211	2554768

19.27.9 Station Transport

SL No	Dept. Name / Officer's Name	Office	Resident
1	S.T.Inquiry	2550270	-
2	Manager, S.T.Depo	2676904	-
3	Divisional Director - Jamnagar	2570608	2570486

19.27.10 Hospitals, Ambulance Sevas, Blood Banks & NGO's

Sr No	Dept. Name / Officer's Name	Telephone No
-------	-----------------------------	--------------

		Office	Residence
Hospital			
1	Guru Govindsinh Hospital (Emergency)	2661087 2550204-06	-----
2	Samarpan Hospital	25566423 2712728	-----
3	Mental Hospital	2712728	-----
4	Dental Hospital	2750218	-----
5	Ayurvedic Hospital	2550368	-----
6	City Dispensary – Ranjit Road	2676456	-----
7	Oswal Hospital	2562705 2566833 2676521	-----
8	Adarsh Hospital	2665566	-----
9	Jivandep Healthcare Pvt Ltd	2558176 2558275	-----
10	KPT Primary Health Centre, Vadinar	256539	-----
Ambulance Seva			
1	Fire Branch, Jamnagar Mahan agar Palikir	102	-----
2	Aaryasamaj	2550220	-----
3	Guru Govindsinh Hospital	2541081	-----
4	Jilla Panchayat, Jamnagar	2550221	-----
5	Taxi Association, Jamnagar	2560547	-----
6	Mahavir Samaj Sevak Dal	2550225	-----
Blood Bank			
1	Guru Govindsinh Hospital	2550227	-----
2	J.H.M. Blood Bank	2550208	-----

3	Deepchand Gardy Memorial Blood Bank	2672529	-----
4	Omkar Charitable Trust Blood Bank	2673339	-----
NGO			
1	Aandabawa Seva Sanstha	2540155	-----
2	Kabir Ashram	2558049	-----
3	Shree Pranami Seva Sanstha	2551353	-----
4	Nawanagar Chamber of Commerce	2550250	-----
5	Youth Hostel Association of India	2558040	-----
6	Jamnagar Factory Owners Association	2560002	-----
7	Jamnagar Brass Foundry Association	2730271	-----
8	M.P.Shah Udyognagar Association	2550960	-----
9	Kasturba Stree Vikasgruh	2751730	-----
10	Indian Road Cross Society	2553583	-----
11	Rotary Club	2550348	-----
12	Lions Club	2673193	-----
13	Jamnagar Vepari Mahamandal	2533185	-----

19.28 Mutual Aid Members

Sr.No	Name of Mutal-Aid-Scheme Member	Telephone No. Office	Residence/ Mobile Nos.
1	Chairman - Collector	2555869 9978406210	2554059
2	Addl. Collector	2550284 99784 05182	2672131
3	Jt.Chairman Commissioner,JMC	2552321	2552372

4	MR Prajapati - Secretary, MAS, GSFC	2432216	2712768/ 9979853306
5	RN Shah - Treasurer-MAS, GSFC	2432242	9979862520

6	MAS OFFICE	2542764	
7	Office of Supdt. of Police	2554203	2555868
8	Police Control Room - Jamnagar	2550200	2344249(Sikka) 2846125(Padana)
9	District Disaster Control Room	2553404 / 2541485/ 1077 (Toll Free)	9426950783 (DDMO) Mr.Yaswant Sinh Parmar
10	PB Shah ,Asst. DISH - Jamnagar	2678206	9824583767
11	Mr. Desai -Home Guard Jamnagar	2553862	
12	Dr. Gosai RMO - GG Hospital	2550240 /2541081	2551689 / 9824258885
13	Control Room GMB - Jamnagar	2711805 / 2756909	
14	KK Bisnoi - JMC CFO	2550340/101 (2662691)	9879531101
15	Indian Coast Guard - Vadinar	02833 - 256579	1090 (Terror Helpline Toll free)
16	Sanjay Goyal -IOCL Vadinar	02833 - 256330	9909909016
17	P Palanivelu- Jt. Secretary MAS,EOL	02833 - 241892	9825210517
18	PK Prasad - IOCL Theba	2570712	9426911475
19	HS Modha - Fire Officer	2344116	9925214054
20	Chetansinh Jadeja - Fire	2344272 -75/	9099038083

	Officer, SDCC	2439322 (Fire)	
21	V.Koti, VP(Fire) RIL	6611193	9998972008
22	D K Thakur Jt. Secretary- MAS-TCL	02892 - 665247	9227676113
23	Mr. Dipak Roy, Mgr.(O&M) - K Kumar AM - GSPL	9925013159 9879599464	
24	MJ Sunaria - Digjam Ltd.	2712972/73/74	
25	PB Sakharkar -GAIL	6611437	9624089696
26	Indian Navy- Valsura	2550263-357	
27	Indian Air Force, Jamnagar	2720007, Extn.4222(fire)	2550245
28	PR Thatte, VP Bharat Oman Refinery	02833 -256450	9427206501
29	MU Khan - Cairn India		966253945
30	For any Emergency Ambulance / Fire		108

19.29 Details of Fire Fighting Equipment at Vadinar

Sr.No	Description of system	Quantity
1	Water Cum Foam Monitors	
	Fixed Monitors	05 Nos.
	(1200/1500/1800/2580/3840) LPM	2138 lpm (475 gpm)
	Portable Monitors	02 Nos. (Fire Station)
	(1200/1500/2580/3840) LPM	1000 gpm (4500 lpm)
	Foam trolley tank capacity and Qty of AFFF in it.	3 No. of trolleys with 200 liters each.
2	Hoses /Nozzles /Accessories	
	Hose	152 No.

	Type	Type B
	Nozzles	
	Universal (Triple purpose) nozzle	33 No. Diffuser branches
	Jet nozzle (Standard branch)	60 Nos. of Aluminium and 6 no. of Gunmetal
	Fog nozzle	11 Nos.
	Foam branch (FB-5X)	07 Nos.
	Water curtain nozzle	01, Good
	Hose Boxes	64 Nos.
	Foam Concentrate (AFFF)	28000Ltrs(Min)
FIRE SIREN		
	Hand operated	02 Nos
	Electrical	03 Nos.
	Sand buckets with cover	30 Nos.
	Manual fire call points	13 Nos.
3	Safety Equipment	
	Explosimeter (make)	02 Nos (ENDEE GP200L)
	Fire proximity suit	11 Nos.
	Water gel blanket (expiry date)	01 No. (Expiry date Feb. 2010)
	Safety torch	10 Nos.
	Safety goggles	30 Nos.
	Red and Green Flags for drill	01 No each
	Breathing Apparatus Set (Indicate make)	07 Nos make DRAGER
	Spare Breathing Apparatus cylinder	06 Nos
4	Fire Extinguishers	
	CO ₂ Type	66 Nos.
	2.0 Kg	28 Nos

	3.2Kg	10 Nos.
	4.5 Kg.	23 Nos.
	6.8 Kg.	05 Nos.
	DCP Type	148 Nos.
	5.0 Kg	28 Nos.
	10.0 Kg	116 Nos.
	75 Kg	04 Nos.
5	Fixed Fire Fighting Facilities	
	Fire water pond/tank (no. and capacity)	3 no. ponds 6000 KL each.
	Foam tender with accessories	3 Nos
6	Fire Fighting Engines	
	Engine driven FF pump a) 385KL/Hr @ 88m b) 350 KL/Hr @ 88m	4 Nos 2 Nos
	Motor Driven FF pump a) 385 KL/Hr @ 91m b) 350 KL/Hr @ 91m	1 No 2 Nos
	Jockey Pump 60 KL/Hr @ 120m	2 Nos

19.30 Details of Fire Fighting Equipment at Jamnagar

Sr.No	Description of system	Quantity
1	Water Cum Foam Monitors	
	Fixed Water Monitors	03 Nos.
	(1200/1500/1800/2580/3840) LPM	3500 lpm
	Fixed Water Cum Foam Monitors	03 Nos.
	(1200/1500/2580/3840) LPM	1200 lpm
2	Hoses /Nozzles /Accessories	

	Hose	15 Nos.
	Type	Type B
	NOZZLES	
	Universal (Triple purpose) nozzle	04 Nos. Diffuser branches
	Jet nozzle (Standard branch)	03 Nos.
	Fog nozzle	03 Nos.
	Foam branch (FB-5X)	03 Nos.
	Water curtain nozzle	02 Nos
	Hose Boxes	10 Nos.
	Foam Concentrate (AFFF)	5100 Liters
	Fire Siren	
	Hand operated	01 No.
	Electrical	01 No.
	Sand buckets with cover	24 No.
	Manual fire call points	06 Nos.
3	Safety Equipment	
	Explosimeter (make)	01 No. (ENDEE GP200L)
	Fire proximity suit	1 No.
	Water gel blanket (Expiry date)	01 No. (Expiry date Feb. 2010)
	Safety torch	02 Nos.
	Safety goggles	1 No.
	Red and Green Flags for drill	01 no. each
	Sand scoops	04 Nos.
	Stretcher	01 No.
	Breathing Apparatus Set (Indicate make)	01 No., make DRAGER
	Spare Breathing Apparatus cylinder	01 No.
4	Fire Extinguishers	

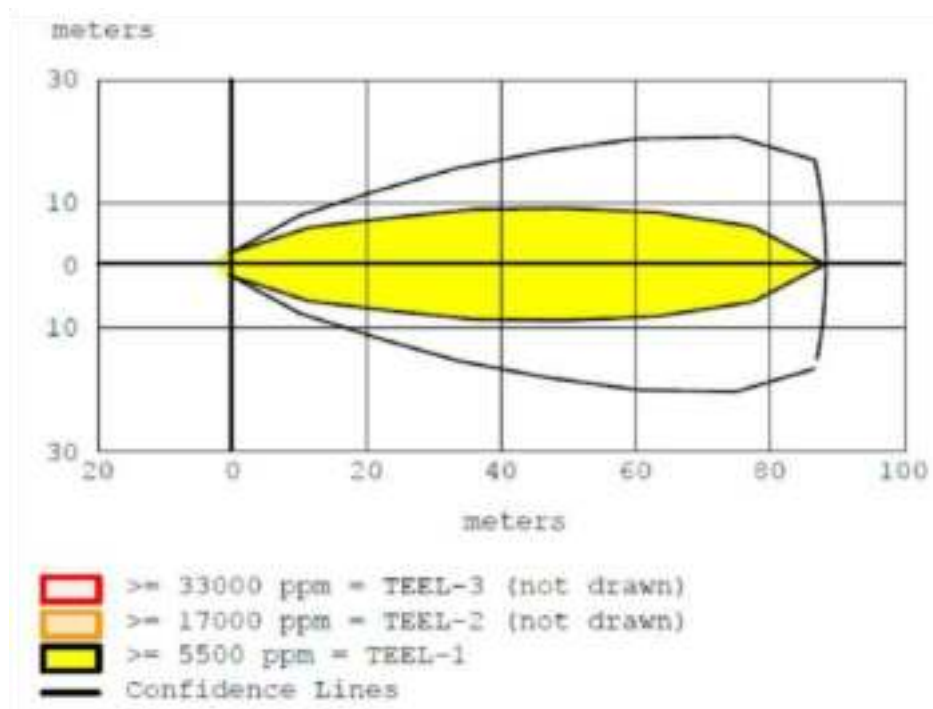
	CO ₂ Type	33 Nos.
	2.0 Kg	13 Nos.
	3.2Kg	Nil
	4.5 Kg.	15 Nos.
	6.8 Kg.	05 Nos.
	DCP Type	27 Nos.
	5 Kg	01 No
	10 Kg	20 Nos.
	75 Kg	06 Nos.
5	Fixed Fire Fighting Facilities	
	Fire Water Mains (size) and date of Pressure Testing	8" Dia tested on July'10
	Fire water pond/tank (no. and capacity)	2 nos above ground tanks of 700 KL each.
	Mainline pump shed fixed foam flooding system (Manual/auto)	Auto with UV/IR detectors
6	Fire Fighting Engines	
	Engine driven FF pumps (150 kl/hr @ 100M)	2 Nos
	Motor Driven FF pump (150 kl/hr @ 100M)	1 No
	Jockey Pump(10 kl/hr @ 100M)	1 No

20 ANNEXURES - GRAPHS

20.1 Graphs & Contours of various MCLS worked out at Jetty (Refer Chapter 4.7)

20.1.1 Jetty One – LPG

20.1.1.1 Instantaneous Release – Toxic Threat Zone (Graph)



20.1.1.2 Instantaneous Release – Toxic Threat Zone (Contour)



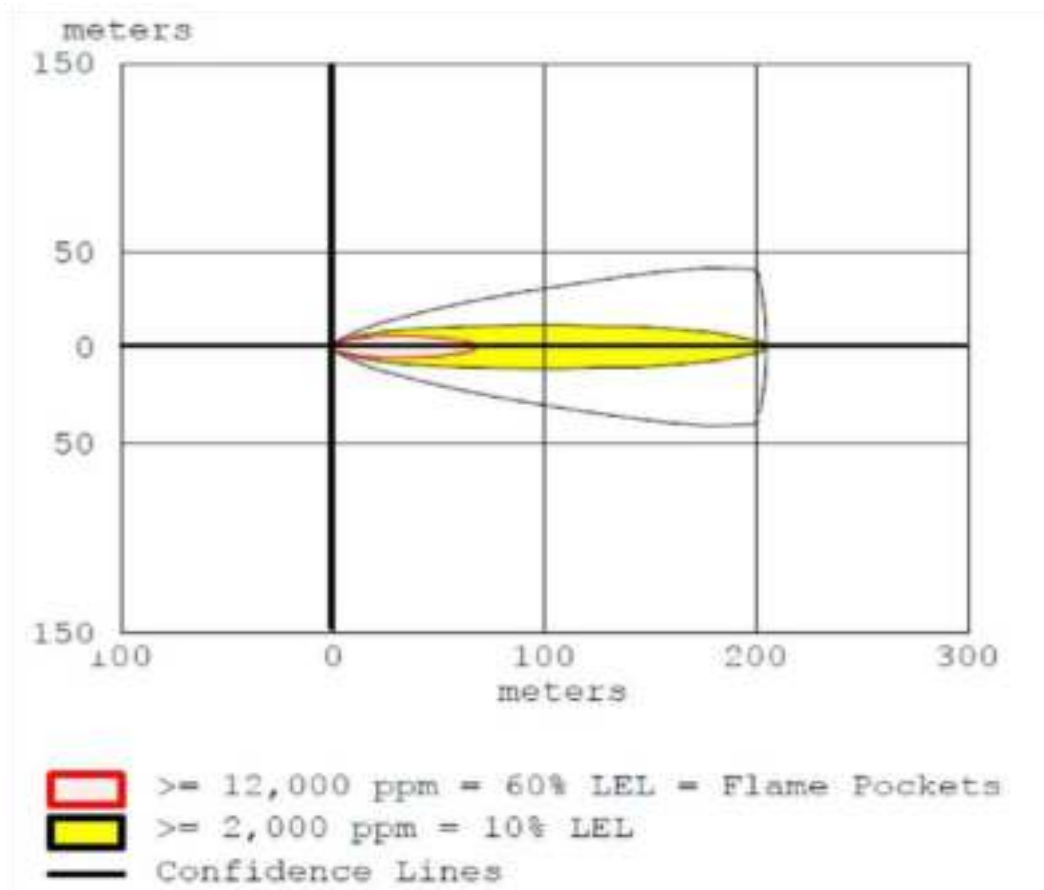
August 25, 2010
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Kandla Jetty Map

OIL JETTY

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Upgraded Emergency Plan / DMP for Kandla Port Gandhidham (Kutch)

20.1.1.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



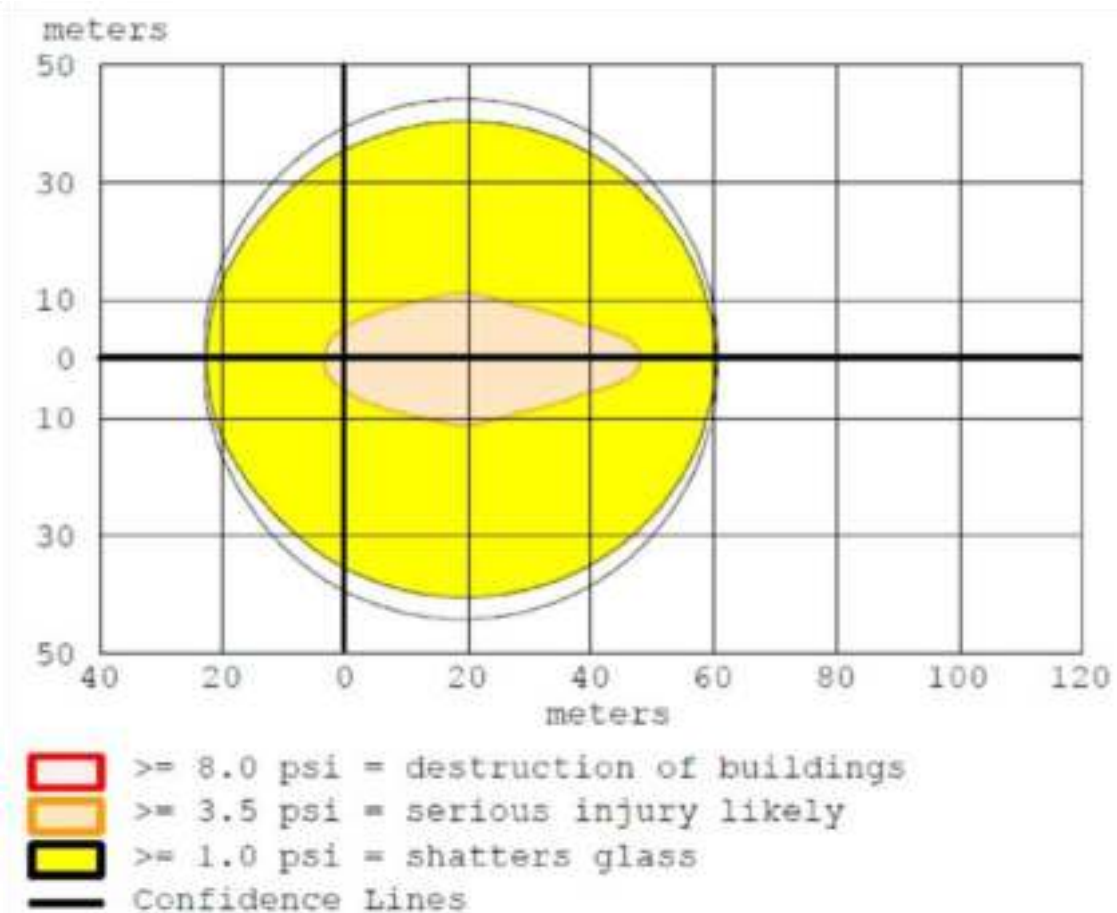
20.1.1.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



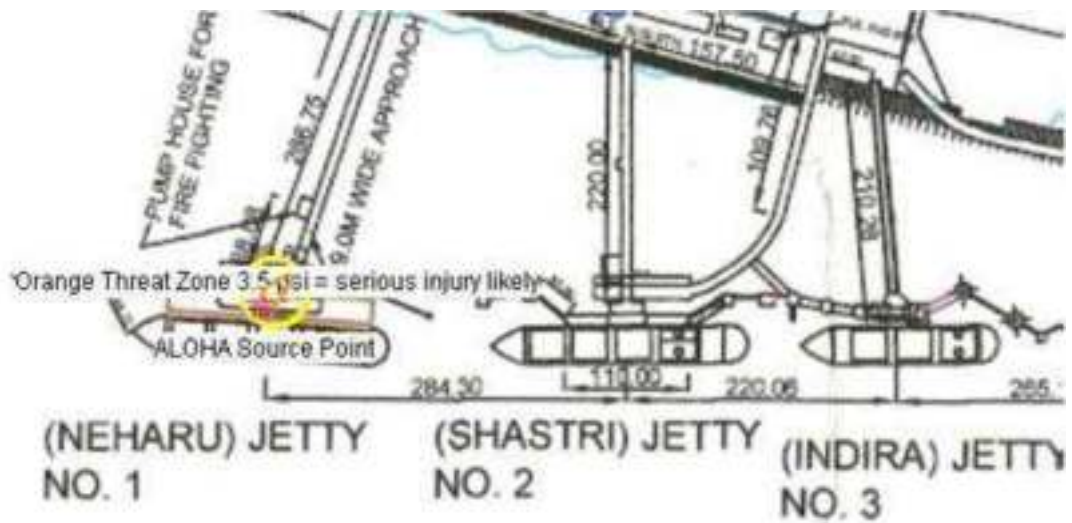
August 25, 2010
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 Kandla Jetty Map

OIL JETTY

20.1.1.5 Instantaneous Release – Overpressure (Graph)



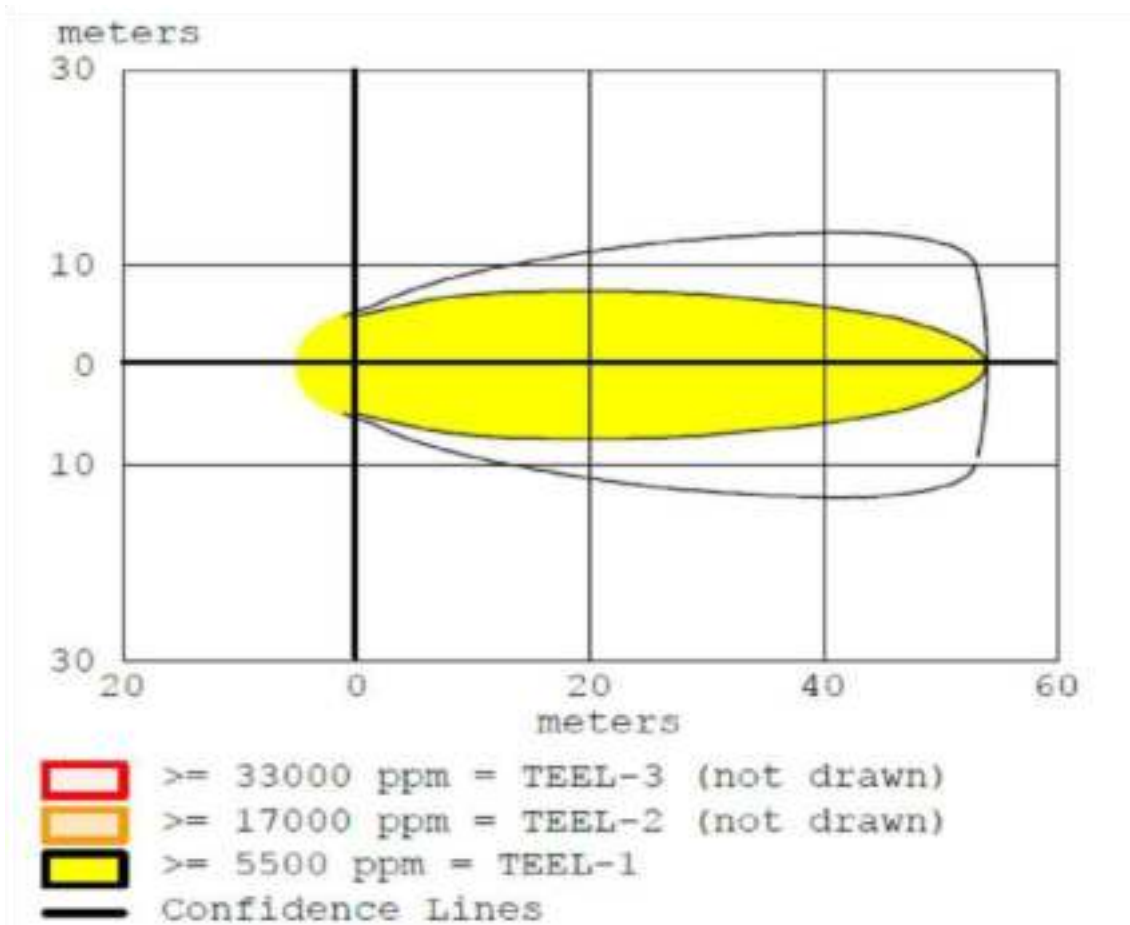
20.1.1.6 Instantaneous Release – Overpressure (Contour)



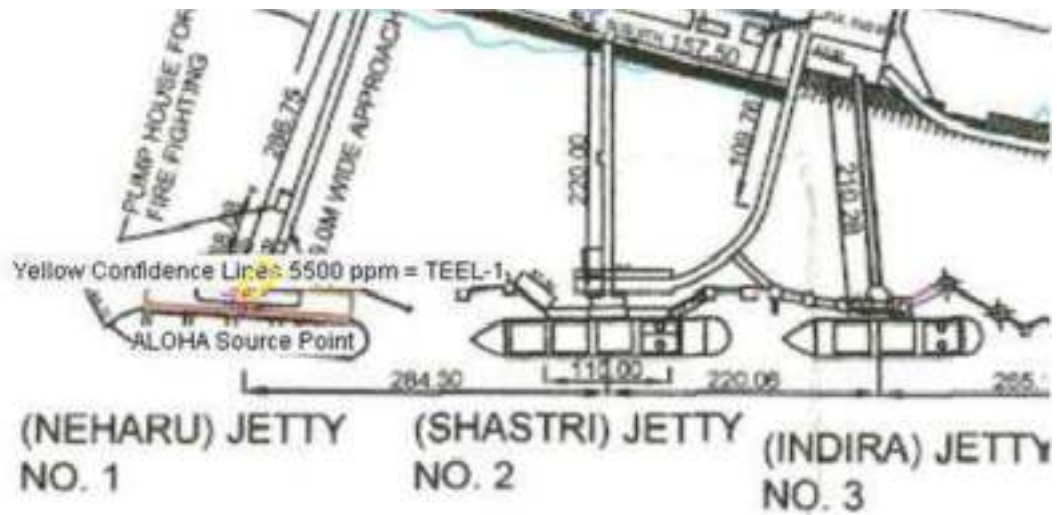
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Kandla Jetty Map

OIL JETTY

20.1.1.7 Evaporating Puddle – Toxic Threat Zone (Graph)



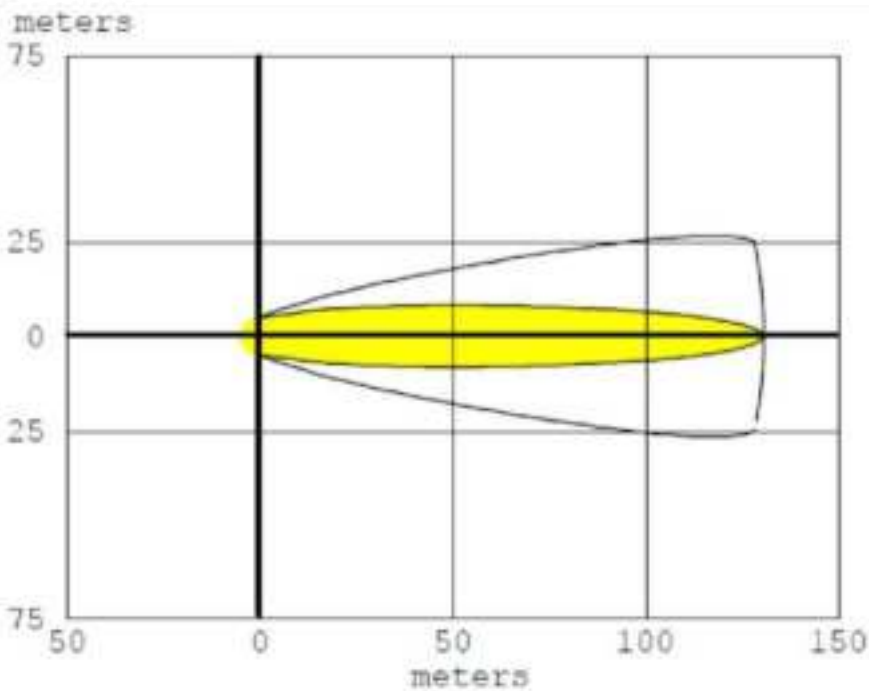
20.1.1.8 Evaporating Puddle – Toxic Threat Zone (Contour)



August 25, 2010
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Kandla Jetty Map

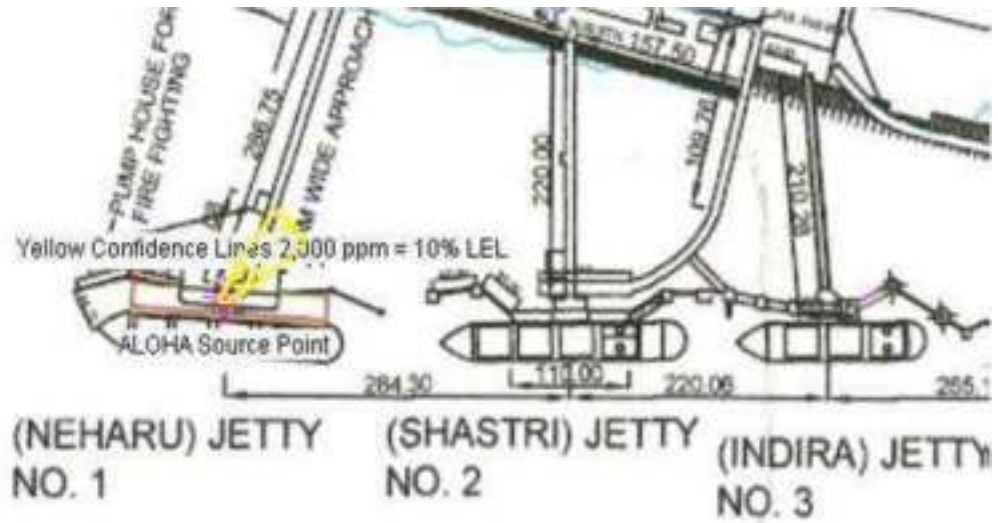
OIL JETTY

20.1.1.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



- $\geq 12,000$ ppm = 60% LEL = Flame Pockets (not drawn)
- $\geq 2,000$ ppm = 10% LEL
- Confidence Lines

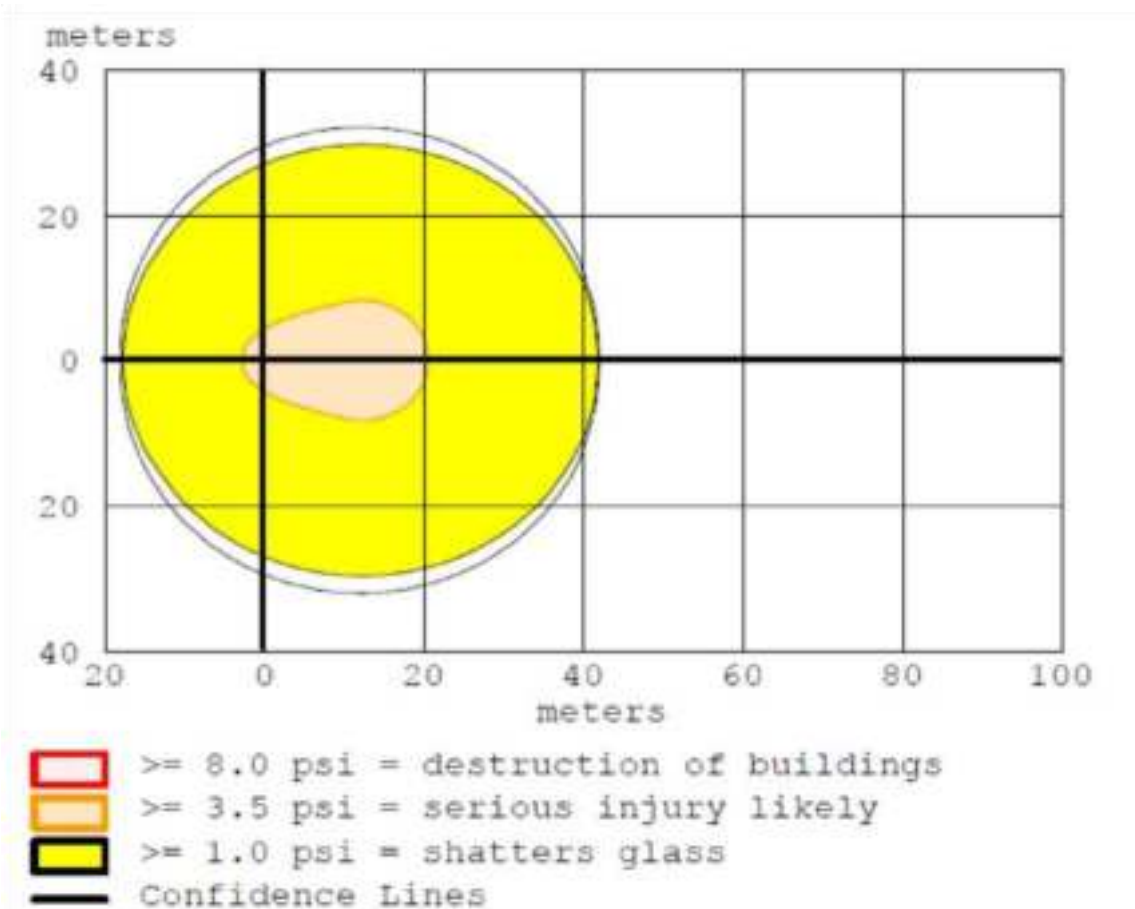
20.1.1.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



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Kandla Jetty Map

OIL JETTY

20.1.1.11 Evaporating Puddle – Overpressure (Graph)



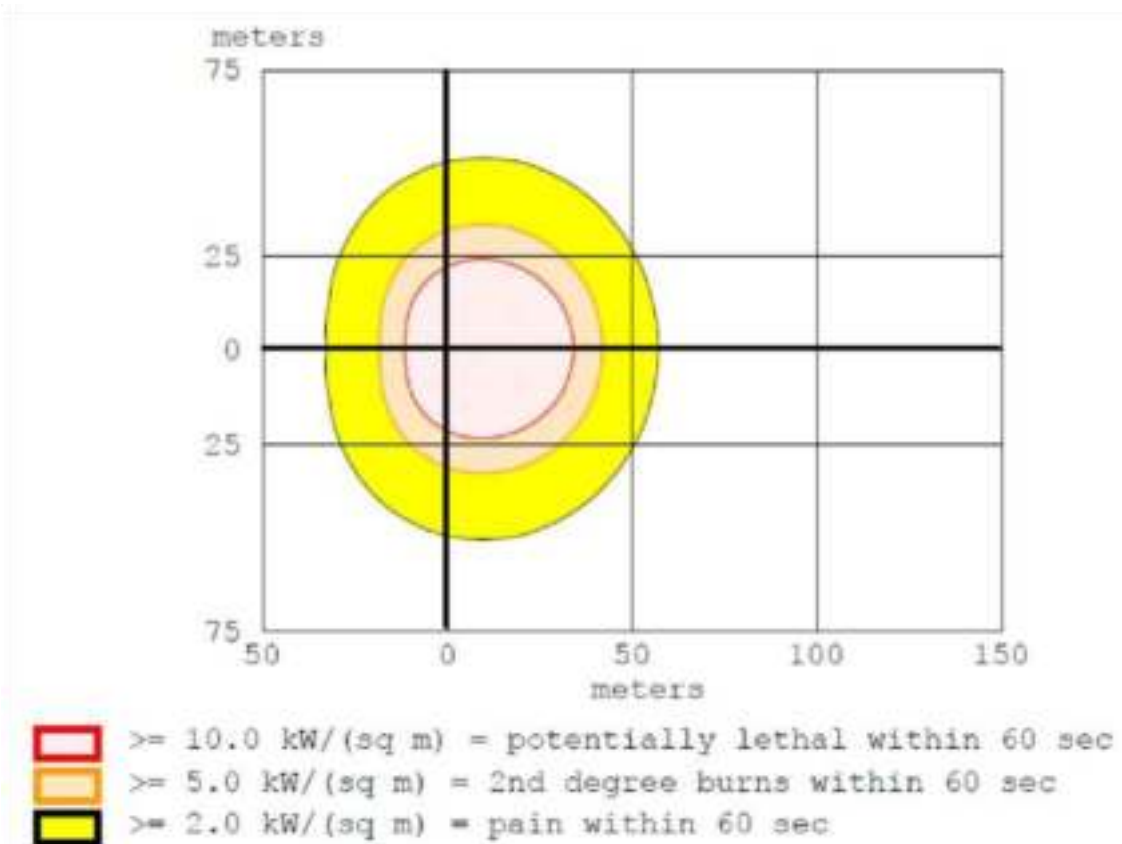
20.1.1.12 Evaporating Puddle – Overpressure (Contour)



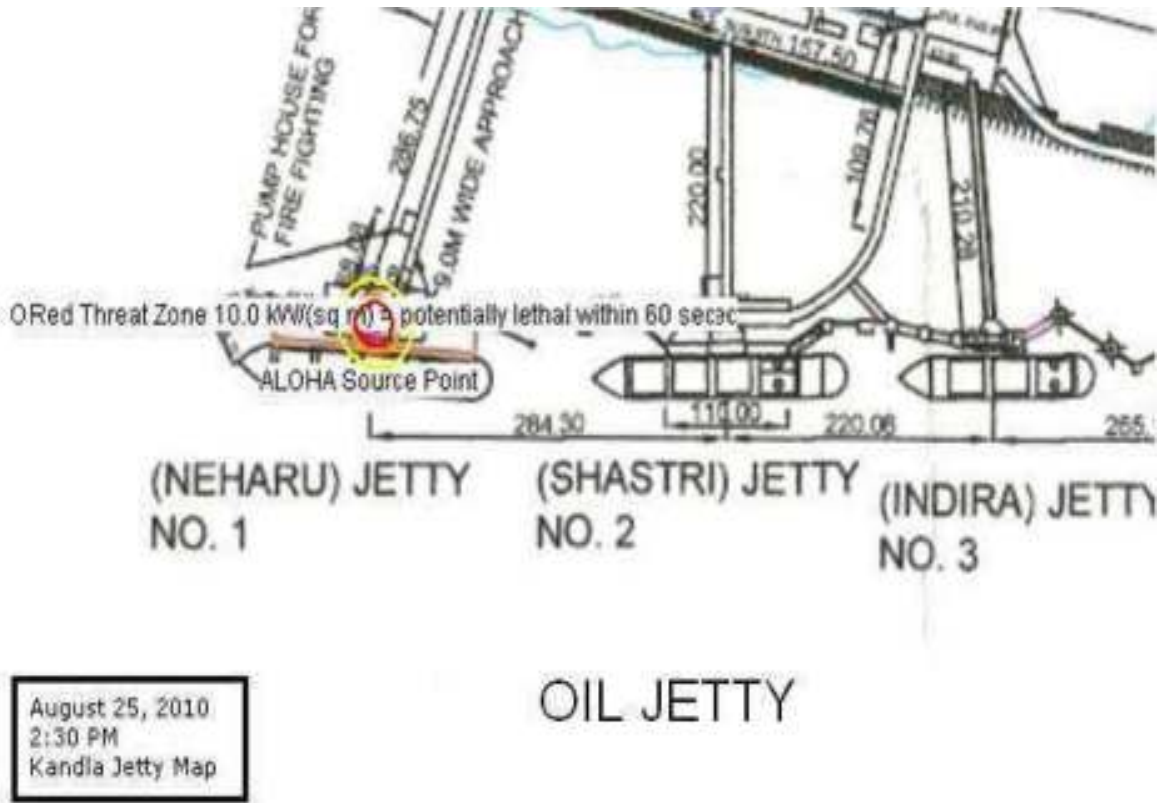
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Kandla Jetty Map

OIL JETTY

20.1.1.13 Burning Puddle – Thermal Radiation (Graph)

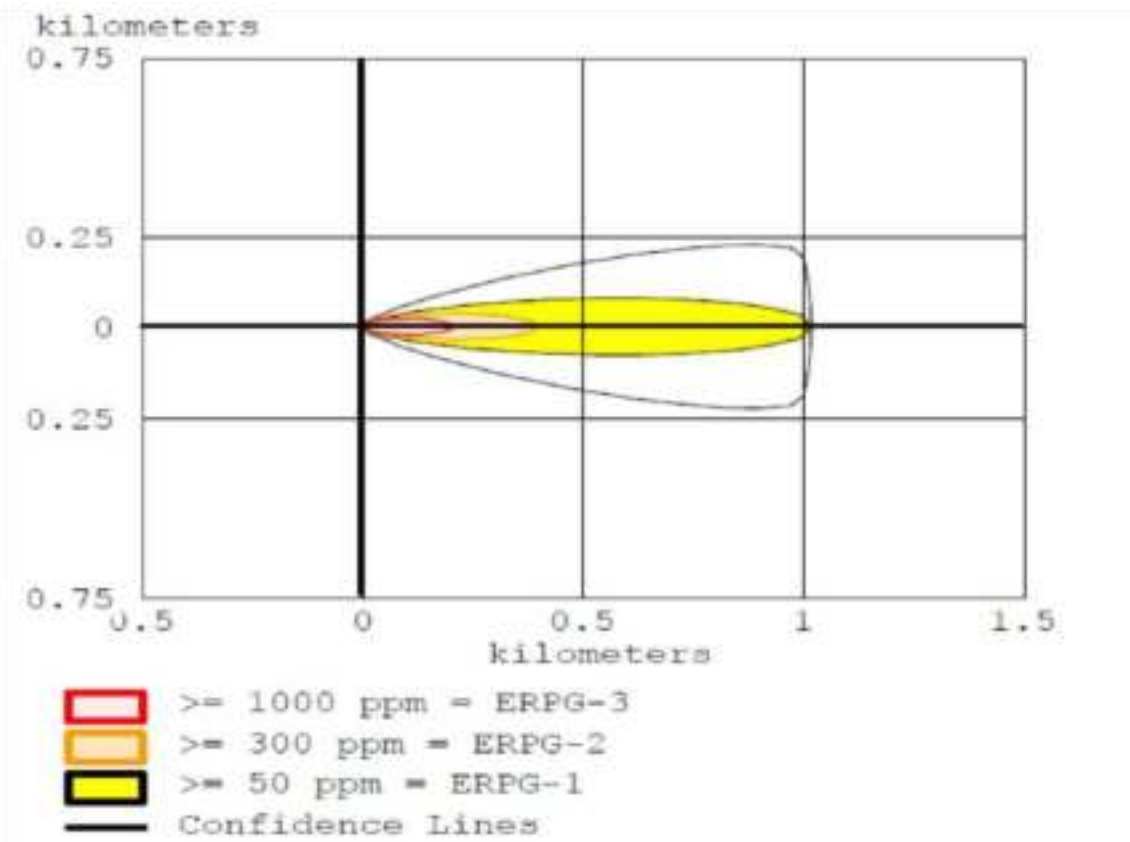


20.1.1.14 Burning Puddle – Thermal Radiation (Contour)

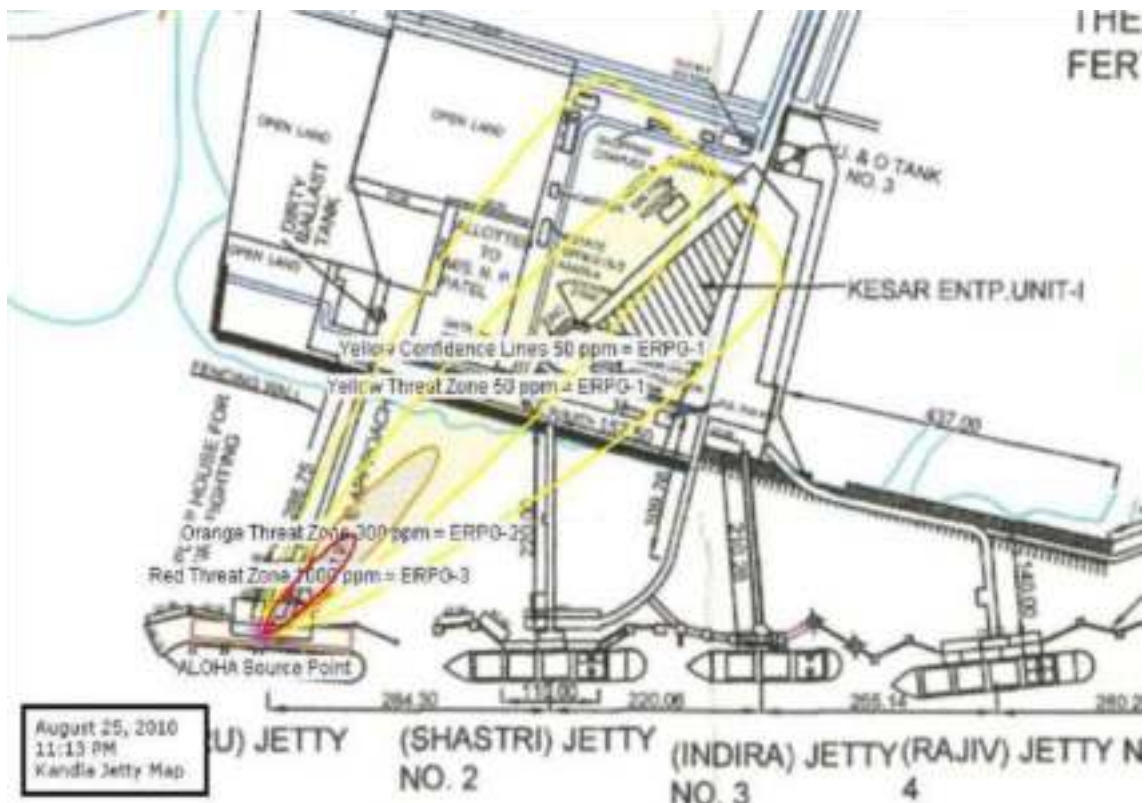


20.1.2 Jetty One – Toluene

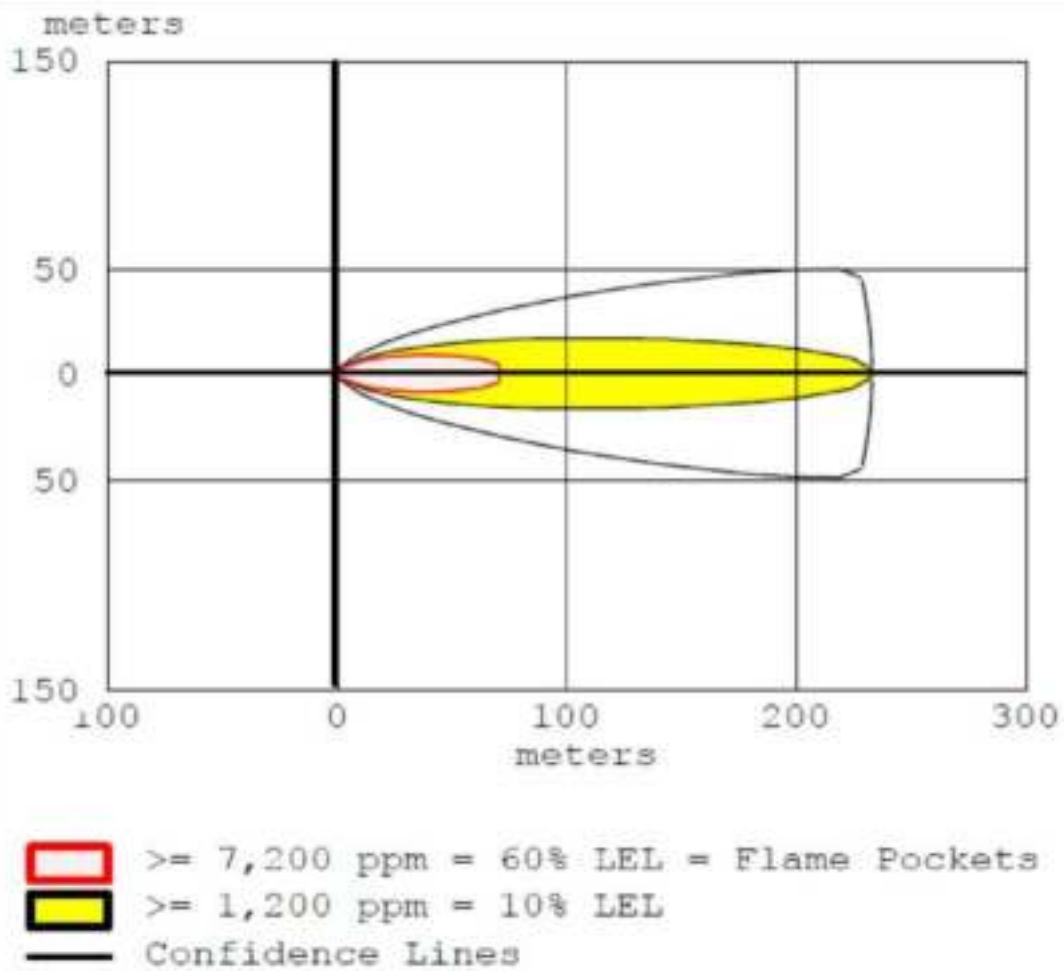
20.1.2.1 Instantaneous Release – Toxic Threat Zone (Graph)



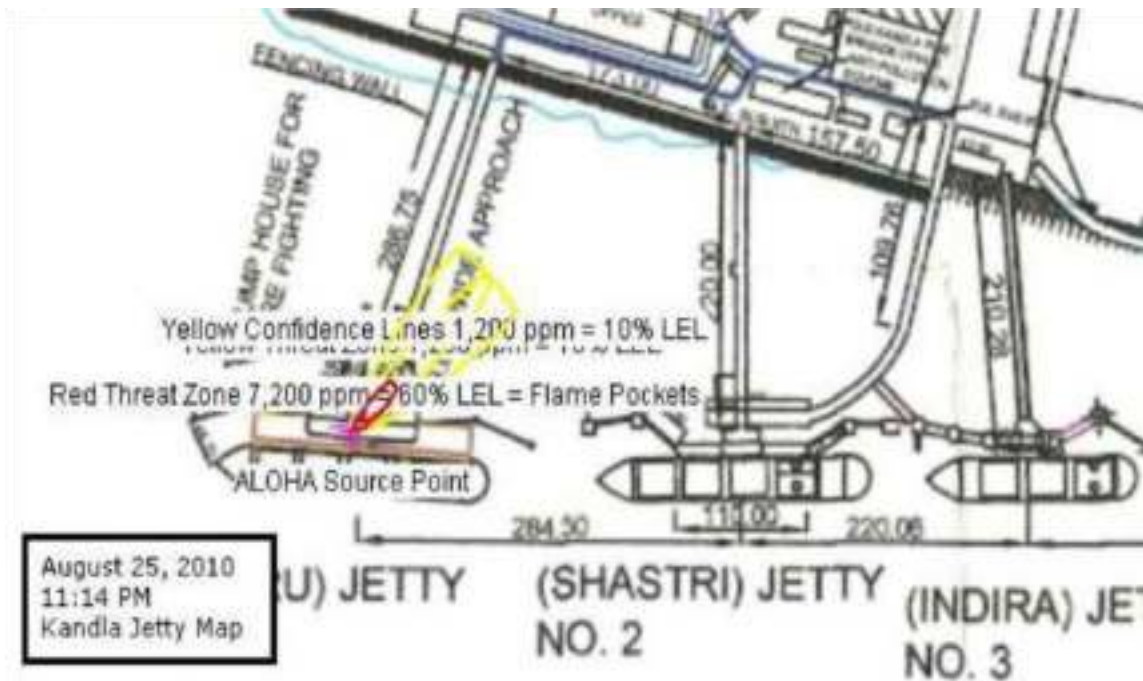
20.1.2.2 Instantaneous Release – Toxic Threat Zone (Contour)



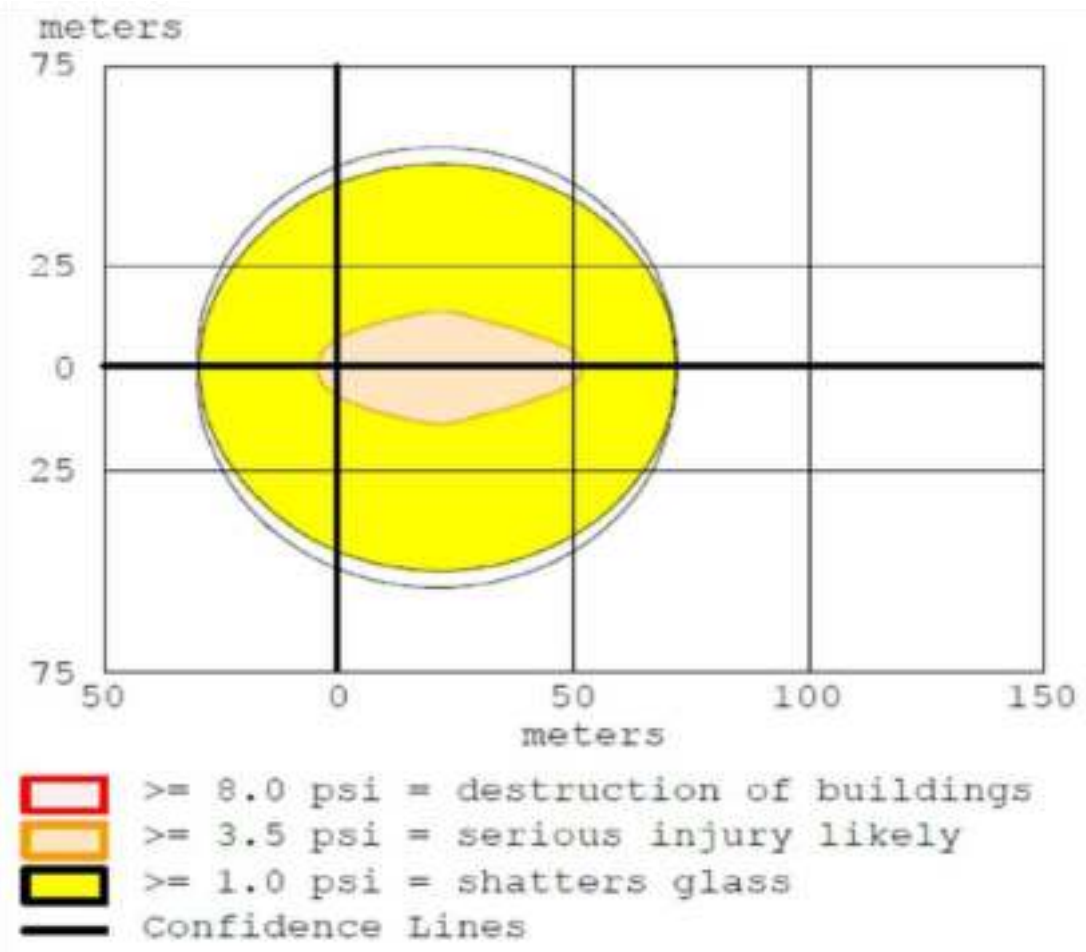
20.1.2.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



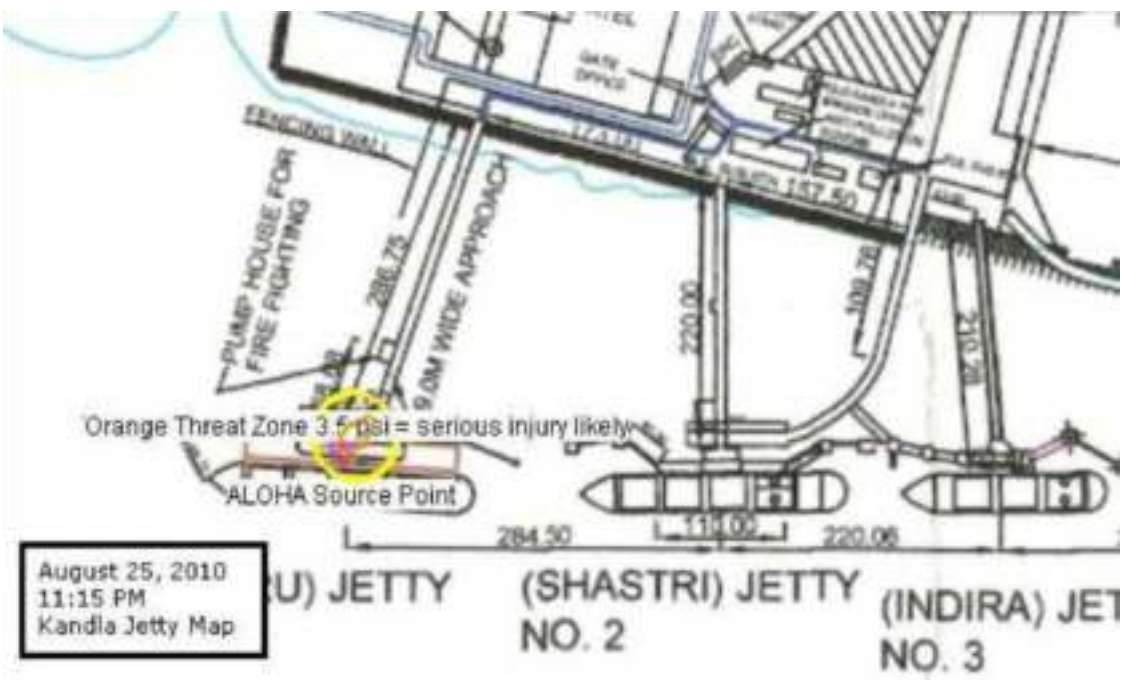
20.1.2.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



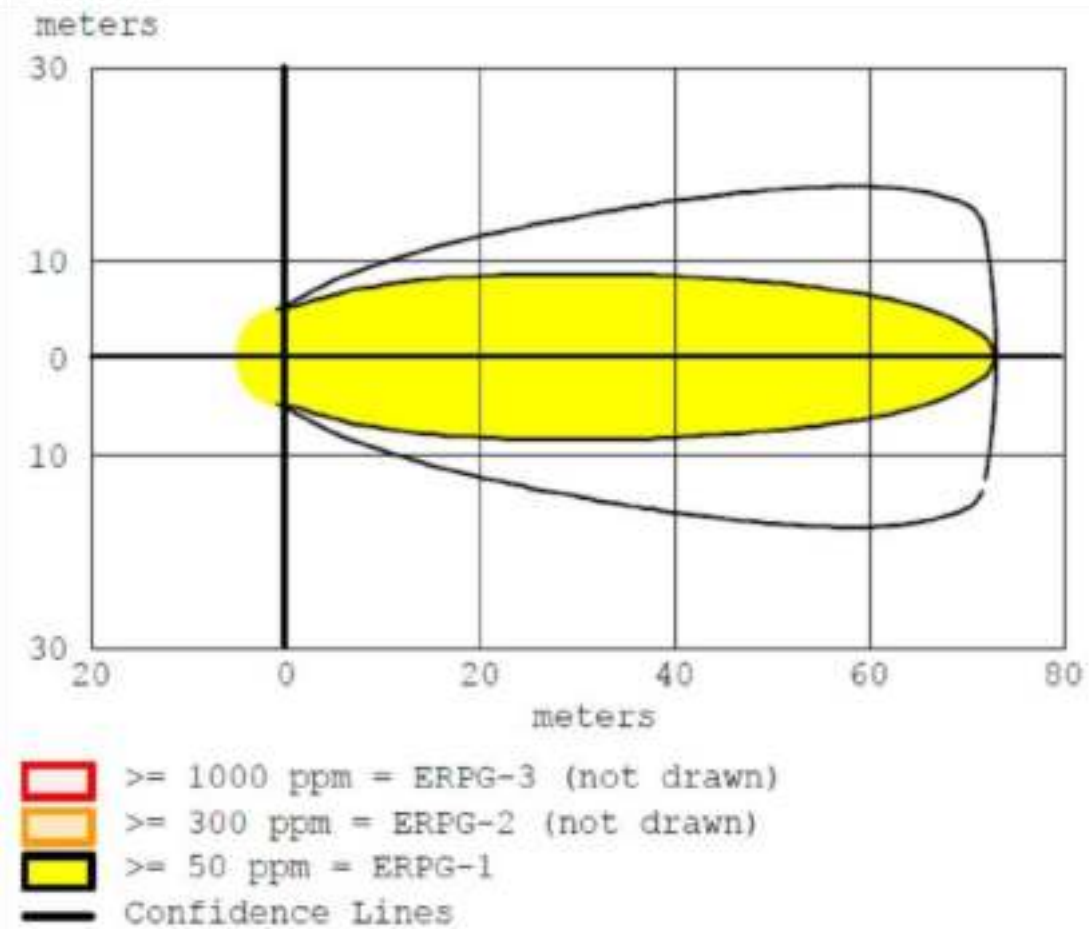
20.1.2.5 Instantaneous Release – Overpressure (Graph)



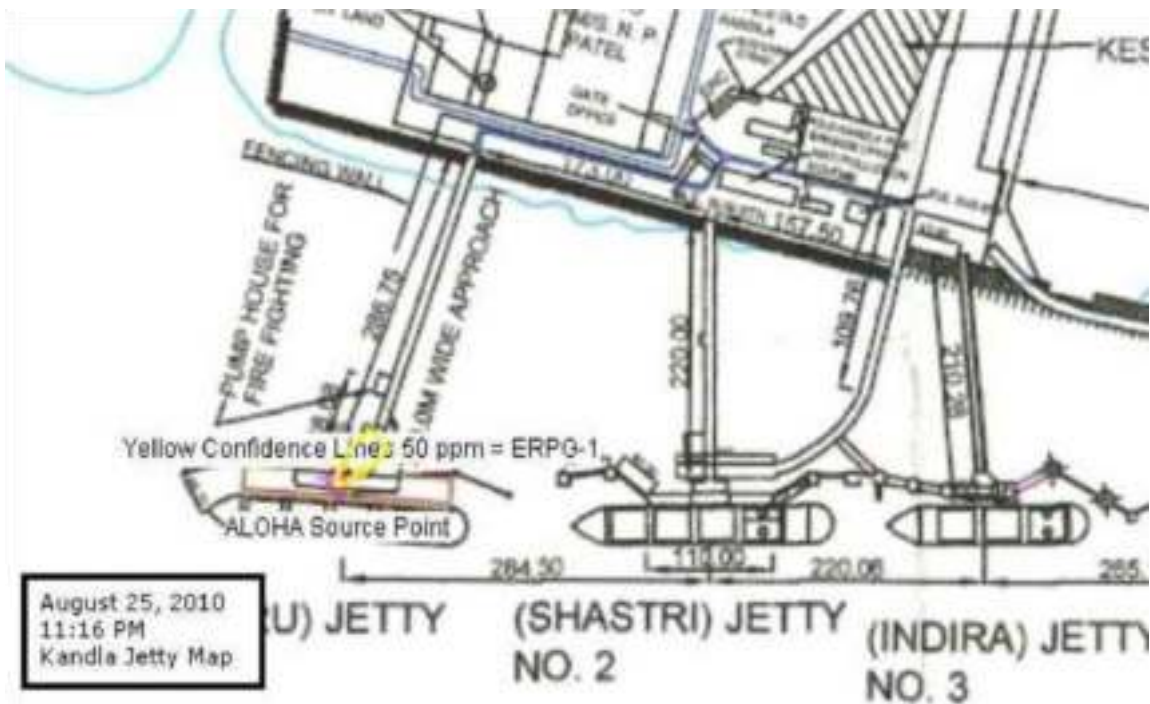
20.1.2.6 Instantaneous Release – Overpressure (Contour)



20.1.2.7 Evaporating Puddle – Toxic Threat Zone (Graph)

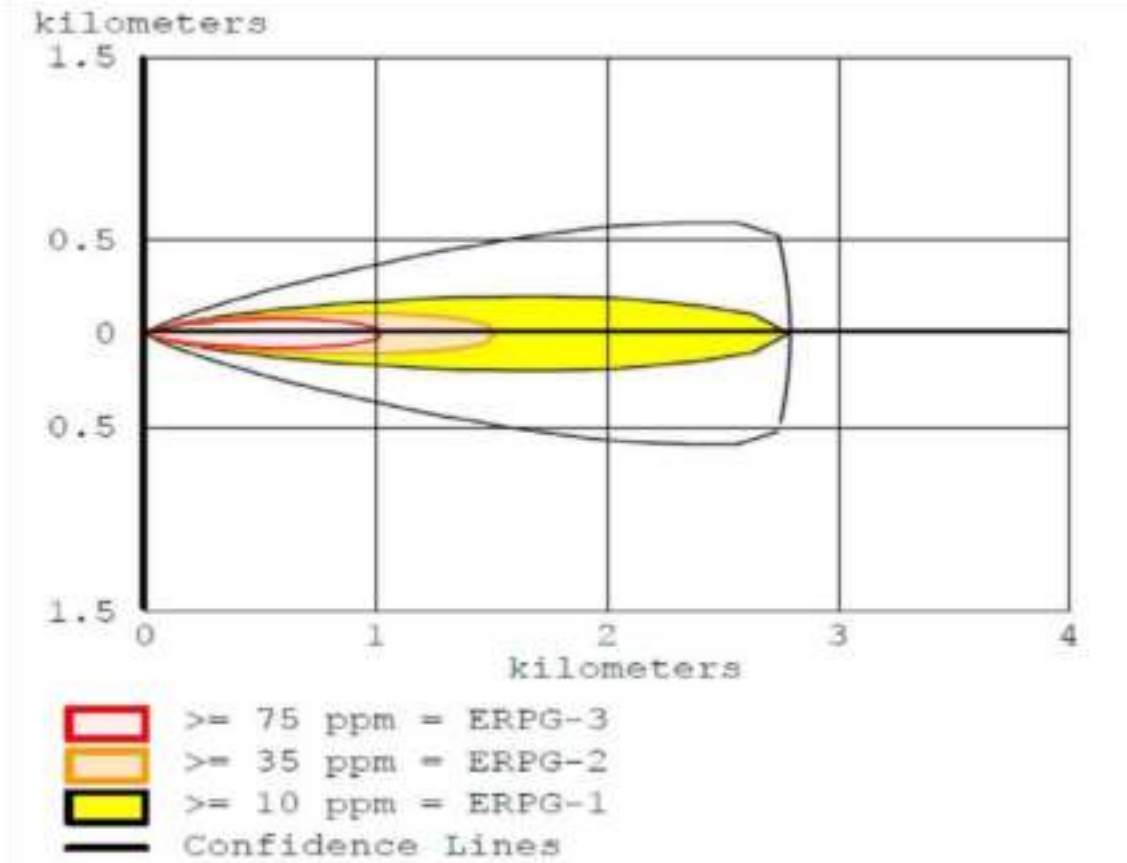


20.1.2.8 Evaporating Puddle – Toxic Threat Zone (Contour)

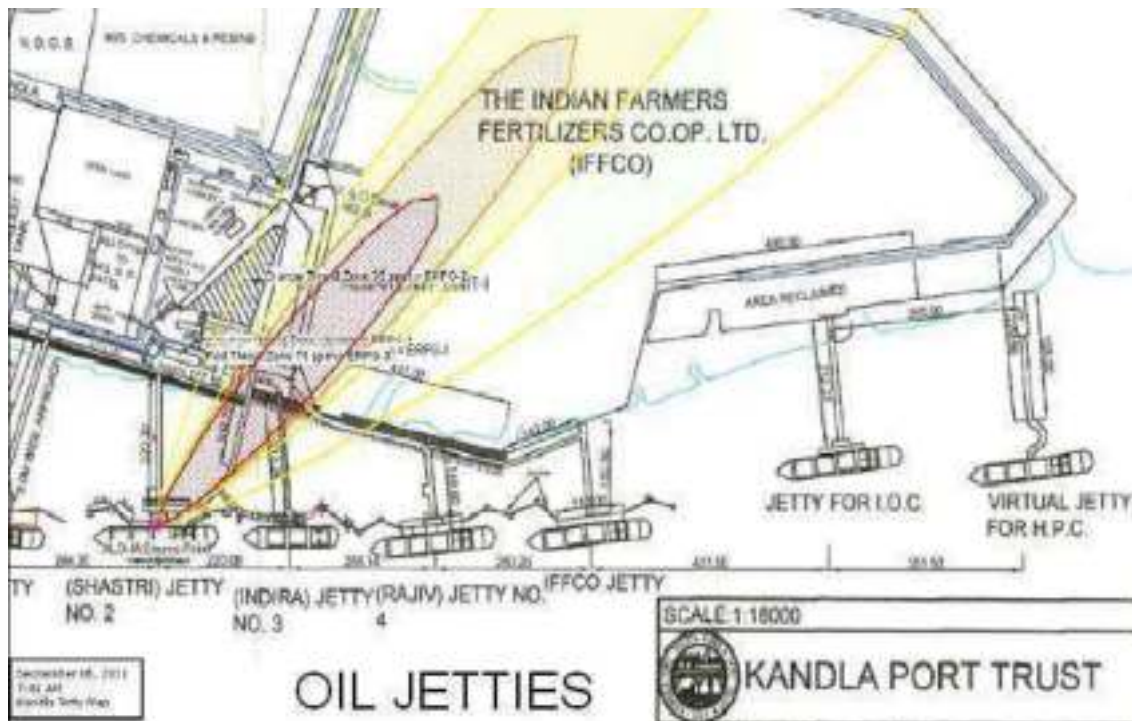


20.1.2.9 Burning Puddle – Thermal Radiation (Graph)

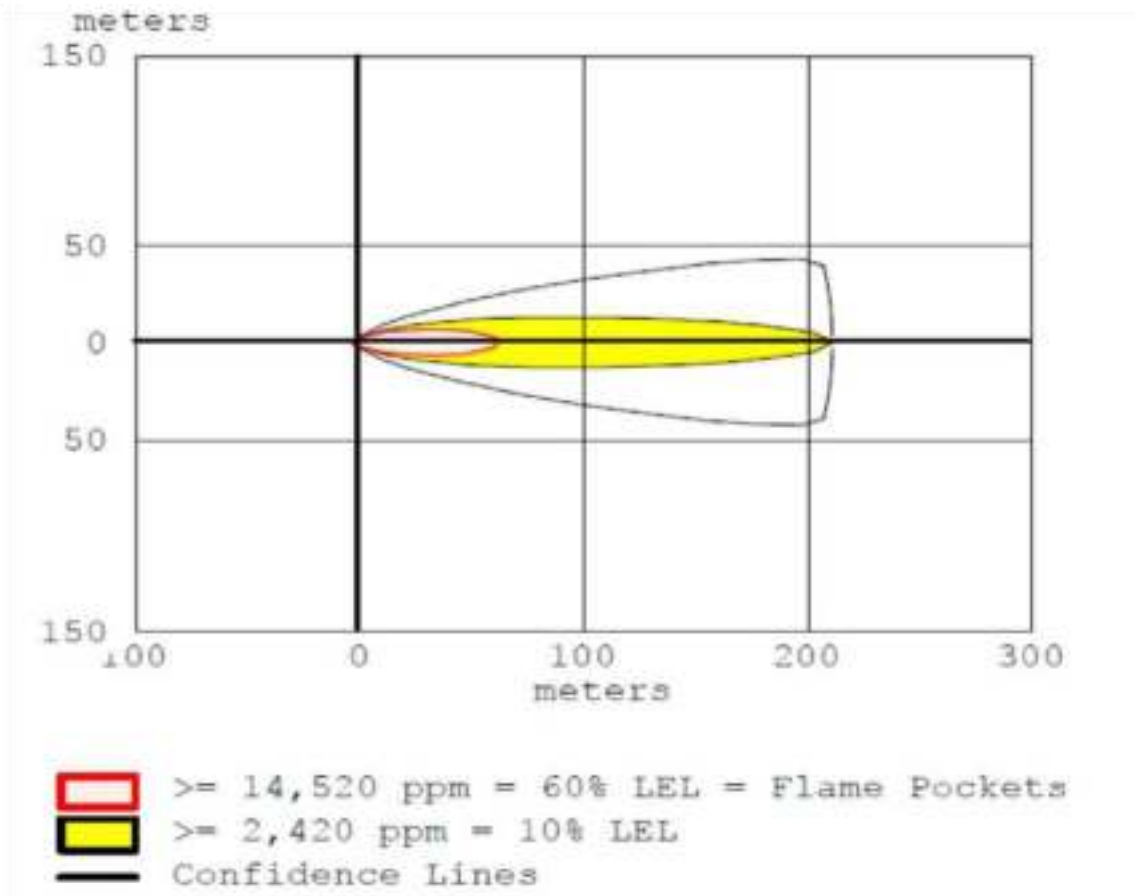
20.1.3.1 Instantaneous Release – Toxic Threat Zone (Graph)



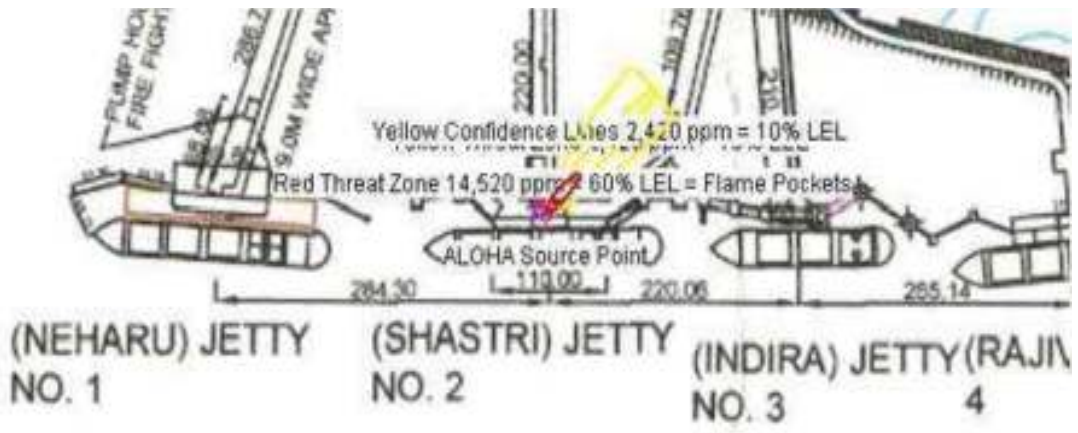
20.1.3.2 Instantaneous Release – Toxic Threat Zone (Contour)



20.1.3.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



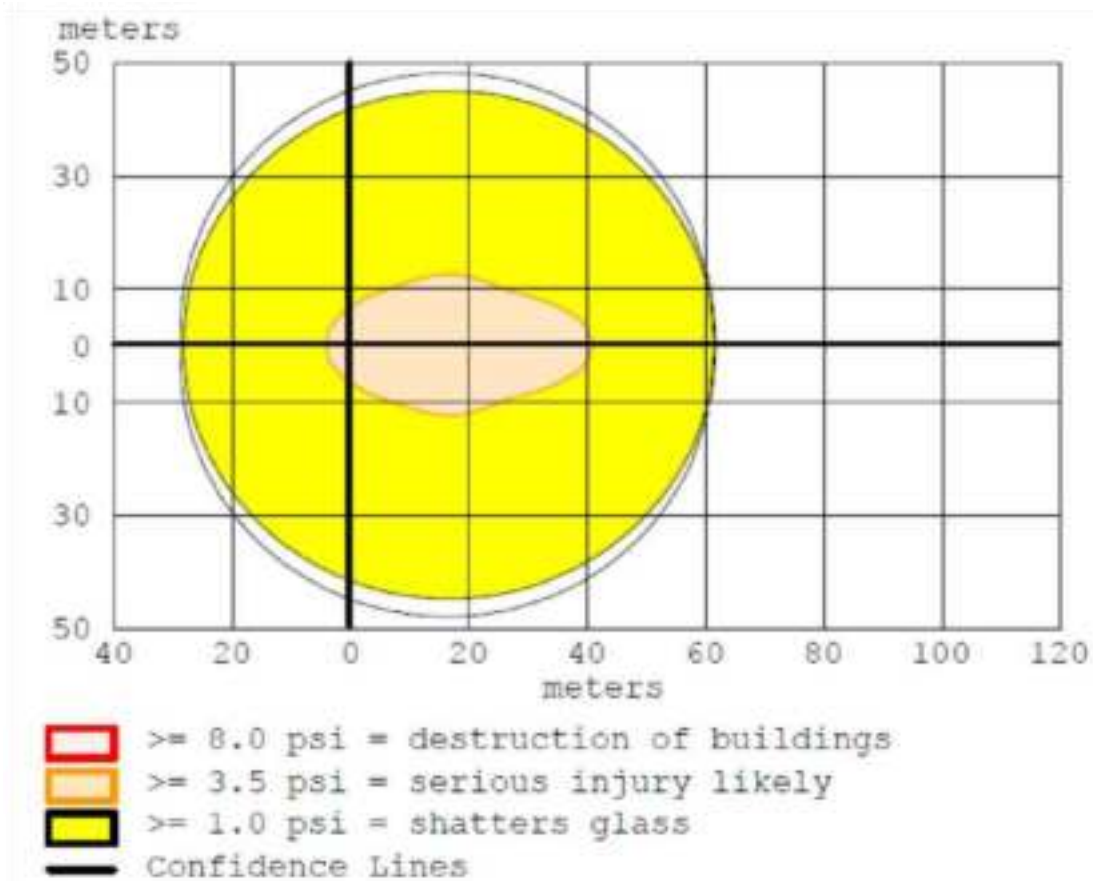
20.1.3.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



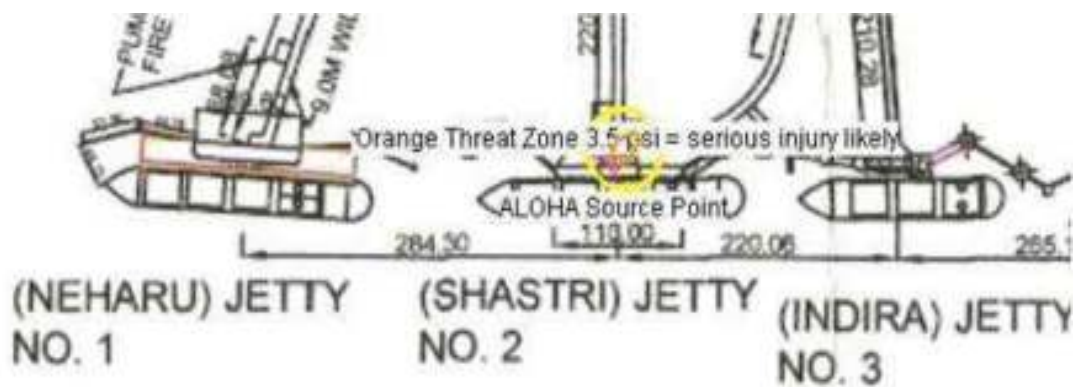
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 Kandla Jetty Map

OIL JETTIES

20.1.3.5 Instantaneous Release – Overpressure (Graph)



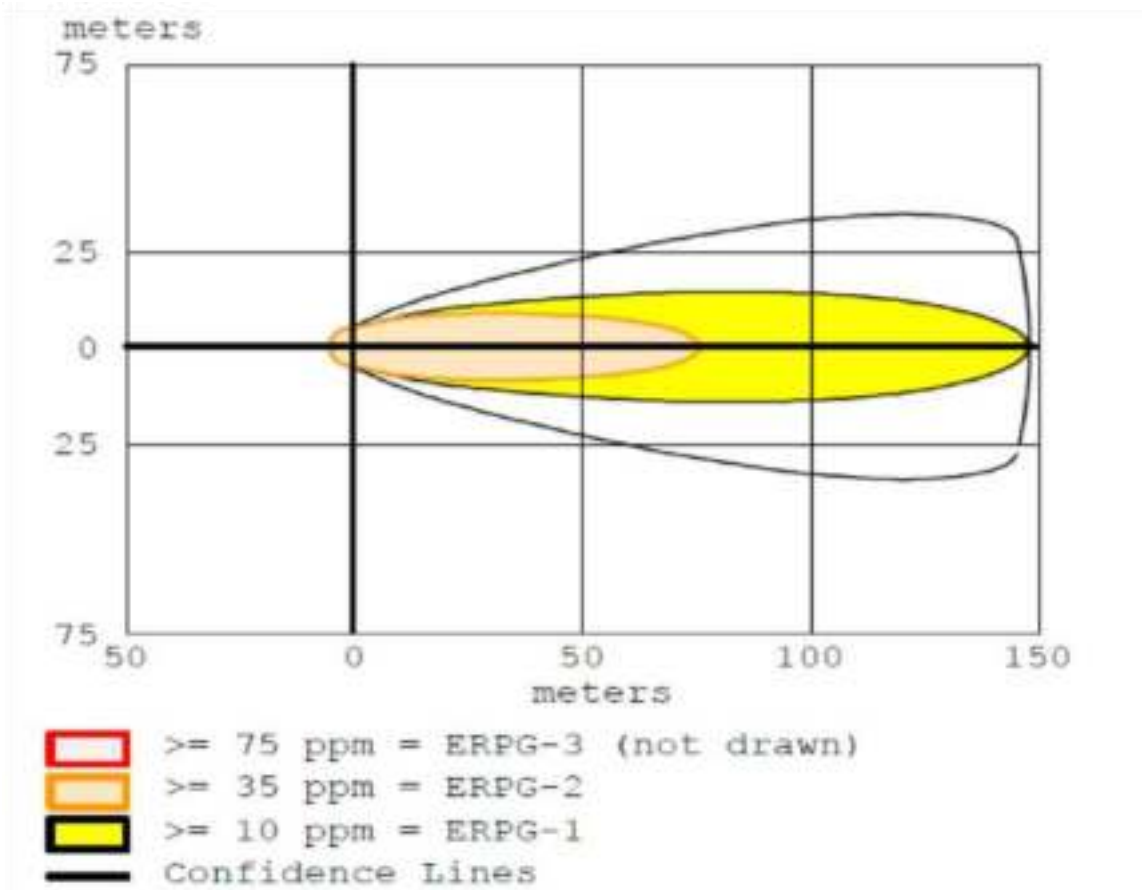
20.1.3.6 Instantaneous Release – Overpressure (Contour)



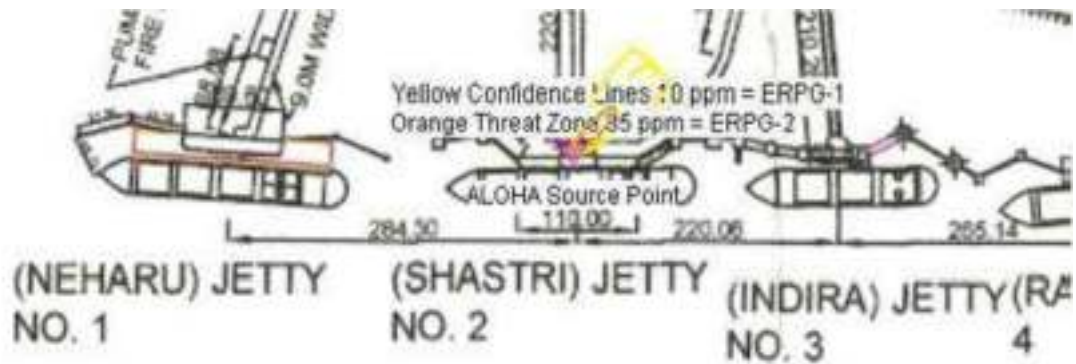
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Kandla Jetty Map

OIL JETTIES

20.1.3.7 Evaporating Puddle – Toxic Threat Zone (Graph)



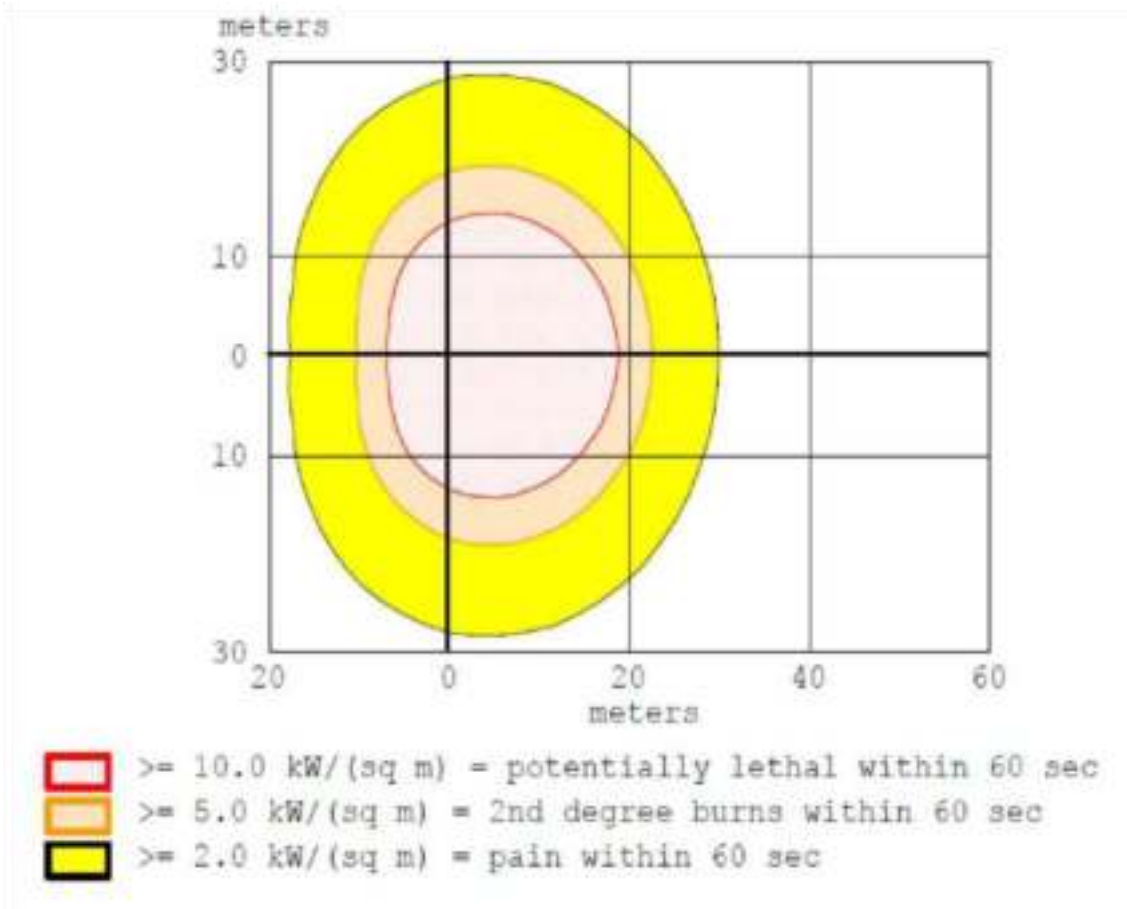
20.1.3.8 Evaporating Puddle – Toxic Threat Zone (Contour)



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Kandla Jetty Map

OIL JETTIES

20.1.3.9 Burning Puddle – Thermal Radiation (Graph)



20.1.3.10 Burning Puddle – Thermal Radiation (Contour)

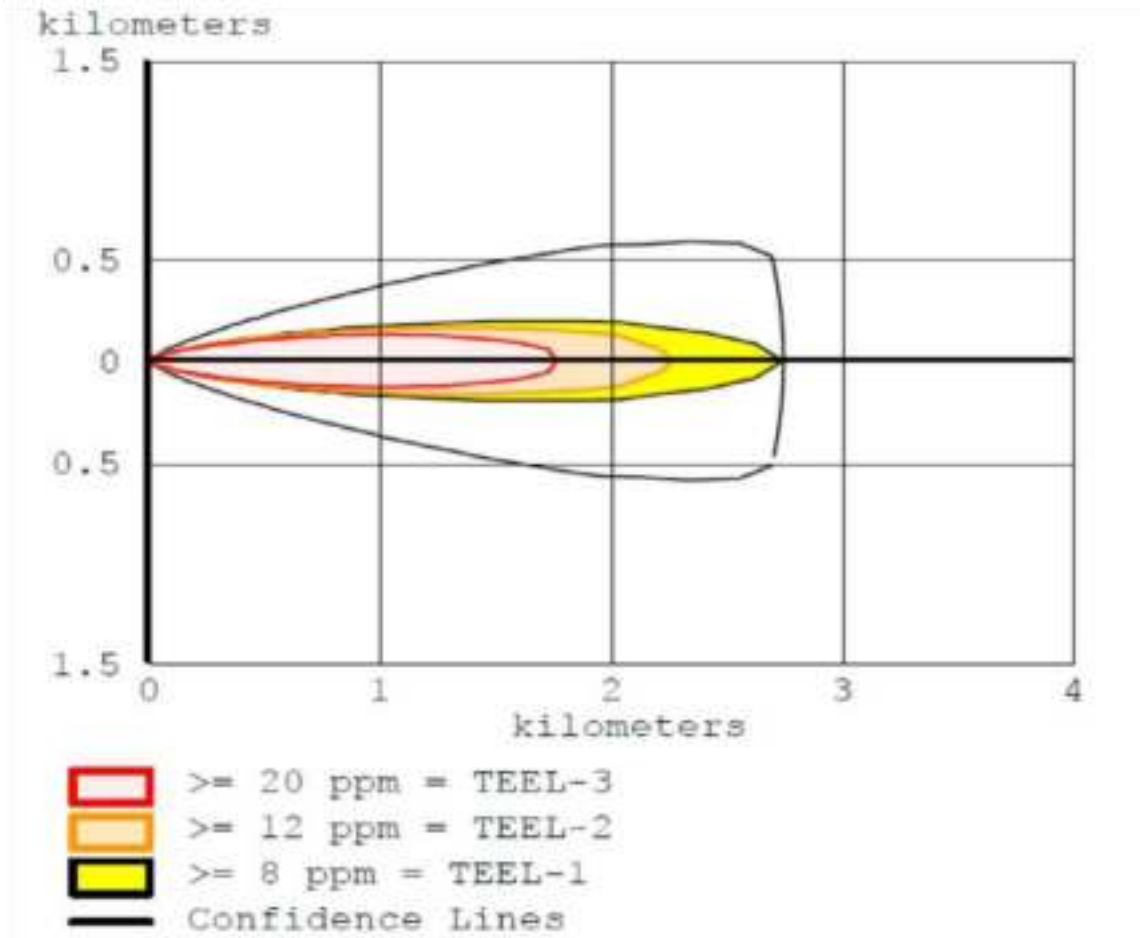


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 Kandla Jetty Map

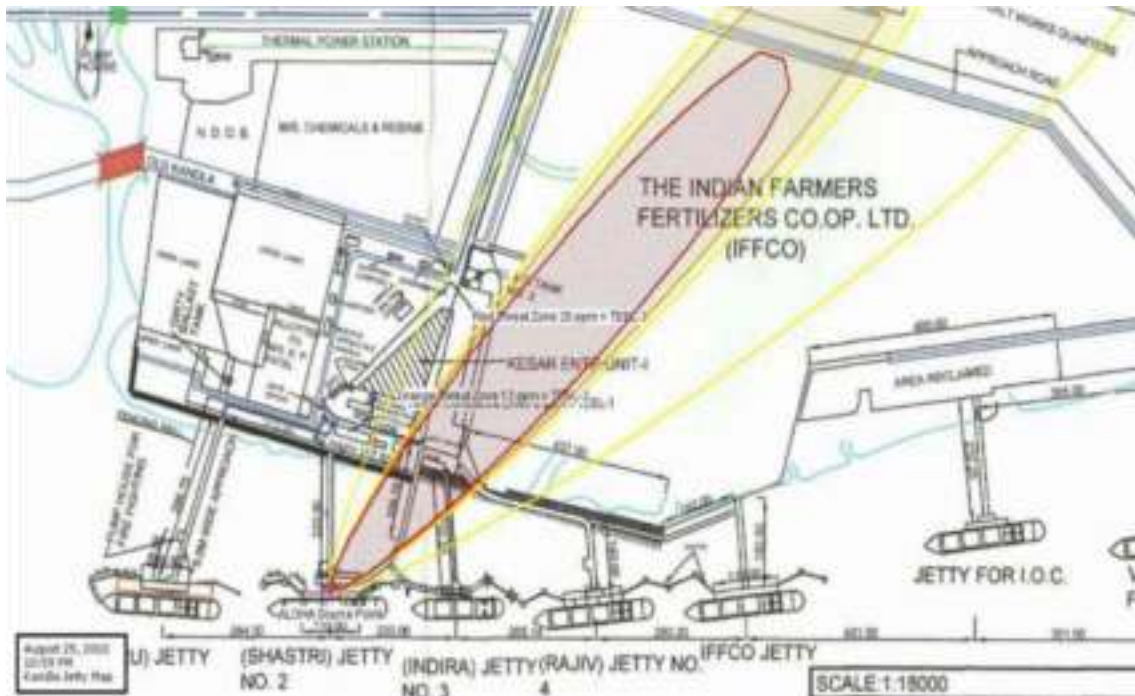
OIL JETTIES

20.1.4 Jetty Two – Aniline

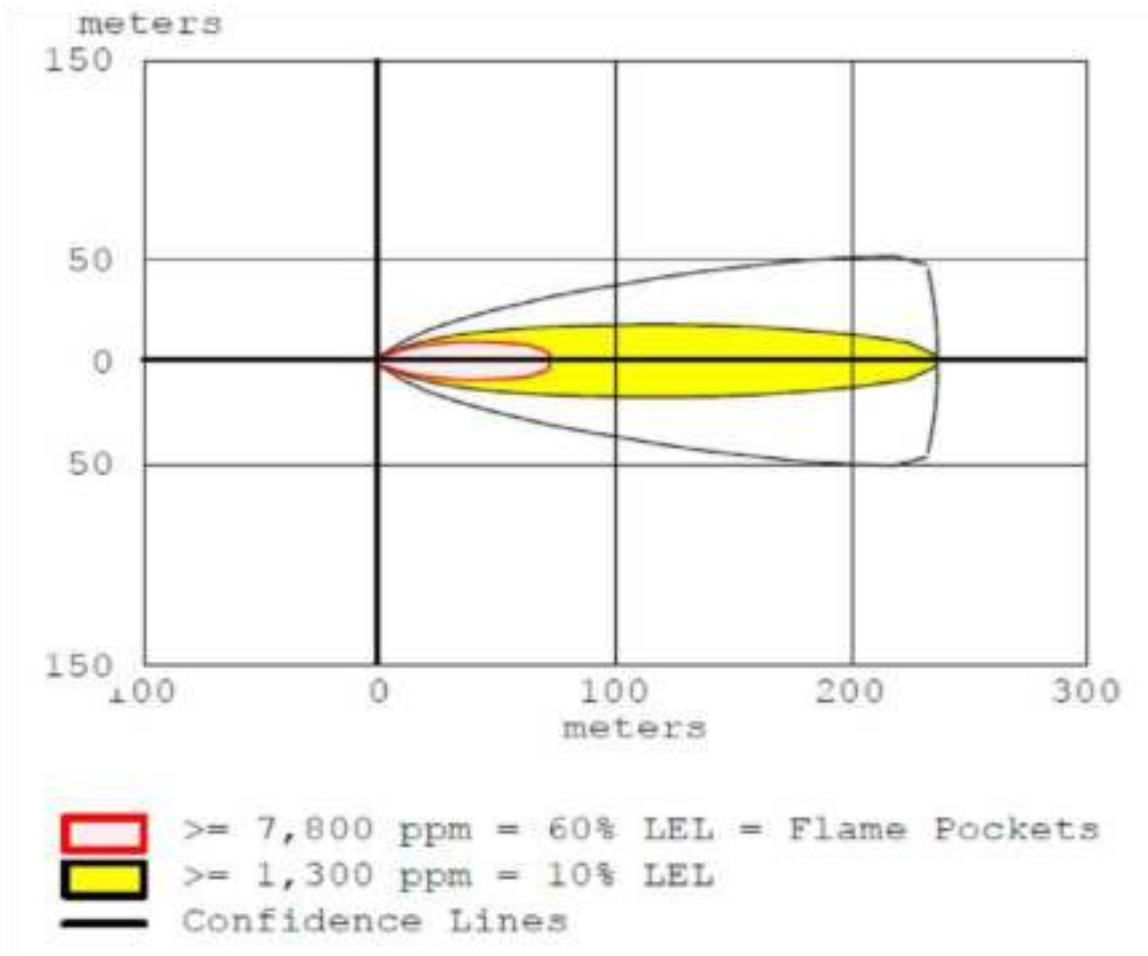
20.1.4.1 Instantaneous Release – Toxic Threat Zone (Graph)



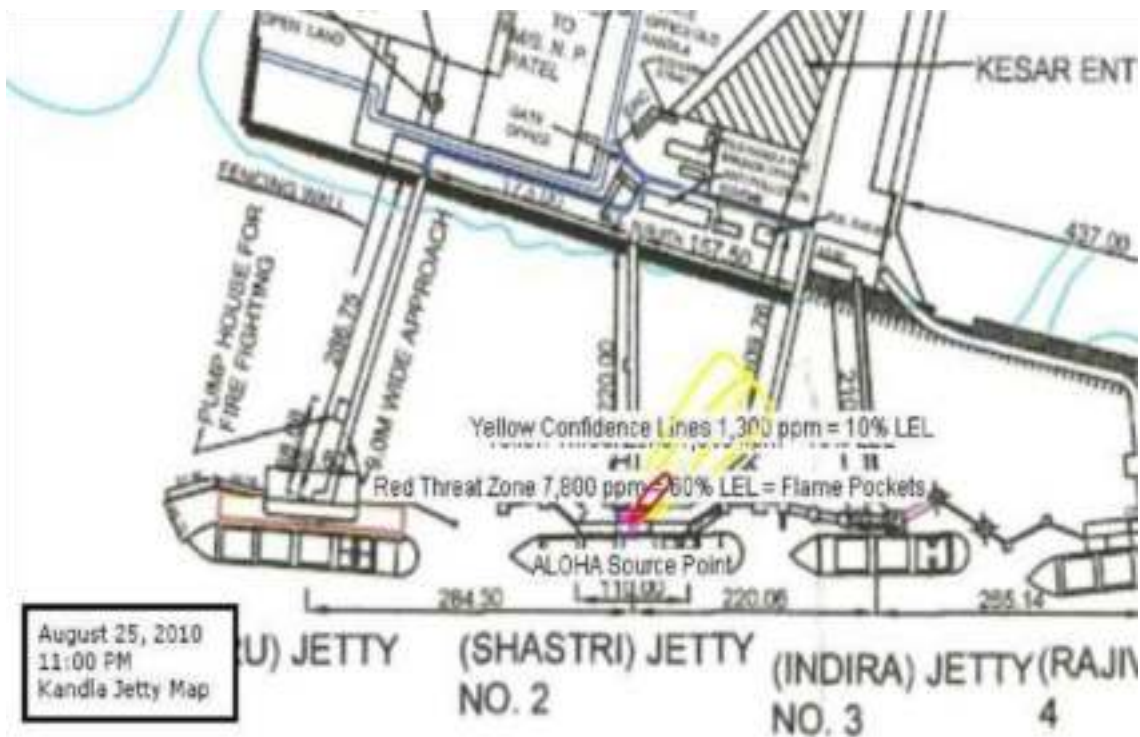
20.1.4.2 Instantaneous Release – Toxic Threat Zone (Contour)



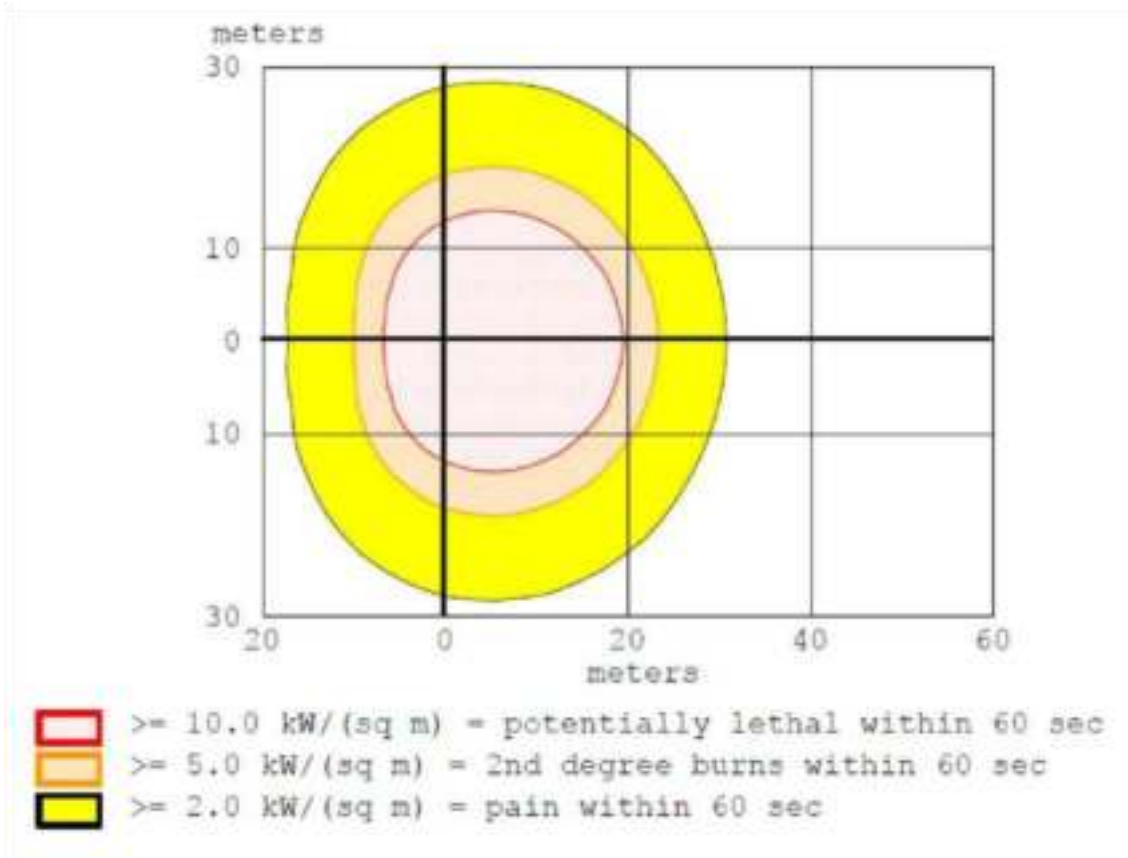
20.1.4.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



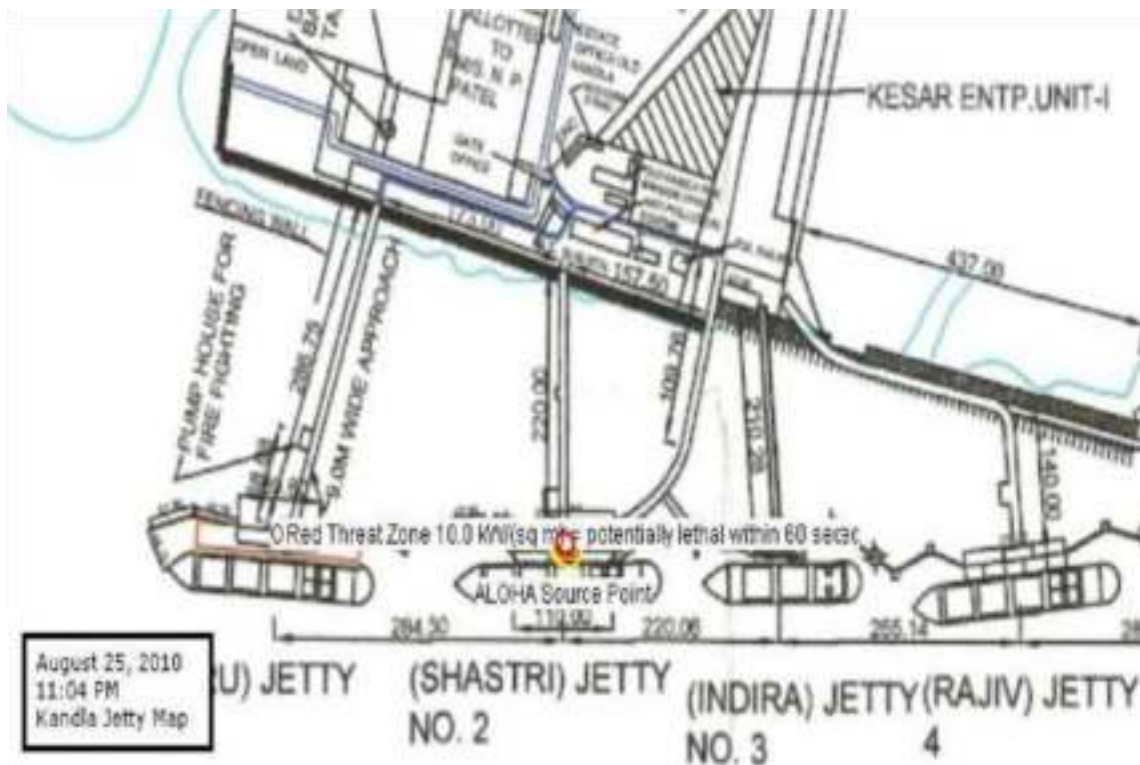
20.1.4.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



20.1.4.5 Instantaneous Release – Overpressure (Graph)

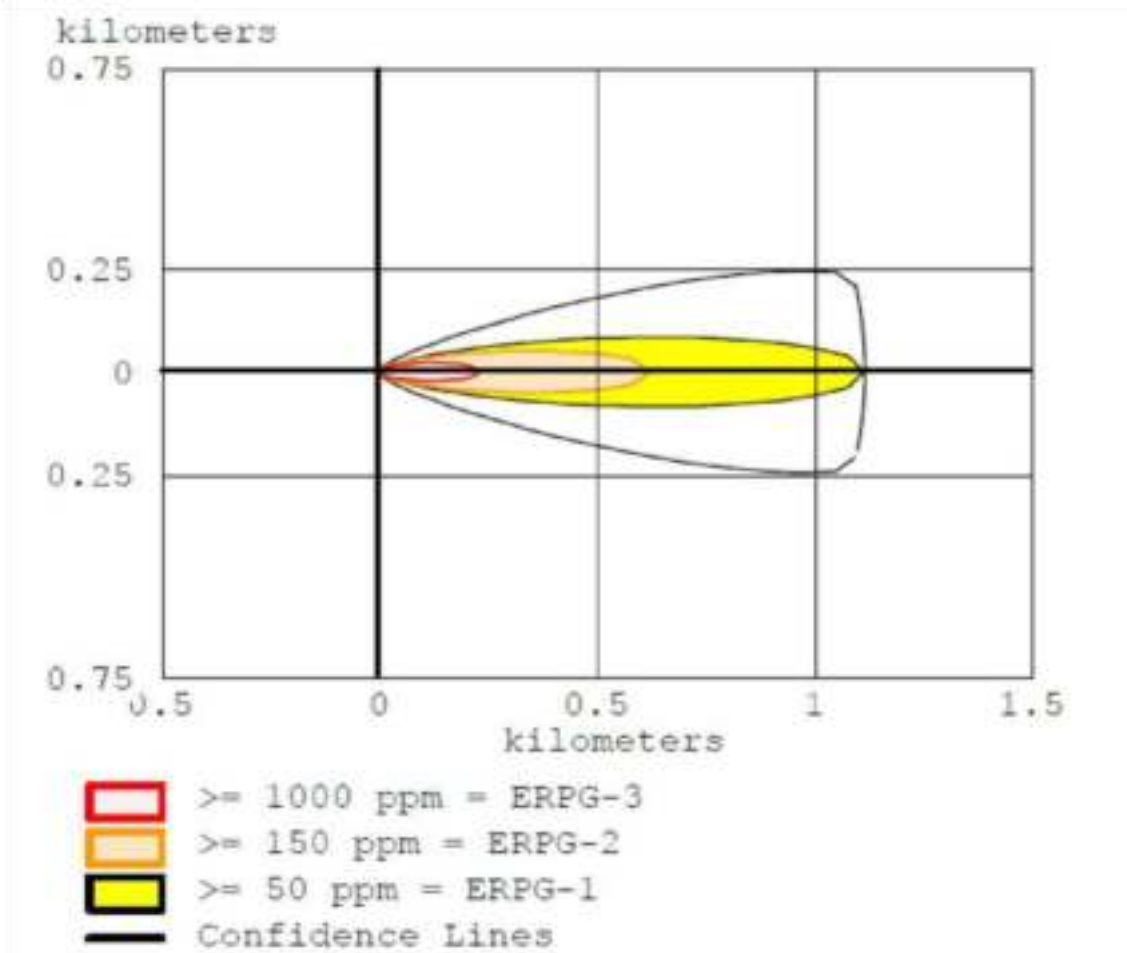


20.1.4.8 Burning Puddle – Thermal Radiation (Contour)

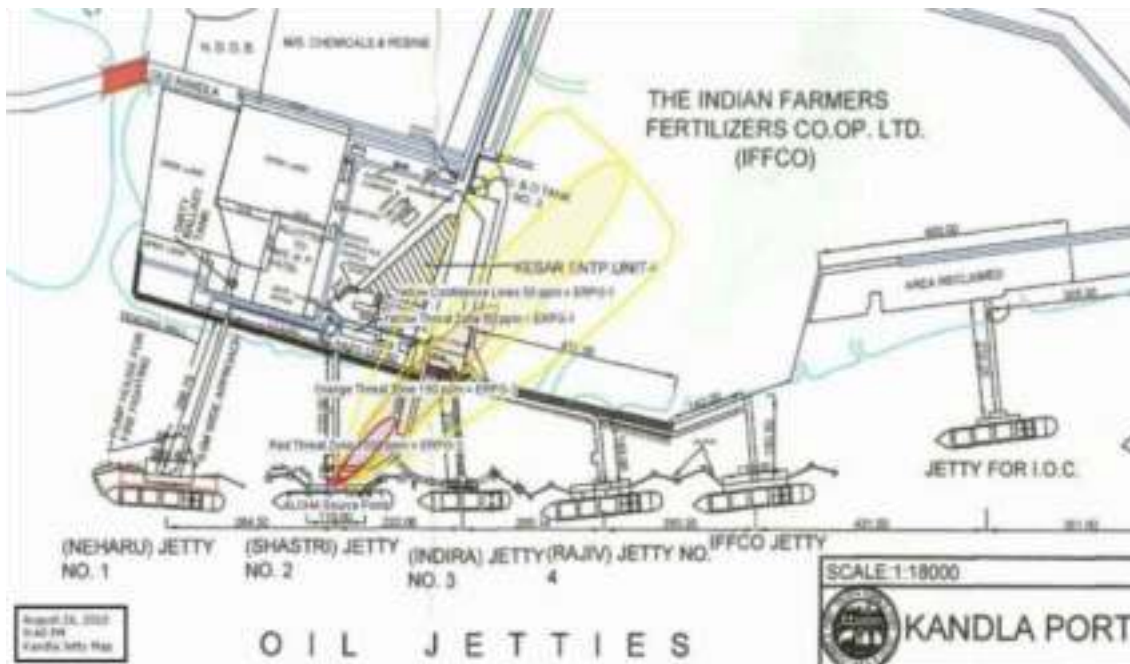


20.1.5 Jetty Two – Benzene

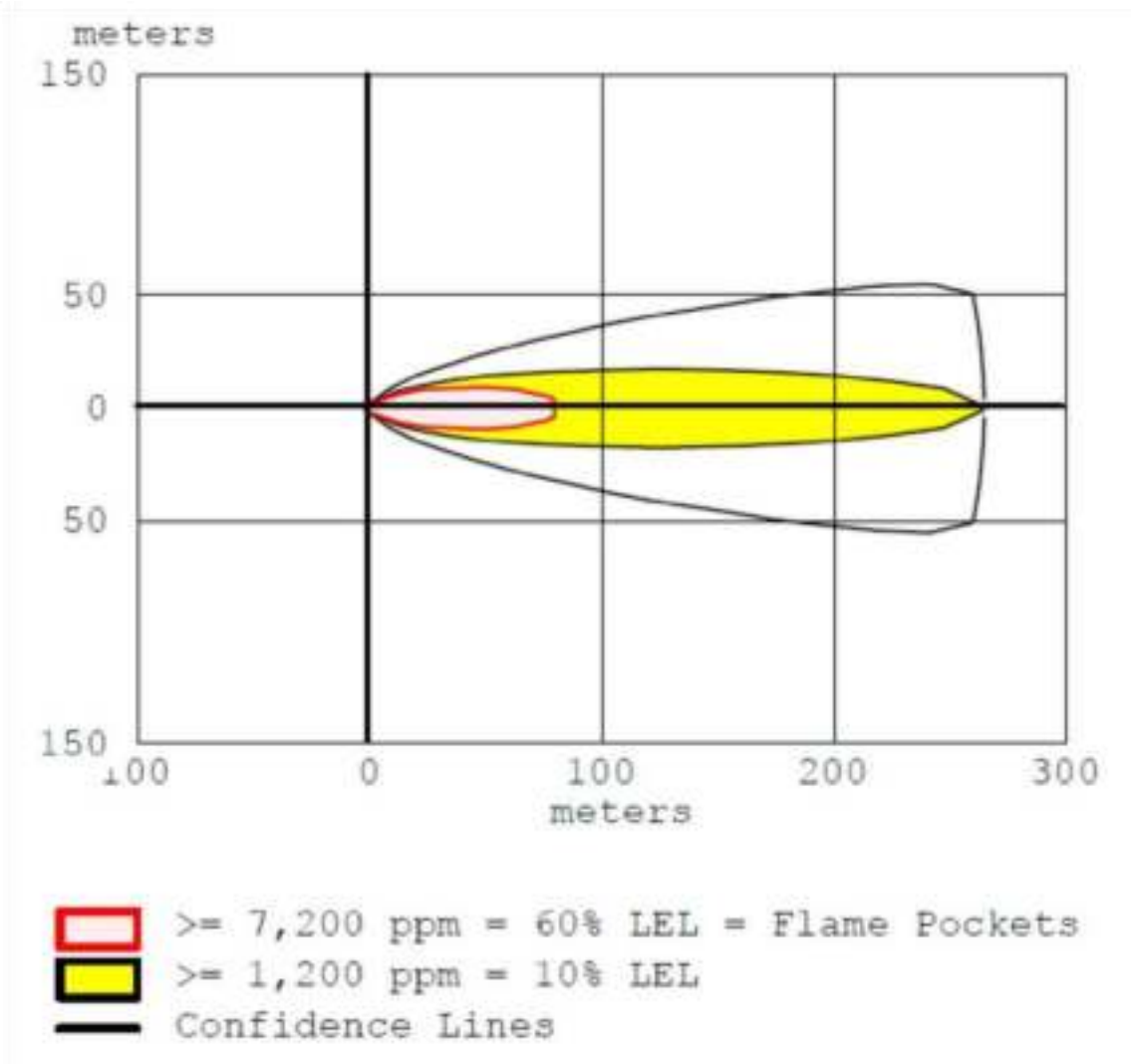
20.1.5.1 Instantaneous Release – Toxic Threat Zone (Graph)



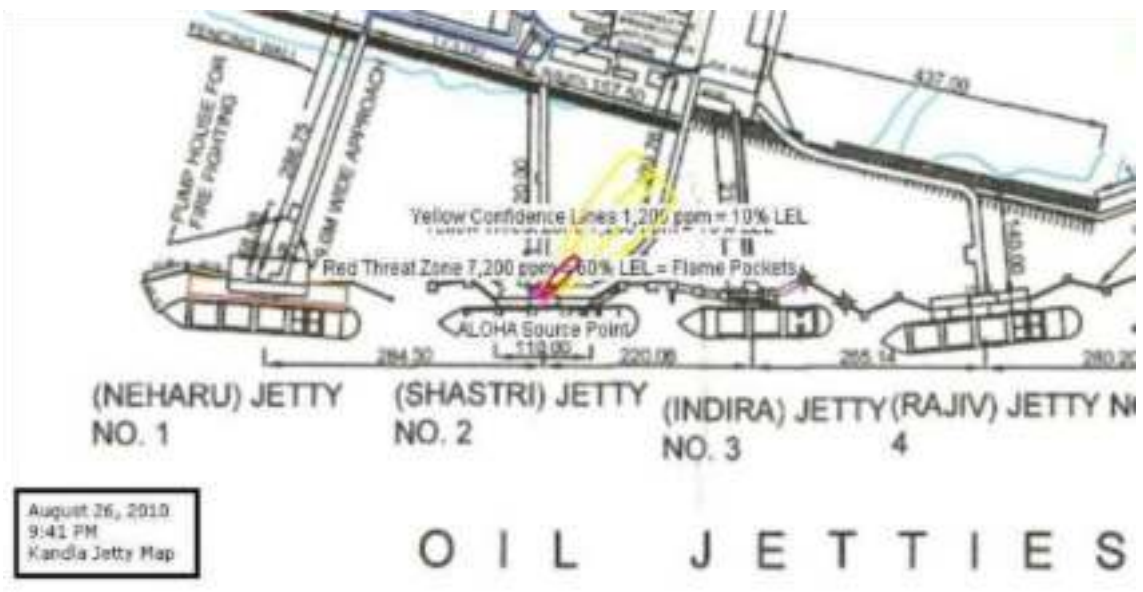
20.1.5.2 Instantaneous Release – Toxic Threat Zone (Contour)



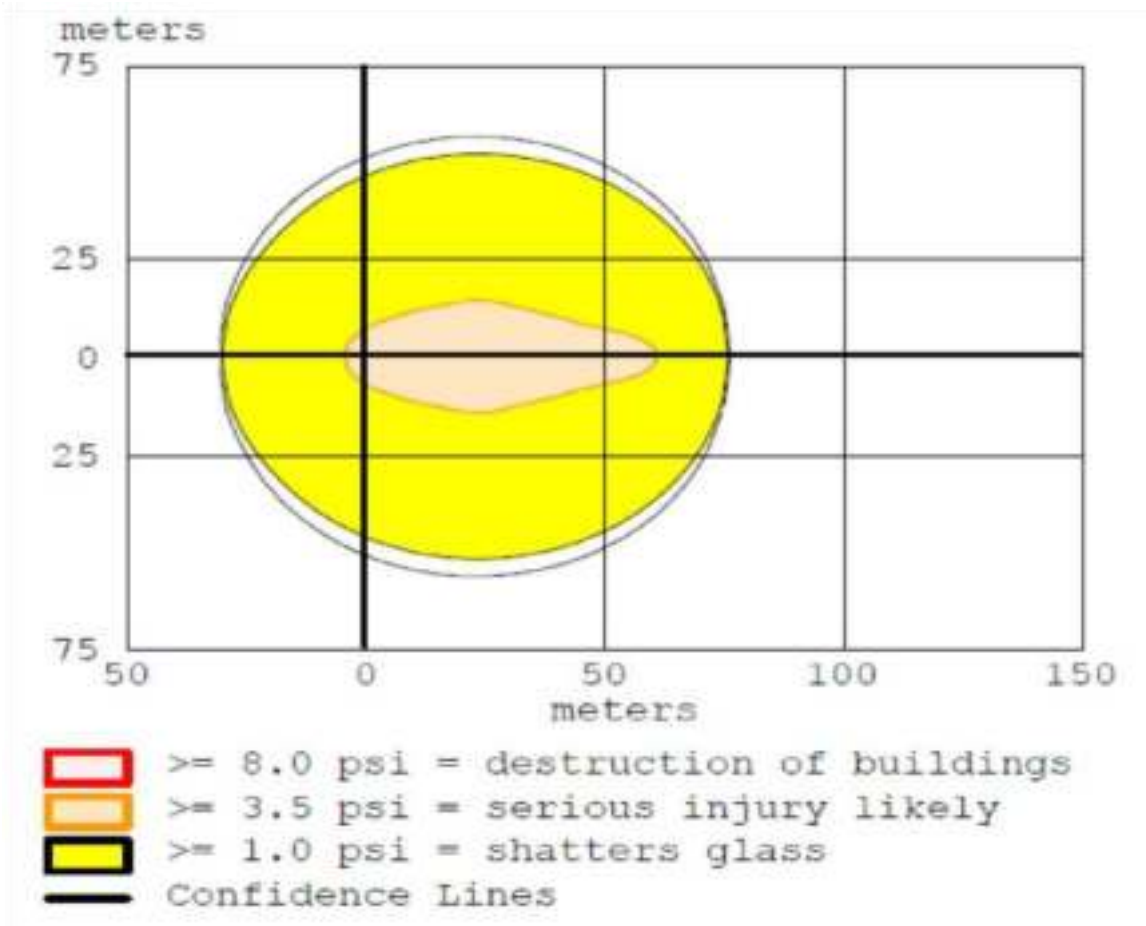
20.1.5.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



