DEENDAYAL PORT TRUST
(Erstwhile: KANDLA PORT TRUST)

Administrative Office Building
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EG/WK/4751/Part (3 remaining facilities-II)/149 Dated :08/02/2022

To,
The Deputy Director General of Forest (Central),
Ministry of Environment, Forests & Climate Change,
Regional Office, Western Region
Kendriya Paryavaran Bhavan
Link Road No.3,Ravi Shankar Nagar,
Bhopal- 462 016(M.P.).
Email : rowz.bpl-mef@nic.in, eccompliance-guj@gov.in

Kind Attn.: Vishwa Bandhu Meena , Scientist C, MoEF&CC,GoI,Bhopal.

Sub: Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Trust (Erstwhile : Kandla Port Trust) at Gandhidham, Kutch, Gujarat - **Environmental & CRZ Clearance – Submission of compliance report of stipulated conditions reg.**

Ref.: 1) EC & CRZ Clearance accorded by the MoEF&CC,GoI,New Delhi vide no. 10-9/2017-IA-III dated 18/2/2020.
2) Regional Office, MoEF&CC,GoI, Bhopal letter vide F.No. 6-8/2020 (ENV)/324 dated 30/05/2020 (Received by DPT on 26/06/2020).
3) DPT letter no. EG/WK/4751/Part (3 remaining facilities)/968 dated 31(13)/7(8)/2020 along with requisite details.
4) Regional Office (Integrated), Gandhinagar, MoEF&CC,GoI, Bhopal letters dated 31/8/2020 & 18/11/2020 & response thereof from DPT vide letters dated 16/9/2020 & 24/12/2020 respectively.
5) DPT letter no. EG/WK/4751/Part (3 remaining facilities-II)/42 dated 13/07/2021.

Sir,

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

In this regard, it is to state that, DPT vide above mentioned letter dated 31(13)/7(8)/2020 (Ref.3 above) had submitted details/information (including point-wise compliance of stipulated conditions & duly filled in data sheet) asked by the Regional Office (Integrated), Gandhinagar, MoEF&CC, GoI, Bhopal in connection with the EC & CRZ Clearance granted by the MoEF&CC, GoI dated 18/2/2020 for the subject mentioned above. Further, DPT vide above mentioned letters dated 16/9/2020 & 24/12/2020 (Ref. 4 above) had submitted additional details asked by the Regional Office, MoEF&CC,GoI. Subsequently, DPT vide above referred letter dated 13/7/2021 had submitted compliance report (up to period May, 2021).

.....cont.....

Now, as directed in the Regional Office (Integrated), Gandhinagar, MoEF&CC,GoI, Bhopal above mentioned letter dated 30/05/2020 (Ref. 3 above), kindly find enclosed herewith compliance report of stipulated conditions mentioned in the EC & CRZ Clearance granted by the MoEF&CC, GoI dated 18/2/2020 **(Annexure 1)** & Monitoring Report in Data Sheet **(Annexure 2)** (Period : up to November, 2021) for kind information and record please.

Further, as per the MoEF&CC, Notification S.O.5845 (E) dated 26.11.2018, which stated that "**In the said notification, in paragraph 10, in sub-paragraph (ii), for the words "hard and soft copies" the words "soft copy" shall be substituted".** Accordingly, we are submitting herewith soft copy of the compliance report in CD as well as through e-mail ID rowz.bpl-mef@nic.in, eccompliance-guj@gov.in .

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

Yours faithfully,

4/12/21

Encl.: As above

Superintending Engineer (PL) & EMC (I/c)
Deendayal Port Trust

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

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

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

3) Smt. Urvashi Upadhyay,
Environment Engineer,
Unit Head, Kachchh ,
Gujarat Pollution Control Board,
Paryavaran Bhavan,
Sector 10A, Gandhinagar- 382 010.
Email-kut-uh-gpcb@gujarat.gov.in

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

Annexure -I

Annexure I

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

CURRENT STATUS OF WORK

Sr.No.	Name of Project	Status
1	**Development of Container Terminal at Tuna off-Tekra on BOT Basis:** *(Jetty: T-shape 1100m X 54m, Capacity: 2.19 Million TEUs/Annum, Capital Dredging: 13,56,000 M3, Maintenance Dredging 271200 M3/year , Land Area req.: 84 ha, Break water: Length of 1400 m, with 20 m of height, Estimated Cost: 3097 cr.).*	The Feasibility Report has been approved by the Board of DPT in its meeting held on 19.02.2021. PPPAC memo along with Bidding documents sent to the Ministry of Ports, Shipping & Waterways, Government of India on 26.02.2021. Tariff Authority of Major Ports has approved the Tariff for the Project on 24.03.2021. The project under appraisal/approval stage by the MoPSW,GoI. **No construction activity started yet.**
2	**Providing Railway Line from NH 8A to Tuna Port.** *(Length – 11 km, Estimated cost: 94 cr.)*	DPT signed the Concession Agreement with M/s. Adani Kandla Bulk Terminal Pvt. Ltd to develop a Dry Bulk Terminal at Tuna Tekra. The commercial operation of this project has already been started by M/s Adani Kandla Bulk Terminal Pvt.Ltd. during February, 2015. The 11 km railway line is essential for operation of this Project because about 70% of the cargo (about 9.8 Million Metric Tonnes per annum out of total 14. 11 MMTPA) will be evacuated through Railway. As per the Concession Agreement, it is the obligation of KPT to provide railway connectivity to M/s. Adani Kandla Bulk Terminal Pvt. Ltd.Therefore, in order to fulfill contractual obligation, DPT taken up the project. **Work completed.**
3	**Construction of Port Craft Jetty & Shifting of SNA Section.** *(Dredging : 27357.00 m3, Estimated Cost: 23.17 cr.)*	Since the establishment of KPT, Signal and Navigational Aid (SNA) Section and Port Craft Parking Jetty have been operated from the Bunder Basin area. These structures were badly damaged in the Cyclone of 1998 and the Earthquake during 2001. This necessitated re-location of SNA Section and Port Craft Jetty from the safety point of view and also for smooth functioning of port operations. **Work completed.**

Point wise Compliance of Stipulated Conditions mentioned in the EC & CRZ Clearance dated 18/2/2020

Sr.No.	A. Specific Conditions	
I	Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.	The compliance with regard to Point no. i to iv had already been submitted by Deendayal Port Trust vide **communication no. EG/WK/4751 /Part (Remaining 3 facilities)/911 dated 3/12/2018** immediately after issuance of Minutes of the EAC (Infra.2) meeting held on 10/8/2018 (Agenda Item no. 33.4.12) vide which, the EAC (Infra.2) has recommend the subject proposal of DPT for grant of Environmental & CRZ Clearance to the MoEF&CC,GoI. However, a copy of the forwarding letter dated 3/12/2018 of DPT submitting requisite details, duly acknowledged by the MoEF&CC,GoI, Regional Office, Bhopal dated 26/12/2018 had already been forwarded along with compliance report submitted earlier . A copy of the same is once again enclosed herewith as **Annexure I** for ready reference, please.
Ii	The project proponents will submit a declaration under Oath that the Railway line will not pass through mangrove area.	
Iii	A detailed traffic management and traffic decongestion plan to ensure that the current level of service of the roads within a 05 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 05 Kms radius of the site in different scenarios of space and time and the traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D. and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.	
Iv	A detailed marine biodiversity impact assessment report and plan shall be drawn up and implemented to the satisfaction of the State Biodiversity Board and the CRZ authority. This shall be prepared through the NIOS or any other institute of repute on marine, brackish water and fresh water ecology and biodiversity. The report shall be based on a study of the impact of the project activities on the intertidal biotopes, corals and coral communities, molluscs, sea grasses, sea weeds, sub-tidal habitats, fishes, other marine and aquatic micro, macro and mega flora and fauna including benthos, plankton, turtles, birds etc. as also the productivity. The data collection and impact assessment shall be as per standards survey methods and include underwater photography.	
The project proponent shall obtain all the documents/certificate mentioned in para (i) to (iv) above and submitted/uploaded online to the Ministry's Regional Office,Bhopal before starting implementation of the project.		
V	Construction activity shall be carried out strictly according to the provisions of the CRZ	It is assured that, Construction activities will be carried outstrictly as per the provisions