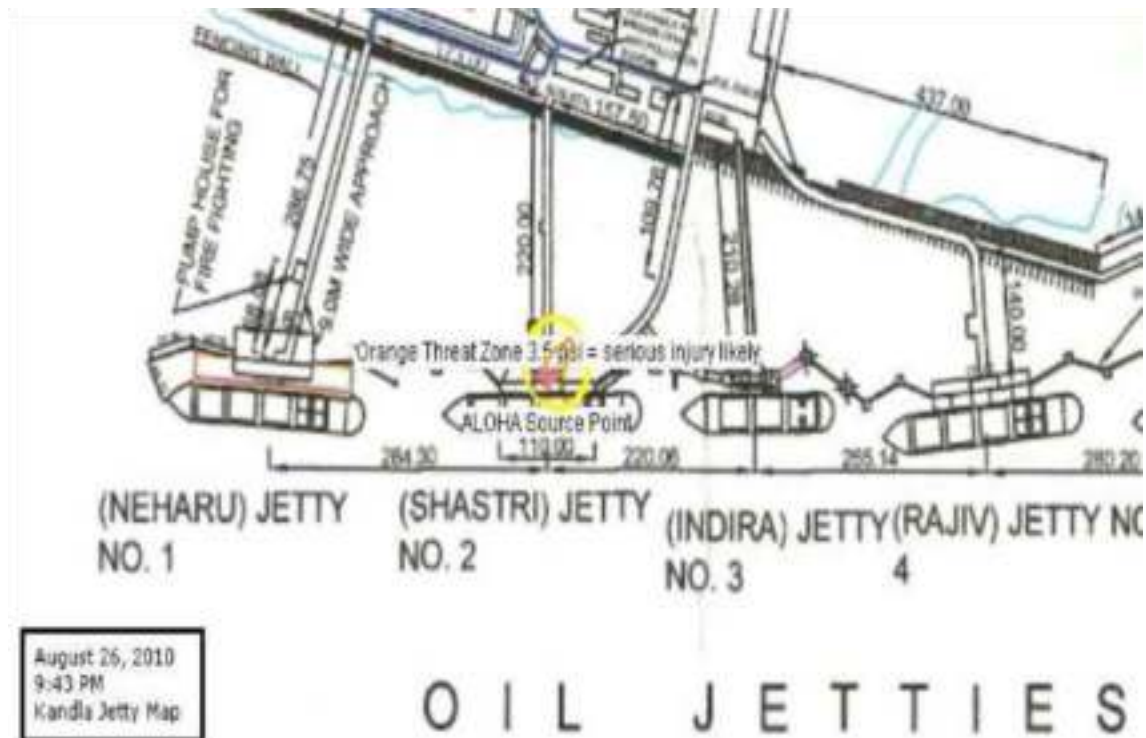
20.1.5.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



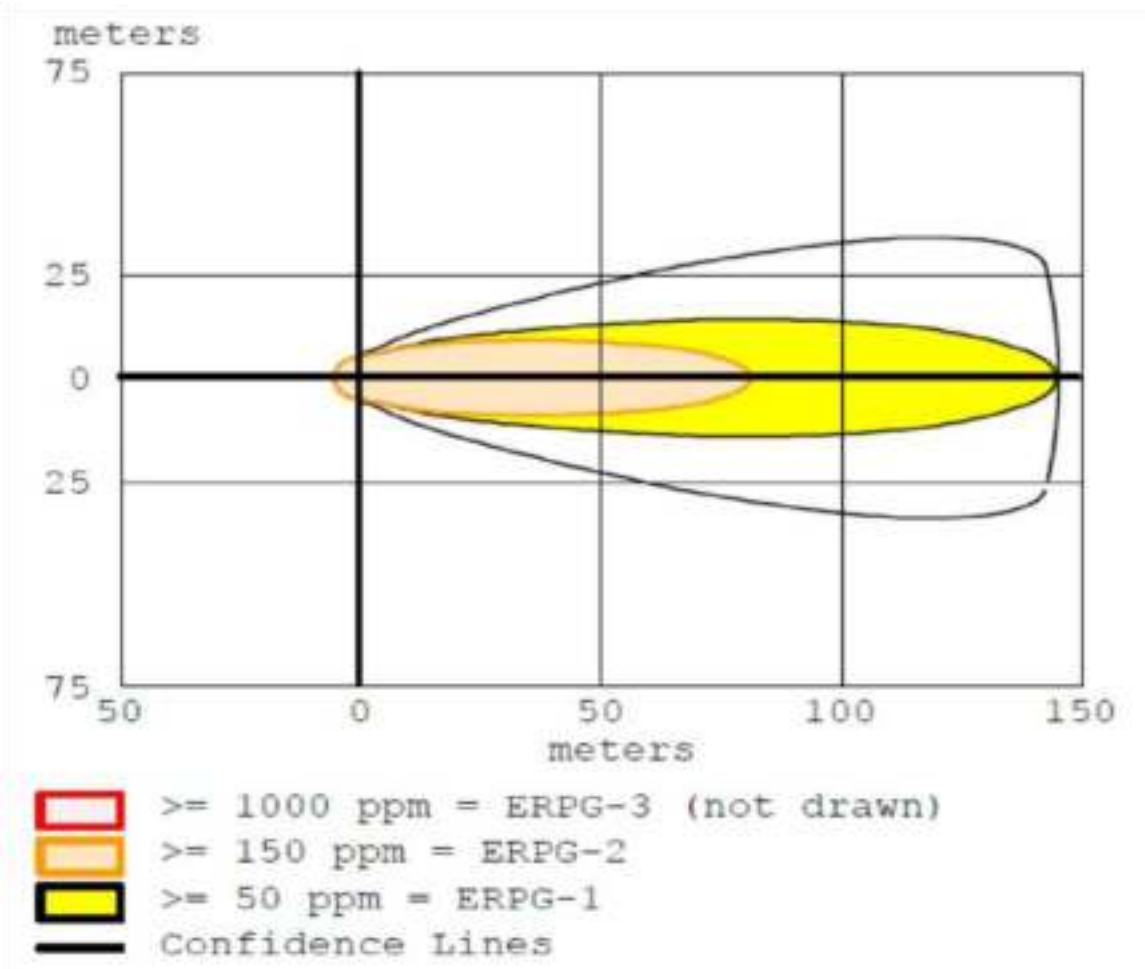
20.1.5.5 Instantaneous Release – Overpressure (Graph)



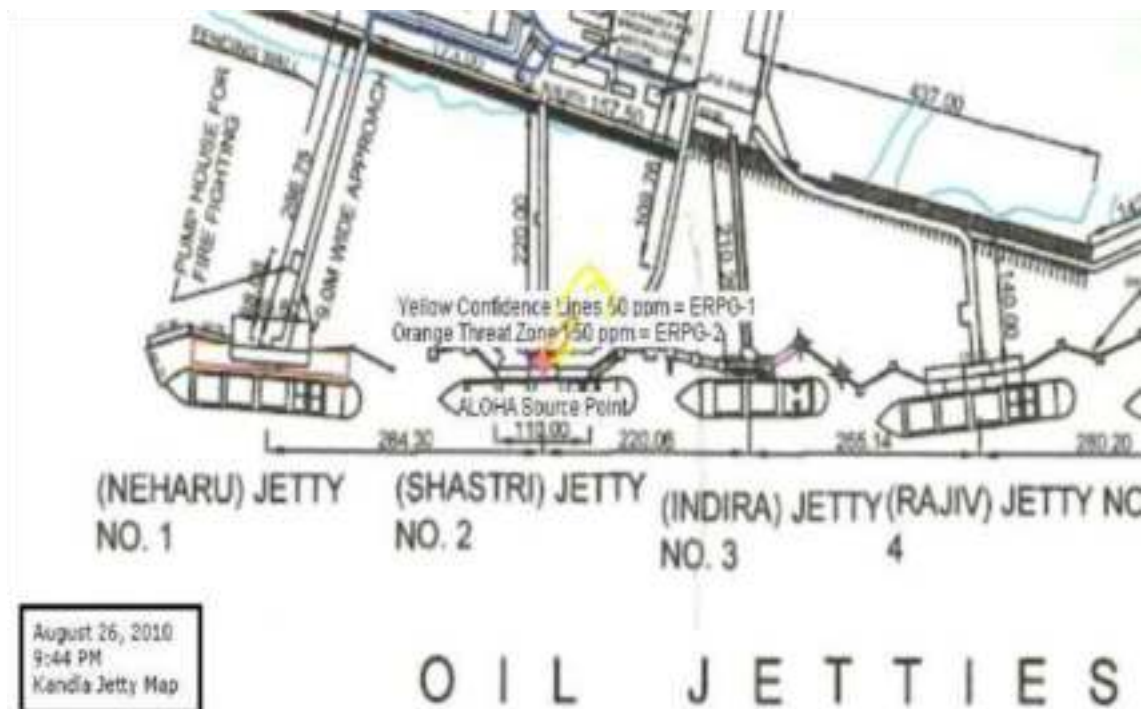
20.1.5.6 Instantaneous Release – Overpressure (Contour)



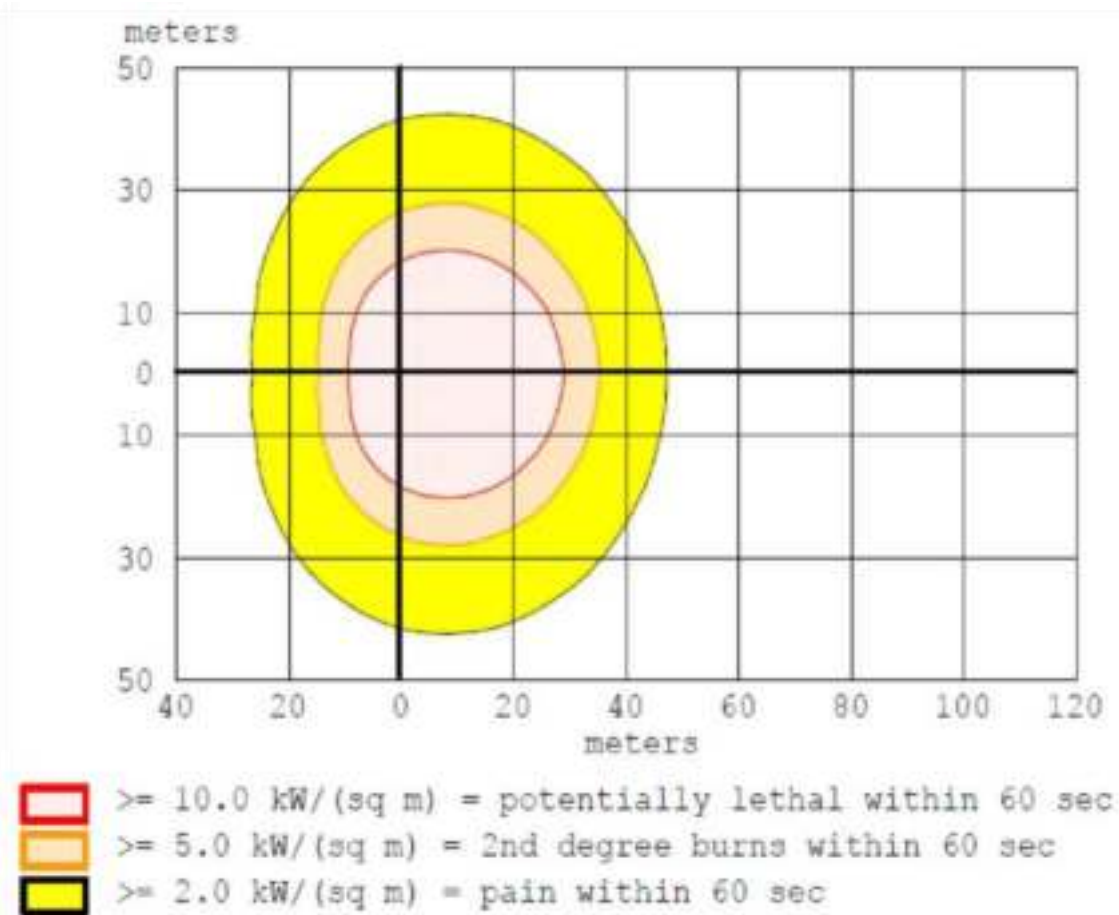
20.1.5.7 Evaporating Puddle – Toxic Threat Zone (Graph)



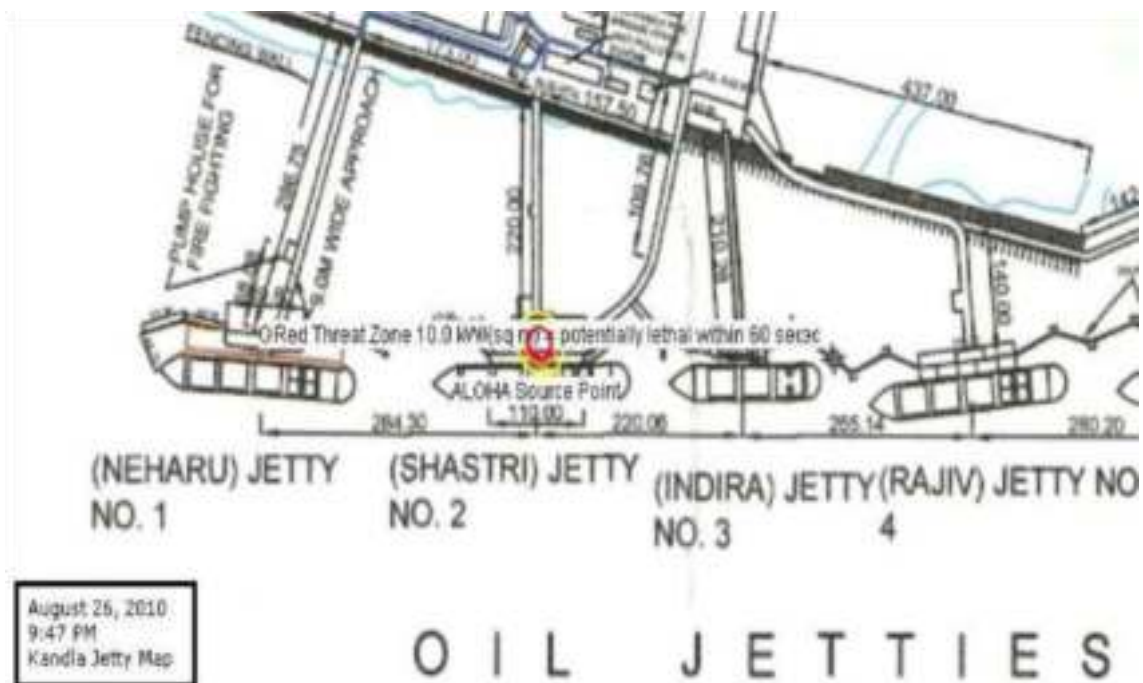
20.1.5.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.5.9 Burning Puddle – Thermal Radiation (Graph)

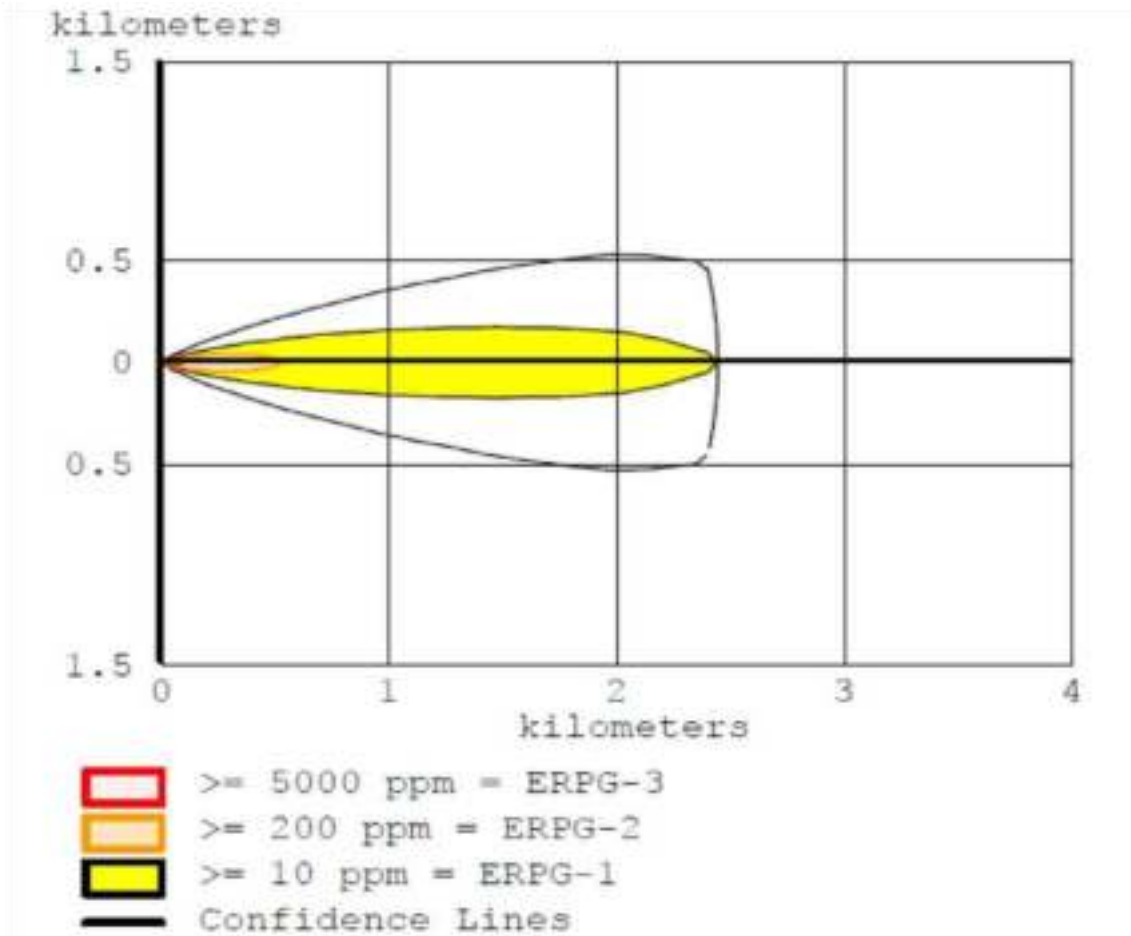


20.1.5.10 Burning Puddle – Thermal Radiation (Contour)

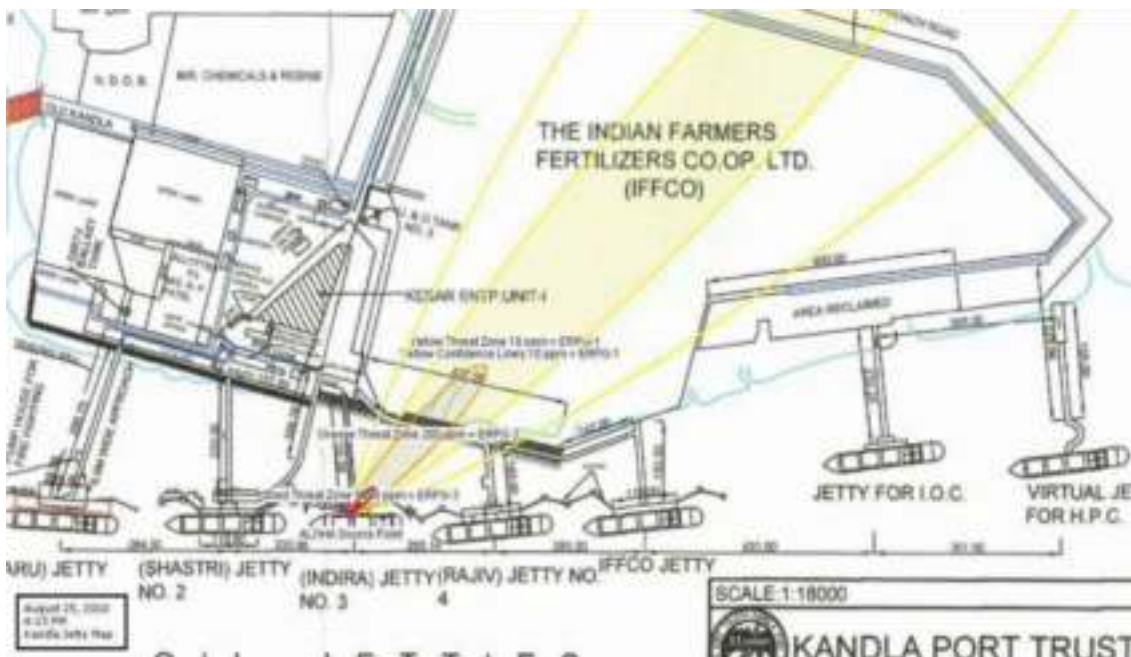


20.1.6 Jetty Three – 1:3, Butadiene

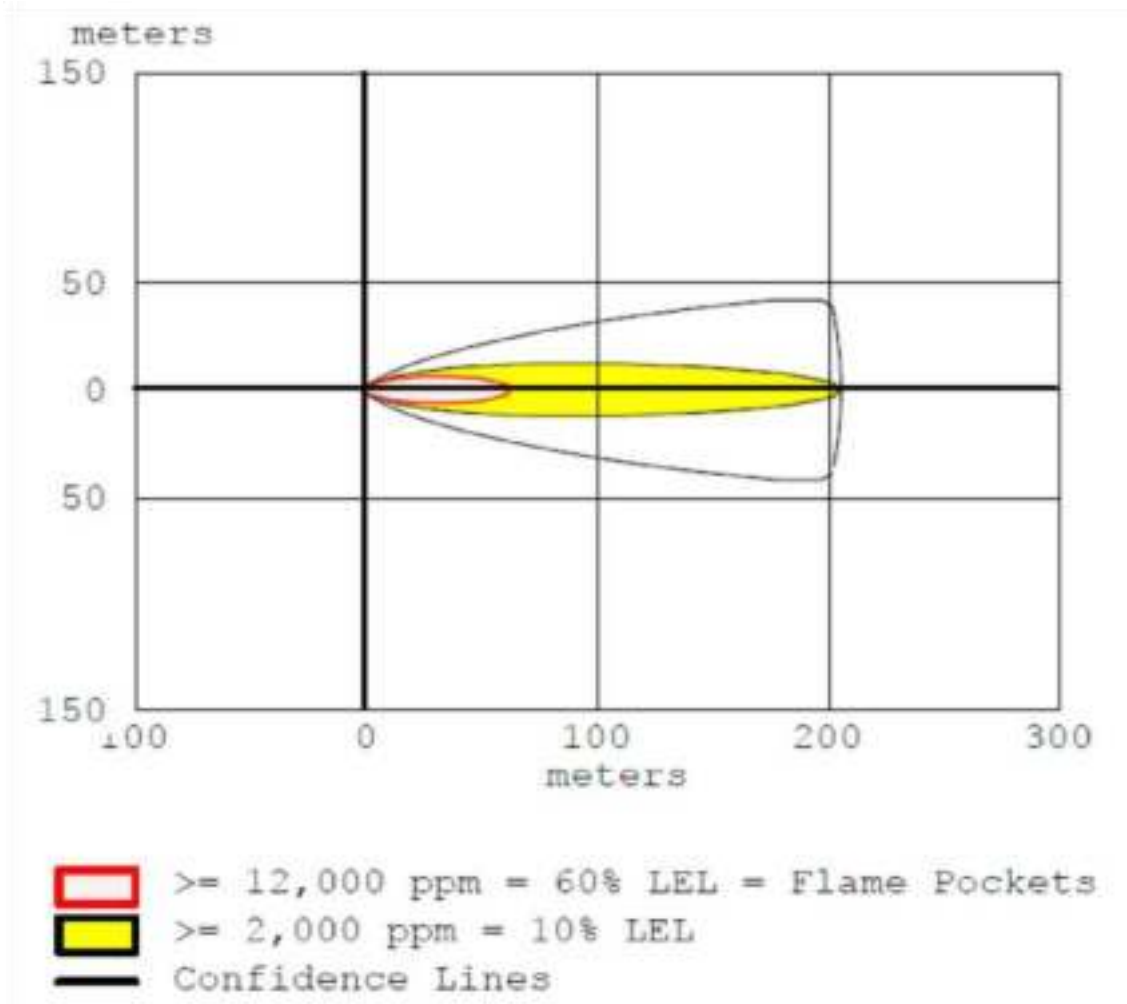
20.1.6.1 Instantaneous Release – Toxic Threat Zone (Graph)



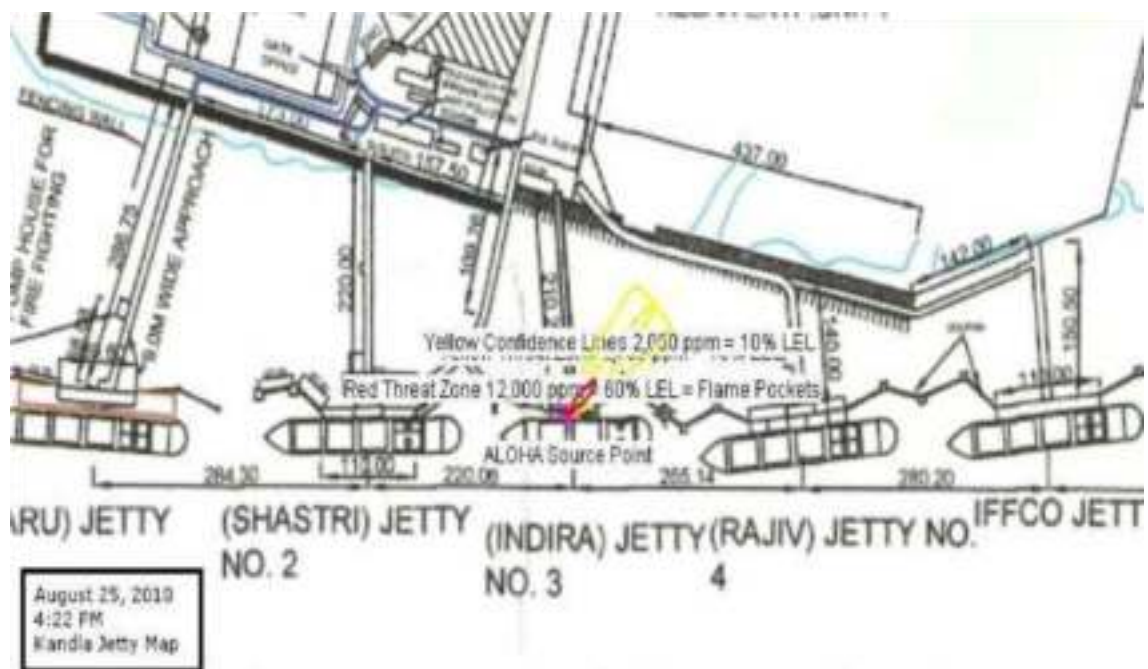
20.1.6.2 Instantaneous Release – Toxic Threat Zone (Contour)



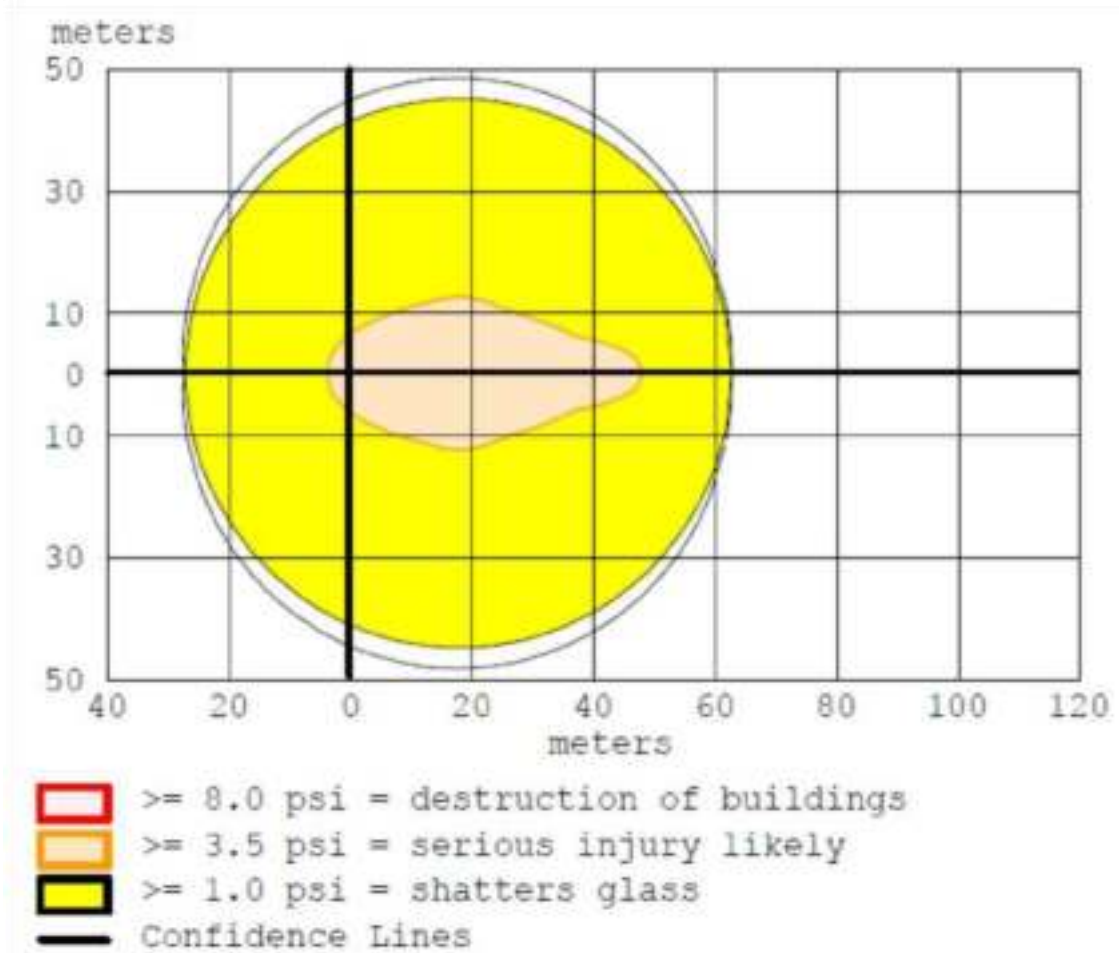
20.1.6.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



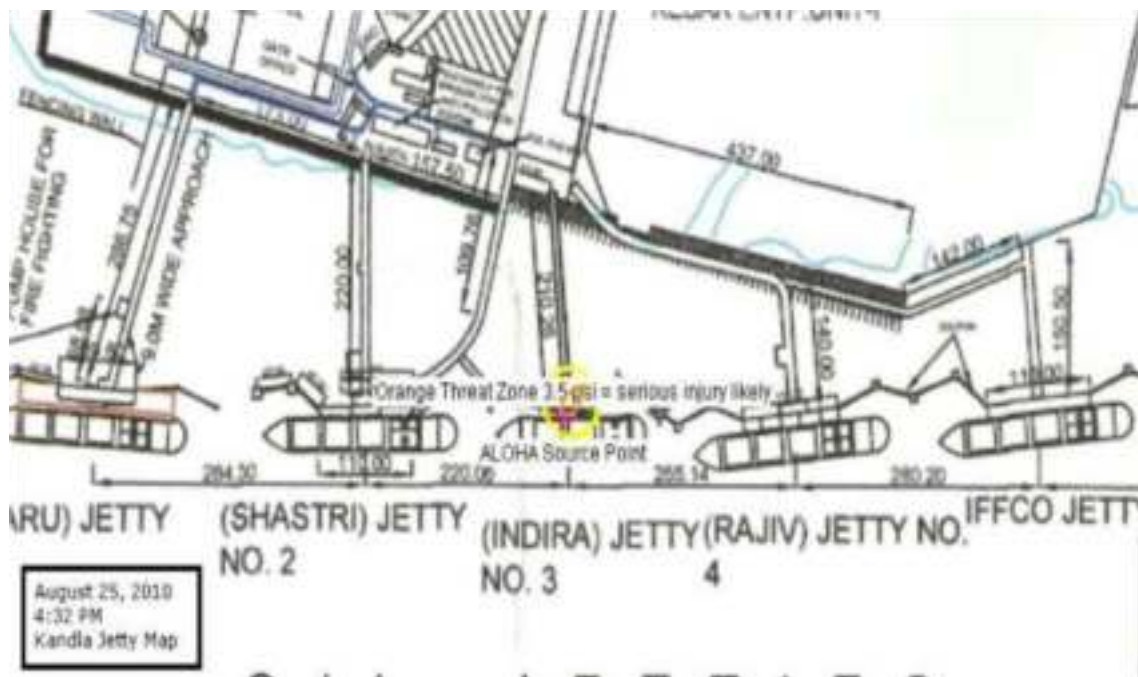
20.1.6.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



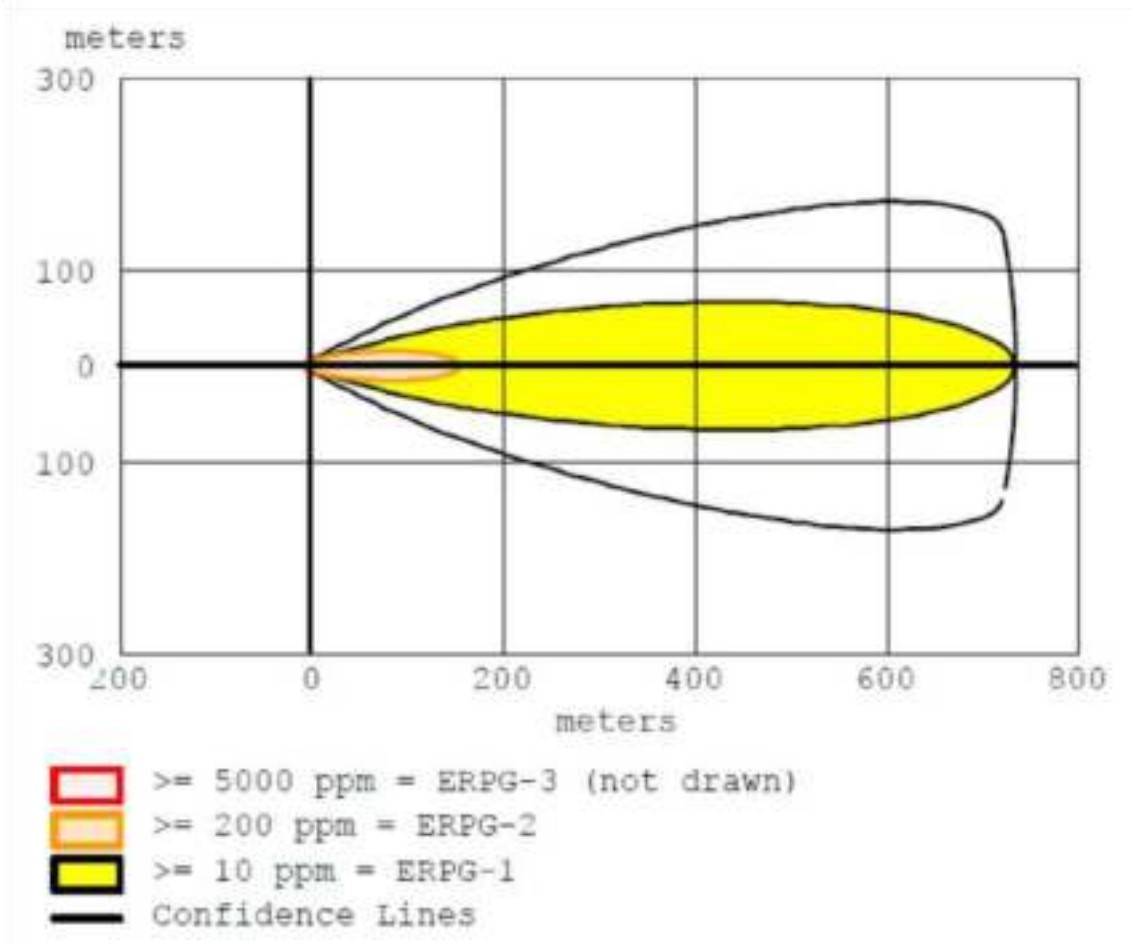
20.1.6.5 Instantaneous Release – Overpressure (Graph)



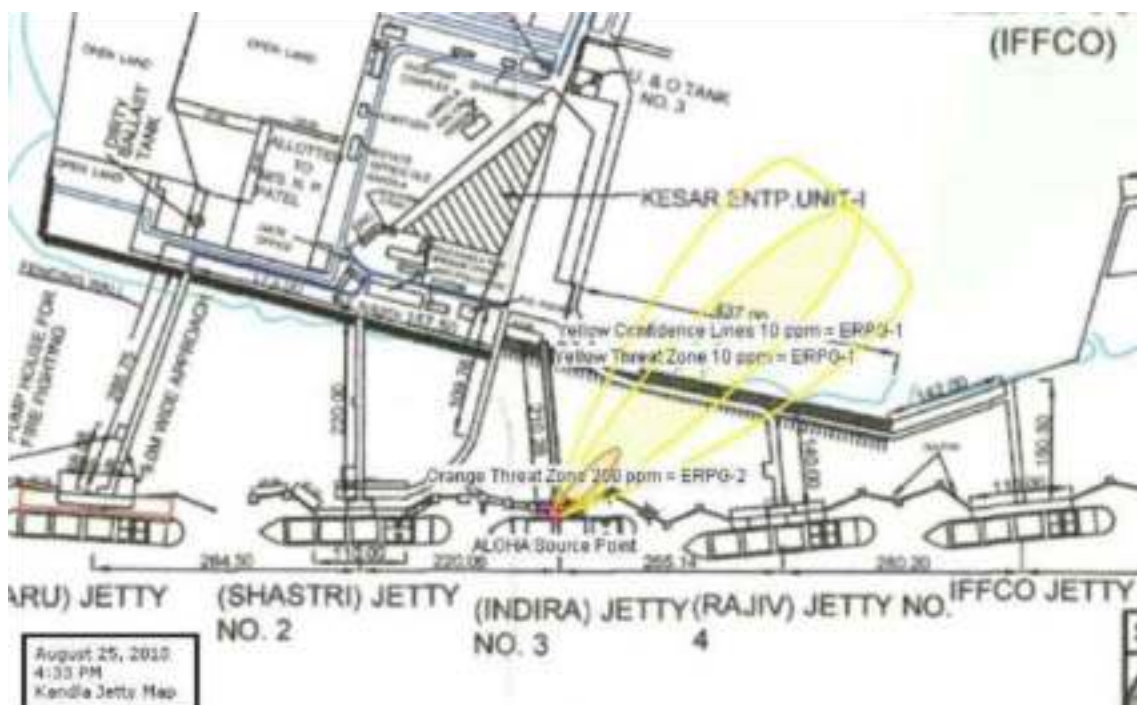
20.1.6.6 Instantaneous Release – Overpressure (Contour)



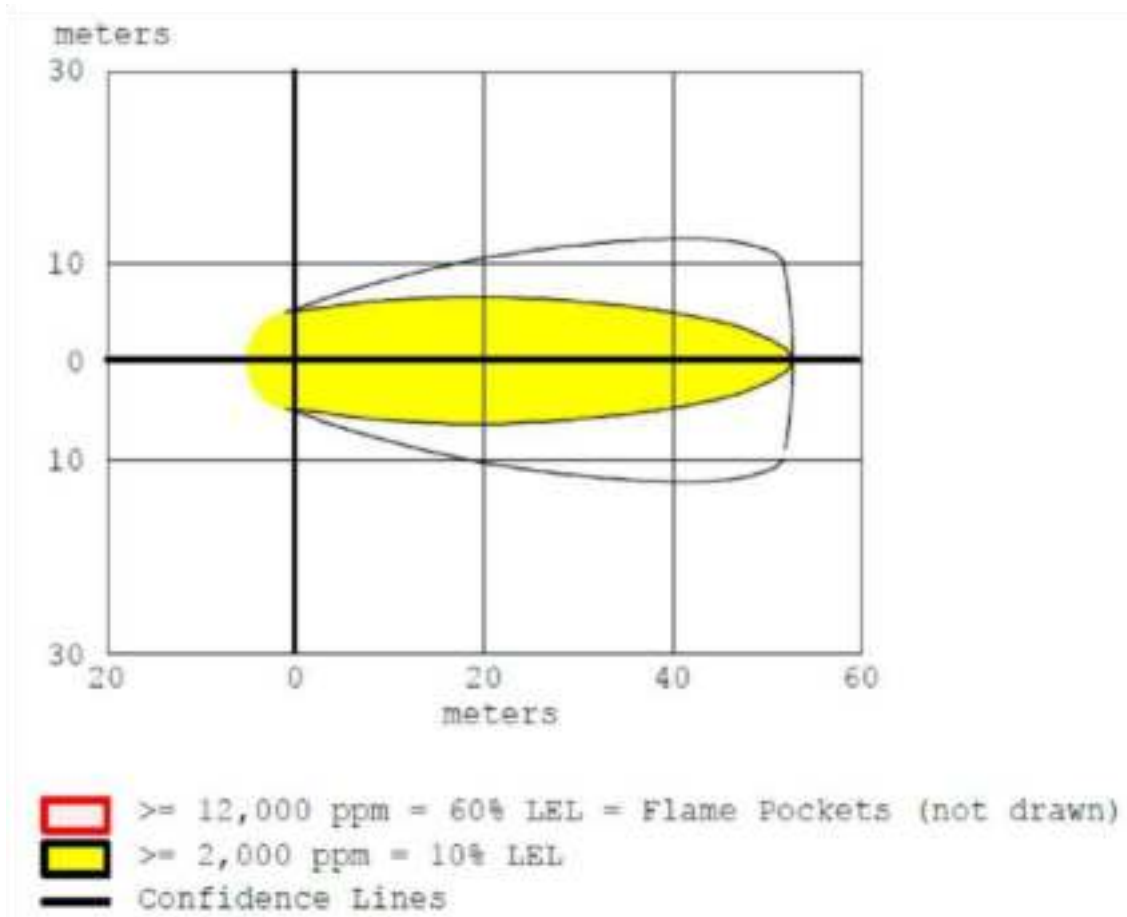
20.1.6.7 Evaporating Puddle – Toxic Threat Zone (Graph)



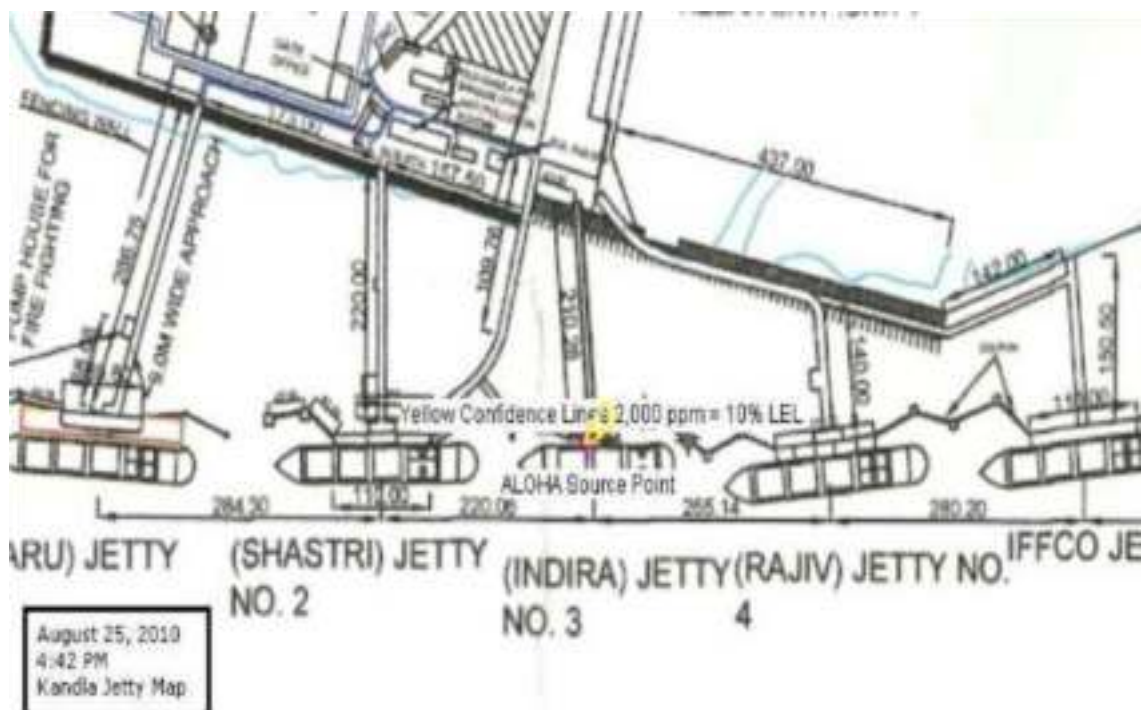
20.1.6.8 Evaporating Puddle – Toxic Threat Zone (Contour)



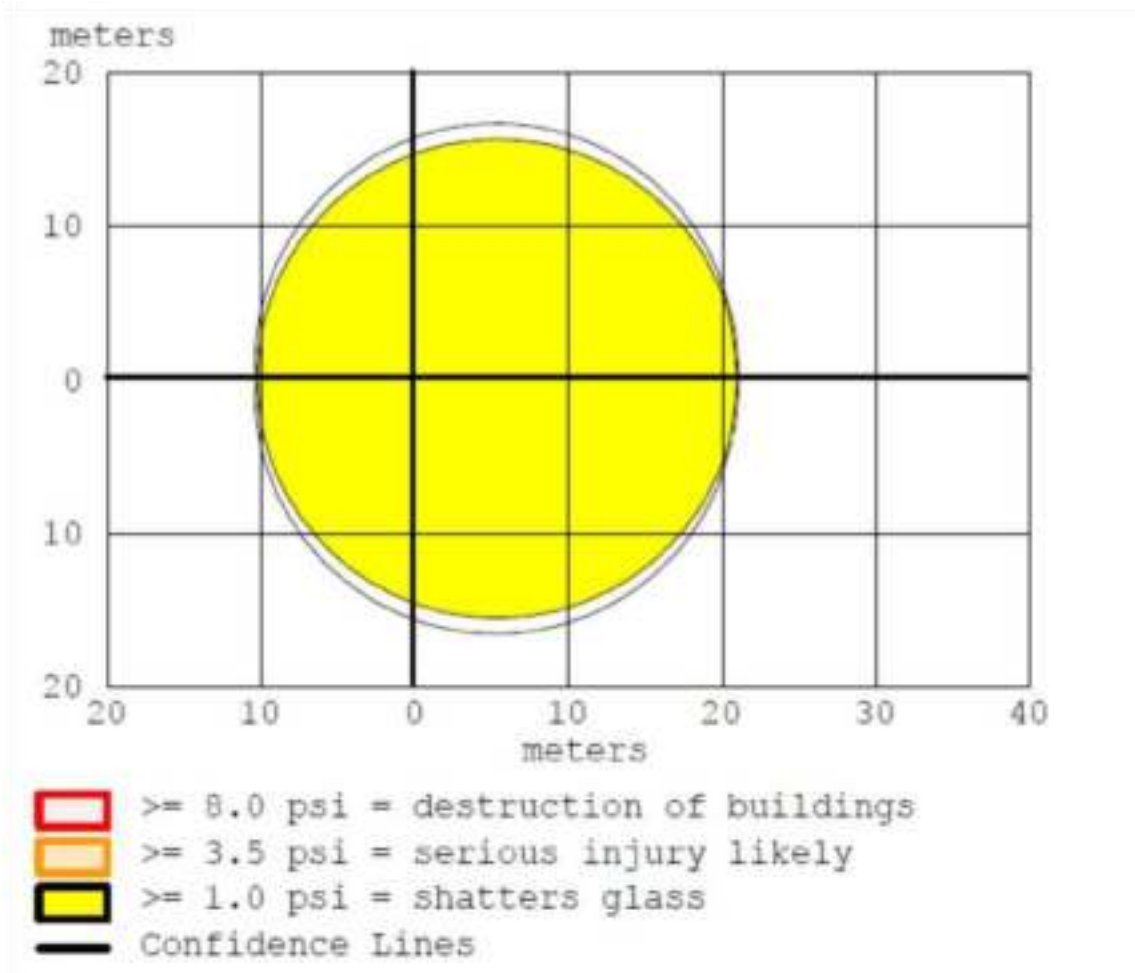
20.1.6.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



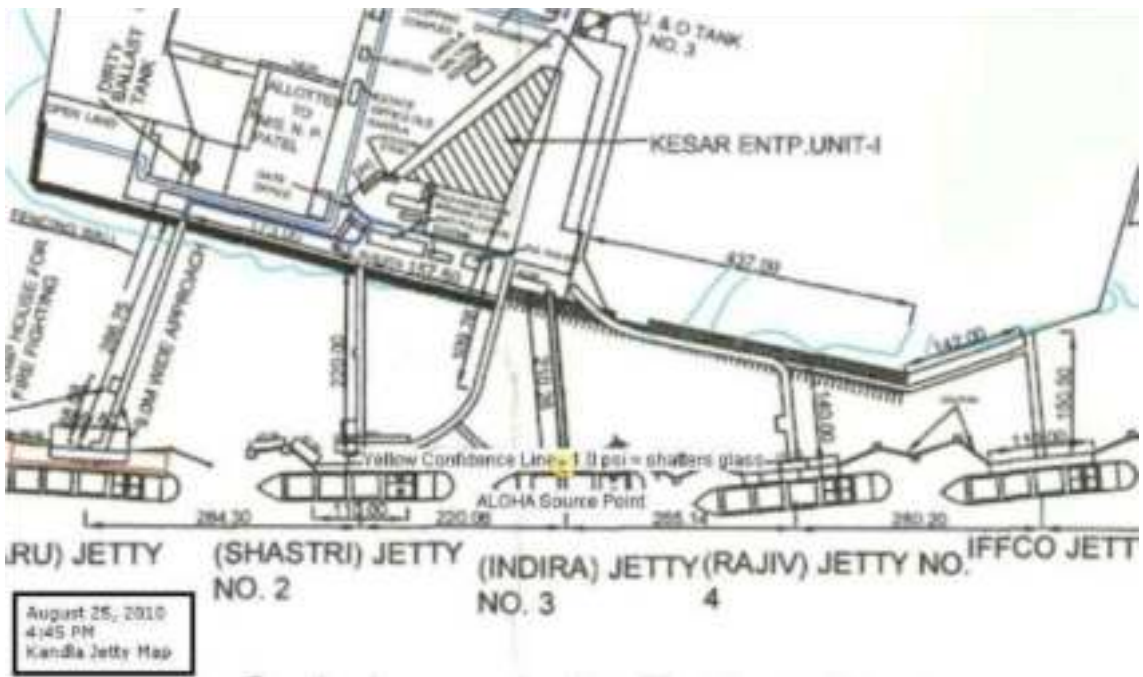
20.1.6.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



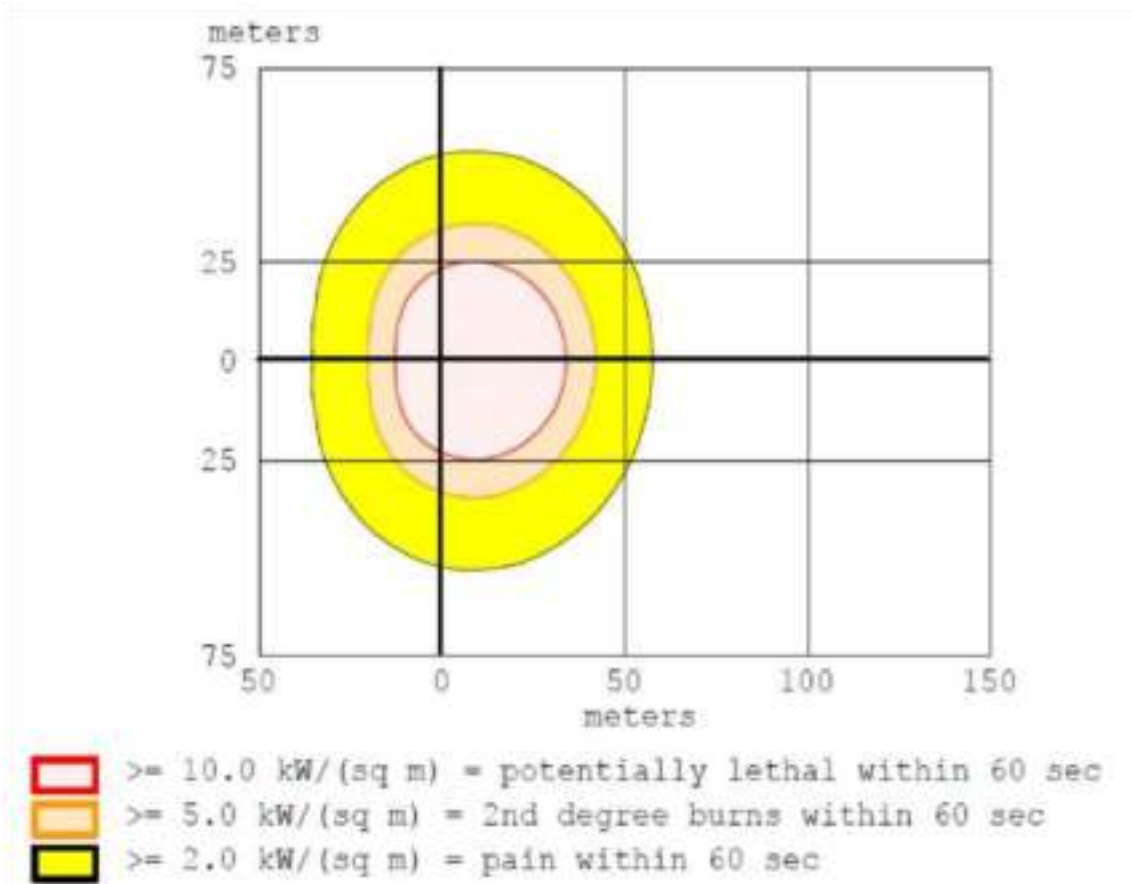
20.1.6.11 Evaporating Puddle – Overpressure (Graph)



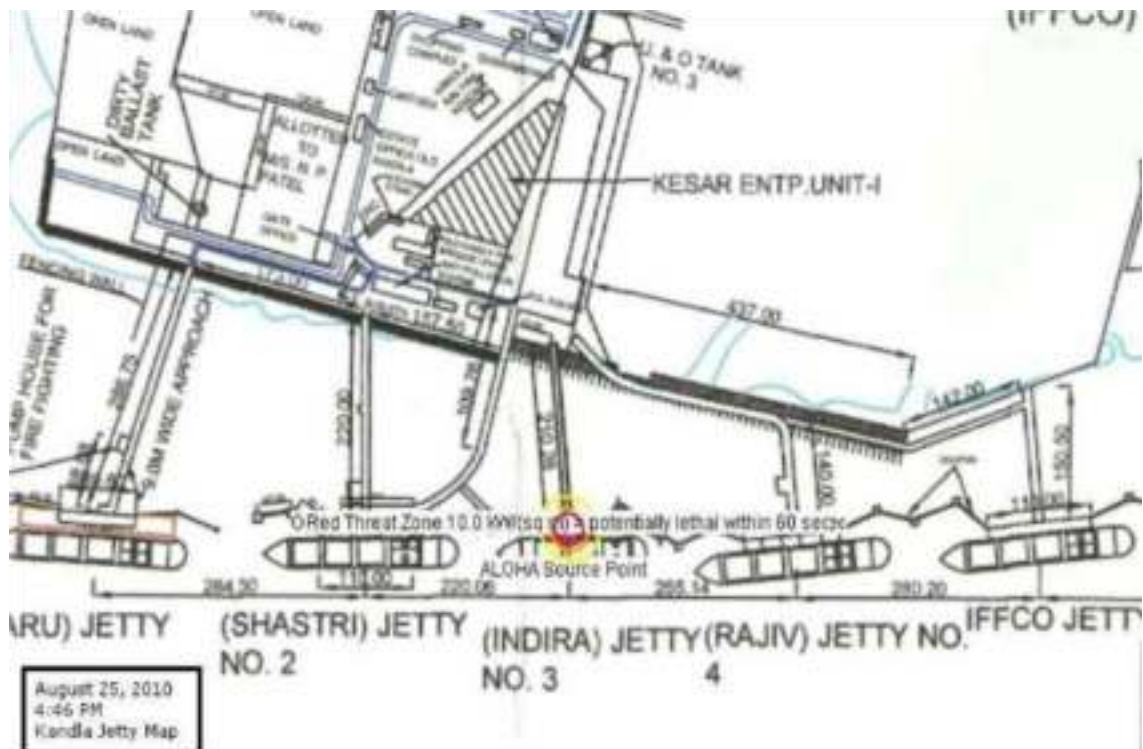
20.1.6.12 Evaporating Puddle – Overpressure (Contour)



20.1.6.13 Burning Puddle – Thermal Radiation (Graph)

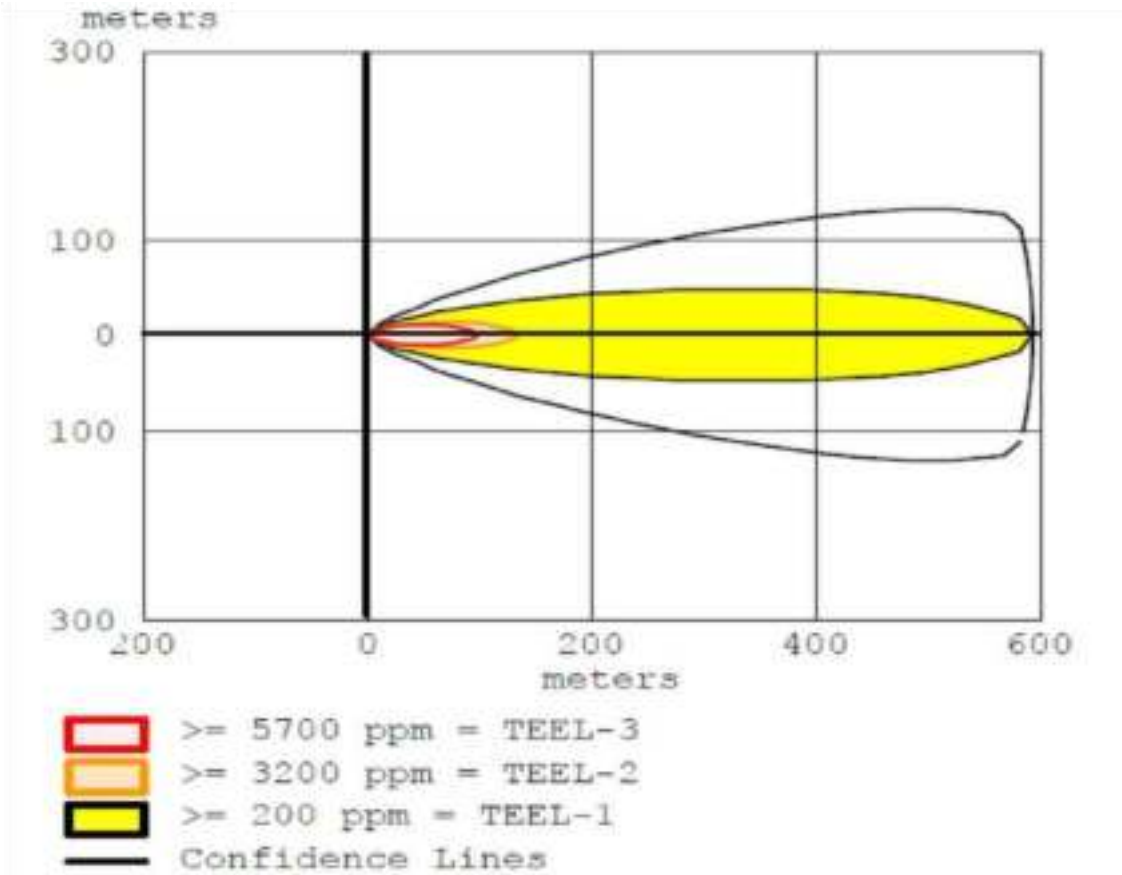


20.1.6.14 Burning Puddle – Thermal Radiation (Contour)



20.1.7 Jetty Three – Acetone

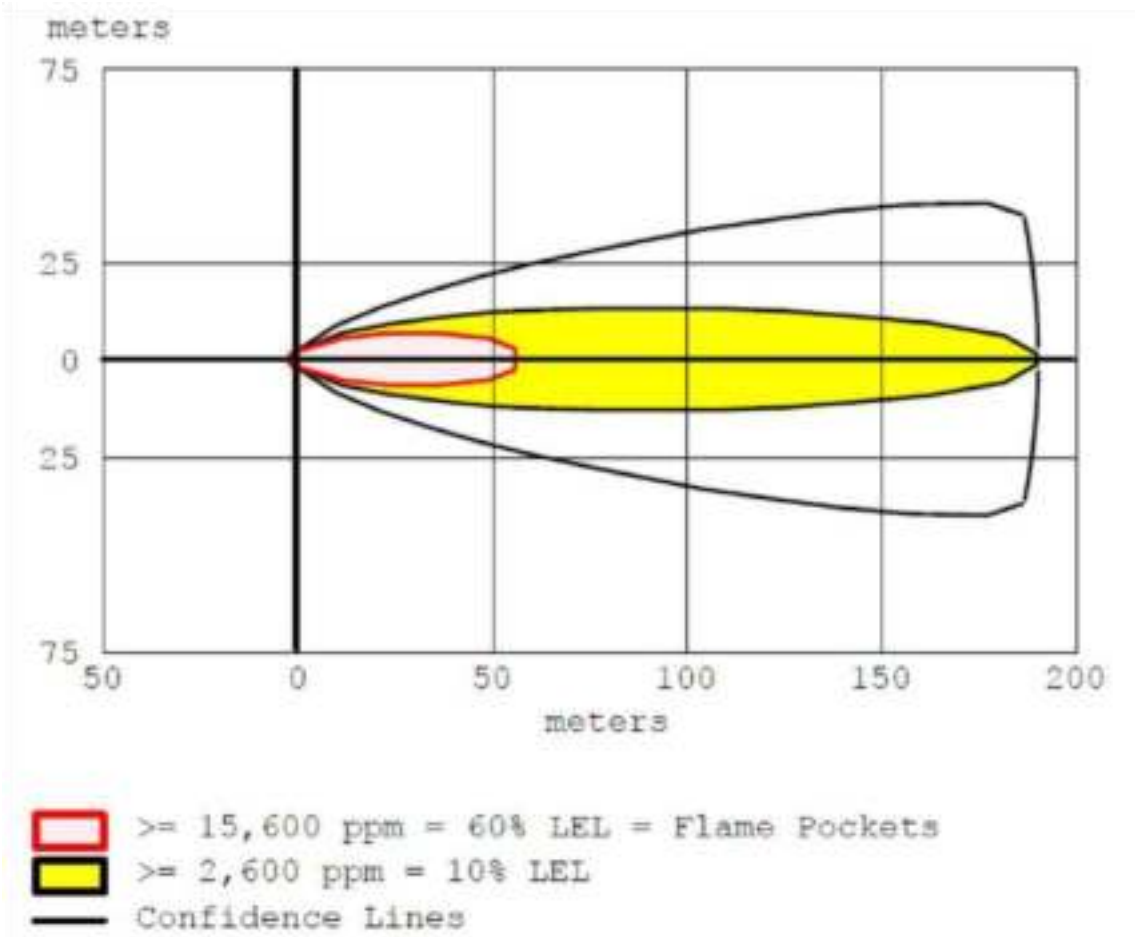
20.1.7.1 Instantaneous Release – Toxic Threat Zone (Graph)



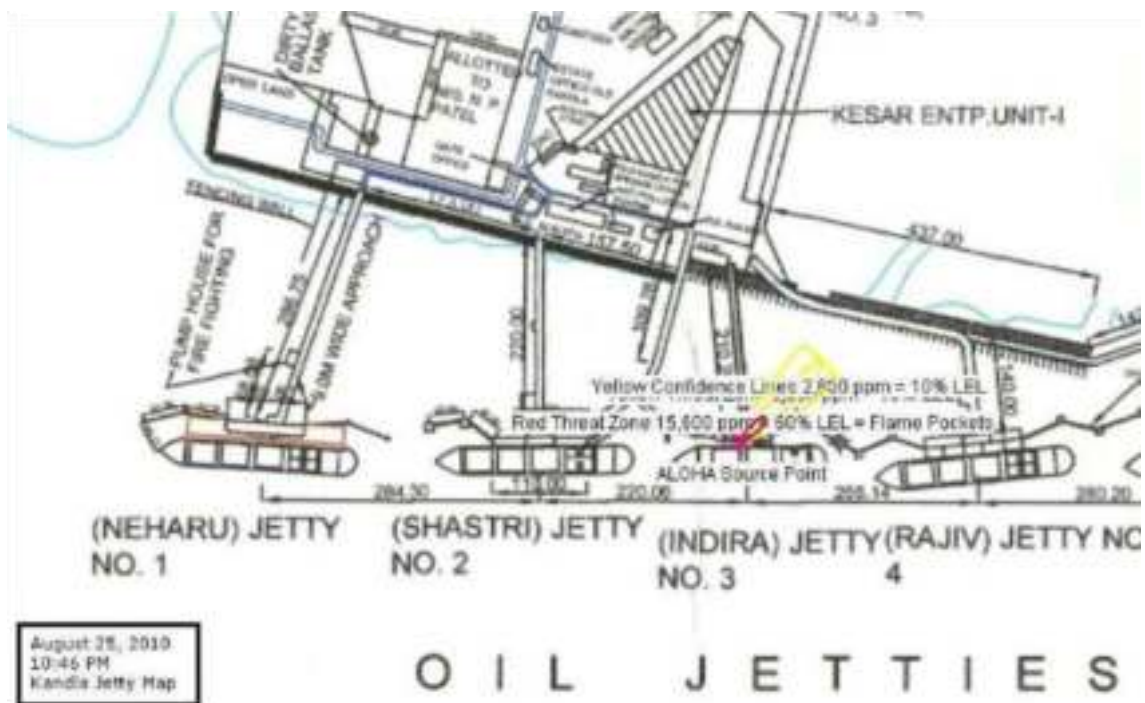
20.1.7.2 Instantaneous Release – Toxic Threat Zone (Contour)



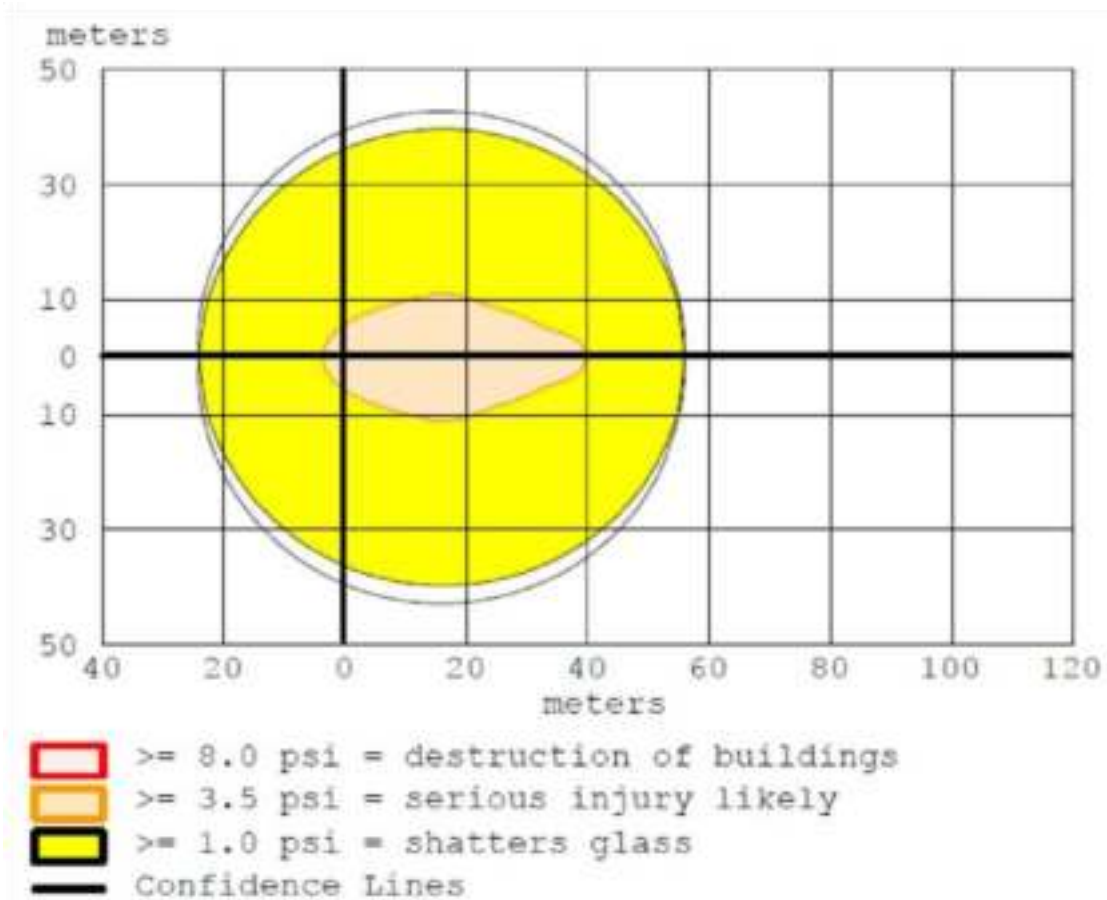
20.1.7.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



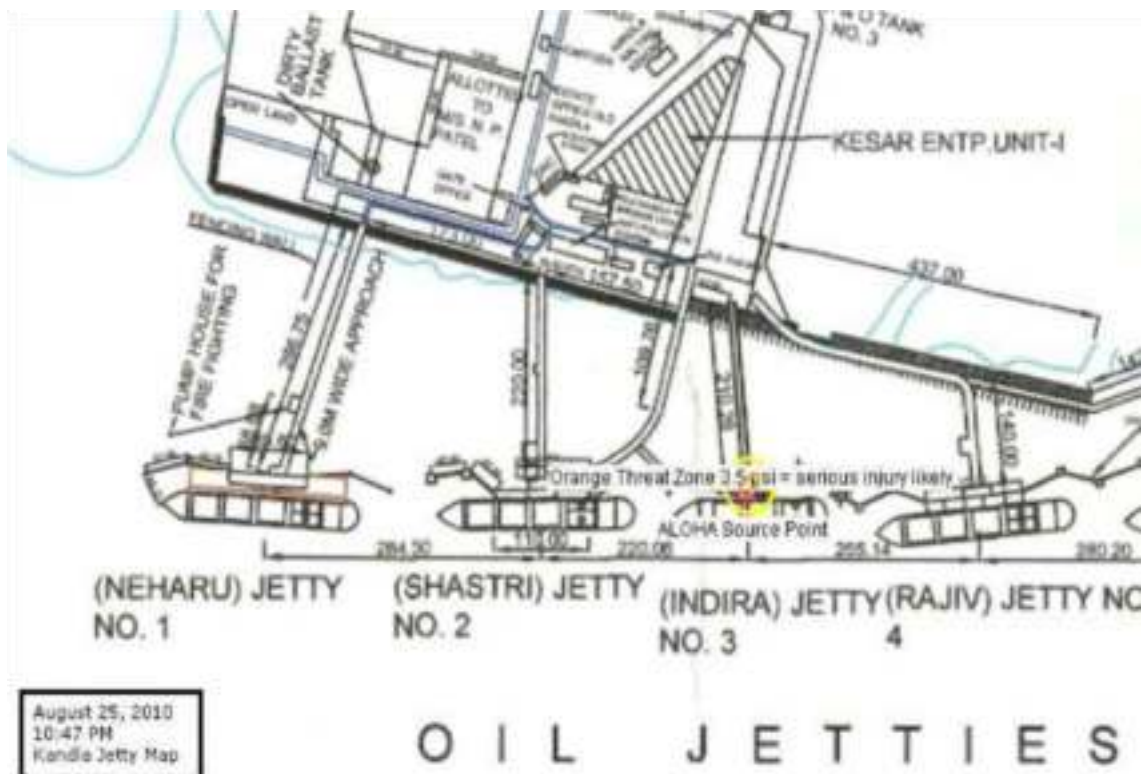
20.1.7.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



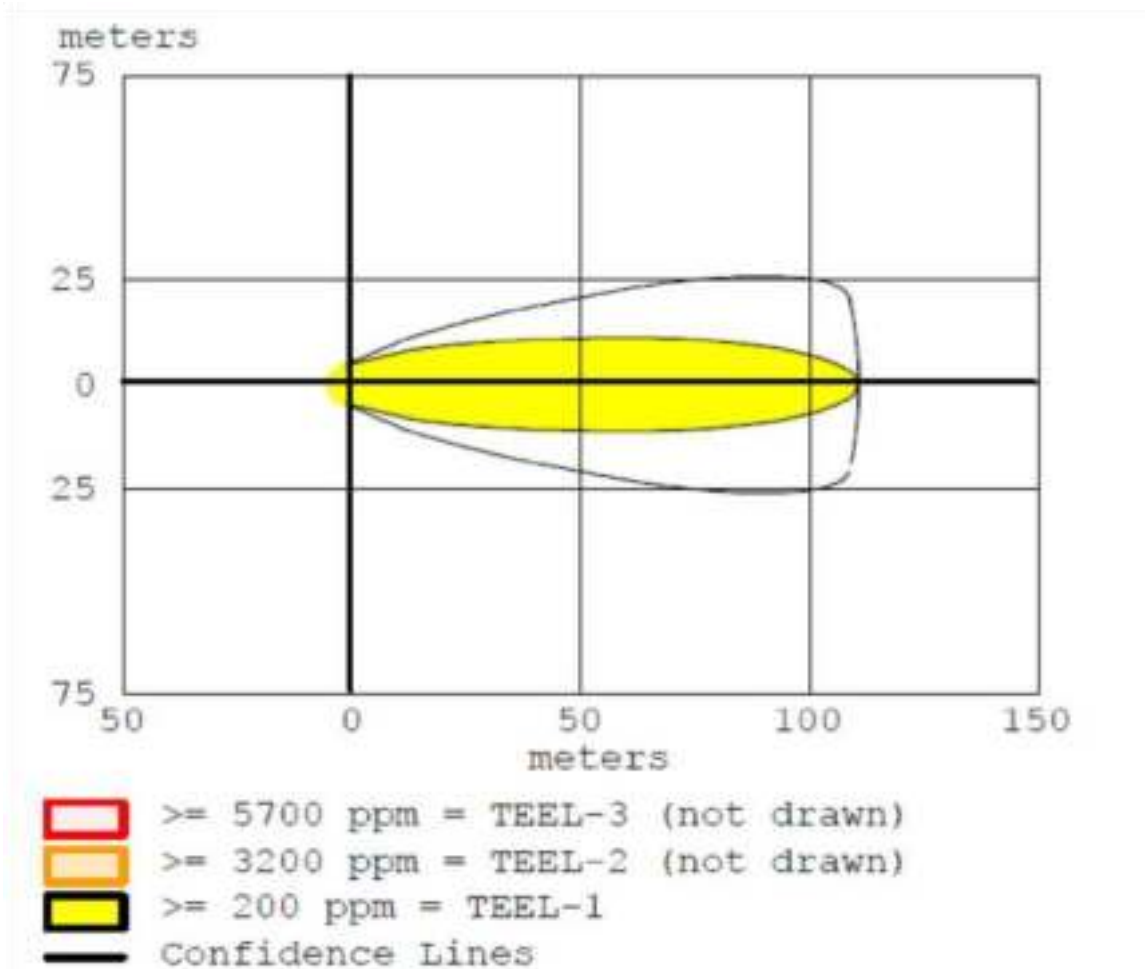
20.1.7.5 Instantaneous Release – Overpressure (Graph)



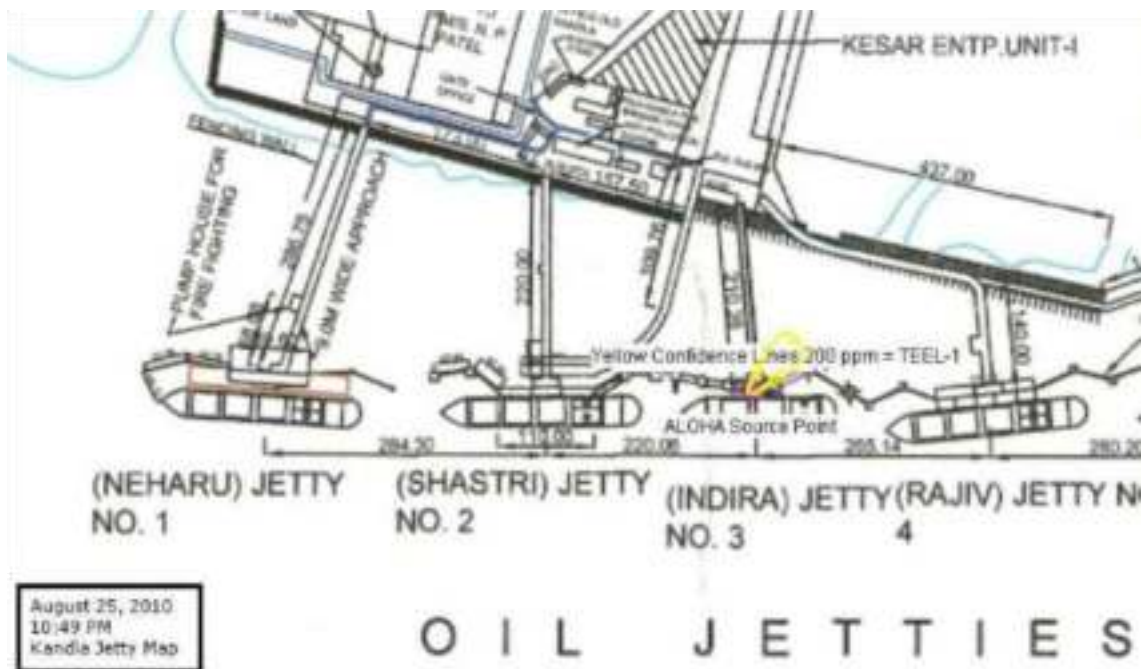
20.1.7.6 Instantaneous Release – Overpressure (Contour)



20.1.7.7 Evaporating Puddle – Toxic Threat Zone (Graph)

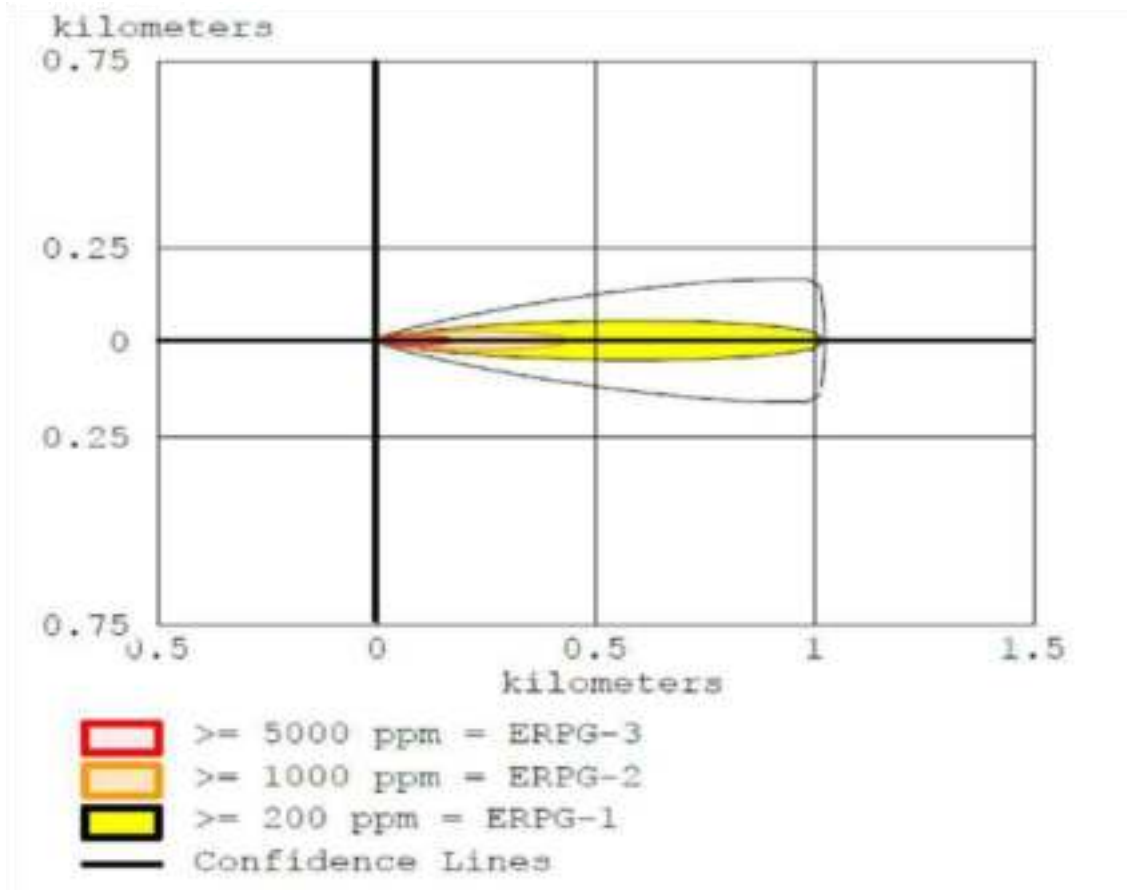


20.1.7.8 Evaporating Puddle – Toxic Threat Zone (Contour)

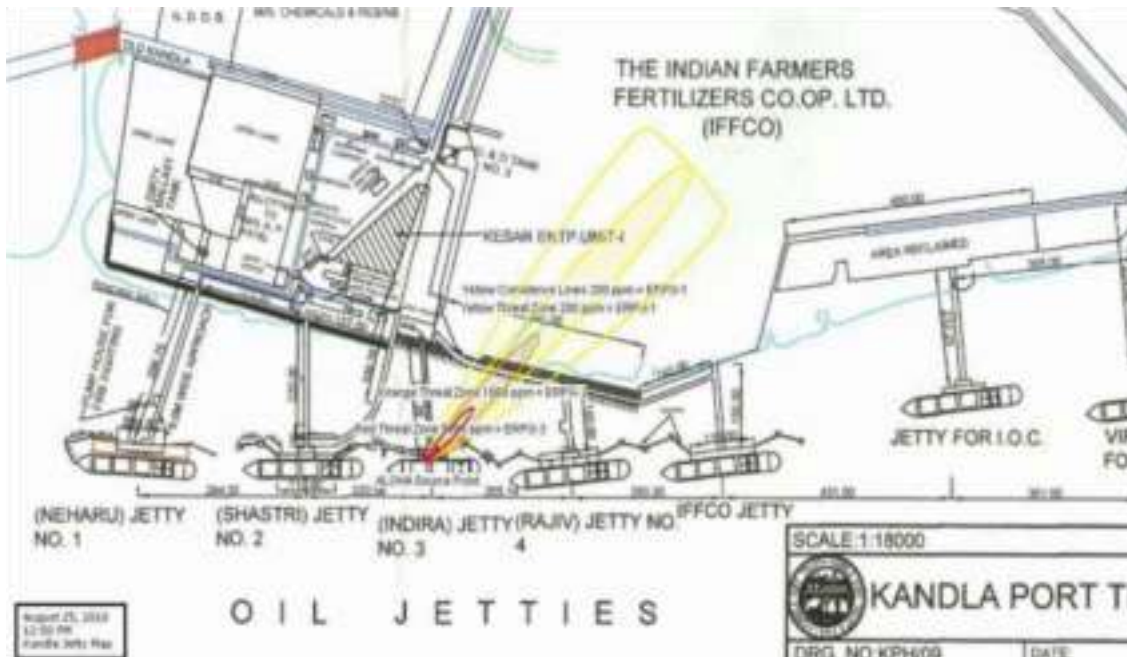


20.1.7.9 Burning Puddle – Thermal Radiation (Graph)

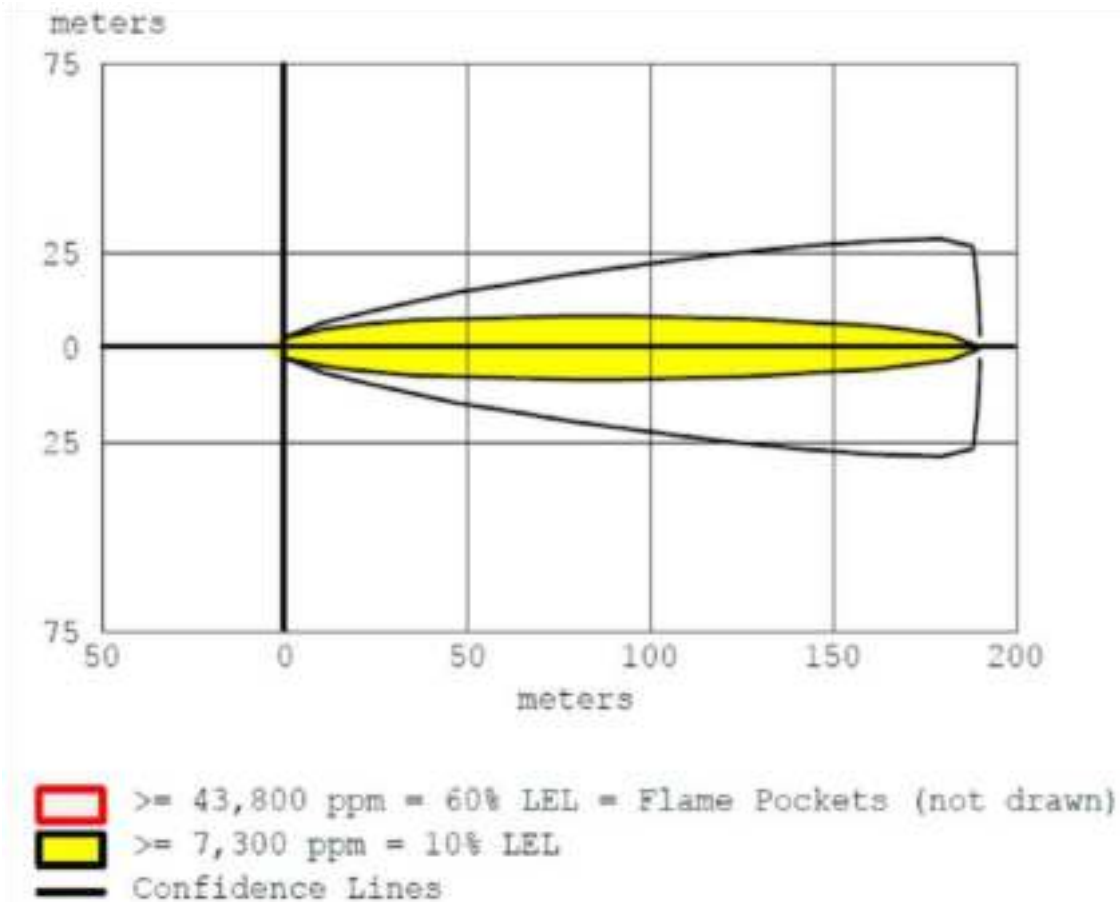
20.1.8.1 Instantaneous Release – Toxic Threat Zone (Graph)



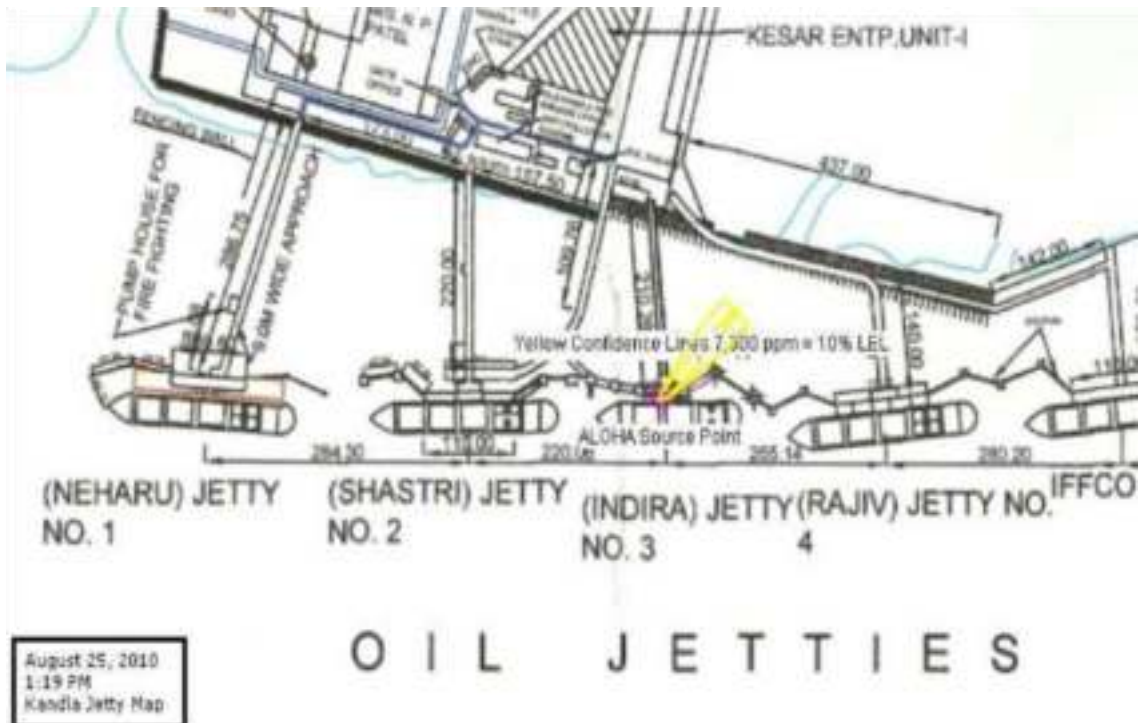
20.1.8.2 Instantaneous Release – Toxic Threat Zone (Contour)



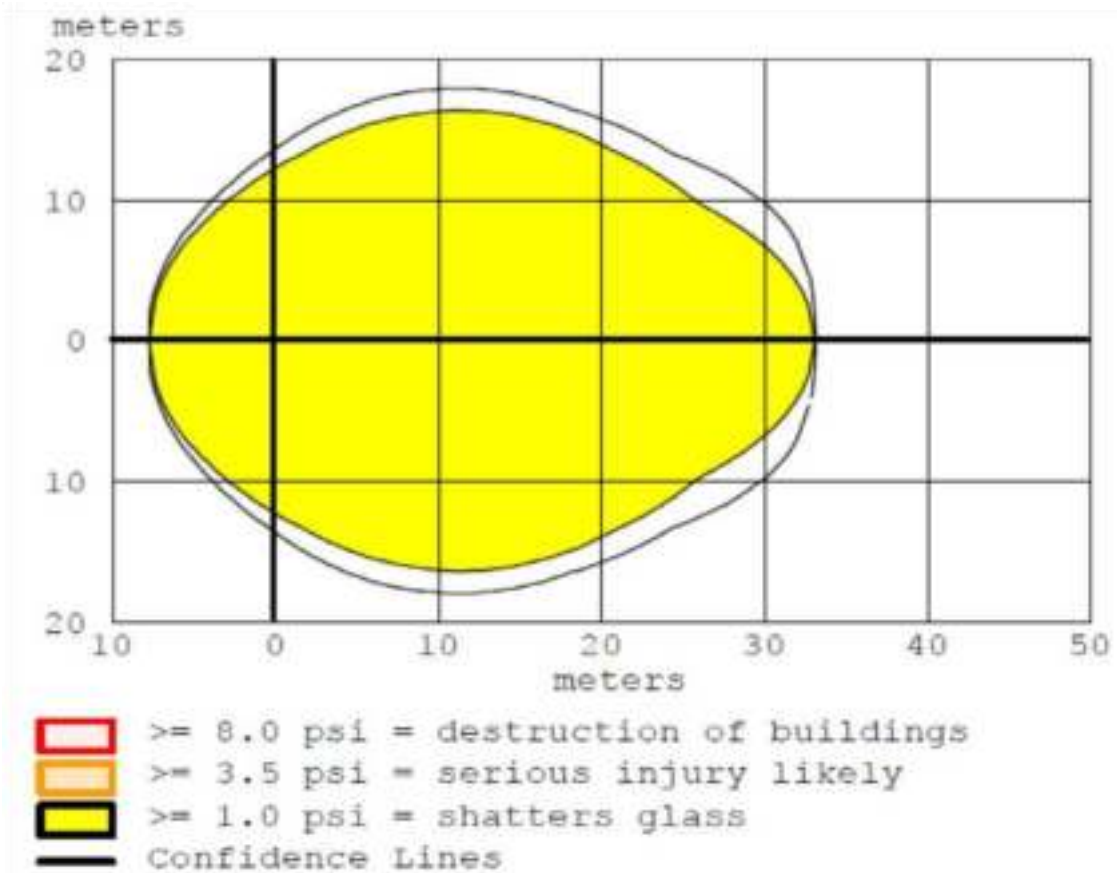
20.1.8.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



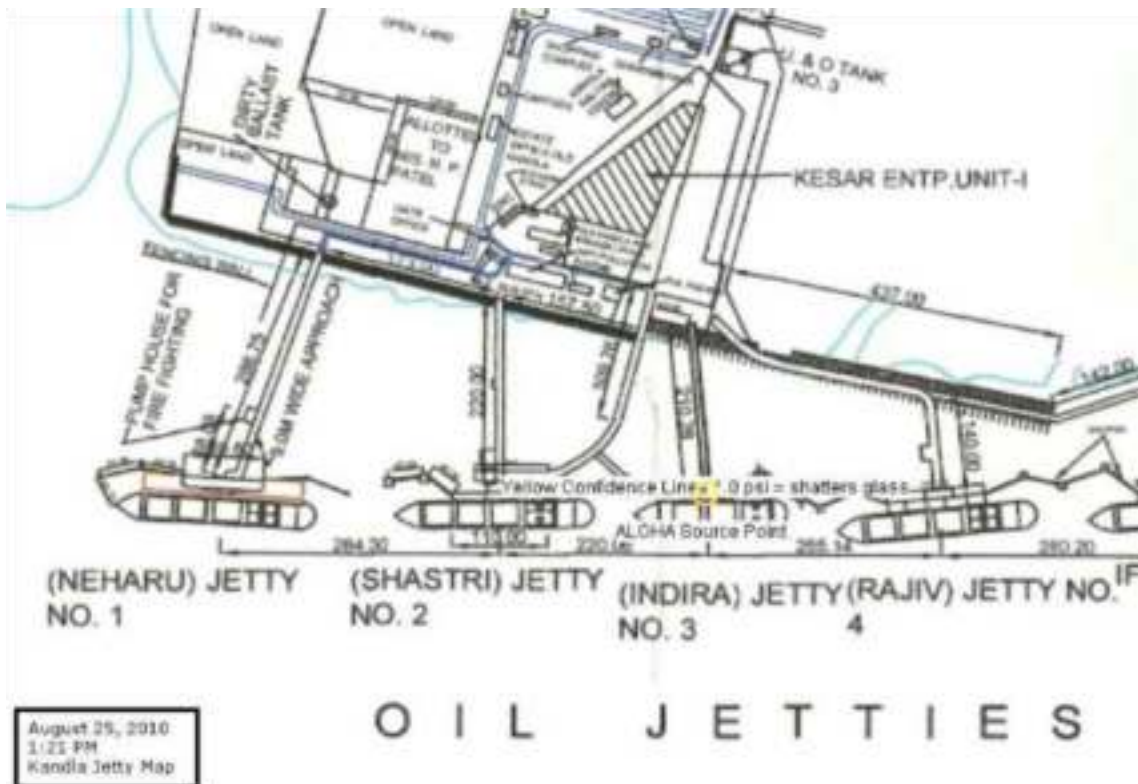
20.1.8.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



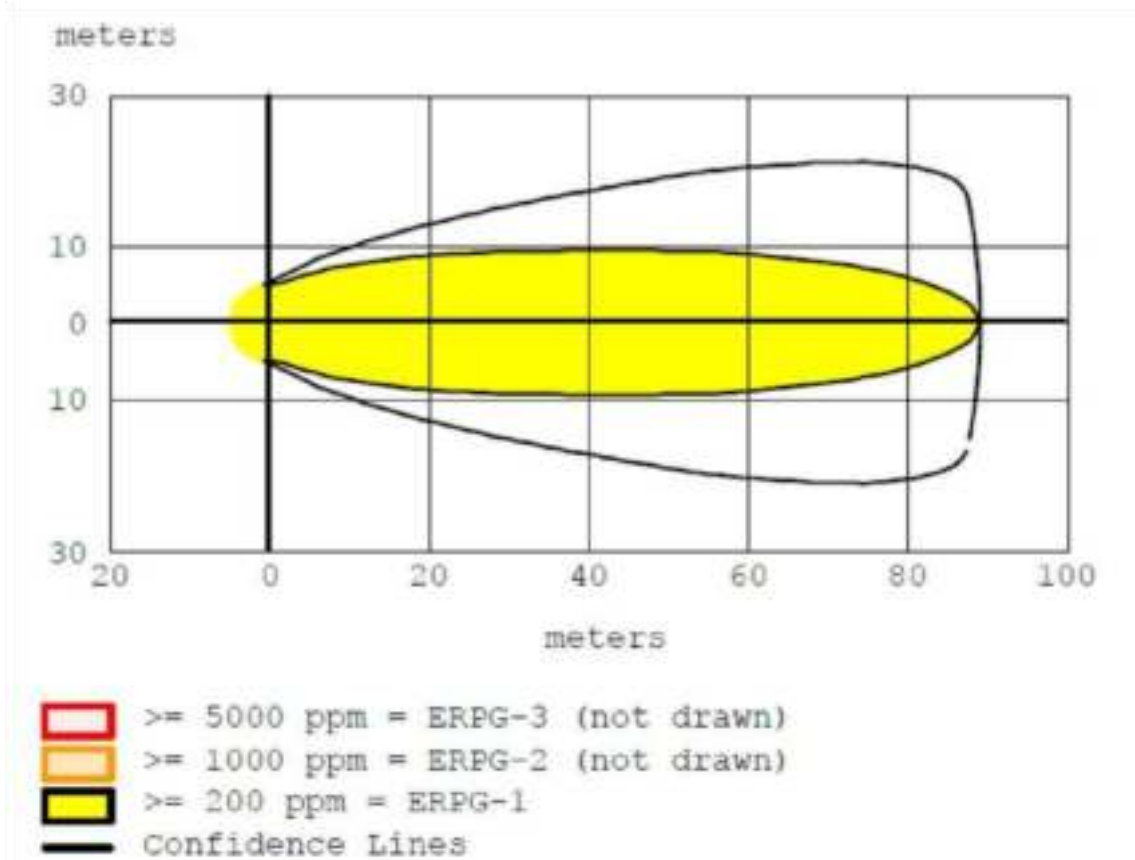
20.1.8.5 Instantaneous Release – Overpressure (Graph)



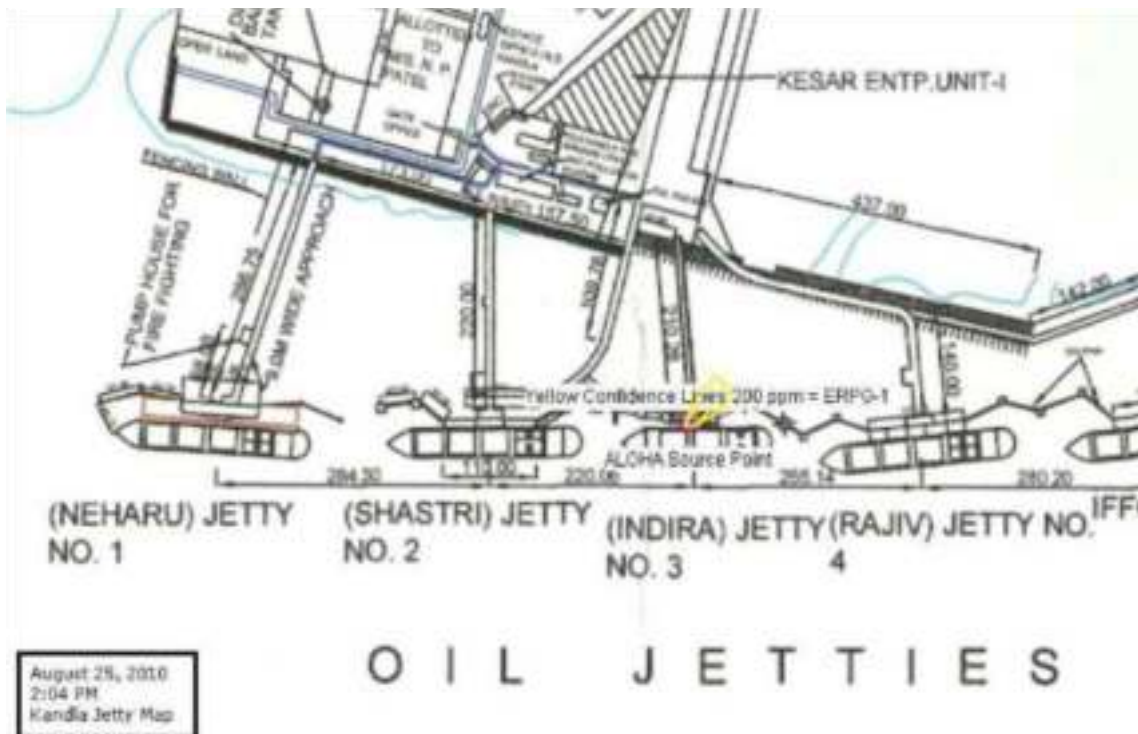
20.1.8.6 Instantaneous Release – Overpressure (Contour)



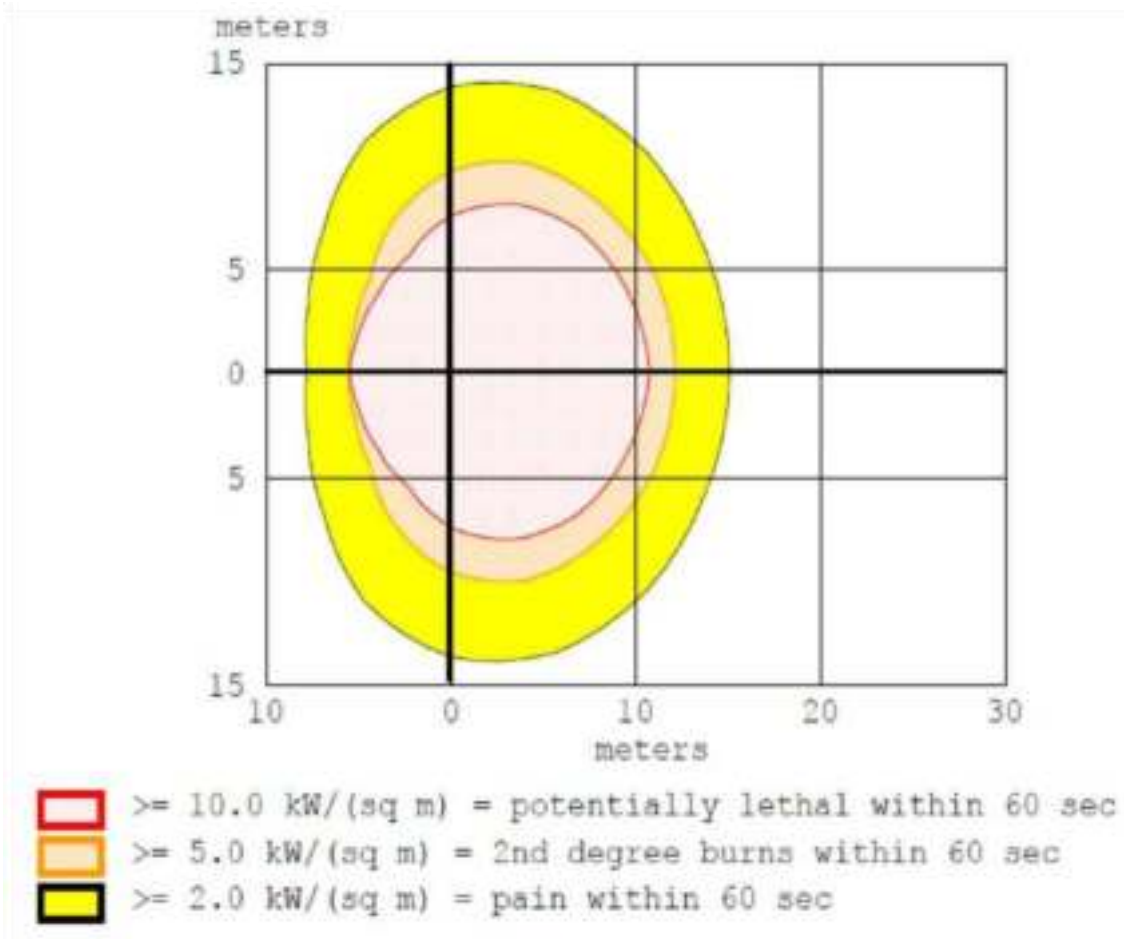
20.1.8.7 Evaporating Puddle – Toxic Threat Zone (Graph)



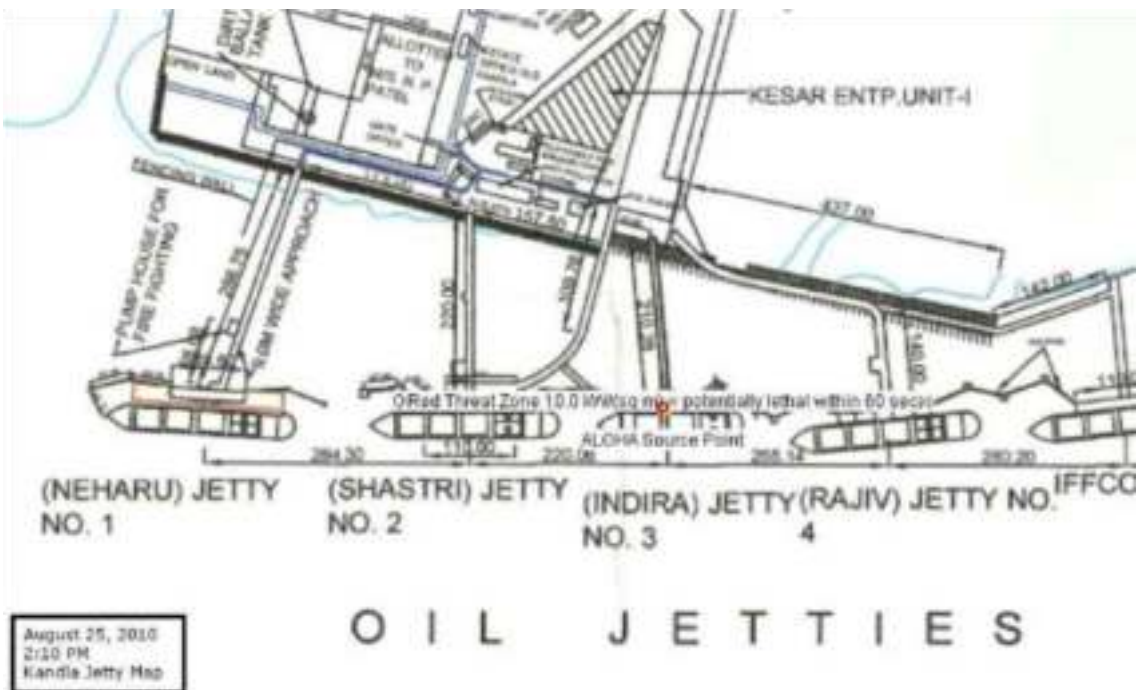
20.1.8.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.8.9 Burning Puddle – Thermal Radiation (Graph)

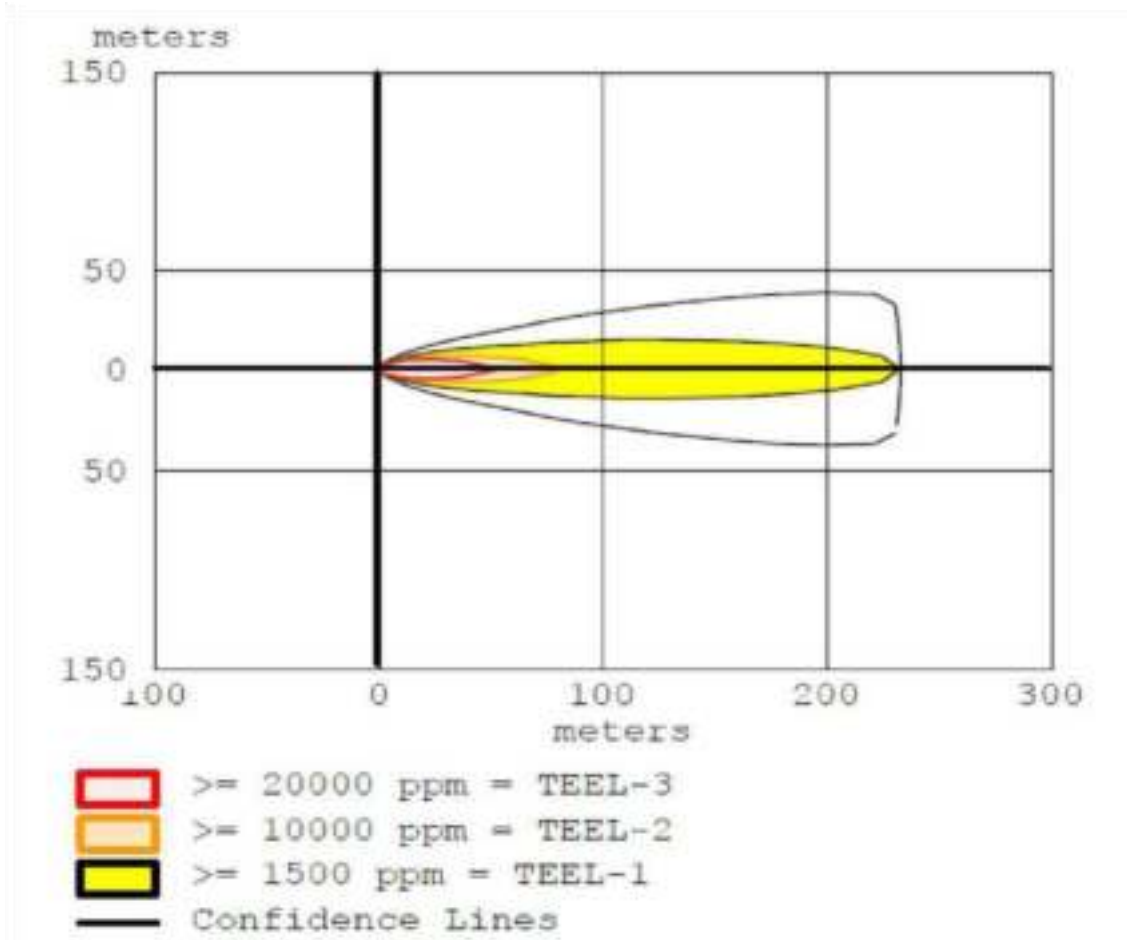


20.1.8.10 Burning Puddle – Thermal Radiation (Contour)

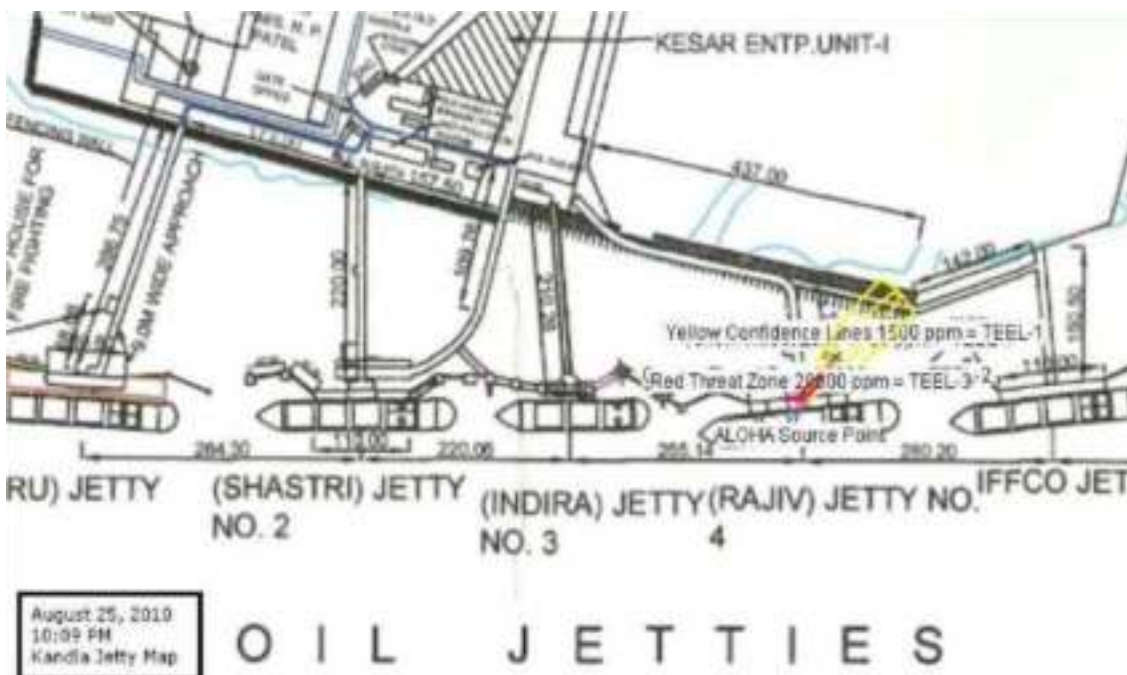


20.1.9 Jetty Four – Propylene

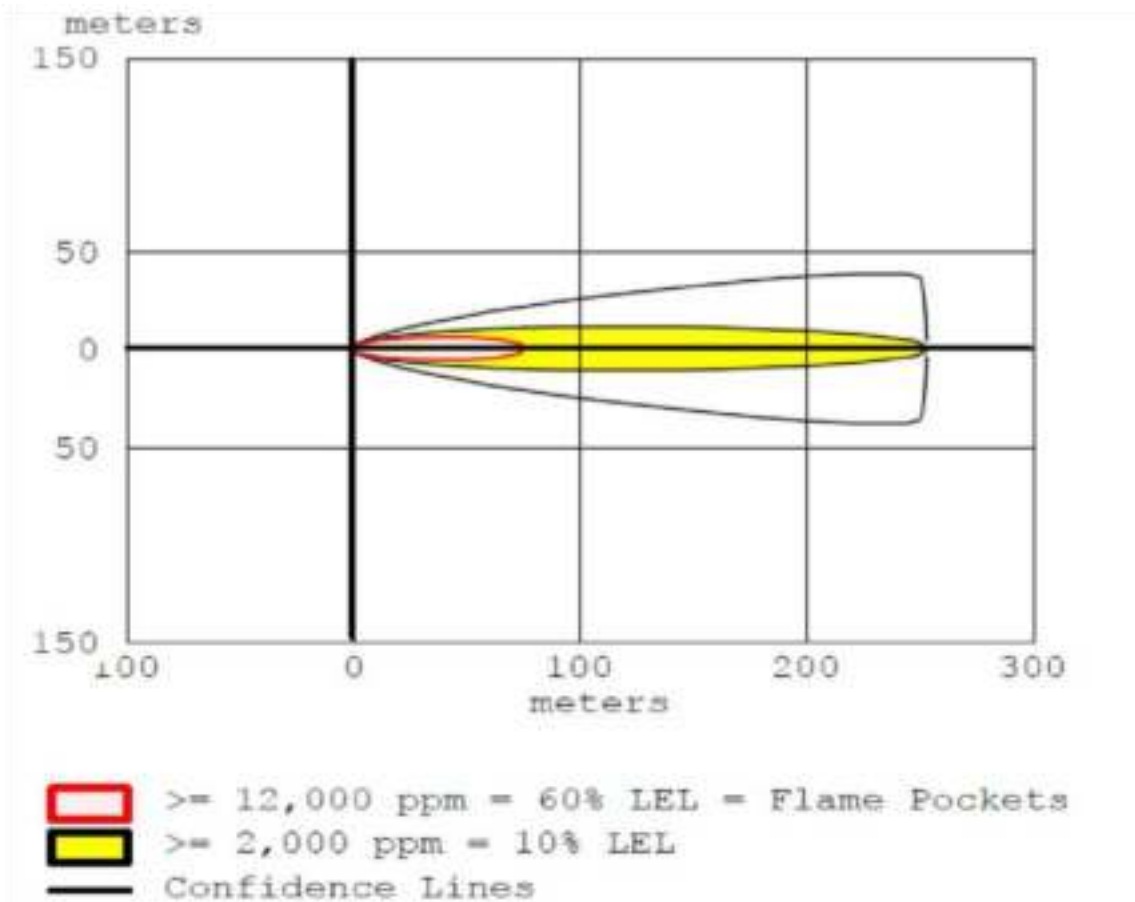
20.1.9.1 Instantaneous Release – Toxic Threat Zone (Graph)



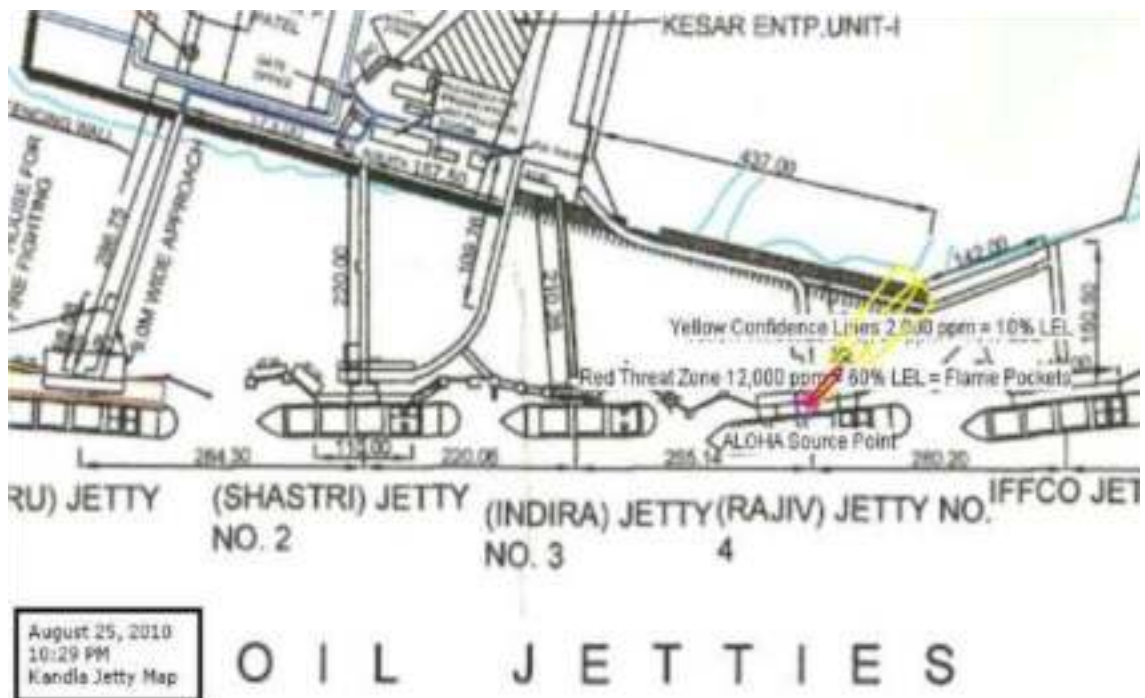
20.1.9.2 Instantaneous Release – Toxic Threat Zone (Contour)



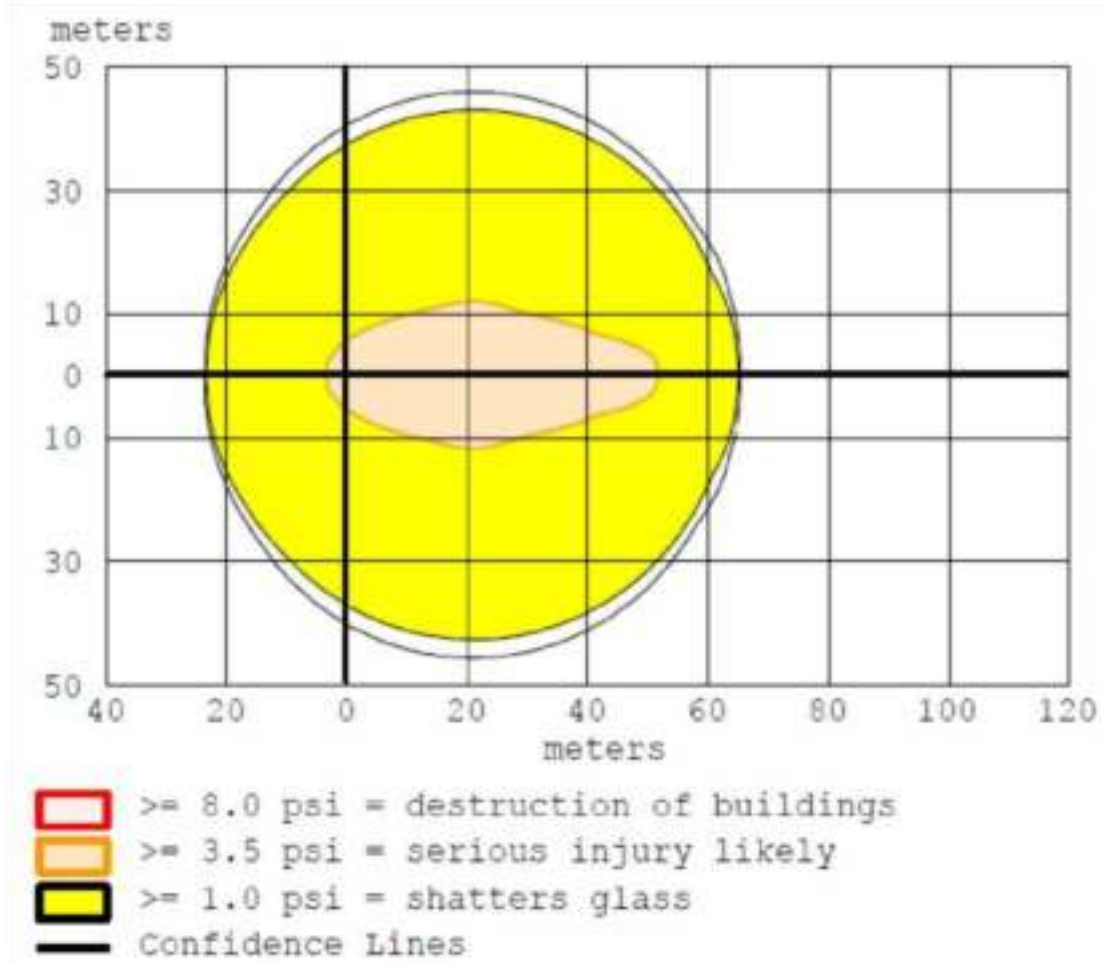
20.1.9.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



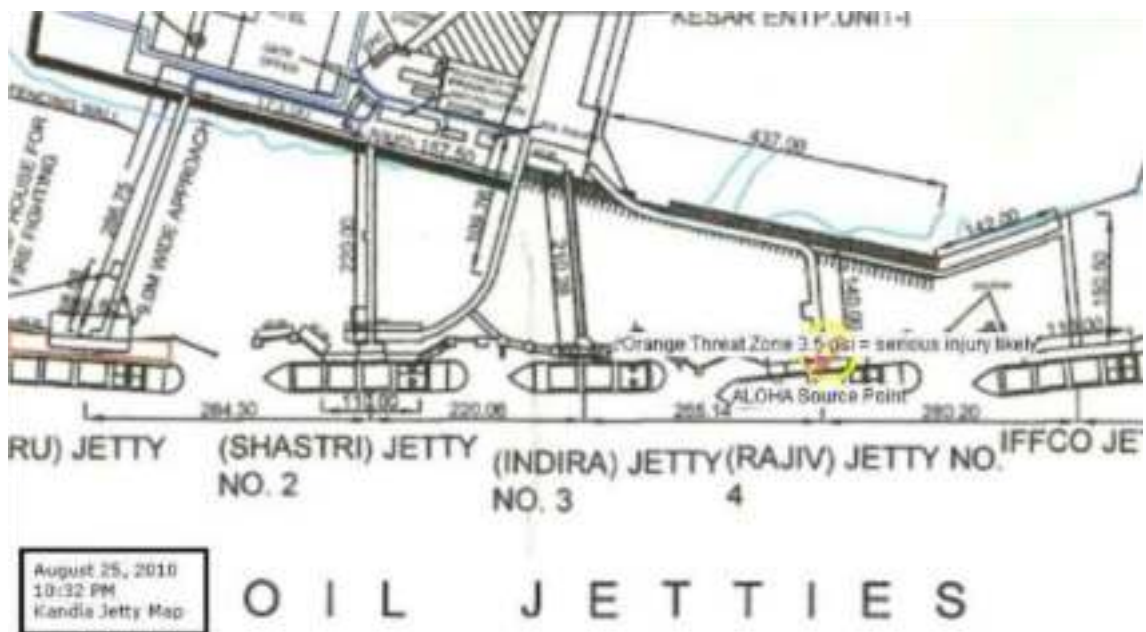
20.1.9.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



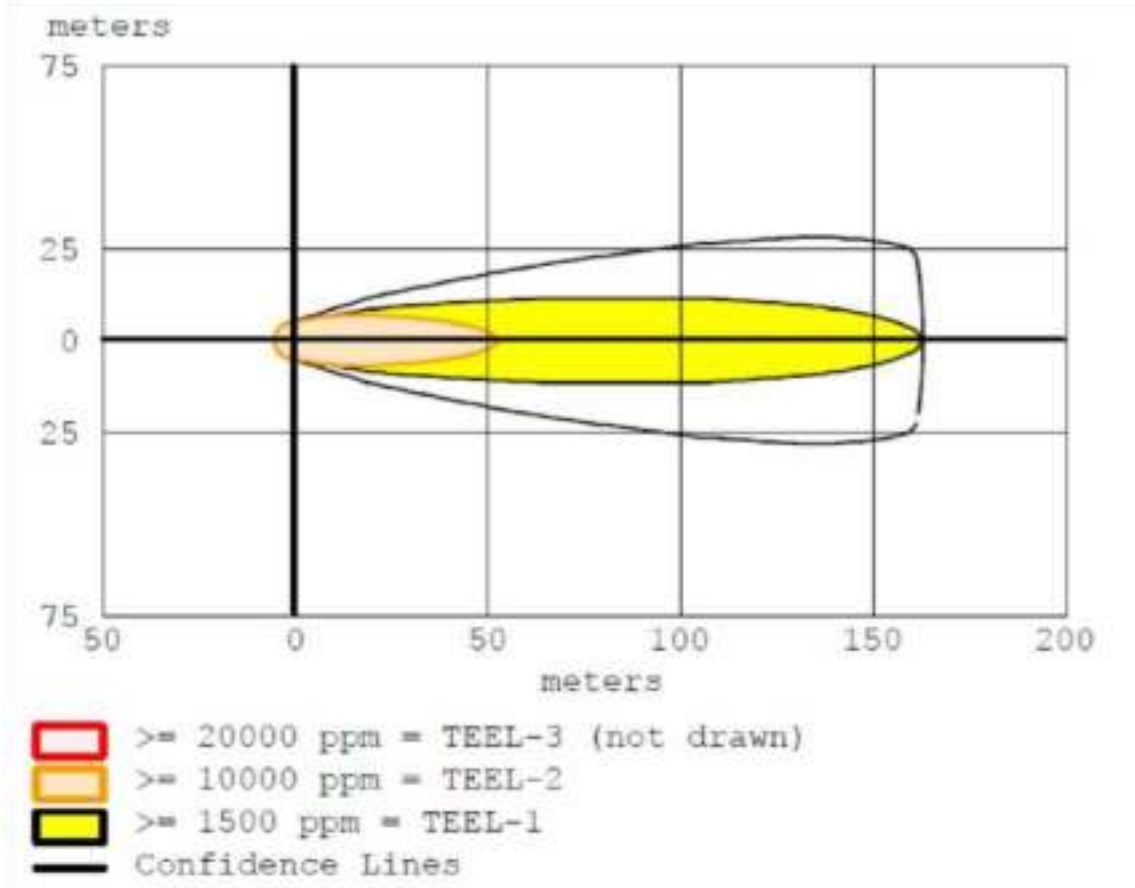
20.1.9.5 Instantaneous Release – Overpressure (Graph)



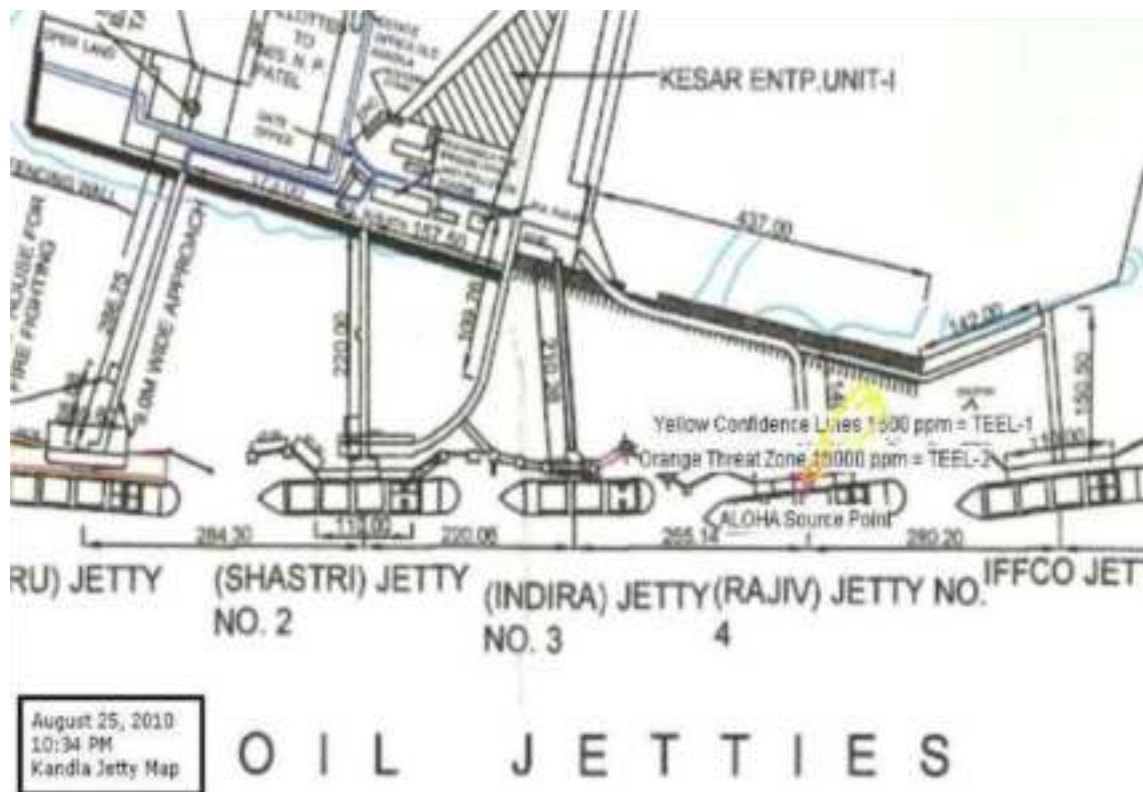
20.1.9.6 Instantaneous Release – Overpressure (Contour)



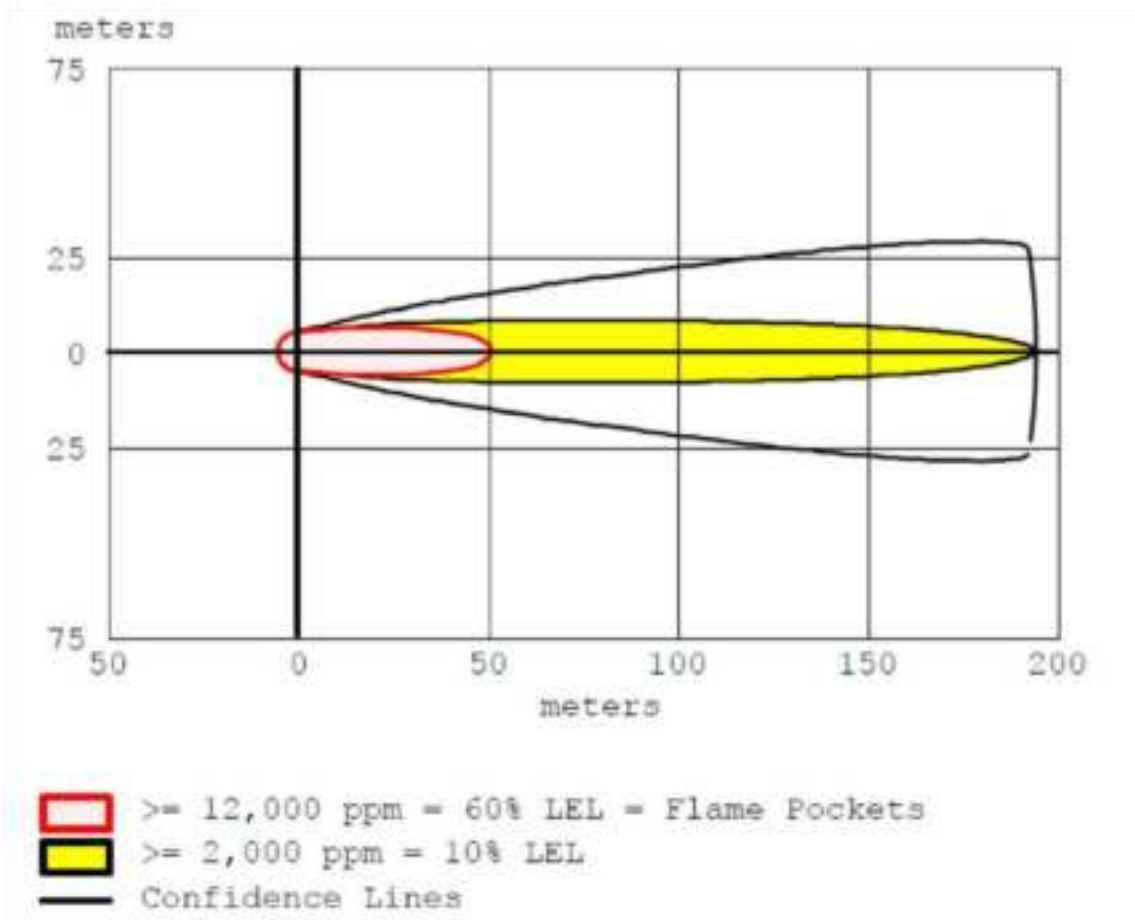
20.1.9.7 Evaporating Puddle – Toxic Threat Zone (Graph)



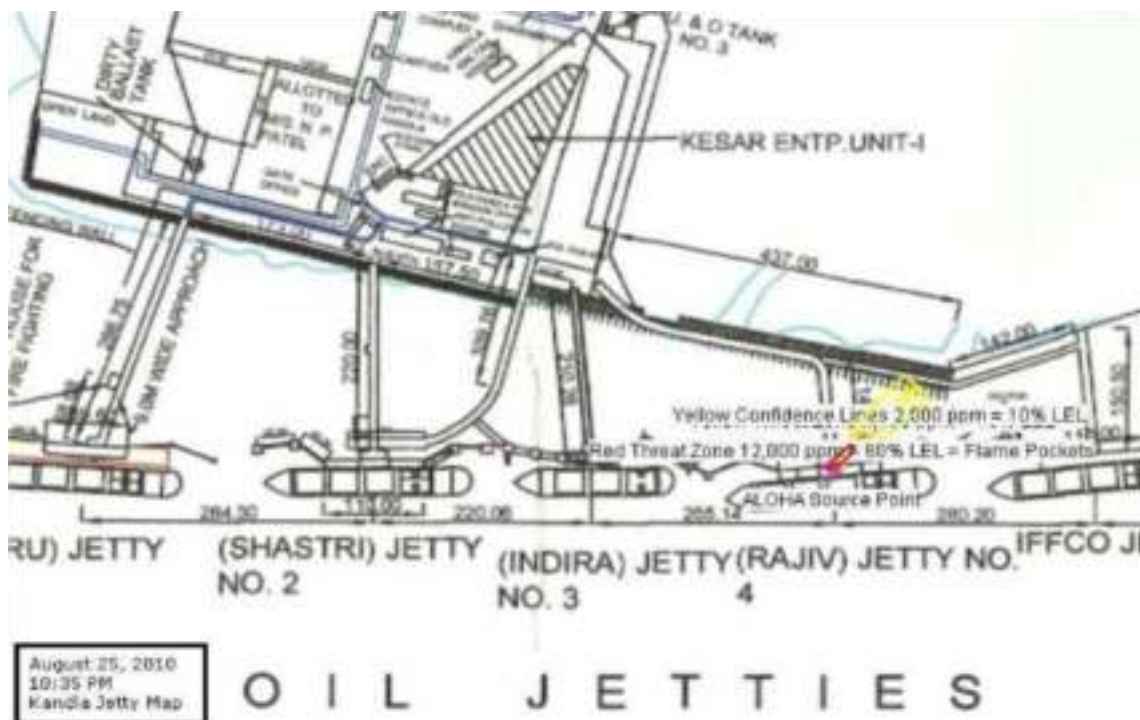
20.1.9.8 Evaporating Puddle – Toxic Threat Zone (Contour)



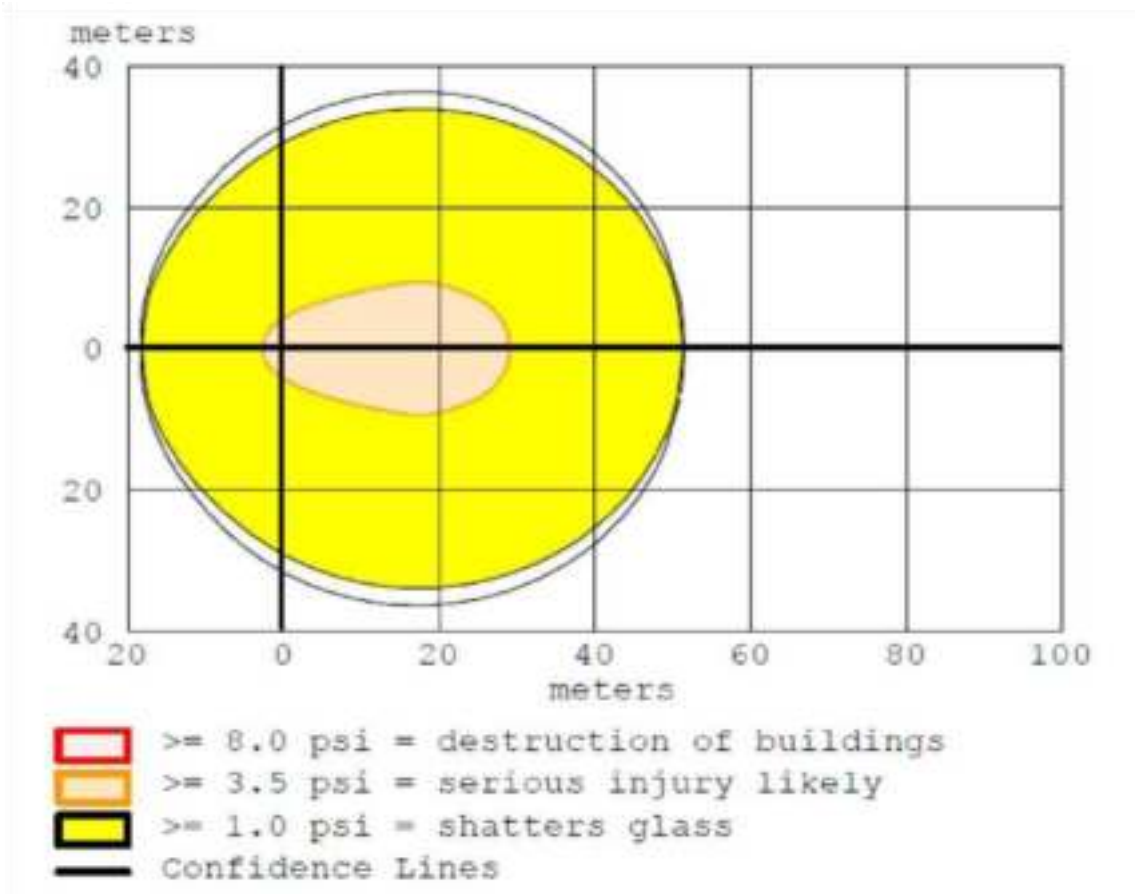
20.1.9.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



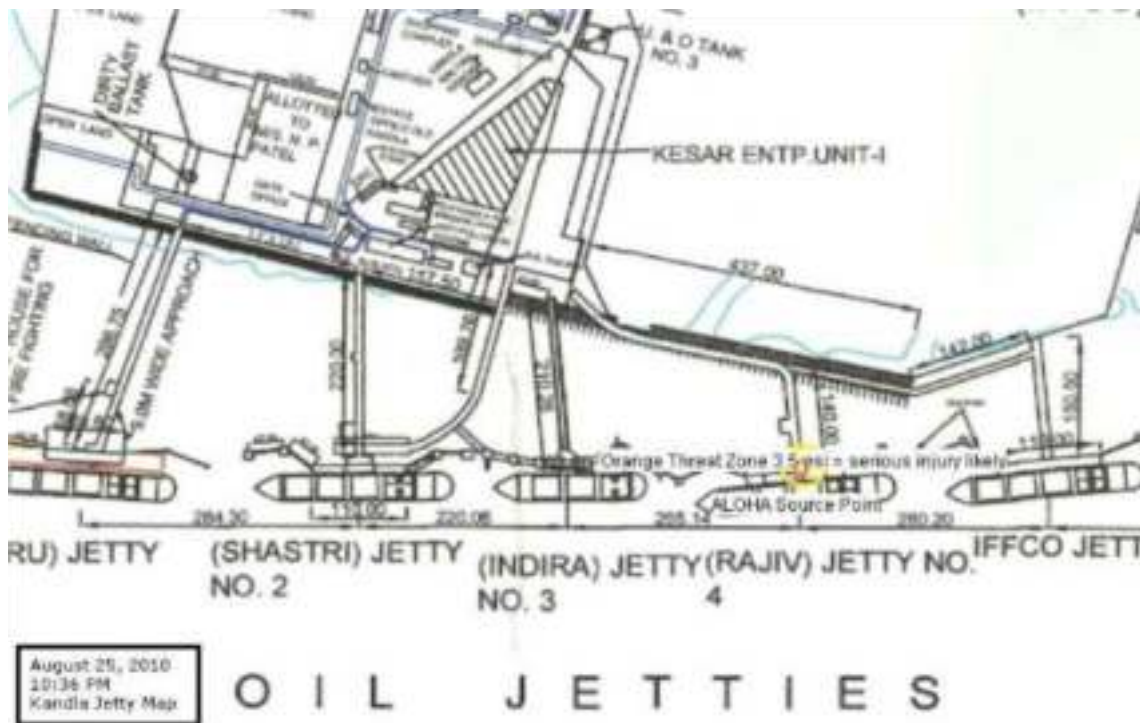
20.1.9.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



20.1.9.11 Evaporating Puddle – Overpressure (Graph)

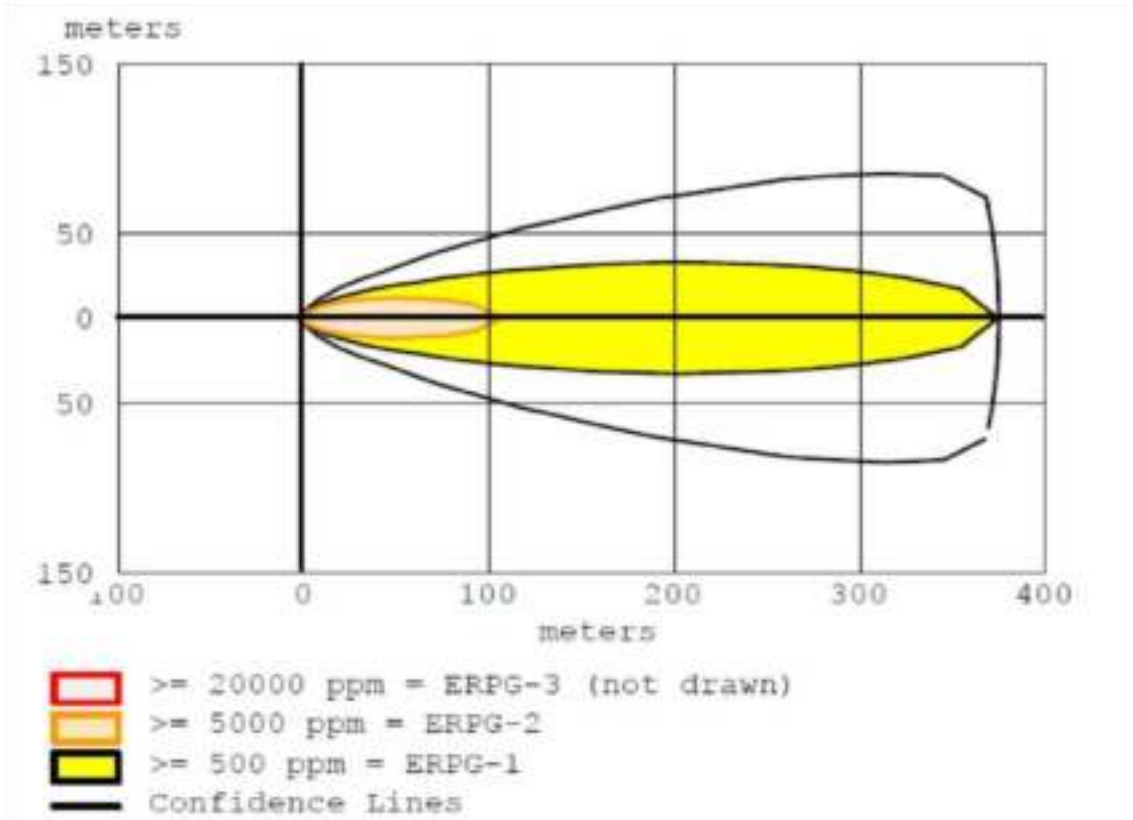


20.1.9.12 Evaporating Puddle – Overpressure (Contour)

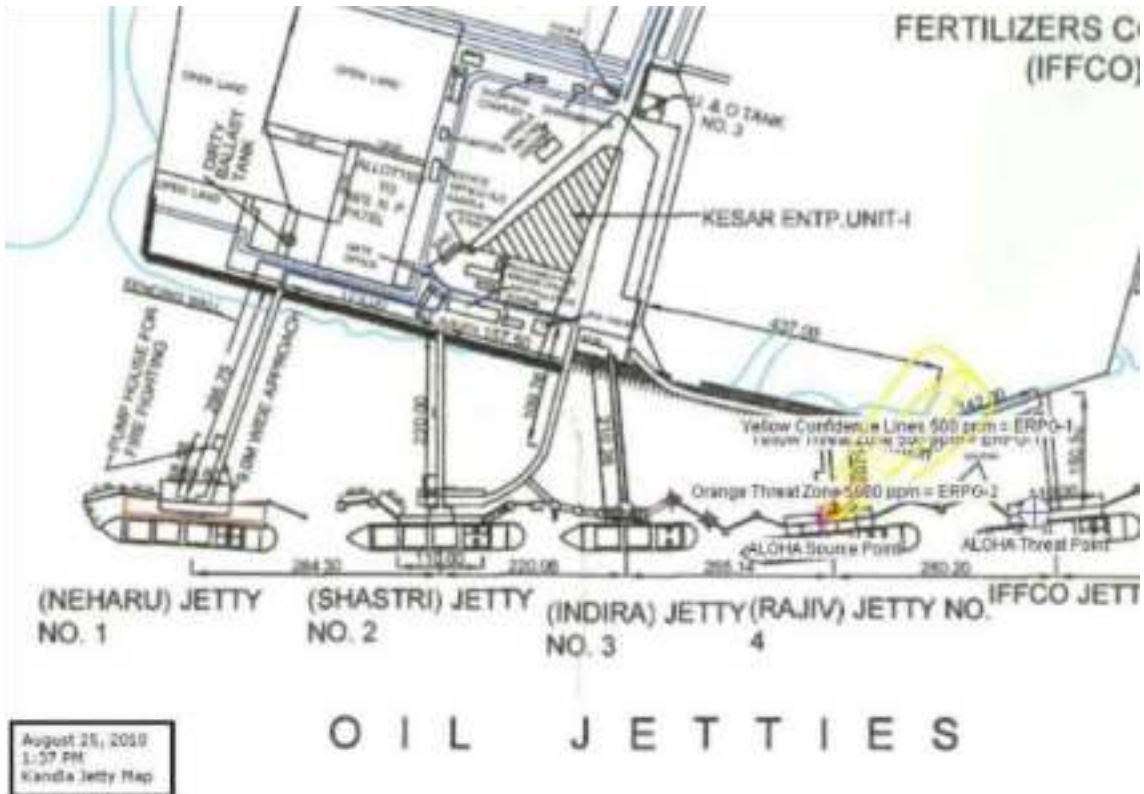


20.1.9.13 Burning Puddle – Thermal Radiation (Graph)

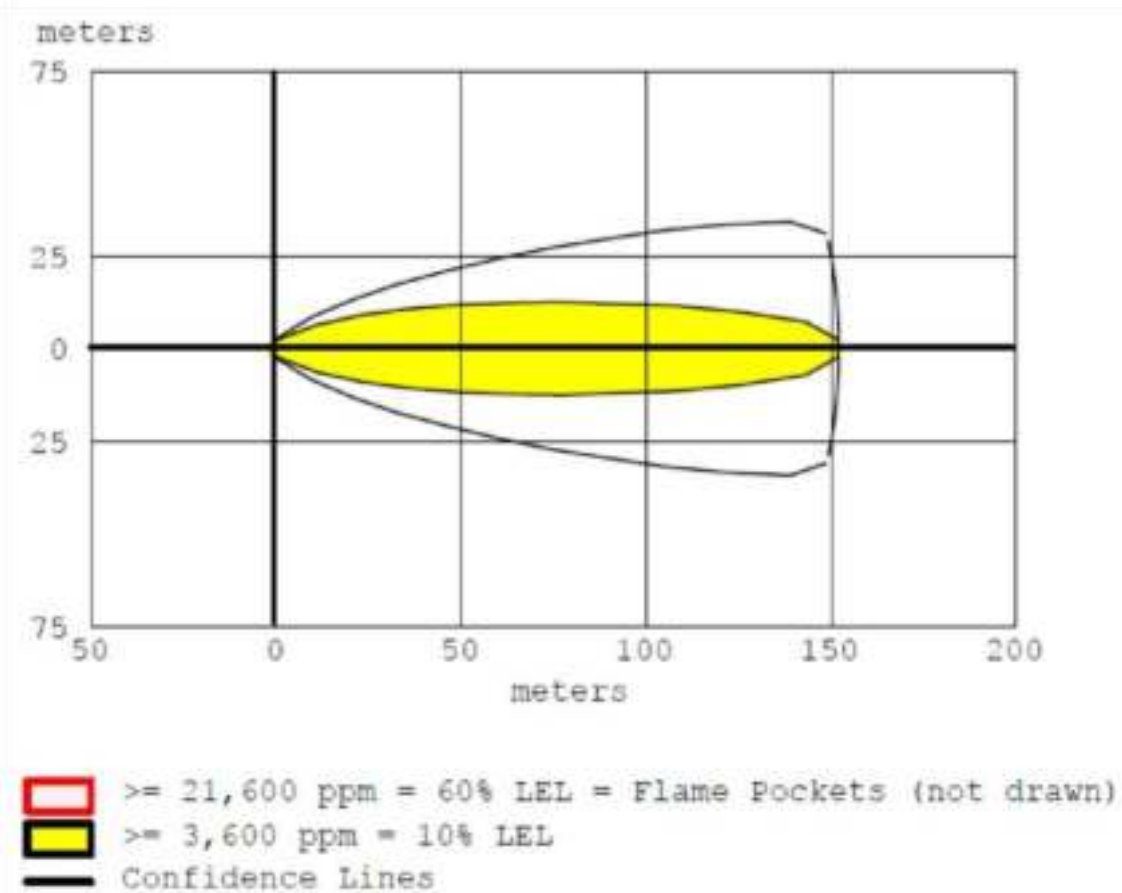
20.1.10.1 Instantaneous Release – Toxic Threat Zone (Graph)



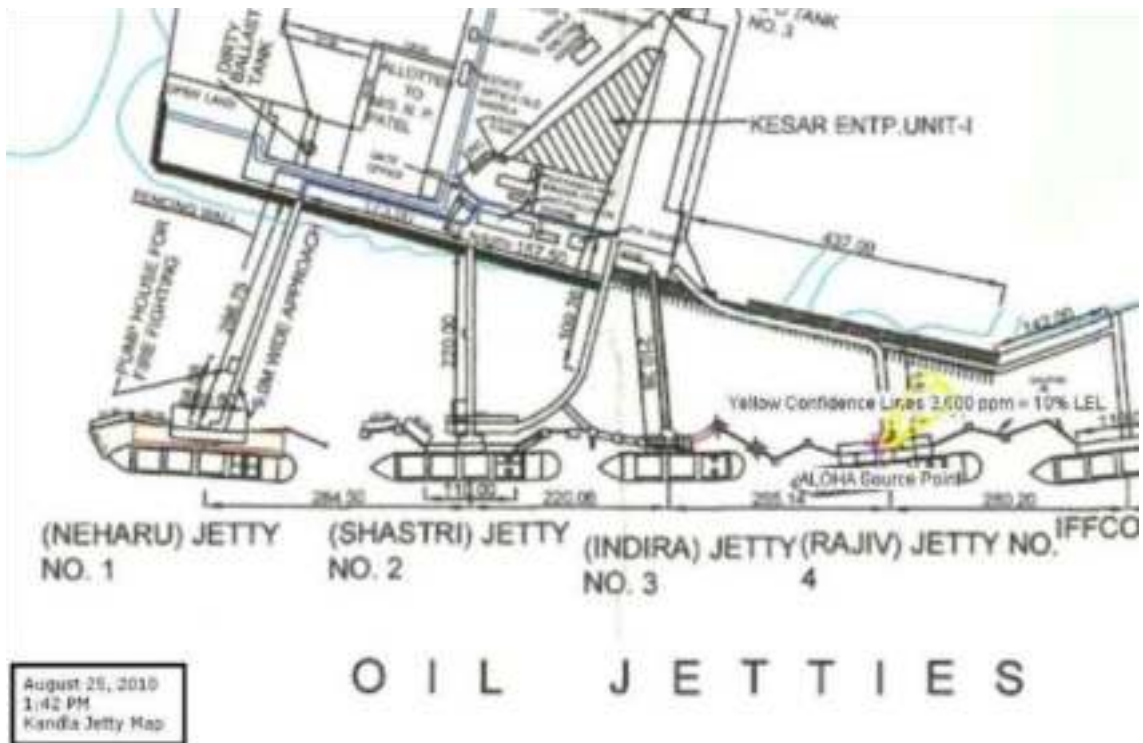
20.1.10.2 Instantaneous Release – Toxic Threat Zone (Contour)



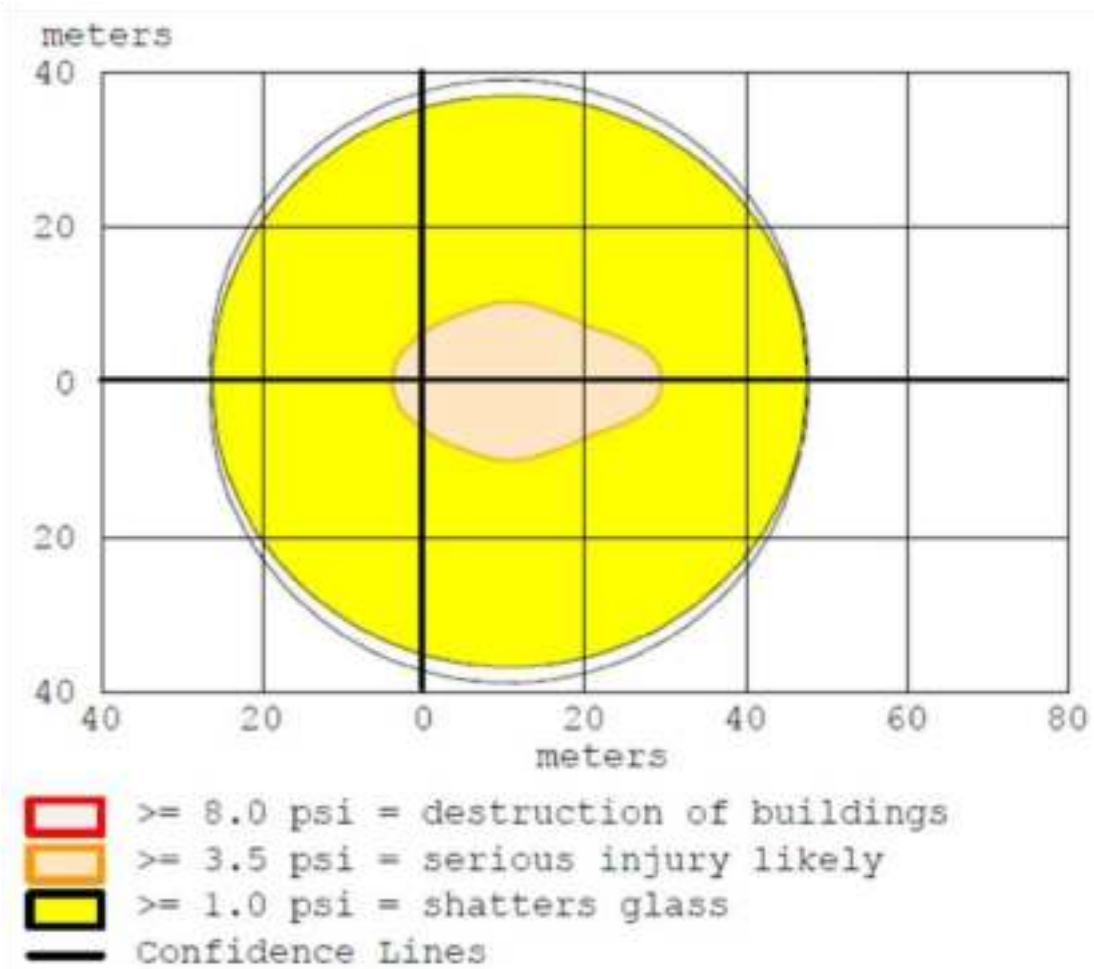
20.1.10.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



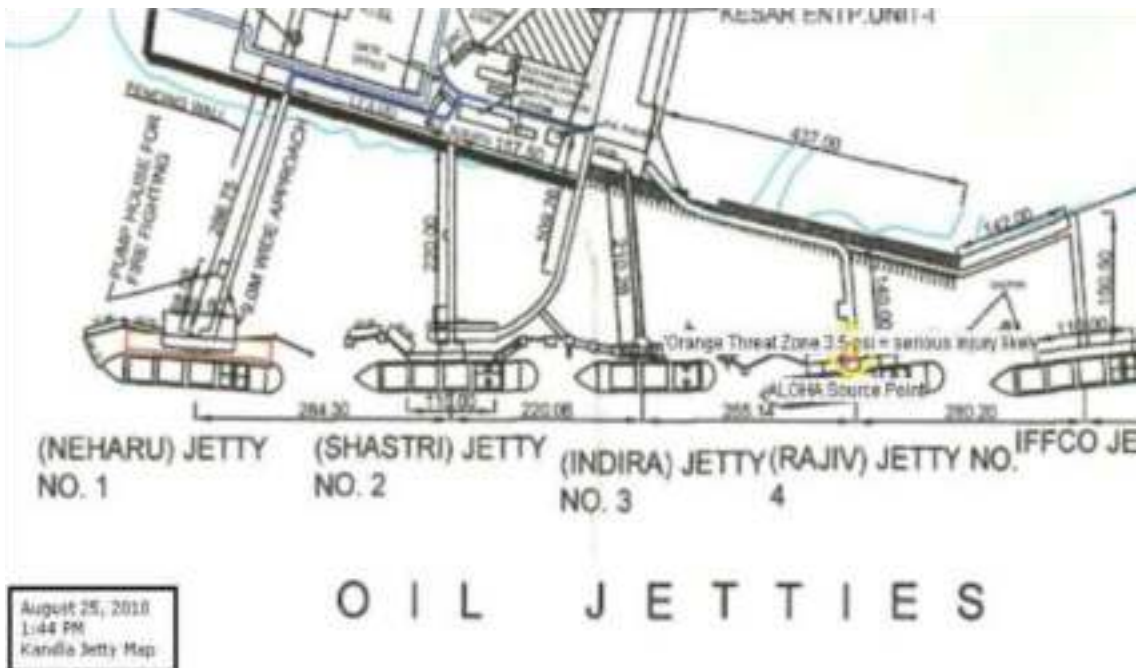
20.1.10.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



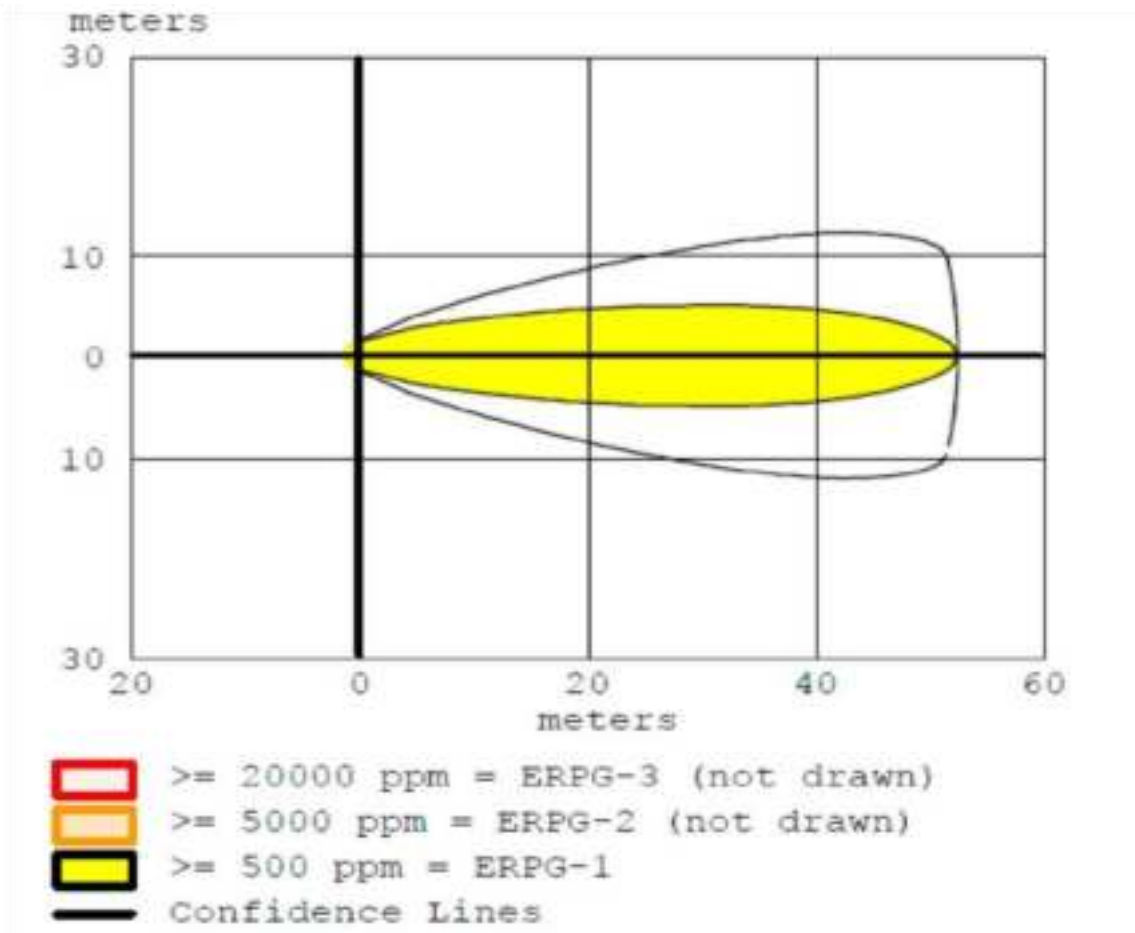
20.1.10.5 Instantaneous Release – Overpressure (Graph)



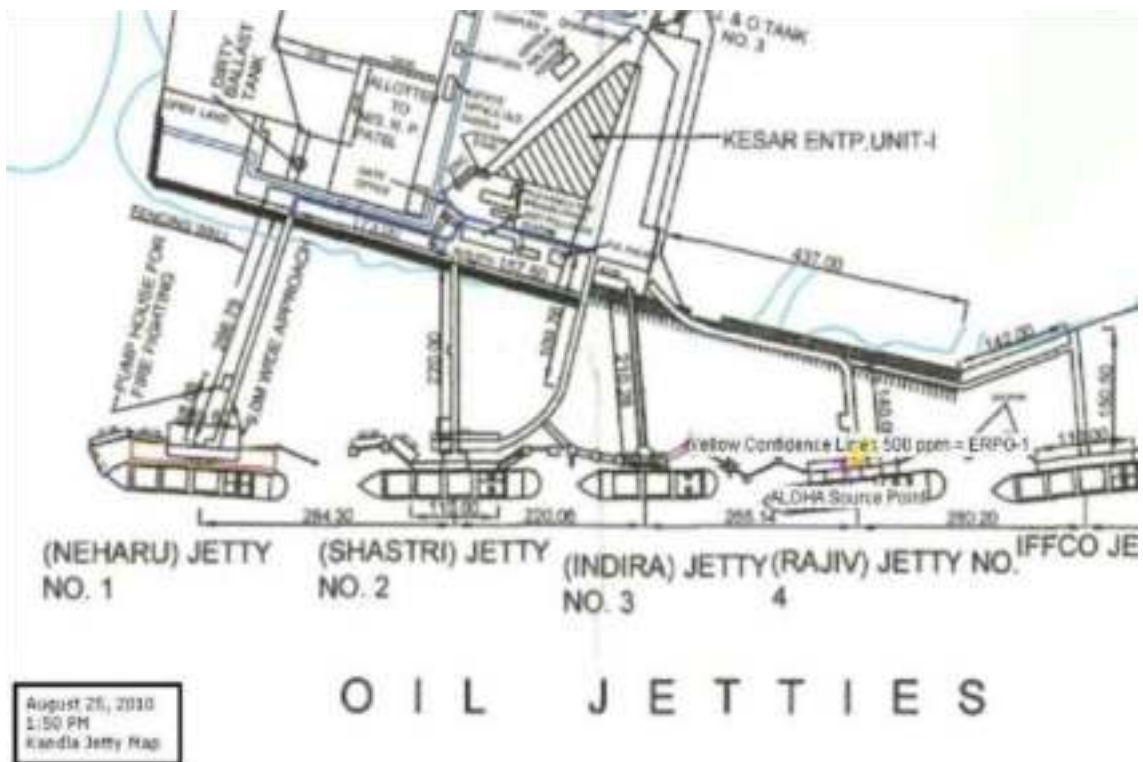
20.1.10.6 Instantaneous Release – Overpressure (Contour)



20.1.10.7 Evaporating Puddle – Toxic Threat Zone (Graph)

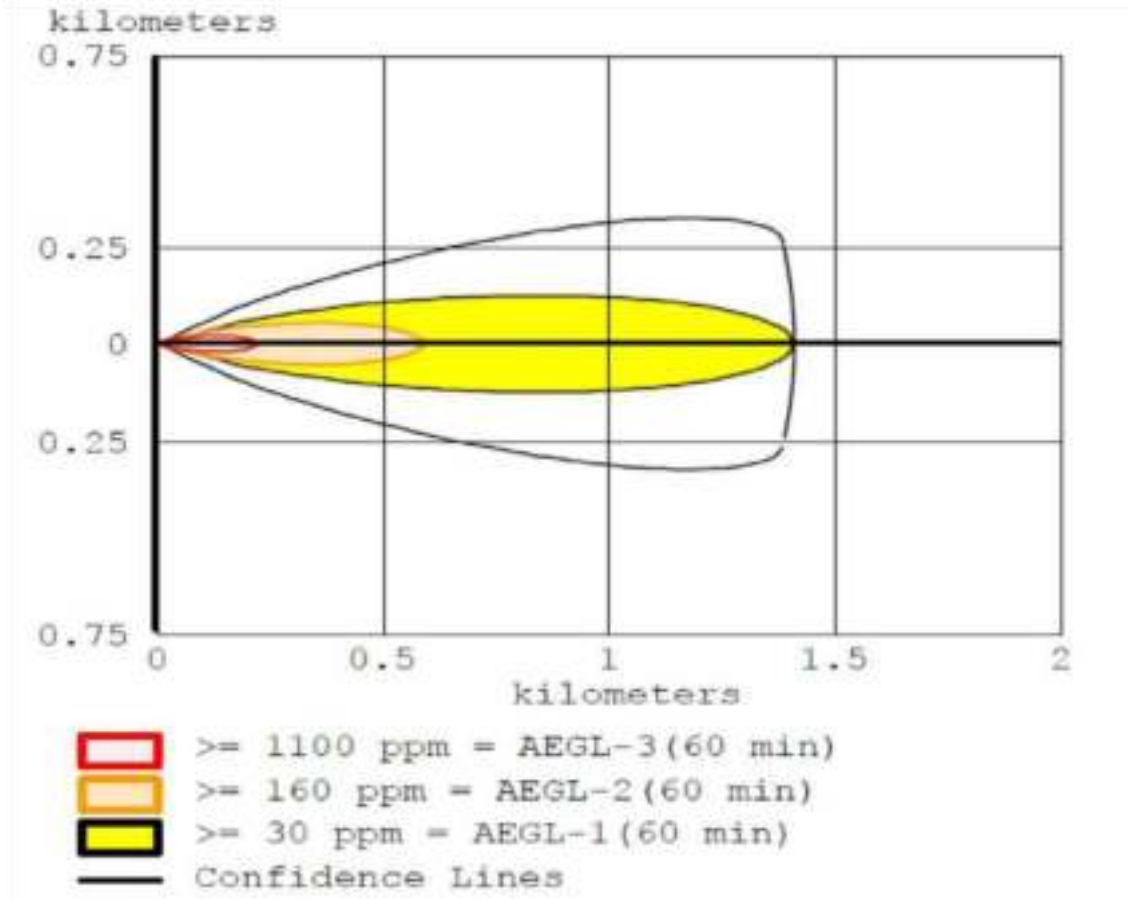


20.1.10.8 Evaporating Puddle – Toxic Threat Zone (Contour)

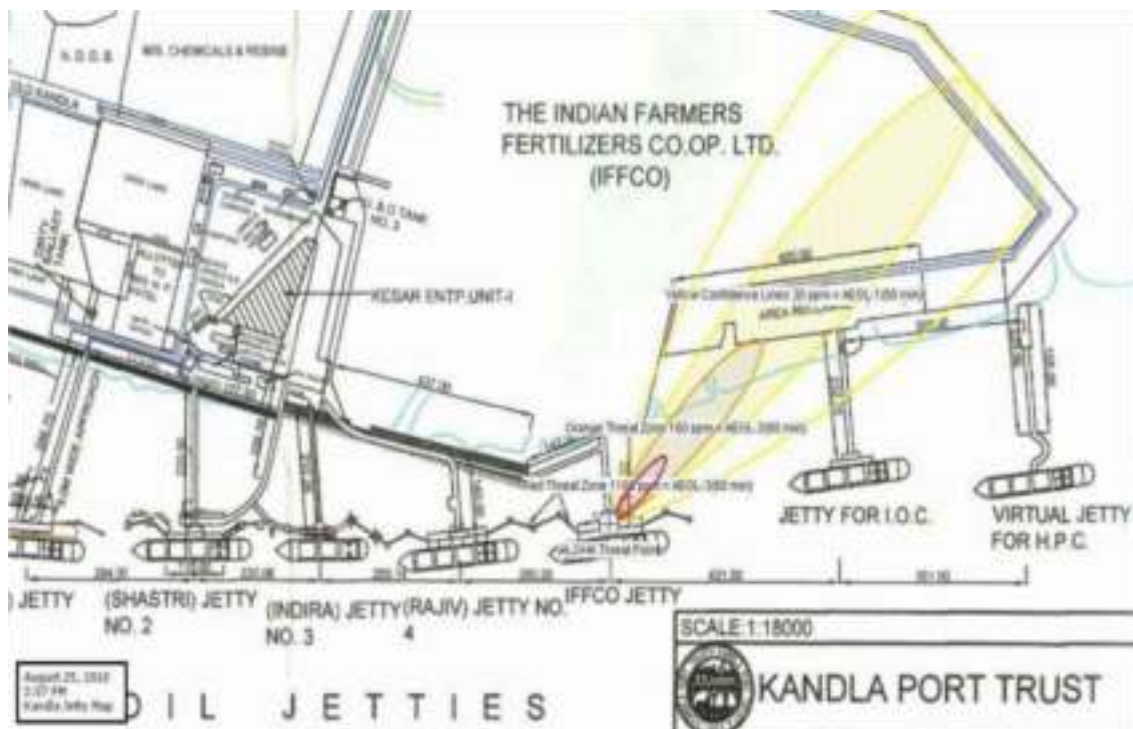


20.1.11 Jetty Five – Ammonia

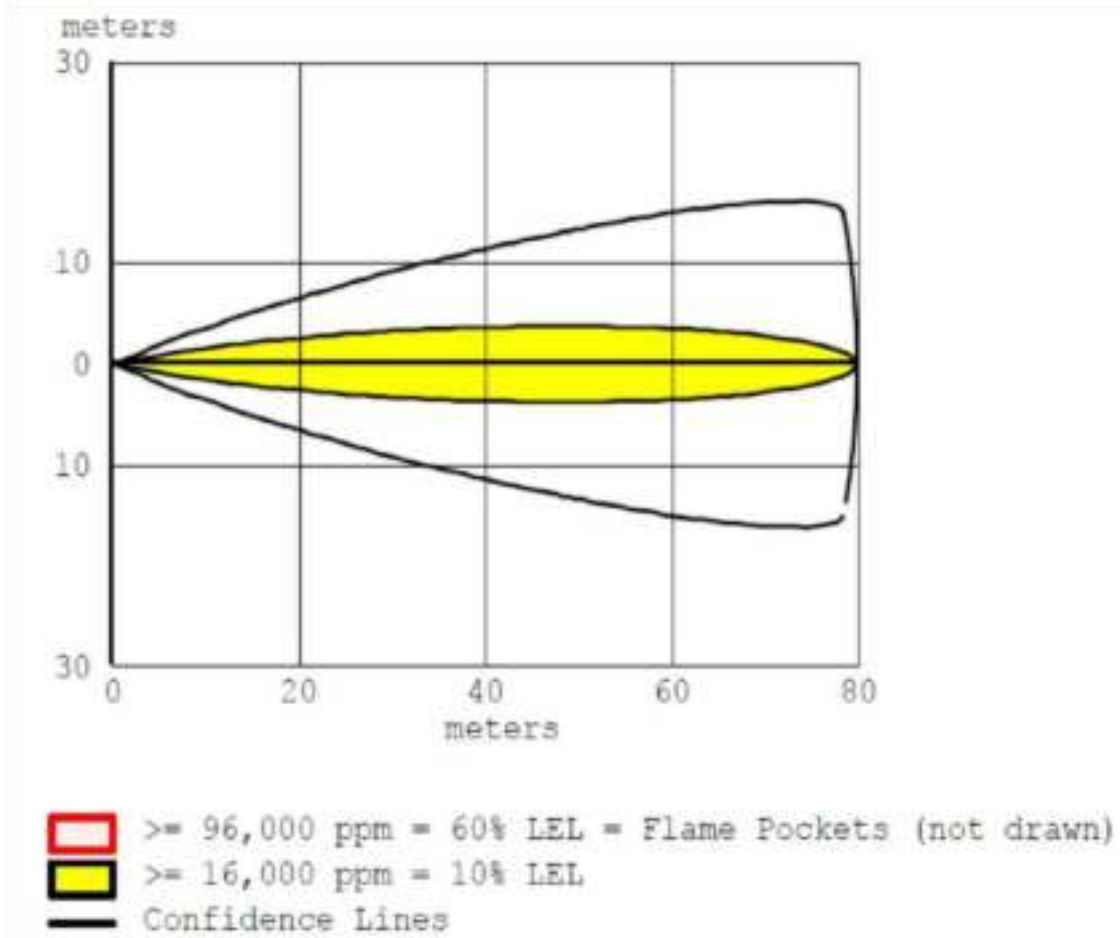
20.1.11.1 Instantaneous Release – Toxic Threat Zone (Graph)



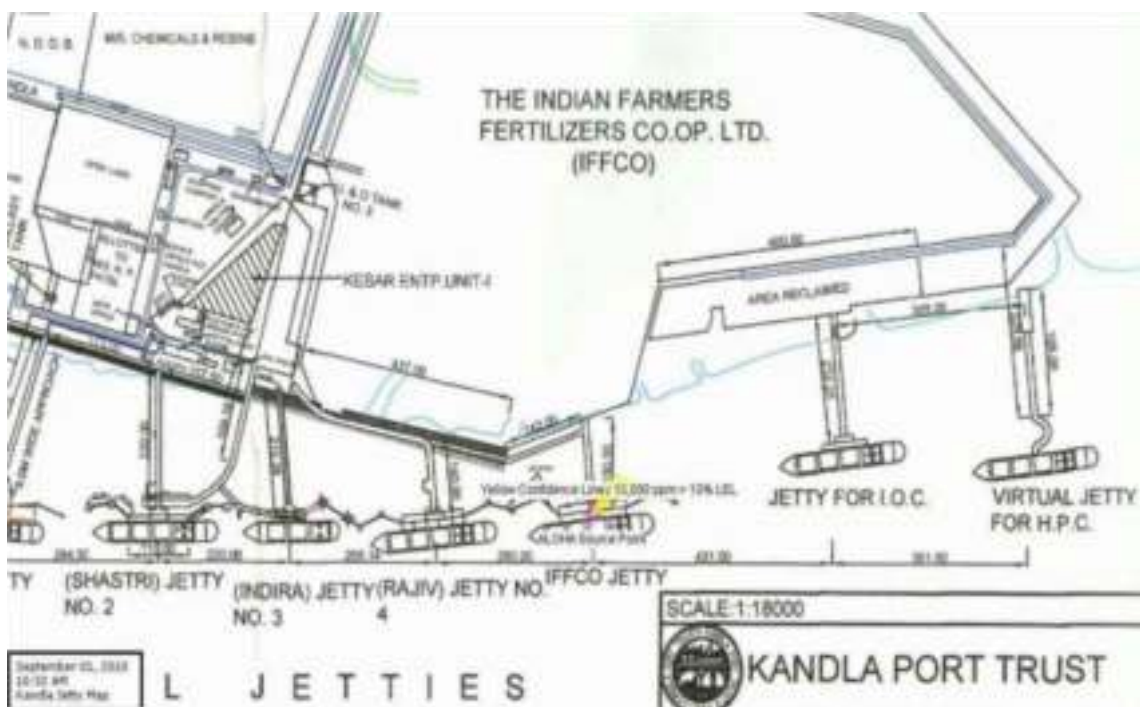
20.1.11.2 Instantaneous Release – Toxic Threat Zone (Contour)



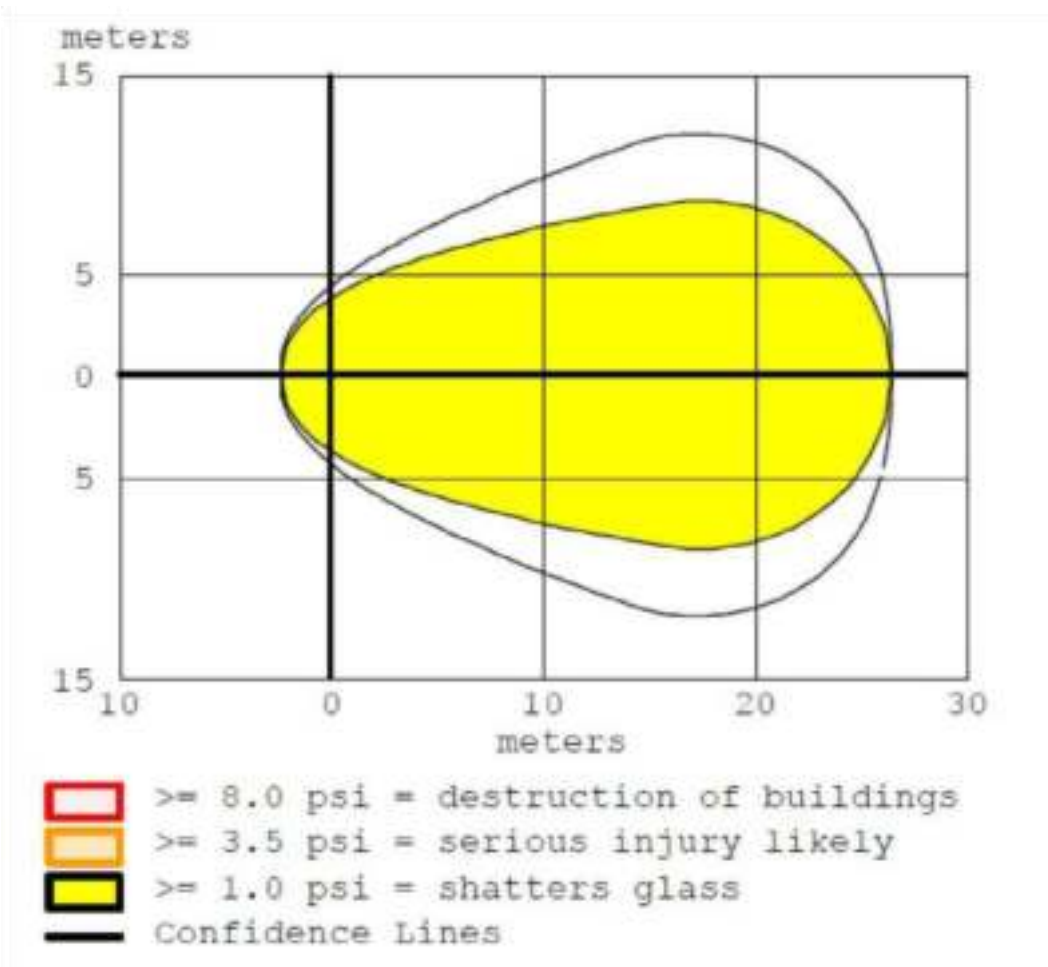
20.1.11.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



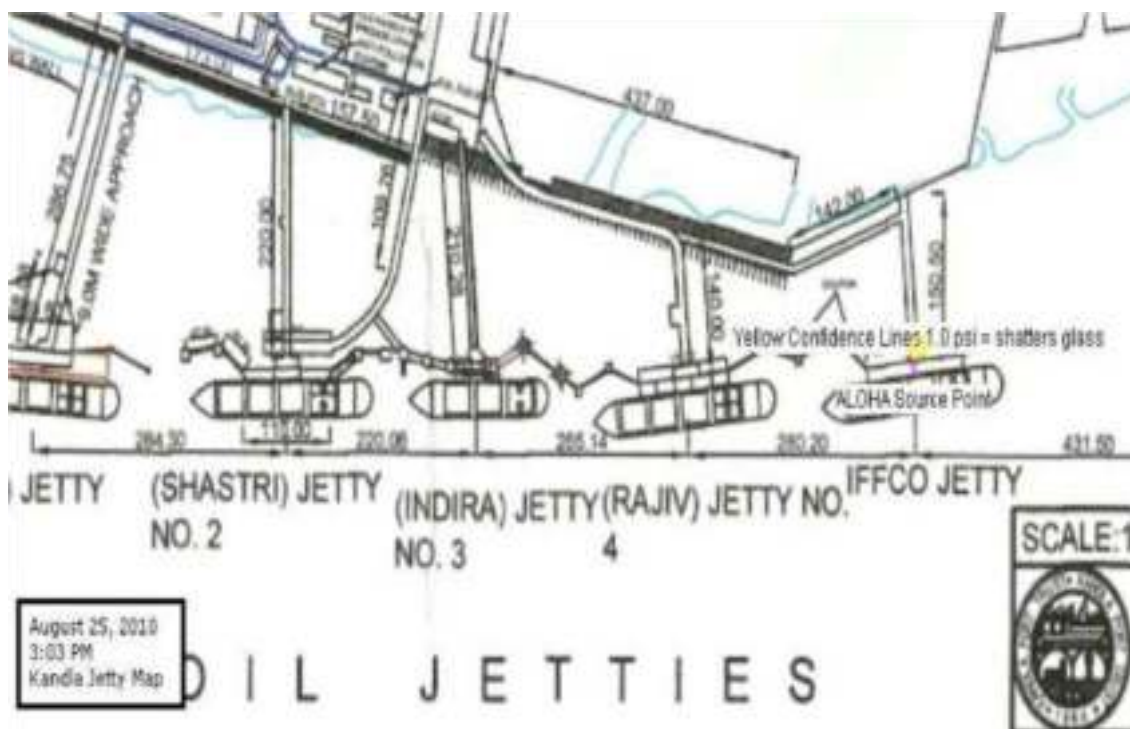
20.1.11.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



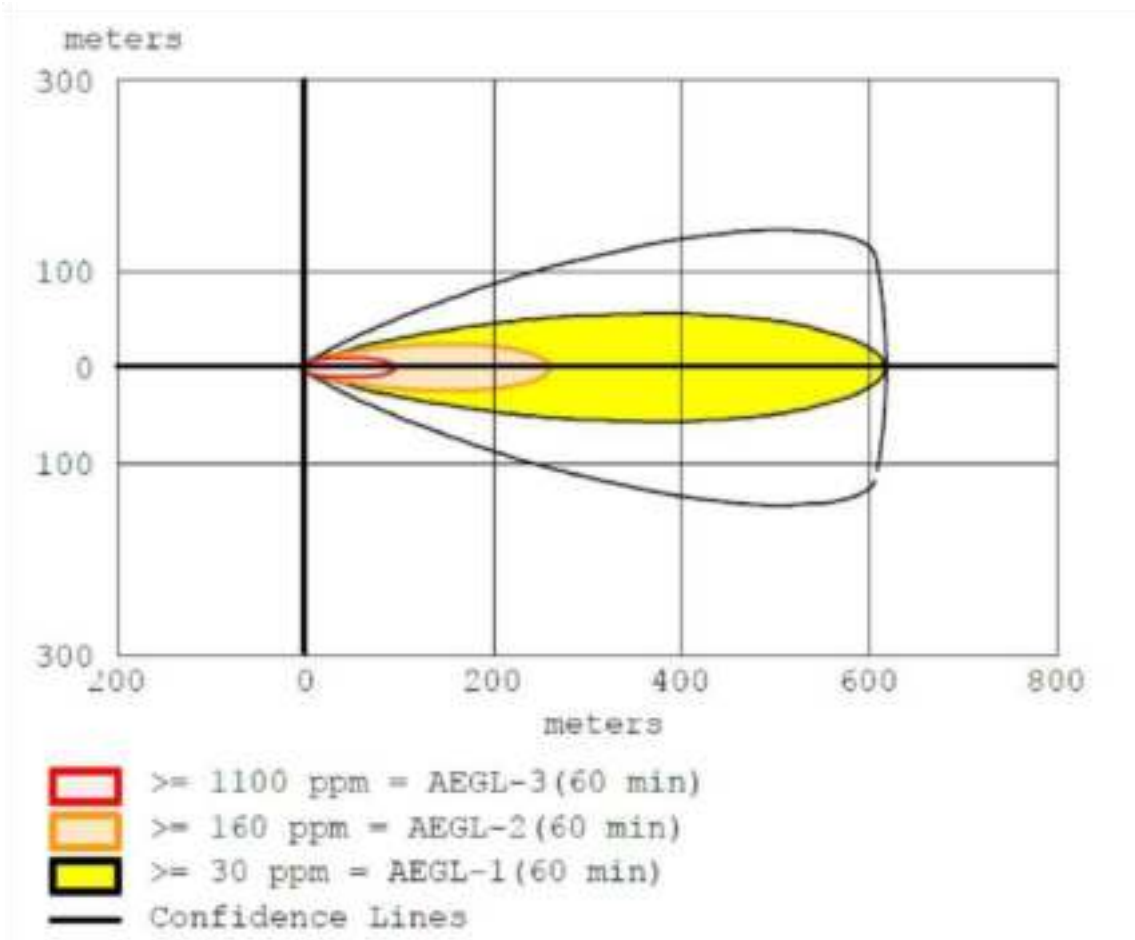
20.1.11.5 Instantaneous Release – Overpressure (Graph)



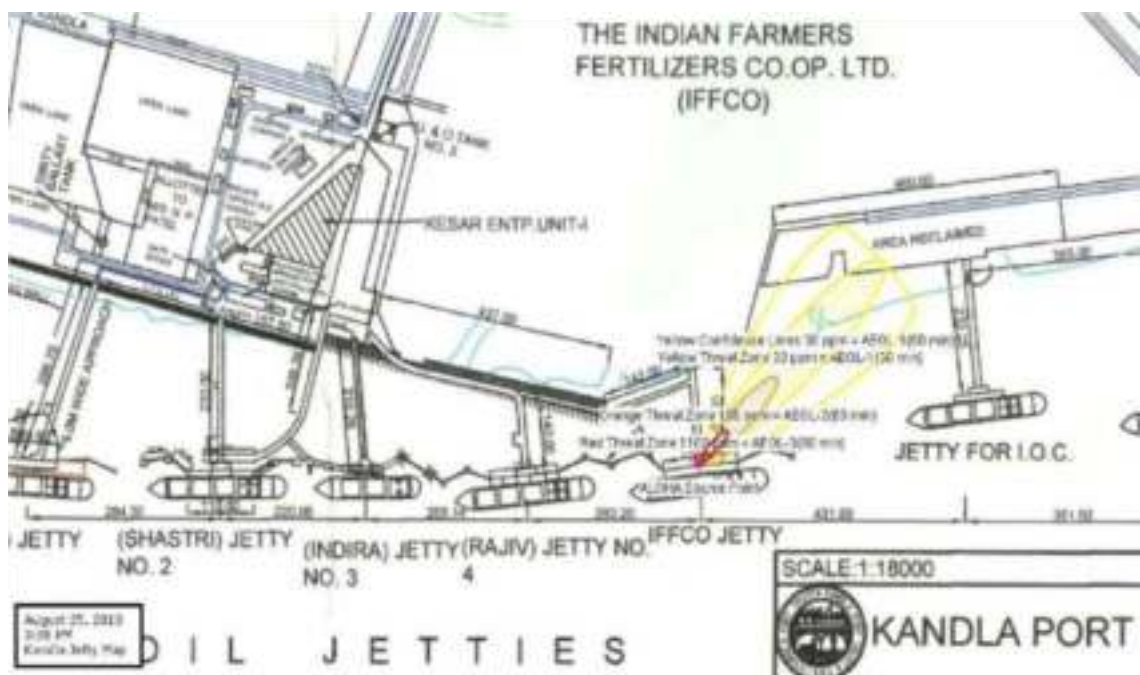
20.1.11.6 Instantaneous Release – Overpressure (Contour)



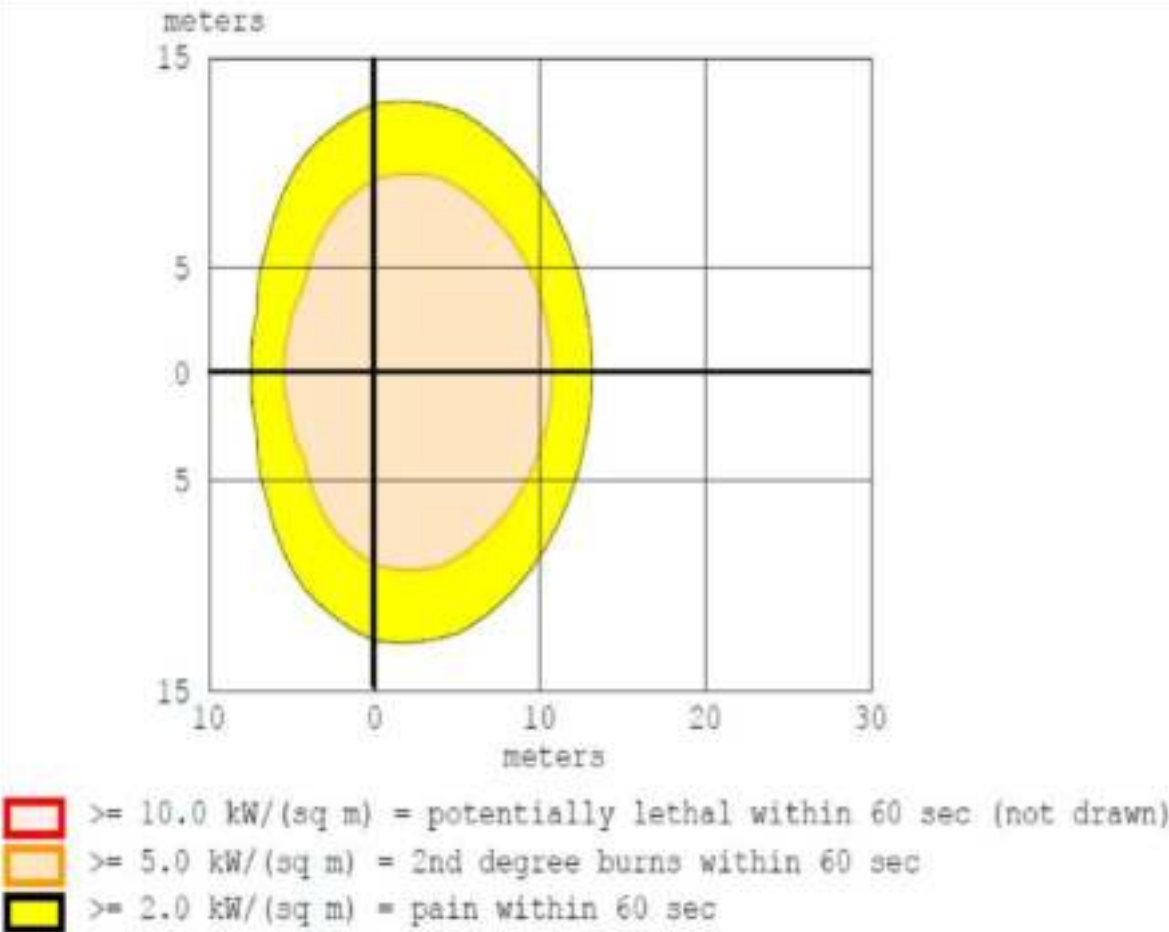
20.1.11.7 Evaporating Puddle – Toxic Threat Zone (Graph)



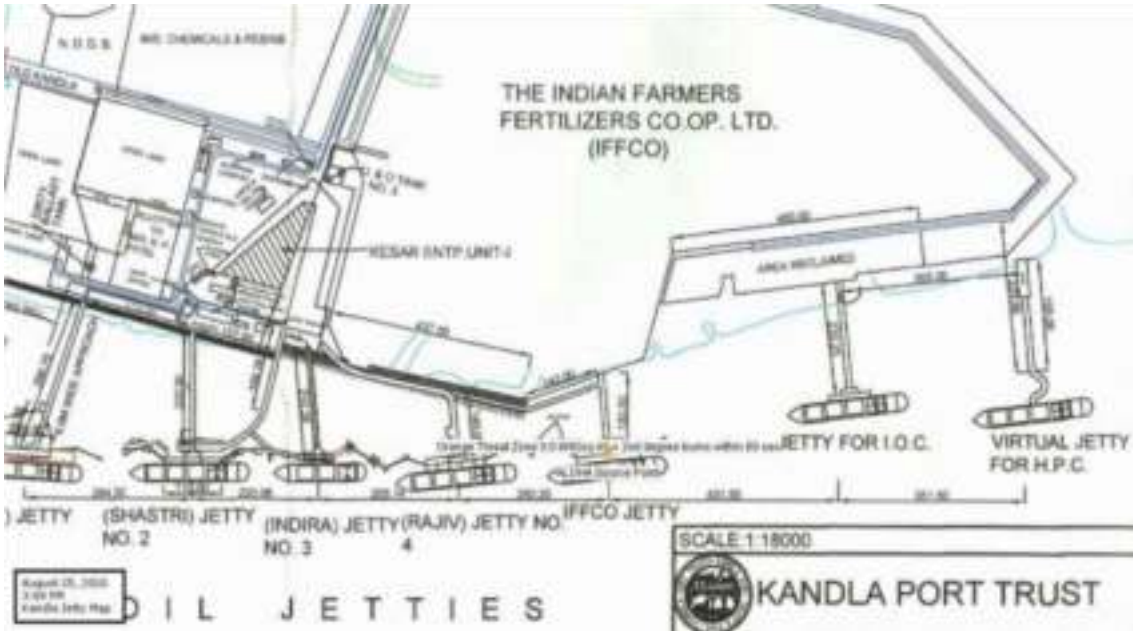
20.1.11.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.11.9 Burning Puddle – Thermal Radiation (Graph)

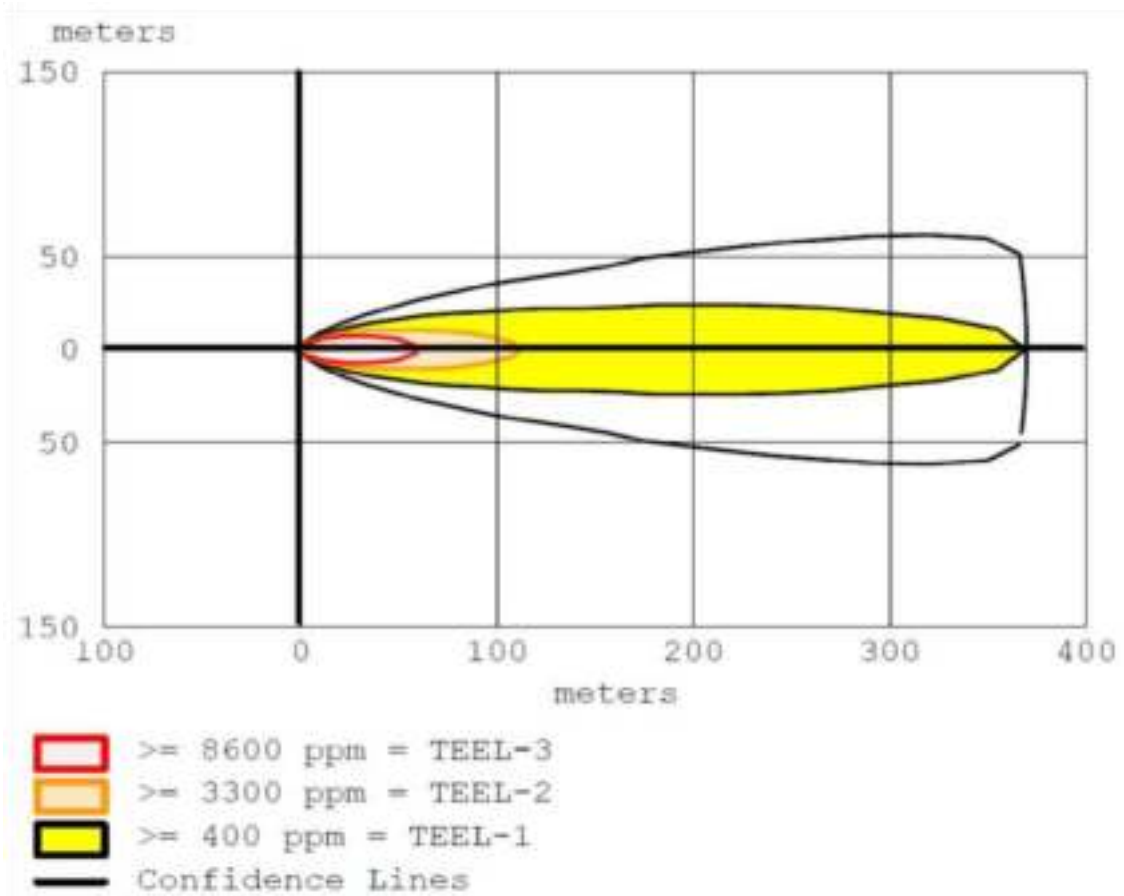


20.1.11.10 Burning Puddle – Thermal Radiation (Contour)

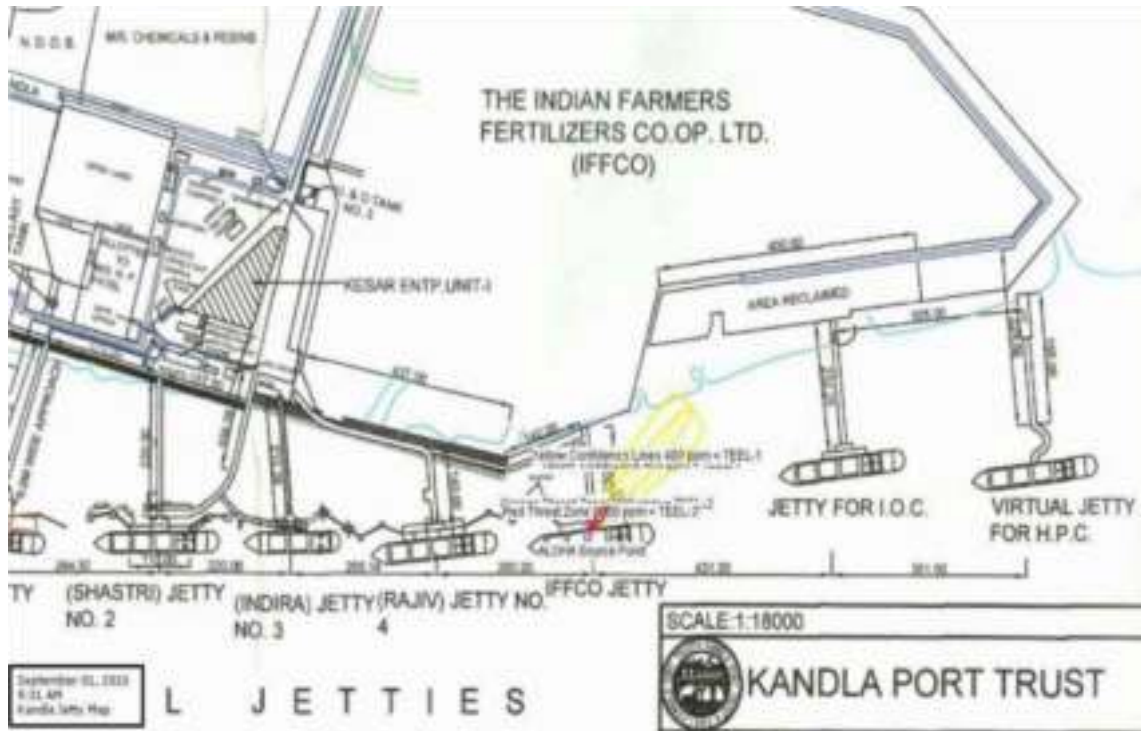


20.1.12 Jetty Five – HSD

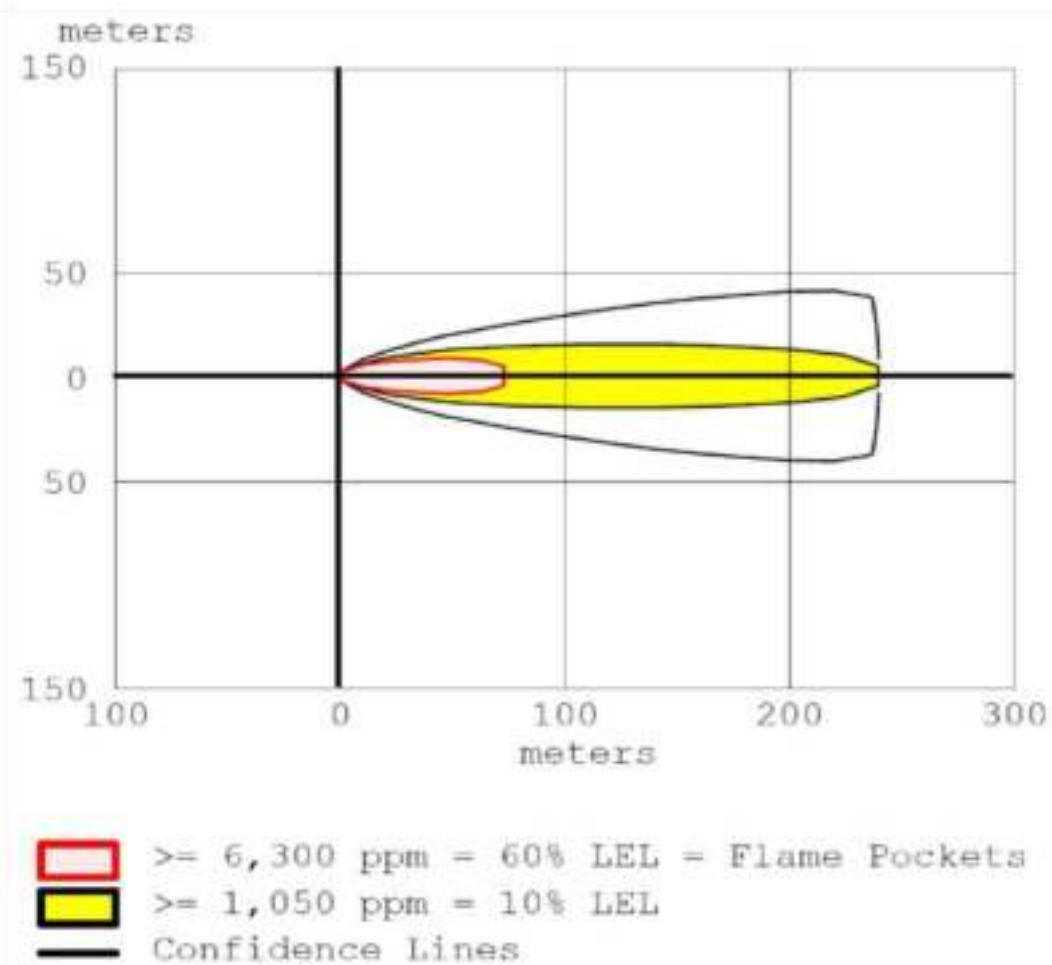
20.1.12.1 Instantaneous Release – Toxic Threat Zone (Graph)



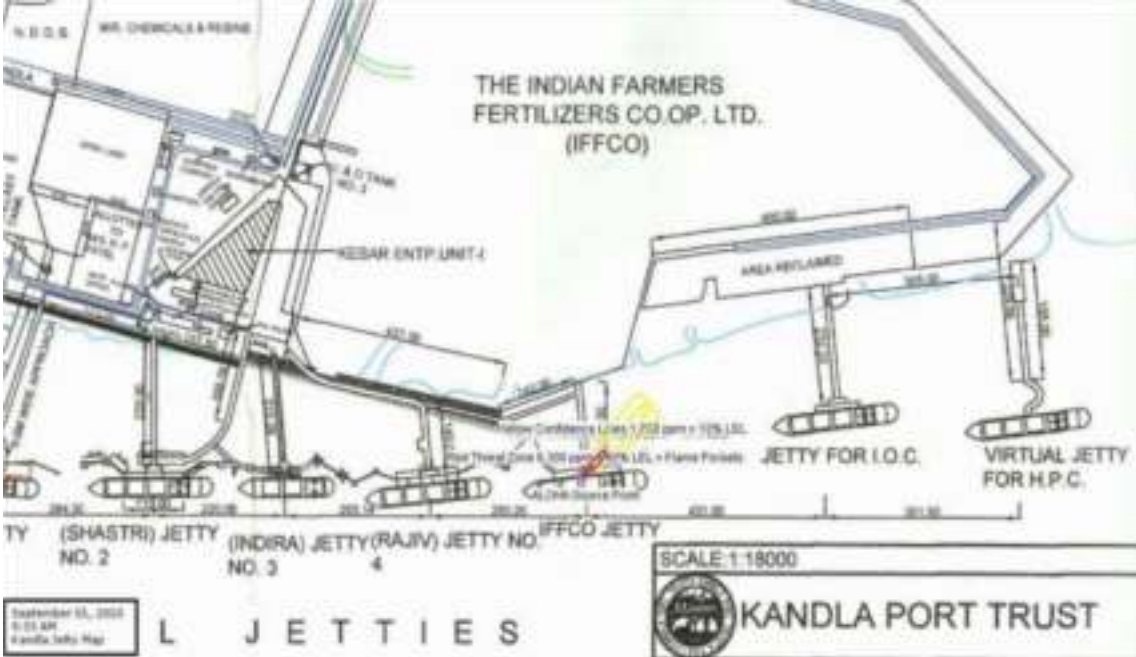
20.1.12.2 Instantaneous Release – Toxic Threat Zone (Contour)



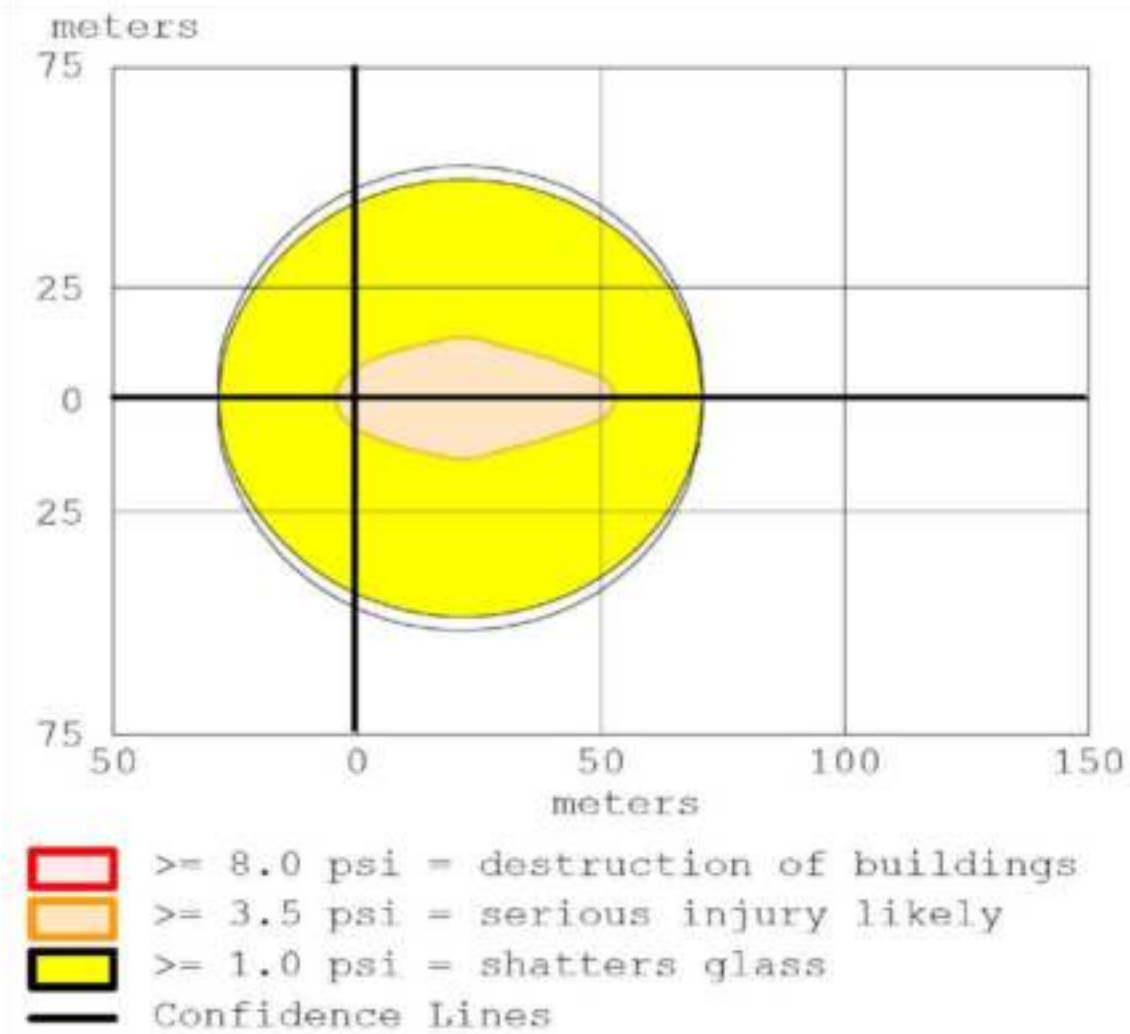
20.1.12.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



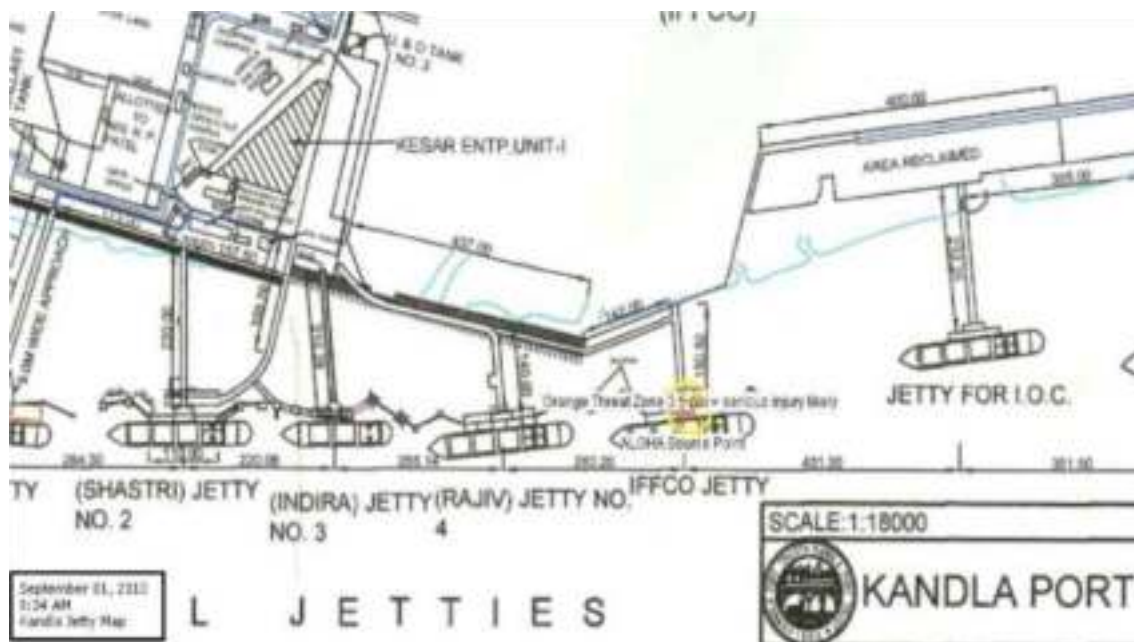
20.1.12.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



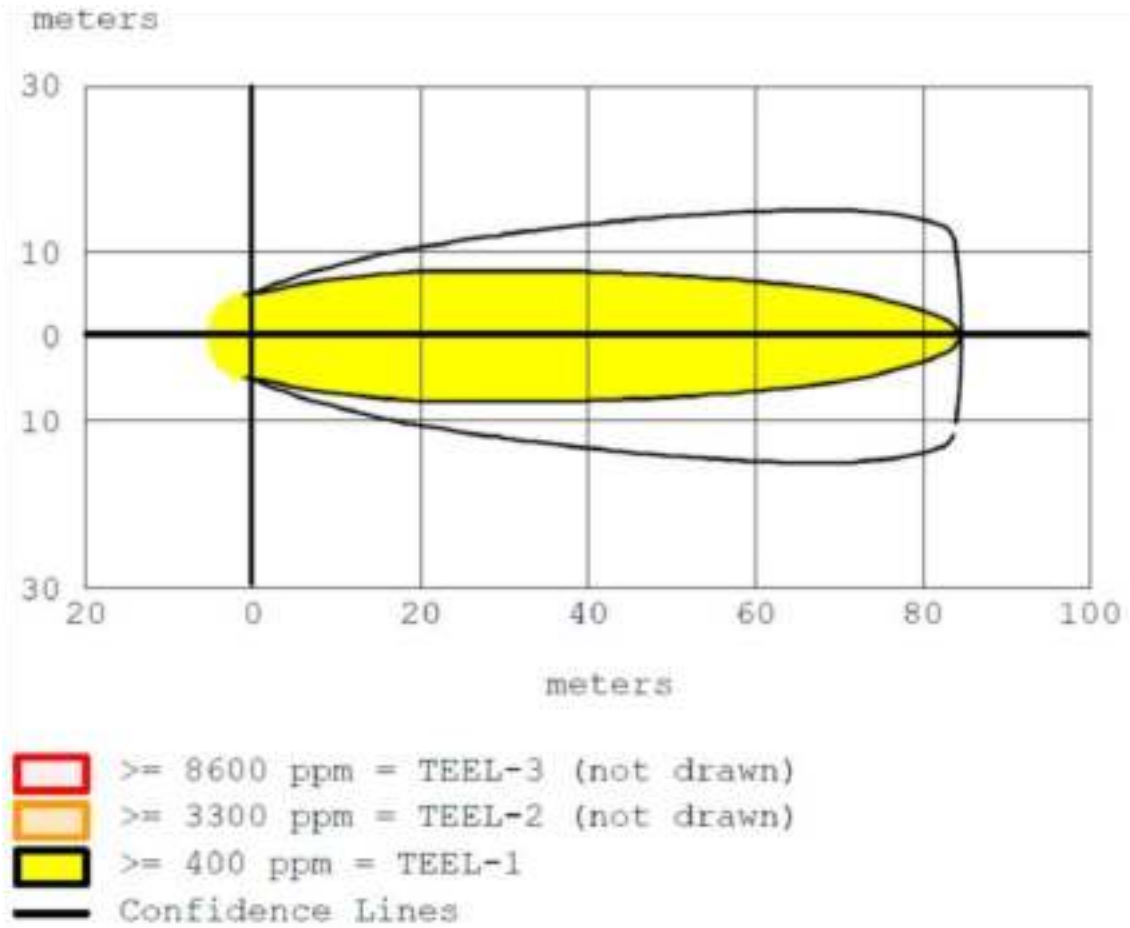
20.1.12.5 Instantaneous Release – Overpressure (Graph)



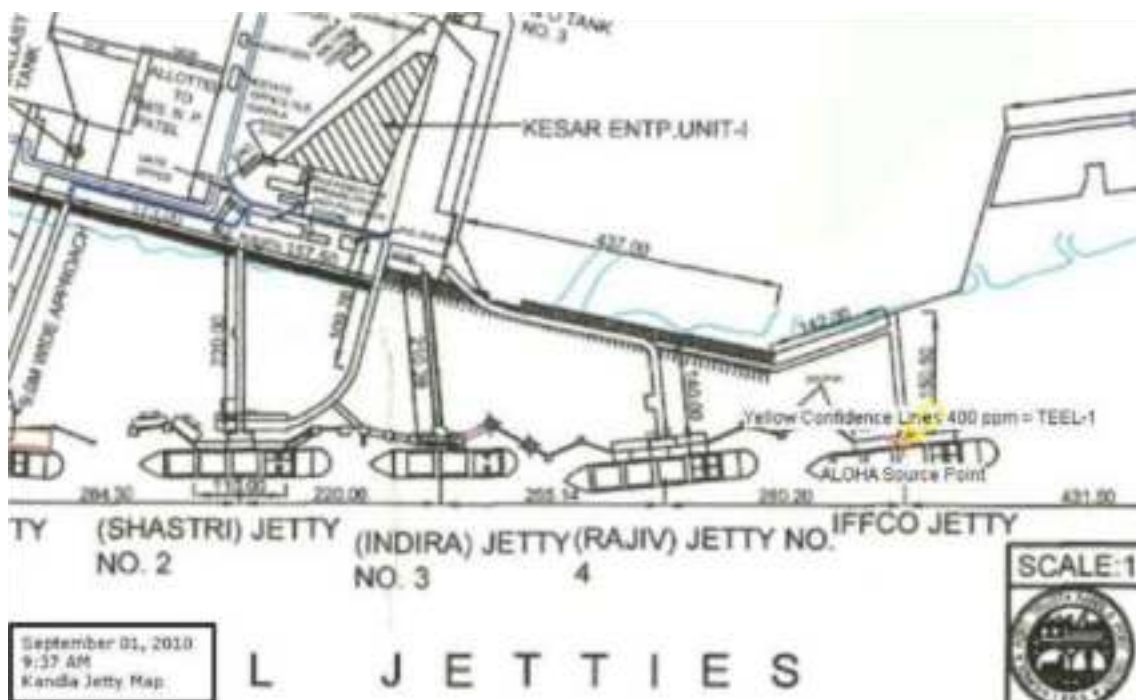
20.1.12.6 Instantaneous Release – Overpressure (Contour)



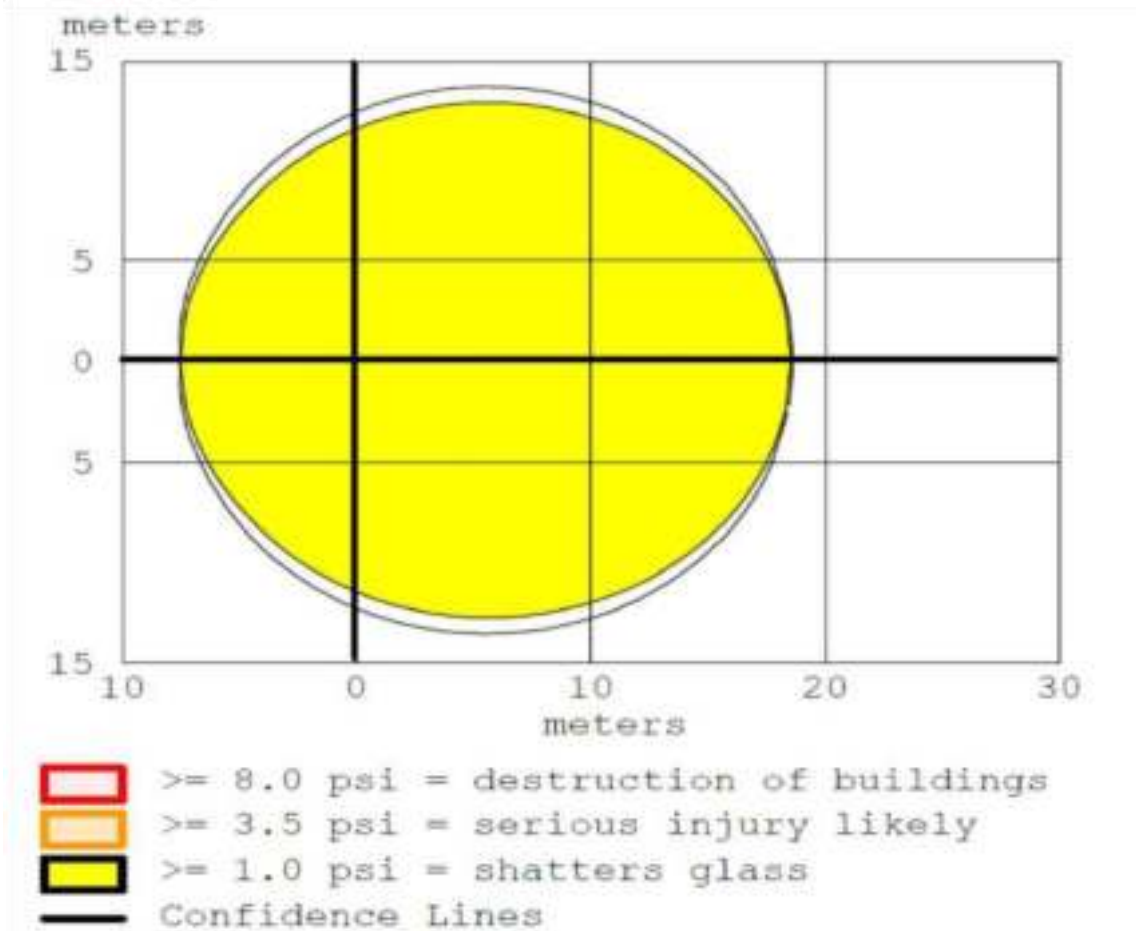
20.1.12.7 Evaporating Puddle – Toxic Threat Zone (Graph)



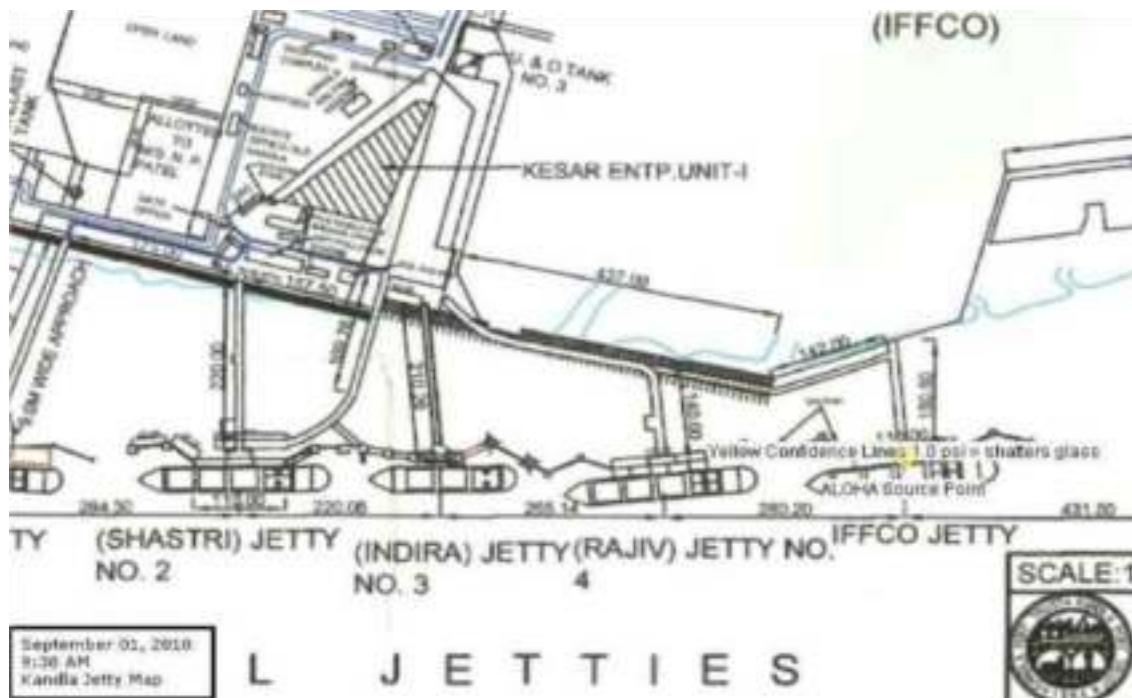
20.1.12.8 Evaporating Puddle – Toxic Threat Zone (Contour)



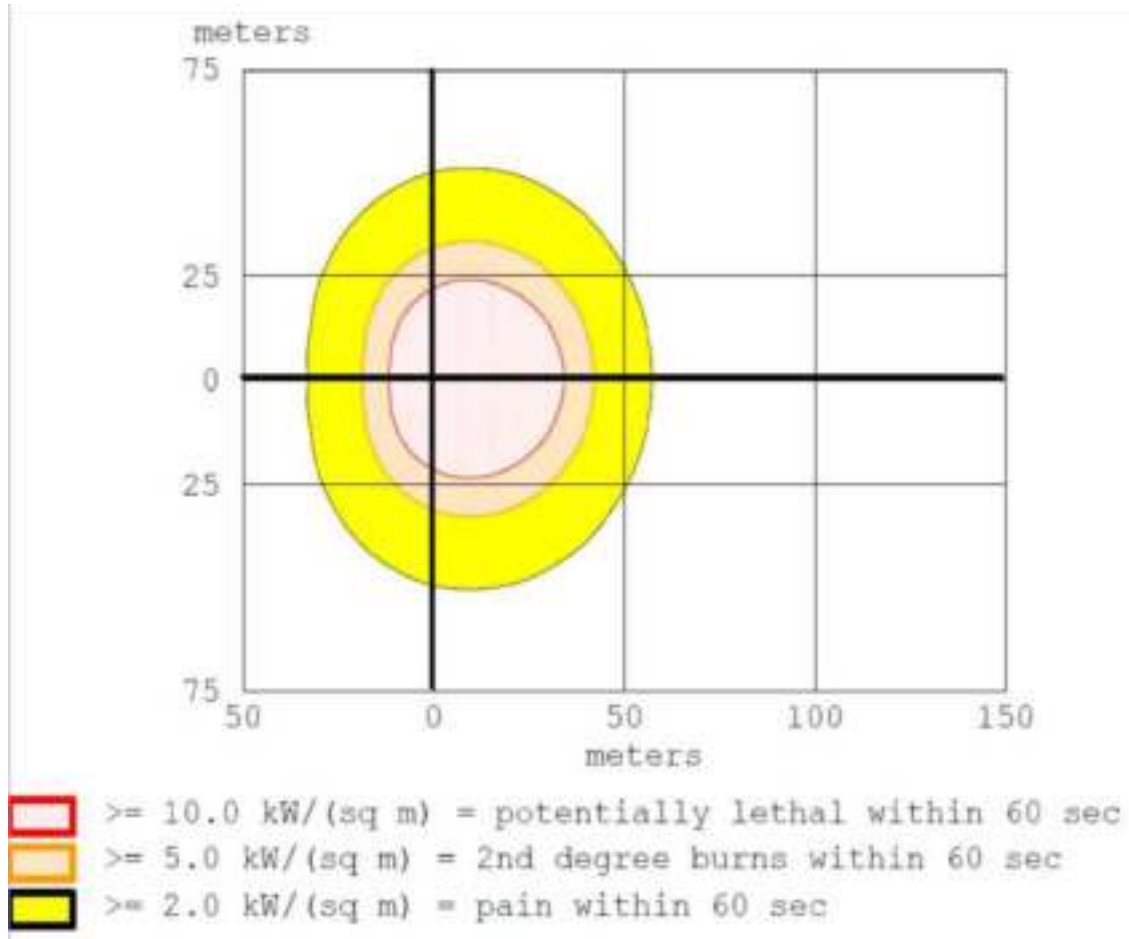
20.1.12.9 Evaporating Puddle – Overpressure (Graph)



20.1.12.10 Evaporating Puddle – Overpressure (Contour)



20.1.12.11 Burning Puddle – Thermal Radiation (Graph)

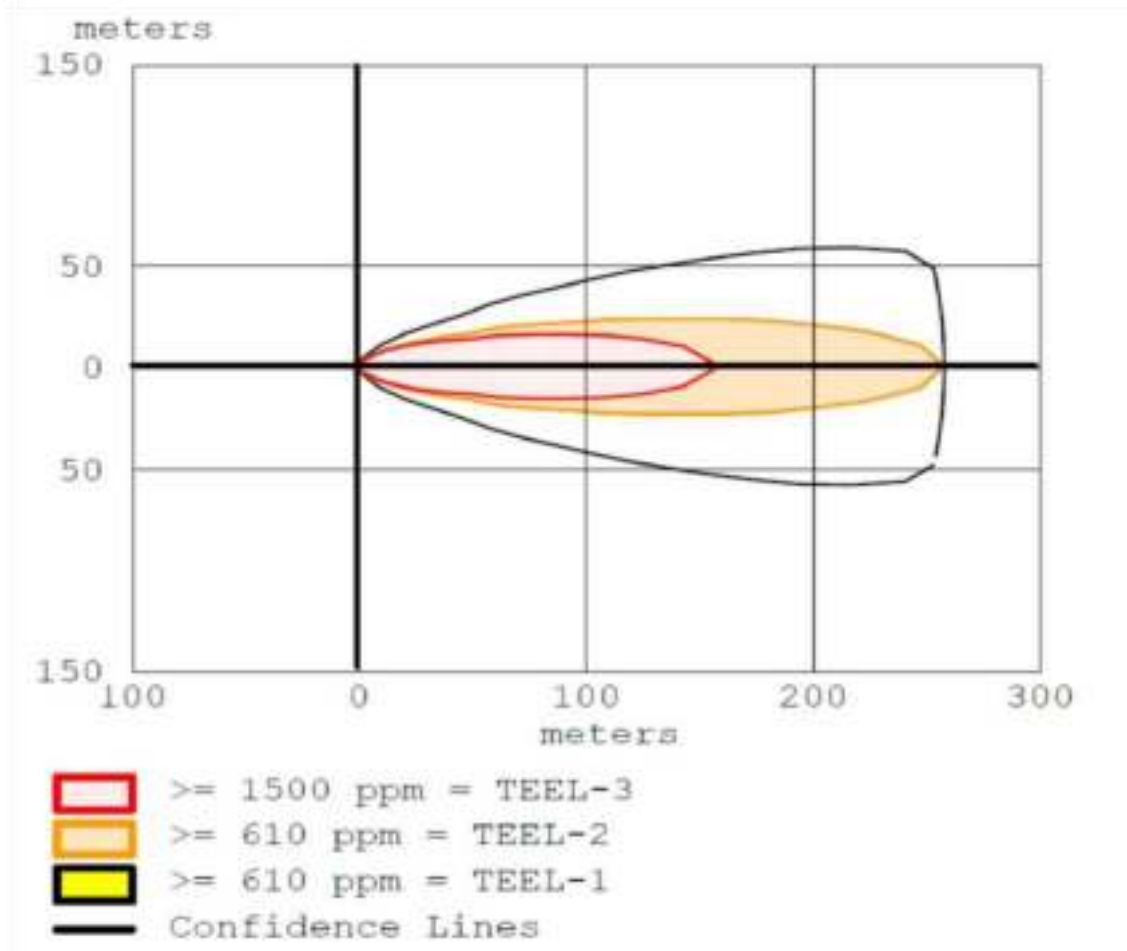


20.1.12.12 Burning Puddle – Thermal Radiation (Contour)

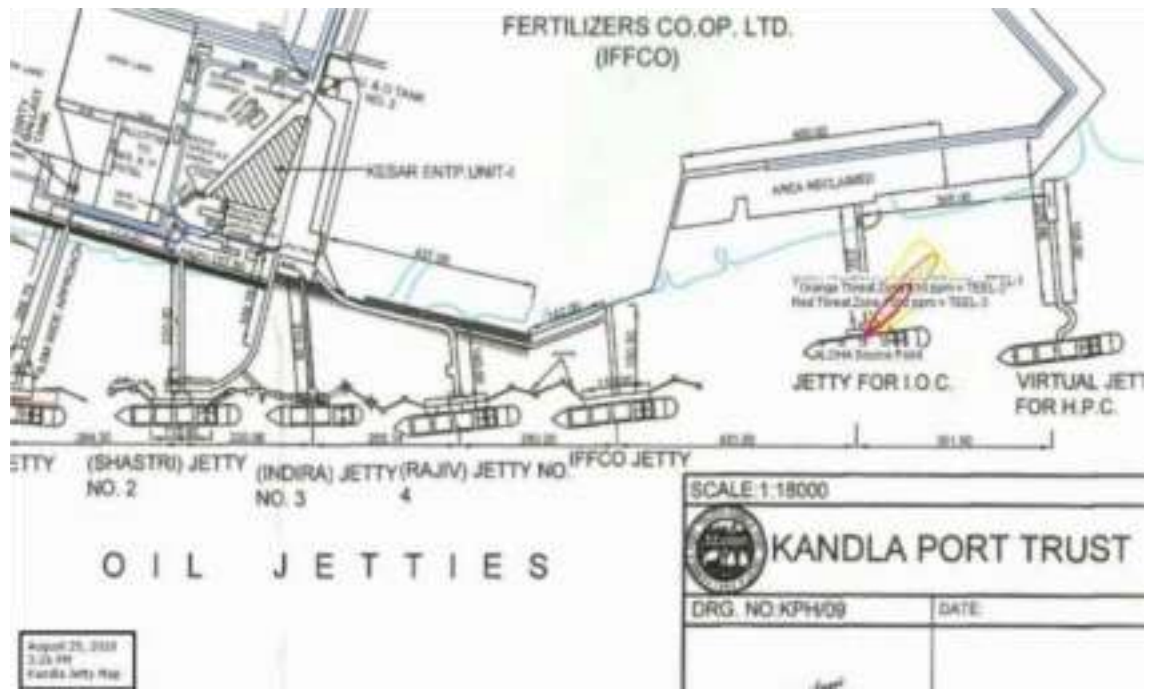


20.1.13 Jetty Six – Motor Spirit

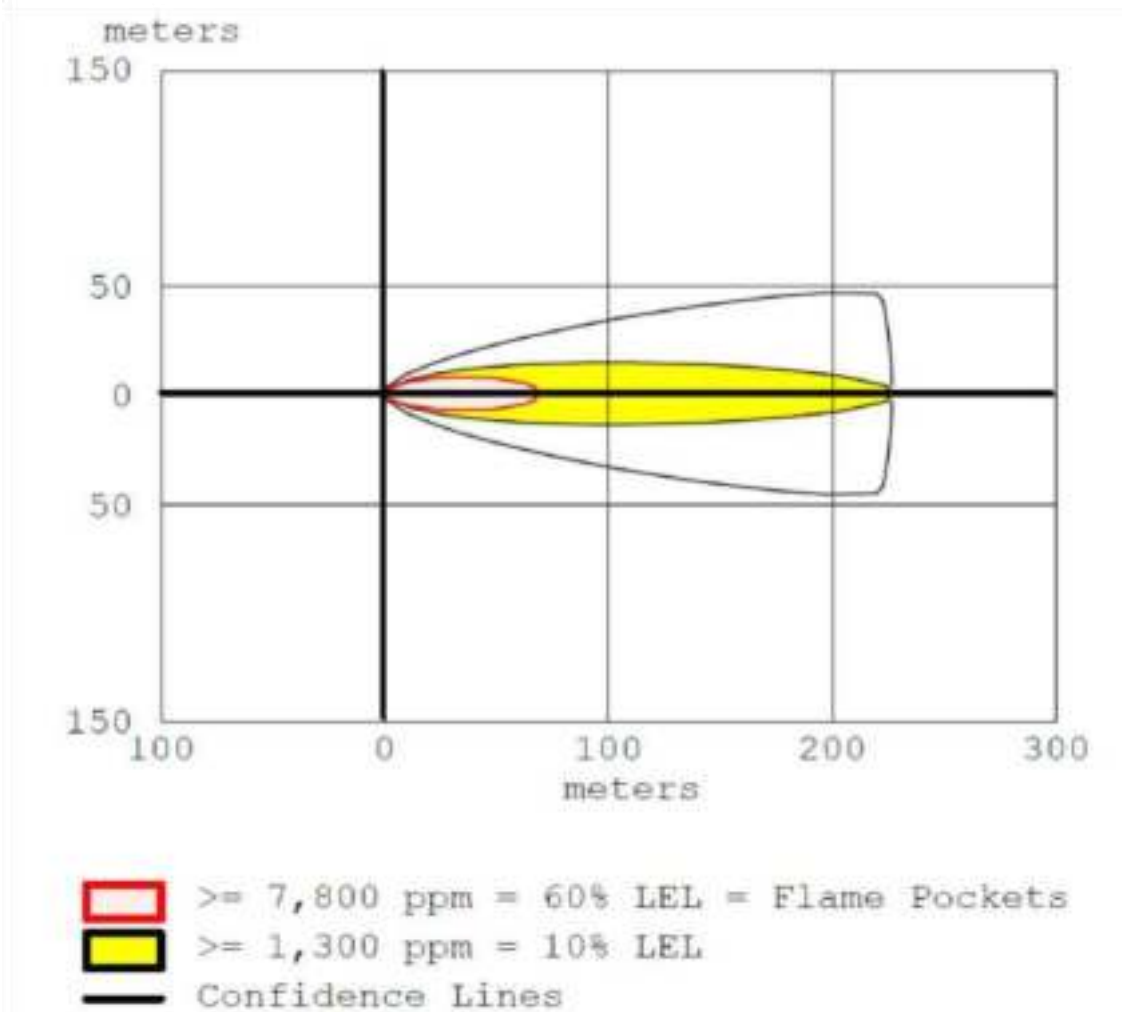
20.1.13.1 Instantaneous Release – Toxic Threat Zone (Graph)



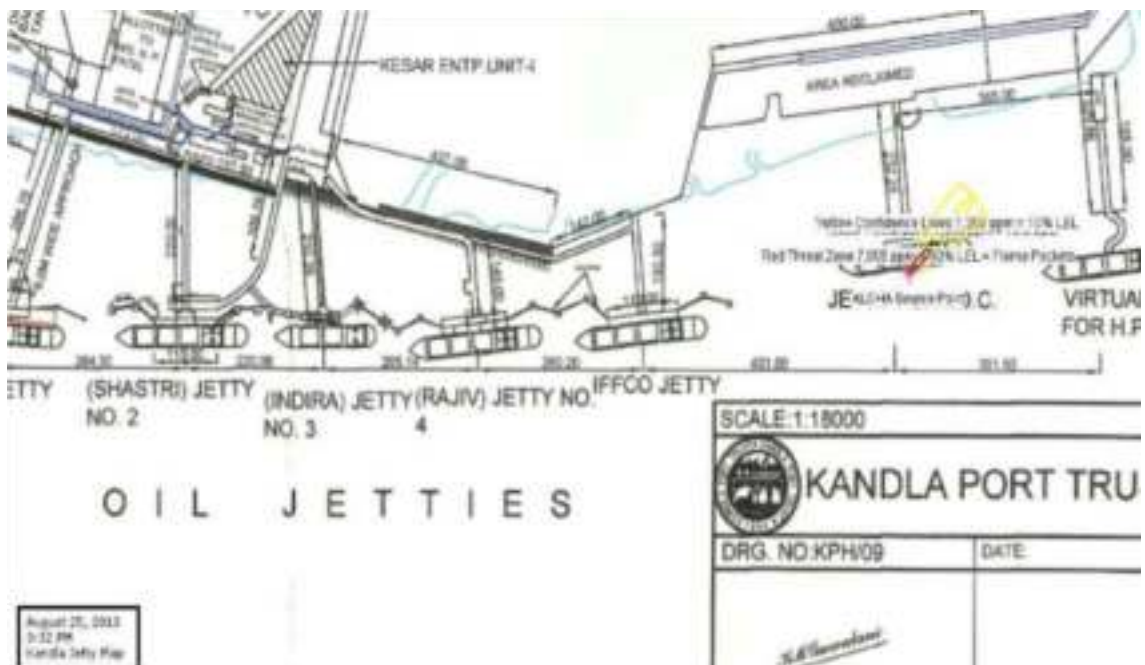
20.1.13.2 Instantaneous Release – Toxic Threat Zone (Contour)



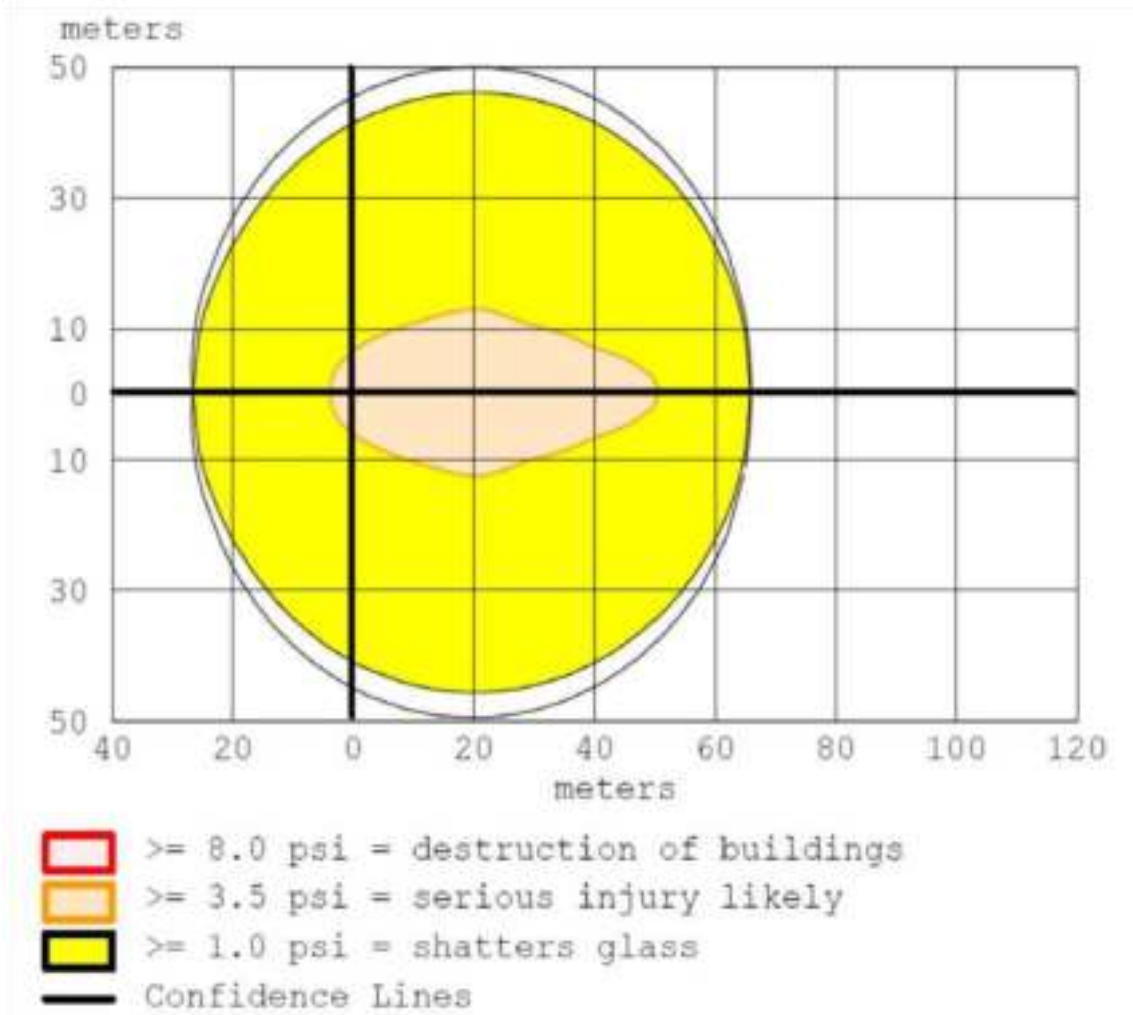
20.1.13.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



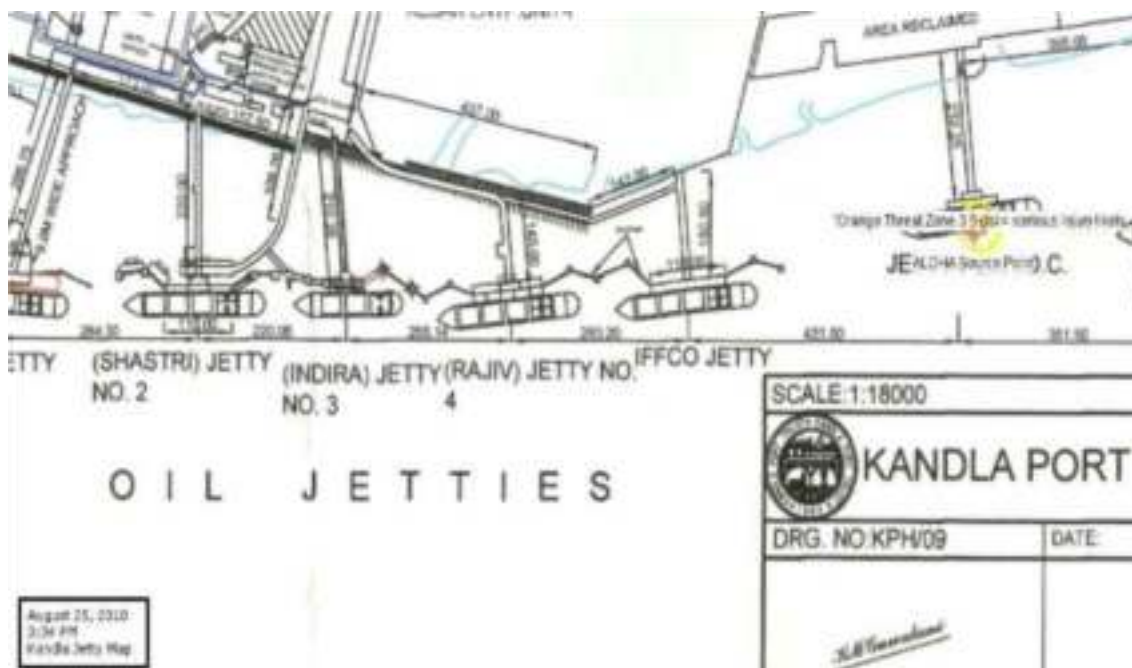
20.1.13.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



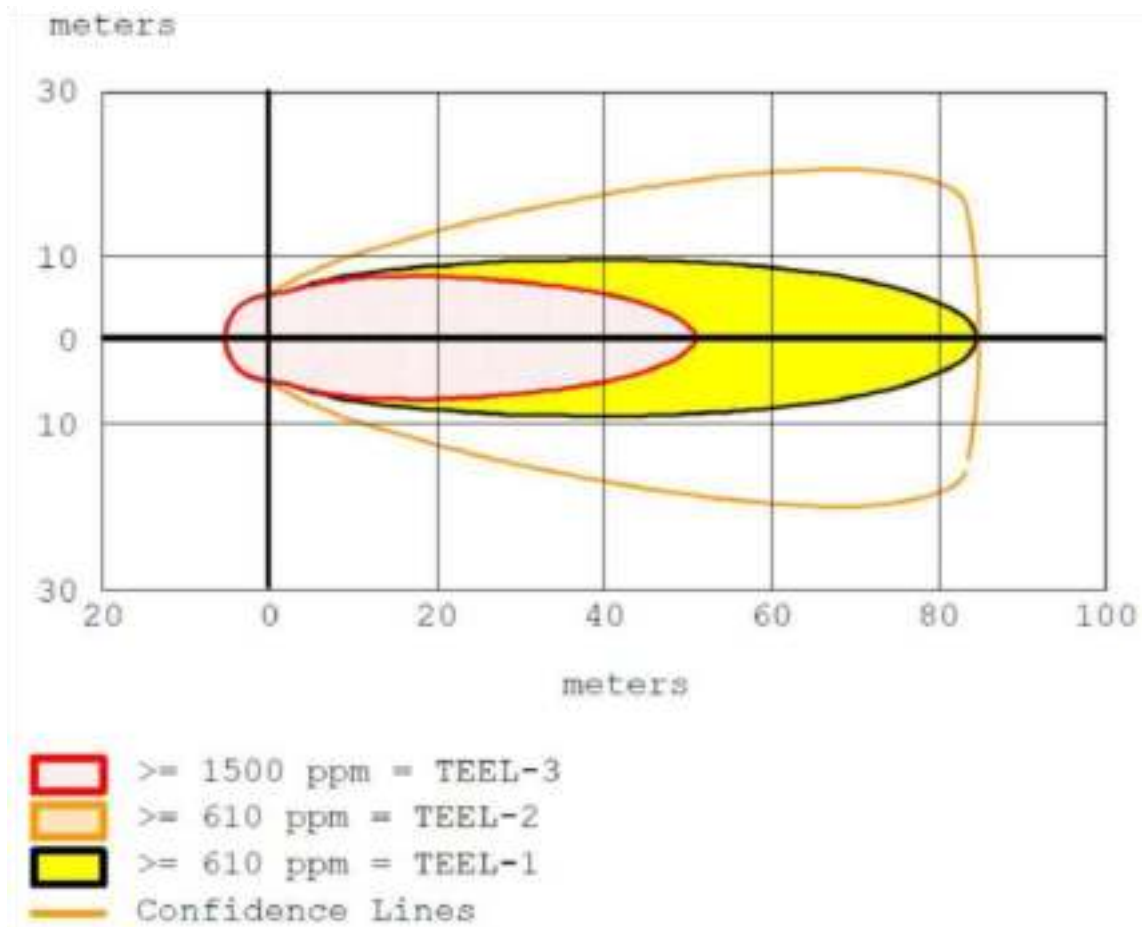
20.1.13.5 Instantaneous Release – Overpressure (Graph)



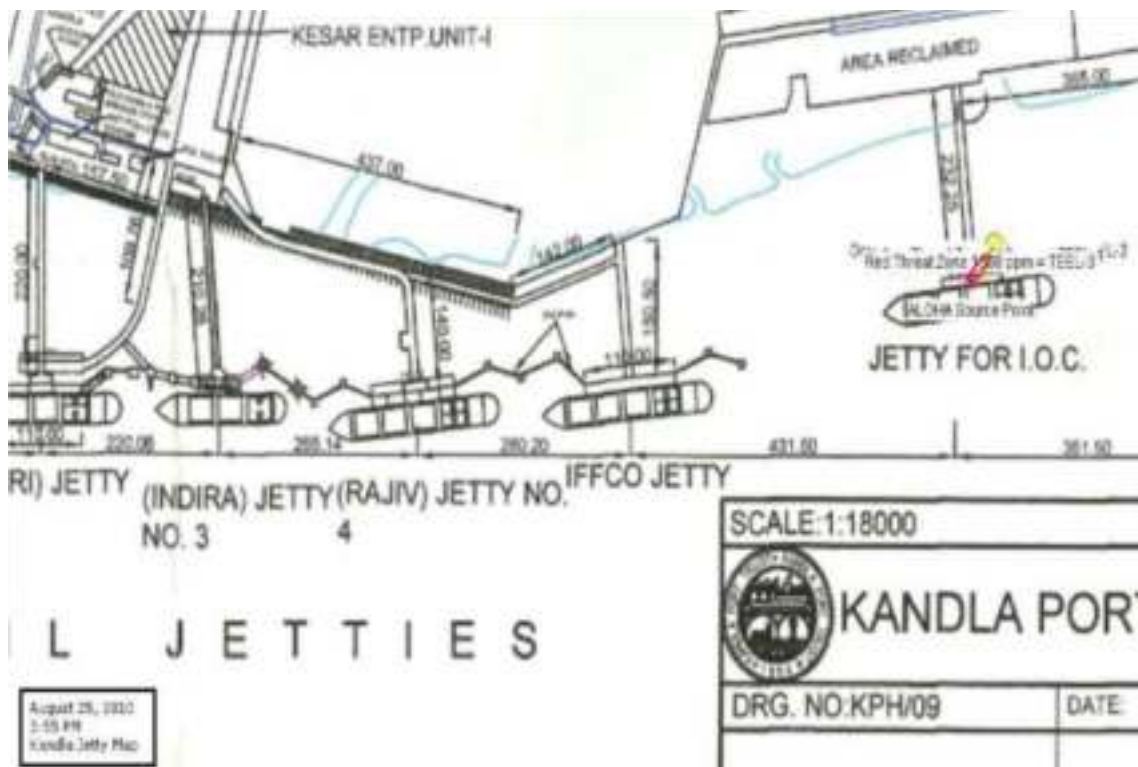
20.1.13.6 Instantaneous Release – Overpressure (Contour)



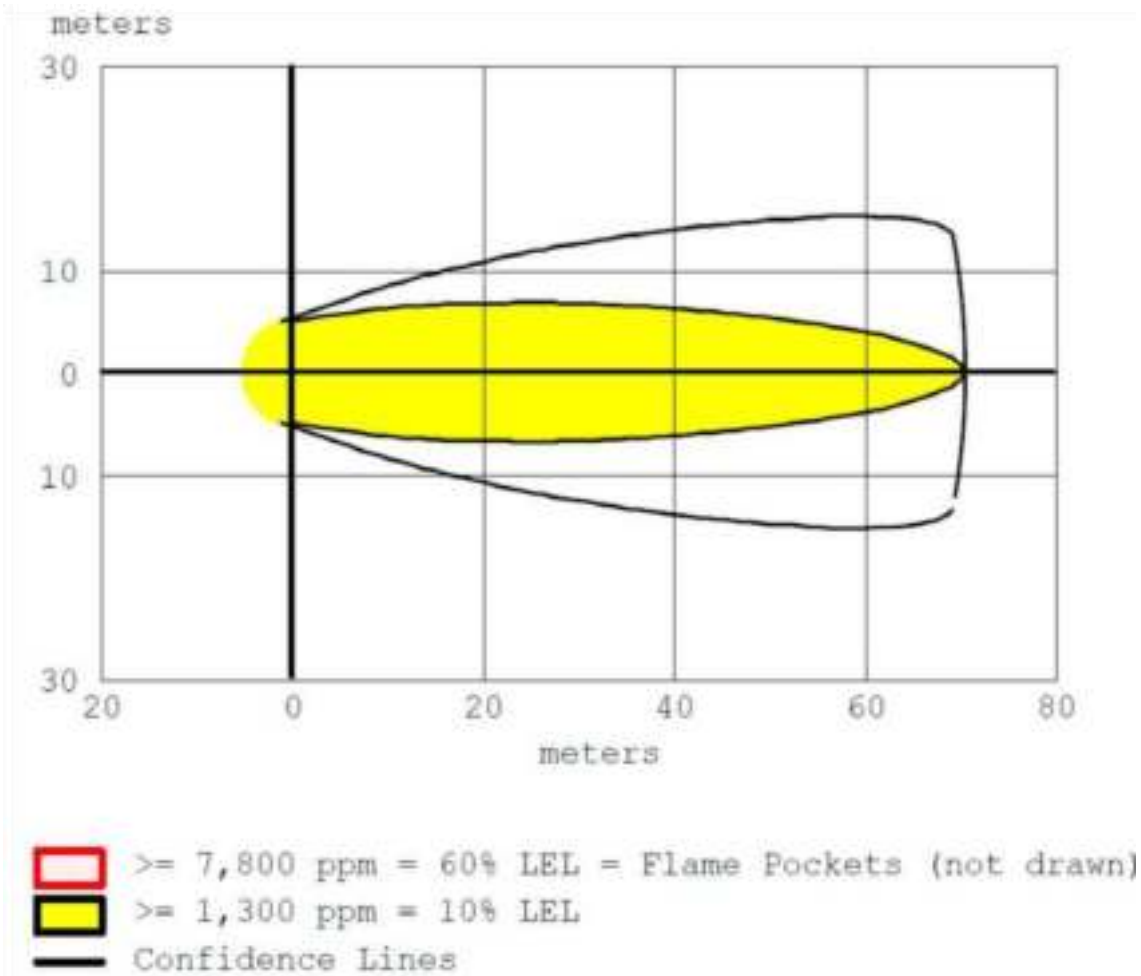
20.1.13.7 Evaporating Puddle – Toxic Threat Zone (Graph)



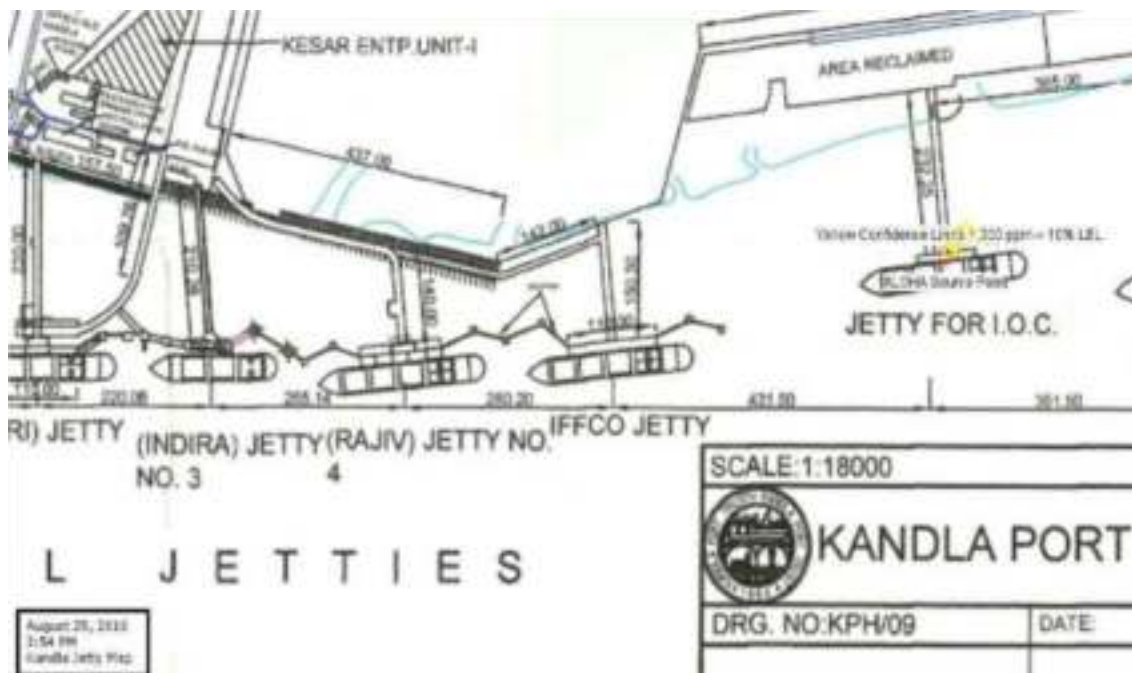
20.1.13.8 Evaporating Puddle – Toxic Threat Zone (Contour)



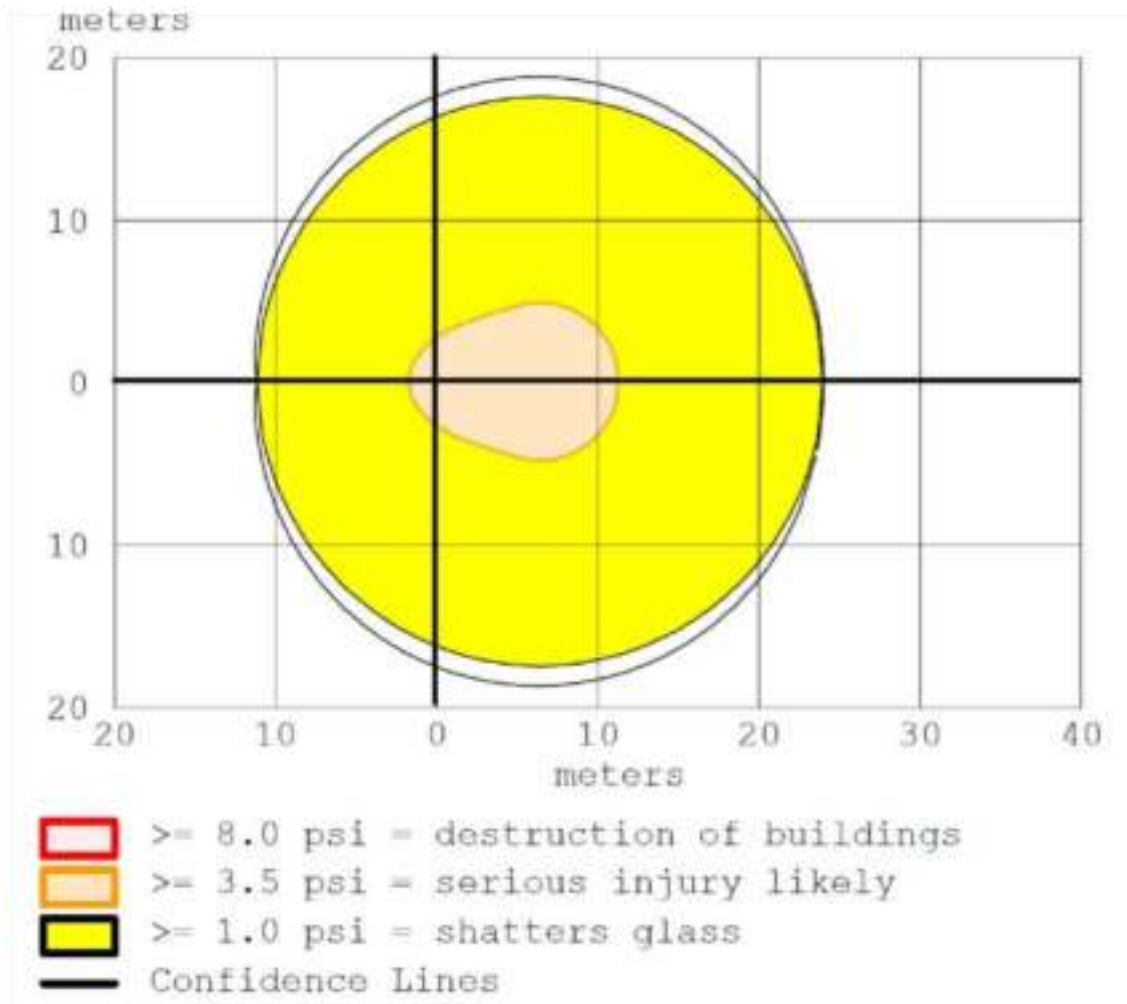
20.1.13.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



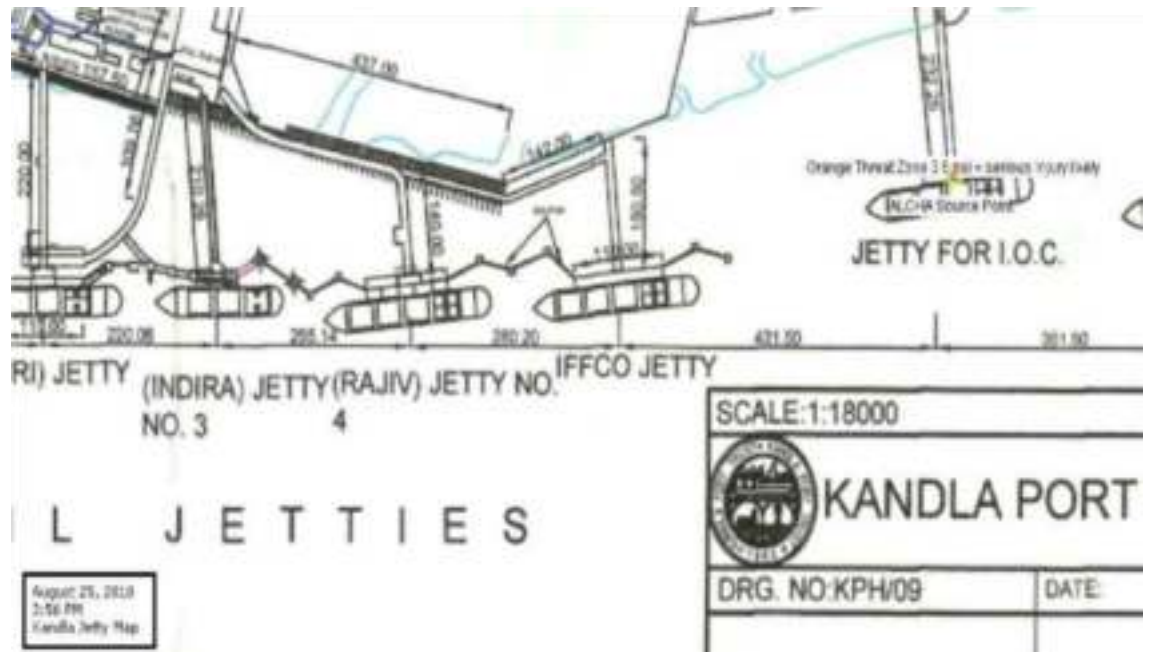
20.1.13.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



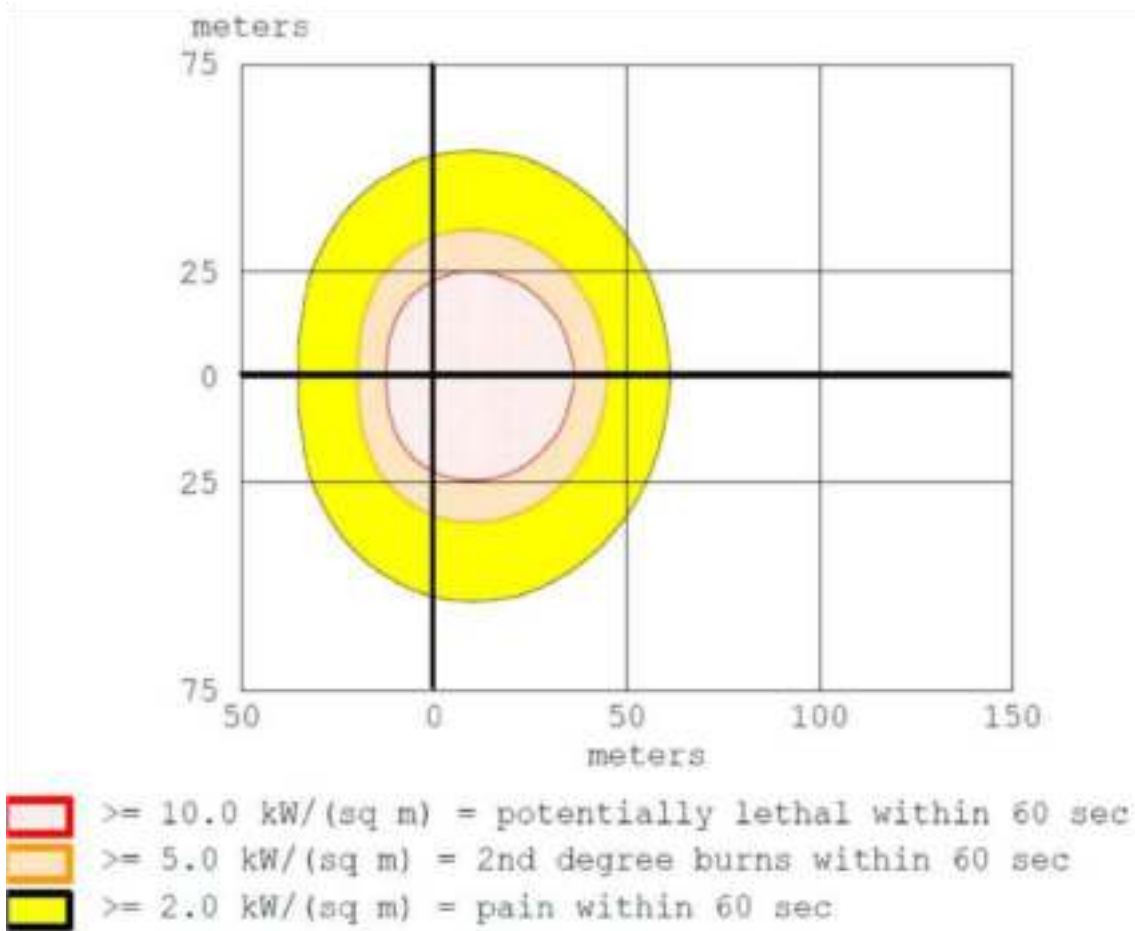
20.1.13.11 Evaporating Puddle – Overpressure (Graph)



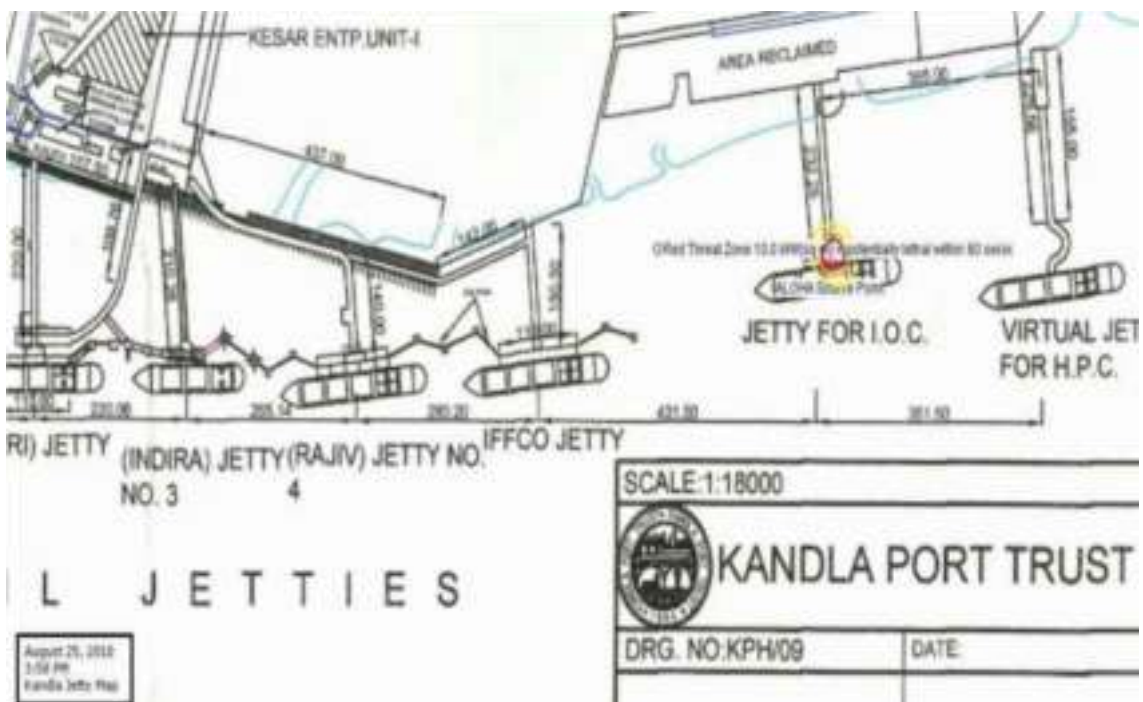
20.1.13.12 Evaporating Puddle – Overpressure (Contour)



20.1.13.13 Burning Puddle – Thermal Radiation (Graph)

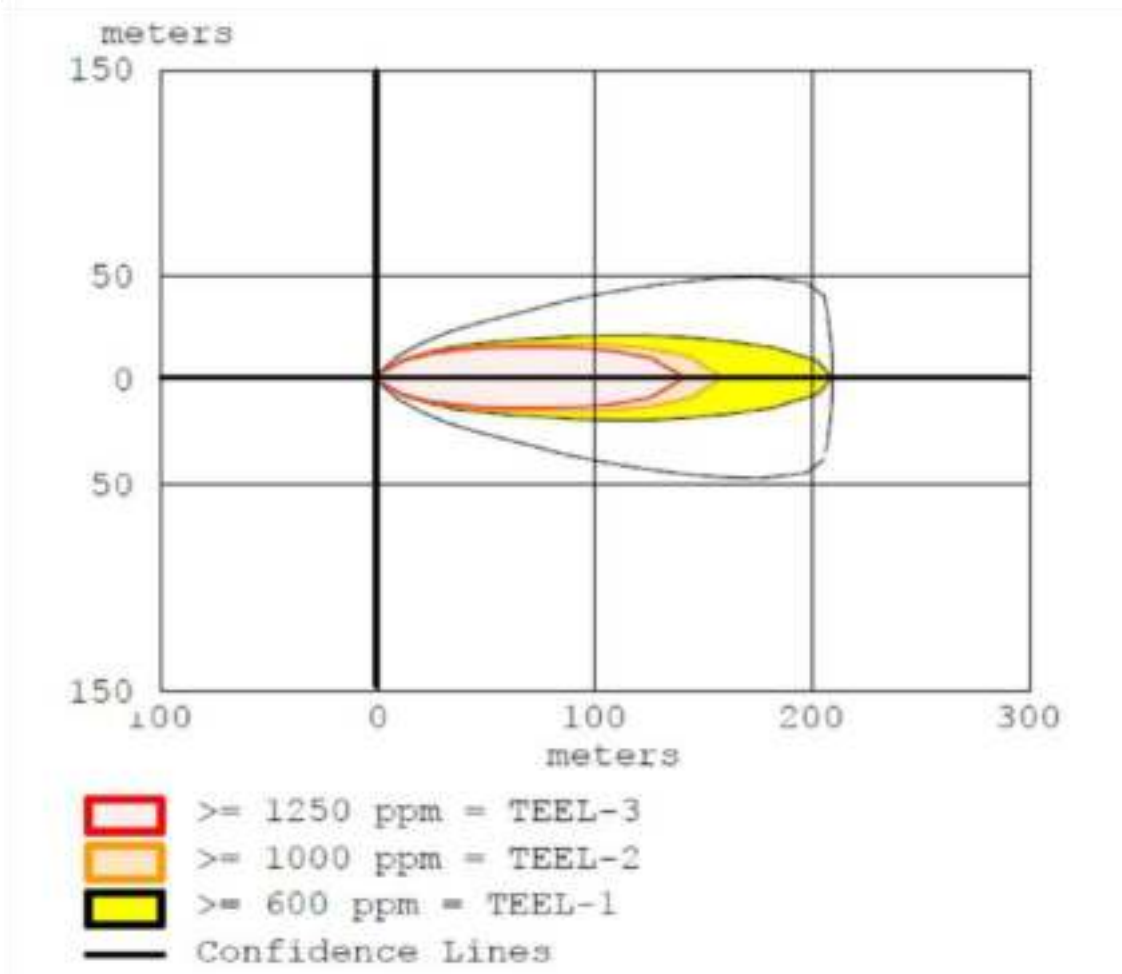


20.1.13.14 Burning Puddle – Thermal Radiation (Contour)

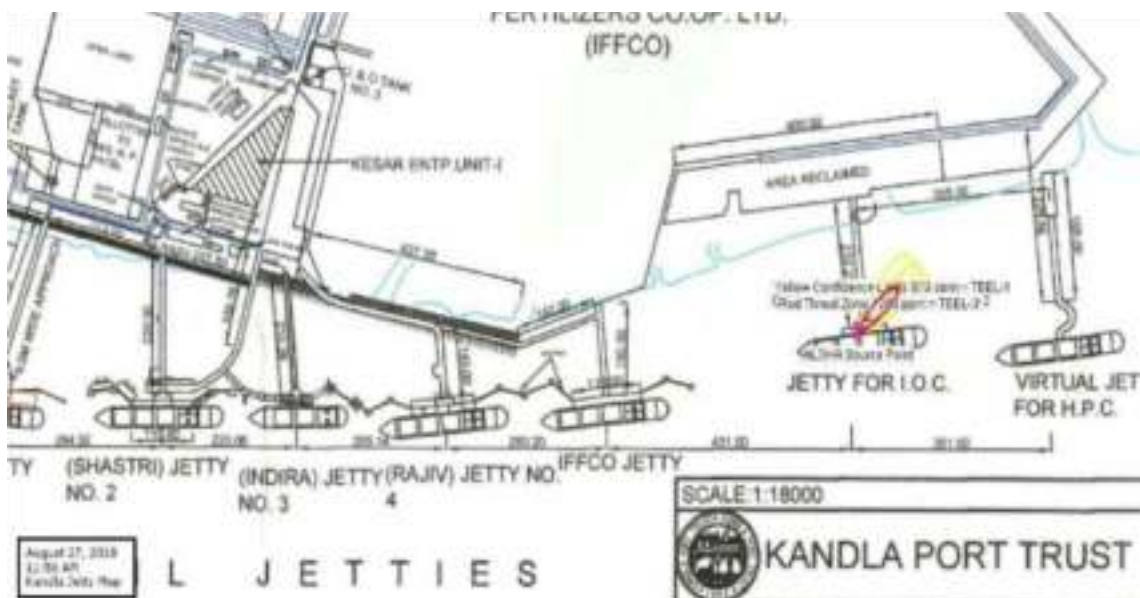


20.1.14 Jetty Six – Motor Spirit

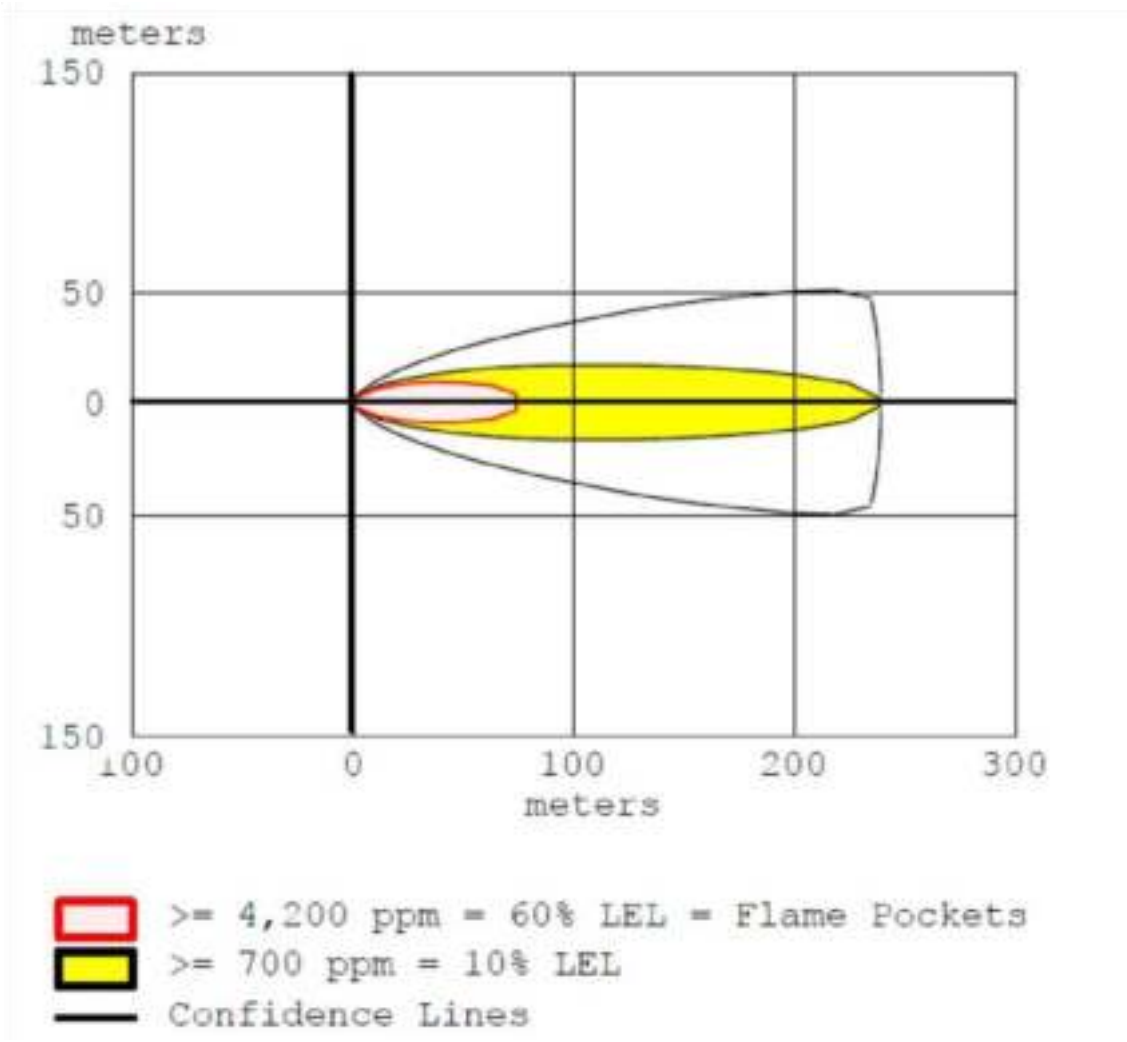
20.1.14.1 Instantaneous Release – Toxic Threat Zone (Graph)



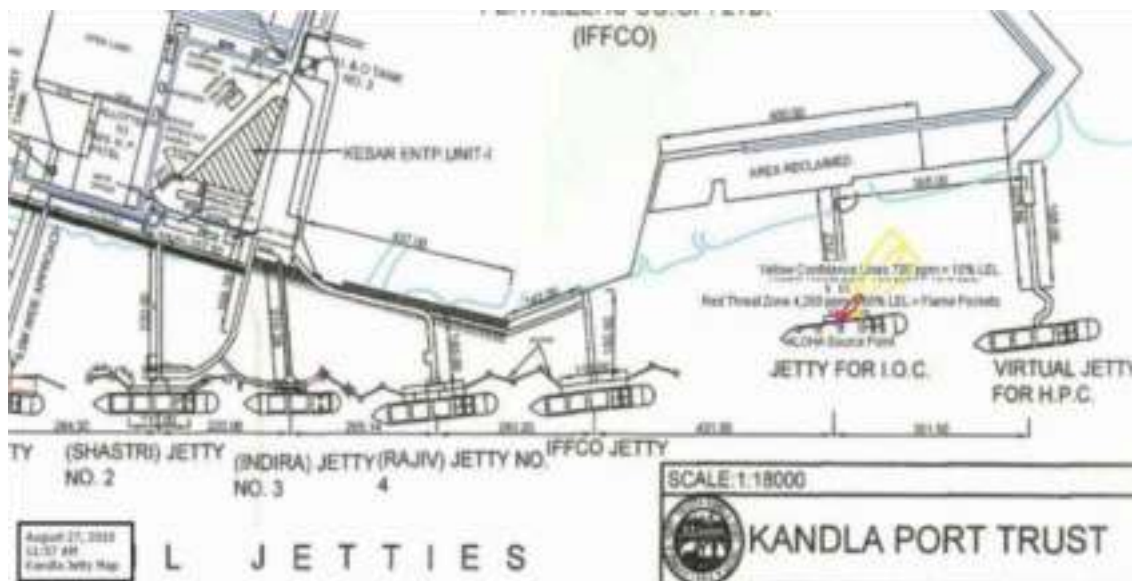
20.1.14.2 Instantaneous Release – Toxic Threat Zone (Contour)



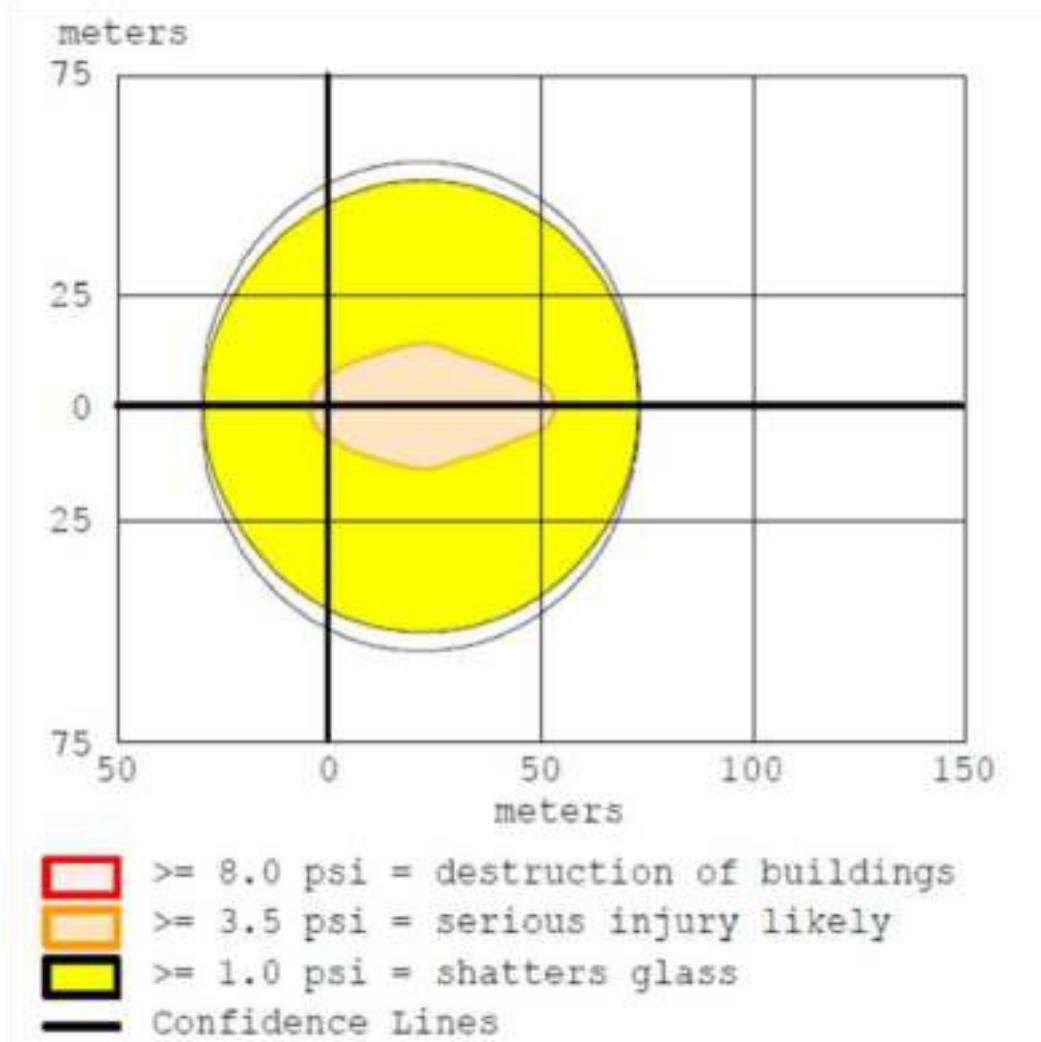
20.1.14.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



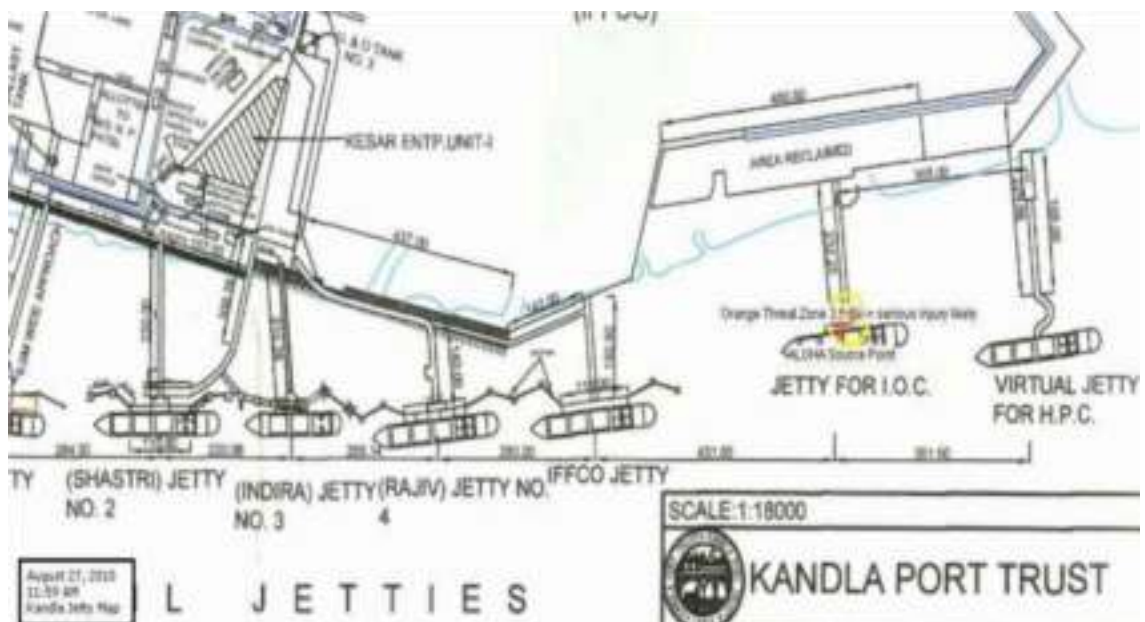
20.1.14.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



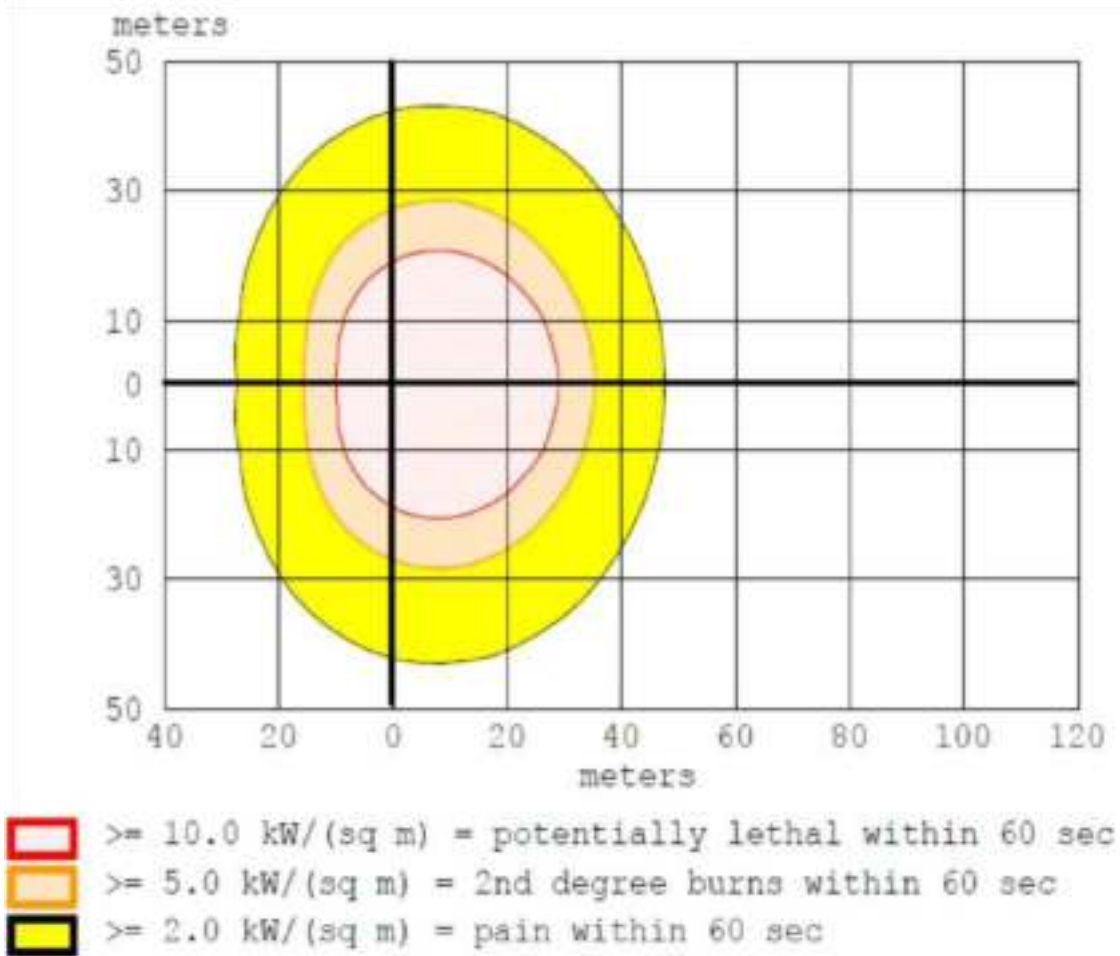
20.1.14.5 Instantaneous Release – Overpressure (Graph)



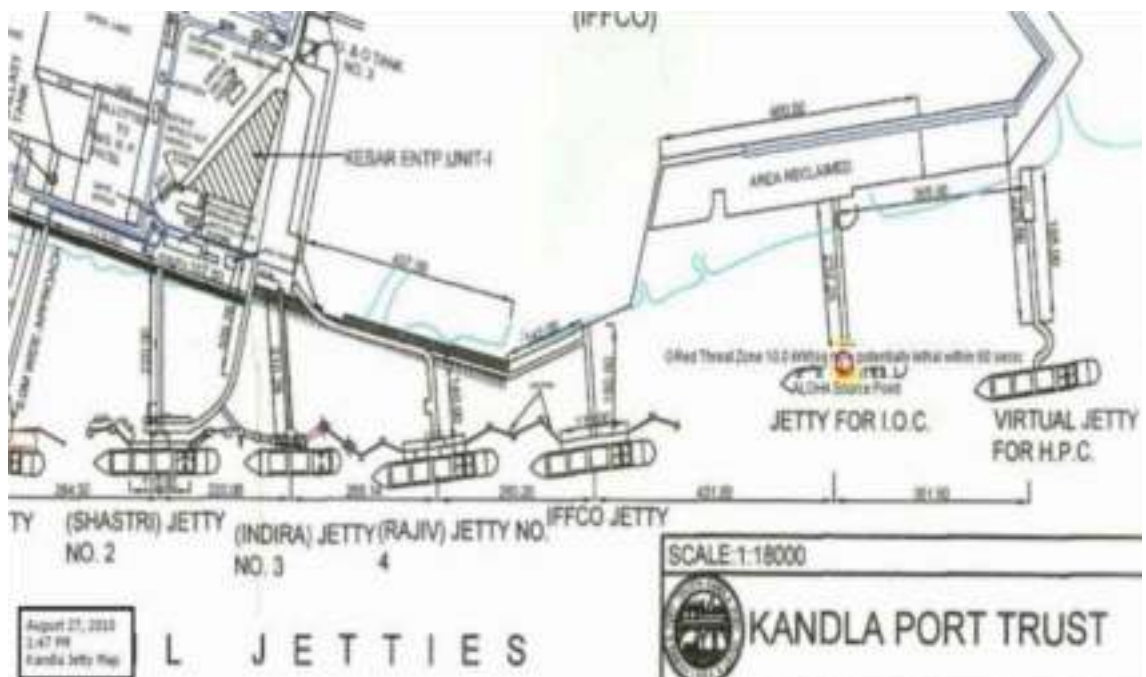
20.1.14.6 Instantaneous Release – Overpressure (Contour)



20.1.14.7 Burning Puddle – Thermal Radiation (Graph)



20.1.14.8 Burning Puddle – Thermal Radiation (Contour)



CBRN: Chemical Biological Radio Activity Nuclear related contingencies Dos & Donts

20 ANNEXURE Very useful telephone numbers

NDMA CONTACT DETAILS

**NDMA Bhawan,
A-1, Safdarjung Enclave,
New Delhi - 110029**
Telephones:
+91-11-26701700
Control Room: +91-11-26701728
Fax: +91-11-26701729
E-mail: controlroom@ndma.gov.in

NDMA CONTROL ROOM

Name	Office	Fax	Mob.	E.mail id
Control Room	011-26701728 011-1078	011-26701729	9868891801 9868101885	controlroom@ndma.gov.in , ndmacontrolroom@gmail.com ,

GSDMA

- **Block No.11 , 5thFloor, Udyog Bhavan , Sector-11 , Gandhinagar, Gujarat.**
- ***Email***

info@gsdma.org
- ***PHONE* +91-79-23259283**

21.1 Telephone Nos of Gujarat State District Collectors

No.	District	Collector Name	Phone	Fax
1	Ahmedabad (079)	Dr. Vikrant Pandey	(O)079-27551681	7927552144
2	Amreli (02792)	Shri Oak Aayush Sanjeev	(O)02792-222307	2792222710
3	Anand (02692)	Shri Dilip Kumar Rana	(O)02692-261575	2692261575
4	Arvalli (02774)	Shri Nagarajan M.	(O)02774-250200	2774250202
5	Banaskantha (02742)	Shri Sagale Sandip J.	(O)02742-257171	2742252740
6	Bharuch (02642)	Shri Ravi Kumar Arora	(O)02642-240600	2642240602
7	Bhavnagar (0278)	Shri Harshadkumar Ratilal Patel	(O)02782428822	2782427941
8	Botad (02849)	Shri Sujeet Kumar	(O)02849271301	2849271304
9	Chhotaudepur (02669)	Shri Sujal Jayantibhai Mayatra	(O)02669-233003	2669233002
10	Dahod (02673)	Shri Vijaykumar Lalubhai Kharadi	(O)02673-239001	2673239005
11	Dangs-Ahwa (02631)	Shri N.K. Damor	(O)02631220201	2631220294

12	Devbhumi Dwarka-Khambhaliya	Dr. Narander Kumar Meena	(O)02833232804	2833232102
13	Gandhinagar (079)	Shri S. K. Langa	(O)079-23220630	7923259040
14	Gir-Somnath-Veraval (02876)	Shri Ajay Prakash	(O)02876240001	2876243300
15	Jamnagar (0288)	Shri Ravi Shanakar	(O)02882555869	2882555899
16	Junagadh (0285)	Dr. Pardhi Sourabh Zamsingh	(O)0285-2630100	2852635599
17	Kachchh (02832)	Ms. Remya Mohan Moothadath	(O)02832250020	2832250430
18	Kheda (0268)	Shri S.B. Patel	(O)0268-2553334	2682553358
19	Mahisagar-Lunavada (02674)	Shri R.B. Barad	(O)02674-250664	2674250655
20	Mehsana (02762)	Shri H K Patel	(O)02762222211	2762222202
21	Morbi (02822)	Shri R. J. Makadia	(O)02822-240701	2822240701

22	Narmada-Rajpipla (02640)	Shri I.K. Patel	(O)02640222161	2640222171
23	Navsari (02637)	Dr. M. D. Modia	(O)02637-244999	2637281540
24	Panchmahal (02672)	Shri Udit Agrwal	(O)02672-242800	2672242899
25	Patan (02766)	Shri Anand Babulal Patel	(O)02766233301	2766233055
26	Porabandar (0286)	Shri M. A. Pandya	(O)0286-2221800	2862222527
27	Rajkot (0281)	Dr. Rahul Babubhai Gupta	(O)0281-2473900	2812453621
28	Sabarkantha (02772)	Ms Praveena D.K.	(O)02772-241001	2772241611
29	Surat (0261)	Dr. Dhaval Kumar Patel	(O)0261-2652525	2612655757
30	Surendranagar (02752)	Shri Kankipati Rajesh	(O)02752-282200	2752283862
31	Tapi-Vyara (02626)	Shri R.S. Ninama	(O)02626224460	2626221281
32	Vadodara (0265)	Ms. Shalini Agarwal	(O)0265-2433000	2652431093
33	Valsad (02632)	Shri C.R. Kharsan	(O)02632253613	2632243417

21.2 District Level Authorities

District Collector Office
Near Circuit House, Mandvi Road,
Nr. Mota Bandh,
Bhuj,
Gujarat - 370001

- +91 2832 250650
- +91 2832 250430
- collector-kut@gujarat.gov.in

Emergencies

District Helpline
Call : +91 2832 1077
District EOCs Helpline No.
Call : +91 2832 250650

Commissioner of Rescue & Relief
Call : 1070

Shri R. M. Thakkar

Dy. Mamlatdar Disaster

+91 2832 250923

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Upgraded Emergency Plan/ DMP for Kandla Port Gandhidham (Kutch)

MP Bhuj		252595	251177
Dy. Collector, Anjar Mob. 9825228049		243345	243363
Shri N. C. Rajgor Mamlatdar, Anjar +91 2836 242588 mam-anjar@gujarat.gov.in		242588	243362
Shri J. S. Sindhi (I/C) Mamlatdar, Gandhidham +91 2836 250270 mam-gandhidham@gujarat.gov.in		250475 250270	222875 250475

Collector, Jamnagar		2555869	2554059
Collector's Control Room, Bhuj. Mehul Padharia Kutch District Project Officer Officer 02832- 252347 09557920767 02832- 224150 mehul.nitb04@gmail.com District Project Officer Disaster Risk Management Program, District Emergency Operation Center(DEOC) , Emergency Operation Branch, Collector Office, Kutch		2252347 2231733 02832- 252347 09557920767 02832- 224150	-
Doordarshan, Bhuj		2251107	
Dy. Mamlatdar, Gandhidham		250475 250270	
Civil Defense, Gandhidham		220221	
PGVCL, Gandhidham		221728 222809	
GW&SB, Gandhidham		220975	
GSRTC, Gandhidham		220198	
Duty Officer, All India Radio, Bhuj		222503	
State Information Dept. (Shri Antani)		224859 250954	253034 252855
Air Force Duty Officer, Bhuj		252501 252502	
Air Force, Bhuj		223450	
Air Port, Bhuj		254550	
Aerodrome Officer, Kandla		238370	223247
Indian Navy, Jamnagar		550263 to 5	550825
Air force, Jamnagar		550245 to 7	550247

21.3 List of Telephone Numbers of Gujarat Maritime Board

Sr. No.	Name, Designation and place of Office	Tele. No. (Office)	Tele. No. (Residence)	Fax No.
1	Chairman, G'nagar	23250508 23250506		079-23250589
2	VC&CEO,Gandhinagar	23238363	23262280	23234703
3	Chief Nautical Officer, Gandhinagar	23238346-47		-do-
4	Chief Engineer(C), Gandhinagar	23238346		-do-
5	Officer on Special Duty, Gandhinagar	23238346	079- 2323232	-do-
6	Exe. Asst. to VC&CEO, Gandhinagar	3238363	7451465	-
7	Head Office, G'nagar	3238346 to 8	-	34703/04
8	Port Officer, Magdalla	0261- 2470533	-	2475645
9	Port Officer, Bharuch	02642- 241772	229082	220377
10	Port Officer, Bhavnagar	0278- 2519221	2568580	2211026
11	Port Officer, Jafrabad	02794- 245165		245152
12	Port Officer, Porbandar	0286- 2242408	2242412	2244013
13	Port Officer, Veraval	02876- 220001	242956	243138
14	Port Officer, Okha	02892-	262010	262002

		262001		
15	Port Officer, Jamnagar	0288- 2755106	2557163	2756909
16	Port Officer, Navlakhi Main Gate	02822- 220435		232470
17	Port Officer, Mandvi	02834- 220033	220040	230033
18	Traffic Inspector, Mundra	02838- 222136	222136	-
19	Executive Engineer(C), Jakhau	02831- 287261	222996	-
20	Gujarat Pipavav Port Ltd., Chief Operating Officer, Duty Office	02794286314 86001/92	286070	-
21	Gujarat Adani Port Ltd., Mundra.	02838- 288201 to 8	287241	-

21.4 For supply of Food Packets etc. following agencies to be contacted.

Sr. No.	Name of Agency	Contact Person	Telephone No.
1	Arya Samaj Mandal	Mr.Vachanidhi	231223 Mob. 9824221332
2	Agrawal Samaj	Mr.Dinanath	231638
3	RSS	Mr. Sunil Kothari	222560 / 232909
4	Lions Club, Gandhidham	Mr. Naresh Bulchandani	220212 Mb: 982428470

5	Rotary Club, Gandhidham	Mr. Rajabhai / P.K. Mukherjee	228213 / 232035
6	Red Cross Society	Dr. Bhavesh Acharya	234854, 232736
7	Lohana Mahajan, Gandhidham	Mr. Premji Bhai Thakker	220925
8	Rajasthan Yuva Mandal	Mr. Sunil Bajaj (President) Mr. Dilip Jain	221459 / 230902 234525 / 9825168170
9	Swaminarain Mandir	Mr.Lavjibhai Thackker	231555, 233666
10	Sindhi Youth Circle	Mr.Vijay Khubchandani & Mr.Kundabhai	220490
11	Satwara Samaj	Mr.Agavjibhai	235659
12	Sitaram Parivar	Mr.Mohanbhai Dharsi	222373, 234603
13	Gurudwara, Gandhidham		220643
14	Swaminarayan Gurukul	Swamimukta Prasadji	228098, 226555

21.5 Apart from the above, if required, the following hotels may be contacted for the supply of food packets:-

Sr. No.	Name of Hotel	Contact Person	Telephone No.
1	Shiv	Mr. Nagendra Singh / Mr. Bharat Singh	237712-13-14-15, 221297
2	Sharma Resorts	Mr. Madan Mohta / Mr. J. Gonasaives	31824/231823/231825/ 224885-86-87-88-89

3	Satkar	Mr. Babu Bhai Agrawal	234100/222597 234101 (R)
4	Natraj	Mr. Maulinbhai Acharya	221749/221956/221955 221954/238002
5	President	Mr. Rameshbhai	220053/229364/238002
6	K.K.Caterers	Kaniyalal Rajwani	(O) 227419, (R) 224995, (Mob) 9825226998
7	Bhawani Caterers	Mr. Hukamsinh Purohit	230366(PP)
8	Hotel Mid-Town, Adipur	Mr. Nagendra Singh	9825226568 260237/260080
9	Hotel Sea-Rock, New Kandla	Mr. Vithal Shetty	270490

21.6 List of Labour contractors operating at Kandla Port

Sr. No.	Name of the Company	Contact person	Address	Contact Nos
1	Neelkant Handling A/c Shree Radhey Shipping	Haresh Bupendra	Tenament B Plot 290, Ward 10/A, G'dham	237040 9825001743
2	Ratnakar Handling A/c Aditya Marine	Radhakishan Parida	83-84, GIDC G'dham	9879123371
3	Tirupati Handling Co.	Dayalal B. Rabari	6-8, Goyal Chamber, GIM	235504 9825056599

4	Al Pirani Al Sailani	Akbar Yakub	CS-10, Port Colony, Kandla	22053,232174 9979331100 9825787808
5	Shree Ravechi Handling A/c Trinity Shipping	Mahadeva Agaria	11,2nd Floor, Plot.343, Ward 12- B, GIM	250286 9825361347
6	Shree Ramdev Handling	Nimbaram Gulabji	377, Sector-7 GIM	9825348935 9979898564
7	AVB & Co	Mukesh Gujjar	15, GF, Gokul Park, GIM	232967
8	Ashapura Labour Supply	Khimji Jallabhai Rathod	48, GIDC, Near Ambika Weigh Bridge, GIM	9979053378 9898128069
9	Shree Krishna Handling	Harinder Yadav	E – 108, GHB ,Sec- 5,GIM	9879549803
10	Naasmin & Co	Umar Osman Chamadia	Plot – 14, Sector- 7, GIM	9898333397
11	M.S. Logistics	Asgar Haji Mungrani	Shop No. 5, Opp.CISF Gate,Kandla	9825241065 9913620407
12	Shree Majeesa Handling	Jugal Kishor Joshi	Block 24, MIG, Kidana, GIM	9879373992 9979898564
13	Shree Kailash Handling Co.	Mohanbhai Heera	Plot No. 7, Sector- 8, GIM	9825228555 9879288875
14	Javed Abu Saicha	Javed Abu Saicha Gani Patel	Shop – 13, Port Colony, Kandla	9825092748 9825563094
			Kandla	

15	Shree Ganesh Handling	Dayabhai Rabari	6-8, Goyal Chamber, GIM	9825056599
16	Bhupendra & Co	Mayur M Ahir	Plot 253, Ward 12/C, GIM	9727762191 9825225239

21.7 List of Doctors in Gandhidham Complex

Sr No	Name of Doctor	Telephone	Telephone	Mobile No
Consulting Physician (MD Medicine)				
1	Dr. Babita	261802	322111	
2	Dr. Gandhi C. K.	234561	230111	
3	Dr. Gonsair R. M.	230333	239944	
4	Dr. Johnson Samuel	222344	232244	
5	Dr. Morkahia V. L.	222008	232161	
6	Dr. Raiyani V. R.	230022	234214	9824241220
7	Dr. Sakaria S. B.	230114	230947	
8	Dr. Siju	230160	223852	
Dentist				
1	Dr. Asha Y. Parekh	234295	234451	
2	Dr. Ajay Bhimjiani	233347	260256	982544118
3	Dr. Chadotra M.	220142	237909	
4	Dr. Hitesh Sheth	226763	220965	
5	Dr. Kela B.V.	222094	231181	
6	Dr. Sanghvi V.K.	234979	223343	
7	Dr. Sharma R.	229211	227627	
8	Dr. Singh N.	230769	261343	

9	Dr. Soneta S.	236319	229172	
Dermatologist				
1	Dr. Jhala J.J.	223568	235567	
2	Dr. Deepak Sorathia	242882		9426909822
E.N.T. Surgeon				
1	Dr. Dave A.B.	221931 260394	260461	
2	Dr. Harani D.D.	222096	239121	9825227322
3	Dr. Khatri R.S.	222701	235959	9879195798
4	Dr. Maheswari S.K.	231874	250940	
M.B.B.S				
1	Dr. Acharya B.F.	220715	232736	9825210157
2	Dr. Acharya C.M.	220263		
3	Dr. (Mrs.) Acharya S.C	232606		
4	Dr. Agarwal B.B.	227767	570212	9825225599
5	Dr. Asher G.K.	239139	233765	
6	Dr. Bhadra D.M.		230259	
7	Dr. (Mrs.) Bhatia K.	260255		
8	Dr. C. Jonwal	220263	263987	
9	Dr. (Mrs.) Chellani	220099	270441	
10	Dr. Chudasama V.K.		240952	
11	Dr. Dasani M.G.	260001	261495	
12	Dr. Goswami S.K.	261399		
13	Dr. Guptabhaya D.N.	221305	231777	
14	Dr. Gurdasani V.S.	260674		
15	Dr. Harani H.C.	235369	239327	

16	Dr. (Mrs.) HitemathU.S.	261844	260097	
17	Dr.Joshi N.L.	260666	261661	
18	Dr. Kela H.V.	232069	232071	
19	Dr. Khushlani A.	260562	260738	
20	Dr. Leon A.	261802	262188	
21	Dr. Makwana	220263	263406	
22	Dr. Minocha Ravi	236306	232127	
23	Dr.Mehta H.K.	231590	235021	
24	Dr. Mehta J.R.	220164	220834	
25	Dr. Morbia V.M.	230011		
26	Dr. Parekh S.K.	260608	261123	
27	Dr. Puri R.P.	223355		
28	Dr.Rawal S.	235119		
29	Dr. Singh D.P.	221990		9825359928
30	Dr. Thakkar A. D.	220582	222829	
31	Dr. Thakkar H. M.	223506	222350	
32	Dr. Thakkar M. C.	260577		
33	Dr. Thakkar S. B.	221046 228267 221177	238467	
34	Dr. Vaccharajani N. D.	220088		
35	Dr. Vasudev Jethani	260577	261650	
36	Dr. Vora C. B.	223084		
37	Dr. Vadhwani Vjay	262076	262843	
38	Dr. Zola Mithubhai	260608		
39	Dr. (Mrs.) Raiyani P.V.	230022	234214	

40	Dr. (Mrs.) Singh R. D.	221990		
General Surgeon				
1	Dr. Ahir J. K.	237744		
2	Dr. Dasani D. G.	229231 227505	223346	
3	Dr. Gandhi R. G.	236700	229156	

4	Dr. Girdhani R. C.	233300	231219	
5	Dr. Jiladiya A.	220263	244844	
6	Dr. Joshi Y. V.	221557 230013	233324	
7	Dr. Naik S. K.	234333	231332	
8	Dr. Patel J .K.	230007		
9	Dr. Vora Chetan	224787	229369	9825225942

Obstetrician & Gynecologist

1	Dr. (Mrs.) Acharya N.B.	220715	232736	9825226700
2	Dr. Alpa D. Mehta	262599	265266	
3	Dr. Chandrakant Thacker	224488	225588	
4	Dr. Darshak Mehta	220263	265266	9824211534
5	Dr. (Mrs.) Gor A. A.	235135	239635	
6	Dr. Khanchandani	260833	260839	
7	Dr. (Mrs.) Kaur J. P.	229655	220673	
8	Dr. (Mrs.) Naik P. S.	234333	231332	
9	Dr. (Mrs.) Patel M. H.	230202	230353	

Ophthalmic Surgeon

1	Dr. Gor A.	235135	239635	
2	Dr. Masand S. N.	220139	234187	9825196989

3	Dr. Parikh Y. B.	234295	234451	
Orthopedic Surgeon				
1	Dr. Hotchandani	220039	261530	
2	Dr. Patel H. A.	230202	230353	
3	Dr. Sailesh Ramawat	230160		
4	Dr. Vachhani P. S.	230400	222400	
Pediatrician				
1	Dr. Dubal J. A.	232591	233777	
2	Dr. Jeswani R. M.	255689		9825229249
3	Dr. Majithiya M. S.	222413 222406	227134	
4	Dr. Rupesh Seth	260836	222397	
5	Dr. Naveen Thacker	230195	230894	
6	Dr. Nitin Thacker	221046	220615	
Pathologist				
1	Dr. Sukla K. L.	221611	234062	
2	Dr. (Mrs.) Pawde S. V.	230370	231352	
3	Dr. (Mrs.) Verma G. H.	229168	238386	
Psychiatrist				
1	Dr. Barot S.	221041	234885	
Radiologist				
1	Dr. Shah R. M.	222878 234215	222868 235868	
2	Dr. Bhupendra Shah	572824	227724	

21.8 List of Essential Services

HOSPITALS	OFFICE	RESIDENT
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1	General Hospital, Bhuj Civil Surgeon, Bhuj	222850	250554
2	Referral Hospital, Anjar	232455	
3	Rambaugh Hospital Gandhidham	220263	
4	Divine Life, Adipur	261802	
5	Railway Hospital Gandhidham	231874	
6	Government Dispensary dipur	260608	
TELECOMMUNICATION			
1	General Manager, BSNL, Bhuj	253000	252322
2	Dy. Manager, Bhuj	252505	251505
3	Area Manager, Gandhidham	238000	235000
4	SDO, Gandhidham	236250	236251
ELECTRICITY			
1	S.E., PGVCL, Bhuj	222550	250189
2	Jr. S.E., Anjar	243008	242656
3	XEN, Anjar	242845	242446
4	Dy. Engineer, Gandhidham	222809	--
5	Line Office, Gandhidham	221728	
WATER SUPPLY			
1	S.E., GWS&SB, Bhuj	221806	250601
2	XEN, Bhuj	250685	253016
3	SE, Anjar	242416	242421
4	XEN, Gandhidham	220717	223273
5	Control Room, Gandhidham	221252	

6	Water Tank, Sunderpuri	231313	
7	Water Tank, NU-4	654564	
8	Gandhidham Municipality	231610	
9	Chief Officer, Gandhidham Municipality	234967	

21.9 List of Vehicle Suppliers

Sl. No	Name of Institution	Contact Person	Parking Place	Name and Phone No.	Availability
			Phone No.	of Driver	Vehicle.
(A) Vehicle Hire Contractors					
2	M/s Rohit Enterprise /RISHABH ENTERPRISE	Mr. Rohit Shah 228550/237538 237547 (O) 234140 (R) Mob.982522512 1			
3	M/s Jai Somnath Travels (GIM)	Mr. Mishra Mob.982538673 9			
(B) Ambulance Pool					
01	St. Joseph Hospital, Gandhidham	Administrator 230160/229336	Hospital Premises	Driver available round the clock	First come first serve

02	IFFCO-Kandla on contract, Dispensary No. 20164 Dr. Mehta (R) 220832 Plant. Dispt. 270832	Mr. Mukesh Agrawal Hotel Gokul 221311			First come first serve
03	Kandla Salt Mfg. Ass. Neelkanth Bldg.	Mr. Shamji Ahir 231485 (R) 222765/220421 (O)	Zanda Chowk	Driver available round the clock	First come first serve
04	Zhulelal Mandir Trust	Mr. Kundan Guwalani 221760 (R) 229800 (O) Kundan Stores 221533/227800 229580	Mandir Premises	255580	
05	Red Cross Society	Dr. B F Acharya 225636/230345	Red Cross	Driver available round the clock	
06	Western Railway, Gandhidham	Medical Supdt. 231874 (R)	Hospital		
07	Rambaugh Government Hospital	220263	Hospital Premises	Driver available round the clock	
				clock	

08	Gautam Frei Pvt Ltd.	Mr. Ramesh Proprietor 232605/220163, 230345 (O)	GIDC Work shop Sector10C, Plot No. 24.		First Come First Serve
09	Sindhu Sewa Trust, Samiti Adipur	Mr. Jotwar (R) 260836, 260698 TBX-45, Adipur	Hospital Premises	Driver round the clock residence in hospital (Break duty at present)	
10	Tolani Eye Hospital	1. Supd (O) 260497 (R) 260773 2. Vic Chairman (C) 260373 Mr. N Chandnani (R) 260456, Prabhu Chaya, Behind Prabhu Darshan	Hospital Premises	One driver in absence of compounder residing in hospital	First Come first Serve
11	Divine Life Society, Adipur	261802	Hospital Premises	Round the clock	
12	Atmaram Severam Charitable Trust	237759 Mok 9825225294	Gandhid ham	Round the clock	
13	Dev Smru Trust	222096/231073			

14	Mobile Morgue	229430/239965	Lions Club		
15	Shav Vahini/Mobile Mrogue	239965			

21.10 List of Clearing & Forwarding Agents at Kandla

A V Joshi & Co Tel. 232605, 232227, 230345	C. Jivram Joshi & Sons (Gujarat) Tel. 220621 Fax. 231141
Fax. 233924 Mr. Harshandu Mr. Vaidya (Mob.) 9825226013	Mr. Sunil Chowdhari (Mob) 9825225400
ACT Shipping Ltd Tel. 270111/12/13, 270530, 220407 Fax. 270579, 232175	Cargo Movers Tel. 220453, 230883, 270563 Fax.231687
A. Jaswantrai & Co. Tel. 222630, 222717, 222145, 221943 Fax. 232308, 270385	Cargo Clearing Agency (Gujarat) Tel. 221721, 221674, 220655, 270542 Fax. 233034
Asia Shipping Services Tel. 230954. Fax. 231285	Chinubhai Kalidas & Brothers Tel. 232284 Fax. 231881
Airol Shipping Services Tel. 230080, 220180. Fax. 236131	CAP Shipping Pvt Ltd Tel. 221460, 232081 Fax. 233734
Aarpee Clearing Agency Tel. 222614. Fax. 255252	Centrans Shipping Agency (I) Pvt Ltd Tel. 256854 Fax. 234074
Ashirwad Clearing Agencies Tel. 232426, 233245 Fax. 234107	Cargo Shipping Tel. 270802, 270803 Fax. 270802
Ambalika Enterprises Tel. 255382. Fax. 255577	C. Joshi & Sons Tel. 221094

Ashmka Shipping (Tel. 222481)	Dilip A Goplani Tel. 224082, 255423 Fax. 224082
Ashis Enterprise (Tel. 234722)	D.B.C. & sons Gujarat Pvt Ltd Tel. 270263, 270348, 270503 Fax. 270631
Anchor Shipping Tel. 235781 Fax. 235781	Damjidhiroo & Sons Tel. 222329, 221328 Fax. 230139
B N Thakkar & Co., Tel. 222293, 222285, 270239 Fax. 230556	Dvji Premji Punara & Sons Tel. 222057, 221338 Fax. 230139
B. Devchand & Sons Pvt Ltd Tel. 232220 Fax. 234014	Express Transport Pvt Ltd Tel. 220193, 220179, 270591, 222565 Fax: 220193
Benits Forwarders Pvt Ltd Tel. 221707, 222086 Fax. 223151	Friends & Friends Shipping Pvt Ltd Tel. 232227, 231588 Fax. 233924
Blue Sea Shipping Agencies Tel. 235317 Fax. 255221	Fast & Fair Company Tel. 255254, 238175 Fax. 255254
Bhanu Clearing Agency Tel. 256861 Fax. 256861	Flamingo Shipping & Forwarding Pvt Ltd Tel. 256755, 257756 Fax. 256755
Global Marine Agencies Tel. 222928, 223196, 223252 Fax.255418	Liladhar Passoo Forwarders Pvt Ltd Tel. 252288, 252297, 252402, 252617 Fax. 252383
Gayatri Shippers Tel. 230692, 223292 Fax. 230818	Lalbahi Trading Company Tel. 222139
Hiral Enterprise Te. 255644	Leap Forwarders Pvt Ltd Tel. 255530, 255509 Fax. 252383
Hindustan Shipping services Tel. 255644, 222821 Fax. 256618	Link International Tel. 255206/07 Fax. 255530

Hardip Shipping Logistics Pvt Ltd Tel. 232909, 222560 Fax. 232909	Lexicon Shipping Agencies Pvt Ltd Tel. 229951- 53 Fax. 229949/50
Hansraj Pragji & Sons Tel. 221650, 255228 Fax. 255228	Logistics Enterprise Pvt Ltd Tel. 255157, 255458 Fax. 255520
H K Dave Pvt Ltd Tel. 221504, 2333632 Fax. 230411	Mathuradas Narndas & Sons Forwards Pvt Ltd, Tel. 252224, 252350, 252115 Fax.252221
Intralink Clearing & Forwarding Tel. 255188 Fax. 23148	Magal Singh & Company Tel. 224030, 255253, 234688
J M Baxi & Co. Tel. 270630/35, 270148/50, 270525 Fax. 270616	Meridian Shipping Services Tel. 233981, 255362 Fax. 230701
Jesia Mistry Agencies Pvt Ltd Tel. 222317, 223317	Megha Shipping Agency Tel. 222671, 255304 Fax. 230937
Jaisu Shipping Company Pvt Ltd Tel. 270428, 270128/538 Fax.270556	Mayur Forwarders Pvt Ltd Tel. 222671, 255304 Fax. 230937
Jivanlal Laloobhai Tel. 220308, 230530 Fax. 231640, 233803	Maritime service Pvt Ltd Tel. 222671, 255304 Fax. 255304
Krishna Clearing Agency Tel. 223813, 230501 Fax. 233135	Marathon Shipping Combine Tel. 222202, 230106 Fax. 255220
Kiran Roadlines Tel. 232297, 231984, 234108 Fax.231422	Shiv Shipping Service Tel. 255568 Fax. 22256
Kandla Clearing Agency Pvt L td Tel. 232337, 223211, 223210 Fax.230402	Narendra Forwarders Pvt Ltd Tel. 232504, 231795 Fax. 256678
Kamat & Co. Tel. 223471, 232730, 232729 Fax. 255243, 270779	Natwar Parikh Industries Ltd Tel. 232628 Fax. 232628

K S Chaya & Co Tel. 256604 Fax. 230693	New Dholera Shipping & Trading Company Limited. Tel. 222637 Fax. 255329
Kashyap Shipping Ltd Tel. 220816 Fax. 230030	National Shipping Tel. 232319 Fax. 232319
Kanak Shipping & Transport Tel. 231314, 230543, 222059 Fax.221702	Navjeevan Enterprise Tel. 252611, 252360 Fax. 252515
IEE & Muirhead Pvt Ltd Tel. 231535/36 Fax. 231018.	N. G. Bhanushali & Company Tel. 233648, 256791 Fax. 256879
OTA Kandla Pvt Limited	Shivji Kanji & Company

Tel. 220145, 223241, 270450 Fax.223241	Tel. 230127, 223728, 223729 Fax.220308
Pravin Bhatt & Sons Tel. 224032, 230079 Fax. 230079	South India Corp. (Agencies) Limited Tel. 234646, 231494, 221276, 255209 Fax.234416
Prime Forwarders Tel. 234047, 232505 Fax. 231345	S J Thacker & Company Tel.255678,221745 Fax.230659
Purshotam Ramjee & Company Tel. 220354, 222287 Fax. 231754	Star Shipping Services Tel.255424,255425,235326(F)255426
Patel Handling Agency Tel. 221718, 224024, 231004, 270017 Fax. 231143	Shivani Shipping, Tel. & Fax.256836
P S Bedi & Company Tel. 223201, 222841 Fax. 255494	Sea Trans Shipping Agency Tel. 255564 Fax. 233228, 233517
Purshotam Chtrabhuj Thacker Tel. 222720	Seaster Shipping Services Tel. 255349 Fax. 232719
Prashant Shipping Tel. 255306, 223927 Fax. 223927	Seaway Shipping Services Tel. 234272 Fax. 232719

Pramukh Forwarders Tel. 255400 Fax. 232602	Star Clearing Agencies Tel. 230273, 255529, 222983 Fax.232719
P M Agency Pvt Ltd Tel. 232553, 233973, 236414 Fax.255413	S S Shipping Agencies Tel. 236605, 238283 Fax. 236605
Raj Shipping Service Tel. 233948, 232402 Fax. 231395	SPN Shipping Services Tel. 222453, 270733 Fax. 236605
Rajesh Shipping Service Tel. 255444, 255450/52, Fax.255151	Sierra Shipping Pvt Limited Tel. 255395 Fax. 232771
Rudra Shipping Service Tel. 220429, 255317 Fax.255317	Sonal Enterprises Tel. 252666, 252053
Rishi Shipping Tel. 220813, 229830, 2555661/2/3 Fax. 238943, 255522 Mr. B K Mansukhani (M)9825225170	S R Clearing Agency Tel. 232974, 255494 Fax. 255494
Rudraksh Shipping Service Tel. 235937 Fax. 255582	St. John Freight System Limited Tel. 235414, 236444 Fax.235414
Sanghvi Freight Forwarders Pvt Ltd Tel. 234993, 234995, 222401 Fax.230508	Siddi Shipping Services Tel. 232356, 230268 Fax.256712
Sri R K Shipping Pvt Ltd Tel. 232028, 231940, 231936 Fax. 232740	Spalsh Shipping Pvt Limited Tel. 255562, Fax. 220710
Shakti Enterprises Tel. 223531, 221591 Fax. 233898	Thakarshi Madhavji & Sons Tel. 255457, 255458 Fax. 221770
Shree Ambica Commercial Company Tel. 220213, 221253	Trinity Shipping & Allied Services Pvt Ltd Tel. 223703, 230911 Fax. 232060

Shri Maruti Shipping Services. Tel. 270760, 256853, 233245 Fax.220308	Tokto Shipping Services Tel. 234040
Unity Shipping Tel. 255271	Vinson Tel. 220466 Fax. 231948
Umiya Shipping Agency Tel. 255640 Fax. 233625	Vaz Forwarders Ltd Tel. 235317 Fax. 255221
Unique Forwarders Tel. 230080, 255417 Fax. 236131	Varsh Shipping & Travels Tel. 222386, 255300 Fax. 255300
V. Arjoon Tel. 221049, 221335, 222058, 223307 Fax. 234167	Venus Clearing Agency Tel. 233960 Fax. 233362
Velji Dosabhai & Sons Tel. 270220, 270025, 221818, 231423 Fax. 270164, 232363	Vishal Shipping & Handling Tel. 223960 Fax. 233362
Vishvajyoti Enterprises Tel. 252381, 252318 Fax. 253091	Worldwide Cargo Care Pvt Ltd Tel. 221290, 221479, 220307, 230217 Fax. 231913
Velji P & Sons Tel. 255327, 231545, 231546, 270976 Fax. 255328	Zenith Trade Link Tel. 223193 Fax. 255522
Vailash Transport Co. Tel. 233579, 223580	

21.11 Surveyors at Kandla

Adnuralty Marine Services Tel. 235412, 256813 Fax. 256813	Marine Consultants & Surveyors Pvt Ltd Tel. 255293 Fax. 234416
Capt. S. Kochar & co. Tel. 222247, 221084 Fax. 231357	Murray Fenton (India) Surveyors Limited Tel. 235960, 236238 Fax. 233335

Dr. Amin Superintendents & Surveyors Pvt Limited, Tel. 221520, 235636 Fax. 226527	M. M. Cargo Gear & Marine Surveyors Tel. 231385 Fax. 235255
Det Norske Veritas (DNV) Tel. 232712	M.B.S. Surveyors Tel. 256782
Geo-Chem Laboratories Pvt Limited Tel. 221841, 222179 Fax. 233743	Navark & Mareng Surveyors & Consultants Tel. 232123, 233270
G. P. Dave & Sons Tel. 234288 Fax. 234382	S.G.S. India Limited Tel. 221857, 238047, 231869 Fax.232883
Gupta & Associates Tel. 222542 Fax. 222542	S. K. S. Surveyors Assessors Tel. 220555
Inspectorate (India) Consulting	Seascan Surveyors Pvt Limited
Engineering Pvt Limited Tel. 221520, 235636 Fax. 255217	Tel. 221833, 233639, 221627 Fax. 233639
Indian Register of Shipping & Indian Register Quality System Tel. 238623, 233695 Fax. 233695	Sterling Surveyors Tel. 230216 Fax. 230216
Iteng Engineering Tel. 221520, 255429 Fax. 255247	Technomar Surveyors Pvt Limited Tel. 221966
J B Boda Surveyors Pvt Limited Tel. 231801, 231946 Fax. 231693	TCRC Surveyors Tel. 220862, 230050 Fax. 230050
Lloyds Register of Shipping Tel. 234068	Uni Lab (India) Surveyors and Superintendents Tel. 255503
Mitra S K Pvt Limited Tel. 222648	Universal Cargo Inspection Agencies Tel. 222542

Metcalfe Hodgkinsons Pvt Limited Tel. 220940, 221740, 233707, 221845 Fax. 231629	U Marine (India) surveyors Tel. 220070 Fax. 233228
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ANNEXURE-I**PARTICULARS OF THE ACTION PLAN COMMITTEE MEMBERS**

Sr. No	Name	Desgn.	Telephone Nos.			
			Office	Resi.	Fax	Mobile
1	Mr SANJAY MEHTA, IFS	Chairman	233001 234601	233002	235982	
2	Mr.	Deputy Chairman	234121	234218	236323	
3	Capt. T. Srivnivas	Dy. Conservator	233585	232806	233585	98252 32982
4	Mr. A. Krishnan	Dy. FA & CAO	220214	223854	-	98252 27036
5	Mr. R. V. Rajwani	Dy. FA & CAO	221648	226112	-	98793 70975
6	Mr. AJAY GUPTA	Sr. DD (EDP)	239623	234116	-	98252 27095
7	Mr. Bimal Kumar Jha	Secretary	220167	231939	233172	81410 84794
8	Mr.	Sr. Dy. Secy	220033	234730	-	98252 27480
9	Mr. Suresh Balan	Dy. Secretary	221375	236086	-	98252 27044
10	Mr.	Sr. Astt. Secy	221679	-	-	82380 37207
11	Mr.	SE(H) and OSD(Estate)	270429	235683		98252 25963
12	Mr. Y. K Singh	Personnel Officer	223828	228584		98252 27079
13	Mr.	Traffic Manager				
14	Mr. S. Krupanand Swamy	Sr. Dy.TM	270270	235100		98252 27049
15	Mr. Shankar Jivaji	Deputy TM	270324	234918		94264 51554
16	Mr. D. N. Sondhi	FA & CAO	233174	-	233174	98252 14726
17	Capt. S. K. Pathak	Harbour Master	270201	231310		98258 03499
18						
19	Mr. Sunil Kumar	Flotilla Supdt.	270280	226121		78746 27756
20	Mr. K. Varughese	FCSO	270176/ 78	227512	270176	98252 27041

21	Mr. SSP PATIL	Chief Engineer	233192	228777	220050	98252 27243
22	Mr	C.M.E.	270632	231043		
23	Mr.	Dy. CME	270426	226067	270184	98252 35196
24	Mr. N M Parmar	DY CHIEF ENGINEER	270787	252624		98252 27046
25	Dr. Kalindi Gandhi	Chief Medical Officer	225767 220072	225555	232288	98256 11208
26	Dr. Mahesh Bapat	Sr. MO	234598	228167		96876 07528
27	Shri CHAUDHRI	Sr. Commandant CISF	271037	229140	271037	98252 27282

THE TELEPHONE NUMBERS OF SOME OF THE VIPS

Sr. No.	Name and Designation	Fax / Mobile	Telephone (Office)	Telephone (Resi)
1	District Collector, Bhuj	02832-250430	250020	250350
2	Resident Add. Collector, Bhuj	250430 9978405099	250650	
3	Superintends of Police, Bhuj,	99784 05073	250444 250250	250850
4	Asstt. Supdt. Of Police, Bhuj		253405	250850
5	Dy. Collector, Anjar	99784 05079	243345	243345
6	Mamlatdar, Anjar		242588	243362
7	Mamlatdar, Gandhidham.	75670 03975	250475 250270	222875 250475
8	Traffic Manager, IOC	234396	231871	236442
9	Air Force Commander, Jamnagar		2550245	-
10	Collector, Jamnagar		2555869	2554059
11	Commandant, BSF, Gandhidham		223845	
12	Mrs. Vinod Chawda, MP, Kachchh	02832 - 225466 9825905467		
13	Mr. Vasan Ahir, MLA, Anjar	9825025148		
14	Dr. Nimaben Acharya, MLA, Bhuj	9825226700	220715	
15	Mr. Rameshbhai Maheshwari, Gandhidham	9909910619		
16	Mr. Tarachand Chedda, MLA, Mandvi	9825225394		
17	Mr. Pankaj Mehta, MLA, Rapar	9825227883		
18	Mr. <u>Shaktisinh Gohil</u> ,	95865 58120		

	MLA, Abdasa,			
19	Kum. Tulsi P. Anandani, SRC	260401	260404 260811	260631
20	Civil Surgeon, GK Gen. Hospital, Bhuj		222850	

ANNEXURE -III**IMPORTANT TELEPHONE NUMBERS OF
INDIAN METEOROLOGICAL DEPARTMENT**

Designation	Address	Office	Resi.	Fax
Director General	Mausam Bhavan, Lodi Road, New Delhi.	011- 24611842	011- 24633692	011- 24611792
		011-		011- 24619167

D.D.G.M. (C.W)	-do -	24611068		
D.D.G.M. (WF)	Met Office, Simla Office, Pune	020- 25535886	020- 25884104	020- 24623210 25893330 25535201
D.D.G.M.	RC Colaba, Mumbai	022- 22150517	22150417	
Director (ACWC)	-do-	022- 22150405	022- 22150452	
Director (I/c)	Met Center Ahmedabad	079- 22865012 22867206		079- 22865449
Met I/C	MET Centre, Ahmedabad	22861413		
Dr. Jayanta Sarkar,	Director I/C.	22865165, 22867657		

Websites

www.imd.emet.in

www.imdmumbai.gov.in

DISASTER MANAGEMENT CELL

Chief Executive Officer,
 9978407002(M), 079-3259276(O)
 079-23254900(R)
 079-3259248(FAX)

ANNEXURE-IV**TELEPHONE NOS. OF STATE MINISTERS**

Sr. No.	Name and Designation	<u>Telephone Numbers</u>		
		Office	Residence	Mobile / Fax
1	Mrs. Anandiben Patel, Hon'ble Chief Minister, Block No.1, 5th Floor, Sachivalaya, Gandhinagar	O) 079 - 23232611- 19	(R) 079 - 23222020	(F) 079 - 23222101
2	Mr Babubhai B. Bokhiriya, Minister for Agri., Animal husbandary. Fisheries	079 - 23238109		079 - 23250133
3	Shri Sankarbhair Chaudhry Min. for Health & Family Welfare and Transport	079 - 23250193		079 - 23250145
4	Shri Ramanlal Vora Min. for Social Justice and Empower	079 - 23238078		079 - 23257973

	Department			
5	Shri Mangubhai C. Patel Forest and Environment, Tribal Development.	079 - 23250113		079 - 23250306
6	Shri Bhupendrasinh Manubha Chudasma, Education, Food and Civil Supplied.	079 - 23243389		079 - 23250120
7	Mr Saurabhai Patel, (Finance, Energy and Petrochemicals, Salt Industries, Tourism)	079 - 23238152	23250625	079- 23250215

OFFICIALS

Sr. No.	Designation	office		Fax
01	Chief Secretary, GAD	23220372		23250305
02	Principal Secretary, GAD	23250016		23222101
03	Addl. Chief Secretary, Port & Road Transport	23250506		23252132
04	Principal Secretary (Industries & Mines)	23250701		23250844
05	Principal Secretary (Labour & Employment)	23250871		
06	Addl. Chief Secretary (Home)	23250701		23250844
07	Principal Secretary (Energy & Petro-chemicals)	23250771		23250797
08	Principal Secretary (Finance)	23220286		
09	Principal Secretary (Revenue)	23251603		23251325

10	Principal Secretary (Education)	23251301		23251325
11	Chairman, GMB	23238346	23249356	

ANNEXURE - V**TELEPHONE NOS. OF GUJARAT STATE DISTRICT COLLECTORS**

Sr. No.	District	Office	Residence
1	Ahmedabad	27551681	22863595
2	Amreli	222307	222301
3	Anand	242871	261000
4	Banaskantha	257171	257007
5	Bharuch	240600	223701
6	Bhavnagar	2428822	2568866
7	Dahod	221999	221888
8	Dang	220201	220202
9	Gandhinagar	23220330	23254884
10	Jamnagar	2555869	2554059
11	Junagadh	2651202	2650203
12	Kachchh	250020	250350
13	Kheda	2550856	2556700
14	Mehsana	222200	253565
15	Narmada	222162	222161
16	Navsari	244999	246000
17	Panchmahal	242800	242900
18	Patan	233301	233300

19	Porbandhar	2243800	2243801
20	Rajkot	2463900	2172900
21	Sabarkantha	241001	223001
22	Surat	2471121	2471416
23	Surendranagar	282200	282201
24	Vadodara	2433000	2313131
25	Valsad	253613	253060
26	Vapi	224400	220221

Control Room (Earthquake, Gandhinagar):

3251914 / 3251910 / 3240339 / 3240303 (Fax)

ANNEXURE – VI

GUJARAT STATE DISASTER MANAGEMENT AUTHORITY
TEL. NOS OF SENIOR OFFICIALS

Sr. No.	Name and Designation	Office	Residence	Mobile
1	Dr.Ranjit Banerjee, IAS, Chief Executive Officer, GSDMA	079-3259276 Fax.0793259248		9978407002
2	Mr V.Thirupuzzah,IAS, Addl. CEO, GSDMA	079-3259502 Fax.0793259275	079- 6309273	9825095148
3.	Mr. H.N. Gamit,IAS, Director(Admn.)	079-3259278		9978407005

ANNEXURE –VII

DISTRICT LEVEL AUTHORITIES (EAST)

Name and Designation of Officer	Fax	Telephone Nos. (Office)	Telephone Nos. (Residence)
District Collector, Bhuj. 9978406212	250430	(02832) 250020	02832- 250350
Resident Add. Collector, Bhuj Mob.9978405099	250430	250650	
Mr. Deepakkumar Menghani (IPS) S. P.-(Purab),9978405690		280233	
Mr. C.R. Kotad, GPS Dy. SP (Anjar)9825304239	243254		
Mr. D.R. Agrawat(GPS) Dy. SP(HQ)9825225071			
Mr. Chirag Patel,(GPS) Dy. SP.9824543004	0837- 224040		
Control Room(DC-5)Purab	280287		
Mr. Vinod Chawda, M.P.,Kachchh		(m)	
Dy.Collector, Anjar Mob. 9825228049		243345	243363
Mamlatdar, Anjar Mob. 9879278174		242588	243362
Mamlatdar, Gandhidham 7567003975		250475 250270	222875 250475
Collector, Jamnagar		2555869	2554059
Collector's Control Room, Bhuj.		2252347 2231733	-
Dy. Mamlatdar, Gandhidham		250475 250270	9427719800
Civil Defence, Gandhidham		220221	

PGVCL, Gandhidham		221728 222809	
GW&SB, Gandhidham		220975	
GSRTC, Gandhidham		220198	
Duty Officer, All India Radio, Bhuj		221412	
State Information Dept. (Shri Sony) (m) 9879012714		224859 250954	253034 252855
Air Force, Duty Officer, Bhuj		252501 252502	
Air Force, Bhuj		223450	
Air Port, Bhuj		254550	
Aerodrome Officer, Kandla		238370	223247
Indian Navy, Jamnagar		550263 to 5	550825
Airforce, Jamnagar		550245 to 7	550247

ANNEXURE – VIII**List of Telephone Numbers of Gujarat Maritime Board**

Sr. No.	Name, Designation and place of Office	Tele. No. (Office)	Tele. No. (Residence)	Fax No.
1	Mr. Rajgopal, Chairman, Gandhinagar.	23250508 23250506		079-23250589

2	Mr. A. K. Rakesh VC & CEO,Gandhinagar	23238363	23262280	23234703
3	Chief Nautical Officer, Gandhinagar	23238346-47		-do-
4	Chief EngineerI, Gandhinagar	23238347		-do-
5	Officer on Special Duty, Gandhinagar	23238346	079- 2323232	-do-
6	Exe. Asst. to VC&CEO, Gandhinagar	3238363	7451465	-
7	Head Office, Gandhinagar	3238346 to 48	-	34703/04
8	Port Officer, Magdalla	0261-2470533	-	2475645
9	Port Officer, Bharuch	02642-241772	229082	220377
10	Port Officer, Bhavnagar	0278-2519221	2568580	2211026
11	Port Officer, Jafrabad	02794-245165		245152
12	Port Officer, Porbandar	0286-2242408	2242412	2244013
13	Port Officer, Veraval	02876-220001	242956	243138
14	Port Officer, Okha	02892-262001	262010	262002
15	Port Officer, Jamnagar	0288-2755106	2557163	2756909
16	Port Officer, Navlakhi Main Gate	02822-220435		232470
17	Port Officer, Mandvi	02834-220033	220040	230033
18	Traffic Inspector, Mundra	02838-222136	222136	-
19	Executive EngineerI, Jakhau	02831-287261	222996	-
20	Gujarat Pipavav Port Ltd., Chief Operating Officer, Duty Office	02794-286314 86001/92	286070	-
21	Gujarat Adani Port Ltd.,	02838-	287241	-

	Mundra.	288201 to 208		
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ANNEXURE – IX**POLICE AUTHORITIES**

Name and Designation of Officer	Telephone Nos. (Office)	Telephone Nos. (Residence)
PARIXITA RATHORE S. P. (Purab), 99784 05690	280233	
Dy. SP (Anjar)9825304239	243254	
Dy. SP(HQ)9825225071	243254	
Dy. SP.9824543004	224040	
Police Control Room,DC-5,Poorab, Gandhidham	280287	
Police Control Room, Bhuj	253593 / 250960	Fax – 250427

Dy. Supdt. Of Police, Anjar	02836-243254	242596
Dy. Supdt. Of Police – Bhachau	02837-224040	224020
Bhachau Police Station	02837-224036	
Anjar Police Station	02836 – 242517	242517
Gandhidham Police Station	A. 100/232500/ 229513 B. 233752	
Kandla Police Station	270527	
Adipur Police Station	260615	
Air Commander, Jamnagar	0288-2720003 -009	
Commandant, BSF, GIM	223845	
Air Force Commander, Bhuj	(02832)244005-10	
Army, Bhuj, C.O 128 AD Regmt	229239,229942	

ANNEXURE – X**For the supply of food packets etc., the following Agencies will be contacted:**

Sr. No.	Name of Agency	Contact Person	Telephone No.
1	Arya Samaj Mandal	Mr.Vachanidhi	231223 / 9824221332
2	Agrawal Samaj	Mr. Sunil Sharma	234977
3	RSS	Mr. Sunil Kothari	222560
4	Rotary Club, Gandhidham	Mr. Samir shah	9825093732
5	Red Cross Society	Dr. Bhavesh Acharya	234854 / 232736
6	Lohana Mahajan, Gandhidham	Mr. J.P. Thakkar	9879109826
7	Marvaari Yuva Manch	Mr.Sunil Bajaj (President) Mr. Prashant Agarwal	9879015408
8	Swaminarain Mandir	Mr.Lavjibhai Thackker	231555, 233666
9	Gandhidham Sindhi Youth Circle	Mr.Vijay Khubchandani & Mr.Kundabhai	220490
10	Satwara Samaj	Mr.agavjibhai	235659
11	Sitaram Parivar	Mr.Mohanbhai Dharsi	222373, 234603
12	Gurudwara, Gandhidham		220643
13	Swaminarayan Gurukul	Swamimukta Prasadji	228098, 226555

Apart from the above, if required, the following hotels may be contacted for the supply of food packets:-

Sr. No.	Name of Hotel	Contact Person	Telephone No.
1	Grand Shiv	Mr Nagendra Singh	221297, 9825226568
2	Sharma Resorts	Mr Madan Mohta	31824/231823/231825/ 224885-86-87-88-89
3	Satkar	Mr Babu Bhai Agrawal	234100/222597
4	Natraj	Mr. Acharya	221749/221956/221955 221954/238002
5	President	Mr. Romesh	220053
6	K.K.Caterers	Mr. Kaniyalal Rajwani	(M) 98252 26998 (M) 98983 74896
7	Hotel Mid-Town, Adipur	Mr. Nagendra Singh	98252 26568 260237/260080
8	Hotel Sea-Rock, New Kandla	Mr. Devidas Shetty	270490

LIST OF LABOUR CONTRACTORS OPERATING AT KANDLA PORT

Sr. No.	Name of the Company	Contact person	Address	Contact Nos
1	Neelkant Handling A/c Shree Radhey Shipping	Haresh Bupendra	Tenament B Plot 290,Ward 10/A, G'dham	237040 98250 01743
2	Ratnakar Handling A/c Aditya Marine	Radhakishan Parida	83-84, GIDC G'dham	98791 23371
3	Ganesh Handling Co.	Dayalal B. Rabari	6-8, Goyal Chamber, GIM	235504
4	Al Pirani Al Sailani	Akbar Yakub	CS-10, Port Colony, Kandla	22053 / 232174 99793 31100 98257 87808
5	Shree Ravechi Handling A/c Trinity Shipping	Mahadeva Agaria	11, Second Floor, Plot.343, Ward 12- B, GIM	250286 9825361347
6	Shree Ramdev Handling	Nimbaram Gulabji	377, Sector-7 GIM	9825348935 9979898564
7	AVB & Co	Mukesh Gujjar	15, GF, Gokul Park, GIM	232967
8	Ashapura Labour Supply	Khimji Jallabhai Rathod	48, GIDC, Near Ambika Weigh Bridge, GIM	9979053378 9898128069
9	Shree Krishna Handling	Harinder Yadav	Plot E – 108, Guj Housing Soceity,Sec- 5,GIM	9879549803
10	Naasmin & Co	Umar Osman Chamadia	Plot – 14, Sector- 7, GIM	9898333397
11	M.S. Logistics	Asgar Haji Mungrani	Shop No. 5, Opp. CISF Gate,	9825241065 9913620407

			Kandla	
12	Shree Majeesa Handling	Jugal Kishor Joshi	Block 24, MIG, Kidana, GIM	9879373992 9979898564
13	Shree Kailash Handling Co.	Mohanbhai Heera	Plot No. 7, Sector- 8, GIM	9825228555 9879288875
14	Javed Abu Saicha	Javed Abu Saicha Gani Patel	Shop - 13, Port Colony, Kandla	9825092748 9825563094
15	Shree Ganesh Handling	Dayabhai Rabari	6-8, Goyal Chamber, GIM	9825056599
16	Bhupendra & Co	Mayur M Ahir	Plot 253, Ward 12/C, GIM	9727762191 9825225239

**ANNEXURE –
XII**

LIST OF CIVIL ELECTRICAL AND MECHANICAL CONTRACTORS

Sr. No.	Name & Address of Contractor	Office	Resi	Mobile
1	Mr. Dilip Bhandbe, M/s Mukund Ltd.	223412		
2	M/s. Maheshwari Const. Co., SDX-N-5, Gandhidham-Kutch Mr Rameshbhai	232134		
3	M/s. Apex Engineers, Bajaj Chambers, 12/B, Gandhidham – Kutch (Mr. Vishal)	222002 222223		9898226666
4	M/s. Gadhvi Constructions, Plot No.524, Sector – 5, Gandhidham – Kutch	235772		9426215258
5	M/s. Advance Builders & Contractors, B-23, Apnanagar, Gandhidham – Kutch.		232864 234242	9825255934
6	M/s. Mohan Construction Co., 415, 2/B, Adipur (Mr.Mohan)		264140	9825174351
7	M/s. Star Decorators, 17, Plot No.5, 12/A, National Highway, Gandhidham – Kutch (Mr. Vinod Bajaj)	221450		
8	M/s. Kamal P. Chellani, DBZ-S-81-A, Gandhidham-Kutch (Mr.Kamal)			9825221542
9	M/s. K.K.Construction, E-71, Gujarat Housing Society,			230064

	Devi Krupa, Sector -5, Gandhidham (Mr Milanbhai)			
10	M/s. Mepabhai Madan, Plot No. 21/22, Sector-9, Opp. KPT Office, Gandhidham Mr Rajubhai	222209 222210		233627
11	M/s. S. B. Singh, B-110, Sapna Nagar, Gandhidham - Kutch	239351		
12	M/s. Dipesh Construction Co., 11, Apurva Chambers, Ganga Gate, Anjar - Kutch. (Mr. Parth) (Mr. Sukhdevbhai)	242997	243319	9824294260 9825179040
13	M/s. Raj Construction Co., Deepak Complex, Plot No.315, Ward 12/B, Gandhidham-Kutch Mr Rajesh Makhijani	220911		
14	M/s. M. V. Rajani,444, 2/B, Matruchhaya,Rambaugh Road, Adipur - Kutch (Mr. Narayan)	260800 262920		9825225690
15	M/s. Bhimji Velji Sorathia, 21, Nilesh Park, Plot No.80, Sector - 8, Near New Court Building, Gandhidham - Kutch (Mr. Bhimji Velji)	231383		9825225948
16	M/s. Sollone & Parco Engg. Co., CCX-165, Adipur - Kutch (Mr Ravi Solanki)	261298 263248		9825222919
17	M/s. Mahesh Construction,			

	Plot No. 415, 2/B, Adipur- Kutch (Mr. Mahesh)		264140	9825091599
18	M/s. Patel Construction Co. Zanda Chowk, Gandhidham (Mr. Tejabhai Kangad)	220421		9825227199
19	M/s. M. G. Bhavnani, Plot No.102, Sector 1/A, Gandhidham – Kutch			9825191636
20	M/s. Patel Engineering Works, Gandhidham	231832		
21	M/s. H.M.G. Gandhidham	235710 234609		
22	M/s. Mukund Limited Mumbai	022- 25347373		
23	M/s. Bajaj Electric Mumbai	022- 23724192		
24	M/s. Mishra Brothers Gandhidham	221172		
25	M/s. Sonu Electricals 18, K.P.Shopping Centre, Near Jivan Bharati School, Karelibaug, Vadodara-390018 Shri Jayendrasingh.B. Thakker	0265- 2464108	2647886	
26	M/s. Ravi Electronics, "Prashant", 20, New Jagnath Rajkot – 360 001 Mr. G.K.Patel	465256 460 253		
27	M/s Megha Technicals, CCX – 165, Adipur – Kutch (Mr. Ravi Solanki)	261298 263248		9375320232

28	M/s Maruti Construction, Gandhidham – Kutch			9824893851
29	M/s Ramesh Meghji Sorathia, Anjar – Kutch			9825225948
30	M/s Mohit Construction, B-168, Shaktinagar, Gandhidham – Kutch			9825227072

ANNEXURE – XIII**LIST OF SALT LAND LESSEES**

Sr. No.	Name of Salt Works	Contact Person	Tel. No. Office	Tel. No. Residence
1	Asstt. Salt Commissioner, Gandhidham	Mr. Jagdish Tripathi	233670	263690
2	M/s. Kanoria Chemicals and Ind. Ltd., Plot No.220,	Mr. B. N. Singh, Mr. J. Singh	229470 0237-74433	283325 9825225841

	Sector -4, Gandhidham	Factory -		
3	Shree Krishna Salt Industries, Central Bank Compound, Gandhidham	Mr. Kantibhai Thakkar Mr. Vikash Patel Mb: 9825206214	234727 233990	235315 234089
4	M/s. Chirai Salt Works, DBZ-S-46, Jawahar Chock, Gandhidham.	Mr.Sureshbhai Mr.Parasbhai Mb: 9825225181 Mr.Mayajar	221109 221267 9826214709	234386 233081
5	M/s. Bhuvneshwari Salt Works, TCX-S-62, Gandhidham	Mr.Sreechandji Jain Mob: 9825222269	237114 235203	233605 236860
6	M/s. Dungershee Salt Works, Shop No. D-93, P.B.No.9, Gandhidham	Mr.Hiralal Parekh Mb: 9825019661 Mr. R.B.Agrawal Mb: 9825019662 Mr. Bhikhabhai (Salt Area)	222765 223440 9825225667	232767
7	M/s. Shree Laxmi Salt Allied Ind., "Shree Sadan", 207 / 12-B, Gandhidham	Mr. Rajubhai Rathi Mr. Rameshbhai Rathi Mob.: 9824214901	232167	232167 235482
8	M/s. Jyoti Salt Industries, "Sukh Sadan", Opp. Hotel President, Gandhidham	Mr.Acharya Sukhdevbhai Mr. Sukhdevbhai Acharya Mb: 9825226075	223776 221082 221089 223094	221876
9	M/s. New Kandla Salt and Chemical Co., "Maitri Bhavan", Plot No.18, Sector 8,	Mr. Ashokbhai Sanghvi Mr. Babulalji Sanghvi	232227 231588 234087	234325 231814 232122

	Gandhidham	Mb: 9825226091 Mr. Sukhrajbhai Mb: 98252 26011		
10	M/s. Kutch Salt Works, New Kandla	Mr. Mitenbhai Mb: 9825225990 Mr. S.P.Giria, Works Manager, Mb: 9825228085	234659 022- 22040561 22041598 270371	238633

11	M/s. Vijay Salt Works and Allied Industries, "Friends House", P.No. 50, Sector -1A, P.B.No.106, Gandhidham	Mr. Harishbhai Chaturani Mb: 9825064241 Mr. Babulal Nahata Mr. Lalchandji Nahata	231119 252247 223743	234856 9825228398
12	M/s. Rajesh Salt Works, "Chandan Chambers" National Highway, Plot No.18, 12/A, Gandhidham.	Mr. Kishorbhai Thakkar Mob: 9825177081 Mr. Rameshbhai Mb: 9825226026	220586 221048 222301	234387
13	M/s. Western Chemical, DBZ-S-151, Gandhidham	Mr. Naranbhai Mb: 9825226092	233185 230913	230141
14	M/s. Urvakunj Nicotine Ltd., Central Bank Compound, Plot No.31, Sector No.9, Gandhidham	Mr. Mahendrabhai Patel - 9825206214 Mr. Vikash Patel Mb: 9825226214	234727	234480
15	M/. Friends Salt Works, "Maitri Bhavan", Plot No.18, Sector No.8, Gandhidham	Mr. Babulalji Mb: 9825226015 Mr. Ashokbhai Mb: 9825226091 Mr. Sukhrajbhai Mb: 9825226011	232227 231588 234087	231646 231814
16	Smt. Savitri H.Pandya, DBZ-N-21/A, Gandhidham	Mr. Jagdihbhai	220212 238112	255612

17	Smt. Vimlaben.H. Pandya, DBZ-N-21/A, Gandhidham	Mr. Jadishbhai Mr.Amritlal Pandya Mb: 9825225212	220212/ 238112/ 238212/ 255612 Fax: 222930	
18	M/s. Rajendra Salt Works, D-125, Jawahar Chowk, Gandhidham	Mr. Tarachand	-	-
19	Mr Natwarlal Agrawal, TCX-S-75, Gandhidham	Mr. Natwarlal Mb: 9825393555	222672	231564
20	Mr Indrumal Khubchand, C/o Gulab Salt Works, D-125, Jawahar Chowk, Gandhidham	Mr. Tarachand	233041 234388	234937
21	Mr Virji Khimji C/o Ajit Salt works, D-75, Gandhidham	Mr. Kirtibhai	220310	-
22	Mr Girdharilal.S. Agrawal, Plot No.126, Ward – 12/B, Gandhidham	Mr. Girdharilal	232862	234755
23	Mr Vijay Kumar.D. Palan & Mri Jagdish Kumar.D.	Mr. Navrotambhai Palan	220310	-
24	M/s. Satya Salt Works, DBZ-S-183, Gandhidham	Mr. Candubhai Mb: 9825225911	224055 221445	234739 234469
25	Shri Premji Gangji Soni,	Mr. Mahesh Soni	221263	-

	DBZ-S-183, Gandhidham			
26	Smt. Geetadevi P. Chaturani Plot No.13, Sector 1, Gandhidham	Mr. Romesh / Ashwin Mr. Dayalbhai Chaturani, Mb:9825064245	221048 256713 220586 256706 Fax: 222930	-
27	Shri Rashmin A.Pandya DBZ-N-21/A, Gandhidham	Mr. Jagdish Pandya	220212 238112 238212 Fax: 222930	-
28	M/s. Neelkanth Enterprise, DBZ-S-60, Gandhidham	Mr. Shamjibhai Mb: 9825 25711	220421 220103 Fax: 223560	231485
29	Dayalal G.Chaturani Shop No.1 to 4, "Chandan Chamber" Plot No.18, Ward No.12, Gandhidham	Mr.Dayal	221048 220588	-
30	Shri Chaganlal Punamchand, DBZ-N-197, Gandhidham	Mr. Chaganlal	220545	-

Annexure -XIV**LIST OF STEVEDORES AT THE PORT**

Sr. No.	Name	Address	Fax No.	Telephone Nos.	
				Office	Resi.
1	M/s. Cargo Movers	"Cargo House" BBZS-32A, Gandhidham	231687	220453 231365	261280
2	M/s. DBC & Sons (P) Ltd.	Seva Sadan-II, Room No. 303 / 304, New Kandla	270631	270503 270263 270348	-
3	M/s. A.V.Joshi & Co.	Plot No. 18, Sector-8, Maitry Bhavan, Nr. Post Office, Gandhidham -Kutch	233924	231070 232227 231588	234909

4	M/s. Agarwal Handling Agencies	DBZ-N-47, Gandhidham – Kutch	232749	220282 233187	232749
5	M/s. ACT Shipping P. Ltd	Seva Sadan-II, Room No. 206/207, New Kandla	232175	270111 270112 270015 229967 231734	261308 231416
6	M/s. Cargo Carriers	214/215, Rishab Corner, Plot 93, Sector- 8, GIM	230030	220816 231649 230030	231694
7	M/s. Cargo Clearing Agency (Gujarat)	Plot No. 271, Ward 12-B, Gandhidham	233034	221721 220655	231452
8	M/s. Chotalal Premji Stevedores Pvt. Ltd	C-8, Shaktinagar, GIM	231509	270009	-
9	M/s. Hiralal Maganlal & Co.	C-11, GIDC Area, Gandhidham – Kutch	223914	223914 231832	223878 232430
10	M/s. New Dholera Shipping Company	Goyal Commerce Centre Building – 1, Plot No.259, Ward 12B, Gandhidham – Kutch	-	222637 232267	237284
11	M/s. J.M. Baxi & Co.	Seva Sadan – II, Room No. 301 / 306, New Kandla	270646	270630 270550 270448	260427
12	M/s. Pestonjee	Seva Sadan-II, Room	270650	270257	262914

	Bhicajee (Kutch)	No.203, New Kandla	270556	270367 270221	
13	M/s. OTA Kandla Pvt. Ltd.	BBZ-N-324, Gandhidham	223241	220145 270560	223241
14	M/s. Purshotamdas Jeramdas & Co.	5, Vaswani Chamber, Plot 16, Sector-8, GIM	222850	238242 222598	220598
15	M/s. R. Tulsidas & Co.	Ahit Building , Plot No.323, Gandhidham – Kutch	232308	222717 221943	-
16	M/s. Robinsons	101 / 102, Maritime House, Plot No.45, Sector – 9A, Gandhidham – Kutch	234394	221578 223836	231767
17	Rishi Shipping	Plot 50, Sector 1/A GIM	238943	229830 229831	
18	M/s. Vinsons	BBZ-S-25, Gandhidham – Kutch	231948	220466	222395 239460
19.	Sical Logistics Ltd	403, 4 th Floor, Madhuban Compex, OSLO, GIM	234416	234646 234194	
20	Parekh Marine Agency	C-8, Shaktinagar GIM	231509	229297 221158 230587	
21	Krishna Shipping and	Transport Nagar, NH	233135	230501	

	Allied Services	GIM		223814 229085	
22	Kevar Carrier Handling & Transport	Shop 24, Tolani Chamber, Sector -8 GIM	228298	228298	
23	Trinity Shipping & Allied Industries	Trinity House, Plot 46 Sec 1/A, GIM	232060	230911 230910	
24	Velji P & Sons(P) Ltd	2 nd Floor, Deepak Compex, 315, 12/B GIM	236168	231545 231546 225466	
25	Asean Marine Services	Ashit Bldg, Plot 33 Sector 1/A, GIM	232308	222717 221943 222145	
26	Rishikiran Roadlines	Kiran House, Plot 8 Sector 8, GIM	231422	231894 234108	
27	Universal Shipping Services	Hotel Sea Bird, Plot 173, Sector 1/A GIM	235251	230663 226050 226037	
28	R.T.Bhojwani & Sons	DBZ -S- 146, GIM	232423	222211 221831	
29	Logistic Enterprises(P) Ltd	C-8, Shaktinagar, GIM	231509	235341 230587	

30	Seaways Shipping (P) Ltd	2 nd Floor, Plot 351 Ward 12/B, GIM		226183 237147	
31	Seacrest Shipping Services Pvt. Ltd	216, 2 nd Floor Om Corner, Plot 336 Ward 12/B, GIM	227028	233325	
32	Shree Maruti Shipping Services	18/21, Swaminarayan Bldg, Sector 9, GIM	234107 250690	233245 237247 250690	
33	Liladhar Pasoo Forwarders P.Ltd	Plot 4, Sector -1 KASEZ, GIM	252383 253506	252286 252297 252612	
34	Shree Radhey Shipping Company	14-16/C, GF Green Park, GIM	232967	222919 228919 238883	
35	Pearl Shipping	220, Rishab Corner, Plot 93, Sector 8 GIM	235570	225283 225284	
36	Patel Shipping Agency	Patel Avenue, Floor 2, Plot 170, Sector 1/A GIM	231143	224024	
37	Ashirvad Shipping	18-21, Swaminarayan Bldg, Sector- 9, GIM	250690	233245 237247 222822	
38.	M/s. Swaminarayan	1 st Floor, H-6, Op. Tejas Society,	079-	231981,	

	Vijay Trade Carriar	Ghatlodia, Ahmedabad	231983	231982	
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LIST OF TANK FARM OWNERS

Sr. No.	Tank Farm Owners	Persons to be contacted in case of emergency		
		Name and Position	Telephone No.	Mobile No.
1	Kesar Enterprises Ltd., Near Oil Jetty, Old Kandla (Kutch)-370210	Mr. R.K. Gupta Gen. Manager	270435 (O) 295676 I	9375349181
2	Kessar Enterprises Ltd, Terminal II, Plot No. 5 &6 Old Kandla	Mr. R.K. Gupta G.M	270435 (O) 270177 (O)	9375349181
2	Chemical & Resins Pvt.Ltd Terminal -I, Near Oil Jetty, Old Kandla, Kutch Terminal - II, Near West Gate, New Kandla - Kutch	Mr. Manoj Kumar Gupta, Terminal Manager	270505(O) 270916 (O)	99240 44424
3	Indo-Nippon Co. Ltd., Plot No.2, K.K.Road, Old Kandla,	Mr. R.N. Pathak Asst. Terminal Manager	270795(O) 235818I 270295 (O)	9879571295
4	J. R. Enterprise, Plot No.3, Old Kandla,	Mr. Devendra Dadhich, Terminal In-charge	653528 (O) 257152 ®	9898238380
5	Friends Oil & Chemical Terminals Pvt. Ltd., Near Booster Pump Station, Old Kandla, Kutch	Mr.S.Ramakrishnan Terminal Manager	270987 (O) 257249 ®	9879572107
6	Indian Oil Corporation Ltd., Main Terminal, GIM	Mr. AK. Khanna Sr. Term. Manager	233274 (O) 229002 I	9427216637

	Foreshore Terminal, Kandla KBPL LPG Import Plant	Mr. KS Rao, Sr.TM Mr. PS Negi Plant Manager	270394 (O) 270628 (O) 270477 (O) 233359 ® 270978 (O) 236944 ®	9426416108 9426725342
7	United Storage & Tank Ltd Near IOC Foreshore Terminals, New Kandla Gas Terminal, Plot No. 4 Old Kandla	Mr. Manoj Gor Terminal Manager Mr. G. Chudasama	270609 (O) 653525 (O) 651238 ® 653529 (O)	989850029 9904366855
8	IFFCO Kandla Unit, Kandla, Kutch	Mr. M.R. Patel. Execut. Director, Mr. N.C. Patel, Sr. Manager	270711 270352(O) 270381 (O)	9687666888 9979026415
9	BPCL, KK Road, GIM	Mr.Vineet Bhudhai Sr. Manager Operations	234313 (O) 257808 ®	9409305433
10	HPCL KK Road, GIM	Mr. Murthy Manager (Installation)	230936 (O) 220084 (O) 233078 Ext 109(R)	
11	INEOS ABS (I) Ltd Plot No. 8 Old Kandla	Mr. Vineeth Nair Dy. Manager	270087 (O) 234409 I	9825237029
12	Liberty Investments Pvt. Ltd., Plot No. 1 & 2, Block 'H', New Kandla	Mr. Jitendra Vaidya Terminal Manager	270151 (O) 270464 (O) 270468 I	9825025645

13	Avean International Pvt. Ltd., Liquid Storage Tank Terminal, Plot No. B-1, New Kandla	Mr. Bharat Rathod Terminal Manager	270537 (O)	9375310260
14	Rishi Kiran Logistics Pvt Limited, Plot No. 7, Link Road Old Kandla	Mr. RH. Pandya GM (Terminal)	270223 (O) 270443 (O)	9879104556
15	N.P.P. Pvt. Ltd., Old Kandla	Mr. Jud Sequeira, GM(Terminal)	270347 (O) 257807 (R)	9099944900
16	Friends Salt Works and Allied Industries, KK Road, Old Kandla	Mr. NJ.Zinduwadia Sr. Manager Mr. HA. Mehta Sr. Manager	270814 (O) 262698 I 271260 (O) 235072 I	9825506361 9825506360
17	IMC Ltd, Cargo Jetty New Kandla	Mr. Anil Brahmbhat	270369(O) 653524 (O) 657963	9898126243
18	Agencies & Cargo Care Ltd., Plot No.3,New Kandla	Mr.Shivkumar Menon, Term. Mgr.	270714 (O)	9825226765
19	Dipak Estate Agency Plot No. 5-6, Block -A Behind Petrol Pump New Kandla	Mr. Narendra Thacker	270375 (O)	9879611243
20	Parker Agrochem Exports Ltd, Plot No. 3 -4,Block- H New Kandla	Mr. Bharat Thacker	270486 (O) 270528 (O) 231876 I	9825238260
21	Tejmalbhai & Co Plot 10, Block- A New Kandla	Mr. Ankitbhai Chandan	271330 (O) 230090 I	9825225101 9825222101
22	Parker Agrochem	Mr. P.Raja Babu	270528 (O)	9979158543

	Product P Ltd, Plot 7-9, Block-A, New Kandla	Dy Manager	231876 I	
23	Mother Dairy Fruit & Vegetable Pvt. Ltd, Near Oil Jetty, Old Kandla	Mr. Saju Therattu	270654 (O) 270655 (O) 230979(R)	9974022681
24	Mother Dairy Fruit & Vegetable Pvt. Ltd., Nr. Oil Jetty, Old Kandla	Mr. Saju Therattu	270654(O) 270655(O) 230979(R)	9974022681

ANNEXURE – XVI**LIST OF SCHOOLS IN GANDHIDHAM – KANDLA COMPLEX**

Sr. No.	Name of School	Contact Person	Telephone No.
1	Dr. C. G. High School	Principal	220271
2	SVP Gujarat Vidhyalaya	Principal	220242
3	M.P. Patel Kanya Vidhyalaya	Principal	220705
4	Adarsh Maha Vidhyalaya	Principal	234172
5	Adarsh Kanya Vidhyalaya	Principal	220175
6	Bhartiya Vidhya Mandir, Kandla Bhartiya Vidhya Mandir, Gopalpuri	Head Master Head Master	271049 233684
7	Central School, (IFFCO)	Principal	221288
8	Central School (Railway)	Principal	220657

9	Modern School	Principal	220284
10	Mount Carmel School	Principal	234262
11	Aum Vidhyalaya, IFFCO	Principal	221104
12	Saint Xavier's School, Adipur	Principal	260265
13	Maitri Maha Vidhyala, Adipur	Principal	260445
14	Maitri Kanya Vidhyalaya, Adipur	Principal	260612
15	Model Excelsior High School, Adipur	Principal	260707
16	Gujarat Vidhyalaya, Adipur	Principal	261312
17	Nagarpalika High School, Anjar	Principal	242510
18	Adarsh Nivasi School, Gandhidham	Principal	223246
19	P.N.Amersey School	Principal	223646
20	Shree Gurunanak English School	Principal	238421
21	Swaminarayan Gurukul	Principal	228098
22	Kairali English School	Principal	221050
23	Sarvodaya Pradhamic Shala Near Oslo Cinema, Gandhidham		227958
24	Ganeshnagar Pr.Shala, G'nagar		
25	Jagjivan Pra. Shala, Sapnanagar, Gandhidham		
26	Cargo Pra. Shala, Sapnanagar, Gandhidham		
27	Old & New Sunderpuri Schools	Head Master	224867
28	G'dham Pr. Shala, Near Shivaji Park, Gandhidham	Head Master	229255
29	Adipur Prathmic Shala, Adipur	Head Master	264525 264181
30	Kandla Pr. Shala, Shirva Camp & Thermal Colony & United Salt Works	Head Master	253198

ANNEXURE – XVII**LIST OF DOCTORS IN GANDHIDHAM COMPLEX**

Sl. No.	Name of Doctor	Telephone Numbers	
		Office	Residential
ANAESTHETIST			
1	Dr. (Mrs.) Dubal	232591	233555
2	Dr. (Mrs.) S.R.Gandhi	236700	229156
3	Dr. P. P. Kour	229655	220673

PHYSICIAN			
1	Dr. (Mrs) Gandhi	234561	230111
2	Dr. Johnson	222344	232244
3	Dr. Morakhiya	222008	232161
4	Dr. Sakaria	230114	230947
5	Dr. Siju Jacob (St. Joseph Hospital)	230160	223852
6	Dr. Acharya	220715	232736
7	Dr. D. P. Singh	221990	221990

SURGEONS			
1	Dr. D.G.Dasani	229231	223346
2	Dr. Girdhani	233300	231219
3	Dr. Y.V.Joshi	221557	233324

4	Dr. Hotchandani	230039	261530
5	Dr. Hemang Patel	230202	230353
6	Dr. Vachani	230400	222400
7	Dr. J.K.Ahir	237744	--
8	Dr. Harani	222096	222096

GYNAECOLOGISTS			
1	Dr. (Mrs.) N.B.Acharya	220715	232736
2	Dr. Chandrakant Thakker	224488	225588
3	Dr. (Mrs.) Rekha Singh	221990	221990
4	Dr. (Mrs.) Naik P.S.	234333	231332

PAEDIATRICIANS			
1	Dr. J. A. Dubal	232591	233777
2	Dr. Navin Thakker	230195	230894
3	Dr. Nitin Thakker	221046	220615

PATHOLOGISTS			
1	Dr. K. L. Shukla	221611	234062
2	Dr. (Mrs.) Seema Pavde	230370	231352
3	Dr. (Mrs.) Verma G.H.	229168	238386

ANNEXURE – XVIII*LIST OF ESSENTIAL SERVICES*

HOSPITALS	OFFICE	RESIDENT
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1	General Hospital, Bhuj Civil Surgeon, Bhuj	222850	250554
2	Referral Hospital, Anjar	232455	
3	Rambaugh Hospital, Gandhidham	220263	
4	Divine Life, Adipur	261802	
5	Railway Hospital, Gandhidham	231874	
6	Government Dispensary, Adipur	260608	

TELECOMMUNICATION			
1	General Manager, BSNL, Bhuj	253000	252322
2	Dy. Manager, Bhuj	252505	251505
3	Area Manager, Gandhidham	238000	235000
4	SDO, Gandhidham	236250	236251

ELECTRICITY			
1	S.E., PGVCL, Bhuj	222550	250189
2	Jr. S.E., Anjar	243008	242656
3	XEN, Anjar	242845	242446
4	Dy. Engineer, Gandhidham	222809	--
5	Line Office, Gandhidham	221728	

WATER SUPPLY			
1	S.E., GWS&SB, Bhuj	221806	250601
2	XEN, Bhuj	250685	253016

3	SE, Anjar	242416	242421
4	XEN, Gandhidham	220717	223273
5	Control Room, Gandhidham	221252	
6	Water Tank, Sunderpuri	231313	
7	Water Tank, NU-4	654564	
8	Gandhidham Municipality	231610	
9	Chief Officer, Gandhidham Municipality	234967	

ANNEXURE – XIX***LIST OF VEHICLES SUPPLIER***

Sl. No	Name of Institution	Contact Person	Parking Place Phone No.	Name and Phone No. of Driver	Availabil ity of Vehicle.
(A) Vehicle Hire Contractors					
1	M/s Rohit Enterprise	Mr Rohit Shah 228550/237538 237547 (O) 234140 I Mob.9825225121			
(B) Ambulance Pool					
01	St.Joseph Hospital, Gandhidham	Administrator 230160/229336	Hospital Premises	Driver available round the clock	First come first serve
02	Red Cross Society, Gandhidham.	230269	Red Cross	Driver available round the	

				clock	
03	Western Railway, Gandhidham	238891, 231874	Hospital		
04	Rambaugh Government Hospital, Adipur	261625	Hospital Premises	Driver available round the clock	
05	Gautam Freight Pvt Ltd.	Mr Ramesh, Proprietor 232605/220163, 230345 (O)	GIDC Work shop Sector- 10C, Plot No. 24.		First Come First Serve
06	Tolani Eye Hospital	Supdt.(O)260497 - 260773	Hospital Premises	One driver in absence of compounde r residing in hospital	First Come first Serve
07	Sterling Divine Life Hospital, Adipur	260577, 7698166555	Hospital Premises	Round the clock	
08	Dev Smruti Trust Dr. Harani	222096, 9825227322			
09	Mobile Morgue	229430/239965	Lions Club		
10	Shav Vahini/Mobile Mrogue	239965			
11	Varsha Cheritable Trust C/o Hareshkumar Tulsidas	9909829555			
12	Hari Om Trust Mr. K. Parmar	260833			

PLACEMENT OF PORT CRAFTS ON CYCLONE WARNING.

(A)	SHIPPING TUGS	Heera Mehul	Bunder
		Kalinga	Maintenance Jetty (West side)
(B)	PILOT LAUNCHES AND SURVEY LAUNCHES	M. L. BHARINI, M.L. NIHARIKA M. T. SWATI	Floating Crafts Jetty
		ML Karishma	Bunder Basin
		ML Nirishak	Inside Bunder Area North Side.
I	G.S. LAUNCHES AND MOORING LAUNCHES	M. L. Mrinal	Inside Bunder Area North Side on Pilot Launches
		M. L. Unnati M.L. Vaishali	Inner Side of Floating Craft Jetty
		M. L. Vijay M. L. Priyadashani PL Rakshak	Inside Bunder Area North on G. S. and Pilot Launches.

ANNEXURE -XXI**LIST OF LICENSE HOLDERS TO KEEP THEIR CRAFTS INSIDE THE PORT AREA.**

Sl. No.	Name of Party	Name of Nodal Officer	Tele. (Office)	Tele. (Resi)
01	M/s Jaisu Shipping Co. P Ltd., Kewalramani House, Dinshaw, Bldg. Road, New Kandla	Mr.Preetam, Director, Mob. 9825226114	270538 270128 270428	260235 260224
02	M/s Gautam Freight Pvt Ltd., Plot No. 24, Sector, 10/C, GIDC Area, Gandhidham	Mr. Ramesh Singhvi, CMD	231386 232605 230345 220163	234176 230328
03	M/s Babu's Shipping, Plot No. 32, Sec - 9 GIM	Mr. Vishalsinh Jadeja	222002	
04	M/s Blue Ocean Sea Transport, Manali Chamber, Plot No.306, Sec 1/A GIM	Mr. Hukumat T. Bhojwani & Mr. Dushyant Patel	239143 222518 230488 239058	
05	M/s Rishi Shipping, Rishi House, Sec 1/A, Plot No. 50 Gandhidham	Mr. Manoj Mansukhani Proprietor	220843 229830 229831 223913 229517 Fax. No. 238943	
06	M/s Velji P & Sons, Deepak Complex, 2 nd Floor, Plot No. 315,	Mr. Sureshchandra	231545 231546	232247

	Ward 12/B, GIM			
07	M/s A.S. Moloobhoy & Sons, Anchor House Shivkripa Bldg, Plot No. 135, Sec 1/A, GIM	Mr. Adil Sheth M- 9375312077	326543 225060 225061 225060	
08	M/s Gudani International Pvt. Ltd, C/o Chemoil Adani Mithakali Circle, Ahmedabad.		079- 25555765 25555266	

LIST OF TRAVEL AGENCIES

Sr. No.	Name of Agency	Phone No.	Mobile
01	M/s. Rathod Tours and Travels, Gandhidham	222444	222959
02	M/s. Rishabh Enterprises, M/s. Rishabh Tours and Travels, 30-31, Tolani Chamber, Plot no. 2, Sector No. 8, Nr. B.M. Petrol Pump, Gandhidham	228550 237538 237547	234140 9825225121
03	M/s. Jai Somnath Travels, Mr. Mishra		9727304414
04	M/s. Agrawal Tourists, Gandhidham	221311 220068	
05	M/s. Krishna Travels, Gandhidham	220683 234838	
06	M/s. Shiv Tourists, Gandhidham	221454	
07	M/s. Thakker Travels, Gandhidham	225097	9825271072

LIST OF MAJOR HEAVY LIFT OPERATORS AT K P T

NAME OF PARTY	NAME OF CONTACT PERSON	Phone Number
Swastik Heavy Lifters	Mr. Jigneshbhai Mr. Aslambhai	9825758151 9825228421
Kutch Carrier Transport Co	Mr. C. R. Thackar	9825225591
Agarwal Handling Agency	Mr. Rakesh Thackar	9426928728
Active Cargo Movers	Mr. Narendra	9825220411
Raghuvirsingh & Sons	Mr. Harcharan	9879104853
Thacker Brothers	Mr. Kamleshbhai	9825296107
Kiran Roadlines	Mr. Pankaj Gadvi	9879104552
Regal Shipping	Mr. Ashok Dudi	9825326328
Rathore Freight Carriers		220759/ 220380

ADDITIONAL LIST OF FIRMS FOR PAY-LOADERS/CRANES

M/s Mahalaxmi Transport Co., Plot No. 35, Sector No. 8, Behind Hotel Fun & Food, Gandhidham	Mr H K Rathod	(O)222387 I233500
M/s Kandla Earth Mover, DBZ-S-151, Gandhidham	Mr Sanjay Goyal	(O)221759 I222338 (M) 9825020550
Mr Lalji Bhavanji Sathwara, Laljibhai Sathwara, Plot No. 27, Shop No.5, Sector-9/A, Gandhidham		(O)234118 I232566 (M) 9825225957

LINER AND STEAMER AGENTS AT KANDLA

Sl. No.	Name	Fax No.	Tele. No.	Mobile
01	M/s ACT Shipping Ltd Mr. Harshad Gandhi	232175/ 270597	270111 270115-6 229967 231734	9825226141
02	M/s Admiral Shipping Ltd	233596	230552 232823	
03	M/s Areadia Shipping Ltd	232542	234254 223486	
04	M/s Ambica Maritime Ltd Mr. Amit Vyas	252447	252479 252349	9825225210
05	M/s APL (India) Pvt Ltd., Mr. Murli Krishnan	236361	224601/2 236357 236355	9825225753
06	M/s Arebee Star Maritime Agencies Pvt Ltd. Mr. anil Talwar	235831	220465 235832	9824229109
07	M/s Ashit Shipping Ser. Pvt Ltd. Mr. Sanjay Thakkar	232308	221943 222717 222145	9825225698
08	M/s Atlantic Shipping Pvt Ltd	223372	230552	
09	M/a Asia Shipping Services. Mr. Mohan Karia239326	231285	234526 230954	
10	M/s Bayland Freight Systems Pvt Ltd., Mr. Danendran Gopalan	239326	225522/23	9825230880
11	M/s B D Vithlani Shipping Services Pvt Ltd.	234104	232220 221081	
12	M/s Cargo Conveyors Mr. Shekhar Ayachi Mob. 9825226102	233034	221460 220655	
13	M/s CCA Shipping Services Mr. K C Varghese	233034	221721 220655	9825225217
14	M/s Chowgule Brothers	229227	278521	9825361782

	Mr. C R Soman		225051 232365	
15	M/s Coastline Services (India) Pvt Ltd.	221137	232095 222853	
16	M/s Container Marine Agency Pvt Ltd	234541	230026 220416	
17	M/s Conftreight Shipping Agency (India) Pvt Ltd. Mr. K T R Nair	-	233615 236157	
18	M/s Cresent Shipping Agency (India) Pvt Ltd Mr. Sanjay Salve.	224506	221290 221957	9825227311
19	M/s DBC Freight International	230832	230832 230639	
20	M/s DBC Sons (Gujarat) Pvt Ltd. Mr. R C Vazirani	270631	270263 270503	
21	M/s Depe Global Shipping Agency Pvt Ltd. Mr. Jaydeep Roy	232079	231528 233608 234582	9825228121
22	M/s Evershine Shipping Services. Mr. Kishan Motwani	234083	221588 237408	
23	M/s Forbes Gokak Ltd	231464	222634 235004	
24	M/s Freight Connection (India) Pvt Ltd	231357 270726	222247 222545 270727	
25	M/s GAC Shipping (India) Pvt Ltd. Mr. V C Rao	231429	231427 237244	9825225136
26	M/s Ganges Liners Pvt Ltd	233437	231608 233436	
27	M/s German Exp. Shipping Agency Pvt Ltd	236040	223269 236040	
28	M/s Goodrich Maritime Pvt Ltd	222875	222882 222883	
29	M/s G P Dave & Sons (Shipping)	234382	234288 234382	
30	M/s Greenways Shipping Agencies Pvt Ltd	232079	233608 234585	
31	M/s K. Shipping Services Pvt Ltd	233632	231933	

32	M/s Halar Ship & Freight Forwarders. Mr. Tejas Shrma	270224	270192 270568	9825212646
33	M/s Hind Shipping Agencies. Mr. Mahesh Vyas	234795	232710 235375	
34	M/s Hindustan Shipping Services. Mr. M D Sorathiya	239110	239110 222821	9824214994
35	M/s Interocean Shipping India Pvt Ltd. Mr. Suresh Tripathy	232579	235201 230589	9825225583
36	M/s Intra Trade Pvt Ltd. Mr. B P Vasavda	233295	233313 231255	9825226129
37	M/s Trades Shipping Pvt Ltd	231463	235572 233606	
38	M/s James Mackintosh Marine (A) Pvt Ltd. Mr. Satish Nair	270793	270792 270846	9825226077
39	M/s. J.M. Baxi & Co.	270646	270630 270635 270525	9825225107
40	M/s Kutch Shipping Agency Pvt Ltd.	233339	221148 250226/ 7/8	
41	M/s Liladhar Passop Forwarders Pvt Ltd. Mr. S. Chakraborty	252383	252297 252402 252288	9825020523
42	M/s Maersk (India) Ltd. Mr. Dinesh Joshi	231388	231387 236192 233963	9825270419
43	M/s Maheshwari Handling Agency Pvt Ltd. MR. Chaggan Maheshwary	230575 234633	223228 230393	9825227111

44	M/s Maltrans Shipping Agencies India Pv Ltd.	230606	220147 230336 235022	
45	M/s Mathurdas N. & Sons	252221	252224	

	Forwarders Ltd.		252350	
46	M/s Meridian Shipping Agency Pvt Ltd	230212	220305 230220	
47	M/s Mitsutor Shipping Agency Pvt Ltd	230411	220110	
48	M/s M M Shipping Services	235255	231385 238385	
49	M/s Modest Shipping Agency Pvt Ltd	-	230576	
50	M/s NLS Agency India Pvt Ltd. Mr. Sanjay Salve	232413	231318 220305	9825237311
51	M/s Orient Express Lines Ltd	230359	232186 232805	
52	M/s Orient Ship Agency Pvt Ltd. Mr. H G Digrani	233518	223430 223487	9824214801
53	M/s Oscar Shipping Agencies.	231812	226959/60 232123	
54	M/s Parekh Marine Agencies Pvt Ltd. Mr. Mitesh Dharamshi	231509	221409 235341	9825226557
55	M/s Patel Handling Agency (Capt. Kalra)- 9825062912	231143	224024 231004 221718	
56	M/s Patvolk (Mr. Shreekumar Nair)	231464	222624 235004	
57	M/s Pearl Shipping Agency. Capt. Kalra	231143	224024 221718	9825062912
58	M/s Penguin Shipping Agencies Pvt Ltd.	230606	230336 220147	
59	M/s Pestonjee Bhieajee (Kutch)	270650 270556	270221 270257 270367	9825226962
60	M/s Prudential Shipping Agencies Pvt Ltd. Mr. Siddharth Mishra	232911	230479 233982	9825226477
61	M/s P&R Nedlloyed India Pvt Ltd	232207	224906/7 232128	

62	M/s R T Bhojwani & Sons Mr. Gopichand Bhijwani	232423	223831 220839	9825225639
63	M/s Sahasu Shipping Services Pvt Ltd	236358	225224 237854	
64	M/s Sai Shipping Co. (P) Ltd Mr. S T Hingorani	231972	221369 231739	9825228681
65	M/s Samrat Shipping Co Pvt Ltd	232890	231983 222939	
66	M/s Samsara Shipping Pvt Ltd. Mr. Pranesh Rathod	233165	228602	9825225755
67	M/s Scorpio Shipping Agency	-	223085	
68	M/s SDS Shipping Pvt Ltd	231542	221326 221087	
69	M/s Seanay Shipping Pvt Ltd	270026	270788	
70	M/s Seabridge Maritime Agencies Pvt Ltd	231509	221409 221158	
71	M/s Seafreight Pvt Ltd	222850	233530 222393	
72	M/s Sealand Agencies India Pvt Ltd	230584	231179 230584	
73	M/s Scamar Shipping India	255563	-	
74	M/s Scatrade Shipping	234171	233810	
75	M/s Sentrans Maritime Pvt Ltd	236129	230002 220702	
76	M/s South India Corporation (Agencies) Ltd Mr. Antony	234416	221276 234646 231494	9825226256
77	M/s Spoonbill Maritime Agencies Pvt Ltd	234167	221049 222058 234454	
78	M/s Star International	231395	233948 232402	

79	M/s Taipan Shipping Pvt Ltd	236040	223269 227010	
80	M/s Taurus Shipping Services. Mr. Sukhveersingh	231266	221334 223074	9825227325
81	M/s Oceanic Shipping Agency Pvt Ltd	270631	270263 270503	
82	M/s TICC Container Line (Kandla) Pvt Ltd	237854	237854	
83	M/s Total Transport Systems Pvt Ltd	231463	222634	
84	M/s Transocean Shipping Agency Pvt Ltd	-	230832	
85	M/s Transworld Shipping Services India Pvt Ltd Mr. Sandeep Rajvanshi	231913	229824 221290	9825225733
86	M/s Trinity Shipping & All. Services Pvt Ltd Mr. Soly	222060	230911 223703	9825225245
87	M/s Unimarine Agencies (Gujarat). Mr. Jaikumar Ramdasani	224633	224631/ 32 223113	9825225216
88	M/s Unique Shipping Services Pvt Ltd	-	232729 232730	
89	M/s United Liner Agencies of India Pvt Ltd, Capt Rakesj Kumar	236040	227779 223269	9825225741
90	M/s Universal Freight Systems	252383	252288 252297	
91	M/s Universal Shipping Services Mr. Anil Pillai	235251	230663 231708	9824215168
92	M/s Velhi P. Sons (Agencies) Pvt Ltd	255328	255327 231545	
93	M/s Vibhuti Shipping Pvt Ltd Mr. Vinod	236219	236719 230035 232424	9825226536

ANNEXURE-XXV**LIST OF CLEARING & FORWARDING AGENTS AT KANDLA**

A V Joshi & Co Tel. 232605, 232227, 230345 Fax. 233924 Mr. Harshandu Mr. Vaidya (Mob.) 9825226013	C. Jivram Joshi & Sons (Gujarat) Tel. 220621 Fax. 231141 Mr. Sunil Chowdhari (Mob) 9825225400
ACT Shipping Ltd Tel. 270111/12/13, 270530, 220407 Fax. 270579, 232175	Cargo Movers Tel. 220453, 230883, 270563 Fax.231687
Jaswantrai & Co. Tel. 222630, 222717, 222145, 221943 Fax. 232308, 270385	Cargo Clearing Agency (Gujarat) Tel. 221721, 221674, 220655, 270542 Fax. 233034
Asia Shipping Services Tel. 230954. Fax. 231285	Chinubhai Kalidas & Brothers Tel. 232284 Fax. 231881
Airol Shipping Services Tel. 230080, 220180. Fax. 236131	CAP Shipping Pvt Ltd Tel. 221460, 232081 Fax. 233734
Aarpee Clearing Agency Tel. 222614. Fax. 255252	Centrans Shipping Agency (I) Pvt Ltd Tel. 256854 Fax. 234074
Ashirwad Clearing Agencies Tel. 232426, 233245 Fax. 234107	Cargo Shipping Tel. 270802, 270803 Fax. 270802
Ambalika Enterprises Tel. 255382. Fax. 255577	C. Joshi & Sons Tel. 221094
Ashmka Shipping (Tel. 222481)	Dilip A Goplani Tel. 224082, 255423 Fax. 224082
Ashis Enterprise (Tel. 234722)	D.B.C. & sons Gujarat Pvt Ltd Tel. 270263, 270348, 270503 Fax. 270631
Anchor Shipping Tel. 235781 Fax. 235781	Damjidhiroo & Sons Tel. 222329, 221328 Fax. 230139
B N Thakkar & Co., Tel. 222293, 222285, 270239	Dvji Premji Punara & Sons Tel. 222057, 221338 Fax. 230139

Fax. 230556	
B. Devchand & Sons Pvt Ltd Tel. 232220 Fax. 234014	Express Transport Pvt Ltd Tel. 220193, 220179, 270591, 222565, Fax. 220193
Benits Forwarders Pvt Ltd Tel. 221707, 222086 Fax. 223151	Friends & Friends Shipping Pvt Ltd Tel. 232227, 231588 Fax. 233924
Blue Sea Shipping Agencies Tel. 235317 Fax. 255221	Fast & Fair Company Tel. 255254, 238175 Fax. 255254
Bhanu Clearing Agency Tel. 256861 Fax. 256861	Flamingo Shipping & Forwarding Pvt Ltd Tel. 256755, 257756 Fax. 256755
Global Marine Agencies Tel. 222928, 223196, 223252 Fax.255418	Liladhar Passoo Forwarders Pvt Ltd Tel. 252288, 252297, 252402, 252617 Fax. 252383
Gayatri Shippers Tel. 230692, 223292 Fax. 230818	Lalbahi Trading Company Tel. 222139
Hiral Enterprise Te. 255644	Leap Forwarders Pvt Ltd Tel. 255530, 255509 Fax. 252383
Hindustan Shipping services Tel. 255644, 222821 Fax. 256618	Link International Tel. 255206/07 Fax. 255530
Hardip Shipping Logistics Pvt Ltd Tel. 232909, 222560 Fax. 232909	Lexicon Shipping Agencies Pvt Ltd Tel. 229951-53 Fax. 229949/50
Hansraj Pragji & Sons Tel. 221650, 255228 Fax. 255228	Logistics Enterprise Pvt Ltd Tel. 255157, 255458 Fax. 255520
H K Dave Pvt Ltd Tel. 221504, 2333632 Fax. 230411	Mathuradas Narndas & Sons Forwards Pvt Ltd, Tel. 252224, 252350, 252115 Fax.252221
Intralink Clearing & Forwarding Tel. 255188 Fax. 23148	Magal Singh & Company Tel. 224030, 255253, 234688
J M Baxi & Co. Tel. 270630/35, 270148/50, 270525 Fax. 270616	Meridian Shipping Services Tel. 233981, 255362 Fax. 230701

Jesia Mistry Agencies Pvt Ltd Tel. 222317, 223317	Megha Shipping Agency Tel. 222671, 255304 Fax. 230937
Jaisu Shipping Company Pvt Ltd Tel. 270428, 270128/538 Fax.270556	Mayur Forwarders Pvt Ltd Tel. 222671, 255304 Fax. 230937
Jivanlal Laloobhai Tel. 220308, 230530 Fax. 231640, 233803	Maritime service Pvt Ltd Tel. 222671, 255304 Fax. 255304
Krishna Clearing Agency Tel. 223813, 230501 Fax. 233135	Marathon Shipping Combine Tel. 222202, 230106 Fax. 255220
Kiran Roadlines Tel. 232297, 231984, 234108 Fax.231422	Shiv Shipping Service Tel. 255568 Fax. 22256
Kandla Clearing Agency Pvt Ltd Tel. 232337, 223211, 223210 Fax.230402	Narendra Forwarders Pvt Ltd Tel. 232504, 231795 Fax. 256678
Kamat & Co. Tel. 223471, 232730, 232729 Fax. 255243, 270779	Natwar Parikh Industries Ltd Tel. 232628 Fax. 232628
K S Chaya & Co Tel. 256604 Fax. 230693	New Dholera Shipping & Trading Company Limited. Tel. 222637 Fax. 255329
Kashyap Shipping Ltd Tel. 220816 Fax. 230030	National Shipping Tel. 232319 Fax. 232319
Kanak Shipping & Transport Tel. 231314, 230543, 222059 Fax.221702	Navjeevan Enterprise Tel. 252611, 252360 Fax. 252515
IEE & Muirhead Pvt Ltd Tel. 231535/36 Fax. 231018.	N. G. Bhanushali & Company Tel. 233648, 256791 Fax. 256879
OTA Kandla Pvt Limited Tel. 220145, 223241, 270450 Fax.223241	Shivji Kanji & Company Tel. 230127, 223728, 223729 Fax.220308
Pravin Bhatt & Sons Tel. 224032, 230079 Fax. 230079	South India Corp. (Agencies) Limited Tel. 234646, 231494, 221276, 255209 Fax.234416
Prime Forwarders	S J Thacker & Company

Tel. 234047, 232505 Fax. 231345	Tel.255678,221745 Fax.230659
Purshotam Ramjee & Compnay Tel. 220354, 222287 Fax. 231754	Star Shipping Services Tel.255424,255425,235326(F)255426
Patel Handling Agency Tel. 221718, 224024, 231004, 270017 Fax. 231143	Shivani Shipping, Tel. & Fax.256836
P S Bedi & Company Tel. 223201, 222841 Fax. 255494	Sea Trans Shipping Agency Tel. 255564 Fax. 233228, 233517
Purshotam Chtrabhuj Thacker Tel. 222720	Seaster Shipping Services Tel. 255349 Fax. 232719
Prashant Shipping Tel. 255306, 223927 Fax. 223927	Seaway Shipping Services Tel. 234272 Fax. 232719
Pramukh Forwarders Tel. 255400 Fax. 232602	Star Clearing Agencies Tel. 230273, 255529, 222983 Fax.232719
P M Agency Pvt Ltd Tel. 232553, 233973, 236414 Fax.255413	S S Shipping Agencies Tel. 236605, 238283 Fax. 236605
Raj Shipping Servie Tel. 233948, 232402 Fax. 231395	SPN Shipping Services Tel. 222453, 270733 Fax. 236605
Rajesh Shipping Service Tel. 255444, 255450/52, Fax.255151	Sierra Shipping Pvt Limited Tel. 255395 Fax. 232771
Rudra Shipping Service Tel. 220429, 255317 Fax.255317	Sonal Enterprises Tel. 252666, 252053
Rishi Shipping Tel. 220813, 229830, 2555661/2/3 Fax. 238943, 255522 Mr. B K Mansukhani (M)9825225170	S R Clearing Agency Tel. 232974, 255494 Fax. 255494
Rudraksh Shipping Servie Tel. 235937 Fax. 255582	St. John Freight System Limited Tel. 235414, 236444 Fax.235414
Sanghvi Freight Forwarders Pvt Ltd	Siddi Shipping Services

Tel. 234993, 234995, 222401 Fax.230508	Tel. 232356, 230268 Fax.256712
Sri R K Shipping Pvt Ltd Tel. 232028, 231940, 231936 Fax. 232740	Spalsh Shipping Pvt Limited Tel. 255562, Fax. 220710
Shakti Enterprises Tel. 223531, 221591 Fax. 233898	Thakarshi Madhavji & Sons Tel. 255457, 255458 Fax. 221770
Shree Ambica Commercial Company Tel. 220213, 221253	Trinity Shipping & Allied Services Pvt Ltd Tel. 223703, 230911 Fax. 232060
Shri Maruti Shipping Services. Tel. 270760, 256853, 233245 Fax.220308	Tokto Shipping Services Tel. 234040
Unity Shipping Tel. 255271	Vinson Tel. 220466 Fax. 231948
Umiya Shipping Agency Tel. 255640 Fax. 233625	Vaz Forwarders Ltd Tel. 235317 Fax. 255221
Unique Forwarders Tel. 230080, 255417 Fax. 236131	Varsh Shipping & Travels Tel. 222386, 255300 Fax. 255300
V. Arjoon Tel. 221049, 221335, 222058, 223307 Fax. 234167	Venus Clearing Agency Tel. 233960 Fax. 233362
Velji Dosabhai & Sons Tel. 270220, 270025, 221818, 231423 Fax. 270164, 232363	Vishal Shipping & Handling Tel. 223960 Fax. 233362
Vishvajyoti Enterprises Tel. 252381, 252318 Fax. 253091	Worldwide Cargo Care Pvt Ltd Tel. 221290, 221479, 220307, 230217 Fax. 231913
Velji P & Sons Tel. 255327, 231545, 231546, 270976 Fax. 255328	Zenith Trade Link Tel. 223193 Fax. 255522
Vailash Transport Co. Tel. 233579, 223580	

ANNEXURE-XXVI**SURVEYORS AT KANDLA**

Adnuralty Marine Services Tel. 235412, 256813 Fax. 256813	Marine Consultants & Surveyors Pvt Ltd Tel. 255293 Fax. 234416
Capt. S. Kochar & co. Tel. 222247, 221084 Fax. 231357	Murray Fenton (India) Surveyors Limited Tel. 235960, 236238 Fax. 233335
Dr. Amin Superintendents & Surveyors Pvt Limited, Tel. 221520, 235636 Fax. 226527	M. M. Cargo Gear & Marine Surveyors Tel. 231385 Fax. 235255
Det Norske Veritas (DNV) Tel. 232712	M.B.S. Surveyors Tel. 256782
Geo-Chem Laboratories Pvt Limited Tel. 221841, 222179 Fax. 233743	Navark & Mareng Surveyors & Consultants Tel. 232123, 233270
G. P. Dave & Sons Tel. 234288 Fax. 234382	S.G.S. India Limited Tel. 221857, 238047, 231869 Fax.232883
Gupta & Associates Tel. 222542 Fax. 222542	S. K. S. Surveyors Assessors Tel. 220555
Inspectorate (India) Consulting Engineering Pvt Limited Tel. 221520, 235636 Fax. 255217	Seascan Surveyors Pvt Limited Tel. 221833, 233639, 221627 Fax. 233639
Indian Register of Shipping & Indian Register Quality System Tel. 238623, 233695 Fax. 233695	Sterling Surveyors Tel. 230216 Fax. 230216
Iteng Engineering Tel. 221520, 255429 Fax. 255247	Technomar Surveyors Pvt Limited Tel. 221966
J B Boda Surveyors Pvt Limited Tel. 231801, 231946 Fax. 231693	TCRC Surveyors Tel. 220862, 230050 Fax. 230050
Metcalfe Hodgkinsons Pvt Limited Tel. 220940, 221740, 233707, 221845 Fax. 231629	U. . Marine (India) surveyors

	Tel. 220070 Fax. 233228
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ANNEXURE – XXVII**LIST OF JOURNALISTS****PRINT MEDIA**

Sr. No.	Name of Newspaper	Correspondent & Address	Tel. No.	Fax
1	Kutchmitra Neewspaper	Mr. Adwait Anjaria Bureau Chief Gandhidham	222930	222930
2.	Kutch Uday,	Mr. Gangaram Bhanushali Editor, Plot.No.287, Sector- 1/A, Nr.Gayatri Mandir, Gandhidham	235851 231213 9825226987	231267 239887
3	Pandya News Agency	Mr. Jagdish Pandya, Main Bazaar, Gandhidham	220212 238112 238212	221412
4.	AAjkal	Mr. Nidhires Raval Bureau Chief Gandhidham	9825517030	229834
5.	Chanchal	Mr. Satish Upadhyay Bureau Chief, Shardha Appartment, Hinglaj Vadi,Bhuj	02832- 252942	02832- 252945
6.	Sandesh	Ms. Kulsumben Yusuf,	02832- 229200	255601

	Bhuj	Editor, Bhuj		228797
7.	Sandesh - Gandhidham	Mr. Jaydeep Purohit Bureau Chief Office No.: 108, Golden Point, Plot No. 31, Sector – 8, Gandhidham	222411	233211
	Sandesh Ahmedabad	Sandesh Sandesh Bhavan, Lad Society Road, Behind Vastrapur Gam, Ahmedabad-380015	079- 6762952, 6765480, 6765481, 6765482,	
8.	Gujarat Samachar Gandhidham	Mr. Awesh Malviya, B-ureau Chief, Gandhidham	9825425978	228222
	Gujarat Samachar Ahmedabad	Lok Prakashan Ltd. Gujarat Samachar Bhavan, Khanpur, AHMEDABAD	30410000	
9.	Jansatta – Loksatta	Ms Jayshreeben Mehta, Bureau Chief,Gim	9825225453 228797	---
10.	Indian Express Rajkot	216, Dhan Rajni Complex, Dr. Yagnik Road,Rakot	0281- 22481156	0281- 2481158
11.	The Times of India	Sterling Apartments,	9879324200	---

	Rajkot	1st floor, Jawahar Road, Rajkot – 360001	0281- 2226995 2227490	
	The Times of India Ahmedabad	SAKAR-1, 2nd Floor, Opp. Gandhigram Rly. Station, AHMEDABAD-380 009	079- 26554430, 26554431	079- 26587741 26554458
9.	DNA	Mr. D. V. Maheshwari Bureau Chief, Bhuj	02832- 251689	
10.	Mumbai Samachar, Chaupal	Mr. Tridev Vaidya Bureau Chief , Bhuj	02832- 231200	
11.	UNI	Mr. Mahesh Gadhvi Bureau Chief , Bhuj	9428294194	
12.	Exim Newsletter	Mr. P. G.,Nair, Bureau Chief Gandhidham	234194 9898573833	
13.	Daily Shipping Times	Mr. Haresh Manji Bureau Chief Gandhidham	222665 9925744679	
14.	Divya Bhaskar	Mr. Jayesh Shah Bureau Chief Gandhidham	9909944054	
15.	ETV	Mr. Rakesh Kotwal Bureau Chief Gandhidham	9909944080	
16.	Bhandarkar Shipping	Mr. Mehul Raval Bureau Chief Gandhidham	231455 / 9724307499	
17.	Hindustan Times, Ahmedabad	50, 5th Floor, Srikrishna Centre,	079- 6560049	079- 6560037

		Mithakali, Ahmedabad	6560061	
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PRINT MEDIA

18.	Mr. Kishore Ahir	Dy. Director	9427974892
19.	Shri Soni	Assistant Director	9879012714
20.	Mr. Shailesh Vyas	Chief News, All India Radio	9426802510

ANNEXURE-XXVIII**LIST OF FLEET OWNERS**

Sl. No.	Name of Company	Contact Person	Tel. Office	Tel. Resi.	Mobile
01	M/s A V Joshi & Company	Mr. Ramesh Singhvi Mr. Thacker MR. Harshandhu	231386 232605 233147	234176 221451 234325	98251 91325 98252 26105 98252 26013
02	M/s Rishi Shipping	Mr. B. K. Manshukhani Mr. Manoj Manshukhani	220843 229830 238943	234889 235587	98252 25170
03	M/s Maheshwari Handling Agency	Mr. C. P. Maheshwari Mr. Chandan Maheshwari	223228 230393	222339	98252 27111
04	M/s ABC	Mr. Latif Mr. Mithu Mr. Kasam	220483 221390 270190	234163 231477 251684	98252 26707
05	M/s Ganesh Transport	Mr. Hira Rabari Mr. Visa Rabari	223638 223915	260425	
06	M/s Kewar Carrier		220483 227553	234163	
07	M/s Krishna Transport Service	Mr. K. M. Thakker Mr. Pankaj Thacker	223814 224938	220998 234988	98250 19699 98252 25228
08	M/s Gautam Freight Ltd	Mr. Ramesh Singhvi	220163 230345	230328 234176	98251 91325

VTS GOK OFFICERS OF MASTER CONTROL CENTER (MCC) KANDLA

Sr. No.	Name	Designation	Mobile number
01	Shir B. Mishra	Deputy Director	7383576832
02	Shri Hansraj	Deputy Director	9428863924
03	Shri Mukesh Parmar	Asstt. Executive Engineer	9016106566
04	Shri M. Nimare	Asstt. Executive Engineer	9408553192

RADIO ACTIVE DISASTERS DOs AND DONTs

NUCLEAR EMERGENCIES - HOW TO RESPOND:

Nuclear facilities in India adopt internationally accepted guidelines for ensuring their safe operations and safety to the public and the environment. An independent regulatory authority oversees their safe operations. While the limits for radiation release/exposure have been set at a fraction of what can cause any significant harm, emergency procedures get implemented even when these very low limits are exceeded. As a result, it is extremely unlikely that the public near a nuclear facility will be exposed to any radiation beyond the permissible limits. However, to reassure the public, contingency plans are put in place even to handle such unlikely scenarios.

Keeping these facts in mind, if you still feel concerned on hearing any news or rumour about an incident at a nearby nuclear facility, follow these simple guidelines. These guidelines could also be followed in the event of any other nuclear emergency in your area, which does not even involve any nuclear facility.

- **DO THE FOLLOWING:**

1. Go indoors. Stay inside.

2. Switch on Radio/TV and look out for public announcements from your local authority.
3. Close doors/windows.
4. Cover all food, water and consume only such covered items.
5. If in the open, cover your face and body with a wet handkerchief, towel, dhoti or saree. Return home, change/remove clothes. Have a complete wash and use fresh clothing.
6. Extend full co-operation to local authorities and obey their instructions completely - be it for taking medication, evacuation, etc.

- **DO NOT DO THE FOLLOWING:**

1. Do not panic.
2. Do not believe in rumours passed on by word of mouth from one person to another.
3. Do not stay outside or go outside.
4. As far as possible, AVOID - water from open wells/ponds, exposed crops and vegetables, food, water or milk from outside.
5. Do not disobey any instruction of the District or Civil Defence Authorities who would be doing their best to ensure the safety of yourself, your family and your property.

AN OVERVIEW OF THE EMERGENCY RESPONSE PLANS IN THE DEPARTMENT OF ATOMIC ENERGY:

1. The Department of Atomic Energy (DAE) has been identified as the nodal agency in the country in respect of man made radiological emergencies in the public domain.
2. For this purpose, a Crisis Management Group (CMG) has been functioning since 1987 in DAE. In the event of any radiological or nuclear emergency in the public domain, the CMG is immediately activated and will co-ordinate between the local authority in the affected area and the National Crisis Management Committee (NCMC). The CMG comprises of senior officials drawn from various units of DAE like the Nuclear Power Corporation of India Ltd (NPCIL), Bhabha Atomic Research Centre (BARC), Heavy Water Board (HWB) and the Directorate of Purchase and Stores (DP&S). It also includes a senior official from the regulatory authority, the Atomic Energy Regulatory Board (AERB). Each member is backed by an alternate member, so that the CMG can be activated at a very short notice. Several Resource Agencies from BARC also backup the CMG. They can provide advice and assistance in the areas of radiation measurement and protection and medical assistance to radiation affected personnel.
3. As regards major nuclear facilities of DAE like the nuclear power stations, they have an Exclusion Zone of 1.6 km surrounding the power station in which no habitation is permitted. The entire area is fenced or walled off and defines the boundary of the site. Beyond this is the public domain and an area of 16 km radius around the plant site is called the Off Site Emergency Planning Zone (EPZ).
4. As a general practice, elaborate and comprehensive safety systems are in place for the operation of any nuclear facility. These are in turn overseen by the AERB who have powers to license and even shutdown any facility which violates their guidelines. However, as a matter of abundant caution, even some "beyond design basis" accidents are postulated for the nuclear power stations. It is only under such highly unlikely scenarios, that there is a possibility of a radiological emergency in the public domain. Therefore, in addition to the other types of emergency response plans in place within the facility to handle local emergencies, response plans have also been drawn up for handling such emergencies in the public domain, which are called as "Off Site Emergencies". These plans - drawn up separately in detail for each site - which are under the jurisdiction of the local District Administration, cover an area of about 16 km radius around the plant or the Off Site Emergency Planning Zone.
5. The first three types of Emergencies which are foreseen and for which detailed plant specific emergency response plans have been drawn up are Emergency Standby, Personnel Emergency and Plant Emergency. In all these, the consequences of the accident are expected to be limited to the plant facility only. The next type of Emergency which is foreseen is the Site Emergency, wherein the consequences of an accident are not expected to cross the site boundary, that is, the Exclusion Zone - which means that even under this condition, there is no radiological emergency in the public domain. The last type of Emergency which assumes the highly unlikely possibility of radiological releases in the public domain is the "Off Site Emergency" and detailed response plans have been drawn up even for this hypothetical scenario at each site. **The local District Administration, the Crisis Management**

Group, DAE and the National Crisis Management Committee (NCMC) get involved in this last type of Emergency.

6. It is mandatory for NPCIL to have comprehensive and well laid out plans to deal with all the above types of Emergencies. Barring the last one, all the others fall within the domain of responsibility of NPCIL, and the AERB as the Regulatory Authority approves these plans. It is also mandatory for the NPCIL to periodically test out these plans by way of Exercises and Drills and take corrective measures as stipulated by the Safety Committees and AERB. As the first stage of the trigger mechanism, the Crisis Management Group, DAE and its resource agencies are automatically alerted even when a Plant or Site Emergency/Exercise takes place.
7. In accordance with statutory requirements, it is the local District Administration which is responsible for drawing up and testing the Off Site Emergency Plans. NPCIL has co-ordinated with all concerned District Administration to enable them to draw up comprehensive Off Site Emergency Plans for each power station. It may be mentioned that the AERB does not permit any nuclear power station to be commissioned unless and until, such plans for all types of Emergencies are in place well before the commissioning date.
8. The Off Site Emergency Plans are also periodically tested and all power stations have ensured that this is being done atleast once in about two years. During these exercises, all the Members and Alternate Members of the Crisis Management Group, DAE, the Resource Agencies and Key Officials in Mumbai and Delhi are alerted. In these Exercises, the district administration is fully involved and the reports of the independent observers (from AERB, NPCIL and CMG) are used as a feedback to further improve the Emergency Response System.
9. Recognising the importance of communications in the handling of any Emergency, **Emergency Control Rooms (ECRs) are maintained at Mumbai at two different locations. These manned and operated on a round-the-clock and on all days of the year and maintain continuous contact with all the critical facilities of DAE.** The ECRs are equipped with Wireless, Telephone, Facsimile, VSAT and Electronic Mail facilities. These are tested practically on a daily basis to ensure their continuous availability. Further, each major site also carries out fortnightly or monthly communication exercises to test all the links in the entire communication chain.
10. In addition to about 165 communication exercises, about 110 emergency exercises are carried out every year. During the period from 1987 to 2000, 34 Off Site Emergency exercises have been conducted by the respective district administrations at various locations in the country. These involve direct participation by local district officials like police, health, transport, etc. At the end of each of these exercises, the District Collector/Magistrate chairs a "critique or feedback" session at which the deficiencies are recorded for taking corrective actions.
11. As regards transport of nuclear material, mandatory design specifications for the packaging, systems and procedures for handling and transport are in place to ensure that there is no release of radioactivity in the public domain in the unlikely event of such an accident. However, even if such an event were to occur, the procedures are such that the Emergency Control Room at the DAE Secretariat gets an alert which in turn would immediately activate the Crisis Management Group, DAE.
12. In the event of any other type of nuclear emergency in the public domain arising from the unauthorized presence or suspected presence of nuclear materials, a booklet giving the essential guidelines to be followed has been circulated to State Governments and Union Territories. Among other steps, the guidelines require that the nearest listed DAE facility as well as the DAE Emergency Control Room be also contacted immediately, who would then advise on the further necessary steps to be taken to attend to the emergency.

This short write up is primarily meant to educate the public and instill confidence about the Emergency Response System of DAE to handle radiation emergencies. As regards nuclear facilities of DAE, the regulatory and safety systems ensure that equipment are designed to operate safely and even in the unlikely event of any failure or accident, mechanisms like plant and site emergency response plans are in place to ensure that the public is not affected in any manner. In addition, detailed plans which involve the local public authorities, are also in place to respond if the consequences were to spill into the public domain. The System is also in a position to respond to any other radiation emergency in the public domain that may occur at locations which do not even have any DAE facility.

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Annexure E

Oil Spill Contingency Plan

15/11 Annexure-H

MEMORANDUM OF UNDERSTANDING

BETWEEN

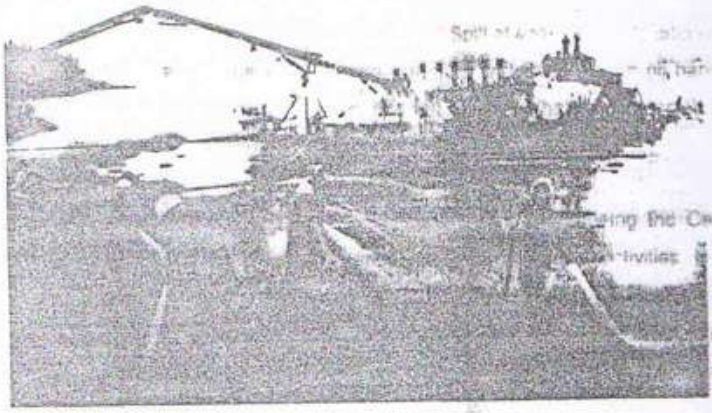
KANDLA PORT TRUST

AND

OIL COMPANIES

ON

SETTING UP OF TIER-I FACILITY FOR COMBATING OIL SPILL AT KANDLA



THE MEMORANDUM OF UNDERSTANDING
AMONGST KPT, BPCL, IOCL, HPCL
ON SETTING UP OF TIER-I FACILITY
FOR COMBATING OIL SPILL AT KANDLA

This Memorandum of Understanding made on this 14th day of June 2011 amongst -

1. Kandla Port Trust having its administrative office at Gandhidham, Kutch District, Gujarat State (hereinafter referred to as KPT),
2. Bharat Petroleum Corporation Limited having its registered office at Bharat Bhavan, 4&6 Currimbhoy Road, Ballard Estate, Mumbai - 400 001 (hereinafter referred to as BPCL),
3. Indian Oil Corporation Limited having its registered office at G-9, Aliyavar Jung Marg, Bandra (East), Mumbai (hereinafter referred to as IOCL),
4. Hindustan Petroleum Corporation Limited having its registered office at 17-Jamshedji Tata Road, Mumbai - 400 020 (hereinafter referred to as HPCL),

BPCL, IOCL and HPCL are hereinafter collectively referred to as Oil Companies wherever the context so requires. KPT and Oil Companies are hereafter collectively referred as parties whenever the context so requires.

WHEREAS in recent times the risk of Oil Spill at various Port locations has gone up rapidly due to increased quantum and frequency in oil handling and recognizing the importance, it is felt essential that oil companies shall participate in the efforts to combat oil spill.

AND WHEREAS the Director General, Coast Guard being the Central Coordinating Authority for marine oil spill response activities in the maritime zones in India has prepared and published the National Oil Spill Disaster Contingency Plan (NOSDCP) to combat oil spill, which delineates the duties and responsibilities of each participating agency. To meet the

Prabhakar
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B.P.C.

HG
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(T.M.A.H.)

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requirement of providing a Tier-I facility to combat oil spill at Kandla, based on the discussions held at various levels amongst KPT and Oil companies operating at Kandla, the parties herein agree to deduce the same into writing by this Memorandum of Understanding (MOU)

NOW, THEREFORE, THE PARTIES HEREIN MUTUALLY AGREE AND WITNESSETH AS FOLLOWS:

1.0 Objective

The objective of this MOU is to strengthen the Oil spill combating Tier-I facilities available at Kandla so as to meet the requirements as mentioned above

2.0 Scheme for setting up of Tier-I facility for combating oil spill

2.1 KPT and Oil Companies hereto have mutually agreed to and shall participate in this scheme for combating the oil spill as mentioned herein.

2.2 Oil Companies jointly agree to make an one time payment of Rs. 500 lakhs (Rupees Five Hundred Lakhs) to KPT and KPT agrees for setting up of Tier-I facilities at Oil Spill Response Centre (OSRC) at Kandla by December 2011. Thereafter, KPT shall develop, operate and maintain these facilities to combat oil spill as required in 1.0 above.

KPT further agrees that the above mentioned payment of Rs. 500 lakhs will only be used for setting up of Tier-I facilities for combating oil spill. Further, Oil Companies shall not be asked for any payments towards purchase of equipments under Tier-II/III facilities. The Oil Companies shall not be responsible for the maintenance of these

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facilities and day to day operating and maintenance costs shall be borne by KPT only

The payment by Oil Companies to KPT will be proportionate to the throughput of each Oil Company as mentioned in 2.3. The amount of Rs. 500 lakhs is based on the estimates as per the enclosed list of equipment. However, the overall payment shall be made based on actual progressive expenditure.

- 2.3 Oil Companies agree that the payment to be made by individual oil company to KPT shall be shared amongst them, on the basis of the volume of the oil handled by the Oil Companies during 2009-10, in the following manner :

Oil Co.	Volume Handled (in MTs) during 2009-10	% Share
IOCL	2017761	77.33
HPCL	291796	11.18
BPCL	299704	11.49
TOTAL	2609261	100.00

The payments by the Oil Companies to KPT shall be made as per the advice of the KPT which will be based on actual expenditure with details of accounts as certified by KPT and Oil Companies shall have access to such documents.

- 2.4 KPT will provide the necessary dedicated sea worthy vessel for installing all the OSRC equipment and it will be kept ready for efficient OSRC activities.

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KPT shall be responsible for taking necessary statutory and other approvals for operation, maintenance and purchase of equipments/facilities and for other obligations as per this MOU. All approvals (tendering process etc.) shall be carried out by KPT.

- 2.5. A separate fund (sinking fund) for expenses for operations, maintenance and replacement of equipments (oil spill combat equipments) including insurance cover of the same, would be created by KPT. The co-ordination/monitoring committee shall monitor the fund management.

In order to implement the model and make it self-sustainable for timely maintenance and replacement of equipments as and when required, KPT to approach TAMP for levying some kind of fee/surcharge on all vessels berthed at Kandla Port, other than participating Oil Companies

All the ships coming to Kandla Port carry POL as bunker fuel and hence tariff for each vessel to be finalized by KPT and the fund to be put in the sinking fund. The tariff will be 'nil' for participating companies.

- 2.6. Some other private companies may be rare users of Port facilities in handling and their volumes of hydro carbons are less. However, if they cause any pollution, they will be charged by KPT for recovery of the oil spill, apart from the other statutory fines. Further, if participating Oil Companies cause any leak/ pollution, no recoveries of any expenses or penalties shall be levied against them.

As regards recovery from non-participating port users identified as the polluter, KPT shall issue a public notice to bring to their knowledge about the recovery of expenditure @ 300 % of actual plus

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supervision and overhead charges (@7 %) towards combating oil spill from non-participating port users identified by KPT as the

polluter. KPT shall co-ordinate for such recovery from the polluter who are non-participating port users. The amount so recovered shall be ploughed back to meet the normal operation & maintenance and manning & crewing of OSRC set up.

For any new entrant, proportionate sharing of costs shall be recovered by KPT. This amount will be part of the sinking fund and available to the Co-ordination committee for appropriate use.

2.7 KPT shall make use of the expertise of the Coast Guard while preparing the specifications of the oil spill combating facilities.

2.8 KPT shall be obliged to provide accounts of expenditures and allow access to such documents as may be asked by Oil Companies and also shall provide necessary documents to Oil Companies to claim rebate on income tax/service tax, as applicable.

3.0 Oil Spill Contingency Plan

KPT has prepared its action plan for setting up the oil spill combating facilities along with target dates, in consultation with Oil Companies.

This plan shall be updated every year. The Action Plan, attached hereto, shall form a part of the MoU. As per the action plan, the oil spill combating facilities shall be fully functional by December 2011. KPT shall maintain and operate these facilities as per the norms prescribed by Original Equipment Manufacturers (OEMs), the Coast Guard, statutory bodies, and Government agencies. KPT shall also

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keep proper record and Oil Companies shall in no way be held responsible for the same.

4.0 Geographical coverage

KPT shall normally operate the oil spill combating facilities within the limits of the Kandla Port. However, KPT will extend the said facilities beyond the limits of Kandla Port, on specific requests from Oil Companies and other Government agencies, on mutually agreeable terms.

5.0 Mock Drill

KPT shall organize at least one mock drill every six months. The date of the mock drill will be communicated to the Coast Guard and Oil Companies well in advance. The Oil Spill Contingency Plan will be modified and updated, if required, to take care of the observations made during the mock drill.

6.0 Co-ordination Committee

For effective coordination and smooth working of the Plan, a Committee, with representative of KPT as Chairman, and representative of the Coast Guard and Oil Companies as Members will be formed to monitor the functioning of the oil spill combating facilities. The decision may be considered to be taken by majority of member committee. The committee shall meet as and when required, but at least four meetings shall be held in a year (one in each quarter).

The committee shall oversee the following :

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W. J.
B. J.

H. J.
14/6/11

14/6/11

- a. Cash flow requirement This will be based on the actual expenses towards procurement of equipment (inclusive of all taxes). This will be based on the PO placed by KPT.
- b. Progress Review Every quarter the progress shall be reviewed and the Committee shall advise on the adequate funds required for next quarter or six months, so as to ensure smooth execution of all activities.

7.0 Notices

All notices, requests, demands and other communications required or provided for under this MoU shall be forwarded to the following respective addresses of the parties hereto :

- 1. The Deputy Conservator,
Kandla Port Trust, Admin Office
Gandhidham - (Dist-Kutchh)
- 2. Senior Manager Operations (Retail),
Bharat Petroleum Corporation Ltd.,
Khari Rohar Road,
Kandla (Dist. Kutchh)
- 3. Senior Installation Manager,
Hindustan Petroleum Corporation Ltd.,
Khari Rohar Road,
Kandla (Dist. Kutchh)
- 4. Sr Terminal Manager,
Indian Oil Corporation Ltd.,
Fore Shore Terminal, K K Road,
Kandla (Dist. Kutchh)

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H/G
hulb

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5. Sr Terminal Manager,
Indian Oil Corporation Ltd.,
Main Terminal,
Kharirohar Road,
Kandla (Dist. Kutchh)

8.0 General

- 8.1 This MoU supersedes all provisions or undertakings arrived at between all the parties herein regarding the subject of these presents, whether in writings or otherwise prior to the date of execution of these presents.
- 8.2 This MoU shall not be amended, varied or modified in any manner except by an instrument in writing and signed by all the parties herein.
- 8.3 Any dispute or difference of any nature whatsoever between any of the parties hereto arising out of or in relation to this MOU shall be referred to the sole Arbitration as detailed in the Arbitration Clause in the Annexure attached hereto.
- 8.4 This MoU shall be made in five copies and each party to the MoU shall have one copy each.
- 8.5 To ensure the compliance by the non-participating Port users, KPT shall issue a Public Notice, which shall be binding on the non-participating users at the time of the incidence

B. Ramani
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B. G.

K. G.
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IN WITNESS WHEREOF THE PARTIES HERETO HAVE SET THEIR HANDS, SIGNED AND DELIVERED THIS M.O.U ON THE DATE ABOVE WRITTEN.

[Signature]
14/6/11
KPT
Dy. Conservator
CAPT H. K. SIBAL

[Signature]
14.06.11
BPCL
Sr Manager Operations (R) Kandla
(R. G. DEKATE)

[Signature]
14/6/11
IOCL
Sr Terminal Manager, FST, Kandla (B-ROUT)

[Signature]
14/6/11
IOCL
Sr Terminal Manager, Main, Kandla
D.V. SARANGIA

[Signature]
14/6/11
BPCL
Sr Installation Manager, Kandla
(J.M. NAJK)

ARBITRATION CLAUSE

(a) Any dispute or difference of any nature whatsoever any claim, counter-claim or set off of the _____ against the _____ regarding any right, liability, act, omission or account of any of the parties hereto arising out of or in relation to this MOU shall be referred to the sole Arbitration of the Director(Marketing) of _____ Oil Company or of some officer of the Oil Company who may be nominated by the Director (Marketing). The _____ will not be entitled to raise any objection to any such arbitrator on the ground that the arbitrator is an officer of the Oil Company or that he has dealt with the matters to which the contract relates or that in the course of his duties as an officer of the Oil Company he had expressed views on and/or any other matters in dispute or difference. In the event of the arbitrator to whom the matter is originally referred being transferred or vacating his office or being unable to act for any reason, the Director(Marketing) as aforesaid at the time of such transfer, vocation of office or inability to act may in the discretion of the Director(Marketing) designate another person to act as arbitrator in accordance with the terms of the MOU to the end and intent that the original arbitrator shall be entitled to continue the arbitration proceedings notwithstanding his transfer or vacation of office as an officer of Oil Company if the director (Marketing) does not designate another person to act as arbitrator on such transfer, vacation of office or inability of original arbitrator. Such persons shall be entitled to proceed with the reference from the point at which it was left by his predecessor. It is also a term of this contract that no person other than the director (Marketing) or a person nominated by such Director (marketing) of Oil Company as aforesaid shall act as arbitrator hereunder. The award of the arbitrator so appointed shall be final conclusive and binding on all parties to the MOU subject to the provisions of the Arbitration Act, 1996 or any statutory modification or re-enactment thereof and the rules made thereunder for the time being in force shall apply to the arbitration proceedings under this clause.

(b) The award shall be made in writing and published by the arbitrator within two years after entering upon the reference or within such extended time not exceeding further twelve months as the sole arbitrator shall by a writing under his own hands appoint. The parties hereto shall be deemed to have irrevocably given their consent to the arbitrator to make and publish the award within the period referred to hereinabove and shall not be entitled to raise any objection or protest thereto under any circumstances whatsoever.

(c) The arbitrator shall have power to order and direct either of the parties to abide by, observe and perform all such directions as the arbitrator may think fit having regard to the matters in difference i.e. dispute before him. The arbitrator shall have all summary powers and may take such evidence oral and/or documentary, as the arbitrator in his absolute discretion thinks fit and shall be entitled to exercise all powers under the Indian Arbitration Act, 1996 including admission of any affidavit as evidence concerning the matter in difference i.e. dispute before him.

P. S. Narain
14/6/11

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B. S.

H. S.
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(d) The parties against whom the arbitration proceedings have been initiated, that is to say, the respondents in the proceeding, shall be entitled to prefer a cross-claim or set off before the arbitrator in respect of any matter in issue arising out of or in relation to MOU without seeking a formal reference of arbitration to the Director (Marketing) for such counter-claim, cross-claim, or set off and the arbitrator shall be entitled to consider and deal with the same as if the matters arising therefrom has been referred to him originally and deemed to form part of the reference made by the Director(Marketing).

(e) The arbitrator shall be at liberty to appoint, if necessary any accountant or engineering or other technical person to assist him, and to act by the opinion so taken.

(f) The arbitrator shall have power to make one or more awards whether interim or otherwise in respect of the dispute and difference and in particular will be entitled to make separate awards in respect of claims or cross-claims of the parties.

(g) The arbitrator shall be entitled to direct any one of the parties to pay the costs of the other party in such manner and to such extent as the arbitrator may in his discretion determine and shall also be entitled to require one or both the parties to deposit funds in such proportion to meet the arbitrators expenses whenever called upon to do so.

The parties hereby agree that the courts in the city of Gandhidham alone shall have jurisdiction to entertain any application or other proceedings in respect of anything arising under this MOU and any award or awards made by the sole arbitrator hereunder shall be filled in the concerned courts in the city of Gandhidham only.

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[Signature] 14/6/11
KPT
Dy. Conservator
CAPT. H-K-SIBAL

[Signature] 14.06.11
BPCL
Sr Manager Operations (R) Kandla
(R. G. DEKATE)

[Signature] 14/6/11
IOCL
Sr Terminal Manager, FST, Kandla
(B. ROUJ)

[Signature] 14/6/11
IOCL
Sr Terminal Manager, Main, Kandla
D.V. SARANGLA

[Signature] 14/6/11
HPCL
Sr Installation Manager, Kandla
(J.M. NATK)

KANDLA PORT TRUST

Annexure - H

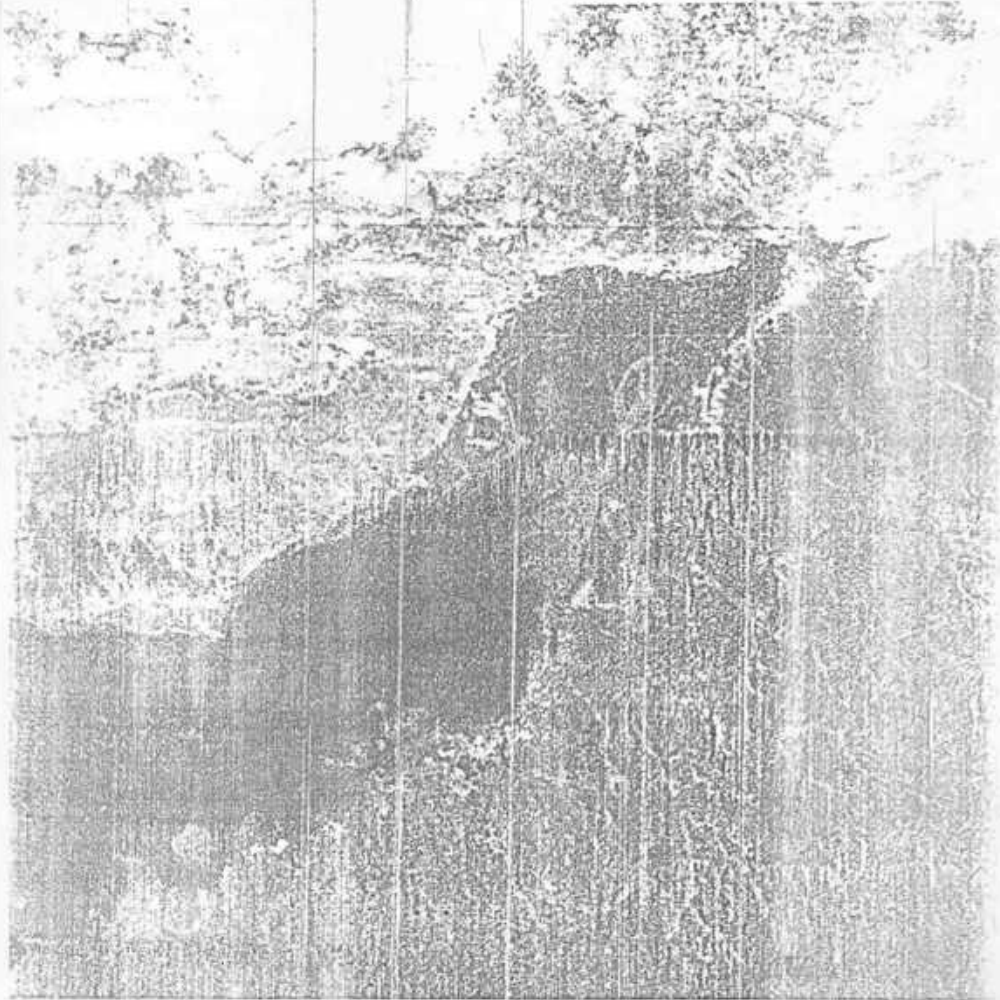
LOCAL OIL SPILL - DISASTER CONTINGENCY PLAN.

(KPT - LOS - DCP)

AUGUST 2000

MARINE DEPARTMENT, KANDLA PORT TRUST, P O BOX - 60, GANDHIDHAM, KUTCH, GUJARAT - 370 240.
Tel: 02836-20235, FAX: 02836-36982, SATELLITE PHONE: 00 973 762092 777.

KANDLA PORT TRUST
LOCAL OIL SPILL - DISASTER CONTINGENCY PLAN.
(KPT - LOS - DCP)



AUGUST 2000

MARINE DEPARTMENT, KANDLA PORT TRUST, P O BOX - 50, GANDHIDHAM, KUTCH, GUJARAT - 370 510.
Tel: 02836-20258, FAX: 02836-25882, SATELLITE PHONE: 91 873 762092 777.

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- 3 Existing oil spill response system at Kandla port
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 - ~~3.3 Communication systems~~
 - 3.4³ Oil spill response equipment and accomplishments
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- V. Oil Spill Report Form
- VI. POLREP Message Format

KANDLA PORT TRUST
LOCAL OIL SPILL – DISASTER CONTINGENCY PLAN,
(LOS-DCP)

INTRODUCTION

The Indian Coast Guard (ICG) has been designated as the nodal agency to deal with all contingencies associated with OIL SPILL DISASTERS in the coastal and marine environs of the Nation. The ICG in this regard had prepared a NATIONAL OIL SPILL – DISASTER CONTINGENCY PLAN popularly known as the NOS-DCP. The NOS-DCP identifies the Major Ports as among the RESOURCE AGENCIES of ICG. Further the plan details co-ordination procedures for the resource agencies to inter act with the nodal agency.

Under the guidelines of the NOS-DCP it is obligatory for the resource agencies to develop a local oil spill disaster contingency plan and link it up with the NOS-DCP. This plan is an effort of KANDLA PORT TRUST to link up its updated LOS-DCP with the NOS-DCP.

Kandla Port is located towards the extreme eastern margin of the GULF OF KUTCH (GOK). Ships calling at Kandla port therefore have to traverse across the GOK, which had been identified as a highly sensitive coastal zone of the maritime state of GUJARAT, owing to the rich bio-diversity persisting all along its southern coast line. The GOK is also significant in maritime culture with the existence of three port complexes viz. KANDLA – VADINAR Major port complex, RELAINCE PETRO-CHEMICALS Ltd.- Marine Terminal complex and the up coming GUJARAT ADANI PORT Ltd. complex. In view of the above ships plying in the GOK and the maritime community associated with them are required to exercise utmost caution particularly with regard to prevention of oil pollution by ships.

KPT - LOS - DCP, jurisdiction and description of the plan area

The plan jurisdiction encompasses the Port limits in general. Fig.1 illustrates the Port limits as defined by the Govt. of India Notification no: 255(E), published in the gazette of India, part II section 5, subsection (1) dated 1st May 1975.



2.1 Oil Spill threat Perception

Oil spill can be broadly categorized into three categories depending upon the volume and area of oil spill, which has taken place. These three categories of oil spill are generally classified as Tier 1, 2 & 3 and each tier will require response strategies suitable to magnitude and manifestations as mentioned below:

Tier - 1: This would be a spill of a magnitude the local resources could respond to, successfully without assistance from other agencies.

Tier - 2: This would be a spill of a magnitude that would outstrip the local resources & would require assistance on a regional basis. This would either come from local/central Government or local Industries Mutual Aid arrangement.

Tier - 3: This would be a spill of a magnitude that would surpass the capabilities of tier one and tier-2. Additional resources would be required on a national and international level.

Tier level	Volume
One	<10 m ³
Two	10m ³ -- 100m ³
Three	>100m ³

The Oil spill threat perception in Kandla Port has taken into consideration various Port facilities, type of port operations in conjunction with local conditions and record of recurrences of oil spill events. A review of the above aspects reveals the following points :-

- ❖ SBM operations at Vadinar are susceptible for probable oil spills.
- ❖ In the entire history of Kandla port, there had been no record of Tier 2 & 3 level oil spills. However, minor occurrence of tier level-1, oil spills are on record. Oil spill on 31st May 1998, which occurred due to failure of submarine hose which, resulted in oil spill of 2000 litres of Bombay High Crude while the second event of oil spill was noticed during the aftermath period of Cyclone of June 1998. The spill was of minor nature and the source of spill was from a badly damaged and grounded ship, which was subsequently salvaged and was berthed, in a cold move. The third occurrence of the oil spill of an uncertain source was established during November 1999. The quantity of oil spilled was also undetermined. This oil spill was established based on the evidences observed on the shoreline in the vicinity of Vadinar.
- ❖ The mitigative action taken in the above accidents was deployment of dispersant chemicals.
- ❖ Owing to the local conditions, any occurrence of the oil spill in the plan area are likely to spread and travel faster, thereby bringing down the available response time to very short duration.
- ❖ Owing to the short duration of the response time available, the danger of oil spill striking the coastline at Vadinar is highly probable.
- ❖ The existence of Coral reefs in the vicinity of Vadinar Port area sensitizes port operations at Vadinar.
- ❖ Use of chemical dispersants, deployment of offshore oil spill containment booms and complimentary skimmers are strongly recommended for SBM operations at Vadinar.
- ❖ The above mentioned oil spill response equipment needs to be kept in readiness at all times.
- ❖ The threat perception in the Kandla scenario is not as much as at Vadinar owing to the decline in POL traffic at Kandla.

In view of above the plan area is classified in to the following zones in the order of importance based on oil spill threat perception:

OIL SPILL THREAT PERCEPTION ZONE	APPROPRIATE OIL SPILL RESPONSE SYSTEM SUGGESTED IN ORDER OF PERFERENCE
Vadinar SBM operational area	Immediate deployment of containment boom system, followed by skimming by MV Sagarika and in the event of inclement weather attempt use of chemical dispersents.
Vadinar Anchorage	Immediate deployment of containment boom system, followed by skimming by MV Sagarika and in the event of inclement weather attempt use of chemical dispersents.
Old Kandla Oil Jetty complex	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispersents.
Vadinar port craft jetty	Press in MV Sagarika for skimming, secondly attempt spraying chemical dispersents to disperse the oil slick.
New Kandla general cargo berths and harbor area	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispersents.
Kandla creek including inner anchorage and moorings	Press in MV Karishma for skimming in case of inclement weather, attempt spraying chemical dispersents.
Kandla outer anchorage (OTB area)	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispersents.
Kandla creek system and area within Port limits other than the above.	Press in MV Karishma for skimming in case of inclement weather attempt spraying chemical dispersents.

2.2 Port facilities

Within the Plan area, the following operational port facilities exist:

KANDLA

- Five 'T' shaped Oil Jetties for handling liquid cargo inclusive of one jetty, which is equipped with LPG handling facilities.
- One Steel Floating Dry Dock for dry docking Port crafts.

- 8
- ❖ A Rectangular shape basin for handling barges
 - ❖ A 90 m. long "L" shaped Berthing Jetty for the use of Port crafts.
 - ❖ 2080 m. long wharf to accommodate 10 to 12 ships in a straight line for handling general cargoes.
 - ❖ Three pre-designated Inner Anchorage points and three mid stream anchorage points.
 - ❖ Shipping tugs, Harbor tugs, Mooring Crafts, General Service launches, Fire Boat, Pilot launches, Buoy laying dumb barge and one Survey Launch equipped with modern automated hydrographic equipment.
 - ❖ One Buoy laying dumb barge equipped with 20 tonne winch.
 - ❖ Two units of land based Fire Brigade System (One located at Oil Jetties Complex and another within the General Cargo Berths complex).
 - ❖ One Multi-purpose anti pollution vessel.
 - ❖ One Tank lorry to receive oily waste from ships along side berths.

VADINAR

- ❖ Two Single Buoy Moorings (SBM) installed at a depth of 33 mtrs. Off Salaiya Creek at Vadinar. The two SBMs are inter-connected with submarine pipeline, which ultimately leads to the tank farms located on the Narara bet.
- ❖ Two Nos. Pull Back / Shipping Tugs.
- ❖ Two Nos. Mooring tenders and a harbor tug.
- ❖ One Multi-purpose Anti pollution vessel.

In addition to the above mentioned Port facilities, well developed infrastructural facilities such as adequate power supply units, adequate water supply units, residential complexes, sewage & drainage system and rail and road net work also exist. While at Vadinar, the Crude Oil discharge facilities is directly connected by inter state across the country pipeline from the IOC tank terminal at Narara bet to Koyali, Mathura and Panipat Refineries with branching at Viramgam and Mathura.

2.3 Port activities

The significant Port activities with particular reference to vulnerability to probable oil spills are as follows:-

Vadinar -

- Waiting of ships at Outer Anchorage at Vadinar
- Crude Oil discharge operations from SBM No.1 & 2 at Vadinar.
- Port craft maintenance operations at Vadinar Port Craft Jetty.
- Ships running aground due to loss of engine control or ^{accident} Weather
- Ship to ship collision due to engine control failure or poor visibility associated with malfunctioning of navigational aids like Radar/ARPA system.

Kandla -

- Waiting of ships at outer anchorage at Kandla.
- Discharge of liquid chemicals and POL through pipelines from Old Kandla Oil Jetty complex to various tank farm complexes belonging to PSU Oil Companies and private sector liquid chemical storage complexes.

- Loading and discharge of dry bulk/break bulk cargoes at the General Cargo Berths.
- Maintenance operations of Port crafts at Steel Floating Dry Dock and at the Port craft Berthing Jetty.
- Ships running aground due to loss of engine control or inclement weather.
- Ship to ship collision due to engine control failure or poor visibility associated with malfunctioning of navigational aids like Radar/ARPA system.

2.4 Local environmental conditions

The local environmental conditions at Kandla Port attract significant consideration with respect to Oil spill prevention, response and mitigation activities owing to the mega tidal domain and the meteorological parameters. In the event of any oil spill, the slick dimensions and the direction of its progradation are dependent on sea surface winds and surface currents. In order to make onsite assessment, the meteorological data recorded at Kandla Observatory is placed at Annexure-I.

Tides and currents – Consequent to the large tidal range, the Port experiences high magnitude tide currents both during ebb and flow (of the order of 3.0 to 3.6 meters per second). Annexure-II illustrates detailed information of tide levels and tidal streams observed at Kandla and Vadinar.

Waves – Kandla Port area being located on the West Bank of Kandla creek which, emerges from the extreme eastern margin of the Gulf of Kutch is well protected from wave action. The significant wave height measures 2.20 mtrs. However, occasionally due to prevailing winds, wind generated waves and associated swells can reach maximum height of 3.5 mtrs.

Wind – The plan area experiences predominantly WSW winds for over 6 months in the year and NE winds are experienced during October to December. The WSW winds tend to push the berthed vessels away from the berths whereas the NE winds tend to push the vessels on to the berth thereby causing probable damages to the ship's side or the port structure.

Turbidity – Due to very high background value of SPM, the waters of Kandla are turbid round the year. Presence of SPM in the creek water enables any event of oil spill to coagulate faster and act as a natural dispersant. This aspect protects the Kandla creek system from ecological perturbation naturally.

Rainfall – Precipitation in the region of plan area is generally categorized under "Scanty rain fall". The major source of rainfall for this region is from the residual southwesterly monsoon clouds. The average rain fall in the region measures 400 mm. Per annum.

3. Existing Oil Spill Contingency System at Kandla Port

3.1 Communication system and Reporting procedures -

Communication System

Kandla Port Trust had established 3 Emergency Response Centres (ERC) which are equipped with a state of art Communication systems. These are located at Administrative Office Building at Gandhidham, Port & Customs Building at Kandla and at Vadinar Port Office. The three ERCs are provided with uninterrupted power supply and are designed for round the clock and round the year operations. The communication system installed in these units include the following:-

- VHF communication system
- P & T Telephones
- Fax facility
- Intercom connection
- Planet - 1 satellite telephone system
- Multi-media P.C. with Internet
- UHF communication system
- Mobile phone (to the officers In-charge of the ERC units & above.)

In addition to the above mentioned communication systems, the Kandla ERC is equipped with Cyclone Warning Dissemination System (CWDS) of IMD. Xerox, transistor Radio and television sets are also provided at all the three ERCs. Details of the above mentioned communication system together with the contact numbers of the resource personnel of the OSRT is placed at Annexure-III & IV.

Reporting procedures

The port operational areas are extensively traversed by Port crew henceforth, the field staff and officers particularly Pilots, Tug Masters and Marine Engineers are instructed to report any occurrence of oil spill to nearest ERC in the format shown at Annexure-V. The ERC in turn, convey particulars of oil spill event to the Oil Spill Response Team (OSRT), which immediately attempt to reach the site of spill occurrence and commence response and mitigative action. The response activities basically include :-

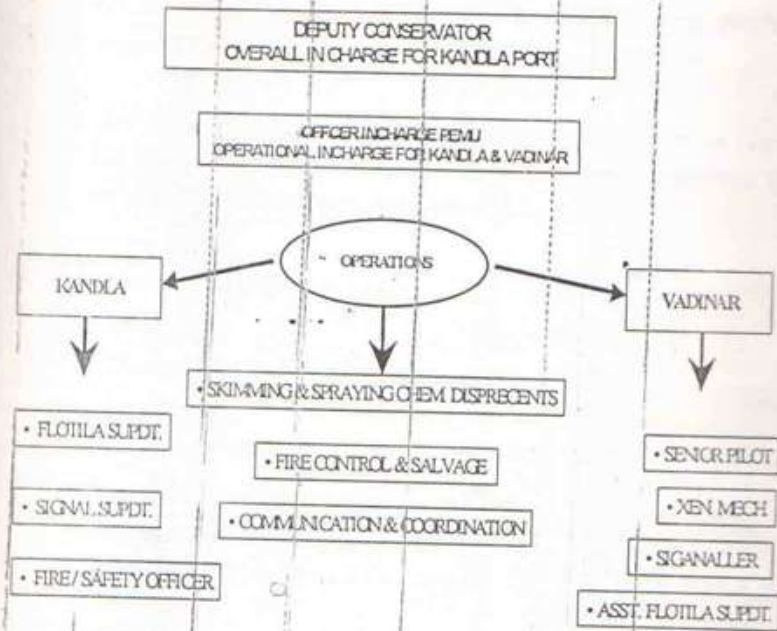
- Detecting the spill and establishment of its current location
- Estimation of the extent and assessment of the oil spill in terms of quantity
- Assessment of the probable direction of slick's progradation
- Selection of appropriate interception mechanism/ mitigative measures.
- Mobilization of resources and execution of actual cleanup operation
- Investigation and report generation.

The OSRT, on reaching the site, shall commence their response activities with the preparation of standard POLREP message in the format placed at Annexure-VI.

3.2 Oil Spill Response Team set up

The overall In-charge of the Oil Spill Response Team is Dy. Conservator and the operational In-charge of Response Team is lead by the Director of Port Environment Management Unit. The Oil Spill Response Team is an inter divisional unit of Marine Department, drawn from trained personnel of Fleet Maintenance Section, Fire Brigade and Environmental Management Unit, coordinated by the Director, Port Environment Management Unit. The organogram is as under :-

OIL SPILL RESPONSE ORGANISATION STRUCTURE



3.3 Oil Spill Response Equipment & Accomplishments

- ❖ Standing stock of 5000 liters of chemical dispersants approved by the NIO/ZSI (separate inventories for Vadinar and Kandla are maintained). Adequate inventories are also maintained on Board Agni Shanti, Anti Pollution Vessels – Karishma at Kandla and Sagarika at Vadinar.
- ❖ MV SAGARIKA and MV KARISHMA are Oil & floating debris recovery vessels fitted with skimmer and dispersant spraying booms.
- ❖ Two Oil-cum-Debris recovery vessels namely MV Sagarika (Vadinar) and MV Karishma (Kandla) with the following systems/capabilities for oil spill recovery operations and floating garbage collection:
 - Speed in picking up oil spill - 0 – 2 knots
 - Slope tank - 25 m³
 - Dispersant tank - 1.0 m³
 - Oil skimmer - 30 m³
 - Capacity of Oil Recovery - 30 t/hrs.
 - Capacity of garbage recovery - 1.0m³/hrs.
 - Garbage tank capacity. - 4 cu.mtrs.
 - Recovered Oil/Slap/Transfer pump - 30 Cu.M./hrs. with a standby pump of same capacity.

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 - Capacity of garbage recovery - 1.0m³/hrs.
 - Garbage tank capacity. - 4 cu.mtrs.
 - Recovered Oil/Slap/Transfer pump - 30 Cu.M./hrs. with a standby pump of same capacity.

3.4 Oil Spill Response Fleet of Kandla Port

VADINAR

Sr. No.	NAME OF THE PORT CRAFT	BULLADR PULL IN TONNES	TYPE OF VESSEL
1	❖ MV SAGARIKA	---	MULTI PURPOSE ANTI POLLUTION VASSEL
2	❖ MT GAJ RAJ	35.0	MARINE TUG
3	❖ MT BANNI	7.5	MARINE TUG
4	❖ MT SURAJBARI	5.0	MARINE TUG
5	MT KUTCH KESARI	40.0	MARINE TUG
6	MT VADINAR	5.0	MOORING TENDER

KANDLA

1	❖ MV KARISHMA	---	MULTI PURPOSE ANTI POLLUTION VASSEL
2	❖ FF AGNI SAMITHI	---	FIRE FLOAT
3	❖ MV KARISHMA	---	MULTI PURPOSE ANTI POLLUTION VASSEL
4	❖ MT KALINGA	35.0	MARINE TUG
5	❖ MT HEERA	35.0	MARINE TUG
6	❖ MT MEHUL	35.0	MARINE TUG
7	❖ MT CHEETAH	35.0	MARINE TUG
8	MT MEKAN	19.0	MARINE TUG
9	MT JUMBO	19.0	MARINE TUG
10	❖ MT SIKANDAR	19.0	MARINE TUG
11	❖ MT GALPADAR	7.5	HARBOR TUG
12	ML NIRISHAK	---	SURVEY LAUNCH
13	ML SURVE SHAK	---	PILOT CUM SURVEY LAUNCH
14	ML LIZA	---	PILOT LAUNCH
15	ML TAPKESHWARI	---	PILOT LAUNCH
16	ML SHAKTI	---	G S LAUNCH
17	ML ROSE	---	G S LAUNCH
18	ML RAGINI	---	G S LAUNCH
19	ML MRINAL	---	G S LAUNCH
20	ML UNNATI	---	MOORING LAUNCH
21	ML VAISHALI	---	MOORING LAUNCH
22	ML MEGHA	---	MOORING LAUNCH
23	ML PRIYADRASHNI	---	MOORING LAUNCH
24	ML MRIGNAYANI	---	MOORING LAUNCH
25	ML VIJAY	---	MOORING LAUNCH

❖ INDICATES THAT THE VESSEL IS FITTED WITH CHEMICAL DISPERCENT SPRAYING BOOMS

4. Oil Spill Response System Upgradation Plan (near future)

4.1 Procurement of equipment (Oil spill containment boom system)

In view of the fragile eco system along the coastline of southern Gujarat it is essential to upgrade the Oil Spill Response system of Kandla Port. State level Review Committee headed by the Chief Secretary to Government of Gujarat with regard to Oil Spill Prevention Preparedness measures in the Gulf of Kutch has emphasized this aspect in January, 2004. Further, the NOS-DCP prepared by the Indian Coast Guard strongly recommended that the Port Establishments in the region should equip themselves with adequate Oil spill containment boom systems.

Appropriate skimmers should also compliment these systems with adequate tank space for recovery of the spilled oil to tackle accidental oil spill at the Tier level 1 & 2.

The Indian Coast Guard through its NOS-DCP also made its emphasis on inter-institutional cooperation. In view of the above, Kandla Port proposes to procure 500 meters of inflatable Oil spill containment boom system.

Details of proposed Oil spill containment boom system:

- Two sets of Diesel powered hydraulically operated Remote mounted inflatable boom systems are proposed to be installed on a suitable vessel with adequate tank space for collection the recovered oil. The vessel shall be on a long-term charter preferably 3 to 5 years and shall be manned by the trained personnel on contract terms. In the vicinity of SBM operations, this vessel shall be kept in readiness at all times.

- The above mentioned system is contemplated as the same is compatible to the Oil spill containment system of RPL marine Terminal at Sikka. This aspect also satisfies the vision of inter-organizational cooperation if need arises (in the event of a Tier 3 level disaster).
- Within the purview of threat perception, logically evaluated scenario inclusive of worst disastrous situation which can result in oil spill in the context of Kandla Port operations are listed below:
 - ✓ Ship accidents resulting in containment failure of ships' cargo/ships' own fuel oils due to :
 - ⇒ grounding and listing of ships
 - ⇒ ship to ship collision
 - ⇒ ship colliding with SBM/Port structures
 - ✓ Hose burst due to
 - ⇒ Failure of floating hose connection (ship to SBM.)
 - ⇒ Failure of under buoy hose
 - ⇒ Failure of valve systems
 - ⇒ Major structural failure of ships during severe sea conditions.
 - ⇒ Hose burst during transshipment/lighterage operations.

4.2 Oily waste reception facilities

The Government of India, is a signatory to MARPOL 73/78. The various annexes of the Convention having been ratified, particularly Regulation 12 of Annexure-I, it is required to create Oily waste reception facilities at Ports where the crude oil is loaded into Oil Tankers or all Ports having ship repair yards and tank cleaning facilities. In view of the above and various other Clauses under Regulation 12 of Annexure-I, Kandla Port had installed a ^{4.522}450 ton capacity tank near Old Kandla complimented with tank lorry. Despite the facility having been provided in Kandla Port, except for one instance, the system was not utilized

optimally to its capacity. The probable reasons for the under utilization of the system may be due to the following reasons:

- Very high berth occupancy
- Non-availability of Oily based reception barges with the Port
- Ambiguity which persists with regard to treatment of oily waste and ultimate disposal.
- Conflicting use of Custom Department with regard to duties on oily waste.

In view of the above probable reasons, the shipping industry perhaps was not motivated to optimally utilize the facility provided by Kandla Port.

Status quo remaining thus and with a futuristic overview, the Port Authorities have reviewed and discussed the issue with other Ports namely, Mumbai, JNPT and Chennai Ports and arrived at the following conclusions:

- That it will be apt for Kandla Port to declare the oily waste reception facility as open to private operators with valid license from the State/Central Pollution Control Board.
- These operators should essentially possess oily waste reception barges, tank lorries and a terminal point from where they can receive/discharge oily waste into a transit storage tank.
- Kandla Port may also contemplate providing infrastructural facilities to the parties who are interested in setting up oily waste treatment plants for the ultimate disposal of oily waste. In connection with the above, a press release is being issued in the leading newspapers.

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Sector:

At present, for the purpose of emergency, there are two private companies operating tanker barges with valid Port Craft License issued by Kandla Port Trust. These barges are available on hire. The particulars of the said companies are as follows:

Name of the company	Address	Contact person	Tel. No.
M/s. Jaisu Shipping Co.	Kewalramani House, Behind Seva Sadan-II, New Kandla	Mr. Suresh Kewalramani	(02836) 70628
M/s. A.V.Joshi & Co.	Maitri Bhavan, Plot No.18, Sector-8, Gandhidham	Mr. Ramesh Singhvi	(02836) 31386 31899

4.3 System to monitor sea surface currents on a regional scale

Surface current monitoring on a regional scale attains a great deal of importance in tracking oil slicks and in mitigating the adverse effects of oil spills. In view of the above it is proposed to acquire a system which operates on RADAR frequencies. The system is capable of logging data into a PC and covers an area of 30 Km radius from the location of the sensor with resolution cells of 100 m². Data thus obtained will be useful for analyzing complex circulation pattern off the creek mouths, which emerge from the Gulf of Kutch. This kind of analysis also enables successful investigations leading to identification of point sources of oil spill.

METEOROLOGICAL INFORMATION - KAMUDA PORT

Annexure-I

MAXIMUM TEMPERATURE	44.4 C	SEASONAL WIND DIRECTION
MINIMUM TEMPERATURE	7.20 C	JAN TO FEB N/NN/ENE
MAXIMUM WIND VELOCITY	180 Km/PH NNN (09- MAR TO SEP S4/NSH	
MAXIMUM GUST	200 Km/PH NNN (09- OCT TO DEC N/NNR	
AVERAGE RAINFALL	400 mm	
MINIMUM ANNUAL RAINFALL	73.00 mm (1979)	
MAXIMUM ANNUAL RAINFALL	1393 mm (1979)	
MAXIMUM RELATIVE HUMIDITY	100%	WAVE DATA OBSERVED AT 0700
MINIMUM RELATIVE HUMIDITY	01%	SIGNIFICANT WAVE Ht. 2.20 m
MINIMUM DEW POINT	-33.30 C	HIGHEST WAVE Ht. 3.70 m
RANGE OF SEA WATER TEMPERATURE	16.8 C to 31.8 C	AVERAGE WAVE PERIOD 3 TO 15 SEC
RANGE OF SEA WATER SPECIFIC GRAVITY	1.002 to 1.034	
RANGE OF S P M IN SEA WATER	94 TO 863 mg/L	
RANGE OF SALINITY	8.50 TO 39.20 ppt (Aug 86)	
	41.40 TO 47.90 ppt (Nov-86)	
	42.20 TO 50.50 ppt (Feb 87)	

PARTICULARS OF WIND GENERATED ANOMALOUS SEA WAVE:

DATE: 09-06-1998
 DURATION: 0915 hrs. TO 1715 hrs
 FETCH: >65 Km.
 AVERAGE WIND VELOCITY: 180 TO 200 Km/PH (ESTIMATED)
 WIND DIRECTION: 0915 TO 1215 hrs. NSH - LULL PERIOD 15 Minutes - 1230 TO 1715 hrs. NE
 MAX. RAISE IN SEA LEVEL: 9.50 m. ABOVE C.D. AT 1440 hrs.

MONTHLY WISE AVERAGED METEOROLOGICAL DATA OF HEW NANUKA OBSERVATORY
 LATITUDE : 21° 01' N
 LONGITUDE : 70° 12' E
 AVERAGED FOR THE YEARS 1978 - 1988
 INDEX NO: 42638
 FIRST RAINY DAY :
 LAST RAINY DAY :

MONT	TEMPERATURE							WIND SPEED				AVERAGE PRESSURE			AVERAGE HUMIDITY			RAIN	
	AVG. MAX. °C	DAY OF MONTHS	MAX. °C	AVG. MIN. °C	DAY OF MONTHS	MIN. °C	AVERAGE K.M.P.H	DAY OF MONTHS	MAX. K.M.P.H	WIND DIR.	0830 Hrs mb	1230 Hrs. mb	0916 Hrs(%)	1716 Hrs(%)	TOTAL Inches)	RAINY DAYS			
JAN	26.36	...	31.70	14.06	...	9.70	11.70	43.00	...	1017.2	1014.3	60.00	39.30	0.10	...				
FEB	27.54	...	34.96	15.90	...	5.00	11.10	55.00	...	1015.3	1012.1	59.50	37.50	0.76	...				
MAR	31.28	...	37.80	20.15	...	13.00	13.50	55.00	...	1013.3	1010.0	69.63	41.13	0.04	...				
APR	34.62	...	42.60	23.63	...	18.50	17.22	60.00	...	1009.8	1006.8	73.78	45.11	0.89	...				
MAY	35.23	...	42.60	33.03	...	19.80	21.44	60.00	...	1007.1	1004.1	77.00	55.11	4.60	...				
JUN	35.14	...	41.10	27.96	...	24.20	21.89	71.00	...	1002.3	999.6	77.22	61.67	65.69	...				
JUL	32.66	...	37.60	27.20	...	23.00	20.60	80.00	...	1001.8	999.6	81.70	67.90	158.25	...				
AUG	31.32	...	37.60	26.02	...	23.00	20.60	50.00	...	1008.0	1000.7	84.70	71.20	191.15	...				
SEP	33.10	...	40.20	25.76	...	22.00	15.80	55.00	...	1008.0	1005.1	79.70	56.10	50.97	...				
OCT	34.25	...	40.10	24.10	...	18.00	10.89	55.00	...	1012.2	1009.1	69.40	45.70	8.68	...				
NOV	30.91	...	37.60	19.93	...	13.80	9.22	100.00	...	1014.7	1011.7	63.33	44.67	34.34	...				
DEC	24.54	...	33.60	15.35	...	7.80	10.50	39.00	...	1017.2	1014.3	56.00	40.30	2.01	...				
AVERAGE	31.38	...	38.08	22.75	...	16.88	15.39	69.25	...	1010.2	1007.3	71.00	50.47				
MAX :			42.60					100.00		1017.2	1014.3								
MIN :						7.80													
TOTAL														517.48					

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW BANDELA OBSERVATORY
 LATITUDE - 23 01 N
 LONGITUDE - 10 13 E
 YEAR : 1990
 INDEX NO. 4209
 POST NAME : 27-05-90
 EST. ESTD. DAY : 02-11-90

PORT	TEMPERATURE							WIND SPEED				AVERAGE PRESSURE			AVERAGE HUMIDITY			RAIN		FALL
	MONTH	AVG MAX. °C	DAY OF MONTHS	MAX. °C	AVG MIN. °C	DAY OF MONTHS	MIN. °C	AVERAGE KMPH	DAY OF MONTHS	MAX. KMPH	WIND DIR.	0800 HR mb	1720 HR mb	0815 Hx(%)	1715 Hx(%)	TOTAL In(mm.)	RAINY DAYS			
1	23.9	24	32.7	15.3	2	12.0	9.0	27	32.0	SSW	1017.5	1014.5	65.0	37.0	0.0	0.0	0.0			
JAN	26.0	7	32.9	17.7	2	13.0	10.0	17	46.0	SSW	1014.7	1011.6	66.0	41.0	29.8	1.0	1.0			
FEB	30.6	19	37.5	19.3	1	14.6	11.0	22	40.0	SSW	1013.9	1010.8	67.0	34.0	10.4	1.0	1.0			
MAR	34.0	30	35.9	23.4	5	21.1	16.0	20	46.0	SSW	1009.2	1005.8	77.0	51.0	0.0	0.0	0.0			
APR	35.2	23	38.1	27.4	7	25.4	20.0	14	47.0	SSW	1005.6	1001.8	75.0	55.0	0.0	0.0	0.0			
MAY	35.2	1	38.3	27.3	25	27.7	22.0	14	48.0	SSW	1002.8	999.7	76.0	58.0	3.3	3.0	3.0			
JUN	32.0	18	33.5	27.3	28	26.2	26.0	10	54.0	SW	1001.7	999.8	78.0	67.0	13.8	11.0	11.0			
JUL	31.2	16	34.5	26.1	25	24.2	18.0	12	46.0	SW	1004.3	1001.9	85.0	73.0	200.6	16.0	16.0			
AUG	32.7	21	34.9	26.0	16	24.6	13.0	12	46.0	SW	1007.9	1004.8	83.0	64.0	28.7	0.0	0.0			
SEP	34.6	11	37.5	24.3	20	20.8	7.0	2	36.0	SE	1012.6	1009.2	67.0	44.0	0.0	0.0	0.0			
OCT	31.1	2	33.6	20.6	25	17.0	6.0	2	41.0	SE	1015.6	1012.5	65.0	38.0	1.0	1.0	1.0			
NOV	26.9	2	29.6	16.3	31	7.5	7.0	29	35.0	N	1017.6	1014.5	65.0	45.0	0.0	0.0	0.0			
DEC																				
AVERAGE	31.6		34.9	22.7		19.5	13.8		42.9		1010.3	1007.2	72.4	50.6						
MAX.			39.30						54.00		1017.6	1014.5								
TOTAL						7.50									289.6	39.0				

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MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW KANDLA OBSERVATORY
 LATITUDE = 23°01'N
 LONGITUDE = 70°13'E
 YEAR: 1991
 RISE NO 4303
 FIRST RECEIVED: 21/06/91
 LAST RAINY DAY: 30/05/91

MFT	TEMPERATURE							WIND SPEED			AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN	
	AVG. MAX. °C	DAY OF MONTH	MAX. °C	AVG. MIN. °C	DAY OF MONTH	MIN. °C	AVERAGE Km.PH	DAY OF MONTH	MAX. Km.PH	WIND DIR.	0830 Hrs. mb	1730 Hrs. mb	0815 Hrs.(%)	1715 Hrs.(%)	TOTAL mm	RAINY DAYS
JAN	25.5	27	35.6	15.1	1.0	8.9	12.0	36.0	NNW	1015.7	1013.5	63.0	35.0	0.0	0.0	
FEB	28.1	08	31.9	17.1	1.0	10.7	9.0	31.0	N	1014.4	1012.3	27.0	34.0	0.0	0.0	
MAR	32.9	29	42.7	21.4	1.0	17.5	10.0	37.0	SSW	1010.3	1007.7	60.0	36.0	0.0	0.0	
APR	34.0	19	38.4	24.9	3.0	21.8	11.0	34.0	SSW	1008.0	1005.1	68.0	45.0	0.0	0.0	
MAY	34.5	31	40.2	27.0	1.0	26.2	10.0	36.0	SSW	1006.0	1003.4	78.0	55.0	0.0	0.0	
JUN	34.6	01	42.6	28.8	1.0	26.8	15.0	47.0	SSW	1000.0	997.8	78.0	68.0	0.0	0.0	
JUL	32.8	15	39.0	27.9	27.0	26.6	15.0	35.0	SSW	999.6	997.5	75.0	68.0	0.2	1.0	
AUG	31.6	24	34.0	27.1	13.0	26.1	14.0	30.0	SSW	1002.2	1000.5	75.0	66.0	129.4	15.0	
SEP	32.3	22	36.1	26.4	19.0	26.0	11.0	28.0	SSW	1009.8	1006.3	69.0	65.0	28.5	14.0	
OCT	35.8	10	38.1	24.1	19.0	22.2	9.0	27.0	SSW	1009.8	1007.1	65.0	65.0	0.0	0.0	
NOV	31.0	01	36.4	20.8	30.0	17.4	9.0	16.0	N	1014.7	1011.7	65.0	42.0	0.0	0.0	
DEC	27.5	07	31.2	16.7	30.0	12.7	8.0	16.0	NNW	1017.6	1014.3	68.0	40.0	0.0	0.0	
AVERAGE	18.5		37.1	27.1		20.1	11.1	31.3		1009.0	1006.4	66.0	47.5		30.0	
MAX.			42.70					47.00		1017.6	1013.3					
MIN.																
TOTAL														158.1	30.0	

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MONTHLY AVERAGE METEOROLOGICAL DATA OF NEW KARNATA OBSERVATORY																		
LATITUDE + 23° 01' N																		
LONGITUDE + 78° 13' E																		
YEAR: 1992																		
PROJECT YEAR: 22-09-82																		
FIRST RAINY DAY: 05-09-82																		
LAST RAINY DAY: 13-09-82																		
FALL																		
MOS	TEMPERATURE							WIND SPEED				AVERAGE PRESSURE			AVERAGE HUMIDITY		TOTAL RAIN (mm)	RAINY DAYS
	AVG. MAX. °C	DAY OF MONTH	MAX. °C	AVG. MIN. °C	DAY OF MONTH	MIN. °C	AVERAGE Hrs. P.M.	DAY OF MONTH	MAX. Hrs. P.M.	WIND DIR.	0300 Hrs. mb	1200 Hrs. mb	0915 Hrs. (%)	1715 Hrs. (%)				
JAN	25.8	11	21.8	14.4	18	10.3	10.0	12	17.0		1018.8	1016.0	65.0	46.0	0.0	0.0		
FEB	26.6	22	31.7	17.4	19	14.6	12.0	06	36.0		1015.2	1013.2	69.0	51.0	0.0	0.0		
MAR	30.6	23	39.7	23.0	09	17.1	14.0	22	23.0		1014.2	1011.8	75.0	63.0	0.0	0.0		
APR	33.4	07	38.2	26.0	01	22.1	20.0	26	32.0		1011.1	1008.9	80.0	62.0	0.0	0.0		
MAY	34.8	04	43.0	30.2	01	25.7	24.0	25	46.0		1007.5	1005.5	83.0	68.0	28.0	11.0		
JUN	36.2	15	38.5	30.3	28	26.5	21.0	31	34.0		1001.9	998.8	85.0	73.0	295.0	10.0		
JUL	34.0	10	35.0	28.7	12	26.0	17.0	21	26.0		1002.1	999.7	86.0	72.0	44.0	2.0		
AUG	32.2	10	34.5	26.4	26	24.5	16.0	24	20.0		1007.9	1005.1	82.0	59.0	0.0	0.0		
SEP	30.8	08	35.4	26.2	31	22.0	9.0	10	22.0		1012.1	1008.9	80.0	56.0	0.0	0.0		
OCT	31.4	08	35.4	22.0	27	18.5	8.0	21	16.0		1016.5	1013.3	81.0	56.0	0.0	0.0		
NOV	31.0	08	35.0	19.0	27	18.5	7.0	21	14.0		1018.2	1015.3	78.0	46.0	0.0	0.0		
DEC	27.7	06	31.8	19.0	14	15.8	7.0	13	14.0		1018.2	1015.3	78.0	46.0	0.0	0.0		
AVERAGE	31.2		31.9	23.6		20.1	14.0		25.6		1010.5	1007.5	78.8	60.6	438.7	24.0		
MAX. TOTAL			43.00			30.30			46.00		1018.8	1016.0						

MONTH WISE AVERAGED METEOROLOGICAL DATA OF NEW KANAKA OBSERVATORY
 LATITUDE = 23 01' N
 LONGITUDE = 70 13' E

INDEX NO. 4539
 FIRST RAINY DAY : 05-03-95
 LAST RAINY DAY : 20-12-95

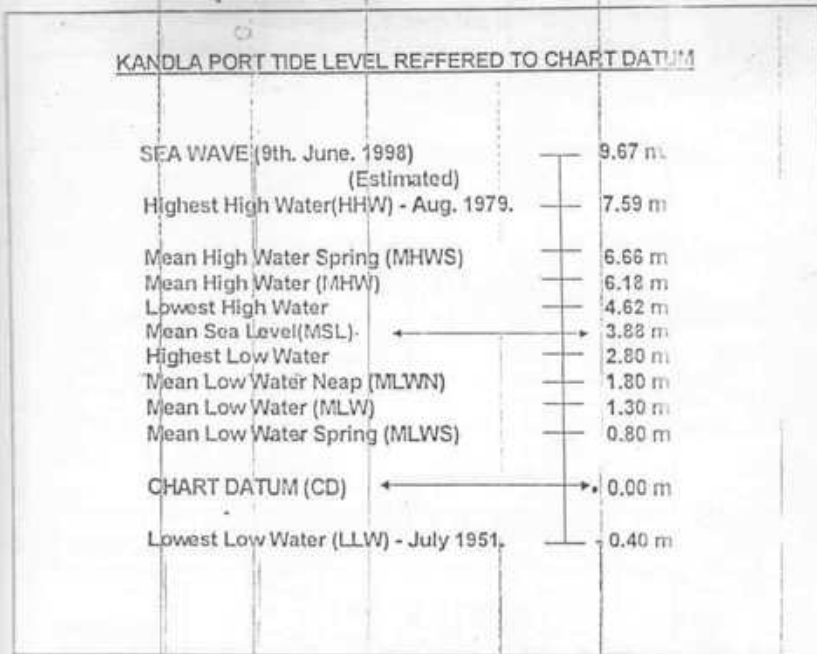
YEAR : 1995

MONTH	TEMPERATURE							WIND SPEED				AVERAGE		PRESSURE		AVERAGE HUMIDITY		RAIN	FALL
	AVG. MAX. °C	DAY OF MONTHS	MAX. °C	AVG. MIN. °C	DAY OF MONTHS	MIN. °C	AVERAGE Km./P.H	DAY OF MONTHS	MAX. Km./P.H	WIND DIR.	0830 Hrs. mb	1730 Hrs. mb	0815 Hrs.(%)	1715 Hrs.(%)	TOTAL Inches)	RAINY DAYS			
JAN	25.3	6	30.9	14.4	19	11.1	9.0	21.0	NNE	1016.4	1015.7	81.0	43.0	0.0	0.0	0.0			
FEB	28.3	9	31.9	16.9	16	15.1	9.0	21.0	SSW	1015.2	1012.2	73.0	38.0	0.0	0.0	0.0			
MAR	30.3	22	36.4	19.6	11	15.5	13.0	26.0	NW	1013.7	1010.6	70.0	39.0	0.2	1.0	0.0			
APR	34.5	12	37.8	23.6	7	20.1	13.0	29.0	WSW	1011.1	1007.6	71.0	38.0	0.0	0.0	0.0			
MAY	36.8	29	44.0	26.8	2	25.1	19.0	32.0	SW	1006.1	1003.5	75.0	59.0	0.0	0.0	0.0			
JUN	35.7	15	39.0	28.6	3	27.2	22.0	34.0	SSW	1002.9	999.8	88.0	65.0	0.0	0.0	0.0			
JUL	33.1	10	36.7	27.6	17	25.2	19.0	38.0	SW	999.9	997.6	88.0	71.0	0.0	19.0*	19.0*			
AUG	32.5	31	34.4	26.9	7	24.5	21.0	40.0	WSW	1003.7	1001.1	82.0	67.0	1.4	1.0	14.0*			
SEP	34.3	2	38.4	28.2	19	24.7	16.0	32.0	WSW	1007.8	1004.7	76.0	56.0	1.4	1.0	14.0*			
OCT	34.4	10	38.6	25.9	31	21.7	9.0	10.0	NW	1011.1	1007.7	70.0	51.0	78.3	3.0	3.0			
NOV	34.1	12	33.8	20.0	30	14.7	7.0	16.0	NW	1014.6	1011.3	59.0	37.0	0.0	0.0	0.0			
DEC	27.9	14	30.8	16.6	1	13.1	9.0	17.0	NNE	1018.7	1015.7	69.0	51.0	0.2	1.0	1.0			
AVERAGE	32.3		36.1	22.8		19.8	11.8	26.3		1010.3	1007.3	75.0	51.3	***	***	***			
MAX. MIN. TOTAL			54.00			11.1		40.00		1018.7	1015.7			282.0		39.0			

MONTHLY WISE AVERAGED METEOROLOGICAL DATA OF NEW MADRA OBSERVATORY
 YEAR : 1956
 INDEX NO 45539
 FIRST RAINY DAY : 15-01-56
 LAST RAINY DAY : 11-09-56

MPT	TEMPERATURE							WIND SPEED			AVERAGE PRESSURE		AVERAGE HUMIDITY		RAIN		RAINY DAYS	
	MONTH	AVG	MAX	MIN	DAY OF MONTH	MAX	MIN	AVERAGE MONTH	MAX	WIND DIRL	0600 HRS mb	1200 HRS mb	0615 Hrs (%)	1715 Hrs (%)	TOTAL (mm)	NO. OF DAYS	RAINY DAYS	
1	JAN	25.90	28.9	14.8	13	9.2	9.0	21	18	S	1016.4	1013.6	66.0	41.0	1.1	1.0	1.0	
2	FEB	29.20	35.2	17.2	26	13.4	9.0	25	32	SW	1014.8	1011.5	64.0	36.0	0.0	0.0	0.0	
3	MAR	33.80	40.0	22.1	28	18.1	11.0	26	32	WSW	1011.9	1008.3	52.0	35.0	0.0	0.0	0.0	
4	APR	35.10	41.8	24.3	15	21.0	14.0	21	30	SW	1009.3	1005.9	77.0	48.0	1.8	1.0	1.0	
5	MAY	34.90	41.2	26.4	8	24.1	20.0	14	38	WSW	1008.1	1005.6	84.0	59.0	0.0	0.0	0.0	
6	JUN	33.50	39.4	28.2	16	24.3	16.0	3	30	WSW	1002.1	999.2	87.0	64.0	256.0	10.0	6.0	
7	JUL	33.50	36.8	26.0	15	25.1	21.0	8	40	WSW	1001.6	1002.5	86.0	75.0	18.5	6.0	1.0	
8	AUG	31.70	33.9	25.9	24	21.3	21.0	8	40	SSW	1007.3	1004.1	84.0	68.0	8.5	1.0	0.0	
9	SEP	32.90	35.5	27.5	23	24.7	16.0	24	40	NE	1007.3	1008.5	67.0	44.0	0.0	0.0	0.0	
10	OCT	34.80	39.4	25.1	18	21.6	10.0	3	20	SW	1012.6	1012.2	62.0	36.0	0.0	0.0	0.0	
11	NOV	31.20	34.6	18.3	7	13.1	7.0	3	20	SW	1015.5	1014.6	56.0	39.0	0.0	0.0	0.0	
12	DEC	28.00	30.7	15.0	7	11.1	9.0	7	20	NNE	1017.8	1014.6	56.0	39.0	0.0	0.0	0.0	
AVERAGE		32.13		22.73			13.50		31.2		1010.1	1007.1	73.0	52.0				
MAX			41.80						48.00									
MIN						-9.20												
TOTAL														3579		28.0		

Details of Tide levels and tidal stream



PLACE	Lat. N	Long. E	HEIGHT IN METRES ABOVE DATUM				
			MHWS	MHWN	MLWN	MLWS	MSL
KANDLA	23° 01'	70° 13'	6.7	5.7	1.8	0.8	3.9

Tidal stream information of Kandla creek

KANDLA		50 m off Berth No. 5		
Hours	Direction	Rate (Kn)		
		Sp	Np	
B	6	100°	0.80	
E	5	040°	0.50	
F	4	300°	1.50	
O	3	266°	1.70	
R	2	270°	1.81	
E	1	340°	1.10	
HW	.	068°	0.20	
A	1	160°	0.70	
F	2	250°	1.00	
T	3	225°	1.30	
E	4	210°	1.20	
R	5	175°	0.80	
	6	140°	0.45	

Tidal stream information at SBM - I

VADINAR		Lat. : 22° 31' 00" N Long.: 69° 41' 30" E		
Hours	Direction	Rate (Kn)		
		Sp	Np	
B	6	354°	0.2	0.1
E	5	038°	1.2	0.8
F	4	042°	1.5	1.0
O	3	049°	1.5	1.0
R	2	047°	1.2	0.8
E	1	036°	0.5	0.3
HW	.	198°	0.4	0.2
A	1	202°	1.0	0.7
F	2	232°	1.3	1.0
T	3	222°	1.4	1.0
E	4	226°	1.3	0.9
R	5	232°	0.7	0.5
	6	310°	0.1	0.1

of Emergency Response Centers

FACILITY	A.O. BUILDING, GANDHIDHAM	P & C BUILDING, NEW KANDLA	VADINAR SIGNAL STATION
TELEPHONE	02836 32990	02836 70277 02836 70549	02833 56555
	02836 33708	02836 70338	02833 56540
EMAIL	kpt@guj1.guj.nic.in	----	----
CWDS OF IMD	----	INSTALLED	----
<u>PLANET-1 SATELLITE</u> <u>PHONE</u>			
VOICE	762092 777	762092 789	762092 786
FAX	762092 778	762092 790	762092 787
DATA	762092 779	762092 791	762092 788

3)

ANNEXURE -IV

Contact numbers of resource personnel of the OSRT.:

	Name	Designation	Tel (O)	Tel (R)	Fax
1	KANDLA Capt. P.C.Chaturvedi	Dy.Conservator	33585 20235	34374	35982
	G.Mallikarjun Rao	Coordinator, PEMU	70277	27327	32040
	C.U.Singh	Flotilla Supdt.	70280	30870	
	M.D.Samuel	Fire-cum-Safety Officer	70176 70178	70267	
	Badrinarayan	Signal Supdt.	70194 70549		
	Name	Designation	Tel(O)	Tel(R)	Fax
2	VADINAR S.K.Kotak	Suptd. Engineer	(02833) 56749	(02833) 56522	(02833) 56540
		Senior Pilot	----	----	(02833) 56540
		Asstt.Flotilla Suptd.	(02833) 56574	----	(02833) 56540

Spill Report Form and POLREP Message Format

Particulars of person / organisation reporting incident :

a. Title :

b. Company :

c. Telephone / FAX / Telex No. :

d. Date / Time :

e. Spill location :

f. Type and Quality of oil spill :

g. Cause of spill :

h. Response to spillage, if any :

i. Any other information :

POLREP MESSAGE FORMAT

(See amplification in succeeding table)
Reference : IMO - 560 (1995)

	Address Date Identification Serial Number	From Time	To Group		
1.	Date and time				
2.	Position				
3.	Incident				
4.	Outflow				
5.	Acknowledge				
40.	Date and Time				
41.	Position				
42.	Characteristics of pollution				
43.	Source and cause of pollution				
44.	Wind direction and speed				
45.	Current or tide				
46.	Sea state and pollution				
47.	Drift of pollution				
48.	Forecast				
49.	Identify of observer and ships on scene				
50.	Action taken				
51.	Photographs or samples				
52.	Names of other agencies informed				
53-59.	Spare				
60.	Acknowledge				
80.	Date and time				
81.	Request for assistance				
82.	Coast				
83.	Pre-arrangements for the delivery				
84.	Assistance to where and how				
85.	Other agencies requested				
86.	Change of command				
87.	Exchange of information				
88.	Names and number of				
89.	Description of equipment				
90.	ETA and arrival information				
91.	Place of embarkation				
92.	Place of disembarkation				
93-98.	Spare				
99.	Acknowledge				

PART III (POLFAC)

CONTENTS	REMARKS
81. REQUEST FOR ASSISTANCE	Type and amount of assistance required in the form of: <ul style="list-style-type: none"> - specified equipment - specified equipment with trained personnel - complete strike teams - personnel with special expertise with indication of country requested.
82. COST	Requirements for cost information to requesting country of delivered assistance.
83. PRE-ARRANGEMENTS FOR THE DELIVERY OF ASSISTANCE	Information concerning customs clearance, access to territorial waters, etc. of the receiving country.
84. TO WHERE ASSISTANCE SHOULD BE RENDERED AND HOW	Information concerning the delivery of the assistance, e.g. rendezvous at sea, radio frequencies to be used, call sign and name of Supreme On-Scene Command, etc. of the receiving country, or land-based authorities with telephone number, telex number, etc.
85. NAMES OF OTHER STATES AND ORGANIZATION	Only to be filled in if no covered by figure 81, e.g. if further assistance is to be requested.
86. CHANGE OF COMMAND	When a substantial part of an oil pollution or serious threat of oil pollution moves into the zone of another Contracting Party, the country which has exercised the supreme command of the operation may request the other country to take over the supreme command.
87. EXCHANGE OF INFORMATION	When a mutual agreement has been reached between two parties on a change of command, the country transferring the supreme command should give a report on all relevant information to the operation to the country taking over the command.
88-89	SPARE FOR ANY OTHER RELEVANT REQUIREMENTS OR INSTRUCTIONS
89. ACKNOWLEDGE	When this figure is used the telex should be acknowledged as soon as possible by the receiving national authority.

/

/

Annexure F

Marine Biodiversity Plan

Marine Biodiversity Management Plan For Deendayal Port Authority, Kandla, Gujarat

EG/WK/4751/part (Marine Ecology Monitoring)/12

Submitted to



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

Submitted by



GUJARAT INSTITUTE OF DESERT ECOLOGY
P.B. No. 83, Mundra Road, Opp. Changleshwar Temple
Bhuj-Kachchh, Gujarat-370001

May 2022

**Marine Biodiversity Management Plan
For Deendayal Port Authority, Kandla, Gujarat**

EG/WK/4751/part (Marine Ecology Monitoring)/12

Submitted to



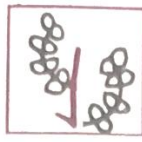
DEENDAYAL PORT AUTHORITY
Administrative Office Building
Post Box No. 50, Gandhidham (Kachchh)
Gujarat-370201

Submitted by



GUJARAT INSTITUTE OF DESERT ECOLOGY
P.B. No. 83, Mundra Road, Opp. Changleshwar Temple
Bhuj-Kachchh, Gujarat-370001

May 2022



Dr. V. Vijay Kumar
Director

CERTIFICATE

This is to state that this Final Report of the work entitled "**Preparation of Detailed Marine Biodiversity Management Plan**" has been prepared in line with the Work order issued by Deendayal Port Authority, vide Letter No. EG/WK/4751/Part (Marine Ecology Monitoring)/12, Dt. 03.05.2021 as per EC & CRZ clearance granted by MOEF&CC, GOI Dt. 20.11.2020 (Creation of Water Front Facilities (OJ 8-11), Para VIII Marine Ecology Specific Condition No. iii).

This Report covers the studies conducted during the period between May 2021 to May 2022 and secondary data from the earlier studies conducted at DPA.

Authorized Signatory



Institute Seal

Project Team

Project Coordinator

Dr. V. Vijay Kumar, Director

Principal Investigators			
	Name of the Staff	Designation	Expertise
1	Dr. M. Jaikumar	Senior Scientist	Marine Ecology
2	Dr. Durga Prasad Behera	Project Scientist	Planktonology and Marine Fisheries
3	Dr. L. Prabha Devi	Advisor	Marine Ecology
4	Dr. Nikunj B Gajera	Scientist	Avifauna
Co-Principal Investigators			
5	Dr. R. Ravinesh	Project Scientist	Marine Biodiversity and Taxonomy
6	Dr. Kapilkumar Ingle	Project Scientist	Seaweeds and Mangroves
7	Dr. Dhara Dixit	Project Scientist	Seaweeds and Halophytes
8	Mr. Dayesh Parmar	Project officer	GIS & Remote sensing

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SNAPSHOT OF
Marine Biodiversity Management Plan for Deendayal Port Authority,
Kandla, Gujarat

S. No	Components of the Study	Remarks
1.	MoEF & CC Sanction Letter and Details	MoEF&CC Clearance dated 20 th November 2020 (VIII Marine Ecology, Specific condition iii)
2.	Deendayal Port letter Sanctioning the Project	DPA work order vide letter no. EG/WK/4751/part (Marine Ecology Monitoring)/ 12 dated 03/05/2021
3.	Duration of the Project	One year from May 2021 to May 2022
4.	Period Of Survey Carried	All the three seasons (Monsoon, Post-monsoon and Pre-monsoon).
5.	Survey Area Within the Port Limit	All major and minor creek systems Proximity to oil jetty 8-11.
6.	Number of Sampling Locations	Fifteen sampling locations in and around Deendayal Port Authority jurisdiction Proximity to oil jetty 8-11 (with special reference to Stations S-3, S-4 & S-7)

Components of the report

Habitat/ Groups	Major Taxa/ General/ Species	Year 2018-19		Year 2019-20		Year 2020-21		Year 2021-22		Site-specific (OJ.8-11) Average 3 season 21-22 MON,PO-MO,PRE-MON
Mangroves	<i>Avicennia marina</i> , <i>Ceriops tagal</i> , <i>Rhizophora mucronata</i> , <i>Aegiceras corniculatum</i>	4	4	4	4	4	4	4	4	DENSITY:4896 no/ha
Intertidal Fauna	Mollusca, Arthropoda, Annelida, Nemetoda, Nemertea, Cnidaria, Chordata	20	24	19	10	10	12	27	21	DENSITY:122 no/m ²
Subtidal Fauna	Mollusca, Arthropoda, Annelida, Nemetoda, Nemertea, Cnidaria, Echinodermata, Chordata	24	31	26	28	22	25	32	22	DENSITY:507 no/m ²
Phytoplankton	<i>Bacillaria</i> , <i>Navicula</i> , <i>Nitzschia</i> , <i>Chaetoceros</i> , <i>Coscinodiscus</i> , <i>Triceratium</i> , <i>Bidulphia</i> , <i>Melosira</i> , <i>Thassiosira</i>	20	24	32	26	23	19	29	22	15 no/L

Zooplankton	Copepods, Harpacticoids, Cyclopoids. brachyurans, cirripedes, Bivalve veligers	23	27	33	36	27	29	29	27	25
Seaweeds	Nil (Drifted tufts only)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	nil
Seagrasses	Nil (Drifted tufts only)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Halophytes	<i>Sesuvium</i> <i>portulacastrum</i> , <i>Salvadora persica</i> , <i>Aeluropus lagopoides</i> , <i>Salicornia brachiata</i> , <i>Suaeda nudiflora</i> and <i>Trianthema</i> <i>portulacastrum</i>	7	7	3	4	4	4	4	4	Percentage cover:19
Avifauna	Charadriiformes, Columbiformes, Coraciiformes, Phoenicopteriformes, Pelecaniformes, Passeriformes	52	74	49	89	58	96	84	52	29

Fishes	<i>Mugil cephalus</i> , Sciaenids Clupeids, <i>Harpodon</i> <i>nehereus</i> , <i>Pampus</i> <i>argenteus</i> , <i>Hilsa</i> sp, <i>Engraulis</i> sp, <i>Coilia</i> sp. <i>Peneaus</i> sp, <i>Portunus</i> sp.	11	11	10	8	5	5	5	8	7
Marine Mammals	Indian Ocean humpback dolphin (<i>Sousa plumbea</i>)	1	1	1	1	1	1	1	1	NIL
Reptiles in the mangroves	The saw-scaled viper, <i>Echis carinatus sochureki</i>	1	0	1	1	1	1	1	1	NIL

1. Introduction

Ports are essential infrastructures for commercial development and growth. They have strategic importance to a country, acting as openings for trade and marketing. They also constitute a crucial node in the global supply chain (Wright, 2013; Puiga et al., 2021). More than 50% of the world population lives near the coast, of which more than 300 million reside the coastal urban cities (Chau 1999; Chua and Ross 1998). There are substantial rises in maritime trade among various countries entering the twenty-first century (Gupta et al., 2005). With the increasing demands of the global population and the necessities of developments, and industries, existing ports are being extended, and new ports and harbours are being constructed worldwide (Chiu et al., 2014). Much of this is in raw materials, oil, petroleum, chemicals, ores, grain, and animal feedstuffs, which are needed to fuel the Indians' economy. In addition, ports facilitate millions of passengers each year and a wide range of goods, including vehicles, fresh foods, steel, timber, building materials, machinery and manufactured goods. As a result, ports attract industry, especially further processing and refining capacity, and act as significant employment generators (Puiga et al., 2021). The port authorities have gradually needed to take into account not only the impact of their developing activities and dredging operations within the port area (Comtois and Slack, 2007) as well as now their role and influence on shipping, the city, logistic chain operations and the overall neighborhood and connections (Ng and Song, 2010; Winnes et al., 2015).

Many modern port companies are now involved in far more than just the handling of ships and their cargoes; they have developed complementary business opportunities by diversifying into the property and the management of industrial estates and free-trade zones. As such, it may be considered that the ports industry constitutes the greatest single business complex and corresponding potential environmental impact at the coast on land, marine and atmospheric environments. In this context, many port areas now exhibit environmental issues typical of other large industrial and manufacturing operations (Wooldridge et al., 1999). Arguably, sustainability of port area activities can only be achieved by elective management protocols that integrate the socio-economic, legal,

technical and environmental imperatives within which the modern port industry has to function. Seaport operations have various commercial effects on regional, national, and global economies (Yochum and Agarwal, 1987), but at the same time, the ecological impacts of said operations are very important. These impacts are becoming a growing concern as the maritime transport sector is increasing continuously. This is leading to larger ships and ports (Cullinane and Khanna, 1999) to accommodate the additional throughput volume and, consequently, more severe negative environmental effects, which are mainly associated with local air quality, climate change, noise, and marine biology (Zis et al., 2018). Port operations affecting local air quality and local environment is affected by the pollutant discharges and noise of marine engines activity. An additional concern is the treatment of ballast waters, which when discharged from transoceanic ships at a port can lead to the accidental invasion of non-indigenous species (Biju Kumar et al., 2021). These organisms can affect negatively the aquatic ecosystems and be the cause of human health issues (Mooney, 2005). Research has shown that microorganisms can also be transported through hull fouling (Drake and Lodge, 2007).

Many major ports of the world have now initiated efforts to preserve their port environment. Even factors such as people, business, culture and history of a place are often included in addition to natural resources in evaluating the greenness of a port. The operation of ports has implications on the air quality at the regional and local level and leads toward the choice of “greener” seaport options. Green port construction is a long, comprehensive, systematic and complex task and is a matter concerning the overall situation and long-term strategic perspective (Bailey and Solomon, 2004).

A green or an ecological port is a sustainable development port in which there is a balance between economic and social goals existing with minimum deterioration of the natural system even though there is the utilization of resources for the various activities. The Ministry of Shipping, Government of India, has flagged off the initiatives on “Project Green Ports, 2016” such as monitoring environmental pollution, waste disposal and management, and relying on renewable energy sources, which leads to reducing the carbon footprint increase in the productivity of ports. The major ports of the country have already introduced the technologies towards reducing oil spillage and the impacts on the

marine environment and the utilization of a large quantity of renewable energy, and promoting waste to wealth through sustainable dredging and domestic ship recycling towards keeping the environment clean and green. As with any polluting industry, there is a menu of measures available to mitigate or eliminate health impacts and these measures range from narrow local changes such as idling limits for trucks to sweeping global changes in international trade. From an environmental and social perspective, seaports are thus key actors in transportation systems, and many ports have also developed corporate social responsibility (CSR) strategies.

1.1. Environmental Management Plan (EMP)

The Environment management plan is the key document in the environmental management system and sets out the detailed targets, objectives and procedures that will be adopted in order to achieve the goals set out in the environmental policy. An Environmental Management Plan (EMP) can be defined as “an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced”. EMPs are therefore important tools for ensuring that the management actions or processes are implemented through all phases of the project life-cycle. It is very much essential that port and harbor projects should have an environmental management plan (EMP), including regular monitoring of air, soil and marine water quality along with the collection of meteorological data to ensure that the port activities are environmentally and ecologically sustainable with minimal impact on the natural environment. Environmental Management Plan describes the adequacy of various pollution control measures predicted from the proposed project and the procedures for the mitigation of the various environmental impacts identified. This plan also helps an organization map its progress toward achieving continual improvements. Each organization is unique, and hence the Environmental Management Plan is not uniform to all of them. Environmental Management Plan (EMP) is a key approach to mitigating and reducing the identified and anticipated impacts arising out of the proposed project. Due to its very nature, EMP is an important and imperative element in any developmental initiative to ensure sustainability. Implementation of EMP in any project requires commitments from all stakeholders of the project like its proponents,

Government bodies overseeing the development and local government and people to ensure that the project is environmentally sound. Having identified the possible impact during the construction and operation phases, EMP aims to suggest concrete measures that would negate or mitigate the impact paving the way for maintaining the integrity of the project environment. EMP will reflect all statutory requirements taking cognizance of all the applicable standards and norms of the guidelines in its preparation.

Maritime development associated with the coastal environment creates a hindrance to the environment and the biotic components within it as well as the people inhabiting in the nearby area depending upon the variations of geography, hydrology, geology, ecology, types of shipping, industrialization and urbanization. Hence, for the determination of the status of the biodiversity in the project area and for the prediction of pollution levels for future, regular monitoring and assessments are required during the entire construction and operation phases for major ports. It is mandatory that port and harbour projects should have an environmental management plan (EMP), which includes monitoring of air and marine water quality along with the collection of meteorological data every year. Also, it is mandatory to incorporate regular monitoring to assess the health of the biotic communities in the adjacent coastal environment and the adjoining land to report the level of impacts due to the variations in the characteristics of the environment as a whole. Further, monitoring the level of heavy metals, petroleum hydrocarbons, pesticides, and other physical and chemical contaminants in the water and soil and measuring the rate of accumulation of major pollutants in the tissues of the fishery resources caught from the nearby inshore areas. The results of the EIA through the quantitative and qualitative analyses should be evaluated by experts to suggest mitigation measures for further improvement of the port operations.

Monitoring and enforcing pollution prevention regulations pertaining to vessel maintenance and waste management could effectively reduce the introduction of solid and liquid wastes on the waterfront as well as on the shore. Developing a green belt around the whole port territory would help to control the greenhouse effect, soil erosion and the associated degradation of the water quality considerably. It is an effective method of attenuating waste residuals subsequent to pollution control measures. Greenbelts

absorb air and water pollutants, arrest noise and soil erosion, and create favorable climatic and aesthetic conditions.

1.2. Purpose of the management plan

A regular expansion of infrastructure and port facilities is required to cater to the logistic requirements with respect to the increasing vessel size and the expansion of trade which necessitate continuous modernization and development of additional structures in the Port. The ongoing developmental activities at DPA has been intended for the creation of waterfront facilities (OJ 8-11) EC & CRZ clearance granted by the MoEF &CC, Gol dated 20/11/20 – (OJ 8 to 11- Para VIII Marine Ecology, specific condition). As per the environmental clearance requirements from the MoEF & CC for these developmental initiatives, among other conditions, continuous monitoring of the coastal environment on various aspects covering all the seasons needs to be done. As, there is always a need to maintain its marine environment pristine and clean so as to support the biodiversity of the entire land and water spread area under the jurisdiction of DPA. In accordance with the MoEF & CC directive, DPA has consigned the project on ‘Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme” to Gujarat Institute of Desert Ecology (GUIDE), Bhuj, during May 2019-2021. Further, DPA authorities has entrusted the Gujarat Institute of Desert Ecology (GUIDE) to continue the study for another three years, i.e., 2021 – 2024.

In the project objectives, it is specifically stated that the regular monitoring will encompass all the habitats and the living resources there in to display the seasonal and yearly biodiversity variations and to suggest conservation and mitigation measures wherever required in the form of a comprehensive marine biodiversity management Action plan. The management action plan was prepared based on the compilation of the results of marine ecology monitoring that includes both the floral and faunal components of marine biodiversity of the major intertidal ecosystems, and the associated water and sediment characteristics for the period 2021 to 2022, and it compared with earlier study of DPA (2019 QND 2020)

1.3. Scope of the Study

The scope of the present study includes the assessment of Physico-chemical and marine biological components as mentioned in the specific conditions of the DPA work order vide letter no. EG/WK/4751/part (Marine Ecology Monitoring)/ 12 dated 03/05/2021, respectively. As per the assigned work, i. e. preparation of detailed Marine Biodiversity Management Plan for the Impact of the project activities as per the requirement of EC & CRZ Clearance accorded by the MoEF&CC, GoI dated 20/11/2020-Creation of waterfront facilities (Oil Jetties 8,9,10,11)-para VIII marine ecology specific condition iii (Impact of project activities on the intertidal biotopes, coral and coral communities, molluscs, sea grasses, seaweeds, subtidal habitats, fishes, other marine and aquatic micro, macro, and mega flora and fauna including benthos, plankton, turtles,birds etc as well as the productivity) and development of Land are 544 acres for associated facilities for storage at Old Kandla, Gandhidham, Kachchh, Gujarat, by M/s Deendayal Port Authority.

The present biodiversity management plan report was prepared based on the results of the studies carried out at the selected sites covering the three-seasons ie June to September (Monsoon) , October to January (Post-monsoon) and February to May (Pre-monsoon) for the period May 2021 to May 2022.

The mitigation and management plan presented in the proceeding section mainly attempts to minimize or avoid the impact of the developmental initiatives. While developing mitigation measures, emphasis will be given to developing approaches that will prevent and minimize impacts through pre-project activities and subsequent management (during operation) rather than compensation and damage control at a later stage. The following section describes the state of the diversity, probable impacts, and impact specific mitigation measures that the proponent will implement both during the construction and operation phases.

2. Current Development activity of Deendayal Port Authority

India is one of the fastest-growing large economies in the world and the ports play an important role in the overall economic development of the country. Many ports in Gujarat, such as, Mundra Port, Sikka Port, Hazira Port, etc., are evolving into specialized centers of economic activities and services and are vital to sustain the future economic growth of the country. However, Deendayal Port Authority (DPA) is one of the major ports of the country and the largest port of India in terms of the volume of cargo handled. As a part of its periodic expansion and modernization plan, DPA has proposed expansion of the port by the creation of water front facilities (Oil jetties 8,9,10 &11) within the existing Deendayal Port Authority jurisdiction area.

Ecological Features of the Development Area

The coastal belt in and around DPA region is characterized by a network of creek systems and mudflats which are covered by halophytic vegetation like moderately dense to sparse mangroves, creek water and salt-encrusted land mass which forms the major land component. The port jurisdiction covers 99986.01 ha (999.86 sq.km). The surrounding environment in a radius of 10 km from the port includes built up areas, salt pans, human habitations and port related structures on north and creek system, mangrove formations and mudflats in the east and south. Western bank of the Kandla creek where Deendayal Port is located is a fully developed area occupied mostly by port infrastructure. The northern bank is constituted by Sat Saida Bet which is a unique Island and a vast mudflat extending to 253.8 sq.km opposite to Deendayal port. As one of the major Island of Gulf of Kachchh, Sat Saida supports a rich marine fauna, flora and avian diversity and deserves special conservation effort.

Total mangrove cover within the DPA limit is 24382.70 ha which constitutes 24.33% of the total land cover of the port. The mudflat area covering 31089.06 ha constituting 31.09 % of the total area. The assessment made from April 2017 to March 2022 clearly shows that overall mangrove area has increased from 19319 ha to 24328 ha, i.e., 5 % of the total area of DPA. Mangrove area is replacing on the mudflat, hence there is a decreasing

trend of the mudflat is clearly seen (Fig .1). Good monsoon and favorable environment have positively impacted the mangroves to flourish.

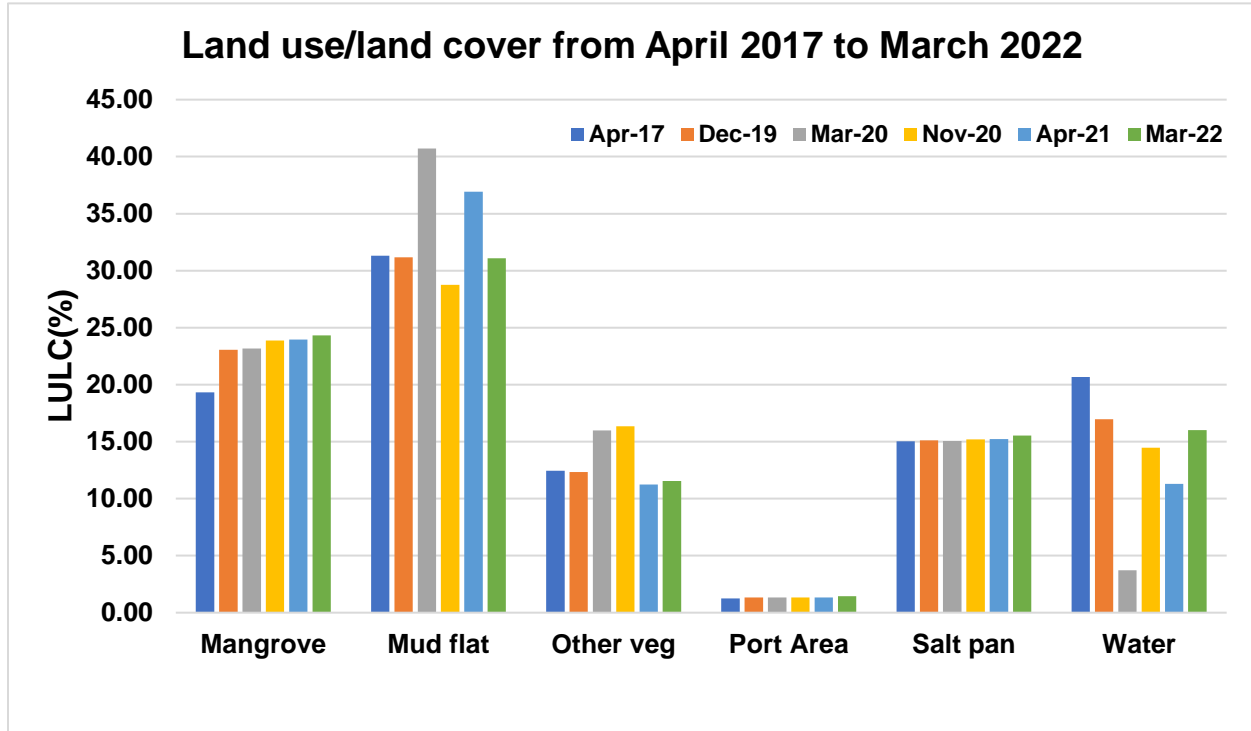


Figure.1. Land use / Land cover changes along Deendayal Port Authority

Water spread which is mostly creek systems constitutes 16.03% of the total port area of 99986.01 ha. Other coastal vegetation with an extent of 11561.20 ha occupies considerable port area constituting 11.56%. The smallest land cover of 1436.75 (1.44%) ha is occupied by the port and other built-up parts



3. Study Area & Methodology

The Deendayal Port Authority (DPA) situated in the Kandla Creek, Latitude: 23° 01" N Longitude: 70° 13"E, of Gulf of Kachchh, has continued to become the No. 1 Port for 14 years successively (Fig.2). DPA created a new record by handling 127.10 million metric tonnes of cargo during FY 2021-2 compared to 117.566 MMT in FY 2020-21, showing a growth of 8.11%. DPA is the only major Indian port to handle more than 127 MMT cargo throughput, and it has also registered the highest cargo throughput in its history. The port has handled a total of 3151 vessels during FY 2021-22 compared to 3095 vessels in FY 2019-20. While the port has flagged off several projects related to infrastructure creation, DPA has successfully awarded the work of augmentation of Liquid cargo handling capacity by revamping the existing pipeline network at the oil jetty area in September 2021. Being one of the 12 Major Ports of India, DPA has crossed 100 MMT (Million Metric Tons) in cargo handling and has handled 13.25 MMT of liquid cargo and 43.76 MMT of dry cargo and containers during the year 2021. Major commodities handled are crude oil, petroleum products, coal, salt, edible oil, fertilizer, sugar, timber, soya bean, wheat etc. Being the busiest port in recent years, it is gearing to add substantial cargo handling capacity with private sector participation.

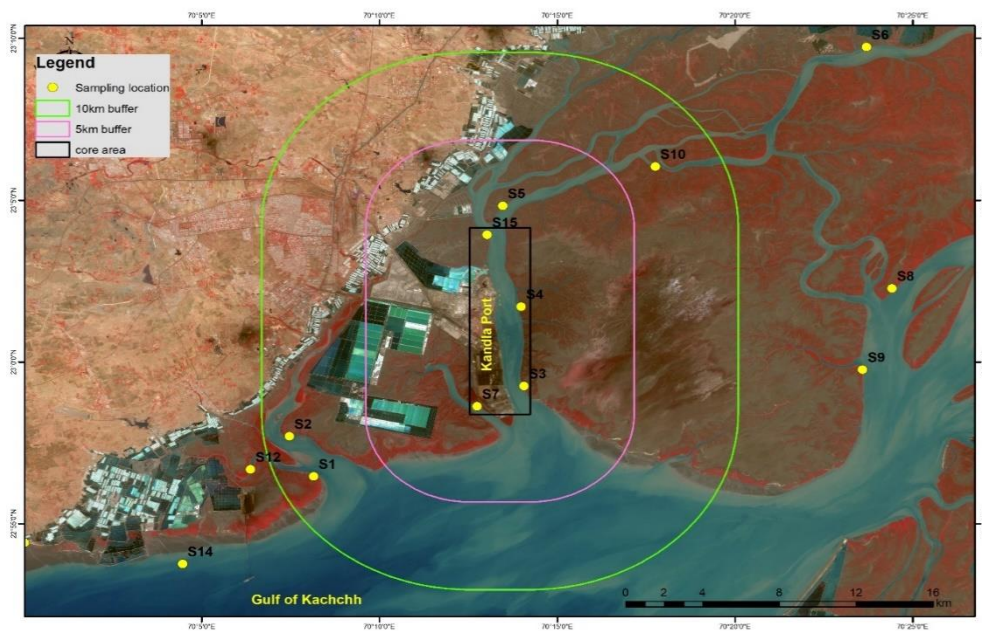


Figure.2. Deendayal Port Authority Core and Buffer Area

Deendayal Port, a leading port in India, encompasses many of the ecosystems with unique habitats and floral and faunal components, which are vulnerable to the port's regular operation, maintenance, and developmental activities. Port activities such as land reclamation, dredging and large-scale construction and its continuous expansion affecting the marine ecosystems in its vicinity. The adjoining are of the port harbours complex ecosystems/habitats such as mangroves, mudflats, salt marshes, creek systems, and coastal waters. This habitat diversity, in turn, supports a multitude of faunal and floral taxa. Co-existence of sensitive habitats such as mangroves, mudflats, and creek systems strongly underline the need to pay serious and focused attention to ensure its protection and conservation. The policy of MoEF & CC also attests to the fact that port development and marine environmental protection should go hand in hand and not at the cost of each other. Thus, assessing and ensuring the environmental well-being of the port becomes imperative in this era of heightened environmental awareness. On their part, ports are legally mandated to render their operation environmentally benign and sustainable so as to increase their green competitiveness. The Deendayal Port Authority is also reportedly developing Greenfield Smart Industrial Port Cities (SIPC) at two locations, including in Gandhidham – Adipur area spanning over 580 acres utilized for commercial, residential, and industrial development.

Deendayal Port is a natural harbour located on the eastern bank of North-South trending Kandla creek at an aerial distance of 90 km from the mouth of the Gulf of Kachchh. The Port's location is marked by a network of major and minor mangrove-lined creek systems with a vast extent of mudflats. The coastal belt in and around the port has an irregular and dissected configuration. Due to its location at the inner end of the Gulf, the tidal amplitude is elevated, experiencing 6.66 m during mean high-water spring (MHWS) and 0.78 m during mean low water spring (MLWS) with an MSL of 3.88 m. A vast intertidal expanse is present in and around the port environment, commensurate with the increasing tidal amplitude. Thus, mudflats on the intertidal zone enable mangrove formation in an extensive area.

The coastal and inland environmental setting of Kandla, similar to other parts of Kachchh, has marked climatological peculiarities like aridity, geomorphology and coastal

and terrestrial ecosystems. Annual rainfall in the Kachchh district is lesser than the southern parts of Gujarat and is often irregular and spanning about 15-20 days. The mean rainfall in the year 2019 was 194 mm.

Contrary to the southern coast of the Gulf of Kachchh, the coral formations, seaweed and seagrass beds are absent in this area along the northern coast due to high turbulence-induced suspended sediment load in the water column, a factor attributed by the conical Gulf geomorphology and surging tides towards its inner end. A number of developmental initiatives are going on for the past 7 decades, which will have their own environmental repercussions. The surrounding environment within 10 km radius of the port includes built-up areas, salt pans, human habitations and port related structures on the west and north and creek system, mangrove formations and mudflats on the east and south. The coastal belt in and around DPA port jurisdiction is characterized by a network of creek systems and mudflats which are covered by sparse halophytic vegetation like scrubby to dense mangroves, creeks and salt-encrusted landmass which form the major land components. The surrounding environment within a 10 km radius from the port includes built-up areas, salt pans, human habitations and port related structures on the west and north and creek system, mangrove formations and mudflats on the east and south.

The intertidal zone surrounding the DPA ranges 8-10 km wide, where mangrove and salt marsh and low lying muddy and sandy saline areas are available. These halophytes can be seen on the coastline in patches, and hence the diversity is very poor, as only *A. marina* and *A. officinalis* are commonly found. The creeks adjoining the main Kandla creeks are bordered with large stretches of mangroves as that of the Sat Saida bet Island, where the biodiversity is high. These coastal water bodies provide a livelihood for traditional fishermen who regularly collect several species of fishes, crabs and shrimps. The mangroves, mudflats, and mangrove-associated halophytes support a large number of avifauna and reptiles. Considering the relatively low level of impact on the mangrove habitats and the intertidal biodiversity, it is imperative to propose a management plan to safeguard the biodiversity of the port influencing area and the coastal water.

3.1. Methodology for assessing the present state of biodiversity

3.1.1 Primary productivity

Phytoplankton possess the plant pigment Chlorophyll a which is responsible for synthesizing the energy for metabolic activities of phytoplankton through the process of photosynthesis in which CO₂ is used, and O₂ is released. It is an essential component to understand the consequence of pollutants on the photosynthetic efficiency of phytoplankton in the system. For the estimation of Chlorophyll 'a' and Phaeophytin pigments, the fluorescence of the Acetone extract was measured using Fluorometer before and after treatment with dilute acid (0.1N HCL) (Strickland and Parsons, 1972).

3.1.2 Phytoplankton

Phytoplankton samples were collected from 15 sampling sites from the coastal water using a standard plankton net with a mesh size of 25µm and a mouth area of 0.1256 m² (20 cm radius). The Quantitative analysis of phytoplankton (cell count) was carried out using a Sedgewick-Rafter counting chamber. The density (No/l) was calculated using the formula: $N = nxv/V$ (Where N is the total No/liter, n is an average number of cells in 1 ml, and v is the volume of concentrate; V is the total volume of water filtered. The identification was done by following the standard literature of Desikachary (1987), Santhanam *et al.*, (2019) and Kamboj *et al.*, (2018).

3.1.3 Zooplankton

Zooplankton samples were collected using a standard zooplankton net made of bolting silk having 50µm with a mouth area of 0.25 m² fitted with a flow meter. The group/taxa were identified using standard identification keys, and their number was recorded. The population density was recorded by using the Sedgewick rafter cell. Univariate measures such as Shannon-Wiener diversity index (H'), Margalef's species richness (d), and Pielou's evenness (J'), Simpson's dominance (D) was determined using PAST software.

3.1.4 Intertidal Fauna

Intertidal faunal assemblages were studied for their density, abundance and frequency of occurrence from the selected locations within the DPA jurisdiction by following the quadrat method (1 x1 m²), and the organisms were identified using standard identification keys (Abott, 1954; Vine, 1986; Oliver, 1992; Rao, 1989; 2003; 2017;

Psomadakis et al., 2015; Apte, 2012; 2014; Naderloo 2017; Ravinesh et al. 2021; Edward et al., 2022).

3.1.5 Subtidal Macro Benthic Fauna

The sub-tidal benthic organisms were collected at each station using the Van Veen grab, which covers an area of 0.04m². The wet sediment was sieved (mesh size 0.5 mm) for segregating the organisms. The organisms were sorted, enumerated and identified by following available literature Day (1967), Hartman (1968, 1969), Rouse and Pleijel (2001), Robin et al. (2003), Amr (2021), were referred for polychaetes; Crane (1975), Holthuis (1993), Naderloo (2017), Xavier et al., (2020) for crustaceans; Chapgar (1957); Rao (1989, 2003, 2017), Apte (2012,2014), Ramakrishna and Dey (2007), Ravinesh et al. (2021) and Edward et al., (2022) for molluscs. Further, the data were processed for univariate statistical methods in PRIMER (Ver. 6.) statistical software (Clark and Warwick, 2001).

3.1.6 Sediment assessment of Mudflats

Mudflats are intimately linked by physical processes and dependent on coastal habitats and they commonly appear in the natural sequence of habitats between subtidal channels and vegetated salt marshes. Mudflats are sedimentary intertidal habitats created by deposition in low energy coastal environments, particularly estuaries and other sheltered areas. Their sediment consists mostly of silt and clay with high organic carbon content. Mudflats are characterized by high biological productivity and abundance of organisms, but low diversity with few rare species. The mudflat biota reflects the prevailing physical conditions of the region. The upper mudflats lie between the mean high-water neap and mean high water springs. Mudflats will often continue below the level of low water spring tides and form sub-tidal mudflats (McCann, 1980). The upper parts of mudflats are generally characterized by coarse clays, the middle parts by silts, and the lower region by sandy mud (Dyer et al., 2000). The upper mudflats are the least inundated part and are only submerged at high water by spring tides (Klein, 1985) and show sparse halophytes. The Sediment samples were collected from the surface up to 100 cm at four intervals (0-25cm, 25-50cm, 50-75cm & 75-100cm), and the bulk density (Maiti, 2012) and total organic carbon (Walkley and Black, 1934) content were estimated.

3.1.7 Mangrove assessment

Mangroves were widely distributed along the different creeks under DPA jurisdiction, such as Tuna creek, Jangi creek, Kandla creek, Khori creek, Phang creek, Vira coast and Navlakhi creek. The vegetation structural attributes of all the mangrove stands were accounted for based on Point Centered Quadrature Method (PCQM) or Quadrature or Transect method. The methodology and measurement accuracy of Cintron and Novelli (1984) was adopted for the measurements of density, height variations, canopy cover and basal area at each stand. At each 200 m transects, sub-plots of 1×1 m² and 2×2 m² have been laid randomly to enumerate regeneration and recruitment class, respectively. Seedlings with a height of <50 cm have been considered regeneration class, while the recruitment class was well-established saplings with >50cm height.

3.1.8 Halophytes

To quantify and document the halophytes at Deendayal Port region, quadrature method was followed. At each sampling location, quadrates of various sizes have been laid during every seasonal sampling. For recording plant density at each transect, quadrates of 10 x 10m, 5 x 5m and 1 x 1m were laid within each tree; quadrates of 10x10m (tree), 5x5m (shrub) and 1x1m (herb) were used randomly (Seema Misra,1968; Bonham 1989). Four quadrates each for shrubs and herbs were laid in side each tree quadrate to assess the halophytes in the study area. To enrich the species inventory, areas falling outside the quadrates were also explored and the observed species were recorded and photographed, and species were identified using standard keys. Specimens of species were collected to know more information on habitat and for the preparation of herbarium.

3.1.9 Marine Fishery

Fishery resources and diversity were assessed from the selected sampling sites. Finfish and shellfish samples were collected using a gill net with 10 mm mesh size. The net was operated onto the water from a canoe or by a person standing in waist deep water during the high tide using a cast net. For effective sampling, points were fixed at a regular distance within the 15 offshore sites for deploying fishing nets to calculate the Catch per Unit effort estimated per hour. The collected specimens were segregated into groups, weighed and preserved in 10% neutralized formalin solution. Finfishes were identified following Fischer and Bianchi (1984), Masuda et al. (1984), de Bruin et al. (1995) and

Mohsin and Ambiak (1996). Relevant secondary information pertaining to fishery resources of Deendayal Port creek systems were gathered through technical reports, District Fisheries department, Government gazette and other research publications.

3.1.10 Avifauna

The mangrove habitat along the Gulf of Kachchh was delineated into 15 major sites based on the subjective magnitude of anthropogenic pressure. At each project site, creeks of varying lengths from 2 to 5 km were surveyed by moving on the boat and adopting “line transect” method. A total of 15 transects (one at each site) were placed to count the birds. Survey was done in both terrestrial habitats like natural mangroves, plantations adjoining the mudflats, wasteland, and aquatic habitats like creek areas, rivers and marshes.



4. State of the Biodiversity of Deendayal Port Authority

4.1 Status of Intertidal & Sub tidal macrobenthic fauna

The results of the three-year monitoring of the macrobenthos inhabiting the intertidal zone in the mangroves and the open coast revealed that the species diversity and the population density of the fauna had declined markedly. The total faunal density was 304/ m² in 2019, and it was reduced to 246 / m² in 2022 (Table-1), which showed an increasing trend ranging between 15-221/ m² in 2022. The sub-tidal benthic fauna population density varied between 375/ m² and 1050/ m² (Table 2). The Shannon diversity (H') values varied from 1.49 (S-5) to 2.51 (S-14) during 2022, which is also better than the previous year. The number of species in the subtidal zone was higher; a maximum of 9 were recorded in 2022, with the highest density of 246 individuals /m² intertidal fauna.

The common group of macrobenthos inhabiting the different levels within the intertidal area are Gastropods, Polychaetes, crabs and the mudskipper. The results of the three-year study indicate that the macrofaunal population tend to increase, even though seasonal fluctuations are existing.

Table-1. Intertidal faunal trend for the period (2019 - 2022)

Year	Population Density (No/m ²)	Total No. of Species
2019	5 to 304	50
2020	1 to 80	20
2021	1 to 65	12
2022	30 to 246	21

Table 2. Subtidal Macrobenthos trend study (2019 - 2022)

Year of report	Population density (No/m ²)	No. of species
2019	300 to 1550	52
2020	250 to 1250	26
2021	200 to 1200	22
2022	275 to 1050	22

4.1.1 Phytoplankton

Phytoplankton samples were collected from prefixed 15 sampling sites from the coastal water using a standard plankton net with a mesh size of 25µm and a mouth area of 0.1256 m² (20 cm radius). The Quantitative analysis of phytoplankton (cell count) was carried out using a Sedgewick-Rafter counting chamber. The density (No/l) was calculated using the formula: $N=nxv/V$ (Where, N is the total No/liter, n is the average number of cells in 1 ml, and v is the volume of concentrate; V is the total volume of water filtered. The identification was done by following the standard literature of Desikachary (1987), and Santhanam et al. (2019). In 2021, the phytoplankton cell density was a maximum of 22653No/L (Table. 3). The total genera observed was 14 from all the sites monitored.

Table 3. Phytoplankton trend study (2019 - 2022)

Phytoplankton				
Overall Average	2019	2020	2021	2022
Genera	16	18	14	20
Density	13509 No/L	17568 No/L	22653/L	12533 No/L

4.1.2 Zooplankton

Zooplankton samples were collected using a standard zooplankton net made of bolting silk having 50µm with a mouth area of 0.25 m² fitted with a flow meter. The group/taxa were identified using standard identification keys, and their number was recorded. The population density was recorded by using the Sedgewick rafter cell. The maximum zooplankton cell density was recorded was 41630 No/L (Table. 4). The total genera observed was 42 from all the sites monitored.

Table 4. Zooplankton trend study (2019 - 2022)

Zooplankton				
Overall Average	2019	2020	2021	2022
Genera	15	25	19	42
Density	13110 No/L	14613/L	41630/L	16777/L

4.1.3 Mangroves

Mangroves were widely distributed in the DPA jurisdiction along the Kandla coast. The 15 mangrove sites were selected at different creeks such as Tuna creek, Jangi creek, Kandla creek, Phang creek, Vira coast and Navlakhi creek. DPA port is probably the only port in India with a largest mangrove extent of 243.287 km², which forms 24.33% of the total area occupied. The present mangrove data (GIS &RS) have been compared with an earlier study by GUIDE (2017-18, 2018-19, 2019-20), which revealed that the mangrove cover had been increased (Table. 5). The recent assessment of the mangrove with respect to plant density indicated that the maximum trees were observed in Kandla creek; the average density was 5444/ ha during 2022.

The surveys during the 2019-2020 periods showed a recovery in the plant density at all the sites ally and showed an increase in the number of plants at all the sites. The plant height varied from a maximum of 2.2 m to 1.5 m (Table 8, Table 9). Among all the sampling sites the highest canopy cover was reported in Tuna creek. At Tuna block, the recruitment plant density was the highest among all the sites in 2017-2018, and later it was reduced. However, the Navlakhi block exhibited higher recruitment in February 2021. Similar to the recruitment density, the regeneration of plants was reduced invariably at all sites. The ratio of recruitment to regeneration density also resulted in distinct variations between sites as well as seasons.

The results on monitoring of mangroves in the year 2022 revealed that the mangrove plant density had increased, particularly in Navlakhi and Kharo creek areas. The overall average density was 3712/ha. The Plant height, Girth and the Canopy cover were also increased compared to the previous years and were maximum at Tuna creek and Navlakhi creeks. The overall tree height was 113.2m, with heights ranging between from 76cm to 170cm at the 15 sites monitored. The average canopy cover of the mangroves was 2 m, and the range was 1- 3 m in the mangrove around DPA coastal environment. The tree Girth average being 10.42 cm, while the average range was 7-15 cm at the different areas monitored. In general, the mangrove plants are growing well in the creek environment where ever the tidal inundation is maximum in a day, then the interior locations where the water reaches only during spring tides.

Table 5. Mangroves trend study (2019 - 2022)

Mangroves			
Average	2019- 2020	2020- 2021	2021-2022
Density (No/Ha)	2702	3134	3712
Height (m)	1.36	1.47	1.13
Canopy (m²)	2.54	3.04	2
Girth (cm)	14.98	21.82	10.42

4.1.4 Seaweeds, Seagrasses and Corals

Apart from the ones that occur in coastal water, seaweeds, seagrasses, and corals are also nurseries for many marine organisms. Along with the coastal environment of DPA port jurisdiction, corals, seaweeds and seagrass formations were not observed. The intertidal area of Kandla is mainly muddy. Coral growth in the sub-tidal region is unlikely in view of the high suspended solids in the water column that do not favour the growth of the benthic macro algae, which need a hard substratum to attach the rhizoids. The seagrasses also prefer sand and mixed soil and shallow bottom with the low suspended matter in the water. The texture of the soil in the study sites were dominated with clay fraction, which may not support the growth of sea grass communities as well.

4.1.5 Halophytes

To quantify and document the halophytes at Deendayal Port region, nested quadrat sampling method was followed. At each sampling location quadrates of various sizes have been laid during every seasonal sampling. For recording plant density at each transect, quadrates of 10 x 10m quadrats were laid for assessment of trees, 5 x 5m for shrubs and 1 x 1m quadrats for herbs (Misra,1968; Bonham 1989). Four quadrates each for shrubs and herbs were laid within the 10X10 m quadrat to assess the halophytes in the study area (Table 6). To enrich the species inventory, areas falling outside the quadrates were also explored and the observed species were recorded and photographed, and species were identified using standard keys. Specimens of species were collected to know more information on habitat and for the preparation of herbarium (Plate 1).

Table 6. Halophytes trend study (2019 - 2022)

2020												
Halophytes	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12
<i>Aeluropus lagopoides</i>						√						
<i>Salicornia brachiata</i>			√	√	√	√			√	√	√	
<i>Salvadora persica</i>			√	√	√							
<i>Sesuvium portulacastrum</i>	√	√		√	√	√	√			√	√	√
2021												
Halophytes	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12
<i>Salicornia brachiata</i>			√	√	√	√	√	√	√	√	√	
<i>Salvadora persica</i>			√	√	√					√		
<i>Sesuvium portulacastrum</i>	√	√		√	√	√	√		√	√	√	√
2022												
Halophytes	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12
<i>Aeluropus lagopoides</i>						√						
<i>Salicornia brachiata</i>			√	√	√	√		√	√	√	√	
<i>Salvadora persica</i>			√	√	√							
<i>Sesuvium portulacastrum</i>	√	√		√	√	√	√			√	√	√
<p>Note: S-1, S-2 and S-12: Nakti creek; S-7: Khari creek; Kandla creek/Phan creek; S-3,S-4, S-5 S-10; S-6 and S-11: Jangi creek; S-8 and S-9: Navlakhi creek</p>												

Plate 1. Halophytes of DPA area



A-B. *Salicornia brachita*



C-D. *Sesuvium portulacastrum*



E-F. *Suaeda sp.*

4.1.6 Marine fisheries

Marine fish production of India during the financial year 2019-2020 was 37.27 lakhs tons (Fisheries Statistics 2021). The production varied from 0.2 to 7.01 lakh tons, and Gujarat state contributed the highest production potential of 7.01 lakhs tons (Fisheries statistics 2021). The Ichthyofauna diversity in, specific to Kandla and its periphery environment, is mostly connected to the Sikka coast of Jamnagar, where 112 ichthyofauna species belonging to 50 families, 12 orders, and 84 genera has been reported (Katira & Kardani 2017). Similarly, the locality of Jamnagar Marine National Park, Gulf of Kachchh, reported 109 ichthyofauna species belonging to 58 families, 19 orders, and 93 genera (Brahmane et al. 2014). Experimental Fish Catch in DPA during 2020-2022 are given in (Table 7).

Table 7. Experimental Fish Catch in DPA during 2020 to 2022

S. No	Species	Khari Creek Weight (Kg)	Tuna Creek Weight (Kg)	Navlakhi Weight (Kg)	Jangi creek Weight (Kg)	Total Weight (kg)
2020						
1	<i>Mugil cephalus</i>	30	-	100	-	130
2	<i>Penaeus indicus</i>	0.2	-	0.5	-	0.72
3	<i>Thryssa sp.</i>	1.5	-	-	-	1.50
4	<i>Liza parsia</i>	1.5	-	-	-	1.50
5	Puffer fish	0.1				0.10
Total weight		33.3	-	100.5	-	133.82
2021						
1	<i>Penaeus indicus</i>	-	0.5	-	-	0.5
2	<i>Chanos chanos</i>	-	0.25	-	-	0.25
3	Mudskipper	-	0.25	-	-	0.25
4	Therapon fish	-	0.1	-	-	0.1

5	<i>Portunus pelagicus</i>	-	0.25	-	-	0.25
6.	Other crab species	-	0.4	-	-	0.04
Total weight			1.39	-		1.39
2022						
1	<i>Chanos chanos</i>	0.79	3	-	4.52	8.31
2	<i>Mudskipper</i>	0.29	.7	-	0.9	1.89
3	<i>Therapon fish</i>	4.5	5.5	-	-	10
4	<i>Scylla serrata</i>	3.2	2.7	-	1.05	6.95
5	<i>Planiliza planiceps</i>	-	3.3	-	1.37	4.67
6	<i>Arius jella</i>	-	1.25	-	-	1.25
7	<i>Eletheronema tetradactylum</i>	1.4	0.96	-	3.25	5.61
8	<i>Brachirus orientalis</i>	-	.3	-	.7	1
Total weight		10.18	17.71	-	11.79	39.68

4.1.7 Avifauna

The present seasonal study revealed 63 species of aquatic birds from the whole study area, of which six were of near threatened category, and the rest all were least concerned on the IUCN (2022) list. Among the six species, lesser flamingos were abundant; a maximum of 81 numbers were reported during winter from the project sites (Table. 8). No endangered aquatic birds were reported from the study area. A few representative photographs are shown on the (Plate. 2).

Table 8. Status of avifauna density and diversity for the period 2019-2022

	Total		
Diversity Indices	2019-20	2020-21	2021-22
No. of Species	89	96	52
Individuals	2534	2869	1554
Shannon_H'	4.152	4.216	3.676

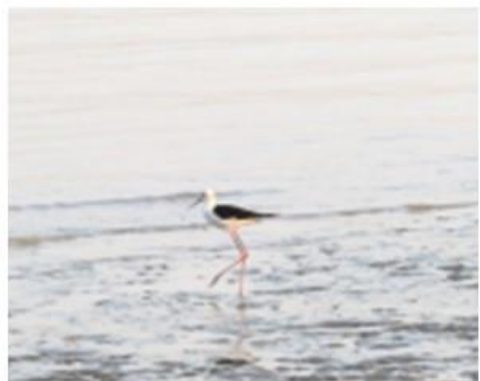
Plate 2. Mangrove associated Avifauna at DPA



A. Ardea cinerea



B. Ardea alba



C. Himantopus himantopus



D. Mycteria leucocephala



E. Egretta garzetta



F. Dromas ardeola

4.1.8 Status of the diversity in and around of proposed berth (Oil jetty 8-11)

The biodiversity status of proposed berth in oil jetty (8-11) covering the station S-3, S-4 and S-7 , detailed diversity status of proposed area presented in table 9.

Table 9. Diversity status of proposed berth (oil jetty 8-11)

Genera/species	Station -3			Station-4			Station-7		
	Mon	PO-Mon	PRE-Mon	Mon	PO-Mon	PRE-Mon	Mon	PO-Mon	PRE-Mon
Intertidal (No/m2)	51	166	207	65	221	131	58	105	91
Subtidal (No/m2)	34	750	575	26	850	875	27	375	1050
Phytoplankton (No/L)	6	21	19	9	18	18	8	21	17
Chlorophyll a (mg/L)	0.11	0.04	0.78	0.01	0.03	0.72	0.04	0.21	0.78
Zooplankton (No/L)	23	25	24	26	27	29	20	24	28
PHc(mg/L)	29	31.24	24.14	6	27.15	21.32	6.5	29.42	19.91
Mangroves (Density No/Ha)	3036	2658	4955	7851	2738	8318	5289	5524	3699
Halophytes (% cover)	5	8	30	8	51	61	10	0	0
Seaweed	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
seagraa	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
coral	NIL	NIL		NIL	NIL		NIL	NIL	
Avifauna (no of species)	25	37	22	24	36	21	21	48	27
Reptiles	NIL	NIL	1	NIL	NIL	NIL	NIL	NIL	NIL
Mammals	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

MON- Monsoon, PO-MO- post monsoon ,PRE-MON-Premonsoon

Presently the biodiversity pattern proposed development is dynamics which is mostly influenced by Physico-chemical and biological characteristic creek ecosystem. The primary productivity (Chlorophyll a) concentration is lower in all station which might be due to due to high suspended load and mud derived from the mangrove environment and in and out flow tidal current. The plankton community, intertidal and subtidal community in all three station followed the same pattern and mostly influenced by the suspended load and it may change in every season by the environmental gradient. Zingde et al.(1996), (NIO, Mumbai) during 1996 and 1998 have conducted extensive studies on the environmental characteristics of the proposed oil jetty area and observed low concentration of PHC in Kandla Creek area.

In the present study the petroleum hydrocarbon concentration was found to increase in the vicinity of the oil jetty sites particularly during post monsoon period in the recent times and it is expected to increase further with the addition of new facilities to handle oil and petroleum products.

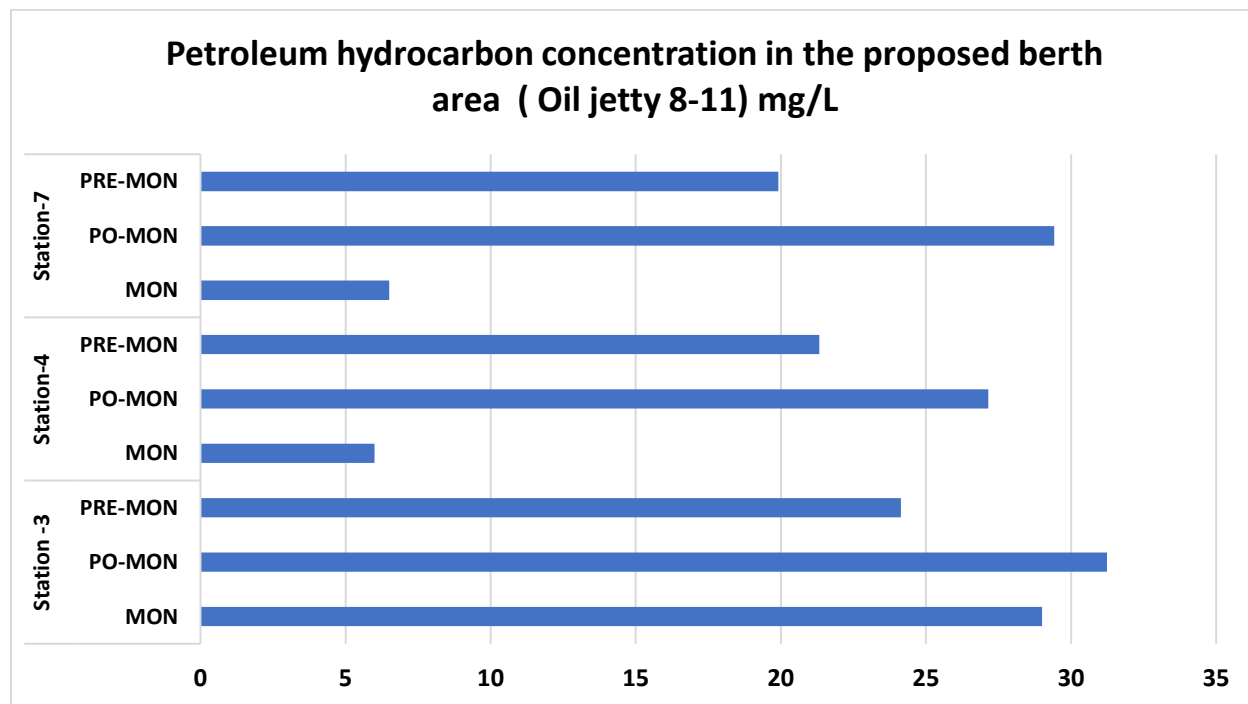


Fig 3 The petroleum hydrocarbon in the water in the oil jetty area

At present the petroleum hydrocarbon concentration of the purposed berth (8-11) sites varied from 6 mg/L to 31.24 mg/L. The Highest concentration was observed during post-monsoon. This might be the result of localized unintentional introduction of oil products during handling the crude petroleum products at the Kandla Port especially at oil terminals (NIO,2002). The lowest concentration was observed in monsoon which might due to the dispersal of the oil slick by the influx of large quantity of rain water away from the the creek environment (fig.3). The high range of petroleum hydrocarbon and phenol results from The increased concentration of PHC is likely to affect the marine biota and primary productivity of the phytoplankton in the water and the mangroves as well since the chloroplasts in the leaves are impaired and slowly the chlorophyll pigment will be reduced. The halophyte density will be affected and make the area unsuitable as wildlife

habitat particularly birds in the entire Kandla Creek. The 'designated best use' for Harbour activities suggest a lower concentration of less than 10 mg/l of PHC and other floating matters (MOEF, 1998)

4.1.9 Land-use and land cover changes

In order to understand the spatial and temporal changes in the vicinity of the Deendayal port jurisdiction area, Remote Sensing and GIS technique has been employed. Land cover classification was carried out using digital satellite imageries. LISS 4 Images for the Deendayal Port area were acquired for the period of April 2017, December 2019 and March 2020, November 2020, April 2021 and March 2022 were used for the study (Table 10).

The GPS locations with the land use details was used for the supervised classification of different images with temporal variability. For the tonal variation and pixel values in the imageries, a supervised Maximum Likelihood Classification (MLC) and NDVI (Normalised Difference Vegetation Index) methods were used for the classification. Six major classes, viz., mangrove, water, mudflat, other vegetation, salt pan and port, were delineated.

Table 10. Details of the satellite imagery used for monitoring studies

Imagery use	Satellite name	Sensor	Spatial Resolution	Date acquired
2017	IRS-R2A	LISS IV	5.8m	26 April- 2017
2019	IRS-R2A	LISS IV	5.8m	24-Dec-2019
2020	IRS-R2A	LISS IV	5.8m	29-March-2020
2020	IRS-R2	LISS IV	5.8m	17-Nov-2020
2021	IRS-R2	LISS IV	5.8m	10-Apr-2021
2022	IRS-R2	LISS IV	5.8m	12-March-2022

ERDAS Imagine 9.3 was used for satellite image processing, classification and data transformation, whereas ARC GIS 10.3 was used for the map formation. For graphs and databases processing, MS WORD and MS EXCEL were used. Ground truth study comprises data collection of ground features along with the respective geographical positions in terms of latitudes and longitudes with Garmin e-Trex Vista GPS. Thus, the data were interpreted using all the collected information.

The data analysis of the imageries of 99986.01ha area of the DPA jurisdiction revealed that the mangrove cover occupies 24.33 % of the total, and the major portion is that of

mudflats, 31.09%. The water spread portion and salt pans occupy 16.03% and 15.55 %, respectively. The vegetation cover is 11.56%, and the rest 1.44% is the port and the adjoining facilities (Table 11).

Table 11. Land use /land cover statistics in the DPA area for March-2022

Class	Area (ha)	Percentage
Mangrove	24328.70	24.33
Mudflat	31089.06	31.09
Other vegetation	11561.20	11.56
Port Area	1436.75	1.44
Salt pan	15545.70	15.55
Water	16024.60	16.03
Total	99986.01	100.00

From April 2019 to March 2022 the overall mangrove area increased from 19319 ha to 24328.7 ha, i.e., 5 % of the total area of DPA. Mangrove area is replacing the mudflat, hence there is a decrease in the mudflat area. However, the overall trend shows mudflat is replaced by mangroves. (Fig 4-7). The relatively lengthy rainy days during the 2020 monsoon would have positively impacted the mangroves to flourish well with the result the mangrove cover has increased (Table. 12).

Table 12. Percentage of Land use /land cover of DPA area during 2019-2022

Month-Year	Dec-19	Mar-20	Nov-20	Apr-21	Mar-22
Class					
Mangrove	23.06	23.17	23.86	23.97	24.33
Mudflat	31.18	40.72	28.77	36.91	31.09
Other vegetation	12.33	15.99	16.35	11.23	11.56
Port Area	1.35	1.35	1.35	1.35	1.44
Salt pan	15.12	15.06	15.20	15.24	15.55
Water	16.96	3.71	14.48	11.30	16.03
Total	100	100	100	100	100

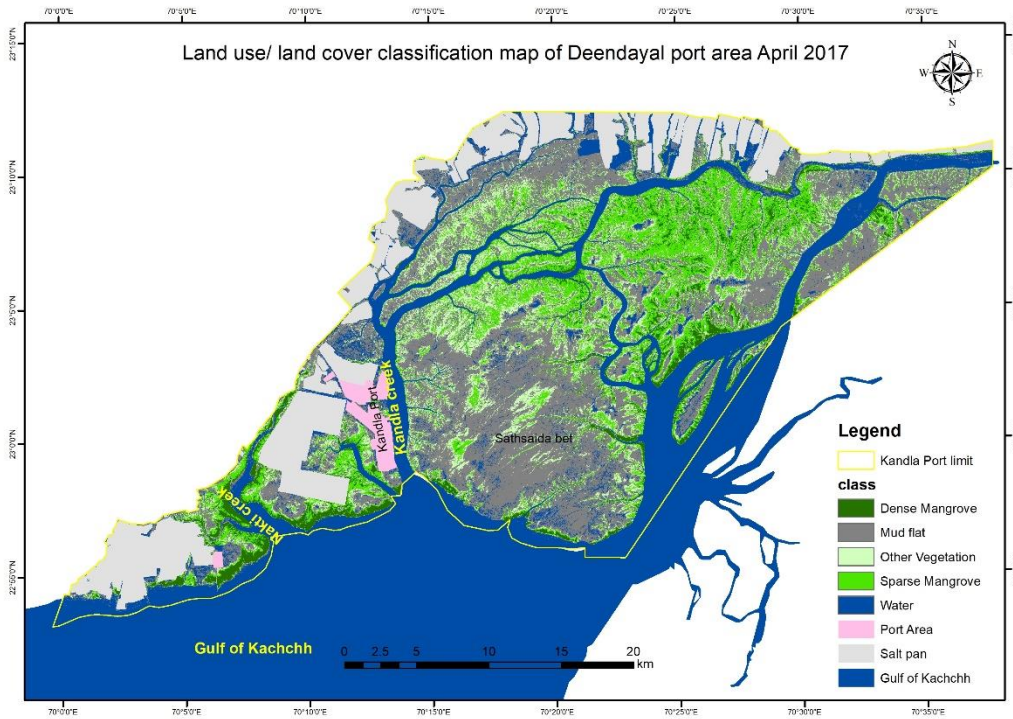


Figure. 4. Land use/ land cover classification in DPA area December-2017

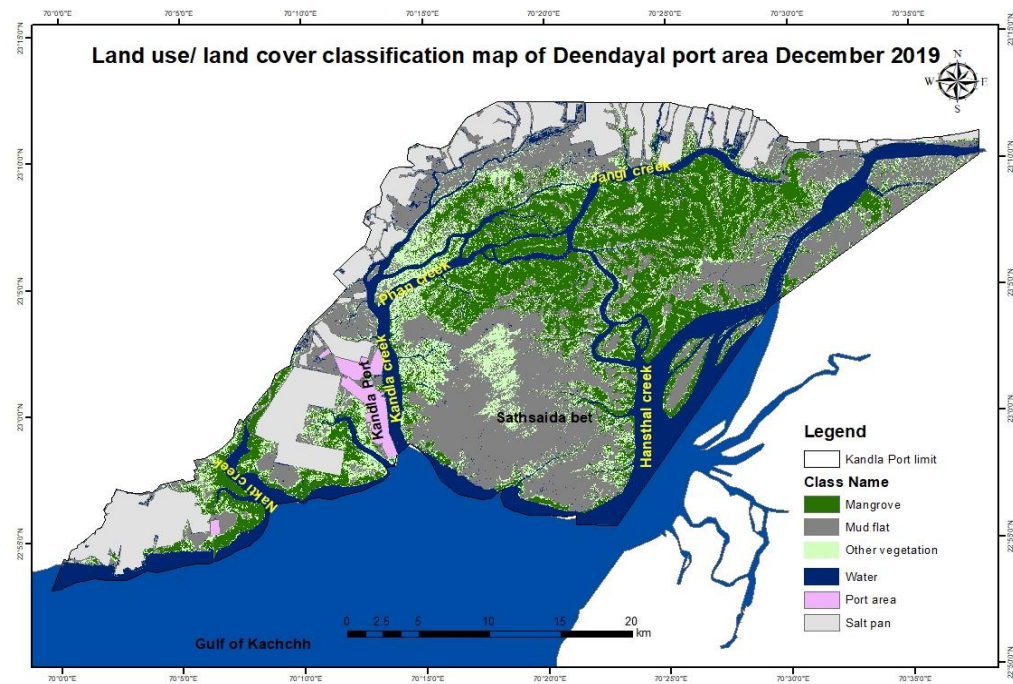


Figure. 5. Land use/ land cover classification in DPA area December-2019

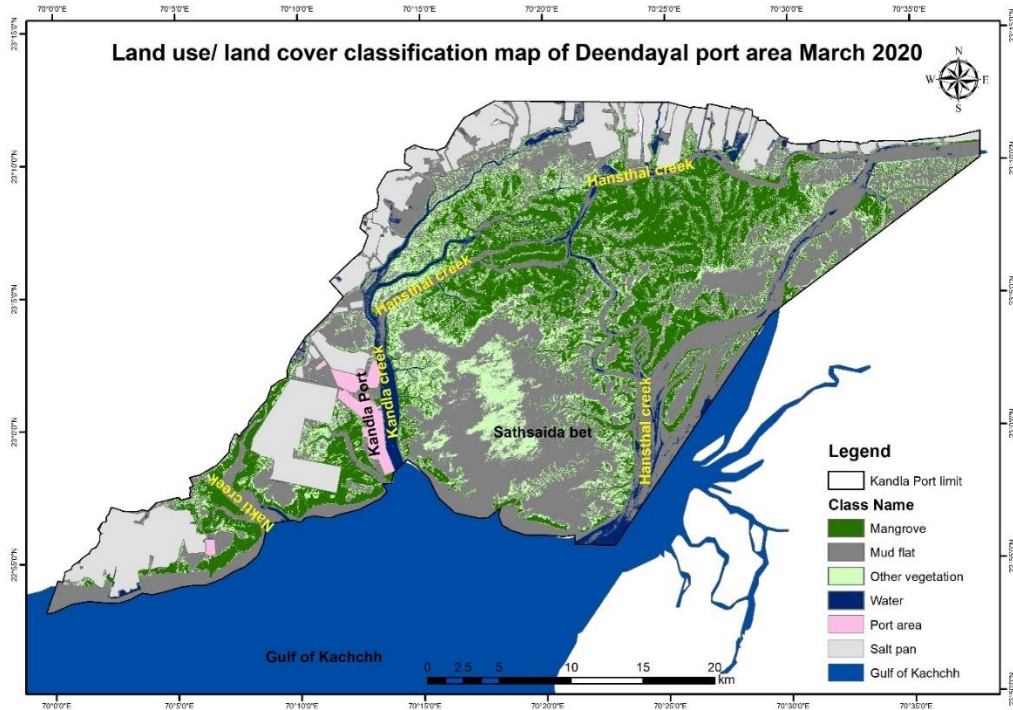


Figure. 6. Land use/ land cover classification in DPA November-2020

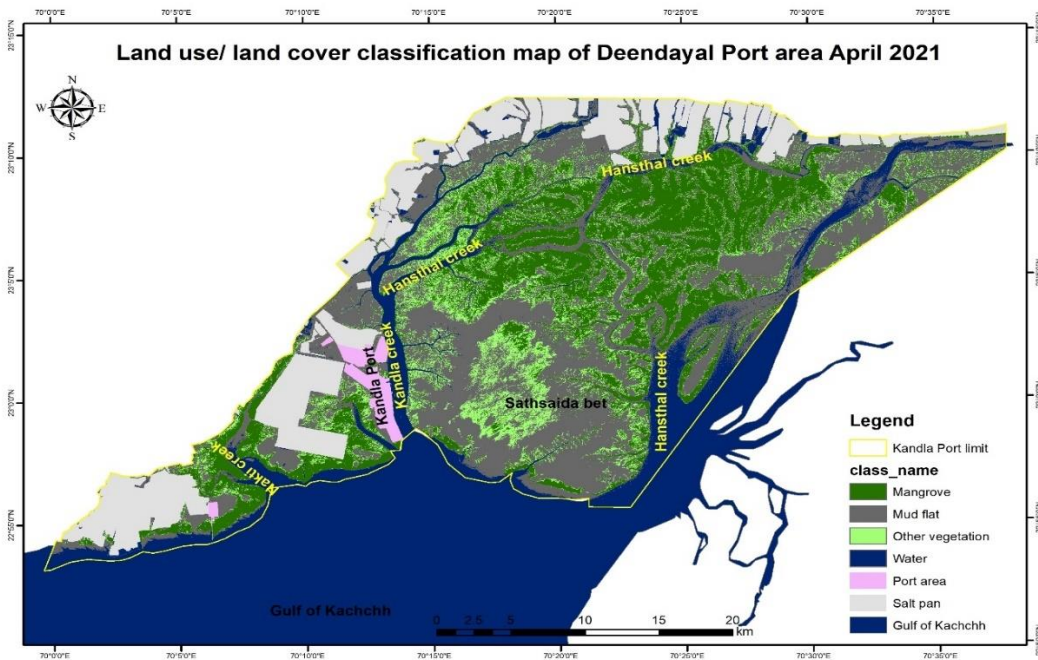


Figure. 7. Land use/ land cover classification in DPA April-2021

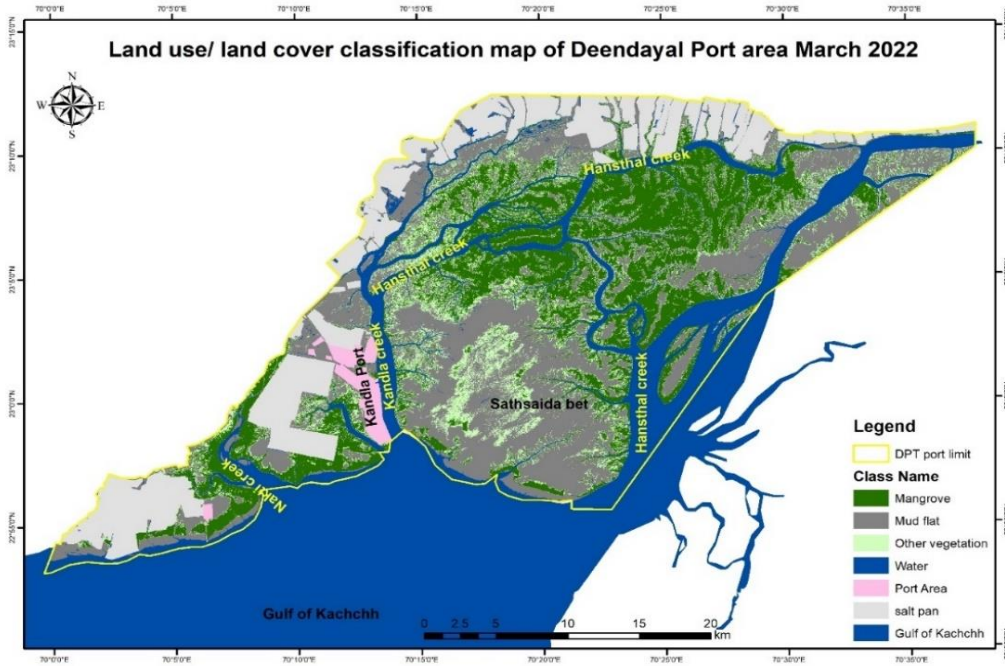
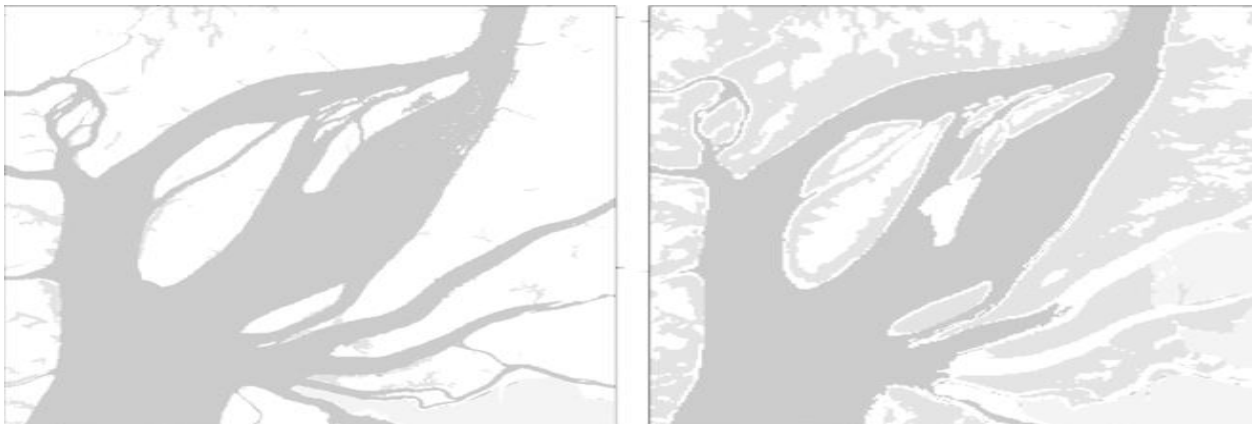


Figure. 8. Land use/ land cover classification of DPA area- March-2022



5. Impact on Biodiversity of Deendayal Port Authority environment

5.1 Intertidal and subtidal zone

The intertidal zones are the regions of high primary productivity and carbon sink and hence highly valuable with respect to climate control. However, this region has been widely exposed to anthropogenic pressures in the form of pollution, harbour activities and recreation points, leading to habitat degradation and loss of valuable animal and plant life. Development and reclamation processes that are carried out in these zones are associated with short and long-term biological, physical and chemical alterations that may negatively impact biodiversity richness, abundance and biomass of marine organisms (Tu Do et al., 2012). A decrease in biodiversity could alter key ecosystem functions, in particular the cycling of carbon and nitrogen, especially as shelf seas are known to host a disproportionately large fraction of productivity (Field *et al.*, 1998).

The common group of macrobenthos inhabiting the different levels within the intertidal area are Gastropods, Polychaetes, crabs and the mudskipper. These organisms are vulnerable to the seasonal variations in the physical and chemical parameters, in addition to the forces exerted by the tidal currents, wave action and the related water movements. The water currents in the Port area influence the sedimentation of the soil that are being taken off from the shore line as well as the turbidity arise from the vessel movements. This could be the reason for the low level of species diversity of the fauna. There were no new genera found in the benthic samples. In this regard, the methods to be followed for the enhancement and survival of benthic fauna should be charted out with measures to minimize shoreline erosion and sediment erosion.

5.2 Phytoplankton and Zooplankton

In the port premises, dredging is the major activity that increases water turbidity and suspended load thereby impacting plankton and productivity. The geomorphology of the Gulf of Kachchh and the prevailing tidal currents tend to create erosion necessitating the frequent removal of the bottom sediments from the channels to facilitate the movement of vessels. This action imparts high suspended matter concentration in the water, which is deleterious to the phytoplankton and the filter-feeding organisms in the pelagic and

benthic realm. Further, the resuspension of the soil fraction, clay and organic particulates takes a long time to settle down in the deeper layers in the creek systems, unlike the open sea, causing conditions not normally experienced by the organisms. Effects of suspended sediments are highly species specific and can vary greatly (Clarke and Wilber, 2000). Increase in suspended materials in the water column will diminish the light penetration with potentially adverse effects on the photosynthetic capability of phytoplankton and other aquatic plants (Iannuzzi *et al.*, 1996). Apart from this, various activities during the construction phase of the project such as dredging, sand compaction and other construction work in water make it turbid and also lead to increased levels of suspended solids.

5.3 Marine Fisheries

Regular dredging activities in the Port area can potentially impact marine fauna through physical contact with dredging equipment and indirectly through changes due to noise and vibrations passed through the water column. The sound waves in the seawater pass at a faster rate than the air, and this property of seawater is a hindrance to the very sensitive marine fishes and makes them to move away from the disturbed area. The most important potential impact of vessel movement in the harbour and the dredging in the navigation channel creates the fine particulate matter to suspend, and the water becomes permanently turbid. Two sites are generally directly affected by dredging, the dredging site and the dredged material disposal site and the sediment plumes can extend several kilometers from the dredging operations, depending on the quantities and grain-size composition of the dredged material and local hydrodynamic conditions (Evans *et al.*, 2012; Fisher, *et al.*, 2015). The tidal water flushing also intensifies the level of turbidity and directly limits the light penetration in the water, and brings down the photosynthesis by the phytoplankton, seaweeds and seagrasses. Thus, the primary productivity of the water will be affected, which is directly correlated with the secondary and tertiary productivity of the water. The coastal fisheries are very much dependent on the productivity on the phytoplankton and zooplankton as food. The high turbidity due to heavy suspended solids (up to 4400 mg/l) load during dredging and reclamation can clog the gills of filter feeders, including fishes affecting the metabolic processes.

5.4 Mangroves

The Direct impacts of port activities like the expansion of infrastructure development on the buffer zone and clearing of the vegetation will impact the intertidal biodiversity, and hence regular monitoring of the water, intertidal zones, coastal vegetation habitats, mangroves, mudflats, marshes and wetlands are to be carried out in order to describe the variations in flora and fauna with respect to the influencing physical and chemical parameters of the water and soil

Dust generated during the construction and operational phases of the proposed development could result in dust being deposited on surrounding mangroves., halophytes Recent research has, however, indicated that iron ore dust on mangroves does not block leaf stomata or restrict transpiration, and does not significantly impact the overall condition of vegetation (Paling et al. 2001). Accumulation of dust on mangrove leaves adjacent to the proposed development may impact on insects inhabiting mangrove canopies. Dust impacts on mangrove canopy insects are not well known, as the insects migrate to suitable habitats. It is also likely that different species will have different tolerance levels to the type of dust particles, which in turn may result in compositional changes to the assemblage of canopy insects in mangroves adjacent to the proposed development. However, insect fauna is integral in the pollination of the mangrove and halophytes and also, the larval stages are serving as an important food source for the fishery resources. Generally, it is expected that intertidal epifauna with are motile will move away from the project area during construction, particularly in the case of some species of mangrove crabs and mudskippers as they have well-developed sense organs. They tend to shift from the disturbed area with the progress of the human interference. Furthermore, surrounding mangrove habitat that will not be cleared is expected to support sustainable populations of all species such that there will be no long-term impacts on populations or species.

5.5 Halophytes

Along the coastal environment of DPA port jurisdiction largely muddy in nature. Most of the area is less tidal inundation so the growth of halophytes such as *Sesuvium portulacastrum* is available only in lower tidal mark in creek system but the *Salicornia*

brachita was available in upper to high water level. Overall, the creek system of DPA port authority area is quite conducive for the growth of halophytes.

5.6 Avifauna

The avifauna from different locations around DPA decreased enormously, and many species are now listed as threatened. Some species were able to exploit new opportunities offered by human activities as breeding sites which is considered vital in maintaining the populations of threatened coastal breeders.



6. Mitigation

6.1 Intertidal and subtidal zones

Intertidal and subtidal animals are vulnerable to seasonal variations in physical and chemical characteristics and the forces exerted by the tidal currents, wave action, and related water movements. The water currents in the Port area influence the settlement rate of sediment taken off from the shoreline and the turbidity due to the vessel movements. In this regard, the methods for the enhancement and survival of benthic fauna should be charted out with measures to minimize shoreline erosion and sediment loss. It is possible to make a thorough Remote sensing and GIS study to locate the shores where sea wall protection techniques can be followed with the consent of the MoEF and CC.

6.2 Phytoplankton and Zooplankton

Various activities during the construction phase of the project, such as dredging, sand compaction and other construction work in water, make it turbid and also lead to increased levels of suspended solids. Keeping the above scenario in mind and in order to understand the environmental impacts of such dredged/dumped materials, a detailed comprehensive dredging plan should be conducted to document the possible effects on the planktonic communities through evaluation of the biodiversity indices. The DPA should take necessary measures to check the introduction of solid and liquid wastes into the coastal water to minimize the TDS level.

6.3 Marine Fisheries

The installation of artificial shore protecting structures, reefs made of cement and rocks and biogenic materials is generally to protect the shore and also to provide surface for the colonization of flora and fauna and to enhance the biodiversity. The recent surge of comparative studies repeatedly showed distinct differences in community structure and functioning between artificial structures and natural rocky shores. Studies have found high abundances of fish either directly on or near the artificial substrata (Sayer et al., 2005) as well as support several species of epibiota such as bivalves and sponges (Wehkamp and

Fischer 2013), hard corals (Chou et al. 2017), chitons (Moreira et al. 2007), other molluscs (Chapman and Clynick, 2006) and algae (Loke et al. 2016). Even though there are many positive and negative effects reported on the effect of these protective structures, they are useful in enhancing biodiversity. The dead shells and coral blocks, oyster beds and natural fibers are widely used to make artificial structures to attract the sedentary organisms which grow, and they serve as the substratum for the attachment of several fish species. The high turbidity due to heavy suspended solids load during dredging and reclamation can clog the gills of filter feeders, including fishes affecting the metabolic processes (Cumming and Herbert 2016). The fishery resources may be affected by the mortality of eggs and larval stages, affecting their development due to reduced oxygen in the water due to a relatively high level of suspended sediment concentration. Hence, suspension of dredging activity during the monsoon period, the breeding and recruitment season of fishes and crustaceans, is recommended. Fishes tend to avoid turbid areas, move to safer zones, migrate to suitable habitats, and return when the conditions are reversed to the optimum and virtually no impact on fishes due to dredging in the long term. It is necessary to avoid the dredging activities near the mangrove bordered creek systems to safeguard the breeders while moving towards the mangroves during the breeding periods.

6.4 Mangroves & Halophytes

Mangrove plantation is necessary on the open mudflats where the sparse distribution of the plants is available to combat erosion due to wave action during cyclonic events. At present, the vegetation density and diversity are quite low, so there is a necessity to plant suitable halophytic species other than true mangroves to stabilize the soil. Several fruit yielding trees can be selected which can survive in saline soil and to be propagated according to their ecological requirements. This attempt would support to increase the faunal diversity in the buffer zone for which nurseries need to be planned on a large scale for intensive, high-density plantations. Whenever seeds are available in the natural stands, provision for collection of seeds as well as their localized germination should be augmented by netting the seeds and propagules in side intertidal water canals and also placing the seeds for gap filling. Planting with trenching model can be more successful as there is the absence of regular tidal water inundation and moisture content in soil. This

may support the germination of more seeds and their survival and increase the biodiversity, but there should be the minimum disturbance to the natural set-up.

For the conservation of mangroves, it is necessary to continue extension activities and education among the local people. This component of the programme may include activities like: nature education camps for coastal peoples, especially students, meetings of villagers to highlight the importance of conservation of mangroves, educational tours for villages and field staff, training for fishermen and other coastal people on mangrove and related activities like fisheries, honey farming etc.

6.5 Avifauna

Indirectly, the proposed development at the port may also impact on avifauna through noise disturbance during the construction and operational phases of the project. Construction and traffic noise have been shown to reduce densities and feeding behaviour of wetland birds and waterbirds (Hirvonen, 2001; Burton *et al.* 2002), and similar effects may be expected if the proposed project is implemented.



7. Management Plan

Conserving and managing the marine environment of the port which is the centre of aggressive activities is a key approach to ensure loss of biodiversity. Managing the environment in its original state is an important and imperative element in any developmental initiative, especially ports to ensure sustainability. Implementation of a viable management plan in any project requires commitments from all stakeholders of the project such as its proponents, Government bodies overseeing the development and local government and people to ensure that the project is environmentally sound. Environmental plan aims to suggest concrete measures that would negate or mitigate the impact paving way for maintaining the integrity of the project environment.

Expansion or development of ports requires adequate attention is to be paid to environmental wellbeing of its surrounding that guarantee both sustainable port growth and a healthy ecosystem functioning in its vicinity. There is a need for innovative solutions for port development which are in harmony with the ecosystem and which are robust or adaptable under change. On-going trends such as global trade growth, increasing vessel sizes, and the need to modernize port facilities, are driving urgent investments in ports (OECD 2011, PIANC 2014). However, activities related to port development negatively impacts its creek water quality and natural resources such as mangroves and marine fauna. This simultaneously calls for sustainable and inclusive development which ensures healthiness of its marine environment. The port authorities, in order to render their port activities environmentally sustainable and benign need to understand the marine ecological milieu of their port including its water quality, biotic components and factors governing it in addition to the impact their operations are likely to produce on the biotic components. The port ecosystem, in spite of facing intense stress delivers many services which are often intangible. In order to maintain these services intact, it is imperative that different biotic and abiotic components of the port environment is sustainably managed in the long run.

Based on the information gathered through three seasonal studies within the limits of the Deendayal port, the present chapter attempts to draw a holistic management framework for conserving the marine biodiversity and ecology of the Deendayal port

marine environment which include many biotopes such as mangroves, intertidal and Subtidal realms, mudflats, creek systems and salt marshes, each serving as an abode for a variety of fauna and flora. Given the economic importance of Deendayal port and the increasing national and global demand for sustainability, it is planned to study the marine ecology of this port regularly on a seasonal basis, with the long term objective of rendering the port existence and operations environmentally sustainable with the net result of 'no-impact'. The proceeding section outlines different management initiatives to be undertaken by the port authorities for the holistic management of marine biodiversity within the port limits envisages several facilities to be built within its port premises in the future.

7.1. Management Plan for Intertidal and subtidal organism

Intertidal zone is a foreshore area where the ocean meets the land and the between the high and low water levels and the Subtidal zone lies below the lowest water level beyond the intertidal zone. Both these zone harbours many marine fauna and needs to be managed effectively for the overall well-being of the ecosystem. In Deendayal port, intertidal and Subtidal zones are mostly muddy-silt in nature, lacking rocky or sandy formations. Intertidal belts of the study area support many biological elements indicating overall ecosystem health. The intertidal zone can be susceptible to a number of natural and anthropogenic pressures, including erosion, pollution, dredging and sedimentation. Intervention is often required to mitigate or support the natural recovery of the intertidal zone in a port environment. A maximum no of 22-32 intertidal macrofauna were recorded in the present study. The International Union for Conservation of Nature's Red List of Threatened Species is considered under the 'Least Concern' or 'Data Deficient' category (IUCN 2022). Nevertheless, it is imperative to take measures to conserve and promote their biodiversity. Nearly 80% of the macro intertidal fauna recorded in the present study inhabit mangroves, and many of them are true mangrove species. Mangroves are the natural abode for numerous intertidal macrofauna. Hence, promoting mangrove abundance, density and extent is the direct measure and management practice to conserve the intertidal macrofauna. A detailed suggestion to conserve and manage mangroves within the port limit is given in the proceeding section

- Erosion, either man-made or natural, is a major threat to intertidal habitats. Often the threat of erosion is severe in a port environment due to vessel movement, altered hydrological regime and other natural causes. Observations carried out in the present study noticed that only a few stretches in Kandla creek is susceptible to erosion.
- It is imperative to identify further stretches that are susceptible to erosion within the port limits, which could be done through a rapid survey. Artificial reef structures could best achieve the dual purpose of controlling erosion and promoting intertidal biodiversity.
- Artificial coastal structures are cheap and easily implementable and can supplement the natural intertidal and subtidal environment by providing a substrate that will support marine organisms.
- The structural diversity of the artificial reef will determine the diversity of marine organisms utilizing the created habitat. Positive effects of artificial reefs include erosion control and enhancement of intertidal and subtidal biodiversity of numerous invertebrates and fishes as they accelerate the reef-building process.
- Artificial reefs, once built, will last many decades, supporting rich faunal components since they provide ideal habitat for them. Since they are built with natural materials such as dead gastropod and bivalve shells, they are quite environment-friendly and become natural in time. They attract diverse marine fauna within a short period of time with a high potential to enhance biodiversity.
- Reef balls, another form of the artificial reef, are increasingly used in western waters to create sustainable marine reef habitat, which could be easily attempted in Deendayal port. As reef balls and artificial reefs could be made with cheap and locally available materials, reefs are a proven way to enhance biodiversity and control erosion in a safe, long term, environmentally friendly manner. Since oysters are endemic and natural species in the port environment, oyster reefs can be easily developed

7.2. Management Plan for Phytoplankton and Zooplankton

In the port premises, dredging is the major activity that increases water turbidity and suspended load, impacting plankton and productivity. The geomorphology of the Gulf of Kachchh and the prevailing tidal currents tend to create erosion necessitating the frequent removal of the bottom sediments from the channels to facilitate the movement of vessels. This action imparts high suspended matter concentration in the water, which is deleterious to the phytoplankton and the filter-feeding organisms in the pelagic and benthic realm. Further, the resuspension of the soil fraction, clay and organic particulates takes a long time to settle down in the deeper layers in the creek systems, unlike the open sea, causing conditions not normally experienced by the organisms. Effects of suspended sediments are highly species-specific and can vary greatly (Clarke and Wilber, 2000). An increase in suspended materials in the water column will diminish the light penetration with potentially adverse effects on the photosynthetic capability of phytoplankton and other aquatic plants (Lannuzzi et al., 1996). Apart from this, various activities during the project's construction phase, such as dredging, sand compaction, and other construction work in water make it turbid and lead to increased levels of suspended solids. Keeping the above scenario in mind and in order to understand the environmental impacts of such dredged/dumped materials, a detailed, comprehensive study comprising three different seasons should be conducted to document the possible effects on the planktonic and benthic communities.

Turbidity decreases water clarity because of suspended matter absorbing or scattering down welling light, and water is considered turbid when the presence of suspended particles becomes conspicuous. Inorganic suspended materials, reduce light penetration, form adsorption and desorption surfaces, and can aggregate with dissolved substances, bacteria, and algae. The adsorbed substances are available for bacteria, algae, and zooplankton. Phytoplankton productivity is affected by turbid inorganic materials, where the photic zone is compressed and such waters have small euphotic–aphotic ratios. The depth of mixing determines the time spent in the dark, and in deep water bodies where the critical mixing depth is exceeded, it could adversely affect integral primary production rates. Phytoplankton community structures are affected by turbidity,

and cyanobacteria often dominate because of their ability to become buoyant. Zooplankton predation and fish feeding are influenced where suspended turbid materials determine the reactive distances of predation. Fish growth rates are reduced by suspended matter, recruitment, and distribution, showing explicit adaptations (Grobbelaar 2009). So a study on the length or growth during the time of sexual maturity in the fish species to be conducted.

7.3. Management Plan for Marine Fisheries

It is necessary to avoid the dredging activities near the mangrove bordered creek systems to safeguard the breeders while moving towards the mangroves during the breeding periods. Suspension of dredging during the monsoon period, the breeding and recruitment season of fishes and crustaceans, is recommended.

7.4. Management Plan for Mangroves & Halophytes

7.4.1 Co-management with the community

Mangroves within the port jurisdiction should be the object of an intense management program with a specific aim to protect them. Such an intense management program is feasible in the case of Deendayal port since all the mangrove formations are under its legal control. Hence, any management program could be implemented without any sectoral conflicts with forests or other government departments. It was proven in many instances that involving the stakeholder communities in the surrounding villages will yield better results in mangrove management. Though the population in the port surroundings have different livelihood activities, the fishermen's community could be targeted to involve in community-based mangrove management.

These fishermen communities living in villages such as Vera, Khari Rohar, and Tuna close to the port could be involved by forming "Samithies" to conserve mangroves with possible funding resources. The community-based organization (Samithi), whose responsibilities and roles are well defined in the specific task of conserving mangrove patches in their vicinity, could play a seminal role in conserving these mangrove patches. Their resource dependency, perception of mangroves, and level of involvement in such resource management activities must be assessed before forming such a community-

based organization. They could be assigned the specific task of conserving these mangroves by involving them in mangrove plantation/restoration activities, physical protection and other conservation measures. This could be taken up as part of the port's CSR activity

7.4.2 Creation of protected Area

Creating protected areas in undisturbed sites could be a suitable option to conserve mangroves. Mangroves of Deendayal port warrant intensive protection as a major means of conservation. The Deendayal Port Authority personnel could be imparted and delivered a message on the ecological significance of mangroves through special awareness programs, and mangrove patrolling can be instituted to enhance the level of physical protection of mangroves. This could be done by appointing special squads to protect this patch from incidents like cattle grazing, fodder collection, firewood and other resource collection. Physical protection of natural stand is often the best conservation measure to fetch positive results. Employees of Deendayal Port need to be urgently inculcated about the environmental and ecological significance of mangroves and other coastal resources within the port limits. Issuing licenses for salt works and other port allied industries is to scrutinize well in fulfilling the requirements on par with government regulations so that later legal actions can be avoided. Short term awareness programs for port employees will be beneficial on several counts. These awareness programs are to be conducted by seasoned marine/mangrove ecologists.

7.4.3 Identification of stress factors

It is important that in any conservation efforts, stressors acting on the mangroves are to be identified and removed in order to maintain the ecosystem balance. Mangrove environment will continue to be stable and balanced if there are no external stressors such as a change in hydrology, elevation, slope, pH and salinity of water and soil, soil composition and wave energy. In addition, Anthropogenic activities like resource collection, tree felling, and habitat modification activities will act as stressors. It would be necessary to find the factors causing stand degradation and scientifically address restoration activities to ensure mangroves are left undisturbed.

7.4.4. Maintenance of hydrobiological regime

Conservation of natural and artificial mangrove stands depends on the hydrological status of the area, sufficient tidal water movement every day, and keeping the soil moist. Maintaining the original hydrology and tidal flow, including depth, duration and frequency of tidal flooding, will help to facilitate the germination and survival of seeds naturally inside the protected pockets within the mangrove cover. Understanding the existing mangrove hydrology at the micro-level and applying this knowledge to protect mangroves and cost-effective restoration and regeneration is important. Micro-topography mostly controls the distribution and well-being of mangroves, and physical processes play a dominant role in the formation and functioning of the mangrove ecosystem (Kjerfve, 1990). Even disturbed by human impact, mangrove forests can self-repair over a period of time provided that the normal tidal hydrology is not disrupted and the availability of waterborne seeds is not blocked. Regularly monitoring mangrove hydrology through simple scientific methods will go a long way in maintaining ecosystem balance.

7.4.5 Promoting Natural Regeneration

Promoting natural regeneration where the mangrove stand has the capacity for self-renewal will ensure the sustained wellbeing of the stand and its succession. The natural regeneration capacity of the stand is to be assessed by quantifying the degree and extent of the entrance of younger classes such as saplings into the mature tree category. The ratio between these different size classes will indicate the dynamic state of the mangrove forest. The observation that natural seedling recruitment is usually occurring will indicate that the system is functioning normally. Only if the natural seedling recruitment is not occurring, the system requires an assisted recovery by plantation and physical amendments. The present study shows that natural regeneration in the studied mangrove formations is normal, as indicated by the entry of younger classes into adult categories. The continuous assessment of this natural succession in all regular mangrove monitoring studies is necessary to ascertain the progress of the natural succession of seedlings through the germination of seeds stranded on the mangrove soil surface by the tidal flushing

The conservation and management plan presented in the proceeding section has the following broad aspects, and different activities under each aspect are dealt with:

- Creation of information to track subsequent changes in natural mangrove formation within the port boundaries through GIS and RS tool
- Periodic field monitoring programs whose results, in comparison with underline changes, pave the way for the formulation of mitigation and preservation efforts in these stands.
- Soil adjustments are used to improve mine soil quality in its structure and biological function in minor mangrove creeks to enhance tidal flushing and hydroperiod.
- Mangrove conservation measures are to be undertaken in accordance with the results of the monitoring programs.

7.4.6 Conservation of biodiversity of Sat Saida Island and other creek systems

Sat Saida is a unique Island and a vast mudflat extending to 253.8 km², located opposite Deendayal port. As one of the major Islands of the Gulf of Kachchh, Sat Saida supports a rich marine fauna, flora and avifaunal diversity and deserves special conservation efforts. Land cover classification of Sat Saida Island using the GIS tool revealed that sparse mangroves (32.8 km²) far exceed dense mangroves (7.74 km²), while mudflats (144.73 km²) and halophytic vegetation other than mangroves (49.6 sq .km) are other prominent land cover categories. This Island is surrounded by Kandla creek and its branches in the west, Navlakhi creek and its branches in the east and Sara and Phang creek in its north. Many majors, medium and minor creek systems of Kandla and Navlakhi creeks divide this Island into varying lengths and dimensions, supplying tidal water to the interior regions. The southern border of the Island represents the innermost end of the Gulf of Kachchh with very few minor creek systems. It is an Island with convex geomorphology and many irregular landforms and elevations that do not even permit tidal flooding. Tidal flooding is high enough to permit mangrove growth only on its periphery.

Though equipped with all the features to support a dense mangrove formation, the mangroves of Sat Saida Island are relatively sparse and scrubby and mainly confined to creek banks. Different elevation features of the Island render the tidal flooding and

hydroperiod in the interior region resulting in sparse and open mangrove formations. This Island could be an ideal site for mangrove plantations while implementing ministry mandated plantation activities, other mangrove restoration and rehabilitation activities with bio-physical amendments such as desilting existing creeks, joining all the existing minor creeks with one another through new creek systems could be taken up which will increase the mangrove cover in this Island. These bio-physical activities in the mangrove-lined minor creeks will increase tidal flooding and hydro-period and convert sparse mangroves into dense mangroves in due course of time. Deendayal port has already carried out 1400 ha of mangrove plantation since 2005 with a reasonable success rate of (56.82%), Sat Saida Island. It is also recommended that all future mangrove plantation/restoration and rehabilitation efforts by the port authorities may be concentrated on this Island after implementing the indicated bio-physical amendments.

7.5. Management Plan for Avifauna

Construction and traffic noise have been shown to reduce densities and feeding behaviour of wetland birds and water birds (Burton et al. 2002), and similar effects may be expected if the proposed project is implemented. But several species are found unaffected by the spile driving. It is possible that local bird populations are acclimatized to high levels of background noise, and as such, it is not considered necessary to manage potential noise disturbance impacts. However, it should be noted that there are no published estimates of what level of cumulative noise may result in avoidance behavior. Management of indirect impacts on mangrove avifauna can only be done by restricting direct habitat loss of the feeding and nesting habitats.

7.6. Management Plan for Mudflat

Mudflats are intimately linked by physical processes and dependent on coastal habitats, and they commonly appear in the natural sequence of habitats between subtidal channels and vegetated salt marshes. Mudflats are sedimentary intertidal habitats created by deposition in low energy coastal environments, particularly estuaries and sheltered areas. Their sediment consists mostly of silt and clay with high organic carbon content. Mudflats are characterized by high biological productivity and abundance of

organisms but low diversity with few rare species. The mudflat biota reflects the prevailing physical conditions of the region. The upper mudflats lie between the mean high-water neap and mean high water springs. Mudflats will often continue below the level of low water spring tides and form sub-tidal mudflats (McCann, 1980). The upper parts of mudflats are generally characterized by coarse clays, the middle parts by silts, and the lower region by sandy mud (Dyer et al., 2000). The upper mudflats are the least inundated part and are only submerged at high water by spring tides (Klein, 1985) and show sparse halophytes.

Tidal mudflats are generally restricted to low energy environments associated with low water movement, mainly along the coastlines, which are favourable areas for the colonization by mangroves, algal and cyanobacterial mats, which play important roles in primary productions and food chains. Subtidal and tidal muddy habitats are extremely rich in macro benthic assemblages, which form the largest and most diverse marine ecosystem. Studies in tidal flats have shown that there is rapid sequestration of carbon in tidal flats where much of the carbon lies below the ground (Thom et al., 2001). They harbor a large number of cyanobacteria and benthic diatoms. Generally, biodiversity and distribution of macrobenthos is primarily governed by sediment type, temperature, salinity, primary productivity, depth and physical disturbances (Coles and MacCain, 1990). Macrobenthic assemblages through their high secondary productivity, contribute significantly to the overall fisheries and marine productivity. Tidal flats support a large number of invertebrates, such as mussels, bivalves and other molluscs, which are harvested as food. It is reported that food provision in tidal flats is 10-20 times higher than in deeper coastal waters. Along with mangroves and seagrasses, tidal flats provide refuges (for spawning and as nurseries) for many species of commercially important fish and crustaceans (Yusoff et al., 2006; MacKinnon et al., 2012). Most microalgae, diatoms, and green and blue-green algae create biofilms on intertidal mudflats and are the primary producers capturing the carbon dioxide from the water and helping in the stabilization of the mud surface and preventing it from being eroded by tidal action or heavy rain (Trites et al. 2005). They are also significant in the diets of shorebirds and some invertebrates, such as snails.

Additionally, mudflat habitats provide feeding and roosting grounds for important shorebird populations (Al-Sayed et al., 2008). Due to developments to accommodate large-scale projects (Khan, 2007) through intensive reclamation and dredging activities, mudflats have reported biodiversity loss. Thus, understanding the scale and nature of changes in biodiversity, ecosystem functioning, and the delivery of the associated services has become a research priority (Dissanayake et al., 2018). In this respect, research on the restoration of biodiversity mudflats should be promoted to enhance carbon sequestration, thereby aids in climate change phenomenon.

Given the ecological and economic importance of intertidal mudflats, it is appropriate to consider a systematic quantitative approach to compiling data on the taxonomic composition and the biological traits of mud-flat assemblages for predicting variations in ecosystem functioning. The entire landscape of impact needs to be reviewed appropriately; this is called a landscape approach to conservation (Meffe et al., 1997). The ecosystem approach integrates ecological, socio-economic and institutional perspectives, applied within a geographic framework defined primarily by natural ecological boundaries. The ecosystem approach recognizes that long term sustainability cannot be achieved if an ecological focus overshadows human welfare and vice versa (Meffe et al., 1997). The ultimate aim is to adopt integrated coastal zone management to protect the shores, mangroves and mudflats.



8. Summary & Conclusion

It is estimated that the whole shipping and port sector are currently responsible for over 3% of global CO₂ emissions, according to data from Ocean, and this is only expected to increase if no action is taken. The International Maritime Organization has put forward strategies to reduce CO₂ emissions by at least 40% by 2030 and pursue efforts towards 70% by 2050. It is expected that these emissions will rise considerably in the future, mainly due to the increased worldwide transport demand. Hence, it can be expected that GHG emission regulations will become more stringent in the future. It must also be considered that, like all other sectors, the port operation should achieve a reduction in emissions as soon as possible, as stated in the Paris Agreement from the United Nations Framework Convention on Climate Change (UNFCCC). At this point it is high time to frame a comprehensive Green Port Action Plan to address the energy and emissions aspects of shipping and port operations.

The coastal pelagic and benthic biodiversity can be promoted through the reduction in the introduction of petroleum wastes, untreated sewage water, solid waste and super brine from the salt pans that are harmful to the planktonic forms. The larvae of invertebrates and fishes are highly imputed by the oil and pesticide residues during their early developmental stages as they are found in the surface water. The mortality and morbidity of these resources later lead to a reduction in the adult population. The pelagic and benthic food chains are heavily affected by the relatively low abundance of phytoplankton, the primary food for the larvae and several adult fishes. There is also the possibility of the introduction of plant and animal species through ballast water, where they may become invasive species that threaten the balance of natural ecosystems. All these expected environmental and biodiversity issues will be addressed through continuous monitoring efforts to keep the total environment healthy and safe for humans at a satisfactory level by the port Authority.

Based on the detailed investigations of different marine ecological components and possible impacts on the DPA port environment, it could be concluded that in the DPA port area the impacts on different marine biota is minimal and confined to the area of

activity with marginal influence in the surroundings. In order to ward off the predicted impacts on specific components of the marine biota, appropriate mitigation and management plan is suggested. Given the vastness of the Gulf, the predicted impact will be negligible, and the baseline background limits of different parameters will be regained on the secession of dredging and disposal activities. In the Kandla creek mangroves, certain environmental repercussions are evident and require efforts to mitigate the problems. The oil emissions are found to affect the plants as the leaves are covered with dark coloured sticky particulate matter, and there is a reduction in bottom fauna at some parts of the mangrove stands.

The contamination from the proposed oil jetty (8-11) can impact the coastal and mangrove biodiversity both pelagic and benthic zones, including the planktonic micro algae, the diatoms, dinoflagellates, the eggs and larvae of several invertebrates and fishes as well as the plant communities. To compensate the loss of the plants and to encourage the inhabitation of the benthic macro and micro fauna, it is necessary to take up large scale mangrove restoration through plantation as well as making provisions for natural seed germination and formation of mangrove stands by providing sufficient amount of tidal water influx. it is recommended that the port authorities should install filters in the emission points from the oil industrial complex and the similar units from where the particular pollutants are being sent out into the air.

To conclude, it is inferred that the biodiversity in the DPA can be improved by adapting the green port mission and the overall reduction in the outline of solid and liquid leftover materials in the creek environment. Above all the port Authority should take measures to minimize or avoid direct spillage oil products into water by providing directions to all the personnel involved and it is mandatory to save the life in the sea as well as our own.

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Annexure G

NCSCM Report

SHORELINE CHANGE STUDY

(DURING THE PERIOD 2009-2021)

**FOR DEENDAYAL PORT AUTHORITY, KANDLA,
KACHCHH DISTRICT, GUJARAT.**

Submitted to

Deendayal Port Authority,
Kandla, Kachchh District, Gujarat.



National Centre for Sustainable Coastal Management
Ministry of Environment, Forest and Climate Change
GOVERNMENT OF INDIA

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1 Introduction

Deendayal port authority also known as Kandla port is in Gandhidham, Kachchh district, Gujarat was constructed in 1950s is the chief seaport for serving western India. This being the first export processing zone and largest port in India has handled million tonnes of cargo. It is India's hub for exporting petroleum, chemicals, Iron and steel, grains and oil in the country. The study area is located at 23° 01" N latitude, 70° 13" E longitude situated in the Kandla creek and is 90 kms from the mouth of Gulf of Kachchh. Due to the development of various facilities in the port, dredging of dumping materials is proposed for maintenance of the port. Thus, Deendayal port has proposed 3 dumping sites, designated at i) 70° 10' 00" E, 22° 51' 00" N ii) 70° 13' 28" E, 23° 04' 28" N – Phang creek iii) 70° 13' 00" E, 22° 56' 31" N – shore channel. Any alteration in these study sites would change the shoreline morphology of the coast. This may eventually lead to coastal erosion and accretion at several sites. Therefore, it is necessary to study site specific short term shoreline change rate which will be estimated using satellite images for the year 2009-2021.

2 Data used and Methodology

Short-term shoreline change for the study is based on the analysis of five satellite images for the period between 2009 to 2021 respectively shown in **Table 1**.

Table 1: Data source for extraction of shoreline

Year of Pass	Satellite	Resolution
2009	Worldview/GeoEye/ Cartosat PAN	2 m 2.5 m
2012	Aerial photo	9 cm GSD
2016	LISS IV	5 m
2019	WorldView3 / Sentinel	2 m 10 m
2021	Cartosat 2 series/3 MX LISS IV	2 m 5 m

The following figure 1 describes the flow diagram of shoreline change analysis.

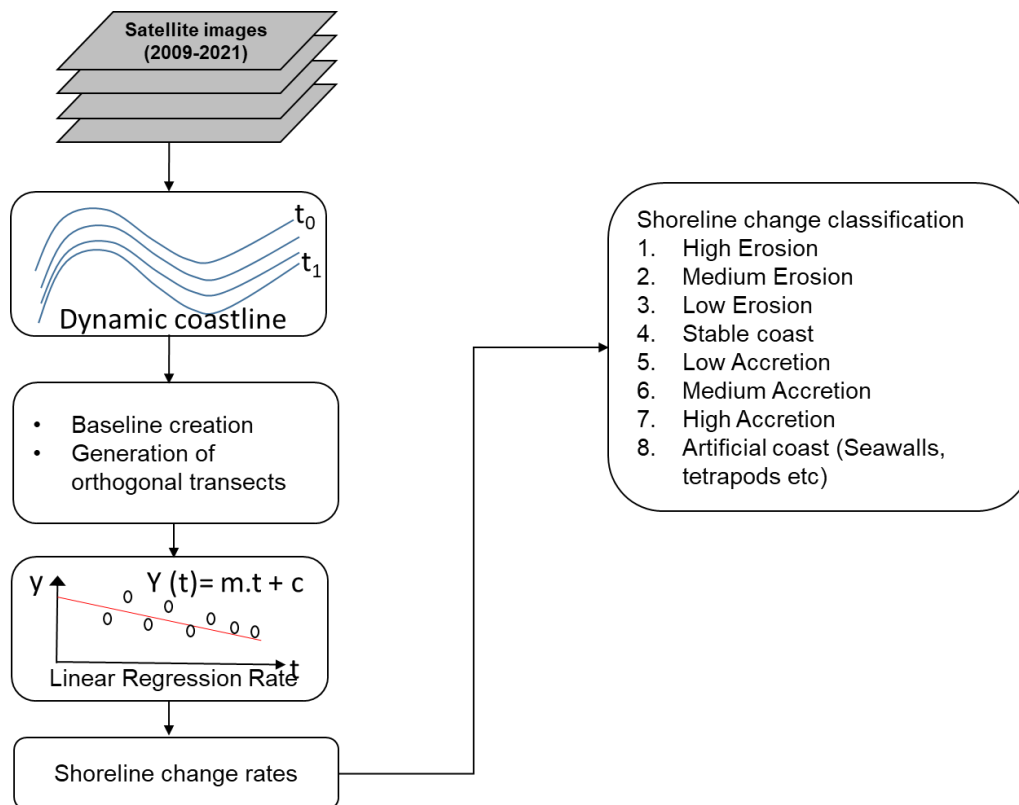


Figure 1: Workflow diagram for Shoreline change rate analysis

3 Pre-processing of Satellite Images

Extraction of shoreline positions from these data sources involves georeferencing of satellite images using aerial photos and subsequently digital image classification of shoreline positions. Rigorous geometric correction of the satellite images is done for the following systematic and non-systematic errors. Systematic errors are corrected through analysis of system characteristics and ephemeris such as scan skew, mirror-scan velocity variance, panoramic distortion, platform velocity, and earth rotation. Non-systematic errors are mainly corrected for variation in altitude and sensor platform attitude using Ground Control Points (GCPs) (Jensen, 1996). Rectification of Satellite images involves georeferencing process i.e. process of assigning map coordinates to image data. In this study image-to-image, registration was applied to rectify satellite images using orthophotos as reference image in ERDAS Imagine software. Georeferencing of all satellite images using orthophotos i.e to a common coordinate system is necessary in order to compare the historical images for analyzing the shoreline change rates of the entire Indian coast. The following steps were adopted for georeferencing the satellite images using orthophotos.

- Acquisition of images and preprocessing of metadata
- Acquisition of Ground Control Points (GCPs) in Image coordinates and map coordinates i.e for X, Y pairs.

- Computation of unknown parameters of mathematical functions used for the geometric correction model for the set of satellite images.
- Resampling technique used for image rectification.

4 Shoreline Extraction

The next step is to extract shoreline position from these georeferenced satellite images. Shoreline indicators were used to identify the morphological features and non-morphological features using satellite images for the years 2009, 2012, 2016, 2019 and 2021.

4.1 Shoreline Indicator

Because of its dynamic nature of the idealized shoreline boundary, practically shoreline indicators are adopted in defining the boundary. A shoreline indicator is a feature used as a proxy (fig.1) to represent the true shoreline position (Boak et al, 2005). In this study different shoreline indicators were adopted based on morphological and non-morphological features: i) Morphological features include vegetation line, berm crest, and cliff toe ii) non-morphological features include wet/dry line, high water line and iii) Man-made Structures such as seawalls. These are selected based on location, data source, and scientific preference used to analyse the shoreline change, (Hapke et al, 2010). Extraction of shoreline indicators have been processed through various image processing techniques.

4.2 Shoreline Proxies

Visual image interpretation technique for delineating shoreline was adopted manually for identifying the feature. Image interpretation is carried out using elements of visual interpretation techniques such as tone, size, shape, texture, pattern, colour and association. Using these elements, identified features like berm line, dune vegetation line, swash line, base of bluff/cliff, high water line, seawall and salt pan on the satellite images were mapped.

- Berm crest:** This is the nearly horizontal portion of the beach or backshore formed by the deposit of materials by wave action at the time of high tide. Some beaches have no berms; others have one or several. In the case of multiple berms, the most landward crest of the berm was chosen in the case of wide sandy beaches.
- Beach cusp:** The beach cusp is a crescent-shaped followed by accumulation of sand surrounding a semicircular depression on a beach. They are formed by swash action and the spacing of the cusps is related to the horizontal

extent of the swash motion. Coarser sediments are found on the steep-gradient, seaward pointing 'cusp horns'.

- c) **Dune Vegetation line:** Coastal sand dunes are ridges or a series of ridges that form at the rear of the beach. The toe of the foreshore face of the dune is considered as shoreline.
- d) **High water line:** High water line (HWL) is considered as the best shoreline indicator by many researchers, because they mark the effective shoreline and is equivalent to "wet/dry line". HWL is the previous tide which is clearly identifiable from all images and is found most appropriate to analyse the shoreline changes.
- e) **Onshore structures:** Visual image interpretation technique is used to identify Coastal engineering structures such as seawalls, embankments, fence line were identified from high resolution satellite images and aerial photos. Seawall towards landward was consider for shoreline mapping, so that major significant change in long and short term rates was computed.

5 Digital Shoreline System Analysis (DSAS) model

Multiple shorelines extracted from satellite images were used to calculate shoreline change rates using Digital Shoreline Analysis System (DSAS) model developed by United States Geological Survey (USGS) in an ArcGIS environment (Thieler and other, 2009). DSAS employs the single-transect method (ST) to calculate change rates and rate uncertainties at regularly spaced transects (measurement locations) alongshore. ST uses various methods (for example, end point rate, least squares, weighted least squares) to fit a trend line to the time series of historical shoreline positions at a transect. ST is the most commonly utilized method for calculating shoreline change (for example, see Fletcher and others, 2003; Morton and others, 2004; Morton and Miller, 2005; Hapke and others, 2006; Hapke and Reid, 2007).

To calculate the rate of change, statistical baselines were constructed on the landward side at a distance of ~100 m adjacent to the series of shoreline positions. Transects were spaced approximately at 100m intervals alongshore, roughly perpendicular to the trend of the shoreline. Rates of short-term (12 years) shoreline change were calculated using the linear regression method included in the Digital Shoreline Analysis

6 Computation Rates of erosion/ accretion using Linear Regression Rate (m/yr)

In this study, Linear Regression Rate (LRR) will be used for expressing the rate of change since it includes all the available time-series shorelines. A linear regression rate-of-change statistic was determined by fitting a least-squares regression line to all shoreline points for a particular transects. The regression line is placed so that the sum of the squared residuals (determined by squaring the offset distance of each data point from the regression line and adding the squared residuals together) is minimized. The linear regression rate is the slope of the line. The method of linear regression includes these features: 1) All the data are used, regardless of changes in trend or accuracy, 2) The method is purely computational, 3) The calculation is based on accepted statistical concepts, and 4) The method is easy to employ. Shorelines were not delineated nor change rates calculated for ports, breakwaters, groynes, seawalls, river deltas because of the high natural variability and complexity of these shoreline reaches.

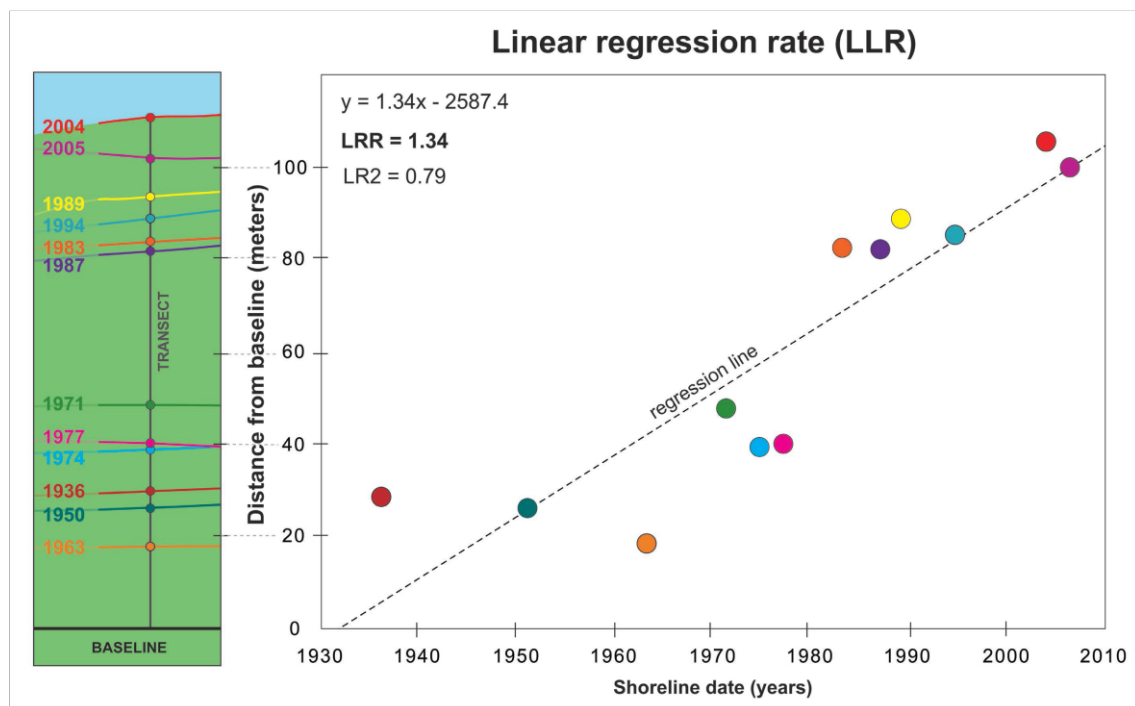


Figure 2: Shoreline position graph plot of the Linear Regression Rate transect (Source: Himmelstoss et al., 2018)

These shoreline change rates have been categorized into eight classes as erosion (high, medium and low erosion) and accretion (high, medium and low accretion), stable and artificial coast as shown in **Table 2**.

Table 2: Classification of Shoreline Change Rates

Categories	Rate of Erosion/Accretion (m/yr)
High Erosion	≥ -5
Medium Erosion	-2 to -5
Low Erosion	-0.5 to -2
Stable Coast	-0.5 to 0.5
Low Accretion	0.5 to 2
Medium Accretion	2 to 5
High Accretion	≥ 5
Artificial coast	<i>Presence of boulders, tetrapods, and other shore protection structures along the coast</i>

7 Results

The shoreline change analyzed for Deendayal port authority is about 150km in length. The high resolution satellite images reveal that the coast is now dominated by accretion. The coast experiences 20% erosion, 34% stable coast and remaining 46% accretion. Based on LRR calculations the coast is classified into 7 categories and out of 150 km, high erosion is occupied by 12 km (7.6%), medium erosion by 7 km (5%), low erosion by 10 km (7%). Almost 51 km of the coast showed no change. While, 50 km of the coast has high accretion, 11 km has medium accretion and 8 km has low accretion shown in **Table 3**.

Figure 3 depicts that i) the western region of the study is predominantly accreting while southern side of the Tuna jetty has high erosion. ii) mouth of Nakti creek has erosion for a stretch of about 5 km may be due to the river mouth dynamics. iii) about 4.4 km of the coast has erosion at the mouth of Kandla creek while the coast inside the creek and near Deendayal port has accretion and stable. iv) south of Hansthal creek has erosion for about 5 km. Thus the coast is less affected by erosion due to natural activities.

Table 3: Shoreline change statistics for Deendayal port (2009-2021)

Shoreline Classification	Length (km)	% of Erosion and Accretion	Cumulative % of Erosion and Accretion
Length of Coastline (km)	149.80		
High Erosion	12.37	8.26	
Medium Erosion	7.17	4.78	
Low Erosion Zone	10.28	6.86	19.91
Stable Coast	50.92	33.99	33.99

Shoreline Classification	Length (km)	% of Erosion and Accretion	Cumulative % of Erosion and Accretion
High Accretion	49.80	33.25	
Medium Accretion	11.48	7.66	
Low Accretion	7.77	5.19	46.10

The shoreline of this region is divided into 3 regions:

- Region1: Chela Nadi to South of Nakti Creek
- Region2: North of Nakti creek to South of Kandla creek
- Region3: North of Kandla creek to South of Hansthal creek

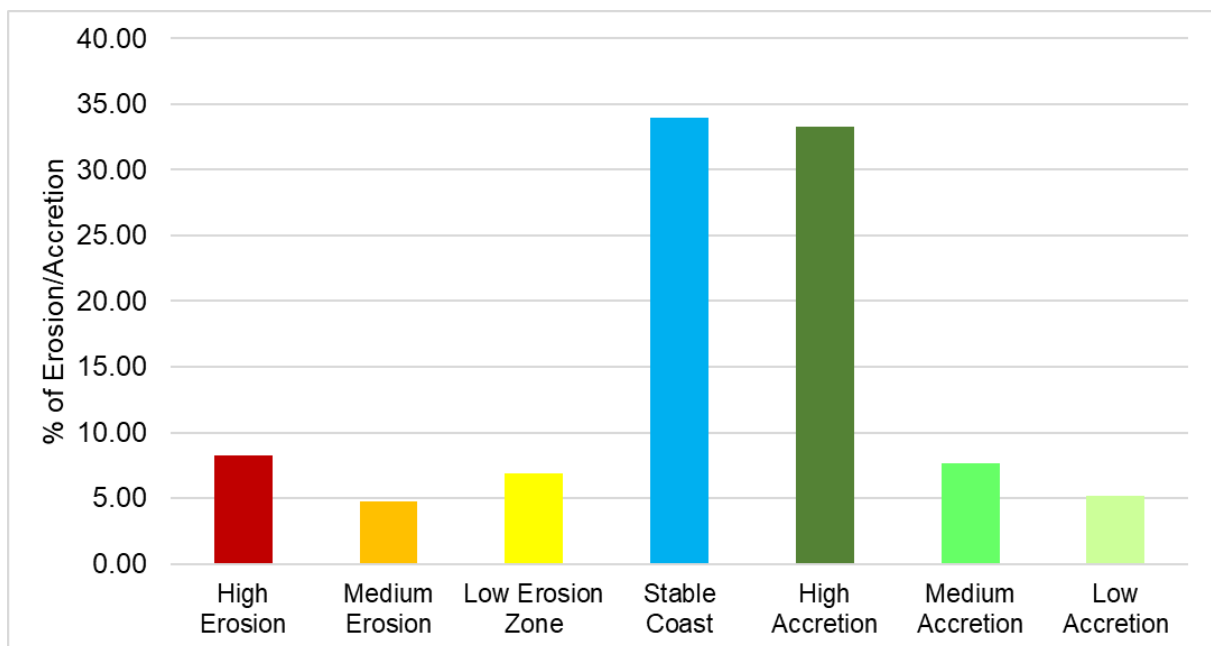


Figure 3: Percentage of erosion/accretion for the study area

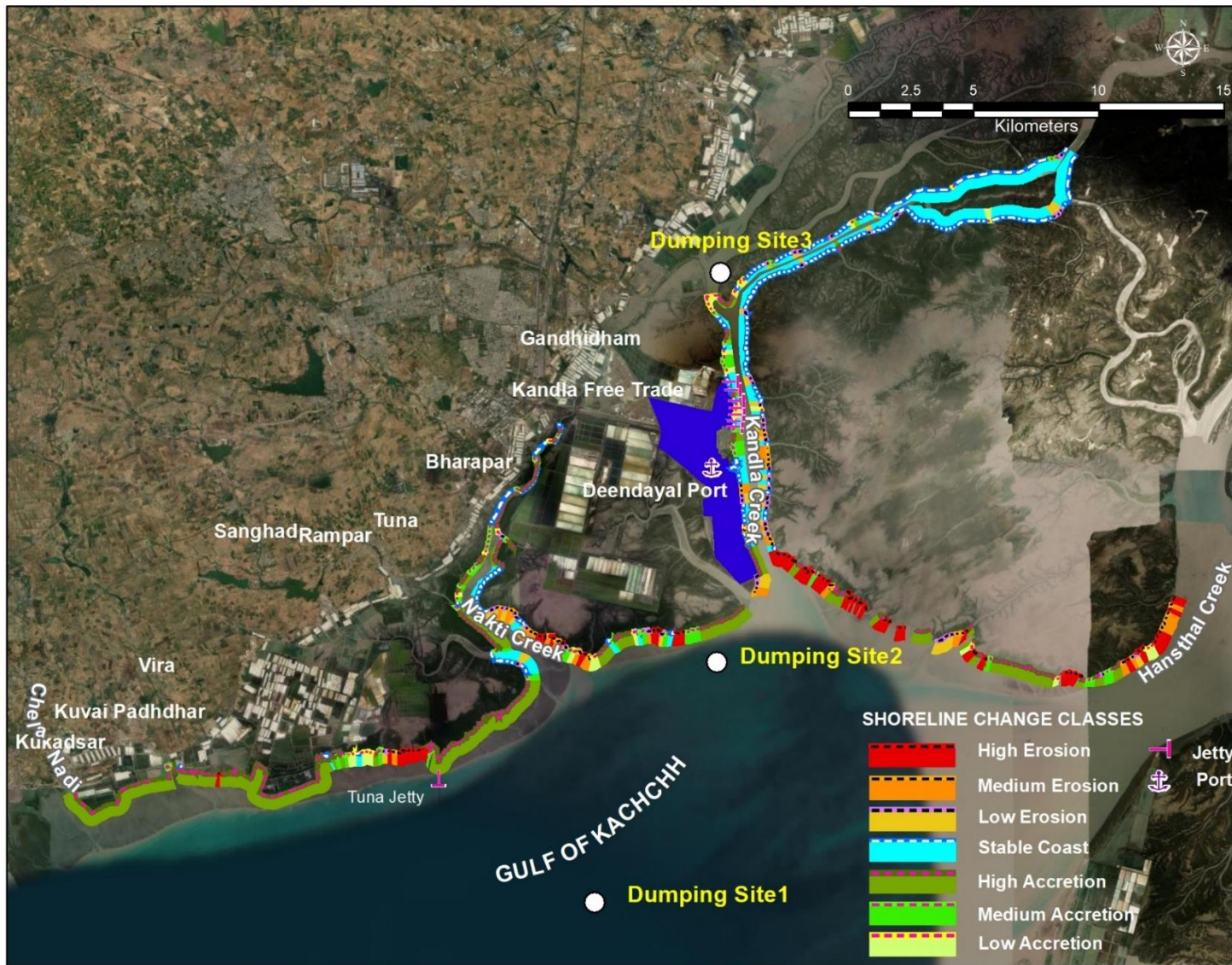


Figure 4: Shoreline change map in and around Deendayal Port Authority

I) From Chela Nadi to South of Nakti Creek:

This region has a shoreline length of about 45 km bounded by salt pan, mangroves and creeks. This area is dominated by accretion and has an average rate of 24 m/yr. Around 67% has high accretion, 11% medium accretion, 4% low accretion, 12% stable coast, 1% low erosion and 4% high erosion. Small patches of high erosion for a length of 2.5 km is found in the southern side of Tuna Jetty shown in Figure. And the rate of change were generally high along this region (ranges from -15 m/yr to -5 m/yr). This may be due to the construction of jetty that has deprived the sediment movement in the southern portion of jetty that has caused erosion in the southern side.

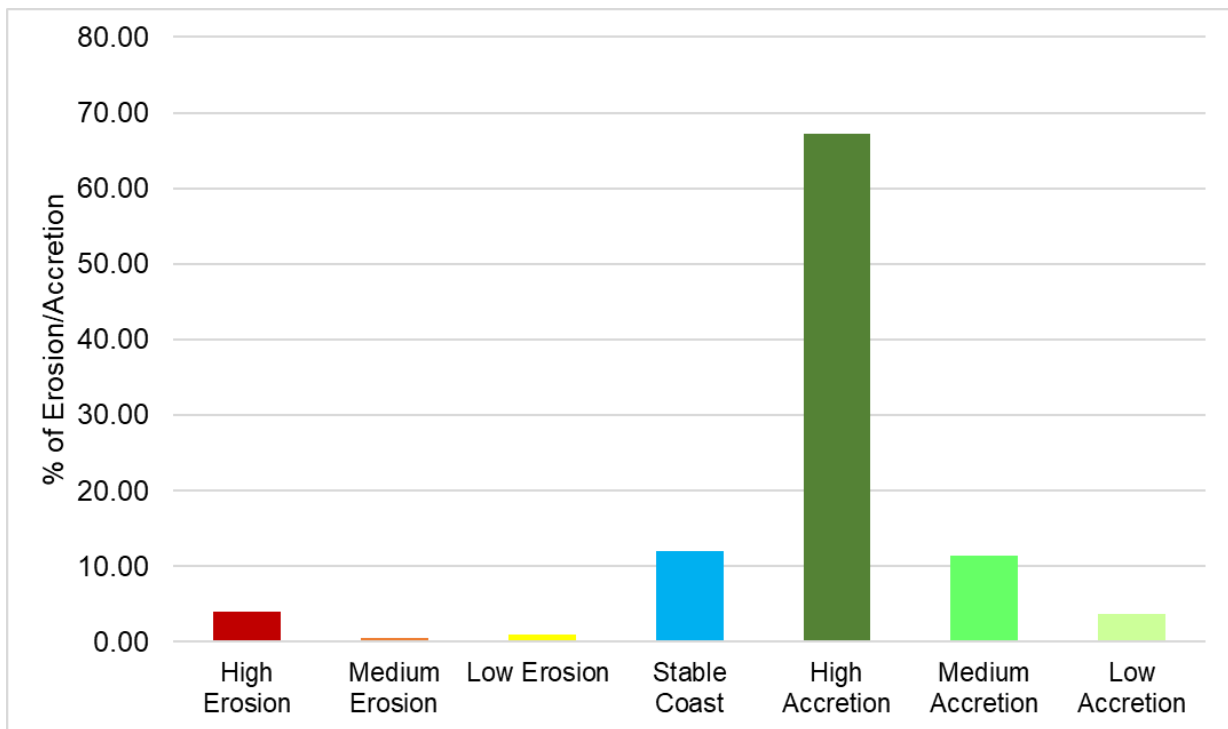


Figure 5: Percentage of erosion/accretion for the study area



Figure 6: Zone1: Shoreline change map from Chela Nadi to Nakti creek

II) North of Nakti Creek to South of Kandla creek:

This region has shoreline length of about 56 km and average accretion rate of 3.35 m/yr. Percentage of shoreline change shows 22% of high accretion, 9% medium and low accretion, 7% medium erosion, 6% low erosion and 4% high erosion. In this portion northern side of the Kandla creek shows patches of erosion due to inadequate supply of sediment from the creek towards the northern direction. High erosion is especially noticed in the mouth of the creek because of the high natural variability of these shoreline reaches. Rate of high erosion along the creek ranges from -10 m/yr to -5 m/yr that is associated with the migration of inlets

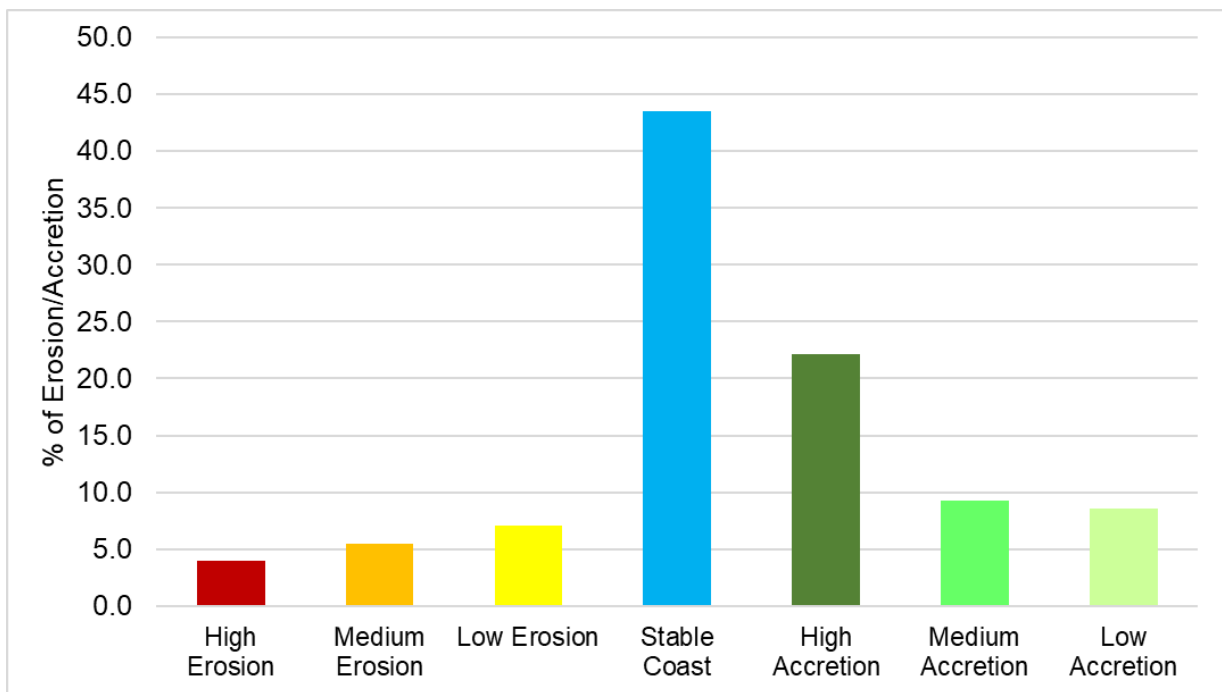


Figure 7: Percentage of erosion/accretion for the study area

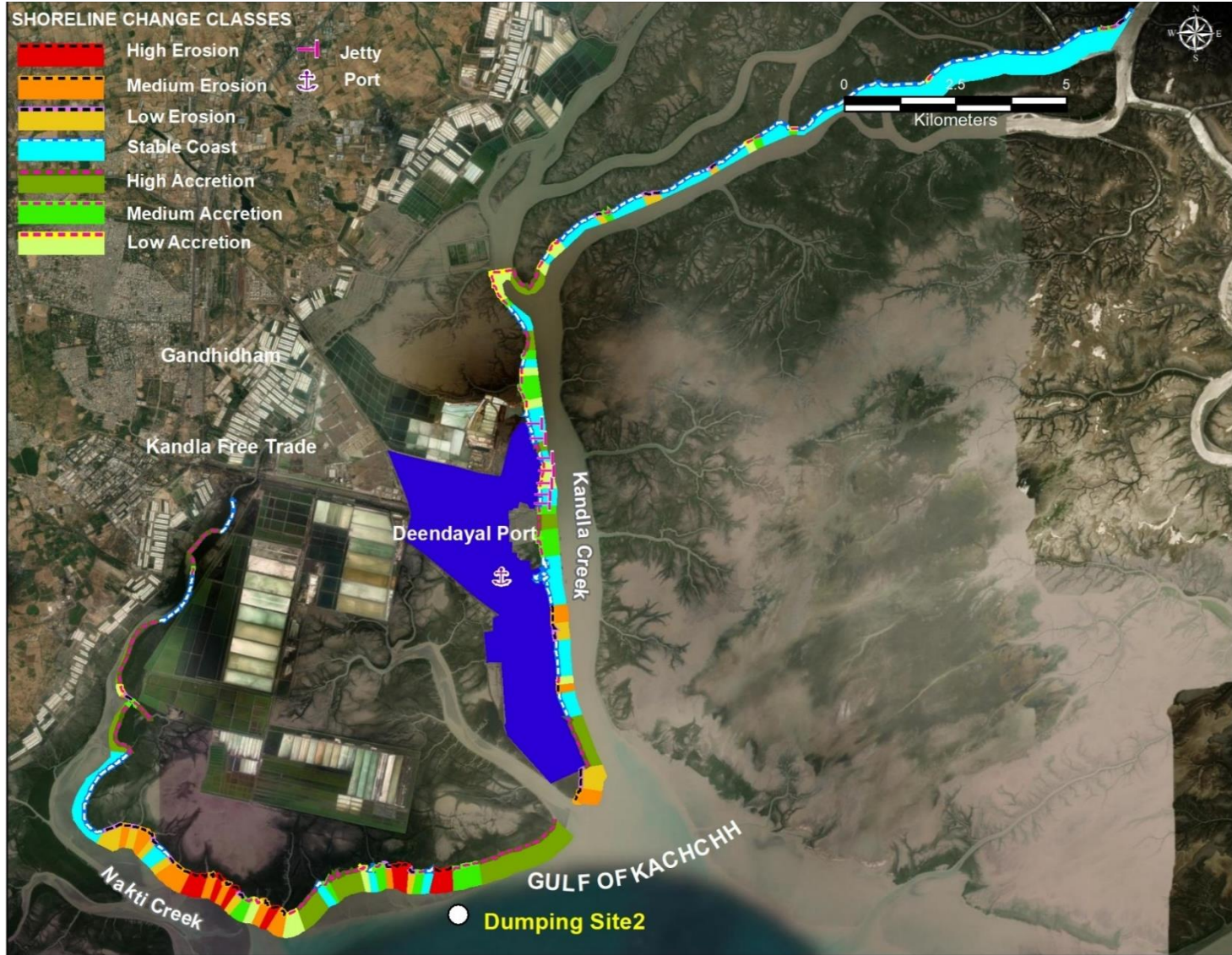


Figure 8: Zone 2 - Shoreline change map from Nakti creek to Kandla creek

III) North of Kandla creek to South of Hansthal creek:

This stretch of coast has a length of about 49 km and average erosion rate of -1.06 m/yr. This shoreline has 16% high accretion, 3% medium and low accretion, 43% stable coast, 12% low erosion, 8% medium erosion and 15% high erosion. This region is more erosion compared to other two zones and the rate of change varies significantly from -30 m/yr to -5 m/yr. Moreover, geomorphology of the coast is characterized by mudflat and there are only sparse mangrove patches found in this region. Hence this may be attributed to the natural effect of sediment variability along the river mouth and also due to tidal effect that are detrimental to the growth of the mangrove canopy.

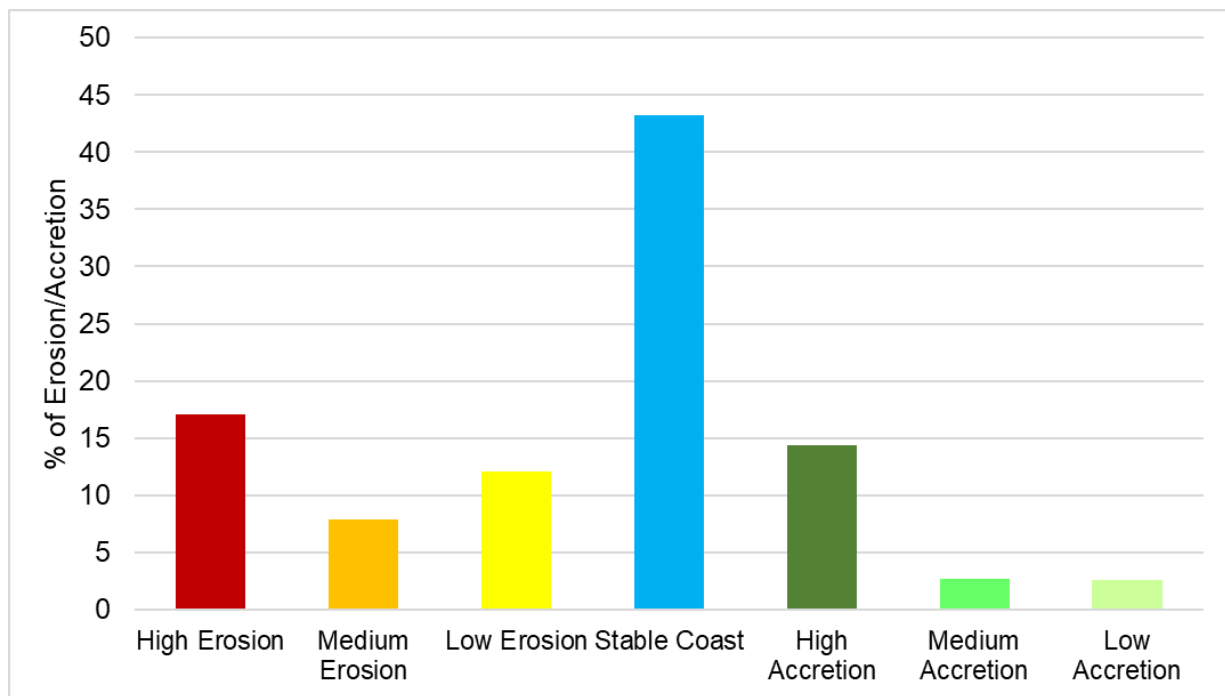


Figure 9: Percentage of erosion/accretion for the study area

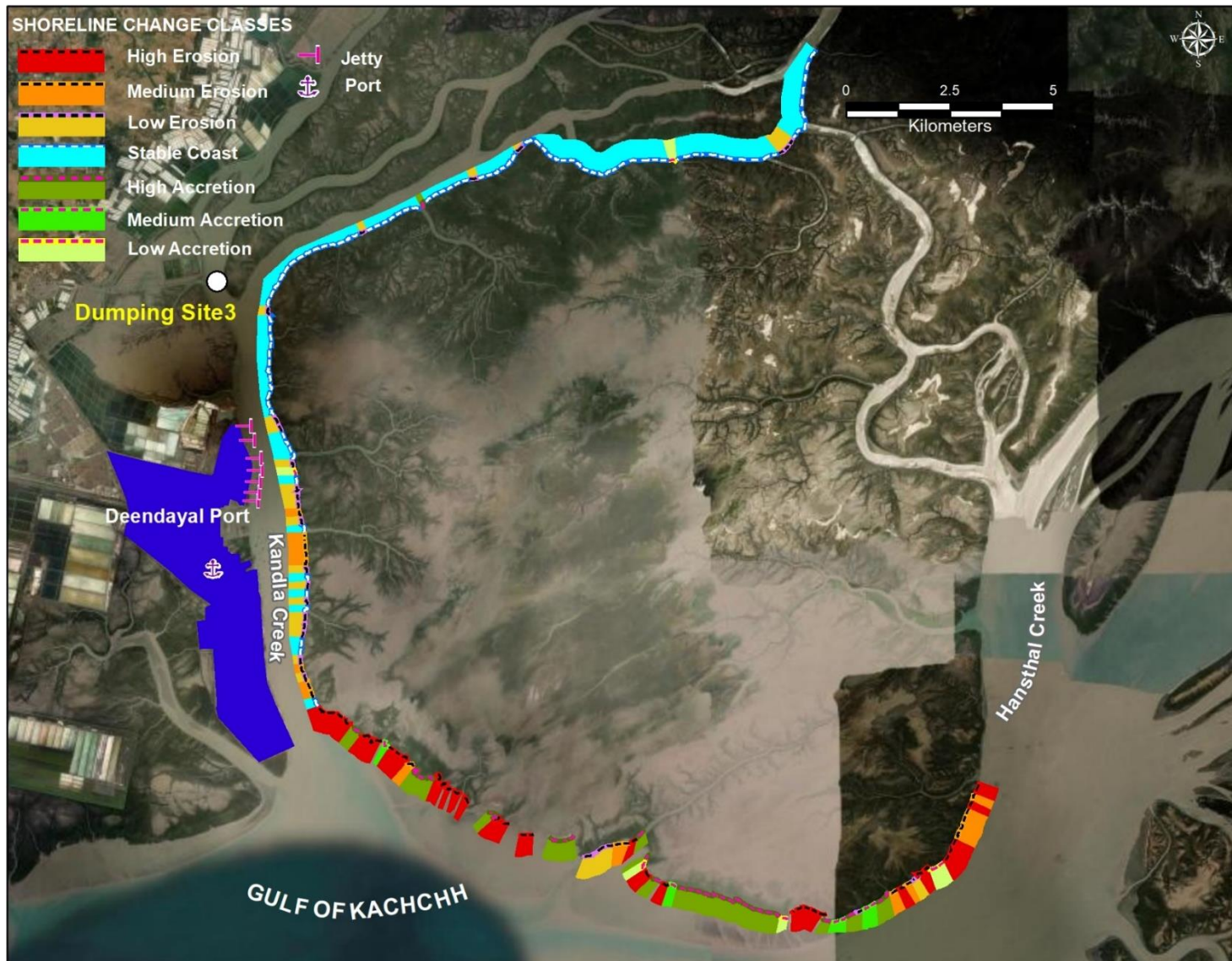


Figure 10: Zone 3 - Shoreline change map from Kandla creek to Hansthal creek

8 References

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11. Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, A., 2009, Digital Shoreline Analysis System (DSAS) version 4.0 – An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2008- 1278, available at <http://woodshole.er.usgs.gov/projectpages/dsas/version4>

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Annexure H

Regular Monitoring of Marine ecology W/O

10.06.2024

DEENDAYAL PORT AUTHORITY



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

Website : www.deendayalport.gov.in

NO.EG/WK/4751/Part (Marine Ecology Monitoring)/72 Dated : 10/06/2024

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

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

Sub: Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority and Continuous Monitoring Programme covering all seasons on various aspects of the Coastal Environs covering Physico-chemical parameters of marine water and marine sediment samples coupled with biological indices (for three years 2024-2027) reg.

Ref.: 1) DPA request vide letter no. EG/WK/4751/Part (Marine Ecology Monitoring)/22 dated 12/2/2024.
2) Offer submitted by GUIDE, Bhuj vide letter no. GUIDE/DPT/Offer/Marine /05/2024-25 dated 2/4/2024.

Sir,

Your offer for the subject work submitted vide above referred letter dated 2/4/2024 (**Copy attached – Annexure A**) amounting to Rs. 1,55,72,700.00+ 18% GST (Rupees One Crore Fifty-Five Lakhs Seventy-Two Thousand and Seven Hundred only plus eighteen percent GST), for a period of three years i.e. 2024-2027 - per year cost Rs. 51,90,900.00 {Rs. 36,60,000 for regular monitoring of Marine Ecology + Rs. 15,30,900.00 for Continuous Monitoring Programme}, including all terms & conditions mentioned in the offer letter, has been accepted by the competent authority in DPA.

2. Scope of work :

- (a) Regular Monitoring of Marine Ecology in and around the Deendayal Port Authority in terms of Sea weeds, Sea grasses, Mudflats, Sand Dunes, Echinodenns, Shrimps, Turtles, Corals, Coastal vegetation, Mangrove and other marine biodiversity components as part of the Management Plan. Marine ecology will also be monitored in terms of all micro, macro and mega floral and faunal components of marine biodiversity.
- The above scope of work is in order to comply with the stipulated condition mentioned in the following EC & CRZ Clearances accorded by the MoEF&CC,GoI to DPA, for various projects :

.....cont.....

- (i) EC & CRZ clearance granted by the MoEF&CC,GoI dated 19/12/16 - Dev. Of 7 Integrated facilities - **Specific condition no. xviii.**
- (ii) EC & CRZ Clearance granted by the MoEF&CC,GoI dated 18/2/2020 - Dev. Remaining 3 integrated facilities - **Specific condition xxiii.**
- (iii) EC & CRZ Clearance granted by the MoEF&CC,GoI dated 19/2/2020 - Dev. Integrated facilities (Stage II- 5 projects - **Specific condition xv.**
- (iv) EC & CRZ Clearance granted by the MoEF&CC,GoI dated 20/11/20 - Creation of water front facilities (OJ 8 to 11) ... - **Para VIII Marine Ecology, Specific condition iv.**

(b) A continuous Monitoring Programme covering all seasons on various aspects of the coastal environs covering Physico-chemical parameters of marine water and marine sediment samples coupled with biological indices such as Sand Dune Vegetation, Mangroves, Sea grasses, Macrophytes and Phytoplankton on periodic basis during construction and operational phase of the project. Additionally, Primary productivity will also be carried.

• The above scope of work is in order to comply with the stipulated condition mentioned in the following EC & CRZ Clearances accorded by the MoEF&CC,GoI to DPA for various projects .:

- (i) EC & CRZ Clearance granted by the MoEF&CC,GoI dated 18/2/2020 - Dev. Remaining 3 integrated facilities - **Specific Condition xix.**
- (ii) EC & CRZ Clearance granted by the MoEF&CC,GoI dated 19/2/2020 - Dev. Integrated facilities (Stage II- 5 projects) - **Specific Condition xiv.**
- (iii) EC & CRZ Clearance granted by the MoEF&CC,GoI dated 1/1/2024 - Augmentation of Liquid Cargo Handling Facility - **Specific condition no. XXV.**

3. The terms of payment:

For the period (2024-25) (Monitoring Period 10 /6/2024 to 09/6/2025):

- 1) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Inception report by GUIDE.
- 2) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of First Season report by GUIDE.
- 3) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Second Season report by GUIDE.
- 4) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Third Season report by GUIDE.
- 5) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Final report by GUIDE.

For the period (2025-26) (Monitoring Period 10 /6/2025 to 09/6/2026) :

- 1) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Inception report by GUIDE.
- 2) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of First Season report by GUIDE.
- 3) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Second Season report by GUIDE.
- 4) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Third Season report by GUIDE.
- 5) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Final report by GUIDE.

.....Cont.....

the period (2026-27) (Monitoring Period 10 /6/2026 to 09/6/2027) :

- 1) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Inception report by GUIDE.
- 2) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of First Season report by GUIDE.
- 3) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Second Season report by GUIDE.
- 4) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Third Season report by GUIDE.
- 5) 20% of the project budget (Rs.51,90,900/year) should be paid within 15 days from the date of submission of Final report by GUIDE.

4. Obligation of DPA :

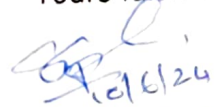
- Assistance regarding the statutory clearance from authorities concerned to be rendered by DPA for field visits.
- Study area map along with GPS coordinates is to be provided by the DPA.

5. Time Period : Three years from date of issue of work order i.e. from 10 /6/2024 to 09/6/2027 (per year three monitoring all three seasons).

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

Thanking you.

Yours faithfully,



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

Annexure -A

Dr. V. Vijay Kumar
Director



Gujarat Institute of Desert Ecology

GUIDE/DPA/Offer/Marine/ 05 / 2024-25
02.04.2024

To
Sh. Rajendra Prasad Bethi
Dy. Chief Engineer & EMC (I/c)
Deendayal Port Authority
Administrative Office Building
Post Box No.50
Gandhidham, Kachchh-370201

Sir,

Sub. : Offer for Regular monitoring of Marine Ecology and Continuous Monitoring Programme
Reg.,

Ref : Your Letter No. EG/WK/4751/Part (Marine Ecology Monitoring)/22 Dt. 12.02.2024.

This is w.r.t the above cited subject and reference, we are herewith submitting the Offer to carry out "Regular Monitoring of Marine Ecology in and around Deendayal Port Authority" along with "Continuous Monitoring Programme covering all seasons on various Coastal environs covering Physico-chemical and Biological components".

Kindly find enclosed herewith our offer to carry out the said study, with a budget of Rs. 51,90,900/- (Rupees Fifty-One Lakhs Nineteen Thousand Nine Hundred only) plus applicable GST per year. The quoted budget will remain same for a period of 3 years i.e., (May 2024 – May 2027) which is Rs. 1,55,72,700 plus applicable GST.

Kindly consider our offer and revert back to us for any further clarifications.

Thanking you,

Sincerely yours,


Director

DIRECTOR

Gujarat Institute of Desert Ecology
Bhuj - Kachchh.



Mangra (EMC) / Shri Anand Singh
EMC
6/4

PO. Box No. 83, Opp. Changleshwar Temple, Mundra Road, Bhuj (Kachchh) - 370 001, Gujarat (India)

Tel : 02832 - 235025-29

www.gujaratdesertecology.com, E-mail : desert_ecology@yahoo.com



COMMERCIAL OFFER

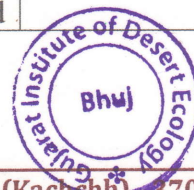
Consignee address	Our Quotation Ref. No.	Date
Deendayal Port Authority Administrative office, Post Box No 50, Gandhidham –Kachchh, Gujarat.	GUIDE / Quotation /DPA / 05 / 2024-25	02.04.2024

Kind Attention.: Sh. Rajendra Prasad, Dy. Chief Engineer & EMC (I/c)

Sub. : Techno-Commercial offer for Regular Monitoring of Marine Ecology and Continuous Monitoring Programme

Ref. : Your Letter No. EG/WK/4751/Part (Marine Ecology Monitoring)/22 Dt. 12.02.2024.

S. No.	EC & CRZ Accorded by MoEF&CC	Service Description	Frequency	Unit Rate Per Season (Rs.)	Total Value Per Year (Rs.)
1.	MoEF&CC EC & CRZ Clearance dated February 19 th December 2016 (Specific condition No. xviii of the letter dated 19.12.2016) MoEF&CC EC & CRZ Clearance dated 18 th February 2020 (Specific condition xxiii) MoEF&CC Clearance dated 19 th February 2020 (Specific condition xv) MoEF&CC Clearance dated 20 th November 2020 (VIII Marine Ecology, Specific condition viii)	Regular Monitoring of Marine Ecology in and around the Deendayal Port Trust in terms of Sea weeds, Sea grasses, Mudflats, Sand Dunes, Fisheries, Echinoderms, Shrimps, Turtles, Corals, Coastal vegetation, Mangrove and other marine biodiversity components as part of the Management Plan. Marine ecology will also be monitored in terms of all micro, macro and mega floral and faunal components of marine biodiversity.	Three season data covering Physico-chemical and biological components (Monsoon, Post-monsoon and Pre-monsoon)	12,20,000	36,60,000
2	MoEF&CC EC & CRZ Clearance dated 18 th February 2020 (Specific condition xix)	A continuous Monitoring Programme covering all seasons on various aspects of the coastal environs covering Physico-chemical parameters of marine water and		5,10,300	15,30,900



Dr. V. Vijay Kumar
Director

MoEF&CC Clearance dated 19 th February 2020 (Specific condition xiv)	marine sediment samples coupled with biological indices such as Sand Dune Vegetation, Mangroves, Sea grasses, Macrophytes and Phytoplankton on periodic basis during construction and operational phase of the project. Additionally, Primary productivity will also be carried		
MoEF&CC Clearance dated 1 st January 2024 (Specific condition xxv)			
		Total budget per year	51,90,900
		Total budget for Three years	1,55,72,700
Rupees in words: One Crore Fifty Five Lakh Seventy Two Thousand and Seven Hundred only			
GST @ 18% extra as applicable			

GUIDE: Scope of work

- Complying with the conditions imposed by the DPA as per the EC & CRZ clearance mentioned above.

DPA: Scope of work

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

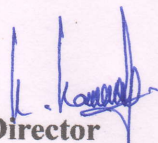
Terms and conditions for Report submission and mode of Payment

- 20% of the budget to be paid to GUIDE within 15 days from the date of submission of Inception report by GUIDE.
- 20% of the project budget should be paid to GUIDE within 15 days from the date of submission of First Season report by GUIDE.
- 20% of the project budget should be paid to GUIDE within 15 days from the date of submission of Second Season report by GUIDE.
- 20% of the project budget should be paid to GUIDE within 15 days from the date of submission of Third Season report by GUIDE.
- 20% of the project budget should be paid to GUIDE within 15 days from the date of submission of Final report by GUIDE.

GUIDE's Recognitions / Accreditations:

- Recognized as DSIR-SIRO, Ministry of Science and Technology, New Delhi.
- Recognized as Schedule I- Environmental Auditors by GPCB, Gandhinagar.

Yours Sincerely


Director

DIRECTOR
Gujarat Institute of Desert Ecology
Bhuj - Kachchh.



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Annexure I

Traffic Management Plan

KANDLA PORT TRUST

COMMODITY WISE IMPORTS / EXPORTS FOR LAST 16 YEARS

(IN METRIC TONNES)

Sr	COMMODITY	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
	A. IMPORTS																			
I	LIQUID BULK	<u>13481022</u>	<u>13637570</u>	<u>13159373</u>	<u>5288015</u>	<u>4463782</u>	<u>5028323</u>	<u>5554498</u>	<u>7404098</u>	<u>7472740</u>	<u>7215128</u>	<u>7538395</u>	<u>5777423</u>	<u>8092345</u>	<u>7997598</u>	<u>7958093</u>	<u>8313635</u>	<u>6877866</u>	<u>7672408</u>	<u>10334668</u>
1	POL	11518847	11503484	9994287	2251321	942127	1111977	1583236	2841428	2587240	2872563	2544743	884537	1366735	1884770	1640572	1203101	702140	867259	1045544
2	EDIBLE/VEG.OIL	148222	322294	812632	389442	371077	307085	338524	505905	745329	524470	617883	669726	666718	628992	351519	576946	2489880	3457865	4906602
3	PHOS ACID	890358	1034834	1250164	1225297	1507929	1748637	1618713	1787182	1806206	1400857	1185049	901731	1502180	1286098	1381763	1349284	990587	1084929	1547310
4	AMMONIA	162382	176092	280442	213621	356444	387730	282222	375984	400472	371528	288579	230227	311380	296236	293120	246270	239758	203713	308709
5	OTHER LIQUIDS	761213	600866	821848	1208334	1286205	1472894	1731803	1893599	1933493	2045710	2902141	3091202	4245332	3904618	4288003	4938034	2455501	2058642	2526503
II	FERTILIZER	<u>731607</u>	<u>588476</u>	<u>1020151</u>	<u>471277</u>	<u>610788</u>	<u>515659</u>	<u>502074</u>	<u>677877</u>	<u>1678599</u>	<u>2049000</u>	<u>3916127</u>	<u>5195085</u>	<u>4911994</u>	<u>5806780</u>	<u>5297166</u>	<u>3677966</u>	<u>2643503</u>	<u>3846922</u>	<u>4361990</u>
6	DAP/UREA	514881	200209	649713	218560	341088	157962	105909	195935	792234	1510705	2930347	3870694	3528726	4311467	4126160	2987481	1683544	2709023	3534157
7	MOP	216726	388267	370438	252717	269700	357697	396165	481942	886365	538295	985780	1324391	1383268	1495313	1171006	690485	959959	1137899	827833
III	FERTILIZER RAW MAT.	<u>660056</u>	<u>593909</u>	<u>495548</u>	<u>254684</u>	<u>264832</u>	<u>292619</u>	<u>268273</u>	<u>277962</u>	<u>251750</u>	<u>171865</u>	<u>159526</u>	<u>297744</u>	<u>787951</u>	<u>582767</u>	<u>761040</u>	<u>945810</u>	<u>991391</u>	<u>655378</u>	<u>169869</u>
8	ROCK PHOSPHATE	111875	160991	125042	25500	27500	0	0	39220	15000	24720	0	209643	656000	483967	658433	945810	991391	655378	169869
9	SULPHUR	548181	432918	370506	229184	237332	292619	268273	238742	236750	147145	159526	88101	131951	98800	102607	0	0	0	0
IV	IRON & STEEL	<u>570254</u>	<u>293770</u>	<u>526161</u>	<u>536547</u>	<u>781494</u>	<u>539010</u>	<u>619509</u>	<u>861836</u>	<u>1463258</u>	<u>1114420</u>	<u>1138342</u>	<u>1038094</u>	<u>1848807</u>	<u>1558230</u>	<u>870232</u>	<u>1225935</u>	<u>842261</u>	<u>1182308</u>	<u>1817460</u>
10	SCRAP	173648	128619	308573	397722	650243	358312	416761	543489	857015	140952	120	149871	504754	125704	4171	79984	19570	85799	425868
11	STEEL BILLETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21917	0	0	0	14780
12	STEEL COILS	87763	127921	128275	100705	115130	161673	194114	224326	488601	684489	927706	724746	969471	830692	525316	746534	533805	730254	1023022
13	PIPES/ANGLES/PLATES	305265	37230	89313	38120	16121	19025	8634	94021	117642	288979	210516	163477	374582	601834	318828	346417	288886	366255	353790
14	PIG/SPONGE IRON	3578	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53000	0	0	0
V	FOODGRAIN	<u>286957</u>	<u>107785</u>	<u>205492</u>	<u>85939</u>	<u>39</u>	<u>638</u>	<u>669</u>	<u>3724</u>	<u>0</u>	<u>1090921</u>	<u>393208</u>	<u>0</u>	<u>0</u>	<u>5021</u>	<u>102</u>	<u>500</u>	<u>250</u>	<u>7392</u>	<u>79424</u>
15	WHEAT	286124	107200	24282	0	0	0	430	3724	0	1090813	393208	0	0	0	0	500	0	2200	2200
16	RICE	833	585	2238	232	39	638	239	0	0	108	0	0	0	0	102	0	250	0	0
17	MAIZE	0	0	178972	85707	0	0	0	0	0	0	0	0	0	5021	0	0	0	5192	5192
VI	METAL & PRODUCT	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
18	METAL IGNOTS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VII	ORES	<u>46149</u>	<u>151812</u>	<u>64600</u>	<u>55867</u>	<u>47286</u>	<u>25930</u>	<u>28420</u>	<u>0</u>	<u>67273</u>	<u>320791</u>	<u>478133</u>	<u>168390</u>	<u>665661</u>	<u>635918</u>	<u>1030327</u>	<u>1056404</u>	<u>597667</u>	<u>1195505</u>	<u>952322</u>
19	PARALITE ORE	4000	3000	6020	7003	0	4000	4000	0	0	27500	0	0	0	0	0	0	0	0	0
20	IRON ORE	0	0	0	0	0	0	0	0	1882	233798	418976	129498	660406	625718	991898	1005936	586318	1160310	952322
21	LEAD/ZINC CONC.	42149	148812	58580	48864	47286	21930	24420	0	65391	59493	59157	38892	5255	10200	38429	50468	11349	35195	0
VIII	OTHER DRY CARGO	<u>1728451</u>	<u>2118620</u>	<u>2545828</u>	<u>2457238</u>	<u>2301012</u>	<u>2351217</u>	<u>2539465</u>	<u>3389480</u>	<u>3354210</u>	<u>3883028</u>	<u>4484566</u>	<u>5206106</u>	<u>8967614</u>	<u>8244818</u>	<u>8732352</u>	<u>8700360</u>	<u>9944501</u>	<u>14597189</u>	<u>20061695</u>
22	CEMENT	0	0	0	0	0	0	0	0	0	2023	0	0	0	0	0	0	0	0	0
	Thermal coal																			
23	HDPE/PVC/LDPE	9341	2607	0	0	0	0	0	0	0	292849	934922	1406754	2295596	3082371	4064413	4064218	6080196	9724853	14783585
24	CONTAINER CARGO	494499	394463	431164	481480	587676	688416	801291	1277022	971810	1046668	1072037	902771	996103	990584	971763	453605	53310	34043	2789
25	MACHINERY	30524	74722	13826	6219	4617	1962	7197	16524	22037	74245	62409	163521	80647	116255	70573	8911	11499	36095	36095
26	SUGAR	33101	47275	97066	0	0	0	0	268770	50100	0	0	141779	1570860	300104	98500	722207	610931	1267231	1266670
27	WOODEN LOGS	766550	818449	1155143	1298375	1297569	1388638	1427780	1456612	1595103	1806357	1940666	1886026	2907962	3114595	2971338	2798898	2651655	2851266	3273414
28	MET/COKING COAL	343193	735505	828998	623556	381339	254525	243880	228927	433629	410850	244079	466612	928651	409739	160825	373653	269951	241641	217235
29	MISCELLANEOUS	51243	45599	19631	47608	29811	17676	59317	141625	281531	250036	230453	238643	187795	231170	394940	278868	266959	478155	481907
	IMPORTS AT KANDLA	<u>17504496</u>	<u>17491942</u>	<u>18017153</u>	<u>9149567</u>	<u>8469233</u>	<u>8753396</u>	<u>9512908</u>	<u>12614977</u>	<u>14287830</u>	<u>15845153</u>	<u>18108297</u>	<u>17682842</u>	<u>25274372</u>	<u>24831132</u>	<u>24649312</u>	<u>23920610</u>	<u>21897439</u>	<u>29157102</u>	<u>37777428</u>
	TEUs in NUMBERS	<u>42025</u>	<u>32682</u>	<u>39424</u>	<u>47260</u>	<u>64783</u>	<u>80216</u>	<u>89369</u>	<u>101255</u>	<u>80177</u>	<u>95715</u>	<u>92805</u>	<u>79050</u>	<u>79049</u>	<u>87003</u>	<u>91341</u>	<u>61910</u>	<u>13782</u>	<u>0</u>	<u>1137</u>
	IMPORTS AT VADINAR	<u>14027606</u>	<u>16234689</u>	<u>18017194</u>	<u>18953558</u>	<u>19987620</u>	<u>21483957</u>	<u>21566909</u>	<u>18771848</u>	<u>20492321</u>	<u>24139571</u>	<u>28598148</u>	<u>35477031</u>	<u>36376600</u>	<u>36164776</u>	<u>35453536</u>	<u>39272742</u>	<u>37594652</u>	<u>40398560</u>	<u>41095878</u>
	TOTAL IMPORTS	<u>31532102</u>	<u>33726631</u>	<u>36034347</u>	<u>28103125</u>	<u>28456853</u>	<u>30237353</u>	<u>31079817</u>	<u>31386825</u>	<u>34780151</u>	<u>39984724</u>	<u>46706445</u>	<u>53159873</u>	<u>61650972</u>	<u>60995908</u>	<u>60194189</u>	<u>63193352</u>	<u>59492091</u>	<u>69555662</u>	<u>78874443</u>
B	EXPORTS																			
I	LIQUID BULK	<u>194820</u>	<u>189853</u>	<u>225441</u>	<u>316472</u>	<u>588900</u>	<u>723502</u>	<u>725453</u>	<u>626634</u>	<u>991073</u>	<u>1583071</u>	<u>2137324</u>	<u>2256505</u>	<u>2678466</u>	<u>2207957</u>	<u>1702662</u>	<u>1481621</u>	<u>1638817</u>	<u>1259877</u>	<u>1681124</u>
1	POL	400	0	0	37578	212508	396281	340000	209648	405895	955767	1463817	1670770	1699300	1404835	1247350	1097727	1318015	1000836	1431164
2	EDIBLE/CASTOR OIL	133963	143561	190885	178778	178871	159698	239950	257955	183566	193279	205513	189080	157124	144309	169872	166143	165859	210027	145727

Sr	COMMODITY	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
3	MOLASSES	0	0	0	0	0	0	0	0	38409	0	0	0	0	5000	0	0	0	0	0
4	OTHER LIQUIDS	60457	46292	34556	100116	197521	167523	145503	159031	363203	434025	467994	396655	822042	653813	285440	217751	154943	49014	104233
II	FOOD GRAINS	1099353	1589469	845146	1186588	2584451	5444499	4802733	2530901	1379092	932715	979956	1029273	631603	669656	1290927	3782098	2731335	2216096	733542
5	RICE	1095342	1588367	843425	679706	1531364	3388022	1960772	1418092	1206338	894558	856338	695340	604951	564419	919267	1556727	670002	323938	600872
6	WHEAT	0	0	0	495881	1035585	2048403	2715075	898773	139093	19285	0	0	0	0	297978	2149623	1682346	1510503	82264
7	MAIZE/BAJRA	4011	1102	1721	11001	17502	8074	126886	214036	33661	18872	123618	333933	26652	105237	73682	75748	378987	381655	50406
III	ORES	289185	341393	255128	237309	224032	400991	408071	506664	389926	507973	580362	331413	410199	264543	503504	892895	444011	463281	337932
8	BENTONITE	167324	222759	122358	139194	164874	156382	145416	228616	118547	166591	194800	159863	140102	141122	231750	226450	268400	124161	125400
9	BAUXITE	0	53190	99972	0	0	82373	0	0	24951	37750	45200	0	0	259069	583420	85710	339120	200202	0
10	COPPER CONCENTRATE	0	1000	0	7288	0	0	0	0	0	0	0	0	0	0	0	0	42844	0	12330
11	COPPER REVERTTS	3500	0	0	17984	5448	6492	7532	0	0	0	0	0	0	0	0	0	0	0	0
12	ZINC CONC/WALLASTONITE	118361	64444	32798	72843	53710	155744	255123	278048	246428	303632	340362	171550	270097	123421	12685	83025	47057	0	0
IV	IRON & STEEL	86063	112440	53150	9605	30050	56340	28931	486594	432724	269538	320871	61044	41023	44962	165155	90117	11509	48439	122399
13	COATED/STEEL PIPES	86063	112375	53150	9605	29613	56340	28931	486081	371019	252517	320871	53468	41023	44962	161442	76621	11509	39321	90786
14	COIL/T.MATERIAL	0	65	0	0	437	0	0	513	61705	17021	0	7576	0	0	3713	13496	0	9118	31613
V	OTHER DRY CARGO	2210219	1946983	2289027	3037068	4277044	3748256	4342994	5394168	6983506	7381671	7818847	7299606	6319644	8725082	10130841	11397593	9164898	5630870	6289648
15	SALT	180201	225355	403494	834849	1298584	927951	862856	2114443	2168874	1241242	1217164	1323236	2079301	2846918	3130906	4494979	3683417	2710612	4153619
16	CONTAINER CARGO	804773	521380	703066	805394	1163799	1537005	1604615	1476948	1339559	1731495	1544868	1232512	1439043	1595405	1794899	1480608	398997	0	53195
17	EXTRACTIONS	979398	1064437	1048639	1139073	1586000	986780	1592434	1467671	2660108	2767569	3512906	3218255	1805067	2328124	2779479	3082008	3299224	1767162	717153
18	COTTON BALES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	SUGAR	45250	0	0	0	7810	72674	56006	6876	0	155519	237263	258617	0	387659	352243	761393	403048	203971	290849
20	DIESEL ENGIENE	2777	2656	4292	2821	2864	2308	1608	2305	1714	1082	145	0	0	0	0	0	0	0	0
21	SILICA SAND/CHINA CLAY	0	0	0	0	0	621	26200	33856	0	0	0	0	0	0	0	0	10149	20698	149058
22	SESAME SEEDS	22010	13487	16880	53885	27405	13717	12031	0	202	0	108	0	0	0	0	0	0	0	0
23	BUSES/CARS	639	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	MISCELLANEOUS(INC TUNA)	175171	119668	112656	201046	190582	207200	187244	292069	813049	1484764	1306393	1266986	996233	1566976	2073314	1578605	1370063	928427	925774
	TOTAL EXPORTS	3879640	4180138	3667892	4787042	7704477	10373588	10308182	9544961	10176321	10674968	11837360	10977841	10080935	11912200	13793089	17644324	13990570	9618563	9164645
	TEUs IN NUMBERS	42169	30754	39665	44274	60580	77048	80666	79662	68447	81876	72287	58450	67723	73240	75147	56382	15684	15684	2034
	TOTAL AT KANDLA	21384136	21672080	21685045	13936609	16173710	19126984	19821090	22159938	24464151	26520121	29945657	28660683	35355307	36743332	38442401	41564934	15684	38775665	46942073
	TOTAL TEUs	84194	63436	79089	91534	125363	157264	170035	180917	148624	177591	165092	137500	146772	160243	166488	118292	29466	0	3171
	TOTAL CONTAINER CARGO	1299272	915843	1134230	1286874	1751475	2225421	2405906	2753970	2311369	2778163	2616905	2135283	2435146	2585989	2766662	1934213	452307	0	89290
	SUMMARY																			
	TOTAL DRY KANDLA	7708294	7844657	8300231	8332122	11121028	13375159	13541139	14129206	16000338	17721922	20269938	20626755	24584496	26537777	28781646	31769678	27371326	29843380	34926281
	TOTAL LIQUID KANDLA	13675842	13827423	13384814	5604487	5052682	5751825	6279951	8030732	8463813	8798199	9675719	8033928	10770811	10205555	9660755	9795256	8516683	8932285	12015792
	CRUDE AT VADINAR	14027606	16234689	18017194	18953558	19987620	21483957	21566909	18771848	20492321	24139571	28598148	35477031	36376600	36164776	35453536	39272742	37594652	40398560	41095878
	TRANSHIPMENT (VADINAR)	3489099	2730406	6601247	3851179	1566619	21973	134834	619345	950450	1263992	1697910	7047165	7526226	8726607	8296367	12573419	13086672	13141000	11736911
	POL EXPORT AT VADINAR	0	0	0	0	0	0	0	0	0	1058420	4678569	1040031	241941	245396	308998	207792	435419	181524	275911
	OVERALL	38900841	40637175	46303486	36741346	37727949	40632914	41522833	41551131	45906922	52982104	64920284	72224910	79500074	81880111	82501302	93618887	87004752	92496749	100050773
	DRY CARGO EXCLUDING CONTAINER CARGO							11135233	11375236	1.4E+07	14943759	17653033	18491472	22149350	23951788	26014984	29835465	26919019	29843380	34836991

/

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Annexure J

Copy of Advertisement

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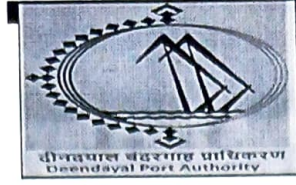
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Annexure K

Letter to Local bodies

Deendayal Port Authority
(Erstwhile : Deendayal Port Trust)

Tel (O) : (02836) 220038,
Fax : (02836) 220050
E - Mail : kptdesignsection@gmail.com
kptemc@gmail.com
Website : www.deendayalport.gov.in



Office of the SE (PL) & EMC (I/c),
ANNEX, Administrative Office
Gandhidham - Kutch
Pin - 370 201.

ISO 9001 - 2015 &
ISO 14001 - 2015 Certified

No. EG/WK/4751/Part (Revamping - EC onwards) | 06 **Dated : 04/01/2024**

To,
The District Collector,
Collector Office,
Jilla Seva Sadan, **Bhuj-370001- Kachchh.**
Email : collector-kut@gujarat.gov.in

Sub: Augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA through modernization of Existing Pipeline network at Oil Jetty Area, Deendayal Port Authority, Kandla - **Environmental & CRZ Clearance accorded by the MoEF&CC, GoI reg.**

Ref. : EC & CRZ Clearance accorded by the MoEF&CC, GoI vide F.No. 10-26/2018-IA.III dated 01/01/2024.

Sir,

Kindly refer to the above cited reference for the subject mentioned above.

In this regard, it is to inform that, the MoEF&CC, GoI vide above mentioned reference dated 01/01/2024 has accorded EC & CRZ Clearance to the subject proposal of the Deendayal Port Authority.

In the said EC & CRZ Clearance letter dated 01/01/2024, Para B. STANDARD CONDITIONS, Sub Para XI. Miscellaneous, Condition (ii), it is mentioned that, **"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"**.

Accordingly, kindly find attached herewith a copy of the EC & CRZ Clearance accorded by the MoEF&CC, GoI dated 01/01/2024 as **Annexure A**, for information & with a request to kindly arrange to display the same as required under the above condition.

Thanking you.

Encl. : As above

Yours faithfully,

24/1/24
Superintending Engineer (PL) & EMC (I/c)
Deendayal Port Authority

Copy also to (along with a copy of EC & CRZ Clearance) :

- 1) The Mamlatdar
Mamlatdar Office, Sector 1A, Kachchh Kala Road,
Gandhidham- 370201, Kachchh.
Email : mam-gandhidham@gujarat.gov.in.

.....Cont.....

- 2) The Taluka Development officer,
Gandhidham Taluka Panchyat,
DC 5, Adipur – 370 205 (Gandhidham – Kachchh)
(Email : tdo.gandhidham@gmail.com).
- 3) The Chief Officer, Gandhidham Municipality
Plot no-35, Sector-9,
Gandhidham – 370 201, Kachchh
(Email: np_gandhidham@yahoo.co.in)
- 4) The Regional Officer,
Regional Office, GPCB (East Kachchh).
Room No. 215-217, Administrative Office Bldg,
Deendayal Port Authority ,Sector 8,
Gandhidham- 370 201, Kachchh.
Email.: ro-gpcb-kute@gujarat.gov.in

ENVIRONMENTAL
CLEARANCE

Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

To,

The Chief Engineer
DEENDAYAL PORT TRUST
A.O. Building ,Annex, P.O.Box No. 50 , Gandhidham- Kutch,,kutch,Gujarat-
370201

Subject: Grant of Environmental Clearance (EC) to the proposed Project Activity under the provision of EIA Notification 2006-regarding

Sir/Madam,

This is in reference to your application for Environmental Clearance (EC) in respect of project submitted to the Ministry vide proposal number IA/GJ/NCP/280634/2018 dated 12 Dec 2022. The particulars of the environmental clearance granted to the project are as below.

- | | |
|---|--|
| 1. EC Identification No. | EC24A033GJ192347 |
| 2. File No. | 10-26/2018-IA.III |
| 3. Project Type | Expansion |
| 4. Category | A |
| 5. Project/Activity including Schedule No. | 7(e) Ports, Harbours |
| 6. Name of Project | Augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA Through Modernisation of Existing Pipeline Network at Oil Jetty Area, Deendayal Port Trust, Kandla |
| 7. Name of Company/Organization | DEENDAYAL PORT TRUST |
| 8. Location of Project | Gujarat |
| 9. TOR Date | N/A |

The project details along with terms and conditions are appended herewith from page no 2 onwards.

Date: 01/01/2024

(e-signed)
Amardeep Raju
Scientist E
IA - (INFRA-1 sector)

Note: A valid environmental clearance shall be one that has EC identification number & E-Sign generated from PARIVESH. Please quote identification number in all future correspondence.

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2. The proposal is for augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA through modernization of existing pipeline network at Oil Jetty Area, Deendayal Port Trust, Kandla, Tal Gandhidam, Dist.Kutch, Gujarat by M/s Kandla Port Trust.

3. Presently Deendayal Port Authority (Erstwhile Deendayal Port Trust) has six oil jetties (OJ no, 1 to 4–DPA & OJ 5 & 6–IFFCO & IOCL respectively) located on western side of Kandla Creek. The five oil jetties presently have a total of 167 nos. pipelines of these, 125 pipelines will be scrapped and the remaining 42 pipelines will be retained 84 new higher capacity pipelines for improving the efficiency and safety over the existing trestle will be laid. The work also envisages replacing inspection of the steel trestles over which the pipelines run and replacing the damaged trestles. Entire project area located within existing Oil Jetty Area of Deendayal Port Authority, Kandla.

4. The Project will be implemented in three phases:

Phase 1: Removal of marine unloading arms, their connected airlines in Oil Jetty 1 & Oil Jetty 4 and Flushing Lines in Oil Jetty and asking M/s HPCL (now taken over by M/s ONGC Ltd.), M/S BPCL, M/S IOCL, M/S IFFCO, M/S Synthetics & Chemicals to remove their redundant pipelines.

Phase 2: Commissioning of Newly Laid Edible Oil Pipelines and subsequently removal of Existing Edible Oil Pipelines by the respective stakeholders. This will be taken up during the final stages of completion of Phase 1.

Phase 3: Removal of Existing Chemical pipelines by the respective stakeholders and laying of New chemical pipelines.

5. The first oil jetty was commissioned during year 1965 & subsequently, other oil jetties were commissioned. DPA has obtained EC and CRZ clearance for the “Development of plots for construction of liquid storage tank farm at Kandla Port Trust at Kandla” vide letter no. F.No. 10-36/2008-IA-III dated 02/02/2010 (for the proposed installation of tanks for storage/handling of the petroleum products and edible oil and laying of inter terminal pipelines) and obtained its extension of validity of EC and CRZ clearance on 18/08/2015 for a period up to 01.02.2020. Out of total 17 plots, DPA allotted 13 plots (3, 4, 5, 6, 7, 10, 12, 13, 14, 15, 17, 18 & 19) to various plot allottees. Further, Ministry of Environment, forest and climate change (CRZ Division) vide letter no. F.No. 19-2/2018-IA.III dated 15/04/2019 clarified on the applicability of CRZ clearance stating that “The need for further CRZ Clearance by the plot holders in the DPT area for which a composite EC & CRZ clearance has been issued therefore does not seem to arise”. All plot allottees (13 No.s) have established their tank farms including interconnecting pipelines from various oil jetties to their terminals. DPA obtained consolidated consent and Authorization from GPCB for the Commercial operation. DPA had obtained the consolidated Consent and Authorization from the GPCB for the said oil jetties and handling of liquid cargo Consent order no. AWH- 43365 Vide



letter no. PC/CCA-Kutch-812/GPCB ID 28494/93560 dated 05/10/2011 valid up to 21/07/2015, Consent order no. AWH- 72820 Vide letter no. GPCB/CCA-Kutch-812(2)/GPCB ID 28494/327172 dated 11/09/2015 valid up to 21/07/2020, Renewal of the Consent order no. AWH-110594 Vide letter no. GPCB/CCA-Kutch-812(5)/GPCB ID 28494/581914 dated 22/01/2021 valid up to 21/07/2025.

6. The proposed project falls under category 'A' of item 7 (e) i.e. 'Ports, harbours, break waters, dredging' of the schedule to the EIA Notification, 2006 and its subsequent amendments. The total project cost is estimated to be Rs. 170.42 Crores.

7. Terms of References (ToR): ToR was recommended by the EAC (infra-2) in its 30th meeting held on 18th -20th April, 2018 and it was granted vide letter No. 10-26/2018-IA.III dated 14th June, 2018. Amendment in ToR was recommended by the EAC (infra-2) in its 51st meeting held on 21st -22nd May, 2020 and it was granted vide letter even no dated 11th June, 2020.

8. Public Hearing: Public Hearing was conducted by Gujarat Pollution Control Board, in district kutch, Gujarat on 10.12.2021. The details of the public hearing is as following:

S.no	Date	Village/Venue	District and State	Chaired by
1	10 th December, 2021	Parking Plot of DPT near Kutch Salt Junction, Kandla Village,	Dist. kutch, Gujarat.	Additional District Magistrate, kutch

9. Land Use Land Cover of the Project site is.

S.no.	Land use/Land cover	Area(ha)	Percentage (%)	Remarks, if any
1	Built-up Area on dry land	8.0	21.16	Entirely within Customs Bonded Area of the port
2	Creek	24.0	63.49	
3	Inter-tidal Zone / Mudflat	3.55	9.39	
4	Mangrove	2.25	5.95	
Total		37.8	100	

10. Terrain and topographical features: The study area is extremely flat. The land is just above the mean sea level. The entire project area is located on the bank of Kandla Creek and is within the Oil Jetty Area of Deendayal Port. No acquisition of additional land will be necessary.

11. Details of water bodies, impact on drainage: The project site is located on the western bank of the Kandla Creek, which joins the Gulf of Kutch ~6.5 km south of oil Jetty 1. Off the project site, the Kandla Creek is more than 1 km wide. The western part of the study area is drained by Kandla Creek, Khori Creek and Nakti Creek, all of which join the Gulf of Kutch. About 3.4 km

north Oil Jetty 5, the Kandla Creek bifurcates into 2 Creeks, Sanu Creek and Phang Creek, which extend further north and north-east through a network of smaller tidal creeks / channels. The eastern half of the study area is dominated by an uninhabited tidal mud-flat called “Sath-Saida Bet”. The western ~1/3 of the Sath-saida Bet drains into the Kandla Creek, whereas the eastern ~2/3 drains into another creek further east.

12. Water Requirement: The domestic water requirement for the existing Oil jetty area is 200 KLD and it will remain unchanged after proposed revamping and replacement of the pipelines. The potable water is supplied mostly by Gujarat Water Supply and Sewerage. Board (GWSSB), an agency of the Government of Gujarat. If there is any shortfall the water is supplied in tankers. Sewage generated at the township is treated in sewage treatment plant. The entire quantity of treated sewage (700 m³ /day) is reused in existing Deendayal Port for miscellaneous purposes. The pipeline revamping and replacement project is not expected to lead to any increase in water demand.

13. Tree cutting: No tree cutting involved in the proposed project. The proposed revamping and replacement of pipelines will be done on already existing Oil Jetty area.

14. Diversion of forest land: There are no forests in the study area. However there are mangroves on the banks of the tidal channels and tidal mud flats in the study area. Beyond the tidal influenced area, the area is semi-arid. The proposed revamping and replacement of pipelines will be done on already existing Oil Jetty area. No new berths will be constructed nor there any proposal to increase the size of the ships presently being handled at the oil jetties. No acquisition of additional land will be required.

15. The proposed project is not located within 10 km of Protected Areas (PA), National Parks, Sanctuaries and Tiger Reserves etc and there are no Eco-Sensitive Zone (ESZ) or Eco-Sensitive Area (ESA) in 10 km radius area.

16. Waste Management: During normal operation of the pipelines no solid wastes will be generated. first a new pipeline should be laid and then only old pipeline should be removed. After detailed deliberations, the sequence for laying of pipelines and removal of old ones has been arrived. This should be strictly followed. Presently, every year about 3600 tonnes of used oil and oily residues are generated at Deendayal Port. These hazardous wastes are packed in labelled plastic drums. Deendayal port has licensed several waste disposal contractors who have necessary authorizations from Central Pollution Control Board (CPCB) and Gujarat Pollution Control Board (GPCB). The wastes are collected by these contractors and taken away for proper disposal with proper documentation. Copies of the documents in the prescribed forms are submitted to DPT as well as GPCB.

17. The oil / sludge removed by Pigging of the revamped pipeline network of the Oil Jetty Area will be considered as Hazardous wastes and disposed off in accordance with the “Hazardous



and Other Wastes (Management and Transboundary Movement) Rules, 2016” & its subsequent amendments. The wastes will be packed in leak-proof containers which will be labelled and temporarily stored in a designated place before being sent to an authorized waste Treatment, Storage & Disposal Facility (TSDF) for proper disposal.

18. The layout on CRZ map of 1:4000 scale prepared by IRS Chennai. MCZMA recommended the project to MoEF& CC vide letter no. ENV-10-2021-41-T dated 25th August, 2022. As per the MCZMA recommendations. The Project Falls in CRZ I(A) (Mangrove), CRZ-I(B), CRZ-III and CRZ-IV. The proposed activities are permissible activities as per the provisions of CRZ Notification 2011.

19. ~130 m - ~220 m offshore. The Jetties are linked to the shore by concrete bridges which also carry power lines and pipelines. The pipelines from the six oil jetties converge at “Y Junction” on the shore from where pipes lead to various storage facilities. The laying of pipeline for the proposed revamping will be entirely on the existing structure like Jetties, Pipelines and Trestles etc and the work involves removal of old pipelines and replacement of the same with the new pipelines. The project does not envisage digging of any foundations. No new berths will be constructed nor there any proposal to increase the size of the ships presently being handled at the oil jetties. Hence no dredging will be required. The new pipelines will be laid on the existing pipe bridges after scrapping some of the existing pipelines. The pipelines are located several feet above the High Tide Line. No land filling will be necessary. There is no proposal to construct any new structure either offshore or on land under the present proposal.

20. The oil jetties were constructed since 1965 i.e much before the EIA notification and CRZ notification therefore, the subject proposal was inspected as per the stipulated condition mentioned in the Consolidated Consent and Authorization order no. AWH-110594 dated 22/01/2021, on 06/09/2022 by the IRO, Gandhinagar. Accordingly detailed monitoring report along with observations had been issued by the IRO, Gandhinagar vide letter no. File No. J-11/77-2022-IROGNER dated 14/11/2022.

21. Land acquisition and R&R issues: No acquisition of additional land will be required for the proposed project.

22. Employment Potential: Deendayal Port Trust employs 2634 persons. It is expected that maximum ~200 workers will be directly engaged at any given time during construction. These will be contractors’ workers. The revamped pipelines will be operated by an external O&M agency hired by DPT.

23. Benefits of the project: Some of existing marine unloading arms and pipelines are no longer in use. They are occupying valuable space. The space freed by scrapping of redundant pipelines can be put to other valuable use. Deendayal Port Trust has decided to revamp the existing pipeline network leading from Oil Jetties, 1, 2, 3 & 4. Some of the existing pipelines along with



allied structures leading from Oil Jetties to the Y-Junction will be scrapped. It has been estimated that-3500 tonnes of pipes and allied structures will be scrapped. These will be replaced by pipelines of higher capacity for improving the efficiency and safety for handling Edible Oils, Chemicals and utilities as Air & Water. This will not only increase cargo-throughput (from 8 to 10 million tonnes per year) but also increase cargo-mix. During the construction period several highly skilled, skilled as well as unskilled workers and other personnel will be employed. As part of its Corporate Environmental Responsibility (CER), DPT shall implement social infrastructure improvement projects in the area in consultation with local people.

24. Details of Court cases: No Court case is pending against the Project.

25. The EAC, after examining the documents submitted by the project proponent and detailed deliberations in its 345th meeting on 09th-10th November, 2023 and **recommended** the proposal for grant of Environmental Clearance and CRZ clearance subject to all specific and standard conditions applicable for such projects.

26. The Ministry of Environment, Forest and Climate Change has considered the proposal based on the recommendations of the Expert Appraisal Committee (Infrastructure, CRZ and other miscellaneous projects) and hereby decided to grant Environmental and CRZ Clearance for the 'augmentation of Liquid Cargo Handling Capacity from 8 MMTPA to 23.8 MMTPA through modernization of existing pipeline network at Oil Jetty Area, Deendayal Port Trust, Kandla, Tal Gandhidam, Dist.Kutch, Gujarat by M/s Kandla Port Trust' under the EIA Notification, 2006 as amended and CRZ Notification 2011, subject to strict compliance of the following specific conditions, in addition to all standard conditions applicable for such projects.

SPECIFIC CONDITIONS

- i. Construction activity shall be carried out strictly according to the provisions of the CRZ Notification, 2011. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.
- ii. All the recommendations and conditions specified by the Gujarat State Coastal Zone Management Authority (GCZMA) vide letter No ENV-10-2021-41-T dated 25th August, 2022 shall be complied with.
- iii. Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.
- iv. PP shall ensue while scrapping of 125 old pipeline and laying of 84 new process shall not cause any spillage/leakage.
- v. As proposed by PP Steel scrap will be temporarily stored in designated area before being auctioned off. The storage of steel scrap and any other scrapped material shall be stored temporarily outside the CRZ area.



- vi. Wastes discharged from ships will be handed over to the port's licensed waste disposal contractors.
- vii. No new berths will be constructed nor there any proposal to increase the size of the ships presently being handled at the oil jetties. Hence no dredging shall be carried out.
- viii. The project proponent shall install system carryout to 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.
- ix. 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.
- x. The project proponent shall submit monthly summary report of continuous stack 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.
- xi. Effective safeguard measures, such as regular water sprinkling shall be carried out in critical areas prone to air pollution and having high level of particulate matter such as around loading and unloading point and all transfer points. Extensive water sprinkling shall be carried out on haul roads. It should be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.
- xii. Risk assessment for spill scenarios and Disaster Management Plan as prepared shall be in place in the environment Management cell of Deendayal Port Authority with all SOP's for various scenarios.
- xiii. 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.
- xiv. 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.
- xv. 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.
- xvi. The proponent shall put in place the detailed on site and off site Emergency Management Plan as per the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, as amended to date which may cover the natural disasters also.
- xvii. The company shall develop a contingency plan for H2S release including all necessary aspects from evacuation to resumption of normal operations. The workers shall be provided with personal H2S detectors in locations of high risk of exposure along with self containing breathing apparatus.



- xviii. Emergency Response Plan (ERP) shall be based on the guidelines prepared by OISD, DGMS and Govt. of India.
- xix. Sediment analysis of harbor at identified locations shall be analyzed and records for past and present period shall be maintained.
- xx. 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.
- xxi. No underwater blasting is permitted.
- xxii. Necessary approvals be taken during implementation and commissioning from statutory bodies concerned.
- xxiii. A site specific biodiversity conservation plan including mitigation measures to be developed from competent nationally/internationally recognized institute with appropriate financial allocation for its implementation.
- xxiv. Shoreline should not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary. The details shall be submitted along with the six monthly monitoring report.
- xxv. A continuous monitoring programme covering all the seasons on various aspects of the coastal and marine environs need to be undertaken by a competent organization available in the State or by entrusting to the National Institutes/renowned Universities/accredited Consultant with rich experiences in marine science aspects. Monitoring should include sea weeds, sea grasses, mudflats, sand dunes, fisheries, mangroves and other marine biodiversity components as part of the management plan.
- xxvi. Necessary arrangements for the treatment of the effluents and solid wastes/ facilitation of reception facilities under MARPOL must be made and it must be ensured that they conform to the standards laid down by the competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986. The provisions of Solid Waste Management Rules, 2016. E- Waste Management Rules, 2016, and Plastic Waste Management Rules, 2016 shall be complied with.
- xxvii. All the commitments made to the public during public hearing/public consultation meeting shall be satisfactorily implemented and adequate budget provision shall be made accordingly.
- xxviii. All the recommendations mentioned in the risk assessment report, disaster management plan and safety guidelines shall be implemented.
- xxix. 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 NPV, Compensatory Aforestation 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.



B. STANDARD CONDITIONS:

I. Statutory compliance:

- (i) The project proponent shall prepare a Site-Specific Conservation Plan & Wildlife Management Plan and approved by the Chief Wildlife Warden. The recommendations of the approved Site-Specific Conservation Plan / Wildlife Management Plan shall be implemented in consultation with the State Forest Department. The implementation report shall be furnished along with the six-monthly compliance report (incase of the presence of schedule-I species in the study area).
- (ii) The project proponent shall obtain the necessary permission from the Central Ground Water Authority, in case of drawl of ground water / from the competent authority concerned in case of drawl of surface water required for the project.
- (iii) All excavation related dewatering shall be as duly authorized by the CGWA. A NOC from the CGWA shall be obtained for all dewatering and ground water abstraction.
- (iv) 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.
- (v) 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.

II. Air quality monitoring and preservation:

- (i) 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 PM_{2.5} in reference to PM emission, and SO₂ and NO_x in reference to SO₂ and NO_x emissions) within and outside the project area at least at four locations, covering upwind and downwind directions.
- (ii) 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.
- (iii) Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.
- (iv) 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.
- (v) Diesel power generating sets proposed as source of backup power should be of 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.

- (vi) 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 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.

III. Water quality monitoring and preservation:

- (i) Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission from competent authority shall be obtained for use of fresh water.
- (ii) 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.
- (iii) 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.
- (iv) No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.

IV. Noise monitoring and prevention:

- (i) 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.
- (ii) 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 equipments.
- (iii) 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.
- (iv) 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.

V. Energy Conservation measures:

- (i) Provide solar power generation on roof tops of buildings, for solar light system for all common areas, street lights, parking around project area and maintain the same regularly;
- (ii) Provide LED lights in their offices and residential areas.

VI. Waste management:

- (i) 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 competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986.
- (ii) The solid wastes shall be managed and disposed as per the norms of the Solid Waste Management Rules, 2016.
- (iii) 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.
- (iv) 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.
- (v) Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination.

VII. Green Belt:

- (i) An overall green area of at-least 33% of the Industrial Area should be developed with native species. The green area shall be 40% in case of critically polluted area. The project proponent of the Industrial Area shall comply with the additional commitment made by them in the EIA report regarding the development of green belt.
- (ii) The Industrial Areas are directed to accordingly allocate the area to be developed as green cover to respective individual industrial units so as to achieve the above mentioned condition.
- (iii) The individual industrial unit, at the time of obtaining EC, shall bring a letter from the Industrial Area for the area allocated to them to be developed as green cover as a part of obligation from the Industrial Area.
- (iv) Wherever possible, plantations around the periphery of the Industrial Area, in the downwind direction and along the road sides shall be provided for containment of pollution and for formation of a screen between the industrial area and the outer civil area. The choice of plants should include shrubs of height 1 to 1.5 m and tree of 3 to 5 m height. The intermixing of trees and shrubs should be such that the foliage area density in vertical is almost uniform.
- (v) The parameters like selection of plant species, procedure for plantation, density of tree plantation etc shall be as per the CPCB guidelines.

VIII. Public hearing and human health issues:

- (i) Workers shall be strictly enforced to wear personal protective equipments like dust mask, ear muffs or ear plugs, whenever and wherever necessary/ required. Special visco-elastic gloves will be used by labour exposed to hazards from vibration.
- (ii) 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.
- (iii) Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.
- (iv) 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.
- (v) Occupational health surveillance of the workers shall be done on a regular basis.

X. Environment Responsibility:

- (i) 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 / 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.
- (ii) 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.
- (iii) 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.
- (iv) Self environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.

XI. Miscellaneous:

- (i) 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.
- (ii) 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.
- (iii) 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.
- (iv) The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal.
- (v) 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.
- (vi) The criteria pollutant levels namely; PM_{2.5}, PM₁₀, SO₂, NO_x (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.
- (vii) The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.
- (viii) The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.
- (ix) 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.
- (x) No further expansion or modifications in the Industrial Area shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).
- (xi) 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.
- (xii) The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.



- (xiii) The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.
- (xiv) 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 / information/monitoring reports.
- (xv) 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.
- (xvi) 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.



(Amardeep Raju)
Scientist-E

Copy to:

1. The Secretary, Forest, Environment and Climate Change Department, Govt. of Odisha, KharavelBhavan, Gopabandhu Marg, Keshari Nagar, Bhubaneswar, Odisha 751001.
2. The Deputy Director General of Forests (C), Ministry of Env., Forest and Climate Change, Integrated Regional Office, A/3, Chandersekharpur, Bhubaneswar – 751023.
3. The Chairman, Central Pollution Control Board, PariveshBhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi – 32.
4. The Member Secretary, Odisha State Pollution Control Board, A/118, Unit-Viii, D A V School Main Road, Gopabandhu Nagar, Near Ommeed, Neelkanth Nagar, Bhubaneswar, Odisha 751012.
5. Monitoring Cell, MoEF&CC, Indira ParyavaranBhavan, New Delhi.
6. PARIVESH Portal.
7. Guard File/Record File.



(Amardeep Raju)
Scientist-E

Signature Not Verified

Digitally signed by: Amardeep Raju
Designation: Scientist E
Date and Time: 17/01/2024 5:32:06 PM

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Annexure L

Form V



DEENDAYAL PORT AUTHORITY
(Erstwhile: DEENDAYAL PORT TRUST)

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

www.deendayalport.gov.in

EG/WK/4751 (CCA Renewal)/ 92

Date: 19/07/2024

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

Sub: Submission of Environmental statement in format form V for the financial year 2022-23 reg. (Detailed Consent Order issued by GPCB vide letter no. GPCB/CCA-Kutch-812/(5)/ID - 28494/581914 dated 22/01/2021 - Consent no. AWH - 110594 & CCA amendment Order - WH-130995).

- Ref.:** 1) KPT letter no. MR/GN/1527(Part I)/535 dated 16/6/2012
2) KPT letter no. MR/GN/1527(Part I)/2011 dated 20/5/2013
3) KPT letter no. MR/GN/1527(Part I)/337 dated 17/05/2014
4) KPT letter no. MR/GN/1527/ (Part I)/dated 27/04/2015
5) KPT letter no. EG/WK/EMC/CCA (Part II)/218 dated 27/6/2016
6) KPT letter no. EG/WK/EMC/CCA (Part II)/214 dated 19/6/2017
7) DPT letter no. EG/WK/EMC/CCA (Part II)/294 dated 13/6/2018
8) DPT letter no. EG/WK/EMC/CCA (Part II) dated 27/5/2019
9) DPT letter no. EG/WK/4751 (CCA Renewal) dated 22/5/2020
10) DPT letter no. EG/WK/4751 (CCA Renewal)/14 dated (30)04/(4)5/2021
11) DPA letter no. EG/WK/4751 (CCA Renewal)/132 dated 06/07/2022
12) DPA letter no. EG/WK/4751 (CCA Renewal)/326 dated 19/06/2023

Sir,

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

In this connection, it is to state that, the Deendayal Port Authority had obtained Renewal of Consolidated Consent & Authorization from the GPCB vide order no. AWH - 110594 dated 22/01/2021 valid up to 21/07/2025 for Port Area of Deendayal Port Authority and subsequently, the GPCB had issued correction in consent vide order dated 09/04/2021. Afterward, DPA has also obtained amendment in Consent Order from the GPCB vide order dated 11/01/2024 (CCA Amendment - WH-130995) **(Copy attached as Annexure I).**

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

Now please find the enclosed herewith Environmental Statement in Form V for the year 2023-24 as **Annexure II.**

This is for kind information and record please.

Encl : As above

Yours faithfully


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



GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN, SECTOR 10-A,

GANDHINAGAR - 382010,

(T) 079-23232152

CCA-Amendment

(WH-130995)

No. PC/CCA-KUTCH- 812(6)/ GPCB ID-28494/

Date: /01/2024

To,

**M/s. Kandla Port Trust,
At Kandla, A.O Building Gandhidham,
Tal: Gandhidham,
Dist: Kutch – 370 201.**

SUB: Amendment in the consolidated consent & Authorization of the Board.

REF. 1) CCA issued by this office vide order no- **AWH- 110594** dated 22/01/2021 valid up to 21/07/2025.

2) Your CCA Amendment Application Inward ID No.277270 dated 23/05/2023.

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 8(2) of the Hazardous And Other Waste (Management and Transboundary) Rules, 2016 & framed under the Environment (Protection) Act-1986, The Board has granted CCA vide order No. **AWH- 110594** issued vide order dated 22/01/2021 valid up to 21/07/2025.

The Board has right to review and amend the conditions of the said CCA and its amendment orders. Now, considering your application for CCA amendment inward ID No.277270 dated 23/05/2023, the said CCA order is amended as below:

1. The order shall be read as CCA amendment Order No.: **WH- 130995** Date of Issue: **14/12/2023**, valid up to 21/07/2025.

SUBJECT TO THE FOLLOWING SPECIFIC CONDITIONS:

1. There shall be no change in existing production and its capacity, raw materials consumption, fuel consumption, flue gas emission & process gas emission. due to CCA Amendment.
2. Industry shall not carry out any activity which may attract the applicability of EIA notification-2006 & its amendment
3. No ground water shall be withdrawal without prior permission from CGWA as per Hon'ble NGT order.
4. Unit shall obtain fresh water from valid source have permission of the competent authority.
5. Industry shall manage Solid Wastes generated from industrial activities as per Solid Waste Management Rules-2016 (solid waste as defined in Rule-3(46)).
6. Industry shall renew Public Liability Insurance Policy time to time & submit a copy of the same to this office.
7. Industry shall comply with circular of the Board dated 27/08/2021 regarding retrofitting of emission control/ equipment in D.G. Set of capacity 125 KVA and above as per system & procedure for emission compliance testing of Retrofit Emission Control Devices (RECD) for D.G. Set issued by CPCB dated 01/02/2022 at the earliest and submit compliance.

2. The condition no. 3 of the said CCA is amended as below:

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

3.1 Water Source: - GWIL

3.2 There shall be no industrial water consumption & waste water generation from manufacturing process & other ancillary operation.

3.3 The quantity of domestic water consumption shall be decreased from 1300 KL/Day to 3000 KL/Day, due to CCA-Amendment.

3.4 The quantity of domestic waste water shall not exceed 800 KL/Day.

3.5 Sewage shall be treated separately to conform to the following standards as per Hon.ble NGT order in the matter of OA No.1069/2018 dated 30/04/2019

PARAMETERS	GPCB NORMS
pH	5.5-9.0
Biochemical Oxygen Demand (BOD)	10 mg/L
Total suspended solids (TSS)	20 mg/L
Chemical Oxygen Demand (COD)	50 mg/L
Nitrogen -Total	10 mg/L
Phosphorous-Total (for discharge into Ponds, Lakes)	1.0 mg/L
Fecal Coliform	Desirable-100 MPN/100ml Permissible -230 MPN/100 ml

3.6 Treated domestic effluent conforming to above standard shall be discharged on land for gardening and plantation purpose within premises.

3.7 Industry shall provide fixed pipeline network with flow meter for even distribution of treated domestic effluent and maintain its record

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

3. The condition no. 5.1 & 5.2 of the said CCA is amended as below:

5.1 Authorization order no. WH-130995 Date of issue. 14/12/2023.

5.2 **M/s. Kandla Port Trust** is hereby granted an authorization based on the enclosed signed inspection report for generation, collection treatment, storage, transport of hazardous waste on the premises situated at Kandla, A.O Building Gandhidham, Tal: Gandhidham, Dist. Kutch;

Sr. No.	Waste	Quantity per Annum		Schedule & Category	Facility
		Existing	After CCA- Amendment		
1	Used or Spent Oil	1125 MT	4250 MT	I-5.1	Collection, storage, transportation and disposal by selling out to registered recycler

Outward No. 7810724/01/2024



GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN, SECTOR 10-A,

GANDHINAGAR - 382010,

(T) 079-23232152

2.	Residue Containing Oil	3444.43 MT	8500 MT	1-5.2	Collection, storage, transportation and disposal by selling out to registered recycler.
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4. Rest of conditions of Consolidated Consent & Authorization (CC&A) order No: AWH-110594 issued vide this office letter no. GPCB/CCA-KUTCH-812(5)/ID: 28494/581914 dated 22/01/2021 shall remain unchanged and industry shall comply with the same judicially.

For and on behalf of
GUJARAT POLLUTION CONTROL BOARD

(T. C. Patel)
Unit Head

Outward No:781072,11/01/2024

Annexure II

Environmental Statement (Form V)
For Deendayal Port Authority, Kandla
For the FY @ 2023-2024

"FORM-V"
(See rule -14)

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

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

Environmental statement for the financial year ending the 31st March, 2024

"PART-A"

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

"PART-B"

WATER AND RAW MATERIAL CONSUMPTION

Sr.No.	WATER CONSUMPTION	KLD
1.	Process	1573
2.	Cooling	
3.	Domestic Purpose	
Total water consumption for the period from April 2023 to March 2024 was 574086 KL hence, average water consumption for per day – 1573 KLD		

I. Water Consumption

Sr. No.	Name of Products	Process Water Consumption per unit of products output	
		During the current financial year 2022-23	During the current financial year 2023-24
01.	Dry Cargo Handling	137.5 MT	132.37 MT
02.	Liquid Cargo Handling		

Deendayal Port Authority has only loading & unloading activities for dry cargo and liquid cargo. Hence consumption of process water consumption per unit of output with respective to production is not applicable.

During FY 2023-24 Total Cargo Handled is **132.37** MMTPA

However, Details of the Domestic water consumption for the financial year 2023-24 please refer **Annexure-A**

II. Raw material Consumption

Sr.No.	Name of Raw Material	Name of Products	Consumption of Raw material per unit of output	
			During the current financial year 2022-23	During the current financial year 2023-24
1.	Deendayal Port Authority has only loading & unloading activities for dry cargo and liquid cargo. Hence consumption of raw material per unit of output with respective to production is not applicable			

"PART-C"

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

Pollutant	Quantity of Pollutant Discharged (mass/day)	Concentration of Pollution in Discharge (mass/volume)	% of Variation from prescribed standard with reasons
Please Refer Annexure -B for Environmental Monitoring Reports of			
<ul style="list-style-type: none">• Ambient Air Quality Monitoring• Drinking Water Quality Monitoring• Marine Water Monitoring• Noise Level Monitoring			

"PART-D"

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

Sr.No.	Hazardous Waste	Total Quantity in MT/Year	
		During the current financial year 2022-23	During the current financial year 2023-24
1.	5.1- Used Spent Oil	4578.79	2431.39
2.	5.2- Waste Residue Containing Oil	9157.58	7294.17
<ul style="list-style-type: none">• Details of Hazardous Waste generated during the financial year 2022-23 please refer Annexure-C			
a. From Process: NA			
b. From Pollution Control facility: NA			

"PART-E"
SOLID WASTE

Sr.No.	Solid Waste	Total Quantity in MT/year	
		During the current financial year 2022-23	During the current financial year 2023-24
1.	From Process	Nil	Nil
2.	From pollution Control Facility	Nil	Nil
a.	Quantity Recycled or Reutilized within the unit	Nil	Nil
b.	Sold	Nil	Nil
c.	Disposed Off	2473.19 MT	2572.94
Details of Solid Waste (Non-Hazardous Waste) generated during the financial year 2023-24 please refer Annexure-C			

"PART-F"

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

Hazardous Waste:

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

Solid Waste:

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

"PART-G"

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

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

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

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

"PART-H"

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

The allocation made under the scheme of "Environmental Services & Clearance there of other related Expenditure" during BE 2024-2025 is Rs. 657 Lakhs

"PART-I"

ANY OTHER PARTICULAR FOR IMPROVING THE QUALITY OF THE ENVIRONMENT

1. DPA is ISO 14001:2015 certified port for "Providing port facility and related maritime services for vessel and Cargo handling including storage
2. DPA has appointed M/s GEMI, Gandhinagar for the work "Making Deendayal Port a Green Port- Intended Sustainable Development under the Green Port Initiatives". M/s GEMI, Gandhinagar had submitted the Final Report on 10/03/2021
3. DPA has accorded the work of Afforestation project in Deendayal Port Area to Forest Department, GoG which includes plantation and maintenance work of 1100 plants per ha.
4. DPA has accorded the work of green belt development in Deendayal port Authority and its Surrounding areas charcoal site to GUIDE for the plantation of 5000 saplings of suitable species.
5. DPA has planted 7500 trees in Deendayal port trust area during the year 2014-15 6000 trees during financial year 2016-17 and the same has been regularly maintained.
6. DPA has planted 4000 trees at A.O building, Gopalpuri residential colony and along the road side at Kandla. Further, approximately 885 no. of trees have been planted since September 2015 onwards.
7. Continuous water sprinkling has been carried out on the top of the heap of coal, at regular intervals to prevent dusting, fire and smoke. DPA already installed sprinkling system inside Cargo Jetty area for coal dust suppression in coal yard (40 Ha. Area) at the cost of Rs. 14.44 crores.
8. DPA has installed Mist Canon at the Port area to minimize the coal dust.
9. Deendayal port Authority (traffic department) issued a Circular (SOP) to the trade with regard to control of dust pollution arising out of coal handling and ensuring safety in coal handling. In case of any violations of SOP, provision of impose of penalty of Rs. 10000/- has been made and if violation is repeated thrice, the same will lead to ban of concerned party into port area. The DPA is taking all the measures to reduce coal dust by implementing the coal handling guidelines through port users.
10. All trucks before leaving the storage yard have been covered with tarpaulin and also trucks are also not over loaded as well as there is no spillage during transportation and there is adequate space for movement of vehicles at the surrounding area.
11. DPA has constantly improving the house keeping in the dry cargo storage yard and nearby approved areas leading to roads. Adequate steps under the

- provisions of air prevention and control of pollution Act 1981, Environmental Protection Act 1986 are taken.
- 12.DPA commissioned STP of capacity 1.5 MLD for treatment of domestic waste water for entire DPA area. (Details of domestic waste water generation is attached herewith as **Annexure D**)
 - 13.Deendayal Port Authority had carried out mangrove plantation in an area of 1600 ha. through various government agencies like Gujarat Ecology Commission, State Forest Department.
 - 14.It is also relevant to mention here that, DPA entrusted work to Forest Department, GoG (Social Forestry Division, Bhuj) during August, 2019 for green belt development in and around port area 31.942 hectares (approx. 35200 plants at various locations) at a cost of Rs. 352.32 lakhs.
 - 15.DPA is involved in various CER activities like providing the proper sanitation and development of better roads for connectivity
 - 16.DPA is managing its plastic waste as per Plastic Waste Management Rules – 2016 and amendments made therein. In order to strictly implement the said rules, DPT had issued a circular regarding plastic waste minimization, source segregation, recycling etc. vide its Circular no. EG/WK/4751/Part 243(A) dated 03/09/2021
 - 17.DPA has entrusted the work to GEMI, Gandhinagar for "Preparation of Plan for Management of Plastic Waste, Solid Waste, C&D Waste, E-waste, Hazardous Waste including Bio-medical Waste and Non-hazardous waste in the Deendayal Port Authority Area
 - 18.DPA has assigned the work to TERI, New Delhi for "Transition of Business Operations to Water Neutrality – Water Neutrality of Deendayal Port, Kandla (Phase I- Study and assessment)
 - 19.Recently, DPA has entrusted the work to GEMI, Gandhinagar for "Study of CO₂ Emission Estimation and Reduction Strategy under Maritime India Vision 2030.
 - 20.Initiative for Installation of Continuous Ambient Air Quality Monitoring System (CAAQMS) for monitoring of Air quality is under process.

Statement Showing the quantity of water consumed from GWSSB from April 2023 to March 2024

Sr.No.	Month	Total Quantity Consumed in KL
1.	April 2023	47342.47
2.	May 2023	48920.55
3.	June 2023	47342.00
4.	July 2023	48920.55
5.	August 2023	48920.55
6.	September 2023	59980.00
7.	October 2023	48680.00
8.	November 2023	57820.00
9.	December 2023	52100.00
10.	January 2024	45566.00
11.	February 2024	30884.00
12.	March 2024	37610.00
Total		574086.12


XEN (PL)

Environmental Monitoring Annual Report
prepared under
**“Preparing and monitoring of environmental monitoring and
management plan for Deendayal Port Authority at Kandla and
Vadinar for a period of 3 years”**

Monitoring Period: April 2023 - March 2024



Document Ref No.: GEMI/DPA/782(2)(3)/2024-25/103

Submitted to:
Deendayal Port Authority (DPA), Kandla



Gujarat Environment Management Institute (GEMI)

(An Autonomous Institute of Government of Gujarat)

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

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



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About this Document

Gujarat Environment Management Institute (GEMI) has been assigned with the work of “Preparing and monitoring of Environmental monitoring and Management plan for Deendayal Port Authority (DPA) at Kandla and Vadinar for a period of 3 years” by DPA, Kandla. Under the said project the report titled “*Environment Monitoring Annual Report (Monitoring Period: April 2023 - March 2024)*” is prepared.

- **Name of the Report:** *Environment Monitoring Report (Monitoring Period April 2023-March 2024)*
- **Date of Issue:** 26/06/2024
- **Version:** 1.0
- **Report Ref.:** GEMI/DPA/782(2)(3)/2024-25/103



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List of Abbreviations

A	Acceptable Limits as per IS: 10500:2012
AAQ	Ambient Air Quality
AWS	Automatic Weather monitoring stations
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BQL	Below Quantification Limit
CCA	Consolidated Consent & Authorization
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
DO	Dissolved Oxygen
DPA	Deendayal Port Authority
EC	Electrical Conductivity
EMMP	Environmental monitoring and Management Plan
EMP	Environment Management Plan
FPS	Fine Particulate Sampler
FY	Financial Year
GEMI	Gujarat Environment Management Institute
IFFCO	Indian Farmers Fertiliser Cooperative Limited
IMD	India Meteorological Department
IOCL	Indian Oil Corporation Limited
LNG	Liquefied Natural Gas
MGO	Marine Gas Oil
MMTPA	Million Metric Tonnes Per Annum
MoEF	Ministry of Environment & Forests
MoEF&CC	Ministry of Environment, Forest and Climate Change
NAAQS	National Ambient Air Quality Standards
NO _x	Nitrogen oxides
NTU	Nephelometric Turbidity Unit
OOT	Off Shore Oil Terminal
OSR	Oil Spill Response
P	Permissible Limits as per IS: 10500:2012
PAH	Poly Aromatic Hydrocarbons
PM	Particulate Matter
PTFE	Polytetrafluoroethylene
RCC	Reinforced Concrete Cement
RDS	Respirable Dust Sampler
SAR	Sodium Adsorption Ratio
SBM	Single Bouy Mooring
SO _x	Sulfur oxides
STP	Sewage Treatment Plant
TC	Total Coliforms
TDS	Total Dissolved Solids
TOC	Total organic Carbon
TSS	Total Suspended Solids
VOC	Volatile Organic Compounds



CHAPTER 1: INTRODUCTION

1.1 Introduction

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

1.2 Green Ports Initiative

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

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

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

1.3 Importance of Environmental monitoring and management plan (EMMP)

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

1. Air pollutant emissions due to ship emissions, loading and unloading activities, construction emission and emissions due to vehicular movement.

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

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

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

It is extremely essential that port and harbour projects should have an Environmental Monitoring and Management Plan (EMMP), which incorporates monitoring of Ambient Air, Drinking Water, Noise, Soil, Marine (water, sediment, ecology) quality along with the collection of online meteorological data throughout the duration of the project.

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

This document presents the Environmental Monitoring Report (EMR) for Kandla and Vadinar for the environmental monitoring done during the period from April 2023-March 2024.

1.4 Objectives and scope of the Study

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

The scope of work includes not limited to following:

1. To review the locations/stations of Ambient Air, Ambient Noise, drinking water, and Marine Water, Soil and Sediments monitoring within the impacted region in-and-around DPA establishment, in view of the developmental projects.
2. To assess the Ambient Air quality, quality at 6 stations at Kandla and 2 at Vadinar in terms of gases and particulate matter.
3. To assess the DG stack emissions (gases and particulate matter).
4. To assess Drinking water quality at twenty locations (18 at Kandla and 2 at Vadinar) in terms of Physical, Chemical and Biological parameters viz., Color, Odor, turbidity, conductivity, pH, Total Dissolved Solids, chlorides, Hardness, total iron, sulphate, NH_4 , PO_4 , and bacterial count on a monthly basis.
5. To assess the Marine water quality in terms of aquatic Flora and Fauna and Sediment quality in terms of benthic flora and fauna.
6. To assess Marine Water Quality and sediment in term of physical and chemical parameter.
7. To assess the trends of water quality in terms of Marine ecology by comparing the data collected over a specified time period.
8. Weekly sample collection and analysis of inlet & Outlet points of the Sewage Treatment Plant (STP) to check the water quality being discharged by DPA as per the CC&A.
9. Carrying out monthly Noise monitoring; twice a day at the representative stations for a period of 24 hours.
10. Meteorological parameters are very important from air pollution point of view, hence precise and continuous data collection is of utmost importance. Meteorological data on wind speed, wind direction, temperature, relative humidity, solar radiation and rainfall shall be collected from one permanent station at DPA, Kandla and one permanent station at Vadinar.
11. To suggest mitigation measures, based on the findings of this study and also check compliance with Environmental quality standards, Green Port Initiatives, MIV 2030, and any applicable Statutory Compliance.
12. To recommend Environment Management Plans based on Monitoring programme and findings of the study.



CHAPTER 2: METHODOLOGY

2.1 Study Area

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

a. Kandla

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

- **Climatic conditions of Kandla**

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

b. Vadinar

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

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

- **Climatic conditions of Vadinar**

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

The Kandla and Vadinar port have been depicted in the **Map 1 & 2** as follows:

SS



Map 1: Locations of Kandla and Vadinar Port



Map 2: Locations of Kandla Port



Map 3: Locations of Vadinar Port

2.2 Environmental Monitoring at Kandla and Vadinar

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

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

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

Methodology adopted for the study

Methodology is a strictly defined combination of practices, methods and processes to plan, develop and control a project along the continuous process of its implementation and successful completion. The aim of the project management methodology is to allow the control of whole process of management through effective decision-making and problem solving. The methodology adopted for the present study is shown in **Figure 1** as given below:

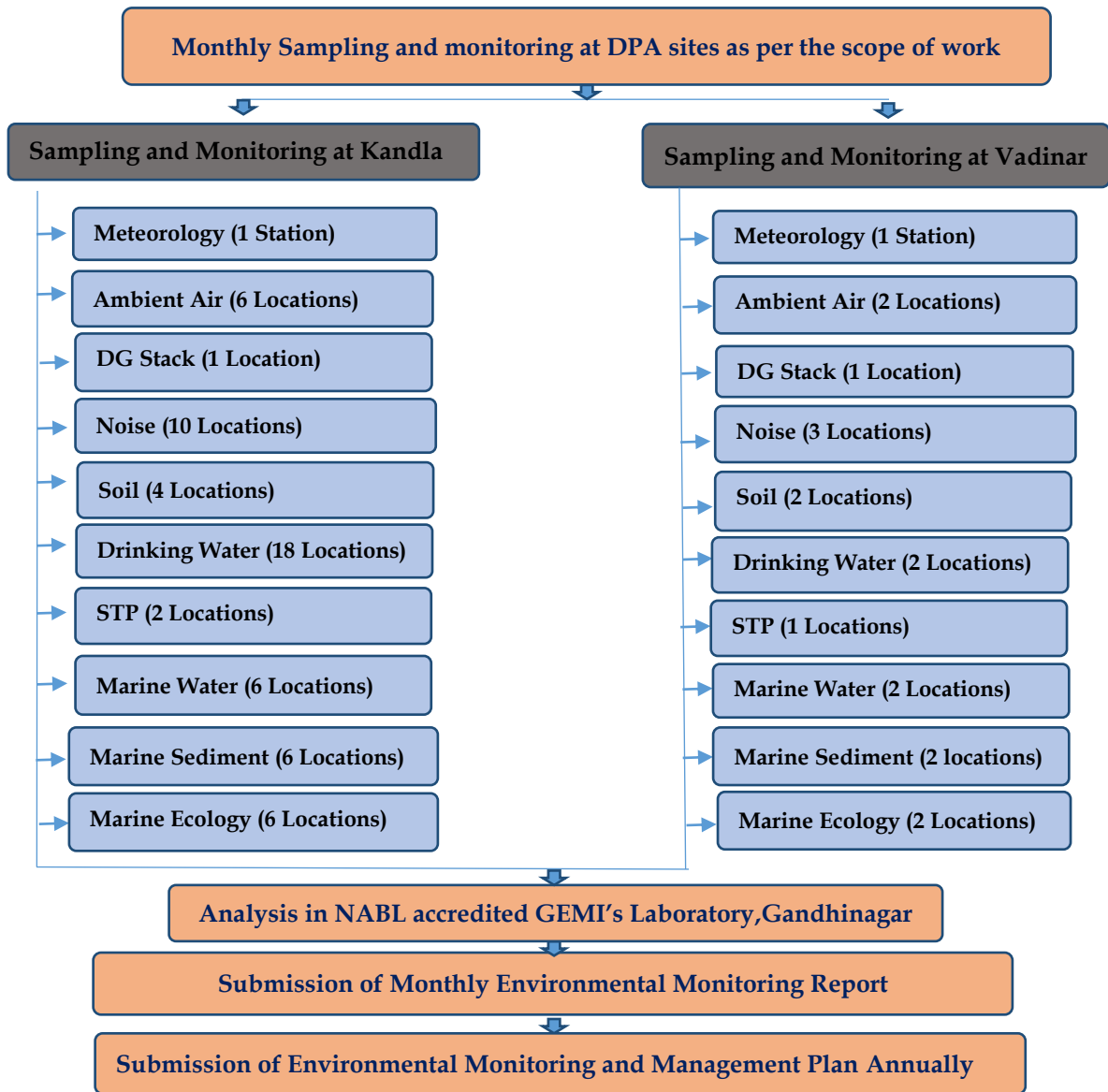


Figure 1: Methodology flow chart

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



CHAPTER 3: METEOROLOGY MONITORING

3.1 Meteorology Monitoring

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

Table 1: Details of Automatic Weather Station

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

Methodology:

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

Table 2: Automatic Weather Monitoring Station details

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

Monitoring Frequency:

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

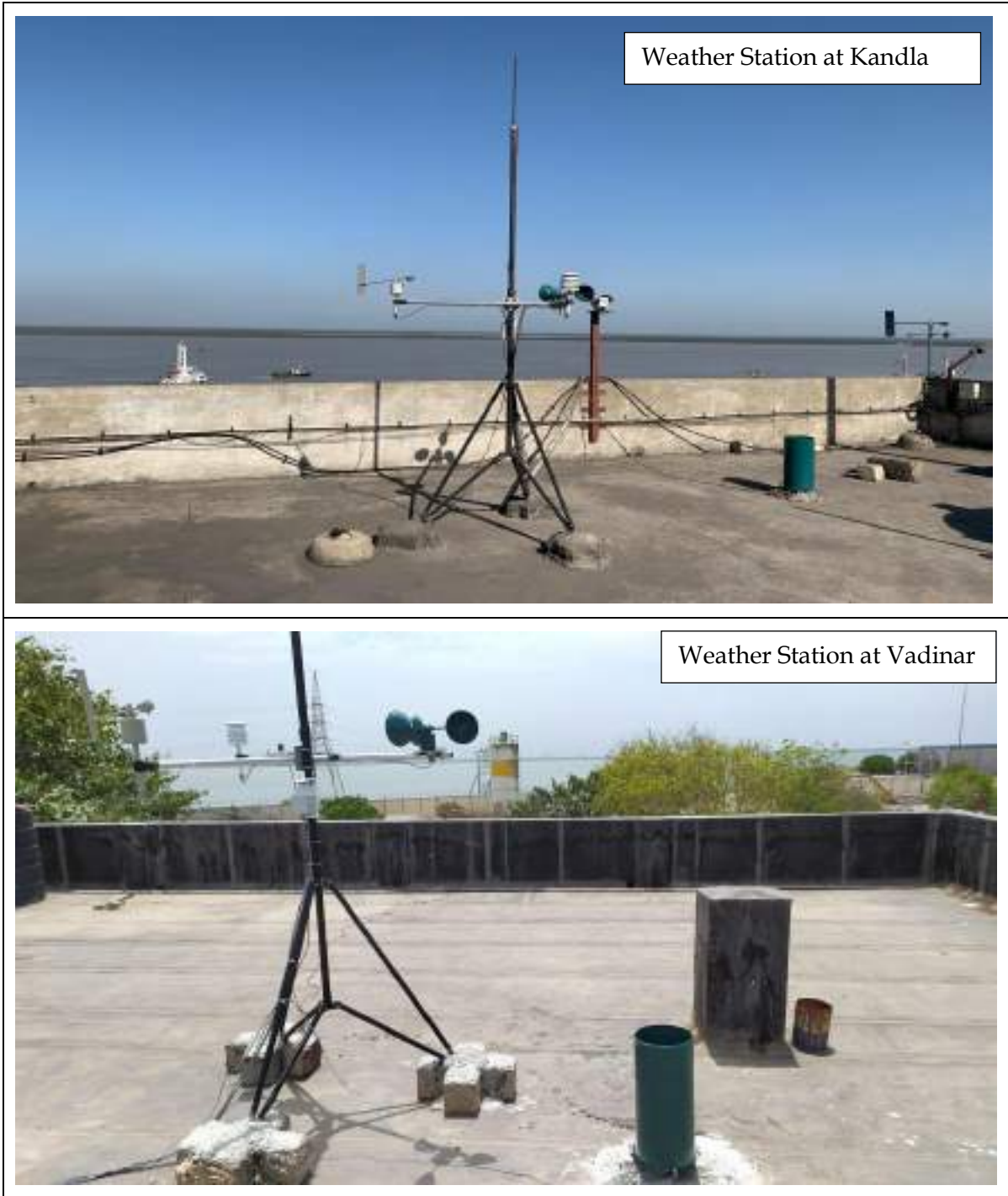


Figure 2: Photographs of Automatic Weather Monitoring Station at Kandla and Vadinar



3.2 Results and discussion

The summary of hourly climatological observations recorded at Kandla and Vadinar during the monitoring period of **April 2023 to March 2024**, with respect to significant parameters has been mentioned in **Table 3** as follows:

Table 3: Meteorological data for Kandla and Vadinar

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



Details of Micro-meteorological data at Vadinar Observatory												
Monitoring Period	Wind Speed (Km/h)			Temperature (°C)			Relative humidity (%)			Solar Radiation (W/m ²)	Wind Direction (°)	Rainfall (mm)
	Max.	Min	Avg.	Max.	Min	Avg.	Mean	Max.	Min			
April-May 23	26.33	7.78	13.24	28.74	28.04	28.17	73.47	70	71.08	110.76	W & South	0.02
May-June 23	34.08	7.63	16.76	29.96	29.22	29.34	71.77	69.03	69.83	102.95	S.S.E	0.19
June- July 23	12.31	1.62	5.19	29.51	28.86	28.94	77.68	75.42	75.95	78.26	South	0.27
July-Aug 23	31.69	5.39	13.12	28.62	27.99	28.06	79.51	77.31	77.77	60.86	South	0.22
Aug-Sep 23	28.07	5.2	12.96	27.75	27.18	27.22	75.13	72.87	73.42	88.14	South & S.W	0
Sep- Oct 23	21.82	4.64	9.59	28.12	27.5	27.56	77.12	74.66	75.32	87.51	South	0.06
Oct- Nov 23	13.8	1.77	4.17	27.89	27.1	27.28	63.61	59.58	61.15	81.61	N.E	0.18
Nov- Dec 23	19.37	3	4.84	24.79	24.11	24.24	64.12	60.47	61.79	70.68	S.S.E	0.03
Dec- Jan 24	16.76	1	4.18	22.94	22.14	22.34	63.13	59.25	60.71	73.37	South	0
Jan- Feb 24	10.62	1.99	3.94	23.24	22.92	22.7	65.66	64.19	64.9	87.29	South	0
Feb- Mar 24	16.92	5.36	8.55	24.16	23.6	23.82	62.34	60.91	61.51	101.99	N.N.W	0
Mar- Apr 24	29.61	0.31	11.63	29.8	24.96	26.5	82.36	57.41	71.08	114.77	N.N.W	0

3.3 Data Interpretation and Conclusion

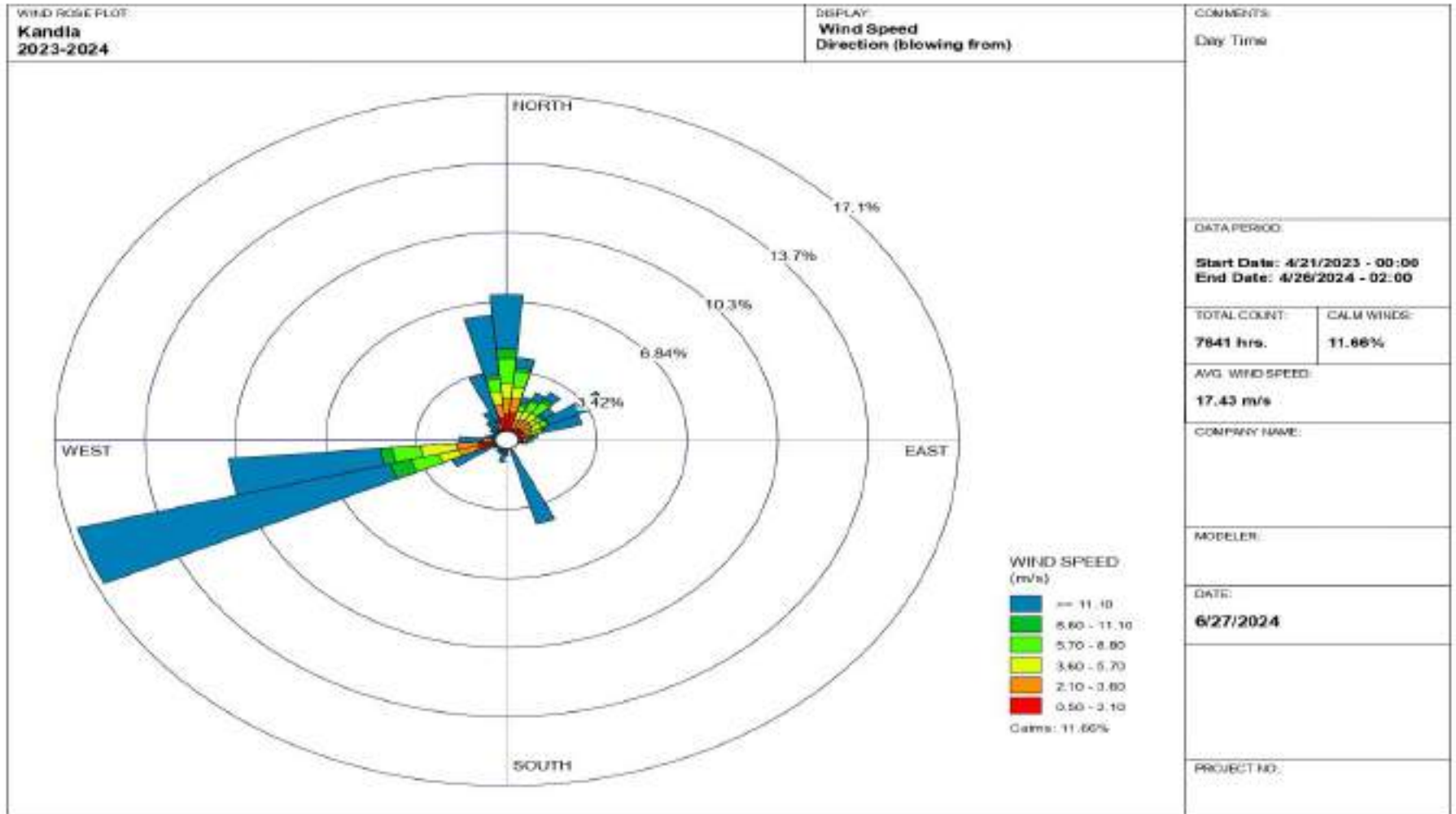
1) Kandla:

- a. The ambient temperature for the summer season varies in the range of **21.68** to **48.44** °C; in the monsoon season, the temperature varies between **29.32** and **33.38** °C; and in the winter season, the temperature varies between **21.68** and **31.24** °C. The yearly average temperature at Kandla is observed to be around **29.217** °C, with a standard deviation of 4.31.
- b. The relative humidity for the summer season was recorded in the range of **30.59%** to **76.32%**; in the monsoon season, relative humidity was recorded in the range of **66.85%** to **84.57%**; and in the winter season, relative humidity was recorded in the range of **49.02** to **59.69%**; the yearly average humidity at Kandla was **61.75%** with a standard deviation of **10.635**.
- c. The maximum rainfall at Kandla was observed at **21.89** mm for the monitoring period of August to September 2023; the yearly average rainfall was found to be **3.72** mm.
- d. Wind speed and direction play a significant role in transporting pollutants and thus determining the air quality. In the summer season, wind blew from the North and North North West directions; in the monsoon season, wind blew from the West South West; and in the winter season, wind blew from the North direction.
- e. The wind speed recorded ranges from **0.025** to **48.85** km/h in the summer season; in the monsoon season, the wind speed recorded ranges from **0.16** to **37.52** km/h; and in the winter season, the wind speed recorded ranges from **0** to **15.75** km/h. The yearly average wind speed at Kandla is **5.77** km/h, with a standard deviation of 3.55.
- f. The **maximum** solar radiation at Kandla was observed at **105.42** W/m² during the monitoring period **April to May 2023**; the **minimum** solar radiation at Kandla was observed at **54.28** W/m² for the monitoring period **November to December 2023**; **and** the yearly **average** solar radiation was found to be **73.445** W/m² with a standard deviation of 15.19.

Wind rose diagram:

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

This Wind Rose Diagram reveals that at Kandla during the monitoring period, the prevailing winds predominantly blow from the West South West direction at Kandla, whereas, high speed winds were also observed to blow from North direction.



WRPLOT View - Lakes Environmental Software

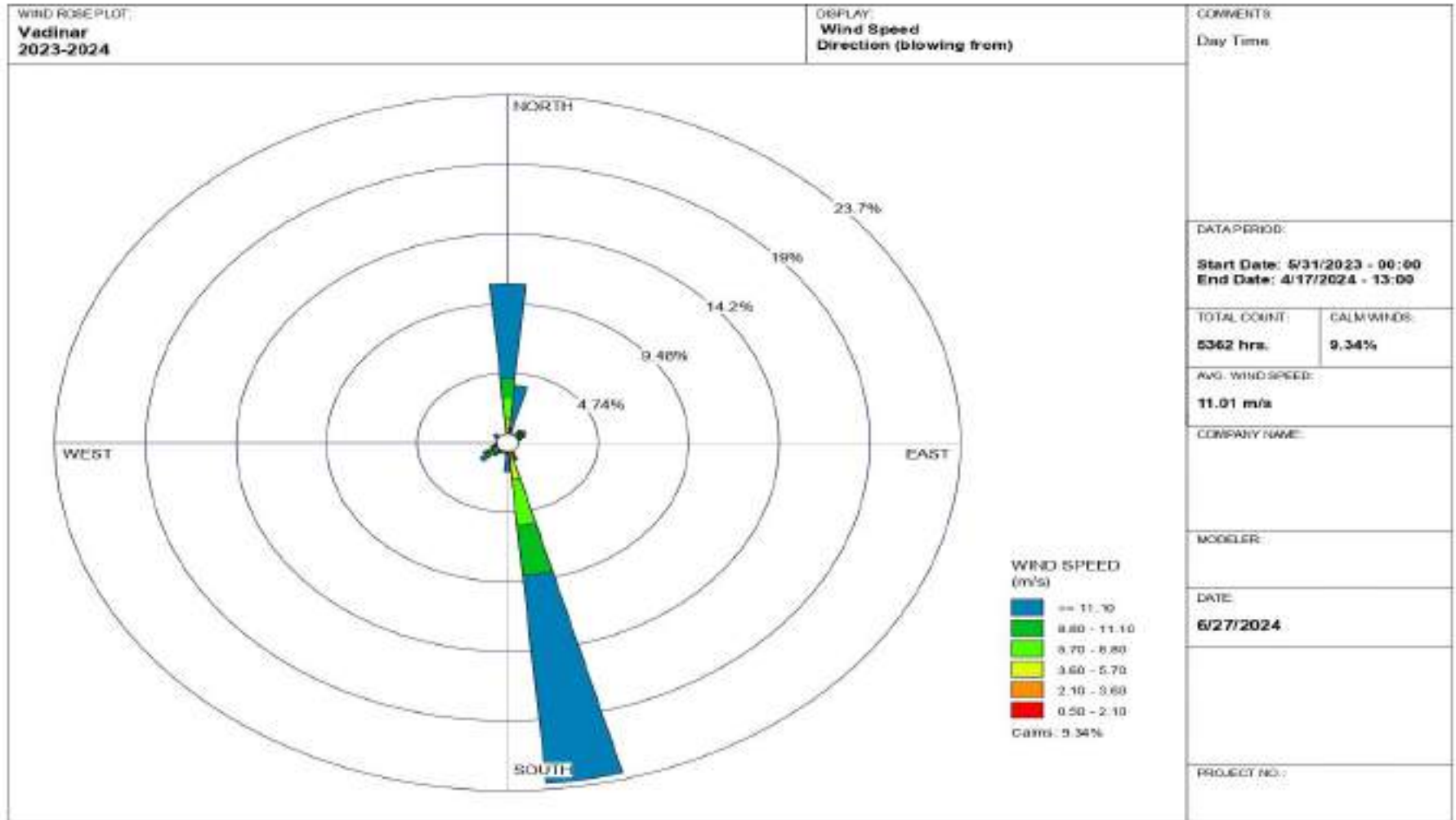
2) Vadinar:

- a. The ambient temperature for the summer season varies between **23.6** and **29.96** °C; in the monsoon season, it varies between **27.18** and **28.62** °C; and in the winter season, it varies between **22.14** and **27.89** °C. The yearly average temperature at Vadinar is **2.347** °C with standard deviation of **2.4**.
- b. The relative humidity for the summer season was recorded in the range of **57.41**% to **82.36**%; in the monsoon season, relative humidity was recorded in the range of **72.87**% to **79.51**%; and in the winter season, relative humidity was recorded in the range of **59.25**% to **65.66**%; the yearly average humidity at Vadinar was **68.7**% with a standard deviation of 6.38.
- c. The **maximum** rainfall at Vadinar was observed at **0.27** mm for the monitoring period from **June to July 2023**; the yearly **average** rainfall was found to be **0.08** mm.
- d. In Summer Season wind blew from South Direction, in Monsoon season wind blew from South and in Winter Season wind blew from South and South West direction. The recorded wind speed ranges from **0.31** to **34.08** km/hr in the summer season, **4.64** to **31.69** km/hr, and in the monsoon season, the recorded wind speed ranges from **1** to **19.37** km/hr. The yearly average wind speed at Vadinar is 9.014 km/h with a standard deviation of **4.49**.
- e. The maximum solar radiation at Vadinar was observed at **114.77** W/m² for the monitoring period April to May 2024; the minimum solar radiation at Vadinar was observed at **60.86** W/m² for the monitoring period July to August 2023; and the yearly average solar radiation was found to be **88.182** W/m².

Wind rose diagram:

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

At Vadinar, the winds were observed to blow from Souths direction.



WRPLOT View - Lakes Environmental Software



CHAPTER 4: AMBIENT AIR QUALITY MONITORING

4.1 Ambient Air Quality

It is necessary to monitor the ambient air quality of the study area, in order to determine the impact of the shipping activities and port operations on the ambient air quality. The prime objective of ambient air quality monitoring is to assess the present air quality and its conformity to National Ambient Air Quality Standards i.e. NAAQS, 2009⁽¹⁾.

Methodology

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

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

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

Table 4: Details of Ambient Air monitoring locations

Sr. No.	Location Code	Location Name	Latitude Longitude	Significance	
1.	Kandla	A-1	Oil Jetty No. 1	23.029361N 70.22003E	Liquid containers and emission from ship
2.		A-2	Oil Jetty No. 7	23.043538N 70.218617E	
3.		A-3	Kandla Port Colony	23.019797N 70.213536E	Vehicular activity and dust emission
4.		A-4	Marine Bhavan	23.007653N 70.222197E	Construction and vehicular activity, road dust emission,
5.		A-5	Coal Storage Area	23.000190N 70.219757E	Coal Dust, Vehicular activity
6.		A-6	Gopalpuri Hospital	23.081506N 70.135258E	Residential area, dust emission, vehicular activity
7.	Vadinar	A-7	Admin Building	22.441806N 69.677056E	Vehicular activity
8.		A-8	Vadinar Colony	22.401939N 69.716306E	Residential Area, burning waste, vehicular activity

The monitoring locations at Kandla and Vadinar have been depicted in map in **Map 4 and 5** respectively.

Ambient Air monitoring photos

Kandla

A-1: Oil Jetty No. 1



A-2: Oil Jetty No. 7



A-3: Kandla Port Colony



A-4: Marine Bhavan



A-5: Coal Storage Area



A-6: Gopalpuri Hospital



Vadinar

A-7: Admin Building

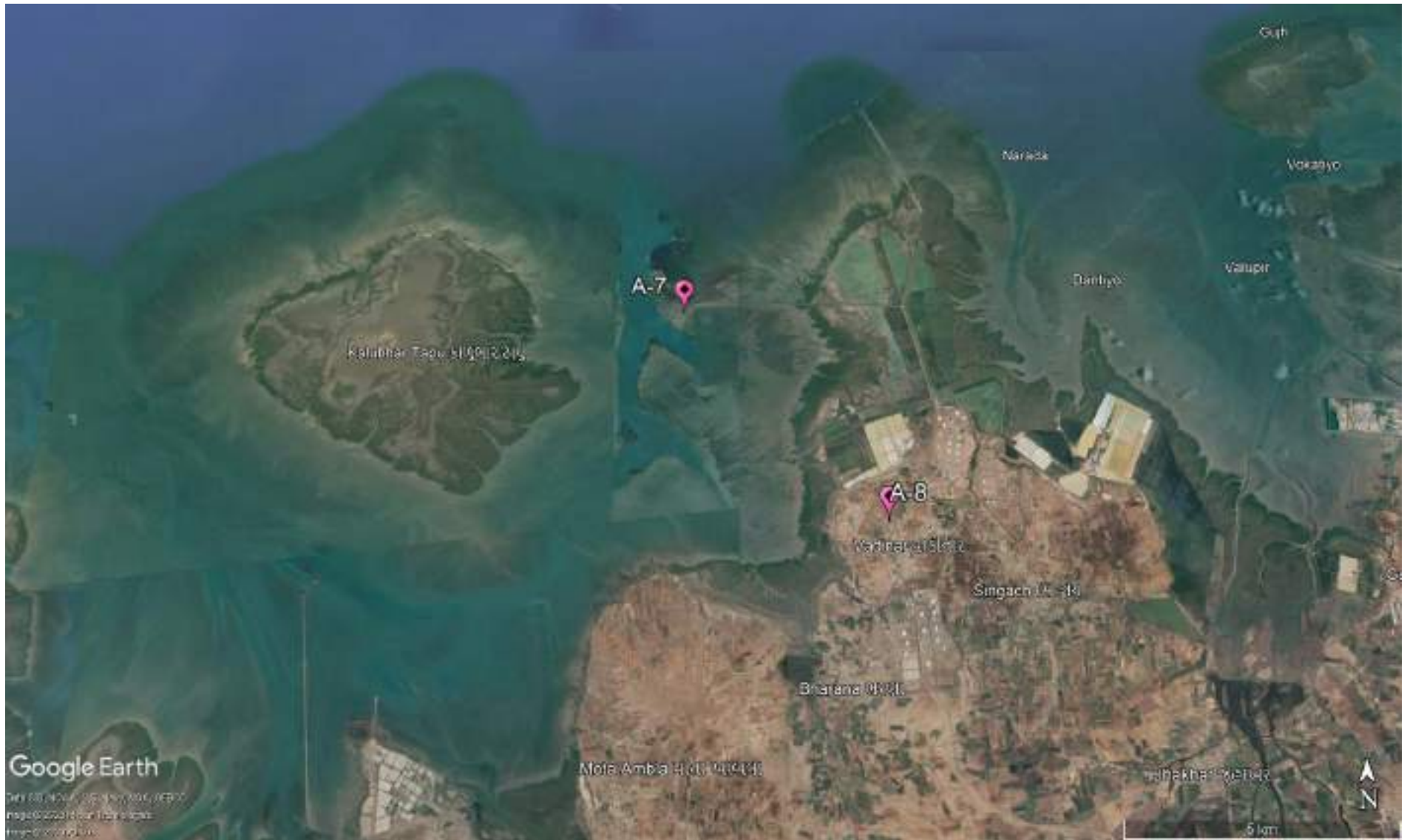


A-8: Vadinar Colony





Map 4: Ambient Air Monitoring locations at Kandla



Map 5: Ambient Air Monitoring locations at Vadinar

Monitoring Frequency

The sampling for Particulate matter, i.e., PM₁₀ and PM_{2.5}, and gaseous components like SO_x, NO_x, and CO, as well as the total VOCs, was monitored twice a week for a period of 24 hours a day. Whereas, the sampling for the components of PAH, benzene, and non-methane VOCs was conducted on a monthly basis. The monitoring period for this study is from April 15, 2023, to April 15, 2024. During this period, 95 air samples were taken from six locations in Kandla, and 97 samples were taken from two locations in Vadinar.

Sampling and Analysis

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

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

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

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

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

Table 5: Parameters for Ambient Air Quality Monitoring

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

4.2 Result and Discussion

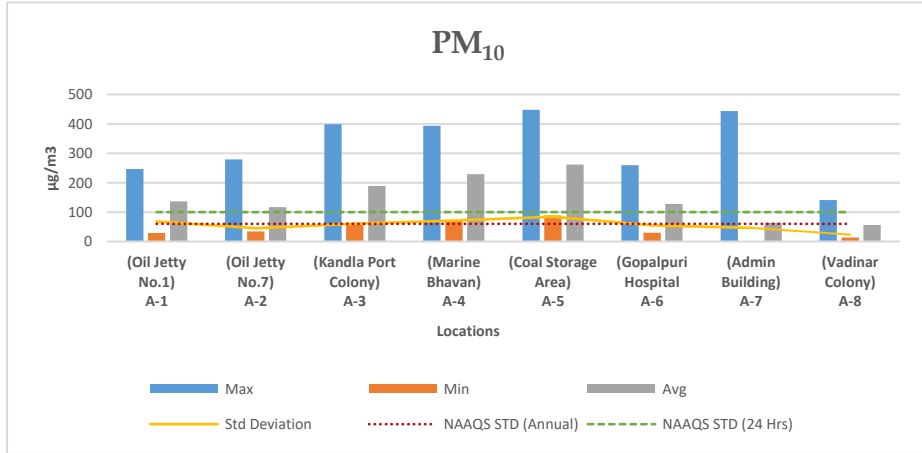
The summarized results of ambient air quality monitoring for the study period are presented in **Table-6 to 9** along with the graphical representation from **Graph 1 to Graph 6**. Various parameters monitored during the study have been presented by their maximum, minimum, average and Standard deviation.



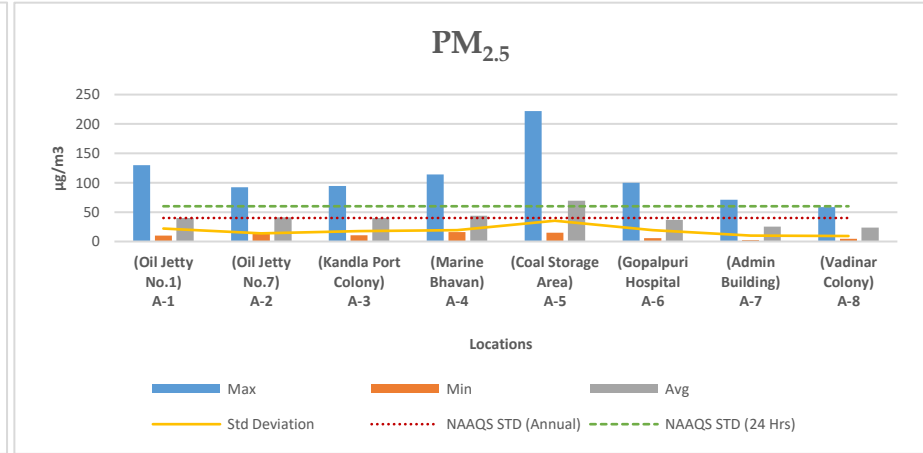
Table 6: Summarized results of PM₁₀, PM_{2.5}, SO₂, NO_x, VOC and CO for Ambient Air quality monitoring

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

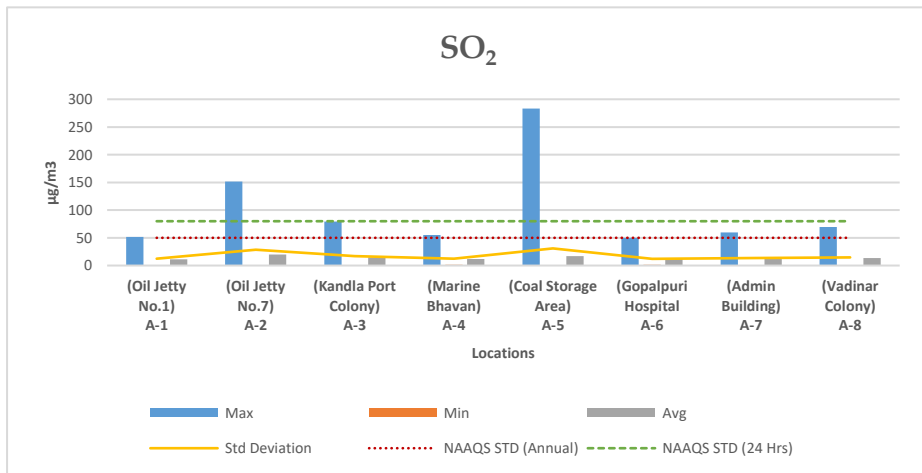
Graphs 1-6 shows spatial trend of ambient air parameter at all the eight-monitoring location (six at Kandla and 2 at Vadinar)



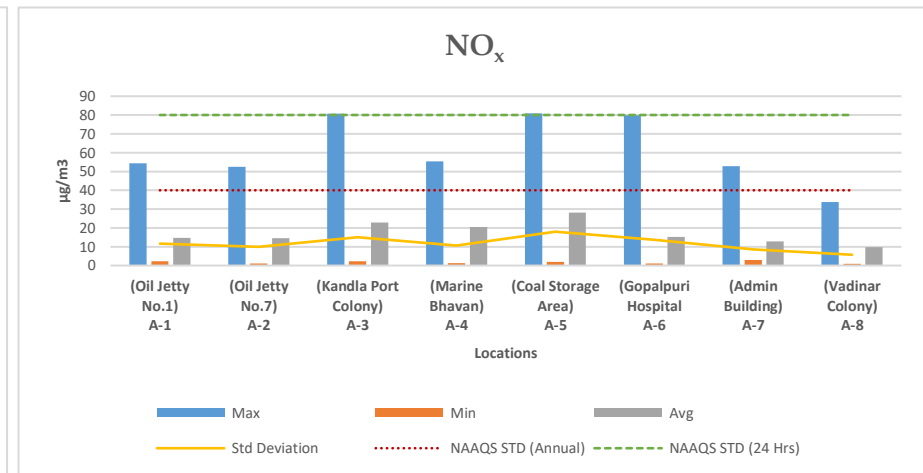
Graph 1 Spatial trend in Ambient PM₁₀ Concentration



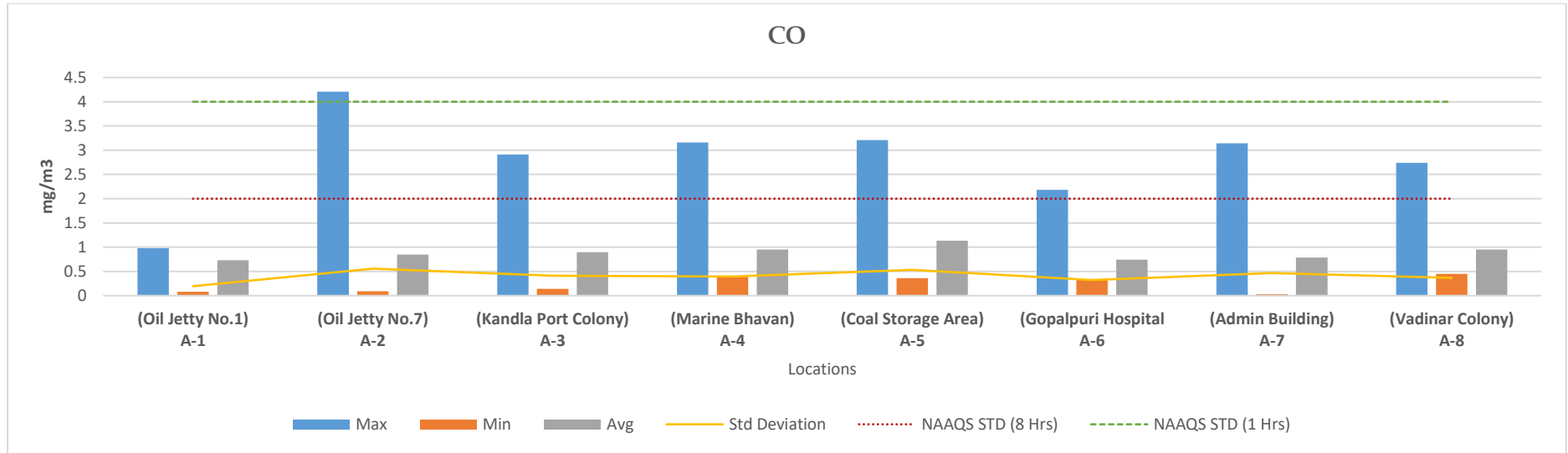
Graph 2 Spatial trend in Ambient PM_{2.5} Concentration



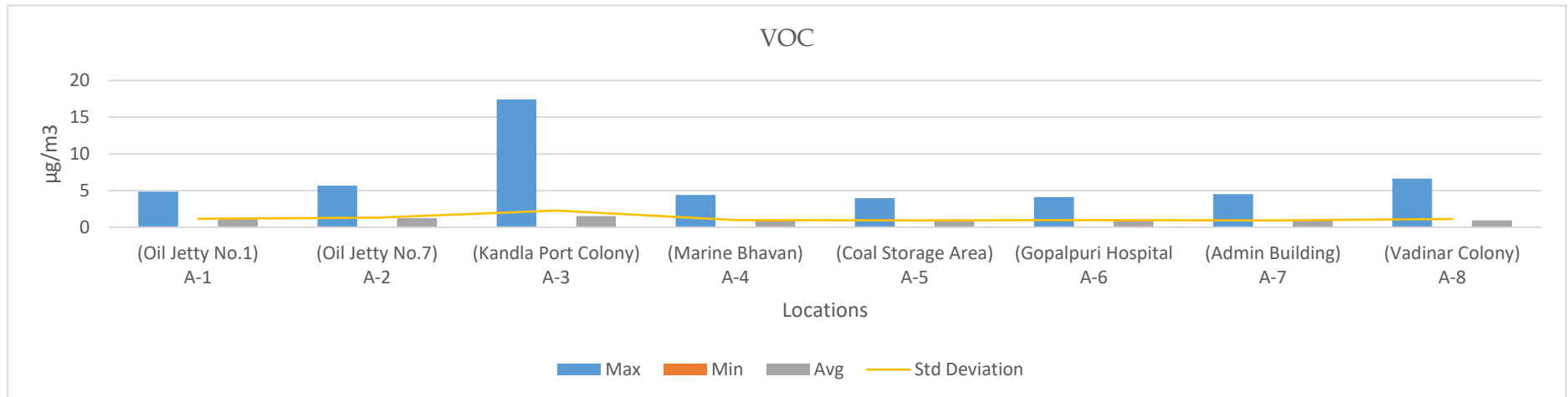
Graph 3 Spatial trend in Ambient SO_x Concentration



Graph 4 Spatial trend in Ambient NO_x Concentration



Graph 5 Spatial trend in Ambient CO Concentration



Graph 6 Spatial trend in Ambient Total VOCs



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

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

Table 8: Summarized results of Polycyclic Aromatic Hydrocarbons

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



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

Table 9: Summarized results of Non-methane VOC

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

4.3 Data Interpretation and Conclusion

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

1) Kandla:

Particulate matter:

- The concentration of PM₁₀ varies very widely and is reported in the range of **28.68** to **448.12** µg/m³, with a yearly average value of **176.83** with standard deviation **64.185** µg/m³. As shown in Graph 1, the highest concentration (value) of PM₁₀ is reported at location A-5 (coal storage area) during the winter. It can be seen that PM₁₀ exceeds the NAAQS annual limit, i.e., 60 µg/m³, in all locations. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-1 (oil jetty No. 1) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 100 µg/m³.
- The concentration of PM_{2.5} varies in the range of 5.51 to 221.9 µg/m³, with a yearly average value of 45.35 with standard deviation 21.16 µg/m³. As shown in Graph 2, the highest concentration of PM_{2.5} is at location A-5 (the coal storage area) in winter. It can be seen that PM_{2.5} exceeds the NAAQS annual limit, i.e., 40 µg/m³, on five locations, and location A-6, i.e., Gopalpuri hospital, falls within the NAAQS annual limit. It can be seen that location A-5 (coal storage area) had the maximum percentage exceedance, and location A-6 (Gopalpuri hospital) had the minimum percentage exceedance while comparing with the NAAQS 24-hour limit, i.e., 60 µg/m³.
- The highest concentration of Particulate matter at locations **A-5, (the coal storage area)**, could be attributed to the presence of heavy vehicular traffic in upwind areas, which have a higher impact, causing the dispersion of emitted particulate matter in the ambient air. The activities observed in the surrounding such as The unloading of coal directly into the truck using grabs, construction in the vicinity causes the dust to disperse in the air as well as coal dust to fall and settle on the ground. This settled coal dust again mixes with the air while trucks travel through it. Also, the coal-loaded trucks are generally not always covered with tarpaulin sheets, and this might result in increased suspension of coal from trucks or dumpers during their transit from vessel to yard or storage site. This might increase the PM in and around the coal storage area and Marine Bhavan.

Gaseous Pollutants:

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

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

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

Polycyclic Aromatic Hydrocarbons (PAHs): are ubiquitous pollutants in urban atmospheres. Anthropogenic sources of total PAHs in ambient air emissions are greater than those that come from natural events. These locations are commercial areas where Vehicular activity and dust emission is common. PAHs are a class of chemicals that occur naturally in coal, crude oil, and gasoline. The higher concentration which results from burning coal, oil, gas, road dust, etc. Other outdoor sources of PAHs may be the industrial plants in-and-around the DPA premises.

- The concentration of Benzene levels was recorded in the range of **0.02** to **3.8** $\mu\text{g}/\text{m}^3$, with a yearly average value of **0.84** with standard deviation **0.64** $\mu\text{g}/\text{m}^3$. The highest concentration of Benzene is at location **A-1, (Oil Jetty No. 1)** in summer. It can be seen that at all locations, Benzene within the NAAQS annual limit, i.e., $5 \mu\text{g}/\text{m}^3$.
- The ambient air monitoring location of Kandla recorded the non-methane VOC (NM-VOC) concentration in the range of **0.08** to **3.54** $\mu\text{g}/\text{m}^3$, with a yearly average value of **0.86** $\mu\text{g}/\text{m}^3$ at Kandla. The highest concentration is at location **A-3, (Kandla Port Colony)** in Winter.

2) Vadinar:

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

- The concentration of PM_{2.5} varies in the range of **2.36 to 71.18** µg/m³, with a yearly average value of **24.42** with a standard deviation of **9.69** µg/m³. As shown in Graph 2, the highest concentration of PM_{2.5} is at location **A-7 (Admin Building Vadinar)** in winter. It can be seen that in all two locations, PM_{2.5} is within the NAAQS annual limit, i.e., 40 µg/m³. It can be seen that on both locations, **A-7 (Admin Building Vadinar)** and **A-8 (Vadinar Colony)** comply with the standards (compliance more than 98% times) while comparing with the NAAQS 24-hour limit, i.e., 60 µg/m³.

Gaseous Pollutants:

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

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

Polycyclic Aromatic Hydrocarbons (PAHs):

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

With reference to the Ambient Air Quality monitoring conducted under the study, it may be concluded that the particulate matter PM_{10} , were reported in higher concentration and apparently exceeds the NAAQS particularly at locations of Kandla., whereas $\text{PM}_{2.5}$ complies with the NAAQS at majority of the locations. For both the ambient air monitoring parameters (PM_{10} and $\text{PM}_{2.5}$), the major exceedance was observed at location A-5 i.e. Coal Storage Area. The gaseous pollutants (NO_x , SO_x , CO, VOCs etc.) falls within the permissible limit. The probable reasons contributing to these emissions of pollutants into the atmosphere in-and-around the port area are summarized as follows: -

1. **Port Machinery:** Port activities involve the use of various machinery and equipment, including cranes, for lifts, tugboats, and cargo handling equipment. These machines often rely on diesel engines, which can emit pollutants such as NO_x , Particulate matter, and CO. Older or poorly maintained equipment tends to generate higher emissions.
2. **Port Vehicles:** Trucks and other vehicles operating within port and port area contributes to air pollution. Similar to port machinery, diesel-powered vehicles can emit NO_x , PM, CO, and other pollutants such as PAH, VOCs etc. Vehicle traffic and congestion in and around port areas can exacerbate the air quality issues.
3. **Coal Handling:** Resuspension of dust occurs due to the transportation of coal and the handling of coal.
4. **Construction Activities:** Another reason for the high particulate matter content in this area is due to high construction activities in the surrounding area.

4.4 Remedial Measures:

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

- Practice should be initiated for using mask as preventative measure, to avoid Inhalation of dust particle-Mask advised in sensitive areas. Covering vehicles with tarpaulin during transportation will help to reduce the suspension of pollutants in air.
- Ensuring maintenance of engines and machinery to comply with emission standards.
- Frequent water sprinkling on roads to reduce dust suspension due to vehicular movement, this can be use during transporting coal to avoid suspension of coal dust.
- Use of proper transport methods, such as a conveyor belt, for excavated material and screens around the construction site.
- End to End pavement of roads in construction site could considerably reduce dust emission. Prohibition of use of heavy diesel oil as fuel could be possibly reduce pollutants. Encouraging use of low-sulfur fuels (viz. Marine Gas Oil (MGO)/Liquefied Natural Gas (LNG), can significantly reduce sulfur and PM emissions from ships.
- Retrofitting ships with exhaust gas cleaning systems can help reduce sulfur emissions. Engine upgrades, such as optimizing fuel combustion and improving engine efficiency, can reduce overall emissions.
- Investing in infrastructure for cold ironing allows ships to connect to the electrical grid while docked, reducing the need for auxiliary engines and associated emissions.
- Implementing efficient cargo-handling processes, optimizing logistics to reduce congestion and idling times, and encouraging use of cleaner port machinery and vehicles can all contribute to reducing air pollution in port areas.
- Shrouding shall be carried out in the work site enclosing the dock/proposed facility area. This will act as dust curtain as well achieving zero dust discharge from the site. These curtain or shroud will be immensely effective in restricting disturbance from wind in affecting the dry dock operations, preventing waste dispersion, improving working conditions through provision of shade for the workers.
- Dust collectors shall be deployed in all areas where blasting (surface cleaning) and painting operations are to be carried out, supplemented by stacks for effective dispersion.
- Periodic vacuum-sweeping mechanisms shall be adopted.



CHAPTER 5: DG STACK MONITORING

5.1 DG Stack Monitoring

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

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

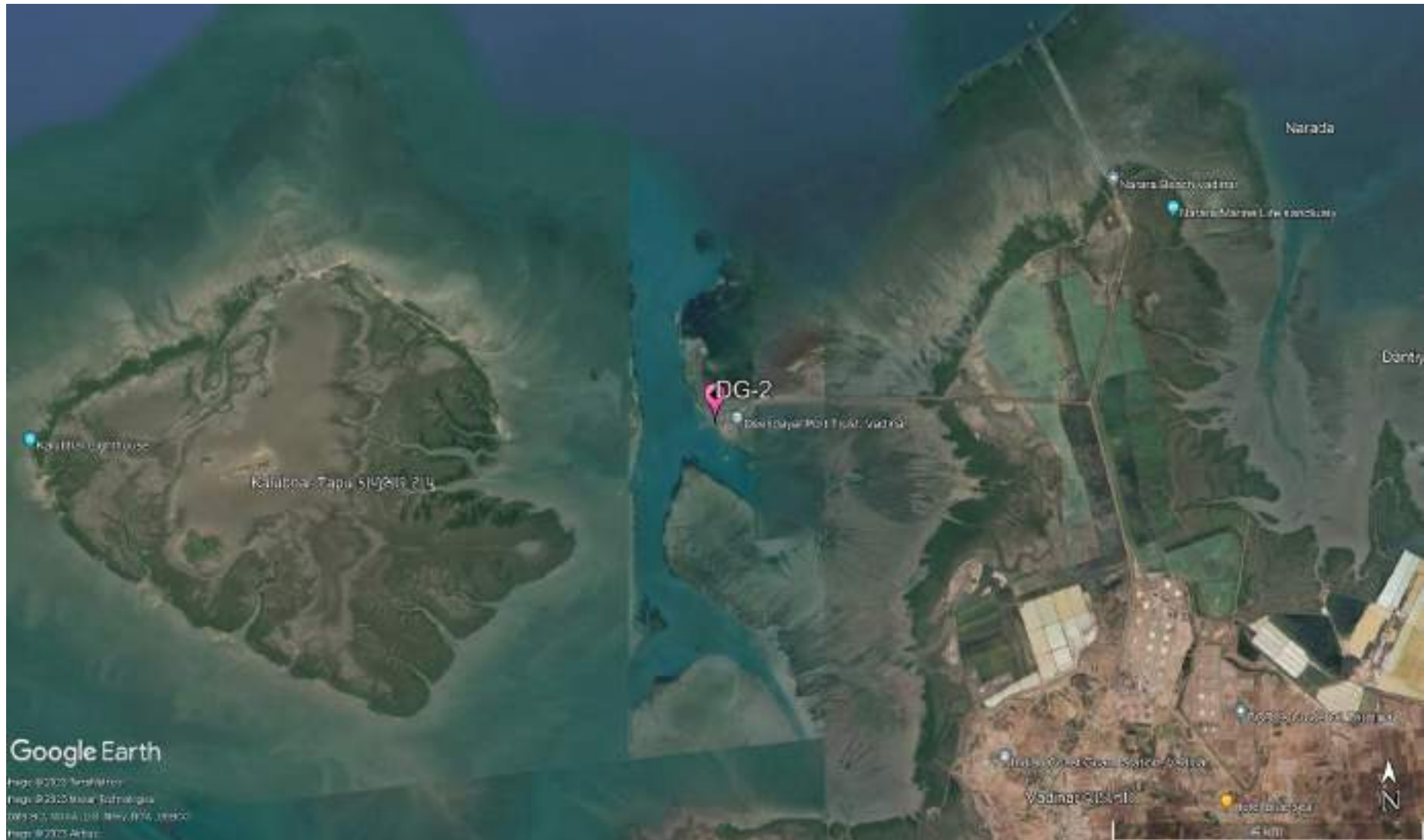
Table 10: Details of DG Stack monitoring locations

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

The map depicting the locations of DG Stack Monitoring to be monitored in Kandla and Vadinar have been mentioned in **Map 6 and 7** as follows:



Map 6: DG Stack monitoring Locations at Kandla



Map 7: DG Stack monitoring Locations at Vadinar

Methodology:

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

Table 11: DG stack parameters

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

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

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

Monitoring Frequency

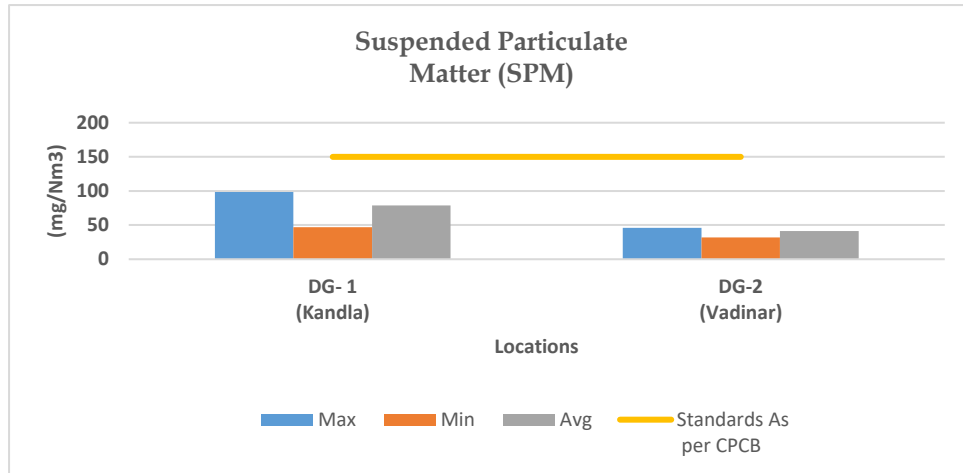
Monitoring is required to be carried out once a month for both the locations of Kandla and Vadinar for a period of April 2023 to March 2024.

5.2 Result and Discussion

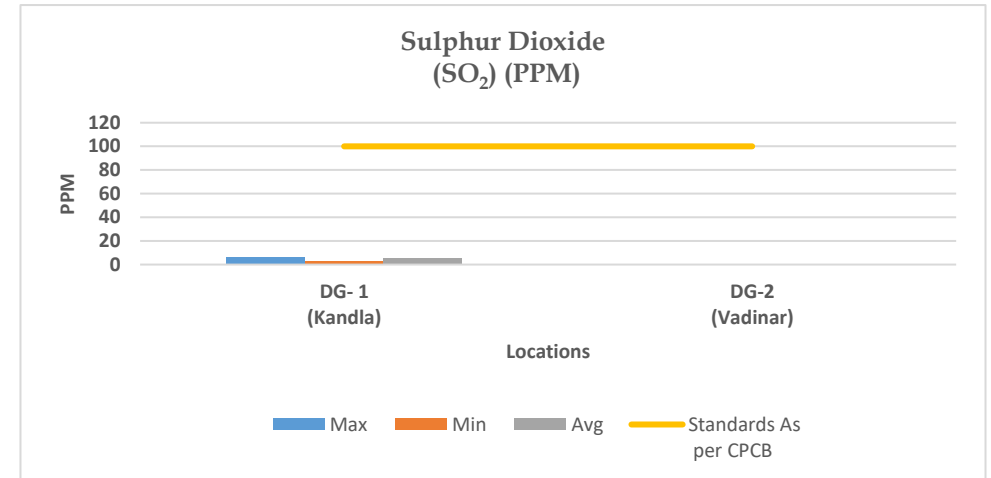
The sampling and monitoring of DG stack emission was carried out for monitoring period at Kandla and Vadinar and its comparison with CPCB or Indian standards for Industrial Stack Monitoring the flue gas emission from DG set has given in **Table 12**.

Table 12: DG monitoring data

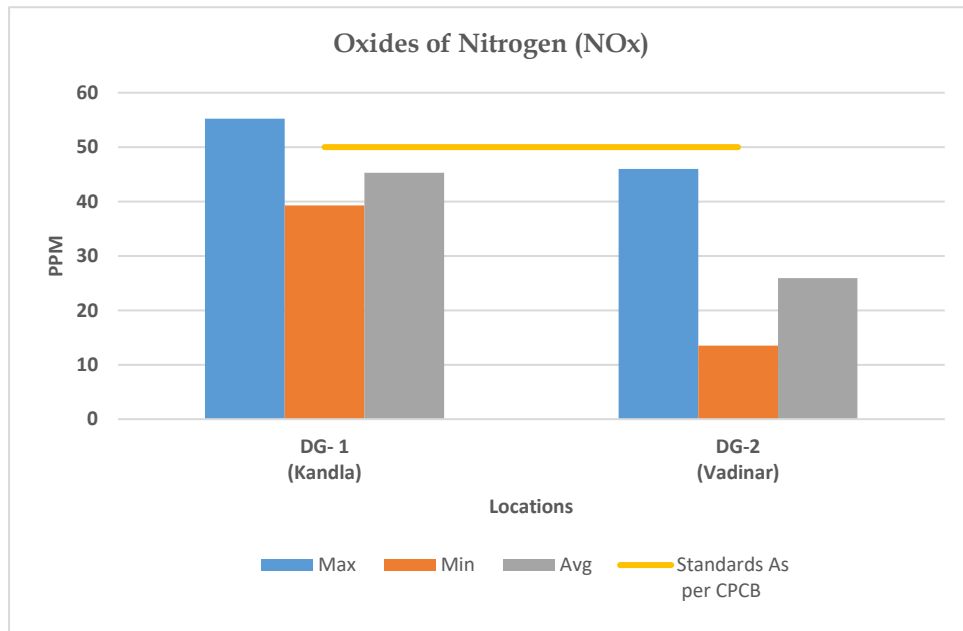
Sr. No.	Stack Monitoring Parameters for DG Sets		DG- 1 (Kandla)	DG-2 (Vadinar)	Stack Monitoring Limits /Standards As per CPCB
1.	Suspended Particulate Matter (SPM) (mg/Nm ³)	Max	98.47	45.32	150
		Min	46.82	31.85	
		Avg.	78.96	41.33	
2.	Sulphur Dioxide (SO ₂) (PPM)	Max	6.45	N.D.	100
		Min	3.25	N.D.	
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



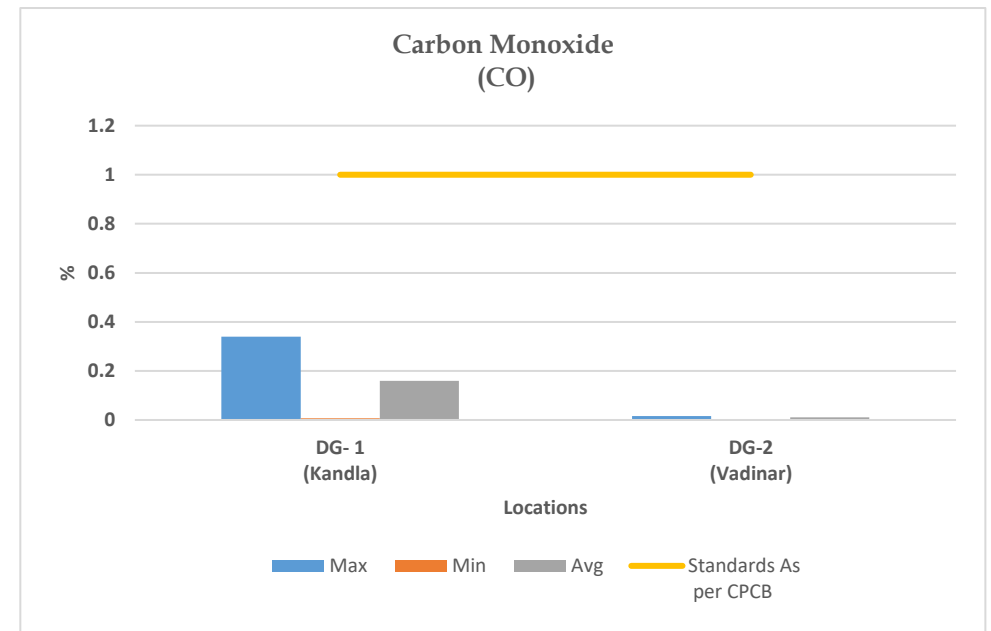
Graph 7 Spatial trend in SPM Concentration



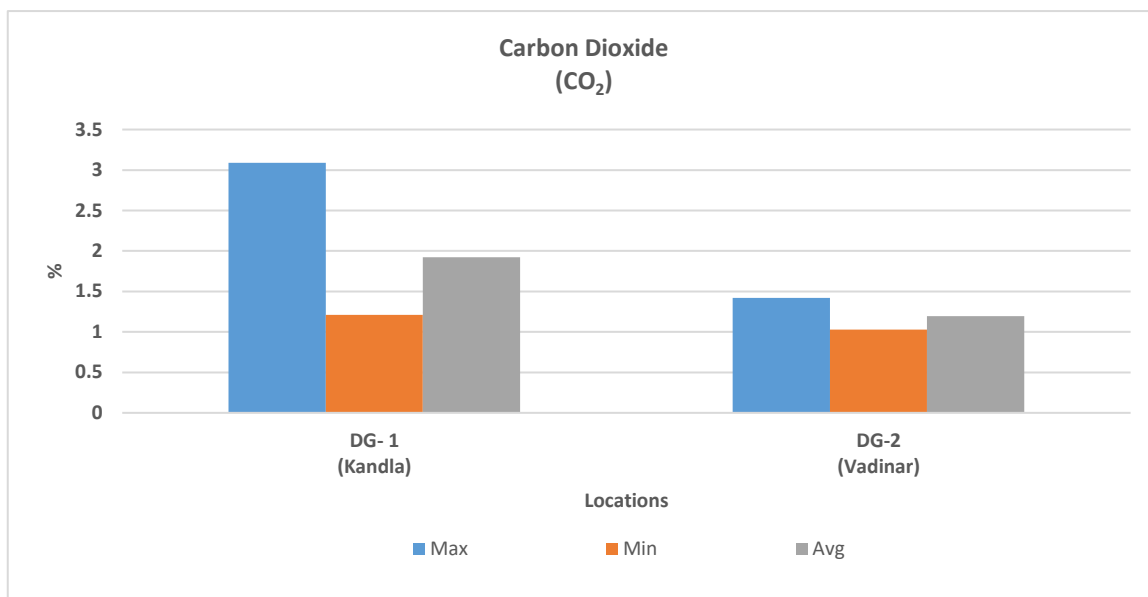
Graph 8 Spatial trend in SO_x Concentration



Graph 9 Spatial trend in NO_x Concentration



Graph 10 Spatial trend in CO Concentration



Graph 11 Spatial trend in CO₂ Concentration

5.3 Data Interpretation and Conclusion

1) Kandla:

The Suspended Particulate Matter (SPM) varies in the range of **46.82** to **98.47** mg/m³. The yearly average SPM of D.G stack-1 is **78.96** mg/m³. The maximum concentration for SPM was observed in the monitoring period of October to November 2023. The Sulphur dioxide (SO_x) varies in the range of **3.25** to **6.45** PPM. The yearly average SO_x of D.G stack-1 is **4.95** PPM. The maximum concentration of SO_x observed in the monitoring period of October to November 2023.

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

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

The CO₂ at Kandla varies in the range of **1.21** to **3.09** %. The yearly average of CO₂ of D.G stack-1 at Kandla is **1.92** %. The maximum concentration of CO₂ observed in the monitoring period of March to April 2024.

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

2) Vadinar:

The Suspended Particulate Matter (SPM) in the range of **31.85** to **45.32** mg/m³. The yearly average SPM of D.G stack-2 at Vadinar is **41.33** mg/m³. The maximum concentration of SPM was observed in the monitoring period of March to April 2024. There is no Sulphur dioxide (SO_x) concentration detected at Vadinar.

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



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

The CO₂ at Vadinar varies in the range of **1.03 to 1.42** %. The yearly average in CO₂ of D.G stack-2 at Vadinar is **1.92** % The maximum concentration of CO₂ observed in the monitoring period of June to July 2024.

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



CHAPTER 6: NOISE MONITORING

6.1 Noise Monitoring

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

The details of the noise monitoring stations are mentioned in **Table 13** and locations have been depicted in the **Map 8 and 9** as follow:

Table 13: Details of noise monitoring locations

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



Map 8: Locations for Noise Monitoring at Kandla

Methodology:

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

Monitoring Frequency

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

Table 14: Details of the Noise Monitoring

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

Standard for Noise

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

Table 15: Ambient Air Quality norms in respect of Noise⁽²⁾

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

6.2 Result and Discussion

The details of the Noise monitoring conducted during the monitoring period April 2023 to March 2024 have been summarized in the **Table 16** as below:

Table 16: The Results of Ambient Noise Quality

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

6.3 Data Interpretation and Conclusion

- 1) **Kandla:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 10 locations at Kandla ranged from **33.5 dB(A)** to **74.5 dB(A)** while, during Night Time the average Noise Level ranged from **31.9 dB(A)** to **58.9 dB(A)**, of which six locations out of ten locations, noise level were within the permissible limits for the industrial, commercial area and residential zone for Day time and night time. Other Four locations such as i.e., **N-3 (Canteen Area)**, **N-7 (Port & Custom Building)**, **N-8 (Nirman Building)** and **N-9 (ATM building)** which are Commercial areas, slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period of **April to May 2023 and May to June 2023**.
- 2) **Vadinar:** The noise level was compared with the standard limits specified in NAAQS by CPCB. During the Day Time, the average noise level at all 3 locations at Vadinar ranged from **34 dB(A)** to **77.5 dB(A)** while, during Night Time the average Noise Level ranged from **34.3 dB(A)** to **71.2 dB(A)** at Vadinar, on location **N-11 (Near main gate)** noise level was within the permissible limits for the industrial zone for Day time and night time. On locations of Vadinar such as i.e., **N-12 (Near Vadinar jetty)**, which are considered as industrial area slightly exceed the standard limits prescribed by NAAQS by CPCB, in the monitoring period of **June to July 2023**. And on location **N-13 (Port Colony Vadinar)**, most frequently exceed the permissible limit during the day time as well as night time.

6.4 Remedial Measures

The noise levels detected at the locations of Kandla and Vadinar, are found within the prescribed norms. The noise can further be considerably reduced by adoption of low noise equipment or installation of sound insulation fences. Green belt of plants can be a good barrier. If noise exceeds the applicable norms, then the working hours may be altered as a possible means to mitigate the nuisances of construction activities.



CHAPTER 7: SOIL MONITORING

7.1 Soil Quality Monitoring:

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

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

Table 17: Details of the Soil quality monitoring

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

Methodology

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

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

Monitoring Frequency

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

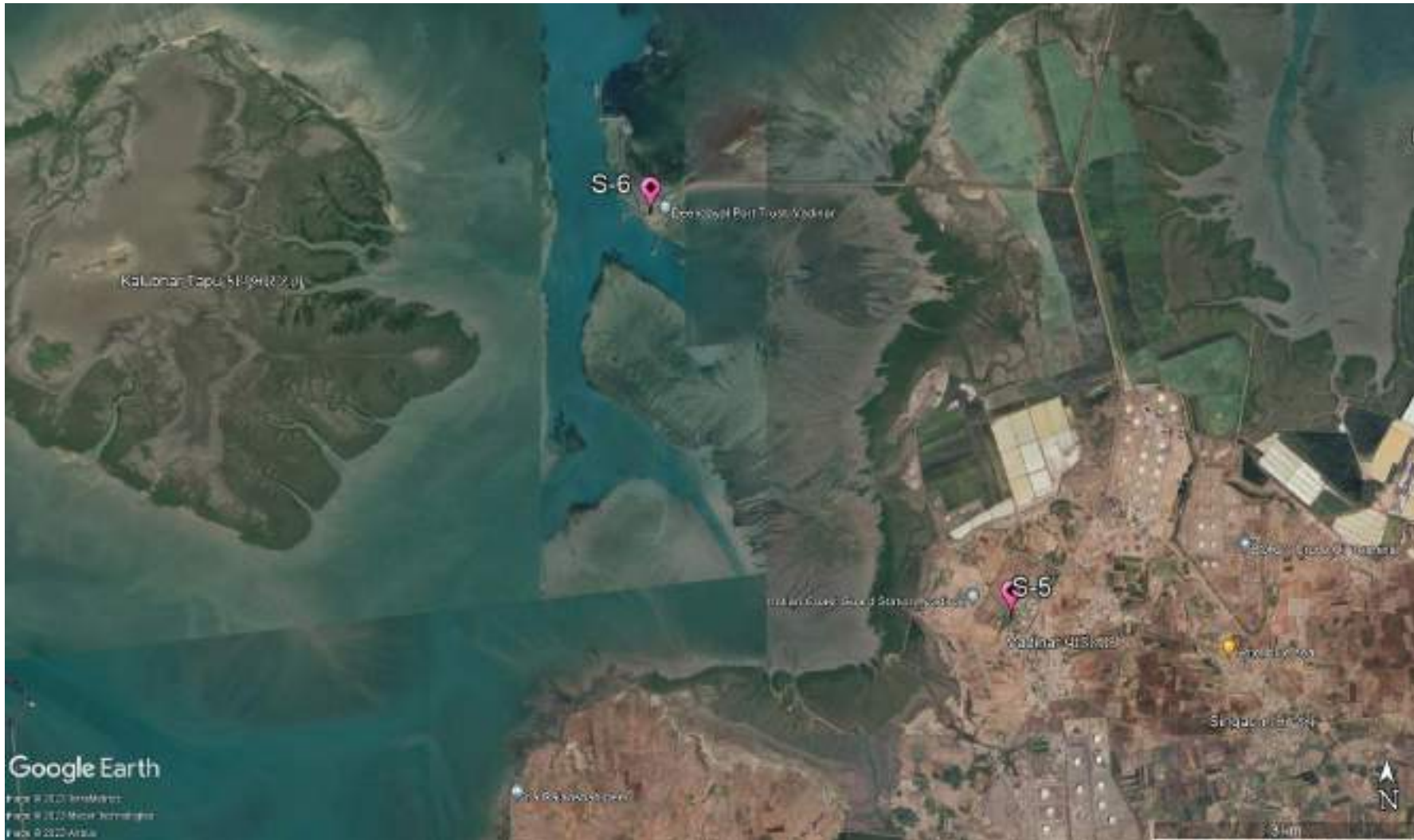
Table 18: Soil parameters

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

The map depicting the locations of Soil Quality Monitoring to be monitored in Kandla and Vadinar have been mentioned in **Map 10 and 11** as follows:



Map 10: Soil Quality Monitoring Locations at Kandla



Map 11: Soil Quality Monitoring Locations at Vadinar

7.2 Result and Discussion

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

Table 19: Soil Quality for the Monitoring period

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

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

7.3 Data Interpretation and Conclusion

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

1) Kandla:

- The value of pH ranges from **6.48** to **9.53**, with the highest at location **S-1 (Oil Jetty 7)** and the lowest at **location S-2 (IFFCO plant)**, while the average pH for Kandla was observed to be **8.23**. The pH in Kandla varies from **Slightly alkaline to strongly alkaline**
- At all monitoring locations, the value of **Electrical Conductivity** ranges from **204** to **75,700 $\mu\text{s}/\text{cm}$** , with the highest at **location S-3 (Khor Creek)** and the lowest at **S-4 (Nakti Creek)**. The average Electrical Conductivity is **16,109.87 $\mu\text{s}/\text{cm}$** .
- The concentration of inorganic phosphate varied from **0.32** to **619.89 kg/ha**, with an average of **17.93 kg/ha**. The highest concentration of inorganic phosphate was found at **S-2 (IFFCO plant)** and the lowest concentration was found at **S-4 (Nakti Creek)**. The availability of phosphorus in the soil solution is influenced by several factors, such as organic matter, clay content, pH, temperature, and more.

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

Heavy Metals

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

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

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

2) Vadinar:

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

Heavy Metals

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

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



CHAPTER 8: DRINKING WATER MONITORING

8.1 Drinking Water Monitoring

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

The details of the drinking water sampling stations have been mentioned in **Table 20** and the locations have been depicted through Google map in **Map 12 and 13**.

Table 20: Details of Drinking Water Sampling Locations

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



Map 12: Drinking Water Monitoring Locations at Kandla

Methodology

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

Table 21: List of parameters for Drinking Water Quality monitoring⁽³⁾

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



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

Monitoring Frequency

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



8.2 Result and Discussion

The drinking water quality of the locations at Kandla and Vadinar and its comparison with the to the stipulated standard (Drinking Water Specifications i.e., IS: 10500:2012) ⁽⁴⁾ have been summarized in **Table 22A, 22B, 22C** as follows:

Table 22A: Drinking Water Quality for the Monitoring period

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



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



Table 22B: Drinking Water Quality for the Monitoring period

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



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



Table 22C: Drinking Water Quality for the Monitoring period

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



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

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

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

8.3 Data Interpretation and Conclusion

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

Physico-Chemical Parameters:

- **pH:** The pH values of drinking water samples in Kandla were reported to be in the range of **6.24 to 8.5**, with an average pH of **7.5**. In Vadinar, its values ranged from **7.05 to 8.38**, with an average pH of **7.36**. Notably, the pH levels at both project sites fall within the acceptable range of 6.5 to 8.5, as specified under IS:10500:2012.
- **Colour:** The colour varies from 1 to 10 at the monitoring locations in Kandla. Locations DW-11, DW-14 and DW-10 showed the value of 10 Hazen at Kandla. At Vadinar, the color was observed within the range of 1 to 20 Hazen. the Colour levels at both project sites fall within the acceptable range of 1 to 15, as specified under IS:10500:2012, except of one location DW-20 within the monitoring period of April to May 2023
- **Electrical Conductivity (EC):** It is a measure of the ability of a solution to conduct electric current, and it is often used as an indicator of the concentration of dissolved solids in water. During the monitoring period, the EC values for samples collected in Kandla were observed to range from **12.83 to 7930 $\mu\text{S}/\text{cm}$** , with an average value of **708.65 $\mu\text{S}/\text{cm}$** . In Vadinar, the EC values showed variation from **30 to 1736 $\mu\text{S}/\text{cm}$** , with an average value of **503.14 $\mu\text{S}/\text{cm}$** . It's important to regularly monitor EC levels in drinking water as it can provide valuable information about water quality and presence of dissolved substances.
- **Salinity:** Salinity at Kandla varies from **0.02 to 4.39 PSU** with an average of **0.396 PSU**, while at Vadinar, salinity was observed within the range of **0.02 to 0.87 PSU**.
- **Turbidity:** The Turbidity values of drinking water samples in Kandla were reported to be in the range of **0.5 to 13.9 NTU**, with an average of **2.32**. In Vadinar, its values ranged from **0 to 5.3**, with an average **2.21**. Notably, the Turbidity levels at both project sites fall within the acceptable range of 1 to 5 NTU, as specified under IS:10500:2012, except DW-7, in the monitoring period of July to August 2023, DW-13 in the monitoring period of May to June 2023 and DW-14 in the monitoring period of September to October and October to November 2023. On all this location most of the time Turbidity observed Below Quantification Limit
- **Chlorides:** The chloride concentrations in Kandla varied from **3 to 689.78 mg/L**, with an average value of **116.85 mg/L**. At Vadinar the chloride concentration was observed within the range of **9 mg/L to 407.37 mg/L**, with an average value of **99.45 mg/L**. Thus, the chloride levels at both project sites fall within the Permissible limit of 1000 mg/L, as specified under IS:10500:2012.
- **Total Hardness (TH):** The concentration of Total Hardness varies from **1.5 to 480 mg/L**, with an average concentration of **88.68 mg/L**. While at Vadinar, the observed values were within range of **2 to 240 mg/L**. at both study areas Total Hardness found

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

- **Total Dissolved Solids (TDS):** Monitoring TDS is crucial because it provides an indication of overall quality of the water. During the monitoring period, the TDS concentrations in Kandla were observed to vary in a wide range i.e., between 8 to **1522** mg/L, with an average concentration of **264.4** mg/L. which is within the permissible limit. while in Vadinar, it ranged from 6 to **882** mg/L, with an average of **255.75** mg/L. It is important to note that the TDS concentrations in both Kandla and Vadinar fall well within the Permissible limit of 2000 mg/L.
- **Fluoride:** The concentration Fluoride varies from 0 to **1.477** mg/L, with an average concentration of **0.44** mg/L. While at Vadinar Fluoride concentration was varies within range of 0 to **1.06** mg/L, with an average concentration of **0.708** mg/L. The Fluoride concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Fluoride found to be within the Permissible limit norm of 1.5 mg/L as specified by IS:10500:2012
- **Sulphate:** The concentration Sulphate varies from 0 to **141.99** mg/L, with an average concentration of **45.67** mg/L. While at Vadinar Sulphate concentration was varies within range of **13.07** to **102.92** mg/L, with an average concentration of **43.94** mg/L. During monitoring period in Kandla and Vadinar, the sulphate concentrations were found to be within the acceptable limits i.e., 200 mg/L as per the specified norms.
- **Nitrate:** The concentration Nitrate varies from 0 to **25.96** mg/L, with an average concentration of **4.08** mg/L. While at Vadinar Nitrate concentration was varies within range of 0 to **18.54** mg/L, with an average concentration of **8.20** mg/L. The Nitrate concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar. at both study areas Nitrate found to be within the Acceptable limit norm of 45 mg/L as specified by IS: 10500:2012.
- **Nitrite:** The concentration Nitrite varies from 0 to **0.2** mg/L. While at Vadinar Nitrite concentration was varies within range of 0 to **1.89** mg/L, with an average concentration of **0.945** mg/L. The Nitrite concentration was found to be **BQL** in majority of the monitoring location at Kandla and Vadinar.
- **Sodium:** During the monitoring period, at Kandla variation in the concentration of Sodium was observed to be in the range of **5.01** to **396.2** mg/L, with the average concentration of **63.71** mg/L. While at Vadinar, the concentration recorded between **6.08** to **204.4** mg/L, with the average concentration of **57.067** mg/L.
- **Odour:** Odour values recorded 1 TON at all monitoring locations of Kandla and Vadinar.

Metals:

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

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

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

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

8.4 Remedial Measures

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

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

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



CHAPTER 9: SEWAGE TREATMENT PLANT MONITORING

9.1 Sewage Treatment Plant (STP) Monitoring:

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

Frequency of monitoring: weekly

Table 23A: Details of the monitoring locations of STP

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

The Consolidated Consent and Authorization (CC&A) issued by the GPCB were referred for the details of the STP for Kandla and Gopalpuri. The CC&A of Kandla and Gopalpuri entails that the treated domestic sewage should conform to the norms specified in **Table 23B**. The treated effluent conforming to the norms shall be discharged on the land within the premises strictly for the gardening and plantation purpose. Whereas, no sewage shall be disposed outside the premises in any manner.

Table 22B: Discharge norms (as per CC&A of Kandla STP)

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

The detailed process flow diagram of the Kandla and Gopalpuri STP have been mentioned in **Figure 3 and 4** as follows:

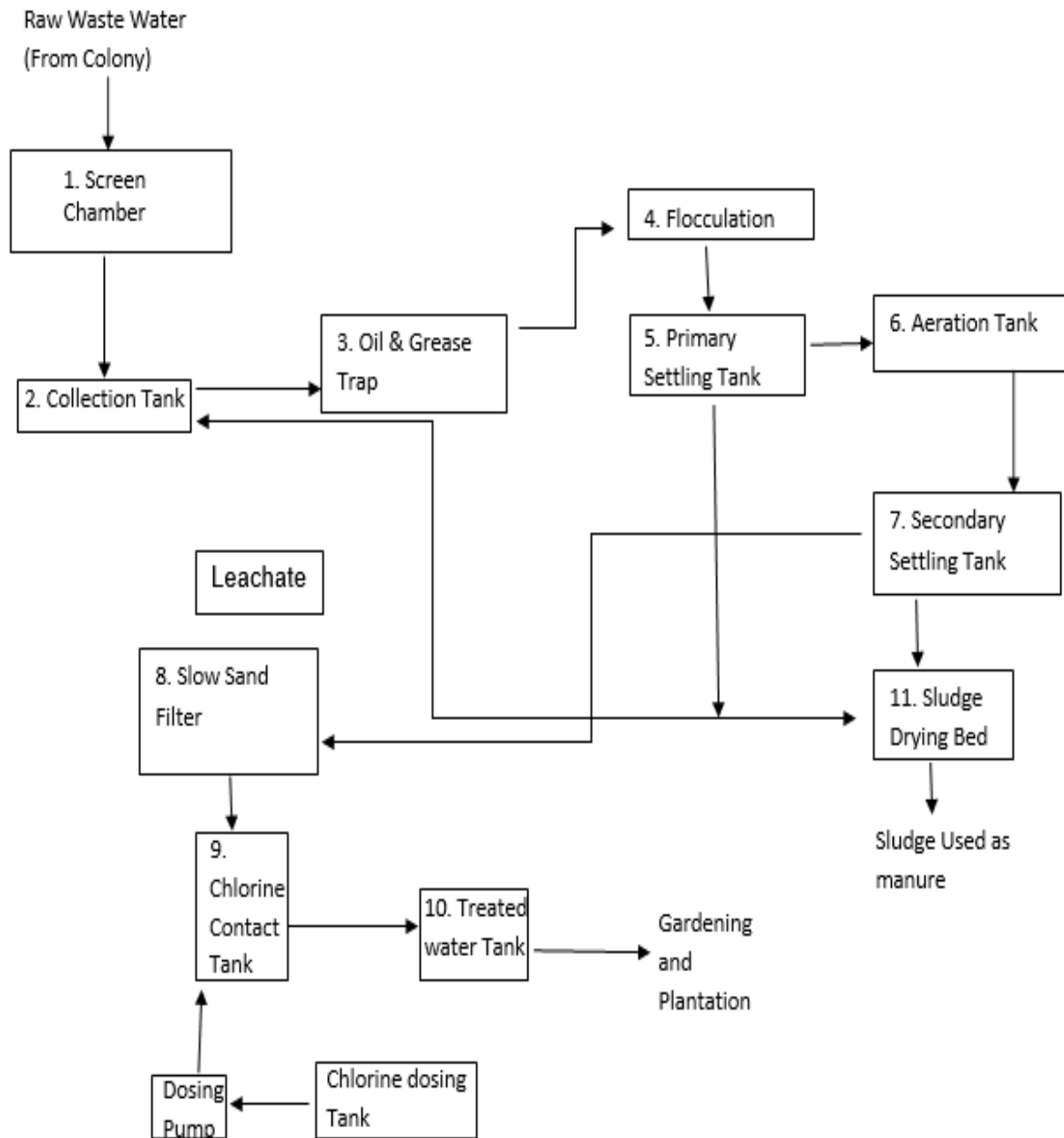


Figure 3: Process flow diagram of STP at Kandla

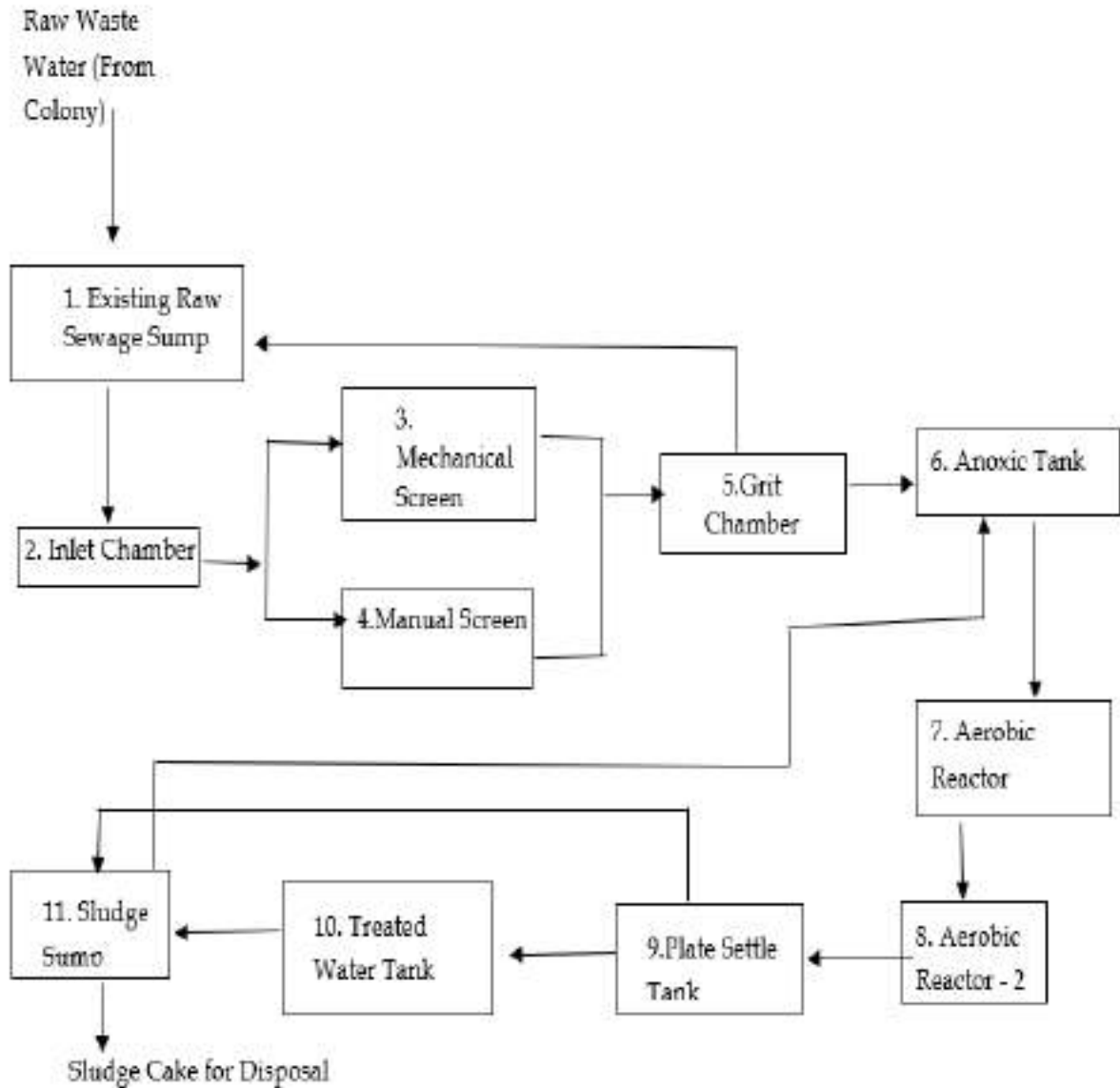


Figure 4: Process flow diagram of STP at Gopalpuri, Kandla

STP at Vadinar

The STP at Vadinar has been built with a treatment capacity of 450 KLD/day. The Consolidated Consent and Authorization (CC&A) issued by the GPCB has been referred for the details of the said STP. The CC&A of the Vadinar STP suggests that the domestic effluent generated shall be treated as per the norms specified in **Table 24**. The treated effluent conforming to the norms shall be discharged on the land within the premises strictly for the gardening and plantation purpose. Whereas, no sewage shall be disposed outside the premises in any manner.

Table 23: Norms of treated effluent as per CC&A of Vadinar STP

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

Sr. No.	Parameters	Prescribed limits
5.	COD	50 mg/L

The detailed process flow diagram of the Vadinar STP have been mentioned in **Figure 5** as follows:

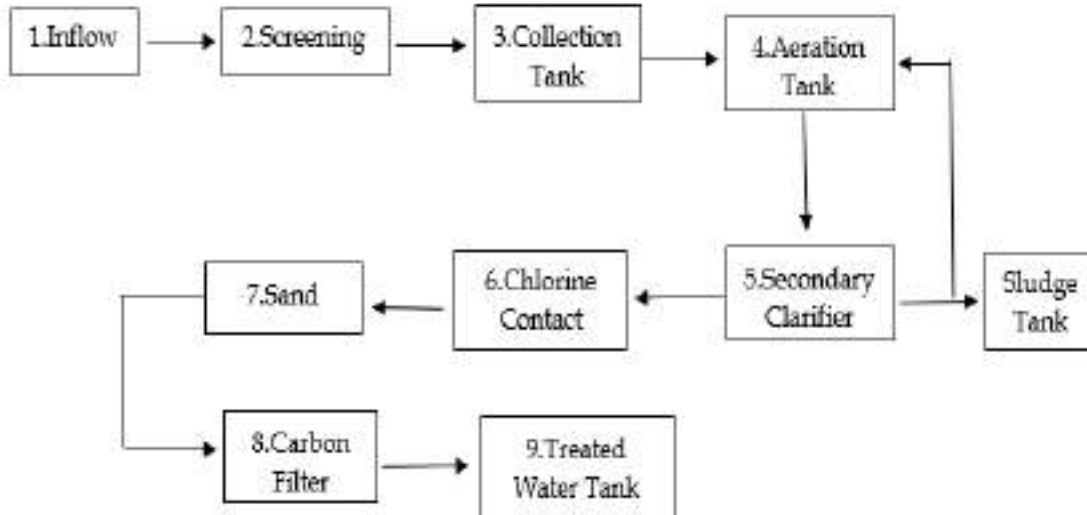


Figure 5: Process flowchart for the STP at Vadinar

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



Map 14: STP Monitoring Locations at Kandla



Map 15: STP Monitoring Locations at Vadinar

Methodology

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

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

Monitoring Frequency

Monitoring is required to be carried out once a week for monitoring location of Kandla and Vadinar i.e., two STP station at Kandla and one STP station at Vadinar. Sample Collected from this location during the monitoring period April 2023 to March 2024.

Table 24: List of parameters monitored for STP's at Kandla and Vadinar

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

9.2 Result and Discussion

Analytical results of the STP samples collected from the inlet and the outlet of the STP's of Kandla and Vadinar have been summarized in **Table 26**. Further it was compared with the standard norms specified in the CC&A of the respective STPs.

Table 25: Water Quality of inlet and outlet of STP of Kandla

Sr No.	Parameter	Units	Kandla							Vadinar			
			GPCB Norms (Kandla)	STP-1			STP-2			GPCB Norms (Vadinar)	STP-3		
				Inlet	Outlet		Inlet	Outlet			Inlet	Outlet	
					Avg	Avg		Max	Avg			Avg	Max
1.	pH	-	6.5-8.5	7.17	7.302	7.65	6.99	7.48	8.88	5.5-9	7.19	7.41	8.46
2.	TDS	mg/L	-	3065.7	2069.28	6228	1099.40	1003.3	1814	-	471.61	402.67	482
3.	TSS	mg/L	100	183.4	20.97	88	115.17	16.45	46	20	38.78	8.42	36
4.	COD	mg/L	-	184.7	32.57	133.1	213.54	25.98	88.4	50	138.27	16.18	40.2
5.	DO	mg/L	-	145.91	37.780	277.09	162.29	21.98	76.92	-	115.12	18.69	54.5
6.	BOD	mg/L	30	56.82	11.937	52.4	61.75	8.40	18.45	10	44.62	6.053	11
7.	SAR	meq/L	-	12.06	9.318	21.04	5.75	5.43	13.1	-	2.71	2.12	3.2
8.	Total Coliforms	MPN/100ml	<1000	1565.95	1530.66	1600	1537.02	1500.51	1600	100-230	1551	1492.3	1600

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

9.3 Data Interpretation and Conclusion

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

- The average pH at the inlet of STP-1, STP-2, and STP-3 is, respectively, **7.17, 6.99, and 7.19**. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum pH of **7.65, 8.88, and 8.46** and an average pH of **7.302, 7.48, and 7.41**, respectively. Which conform to their respective stipulated norms of 6.5–8.5 at Kandla and 5.5–9 at Vadinar, respectively.
- The average TDS concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **3065.8, 1099.4, and 471.33** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TDS concentration of **6228, 1814, and 482** mg/L, and an average TDS concentration of **2069.3, 1003.3, and 402.67** mg/L, respectively.
- The average TSS at the inlet of STP-1, STP-2, and STP-3 is respectively **183.43, 115.17, and 38.78** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum TSS of **88, 46, and 36** mg/L, and an average TSS of **20.974, 16.452, and 8.41** mg/L, respectively. Which conform to their respective stipulated norms of 100 mg/L at Kandla and 20 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average COD at the inlet of STP-1, STP-2, and STP-3 is respectively **184.7, 213.54, and 138.27** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had maximum COD concentrations of **133.1, 88.4, and 40.2** mg/L, and average COD concentrations of **32.576, 25.97, and 16.18** mg/L, respectively. There are no discharge norms for the COD parameter in STP-1 and STP-2 at Kandla, and they conform to their respective stipulated norms of 50 mg/L at Vadinar as mentioned in their respective CCA.
- The average DO concentrations at the inlet of STP-1, STP-2, and STP-3 are, respectively, **145.91, 162.29, and 115.12** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum DO concentration of **277.09, 76.92, and 54.5** mg/L, and an average DO concentration of **37.78, 21.98, and 18.68**, mg/L respectively.
- The average BOD at the inlet of STP-1, STP-2, and STP-3 is respectively **56.82, 61.76, and 44.62** mg/L. After treatment, the treated effluent from STPs at Kandla (STP-1 and STP-2) and Vadinar (STP-3) had a maximum BOD of **52.4, 18.45, and 11** mg/L, and an average BOD of **11.93, 8.40, and 6.05** mg/L, respectively. Which conform to their respective stipulated norms of 30 mg/L at Kandla and 10 mg/L at Vadinar, respectively, as mentioned in their respective CCA, except in STP-3 at Vadinar, which exceeds norms in the 3rd and 4th weeks of April 2023.
- The average SAR concentrations at the inlet of STP-1, STP-2 and STP-3 are respectively **12.068, 5.75 and 2.71** meq/L. After treatment, the treated effluent from

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

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

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

9.4 Remedial Measures:

- The quantum of raw sewage (influent) entering the STP should be monitored by installation of the flow meter. If the quantity of the sewage exceeds the treatment capacity of the treatment plant, then provision of additional capacity of collection sump should be provided.
- The adequacy and efficacy of the stages of Sewage treatment units shall be conducted.
- The results show the presence of total coliforms; hence the method of disinfection (Chlorination) sodium or calcium Hypochlorite can be used.
- Effectiveness of any technology depends on factors such as the specific pollutants in the wastewater, plant size, local regulations, and available resources. There are several processes that may be implemented such as - Advanced oxidation process involve using strong oxidants to break down complex organic compounds. Methods like Fenton's reagent (hydrogen peroxide and iron catalyst) and UV/H₂O₂ treatment can help in reducing COD through oxidation.
- Electrochemical processes like Electrocoagulation (EC) and Electrooxidation (EO) that involve the application of an electric current to facilitate the removal of pollutants through coagulation, flocculation, and oxidation. These methods can be useful for treating sewage containing various pollutants.



CHAPTER 10: MARINE WATER QUALITY MONITORING

10.1 Marine Water

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

Major water quality concerns at ports include wastewater and leakage of toxic substances from ships, stormwater runoff, etc. This discharge of wastewater, combined with other ship wastes which includes sewage and wastewater from other on-board uses, is a serious threat to the water quality as well as to the marine life. As defined in the scope by DPA, the Marine Water sampling and analysis has to be carried out at a total of eight locations, six at Kandla and two at Vadinar. The marine water sampling has been carried out with the help of Niskin Sampler with a capacity of 5L. The Niskin Sampler is a device used to take water samples at a desired depth without the danger of mixing with water from other depths. Details of the locations to be monitored have been mentioned in **Table 27**:

Table 26: Details of the sampling locations for Marine water

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

The map depicting the locations of Marine Water to be sampled and analysed for Kandla and Vadinar have been mentioned in **Map 16 and 17** as follows:



Map 16: Marine Water Monitoring Locations at Kandla



Map 17: Marine Water Monitoring Locations at Vadinar

Methodology

The methodology adopted for the sampling and monitoring of Marine Water was carried out as per the ‘**Sampling Protocol for Water & Wastewater**’ developed by GEMI. The water samples collected through the Niskin Sampler are collected in a clean bucket to reduce the heterogeneity. The list of parameters to be monitored under the project for the Marine Water quality have been mentioned in **Table 28** along with the analysis method and instrument.

Monitoring Frequency

As defined in the scope by DPA, the sampling and analysis of Marine Water has to be carried out once in a month at the eight locations (i.e., six at Kandla and two at Vadinar). For the period April 2023 to March 2024.

Table 27: List of parameters monitored for Marine Water

Sr. No	Parameters	Units	Reference method	Instrument
1.	Electrical Conductivity	µS/cm	APHA, 23 rd Edition (Section-2510 B):2017	Conductivity Meter
2.	Dissolved Oxygen (DO)	mg/L	APHA, 23 rd Edition, 4500 O C, 2017	Titration Apparatus
3.	pH	-	APHA, 23 rd Edition (Section-4500-H+B):2017	pH meter
4.	Color	Hazen	APHA, 23 rd Edition, 2120 B: 2017	Color comparator
5.	Odour	-	IS 3025 Part 5: 2018	Heating mantle & odour bottle
6.	Turbidity	NTU	IS 3025 Part 10: 1984	Nephlo Turbidity Meter
7.	Total Dissolved Solids (TDS)	mg/L	APHA, 23 rd Edition (Section-2540 C):2017	Vaccum Pump with Filtration Assembly and Oven
8.	Total Suspended Solids (TSS)	mg/L	APHA, 23 rd Edition, 2540 D: 2017	
9.	Particulate Organic Carbon	mg/L	APHA, 23 rd Edition, 2540 D and E	TOC analyser
10.	Chemical Oxygen Demand (COD)	mg/L	IS-3025, Part- 58: 2006	Titration Apparatus plus Digester
11.	Biochemical Oxygen Demand (BOD)	mg/L	IS-3025, Part 44,1993,	BOD Incubator plus Titration apparatus
12.	Silica	mg/L	APHA, 23 rd Edition, 4500 C, 2017	UV- Visible Spectrophotometer
13.	Phosphate	mg/L	APHA, 23 rd Edition, 4500 P-D: 2017	
14.	Sulphate	mg/L	APHA, 23 rd Edition, 4500 SO4-2 E: 2017	
15.	Nitrate	mg/L	APHA, 23 rd Edition, 4500 NO3-B: 2017	
16.	Nitrite	mg/L	APHA, 23 rd Edition, 4500 NO2- B: 2017	
17.	Sodium	mg/L	APHA, 23 rd Edition, 3500 Na-B: 2017	Flame photometer

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

10.2 Result and Discussion

The quality of the Marine water samples collected from the locations of Kandla and Vadinar during the monitoring period has been summarized in the **Table 29**. The said water quality has been represented in comparison with the standard values as stipulated by CPCB for Class SW-IV Waters.



Table 28: Results of Analysis of Marine Water Sample for the sampling period

Parameters	Primary Water Quality Criteria for Class SW-IV Waters	Kandla																		Vadinar					
		MW-1			MW-2			MW-3			MW-4			MW-5			MW-6			MW-7			MW-8		
		Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Density (kg/m ³)	-	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
pH	6.5-9.0	6.12	8.32	7.89	7.04	8.36	7.99	7.83	8.33	8.11	7.69	8.31	8.05	7.19	8.48	8.03	6.01	8.31	7.94	7.98	8.2	8.11	7.07	8.22	8.06
Colour (Hazen)	No Noticeable	1	10	5.41	1	20	7.83	1	15	7.16	5	20	9	5	15	7.41	5	20	8.27	1	10	5.66	1	10	5.08
EC (µS/cm)	-	49700	63600	54282.5	49800	61700	54490.91	50200	60600	53767.75	50400	75300	55689.91	50100	65100	55115.58	15950	61528	50873.17	52200	56900	54239.2	52.119	57500	50312.6
Turbidity (NTU)	-	56.4	310	188.26	33.9	314	206.76	61.8	317	203.81	69	300	216.66	94.5	379	202.5	70.1	346	209.23	3.15	12.5	5.36	3.42	13.8	6.39
TDS (mg/L)	-	24800	44466	36356.3	24900	41922	36679.5	25100	41624	35690.92	25200	64721	38189.5	25000	47159	36938.58	9970	41436	32927.91	25784	38620	35400.16	26882	41790	35965.75
TSS (mg/L)	-	44	436	342.42	26	563	374.58	52	478	340.75	58	924	402.33	80	682	427.66	58	852	387.72	78	341	255.08	151	346	282.33
COD (mg/L)	-	29.2	79.37	49.62	11.98	79.37	47.81	25.41	81	47.68	22.65	81	52.12	31.56	79.37	53.76	22.97	88.8	49.34	21.28	75	50.98	17.92	75	47.63
DO (mg/L)	3.0 mg/L	4.7	6.4	5.76	5.3	6.4	6.07	4.5	6.7	5.87	3.4	6.5	5.85	5	6.6	6.07	5.6	8.4	6.49	4.3	7.6	6.25	4.4	7.9	6.48
BOD (mg/L)	5.0 mg/L	5.24	8.54	7.56	8.4	8.9	8.57	3.74	8.45	6.81	5	8.78	7.755	9.32	9.87	9.57	3.6	11.1	8.64	3.91	7.5	6.51	4.2	7.16	6.16
Oil & Grease (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphate (mg/L)	-	2056	2937.5	2529.7	2156.32	2897.7	2544.18	2083.7	2925.2	2530.85	2239	3704.9	2879.88	2334.9	2916.8	2652.42	632.62	3612.8	2561.07	1846.3	3225.8	2472.195	2039.9	3236.8	2664.27
Nitrate (mg/L)	-	1.89	5.40	4.28	1.12	5.16	3.75	3.21	5.68	4.17	3.41	5.85	4.64	3.17	6.92	4.21	3.06	6.84	4.06	2.225	5.17	3.56	1.759	5.1	3.39
Nitrite (mg/L)	-	0.12	0.12	0.12	0	0	0	0	0	0	0	0	0	0.11	0.11	0.11	0.13	0.16	0.14	0	0	0	0	0	0!
Phosphate (mg/L)	-	0.25	1.59	0.82	0.09	1.34	0.69	0.57	1.46	0.96	0.61	2.01	0.92	0.29	1.34	0.76	0.54	1.61	0.81	0.64	0.94	0.79	1.43	1.43	1.43
Silica (mg/L)	-	0.29	3.24	2.12	0.22	4.04	2.24	0.2	3.73	2.19	1.12	3.69	2.54	1.26	4	2.64	0.33	3.74	1.92	0.11	0.96	0.56	0.09	1.86	0.76
Sodium (mg/L)	-	7686	10625	9475.57	7811	10341	9242.42	7763	10308	9347.33	9101	10323	9724.14	8789	10278	9403.67	2086	10722	8042.71	2149.6	9485	6743.97	2349.4	9542	7244.66
Potassium (mg/L)	-	68.35	451.9	318.57	69.27	446.5	303.94	68.57	421	290.60	71.73	543.96	342.71	69.63	423.34	324.92	68.34	442.63	272.9	10.86	421.7	259.6	76.31	518	327.43
Hexavalent Chromium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	321	321	321	333	333	333
Odour	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arsenic (mg/L)	-	5.13	5.13	5.13	5.25	5.25	5.25	5.4	5.4	5.4	0	0	0	0	0	0	9.44	12.94	11.19	0.11	1	0.41	0.08	1	0.38
Cadmium (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper (mg/L)	-	5.1	6.99	5.8175	0.006	10.9	5.79	0.005	7.7	3.85	5.34	12.01	8.224	0.0067	7.6	5.13	8.07	10.2	9.49	3.4	3.4	3.4	0	0	0
Iron (mg/L)	-	0.69	4.11	1.38	0.21	4.07	1.76	0.37	3.92	1.79	1.02	7.93	2.49	0.98	5.45	2.09	0.43	5.3	2.005	0.01	0.25	0.145	0.08	0.66	0.21
Lead (mg/L)	-	0.002	3.44	2.067	0.0029	3.44	2.29	0.0026	3.06	1.98	0.002	9.68	4.32	0.002	4.65	2.39	0.0029	3.65	2.47	0.0023	2.26	1.035	0.002	2.75	0.96
Manganese (mg/L)	-	0.082	129.91	71.47	0.12	159.78	83.88	0.1085	125.66	74.0	0.096	294.91	93.56	0.074	213.14	74.7	0.11	156.41	80.27	2.39	113.93	39.62	1.97	98.8	34.64
Total Chromium (mg/L)	-	0	0	0	5.62	7.8	6.71	5.67	5.67	5.67	5.14	15.99	12.28	5.11	9.65	7.207	0	0	0	0	0	0	45.75	45.75	45.75
Zinc (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury (mg/L)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Particulate Organic	-	0.51	900	76.22	0.51	35	3.98	0.42	10	1.94	0.58	55	6.03	0.92	30	3.89	0.85	44	5.01	0.47	4.67	1.62	0.32	4.76	1.51



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

10.3 Data Interpretation and Conclusion

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

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

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

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

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

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

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



CHAPTER 11: MARINE SEDIMENT QUALITY MONITORING

11.1 Marine Sediment Monitoring

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

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

Methodology

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

Table 29: Details of the sampling locations for Marine Sediment

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

The map depicting the locations of Marine Sediment sampling at Kandla and Vadinar have been mentioned in **Map 18 and 19** as follows:



Map 18: Marine Sediment Monitoring Location at Kandla



Map 19: Marine Sediment Monitoring Locations at Vadinar

The list of parameters to be monitored under the projects for the Marine Sediment sampling been mentioned in **Table 31** as follows:

Table 30: List of parameters to be monitored for Sediments at Kandla and Vadinar

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

11.2 Result and Discussion

The quality of Marine Sediment samples collected from the locations of Kandla and Vadinar during the monitoring period of April 2023 to March 2024 has been summarized in the **Table 32**.



Table 31: Summarized result of Marine Sediment Quality

Parameters	Kandla																		Vadinar					
	MS-1			MS-2			MS-3			MS-4			MS-5			MS-6			MS-7			MS-8		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Inorganic Phosphate (kg/ha)	16.85	0.86	6.6042	14.37	0.67	8.81	41.2	0.8	16.98	19.44	0.81	9.532	45.1	0.72	14.48	34.6	0.66	15.24	14.5	1.24	5.65	18.51	0.82	5.7325
Phosphate (mg/Kg)	3247.8	290.8	1280.63	2514.7	258.3	1304	3736	226.6	1515	3871	353.7	1287	3741	306.8	1442	14076	578.3	2793.9	3002	152.5	770.24	3477.29	167.93	940.70
Organic Matter (%)	1.42	0.21	0.7875	2.17	0.29	1.13	1.01	0.17	0.593	2.1	0.33	0.975	1.24	0.67	0.911	2.06	0.21	0.915	2.29	0.15	1.04	1.65	0.17	0.89
Sulphate as SO⁴⁻ (mg/Kg)	905.25	110.2	366.8	1022.25	98.2	370.03	571.64	95.33	275.09	650.25	97.45	268.51	768	87.28	294.27	732	96.38	249.1	296	74.07	126.31	213.4	80.06	132.03
Calcium as Ca (mg/Kg)	13800	1612	3464.3	5800	1259	2836	4200	962	2163	4200	1102	2669	10500	1089	3102	3800	1047	2274.6	3700	2200	2930.9	3974.2	2100	2805.45
Magnesium as Mg (mg/Kg)	1952	1225	1538.53	3050	826.46	1810.84	2136	764	1592.59	3172	866.94	1810.6	2440	1032	1622.80	2745	906.98	1581.95	1952	854	1385.18	14640	1167	2920.83
Silica (g/Kg)	671.25	261.3	479.11	612.51	289.4	481.7	571.5	329.1	444.8	555.2	245.7	392.1	597.1	179.2	418.6	580.4	245.3	436.12	529.8	220.9	377.71	546.08	264.92	426.66
Nitrite (mg/Kg)	0.75	0.12	0.41	0.92	0.13	0.50	0.81	0.08	0.41	0.91	0.01	0.43	0.71	0.11	0.375	0.89	0.07	0.489	0.22	0.07	0.159	0.37	0.04	0.23
Nitrate (mg/Kg)	22.34	5.86	16.58	37.12	7.59	18.29	36.47	4.51	15.50	25.94	4.31	13.99	10.34	5.24	13.17	20.38	6.34	14.52	25.33	9.54	15.36	25.21	4.75	10.52
Sodium (mg/Kg)	7860	3194	4512.43	14688	2453	5318	8612	2072	4550	18308	2612	6435	10520	2063	4665	14076	2072	5639.6	11944	3971	7904.6	13660	2719.42	9536.63
Potassium (mg/Kg)	2610.7	241	1525.98	11580	276	2320	3479	260.7	2126	4208	294	2424	3152	205	1790	3479	236.9	2233.4	3372	699	1876.1	4377	1028	2025.66
Aluminium (mg/Kg)	8371.7	2116	3827.74	10641	1237.1	4465.9	10363.1	1278.5	4370.2	12008.4	1971.2	5025.2	10361.1	1264.58	3891.23	12314.1	1273.22	4384.20	14179.7	358.3	4028.56	19356.55	479.16	4883.52
Mercury (mg/Kg)	4.71	4.71	4.71	10.74	10.74	10.74	41.29	41.29	41.29	6.44	6.44	6.44	15.21	15.21	15.21	34.69	34.69	34.69	0	0	0	0	0	0
Texture	Sandy loam	Sandy loam	Silt loam	Sandy loam	Silt loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Loam	Loam	Loam

11.3 Data Interpretation and Conclusion

The Marine sediment quality at Kandla and Vadinar has been monitored for various physico-chemical parameters during the monitoring April 2023 to March 2024. The detailed interpretation of the parameters is given below:

- **Inorganic Phosphate** for the sampling period was observed in range of **0.66 to 45.12** Kg/ha for Kandla. Whereas for Vadinar the value observed Within range of **0.82 to 18.51** Kg/ha. For Kandla and Vadinar the average value of Inorganic Phosphate was observed **13.77** and **7.74** Kg/ha respectively.
- The concentration of **Phosphate** was observed in range of **226.6 to 3871.15 mg/Kg** for Kandla and for Vadinar the value observed within the range of **152.53 to 3477.29** mg/Kg. For Kandla and Vadinar the average concentration of Phosphate was observed **1616.78** and **1418.5** mg/Kg respectively.
- The **Organic Matter** for the sampling period was observed in the range of **0.17 to 2.17** % for Kandla with the average value of **0.95%** and for Vadinar the value recorded Within range of **0.15 to 2.29%**, with average concentration as **1.03** %.
- The concentration of **Sulphate** was observed in the range of **87.28 to 1022 mg/Kg** for Kandla and for Vadinar the value observed Within range of **74.07 to 296** mg/Kg. For Kandla and Vadinar the average value of Sulphate was observed **392.10** and **153.64** mg/Kg respectively.
- The value of **Calcium** was observed in the range of **962 to 13800 mg/Kg** for Kandla and for Vadinar the value observed within the range of **2100 to 3974.5** mg/Kg. The average value of Calcium for the monitoring period was observed **3660.21** mg/Kg and **2951.76** mg/Kg at Kandla and Vadinar, respectively.
- The value of **Magnesium** for the sampling period was observed in the range of **764 to 3172 mg/Kg** for Kandla and for Vadinar the value observed Within the range of **854 to 1952** mg/Kg. For Kandla and Vadinar the average value of Magnesium was observed **1726.35** mg/Kg and **1440.69** mg/Kg respectively.
- For the sampling period **Silica** was observed in the range of **179.25 to 671.25 mg/Kg** for Kandla with average value **432.83** mg/Kg and for Vadinar the value observed within the range of **220.98** and **546.5** mg/Kg with average **394.35** mg/Kg.
- The value of **Nitrate** was observed in the range of **4.31 to 37.12 mg/Kg** for Kandla with average value **15.47** mg/Kg and for Vadinar the value observed within the range of **4.75 to 25.33** mg/Kg. with average **15.12** mg/Kg.
- The value of **Nitrite** was observed in the range of **0.01 to 0.92 mg/Kg** for Kandla with average value **0.45** mg/Kg and for Vadinar the value observed to be within the range of **0.04 to 0.37** mg/Kg, with average **0.1828** mg/Kg.
- The value of **Sodium** was observed in the range of **2063.3 to 18308 mg/Kg** for Kandla with average value **6647.43** mg/Kg and for Vadinar the value observed within the range of **2719.42** and **13660** mg/Kg, with average **8289** mg/Kg.
- The value of **Potassium** was observed in the range of **205.08 to 11580 mg/Kg** for Kandla with average value **2357.95** mg/Kg and for Vadinar the value observed within range of **699.09 to 4377** mg/Kg, with average **2229.65** mg/Kg.

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

Heavy Metals

The sediment quality of Kandla and Vadinar has been compared with respect to the Average Standard guideline applicable for heavy metals in marine sediment specified by EPA have been mentioned in **Table 33**.

Table 32: Standard Guidelines applicable for heavy metals in sediments

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

ND = Not Detected

(Source: G Perin et al. 1997)

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

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

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

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

Analysis of the sediments indicates moderate pollution. However, it may be noted that, the sediments are highly dynamic being constantly deposited and carried away by water currents. Hence maintaining the quality of sediments is necessary as it plays a significant role in regulating the quality of the marine water and the marine ecology.

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



CHAPTER 12: MARINE ECOLOGY MONITORING

12.1 Marine Ecological Monitoring

The monitoring of the biological and ecological parameters is important in order to assess the marine environment. A marine sampling is an estimation of the body of information in the population. The theory of the sampling design is depending upon the underlying frequency distribution of the population of interest. The requirement for useful water sampling is to collect a representative sample of suitable volume from the specified depth and retain it free from contamination during retrieval. Deendayal Port and its surroundings have mangroves, mudflats and creek systems as major ecological entities.

As defined in the scope by DPA, the Marine Ecological Monitoring is required to be carried out once a month specifically at eight locations, six at Kandla and two at Vadinar. The sampling of the Benthic Invertebrates has been carried out with the help of D-frame nets, whereas the sampling of zooplankton and phytoplankton has been carried out with the help of Plankton Nets (60 micron and 20 micron). The details of the locations of Marine Ecological Monitoring have been mentioned in **Table 35** as follows:

Table 34: Details of the sampling locations for Marine Ecological

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

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



Map 20 Marine Ecological Monitoring: Locations at Kandla



Map 21: Marine Ecological Monitoring Locations at Vadinar

The various parameters to be monitored under the study for Marine Ecological Monitoring are mentioned in **Table 36** as follows:

Table 35: List of parameters to be monitored for Marine Ecological Monitoring

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

Methodology

- **Processing for chlorophyll estimation:**

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

- **Phytoplankton Estimation**

Phytoplankton are free floating unicellular, filamentous and colonial eutrophic organisms that grow in aquatic environments whose movement is more or less dependent upon water currents. These micro flora acts as primary producers as well as the basis of food chain, source of protein, bio-purifier and bio-indicators of the aquatic ecosystems of which diverse array of the life depends. They are considered as an important component of aquatic flora, play a key role in maintaining equilibrium between abiotic and biotic components of aquatic ecosystem. The phytoplankton includes a wide range of photosynthetic and phototrophic organisms. Marine phytoplankton is mostly microscopic and unicellular floating flora, which are the primary producers that support the pelagic food-chain. The two most prominent groups of phytoplankton are Diatoms (*Bacillariophyceae*) and Dinoflagellates (*Dinophyceae*). Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro

flagellates (naked flagellates) as well as Cyanophytes (Bluegreen algae). Algae are an ecologically important group in most aquatic ecosystems and have been an important component of biological monitoring programs. Algae are ideally suited for water quality assessment because they have rapid reproduction rates and very short life cycles, making them valuable indicators of short-term impacts. Aquatic populations are impacted by anthropogenic stress, resulting in a variety of alterations in the biological integrity of aquatic systems. Algae can serve as an indicator of the degree of deterioration of water quality, and many algal indicators have been used to assess environmental status.

- **Zooplankton Estimation**

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

- **Diversity Index**

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

1. **Shannon-Wiener's index:**

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

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

Where, \sum = Summation symbol,

p_i = Relative abundance of the species,

\ln = Natural logarithm

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

2. Simpson's index:

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

The formula for calculating D is presented as:

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

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

3. Margalef's diversity index:

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

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

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

Where, N = total number of individuals collected

S = No. of taxa or species or genera

4. Berger-Parker index:

This is a useful tool for tracking the biodiversity of deteriorated ecosystems. Environmental factors have a considerable impact on this index, which accounts for the

dominance of the most abundant species over the total abundance of all species in the assemblage. The preservation of their biodiversity and the identification of the fundamental elements influencing community patterns are thus critical for management and conservation. Successful colonising species will dominate the assemblage, causing the Berger-Parker index to rise, corresponding to well-documented successional processes. The environmental and ecological features of the system after disturbance may therefore simply but significantly determine the identity of the opportunistic and colonising species through niche selection processes.

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

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

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

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

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

5. Evenness index-

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

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

Where, H= Shannon value

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

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

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

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

Monitoring Frequency:

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

12.2 Result and Discussion

The details of Marine Ecological Monitoring conducted for the locations of Kandla and Vadinar during the monitoring period has been summarized in the **Table 37**.

Table 36: Values of Biomass, Net Primary Productivity (NPP), Gross Primary Productivity (GPP), Pheophytin and Chlorophyll for Kandla and Vadinar

Sr. No.	Parameters	Kandla						Vadinar	
		ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khorī Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
		Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
1.	Biomass	115	115	96	142	102	121	78	111
2.	Net Primary Productivity	2.91	3.77	3.08	2.99	5.47	2.49	4.16	2.64
3.	Gross Primary Productivity	2.95	3.04	3.73	3.26	2.44	2.85	3.67	3.09
4.	Pheophytin	1.10	1.28	0.80	1.35	0.82	5.81	2.66	2.43
5.	Chlorophyll-a	2.40	1.61	1.72	1.72	2.04	12.43	2.37	3.24
6.	Particulate Oxidisable Organic Carbon	1.34	1.12	1.18	1.51	1.45	1.40	1.26	1.20
7.	Secchi Depth	0.61	0.63	0.56	0.60	0.56	0.62	3.93	2.61

- Biomass:**

With reference to **Table 37**, the average concentration of biomass during the monitoring period, for locations ME-1 to ME-6 was reported within the range of **96-142 mg/L**, with the lowest biomass present in **ME-3 (near coal berth)** and the highest biomass present in **ME-4 (Khorī Creek)** during the sampling period. In Vadinar, the value of biomass was observed at **78 mg/L** at ME-7 (near SPM) and **111 mg/L** at ME-8 (near Vadinar Jetty) monitoring station.

- Productivity (Net and Gross)**

Gross primary productivity (GPP) is the rate at which organic matter is synthesised by producers per unit area and time (GPP). The amount of carbon fixed during photosynthesis by all producers in an ecosystem is referred to as gross primary productivity. During the Monitoring Period, the monitoring location of Kandla reported GPP value in range between **2.44 to 3.73 mg/L/48 Hr** where the highest value recorded

for ME-3 (Near Coal Bearth) and lowest recorded at ME-5 (Nakti creek-near tuna port). In Vadinar, the value of **GPP** was observed **3.67** at ME-7 (Near SPM) and **3.09** mg/L/48 Hr at ME-8 (Near Vadinar Jetty) monitoring station.

Net primary productivity, is the amount of fixed carbon that is not consumed by plants, and it is this remaining fixed carbon that is made available to various consumers in the ecosystem. During the monitoring period of 2023 to 2024 the Net primary productivity of the monitoring location at Kandla from (ME-1 to ME-6) has been estimated to be between **2.49 to 5.47 mg/L/48 Hr**. While in Vadinar, the value of **NPP** was observed **4.16** at ME-7 (Near SPM) and **2.64** mg/L/48 Hr at ME-8 (Near Vadinar Jetty) monitoring station.

- **Pheophytin**

The level of Pheophytin was detected in the range from **0.8 to 5.81 mg/m³** where the highest value observed at ME-6 (Nakti Creek (Near NH-8A)) and the lowest value observed at ME-3(Near Coral Breth), While in Vadinar, the value of Pheophytin was observed **2.66** mg/m³ at ME-7 and **2.43** mg/m³ at ME-8 monitoring station.

- **Chlorophyll-a**

In the sub surface water, the value of Chlorophyll-a reported in range from **1.61 to 12.43 mg/m³**. The highest value observed at ME-6 (Nakti Creek (Near NH-8A)), while the lowest value observed at ME-2 (Kandla Creek). In Vadinar, the value of chlorophyll-a was observed **2.37** mg/m³ at ME-7 (Near SPM) and **3.24** mg/m³ in ME-8 (Near Vadinar Jetty) monitoring station.

- **Particulate Oxidisable Organic Carbon**

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

- **Secchi Depth**

In monitoring station of Kandla (ME-1 to ME-6) the level of Secchi Depth was observed between **0.56 to 0.63 ft** whereas at Vadinar, the value recorded at ME-7 i.e. Near SPM is **3.93** ft and in Near Vadinar Jetty is **2.61** ft.

Ecological Diversity

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

The details of variation in abundance and diversity in phytoplankton communities is mentioned in **Table 38**.

Table 37: Phytoplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khorī Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
<i>Bacillaria sp.</i>	360	391	271	404	374	521	390	347
<i>Biddulphia sp.</i>	492	340	73	542	315	434	402	274
<i>Chaetoceros sp.</i>	279	379	316	258	627	322	462	394
<i>Chlamydomonas sp.</i>	286	312	147	329	478	456	325	503
<i>Cyclotella sp.</i>	367	443	284	418	454	609	303	378
<i>Coscinodiscus sp.</i>	455	412	290	206	330	376	370	244
<i>Ditylum sp</i>	342	322	124	241	225	205	227	294
<i>Fragilaria sp.</i>	395	381	336	300	355	0	350	360
<i>Bacteriastrum sp.</i>	178	96	52	166	111	252	162	252
<i>Pleurosigma sp.</i>	236	236	129	565	276	675	352	219
<i>Navicula sp.</i>	366	488	472	393	420	332	375	856
<i>Nitzschia sp.</i>	309	272	249	295	366	284	418	435
<i>Synedra sp.</i>	479	328	82	322	144	541	192	327
<i>Skeletonema sp.</i>	270	566	130	0	488	536	521	495
<i>Oscillatoria sp.</i>	341	351	176	251	493	423.5	144	306
<i>Thalassiosira</i>	147	134	64	132	170	224	235	161
<i>Gomphonema sp.</i>	550	495	128	360	600	310	564	500
<i>Planktothrix sp.</i>	140	302	123	411	393	495	272	353
<i>Gyrosigma sp.</i>	410	560	130	750	0	685	400	667
<i>Actinestrum sp.</i>	0	0	0	0	0	500	0	0
<i>Cymbella</i>	500	500	0	550	0	685	700	500
<i>Limnothrix sp.</i>	0	700	0	650	0	800	750	0
<i>Scendesmus sp.</i>	0	0	0	485	0	630	0	0
<i>Mougeotia sp.</i>	0	0	0	8	0	20	0	4
<i>Chlorella sp.</i>	0	0	0	0	0	850	0	0
Density-Units/L	3107.1	3525	3177.3	2918	3073	3704	3357	3576
No. of genera	20	21	19	22	18	24	21	21

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

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

The density of phytoplankton of the sampling stations from ME-1 to ME-6 (Kandla) varying from **2918** to **3704** units/L, while for Vadinar its density of phytoplankton observed **3357** units/L at ME-7 and **3576** units/L at ME-8. During the sampling, all communities were contributing in phytoplankton on both location of Kandla & Vadinar except *Gyrosigma sp*, *Actinestrum sp*, *cymbella*, *Limnothrix sp*, *Scendesmus sp*, *Mougeotia sp* and *cholera sp*.

The details of Species richness Index and Diversity Index in Phytoplankton is mentioned in **Table 39**.

Table 38: Species richness Index and Diversity Index in Phytoplankton

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khorī Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	13	14	13	14	13	15	14	13
Individuals	3099	3408	3202	2926	3094	3768	3357	3597
Shannon diversity	2.09	2.12	2.05	1.97	1.94	2.02	2.10	1.95
Simpson 1-D	0.86	0.86	0.85	0.83	0.83	0.84	0.86	0.80
Species Evenness	0.92	0.91	0.90	0.89	0.90	0.87	0.90	0.85
Margalef richness	1.03	1.09	1.02	1.00	0.93	1.01	1.07	1.01
Berger-Parker	0.20	0.21	0.22	0.24	0.25	0.24	0.22	0.28
Relative abundance	0.41	0.44	0.38	0.44	0.38	0.41	0.40	0.41

- **Shannon- Wiener’s Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wiener’s index of phytoplankton communities was in the range of **1.94 to 2.12** between selected sampling stations from ME-1 to ME-6. While for Vadinar, Average Shannon Wiener’s index of phytoplankton communities recorded to be **2.10** at ME-7 and **1.95** at ME-8. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla and Vadinar.
- **Simpson diversity index (1-D):** During the monitoring period **2023 to 2024**, average Simpson diversity index (1-D) of phytoplankton communities was ranged between **0.83 to 0.86** at all sampling stations in the Kandla creek and nearby creeks. Similarly, for Vadinar average Simpson diversity index (1-D) of phytoplankton communities was **0.86** at ME-7 and **0.80** at ME-8.
- **Margalef’s diversity index (Species Richness):** During the monitoring period **2023 to 2024**, average margalef’s diversity index of phytoplankton communities in Kandla and nearby creeks sampling stations was varying from **0.93 to 1.09**. While for Vadinar, average Margalef’s diversity index (Species Richness) of phytoplankton communities observed **1.07** at ME-7 and **1.01** at ME-8.
- **Berger-Parker Index (d):** During the monitoring period **2023 to 2024**, average Berger-Parker Index (d) of phytoplankton communities was in the range of **0.20 to 0.25** between selected sampling stations from ME-1 to ME-6. at Kandla creek and nearby creeks.

Average Berger-Parker Index (d) of phytoplankton communities in the sampling stations of Vadinar, was in the range of **0.22 to 0.28**. All the monitoring station signifies a low diversity with an even distribution among the different species.

- The Average **Species Evenness** is observed in the range of **0.87 to 0.92** for all the six-monitoring station of Kandla and for the Vadinar the average species evenness is observed in the range of **0.85 to 0.90**.
- During the sampling period, average **Relative Abundance** of phytoplankton communities was in range of **0.38 to 0.44** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative Abundance value **0.40** at ME-7 and **0.41** at ME-8. thus, it is concluded that the studied species can be stated as neither highly dominant nor rare.

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

Table 39: Zooplankton variations in abundance and diversity in sub surface sampling stations

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khori Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
<i>Acartia sp.</i>	2	2	2	2	2	2	3	2
<i>Acrocalanus</i>	2	2	2	2	2	2	2	4
<i>Amoeba</i>	3	2	3	3	4	2	3	2
<i>Brachionus sp.</i>	3	2	2	2	2	3	4	2
<i>Calanus sp.</i>	2	3	3	2	2	3	2	3
<i>Cladocera sp.</i>	2	3	5	2	3	2	3	3
<i>Cyclopoid sp.</i>	5	4	4	4	2	2	4	2
<i>Copepod larvae</i>	2	3	2	3	2	4	2	2
<i>Diaptomus sp.</i>	5	2	4	2	3	2	3	3
<i>Eucalanus sp.</i>	3	2	2	4	3	6	3	4
<i>Mysis sp.</i>	3	9	7	5	1	6	6	8
<i>Oithona sp.</i>	1	2	4	2	1	4	4	9
<i>Paracalanus sp.</i>	8	7	4	8	11	8	9	10
Density Unit/L	24.45	24.91	25.82	26.00	22.91	26.45	27.64	27.36
No. of genera	13	13	13	13	13	13	13	13

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

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

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

Table 40: Species richness Index and Diversity Index in Zooplankton

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khorl Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	11	13	10	13	10	12	13	10
Individuals	24	57	26	26	23	26	28	27
Shannon diversity	1.77	1.74	1.76	1.79	1.67	1.76	1.79	1.72
Simpson (1-D)	0.79	0.75	0.79	0.79	0.76	0.77	0.79	0.77
Species Evenness	0.78	0.61	0.78	0.79	0.79	0.73	0.82	0.76
Margalef	2.15	2.21	2.07	2.21	2.06	2.34	2.22	2.16
Berger-Parker	0.34	0.42	0.32	0.34	0.35	0.37	0.31	0.35
Relative abundance	34.93	40.08	31.95	37.76	39.98	38.18	39.18	37.27

- Shannon- Wiener’s Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wiener’s index of zooplankton communities was in the range of **1.67 to 1.79** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener’s index of zooplankton communities recorded to be **1.79** at ME-7 and **1.72** at ME-8. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla and Near SPM (Vadinar).
- Simpson diversity index (1-D):** During the monitoring period **2023 to 2024**, average Simpson diversity index (1-D) of zooplankton communities was ranged between **0.75 to 0.79** at all sampling stations in the Kandla creek and nearby creeks, for Vadinar average Simpson diversity index (1-D) of zooplankton communities was **0.79** at ME-7 and **0.77** at ME-8.
- Margalef’s diversity index (Species Richness):** During the monitoring period **2023 to 2024**, average margalef’s diversity index of zooplankton communities in Kandla and nearby creeks sampling stations was varying from **2.06 to 2.34**, during the sampling period. While for Vadinar, average Margalef’s diversity index (Species Richness) of zooplankton communities observed **2.2** at ME-7 and **2.16** at ME-8.
- Berger-Parker Index (d):** During the monitoring period **2023 to 2024**, average Berger-Parker Index (d) of zooplankton communities was in the range of **0.32 to 0.42** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. Average Berger-Parker Index (d) of zooplankton communities in the sampling stations of Vadinar, was in the range of **0.31 to 0.35**. All the monitoring station signifies a low diversity with an even distribution among the different species.

- The average **Species Evenness** is observed in the range of **0.61 to 0.79** for all the six-monitoring station of Kandla whereas, for the Vadinar the average species evenness was observed in the range of **0.76 to 0.82**, during the monitoring period.
- During the sampling period, **average Relative Abundance** of zooplankton communities was in range of **31.95 to 40.08** between selected sampling stations from ME-1 to ME-6. at Kandla creek and nearby creeks. Whereas for Vadinar the average relative abundance value **39.18** at ME-7 and **37.27** at ME-8, thus it can be concluded that the studied species is stated as neither highly dominant nor rare.

The details of variation in abundance and diversity in **Benthic organism** is mentioned in **Table 42**.

Table 41: Benthic Fauna variations in abundance and diversity in sub surface sampling

Genera	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khor Creek)	ME-5 (Nakti Creek- near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg
<i>Thiaridae</i>	2	1	2	2	2	2	1	3
<i>Mollusca sp.</i>	2	1	2	2	3	2	2	3
<i>Odonata sp.</i>	2	1	2	3	2	2	2	3
<i>Lymnidae</i>	2	1	5	2	2	2	3	2
<i>Planorbidae</i>	1	1	2	1	2	2	2	1
<i>Atydae</i>	2	1	2	2	1	2	2	2
<i>Gammaridae</i>	2	1	1	2	1	2	2	3
<i>Portunidae</i>	1	1	1	1	0	1	1	1
<i>Turbinidae</i>	2	1	3	1	1	2	2	2
<i>Palaemonidae</i>	1	1	2	3	3	1	2	2
<i>Diapatra sp.</i>	2	1	3	4	2	4	2	3
<i>Coleoptera sp.</i>	2	1	3	3	0	1	3	2
<i>Crustacea sp.</i>	3	1	3	3	3	3	2	1
<i>Hemiptera sp.</i>	2	1	0	2	2	2	3	2
<i>Tricoptera sp.</i>	2	1	3	4	3	5	2	1
<i>Hydrobidae</i>	1	1	1	2	1	3	0	3
<i>Viviparidae</i>	3	1	0	1	2	2	3	3
<i>Neridae</i>	2	1	2	0	4	2	1	2
Density-m³	10.18	8.82	9.64	10.09	8.5	9.73	9.73	9.55
No of genera	18	18	16	5.00	16	18	17	18

Few Benthic organisms were observed in the collected sample by using the Van-Veen grabs during the sampling conducted for DPA Kandla and Vadinar. Majority of the species were found under the Macro-benthic organisms during the sampling period were represented by *Atyde*, *Palaemonidae*, *Mollusca sp.*, etc. The average density of benthic fauna was varying from **8.55 to 10.18 m³**.

The details of Species richness Index and Diversity Index in Benthic Organisms is mentioned in **Table 43**.

Table 42: Species richness Index and Diversity Index in Benthic Organisms

Indices	ME-1 (Near Passenger Jetty One)	ME-2 (Kandla Creek)	ME-3 (Near Coal Berth)	ME-4 (Khorl Creek)	ME-5 (Nakti Creek-near Tuna Port)	ME-6 (Nakti Creek near NH - 8A)	ME-7 (Near SPM)	ME-8 (Near Vadinar Jetty)
	Avg.	Avg	Avg	Avg	Avg	Avg	Avg	Avg
Taxa S	6	7	6	6	7	6	6	6
Individuals	10	9	10	10	9	10	9	10
Shannon diversity	1.55	1.42	1.47	1.50	1.43	1.48	1.43	1.43
Simpson 1-D	0.76	0.73	0.75	0.75	0.73	0.75	0.73	0.74
Species Evenness	0.89	0.89	0.92	0.92	0.90	0.91	0.90	0.89
Margalef	1.92	1.77	1.73	1.81	1.83	1.79	1.76	1.68
Berger-Parker	0.33	0.37	0.33	0.34	0.37	0.34	0.38	0.36
Relative abundance	55.92	57.66	53.67	56.55	60.63	56.18	57.46	51.58

- Shannon- Wiener’s Index (H):** During monitoring period 2023 to 2024, Average Shanon- Wiener’s index of benthic organism was in the range of **1.42 to 1.55** between selected sampling stations from ME-1 to ME-6, at Kandla creek and its nearby creeks. While for Vadinar, average Shannon Wiener’s index of benthic organism recorded to be **1.43** at ME-7 and ME-8. The apportionment of the numbers of individuals among the species observed higher stability at all monitoring location of Kandla and Vadinar.
- Simpson diversity index (1-D):** During the monitoring period **2023 to 2024**, average Simpson diversity index (1-D) of benthic organism was ranged between **0.73 to 0.76** at all sampling stations in the Kandla creek and nearby creeks, Similarly, for Vadinar average Simpson diversity index (1-D) of benthic organism was **0.73** at ME-7 and **0.74** at ME-8.
- Margalef’s diversity index (Species Richness):** During the monitoring period **2023 to 2024**, average margalef’s diversity index of benthic organism in Kandla and nearby creeks sampling stations was varying from **1.73 to 1.92**. While for Vadinar, average Margalef’s diversity index (Species Richness) of benthic organism observed to be **1.76** at ME-7 and **1.68** at ME-8.
- Berger-Parker Index (d):** During the monitoring period **2023 to 2024**, average Berger-Parker Index (d) of benthic organism was in the range of **0.33 to 0.37** between selected sampling stations from ME-1 to ME-6, at Kandla creek and nearby creeks. average Berger-Parker Index (d) of benthic organism in the sampling stations of Vadinar, was in the range of **0.36 to 0.38**. All the monitoring station signifies a low diversity with an even distribution among the different species.



- The average **Species Evenness** is observed in the range of **0.89 to 0.92** for all the six-monitoring station of Kandla and for the Vadinar the species evenness is observed in the range of **0.89 to 0.90**.
- During the sampling period, **average Relative Abundance** of Benthic organisms was in range of **53.67 to 60.63** between selected sampling stations from ME-1 to ME-6 at Kandla creek and nearby creeks. Whereas for Vadinar the Average relative abundance value **57.46** at ME-7 and **51.58** at ME-8, thus it is concluded that the studied species can be stated as neither highly dominant nor rare.



CHAPTER 13: SUMMARY AND CONCLUSION

13.1 Summary and Conclusion

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

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

Methodology

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

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

- **Ambient Air Quality Monitoring**

Particulate matter (PM₁₀ and PM_{2.5}) levels exceeded the national ambient air quality standards (NAAQS) at most monitoring locations, especially at the coal storage area. The high particulate matter levels were attributed to heavy vehicular traffic, loading/unloading of cargo, and dust from unpaved roads. For Gaseous monitoring, sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) were generally within the NAAQS limits.

The noise level was within the permissible limits for the industrial, commercial, and residential zones for daytime and nighttime.

- **DG Stack Monitoring**

Monitoring of the diesel generator (DG) stacks was conducted at one location each in Kandla and Vadinar. Parameters like suspended particulate matter, SO₂, NO_x, CO, and CO₂ were measured and found to be within the prescribed emission limits.

- **Soil Monitoring**

The pH in Kandla varies from slightly alkaline to strongly alkaline, while the soil at Vadinar was found to be moderately alkaline. The soil texture was observed as “sandy loam” to “loamy sand” at all the monitoring locations in Kandla, and the soil texture of Vadinar varies from “loam” to “slit loam. Kandla displays higher salinity and nutrient levels, while Vadinar exhibits lower nutrient levels. Vadinar generally shows moderate conditions with higher water holding capacity and more consistent soil composition. The presence of heavy metals such as aluminium, chromium, nickel, copper, zinc, lead, arsenic, and cadmium vary considerably at both study area.

- **STP Monitoring**

After the effluent treatment in both the study areas, the treated water followed the GPCB discharge norms except for total coliform.

- **Drinking Water Quality Monitoring**

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

- **Marine Water and Sediment Quality Monitoring**

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

- **Marine Ecology Monitoring**

Monitoring of marine ecology was conducted at 6 locations in Kandla and 2 locations in Vadinar. The analysis indicates that both regions exhibit low diversity with an even distribution among species, as evidenced by the Berger-Parker Index and Simpson Diversity Index values. These indices suggest a stable ecosystem where no single species overwhelmingly dominates, nor are any species exceedingly rare. The even distribution of species, coupled with moderate levels of biomass and primary productivity, highlights the resilience of these ecosystems.

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

Annexure 1: Photographs of the Environmental Monitoring conducted at Kandla

STP Monitoring



Noise Monitoring



Soil Monitoring



Marine Monitoring



Air Monitoring



Drinking Water Monitoring



Annexure 2: Photographs of the Environmental Monitoring conducted at Vadinar



Source: GEMI



CHAPTER 14: REFERENCES



References:

- (1) National ambient air quality standards central pollution control board, 2009
- (2) Ambient Air Quality Standards in respect of Noise,2000.
- (3) American Public Health Association 23rd Addition, Standard Methods for Water and Waste water analysis, 2017.s
- (4) Indian Standard DRINKING WATER – SPECIFICATION (Second Revision), 2012.



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MARINE DEPARTMENT
(ACCOU SECTION)

Annexure C

Sub :- Annual return statement showing the collection and disposal of Hazardous and Non Hazardous Wastes carried out by various parties for the year 04/2023 to 03/2024.

With reference to the above subject, the annual return showing the collection and Disposal of Hazardous and Non Hazardous Wastes carried out by various parties for the period 01.04.2023 to 31.03.2024 of Marine department is enclosed herewith.

Encl : AS above



Dy. Conservator
Deendayal Port Authority

✓ EMC (I/C)

NO: MR/WK/1316/282

Dt. 21.06.2024

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**Deendayal Port Authority
Marine Department**

**Statement of Hazardous and Non hazardous Waste disposal from the Vessels
at Kandla Port for the Period April 2023 to March 2024 – For the Whole Port
Area**

(PCB ID 28494)

Sr.No.	Month	Year	Hazardous Waste Generation in MT			Solid Waste Generated in MT
			Total Quantity	Used Oil	Waste Residue Containing Oil	
1.	April	2023	484.45	121.11	363.34	169.57
2.	May	2023	1065.92	266.48	799.44	307.83
3.	June	2023	671.82	167.96	503.87	155.03
4.	July	2023	743.45	185.86	557.59	207.71
5.	August	2023	814.63	203.66	610.97	221.78
6.	September	2023	758.07	189.52	568.55	318.76
7.	October	2023	1002.51	250.63	751.89	144.20
8.	November	2023	982.88	245.72	737.16	198.54
9.	December	2023	802.58	200.65	601.94	254.75
10.	January	2024	825.89	206.47	619.41	207.61
11.	February	2024	549.50	137.38	412.13	200.38
12.	March	2024	1023.87	255.97	767.90	186.79
Total			9725.56	2431.39	7294.17	2572.94



Deputy Conservator
Deendayal Port Authority

Marine Department

Statement showing the Collection and disposal of Hazardous and Non-Hazardous Wastes carried out by

Name of Party	Type of Licence	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Total
1 Acid Organic Industries Limited	Hazardous	-	-	-	-	-	-	-	-	36.75	-	-	-	36.75
2 Amar Hydrocarbon Pvt Ltd	Hazardous	-	-	-	-	-	-	-	18.42	-	-	-	11.48	39.90
3 Atlas Organics Pvt Ltd	Hazardous	-	-	-	19.24	7.00	-	-	-	-	-	-	-	26.24
4 Aviation Corporation	Hazardous	9.60	18.45	23.97	-	-	-	-	-	-	-	-	-	52.02
5 Mahalaxmi Asphalt Pvt Ltd	Hazardous	102.96	-	-	138.88	-	25.21	67.34	-	73.93	50.49	14.85	43.97	517.65
6 Priyansu Corporation	Hazardous	16.25	91.36	87.35	-	-	29.89	-	35.57	67.03	-	-	-	327.45
7 Revolution Petrochem LLP	Hazardous	379.86	591.26	594.09	622.50	534.20	453.78	589.26	681.93	423.16	383.95	442.62	648.60	6,345.21
8 Shana Oil Process	Hazardous	-	-	-	-	-	-	-	-	-	-	-	-	-
9 United Shipping Company	Hazardous	-	418.14	-	-	314.16	287.07	396.04	296.10	241.83	432.74	119.51	341.01	2,846.60
10 Chitrekut Trading & Industries	Non-Hazardous	7.24	28.39	14.70	14.98	10.70	6.35	4.78	-	-	0.83	-	-	87.97
11 Golden Shipping Services	Non-Hazardous	1.03	61.82	-	56.87	43.26	77.20	36.10	23.64	75.26	42.55	37.33	49.00	504.06
12 Green Earth Manne Solutions	Non-Hazardous	18.50	37.68	4.42	18.50	27.60	5.00	-	20.34	-	3.71	6.71	-	142.46
13 Hansh A. Pandya	Non-Hazardous	12.00	7.18	1.95	-	5.02	-	6.42	-	12.59	7.29	-	-	52.45
14 K M Enterprise	Non-Hazardous	62.00	99.18	74.30	64.40	64.00	48.37	36.34	56.74	70.28	64.32	67.04	113.62	820.79
15 Naaz Shipping Services Ent	Non-Hazardous	-	-	-	7.56	-	12.40	6.35	5.47	6.35	6.36	-	-	44.49
16 New India Manne Works	Non-Hazardous	4.00	-	-	10.50	23.70	45.15	7.00	11.00	17.80	9.00	-	-	128.15
17 Omega Manne Services	Non-Hazardous	23.81	31.42	30.66	-	-	68.44	19.51	47.35	46.10	30.11	58.85	-	356.45
18 V K Enterprise	Non-Hazardous	24.00	30.00	-	15.00	18.00	18.00	18.00	15.00	15.00	15.00	9.00	-	177.00
19 Vishwa Trade-link Inc	Non-Hazardous	16.99	12.16	29.00	19.90	29.50	37.85	9.70	19.00	11.37	29.14	21.45	24.17	259.13
Hazardous - Total		508.67	1,118.21	705.41	780.62	866.36	796.97	1,052.64	1,032.02	842.71	867.18	576.98	1,075.06	10,211.83
Non-Hazardous - Total		169.57	307.83	155.03	207.71	221.78	318.76	144.20	198.54	254.75	207.61	200.38	186.79	2,572.94

Copy to : GPCB, Gandhidham / Harbour Master

Annexure D

Statement Showing the quantity of Domestic Waste Water Generation (STP – Kandla) for the period from April 2023 to March 2024

Sr. No.	Month	Average Quantity of Domestic Waste Water Generation (KLD)
1.	April 2023	225
2.	May 2023	200
3.	June 2023	210
4.	July 2023	220
5.	August 2023	230
6.	September 2023	225
7.	October 2023	230
8.	November 2023	210
9.	December 2023	235
10.	January 2024	255
11.	February 2024	230
12.	March 2024	220
Average		224.16

XEN (Road)


19/06/24
DEENDAYAL PORT AUTHORITY