	Notification, 2011. No construction work other than those permitted in Coastal Regulation Zone Notification shall be carried out in Coastal Regulation Zone area.	of the CRZ notification, 2011. Further, it is also assured that, no activity other than those permissible in Coastal Regulation Notification shall be carried out in CRZ area.
Vi	All the recommendations and conditions specified by the Gujarat Coastal Zone Management Authority who has recommended the project vide letter No. ENV-10-2015-249-E (T cell) dated 19.06.2017 shall be complied with.	The compliance report of the CRZ Recommendation issued by the GCZMA vide letter dated 29/6/2016 is attached herewith as **Annexure II.**
Vii	The project proponent shall ensure that the project is in consonance with the new CZMP prepared by the State Government under the provisions of the CRZ Notification, 2011.	The MoEF&CC, GoI accorded EC & CRZ Clearance for the subject proposal of DPT dated 18/2/2020. Project at sr.No. 2 & 3 completed. However, for project at Sr.No. 1 , implementation of the project will be carried out as per the EC & CRZ Clearance accorded by the MoEF&CC,GoI.
Viii	Notification GSR 94(E) dated 25.01.2018 of MoEF&CC regarding Mandatory Implementation of Dust Mitigation Measures for Construction and Demolition Activities for projects requiring Environmental Clearance shall be complied with.	DPT effectively implemented applicable measures for dust mitigation as under: 1) The EIA & EMP Report prepared by M/s Mantec Consultants Pvt.Ltd. was submitted to the MoEF&CC,GoI and accordingly, the MoEF&CC,GoI accorded EC & CRZ Clearance dated 18/2/2020 for 3 project activities. 2) All the vehicles carrying Construction material and waste have been covered. 3) Construction material and waste have been stored in earmarked area. DPT had already issued general circular vide dated 3/9/2019 **(Copy – Annexure III)** regarding C and D Waste Management for strict implementation in DPT. Project at sr.No. 2 & 3 completed. Further, for project at Sr.No.1, it is hereby assured that, dust mitigation measures will also be implemented by the selected BOT Operator after tendering process for the project of "Development of Container Terminal at Tuna off-Tekra on BOT Basis".
ix	The Project proponent shall ensure that no creeks or rivers are blocked due to any activities at the project site and free flow of water is maintained.	During the construction activities due care will be taken to comply with the condition stipulated.
x	No solid, semi solid cargos would be handled	**Project at Sr.No.1** i.e. Development of Container Terminal at Tuna off-Tekra on

		BOT Basis – **Containerized cargo will be handled.** **Project at Sr.no. 2** i.e. Providing Railway Line from NH 8A to Tuna Port. – **For movement of cargo in connection with the Dry Bulk Terminal at Tuna Tekra.** **Project at Sr.no.3** i.e. Construction of Port Craft Jetty & Shifting of SNA Section – **For parking of Port crafts.**
xi	Dredging shall not be carried out during the fish breeding season.	Point Noted for compliance.
xii	Dredging, etc. shall be carried out in the confined manner to reduce the impacts on marine environment including turbidity.	Point Noted for compliance.
xiii	Dredged material shall be disposed safely in the designated areas	Dredged Material shall be disposed off at designated location as identified by the CWPRS,Pune.
xiv	Shoreline should not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigationcarried out, if necessary. The details shall be submitted along with the six monthly monitoring report.	Dredging material shall be disposed off at designated location as identified by the CWPRS,Pune. DPT issued work order vide no. EG/WK/4751/Part (EC- Shoreline study) Dated: 12/10/2021 **(Copy of work order – Annexure IV)** to NCSCM, Chennai for Shoreline Change Study for Deendayal Port Trust , Kandla, Kachchh District, Gujarat, to Study the Effect of Dumping, if any reg. The work is in progress.
xv	While carrying out dredging, an independent monitoring shall be carried out by Government Agency/Institute to check the impact and necessary measures shall be taken on priority basis if any adverse impact is observed.	Point noted and will be complied with by the DPT/BOT operator to be selected for the project at Sr.no.1.
xvi	Water will be received from high service reservoir nearBhachau and Narmada Canal through pipeline of Gujarat Water supply and Sewerage Board. 5.0 KLD water will be used for various purposes during the project. Rain water harvesting shall be followed as per local byelaw and harvested water shall be stored, treated and reused to reduce the additional water requirement since Chennai is a water deficient area, besides use of water efficient appliances.	The project is to be implemented at Deendayal Port Trust, Kachchh District, Gujarat. As suggested in the condition,it is assured that, DPT will explore the possibility for Rain water harvesting for additional water requirement if any.

xvii	The concerns expressed during the public hearing held by the M/s Kandla Port Trust for development of 3 remaining integrated facilities (Stage I) within the existing Kandla Port needs to be addressed during the project implementation. These would also cover socio-economic and ecological and environmental concerns, besides commitment by the management towards employment opportunities.	Not applicable, as Public Hearing exempted.
xviii	The Marinebiodiversity impact assessment report and management plan prepared by Gujarat Institute of Desert Ecology (GUIDE), Bhuj and approved by NIO and its mitigation measures for protection of sand dune vegetation, mangroves, sea grasses, macrophytes and phytoplankton etc. as given in the EIA-EMP Report shall be complied with in letter and spirit.	It is assured that, mitigation measures suggested in the Marinebiodiversity impact assessment report and management plan prepared by Gujarat Institute of Desert Ecology (GUIDE), Bhuj, will be complied with.
xix	A continuous monitoring programme covering all the seasons on various aspects of the coastal environs need to be undertaken by a competent organization available in the State or by entrusting to the National Institutes/renowned Universities/accredited Consultant with rich experiences in marine science aspects. The monitoring should cover various physico-chemical parameters coupled with biological indices such as sand dune vegetation, mangroves, sea grasses, macrophytes and phytoplankton on a periodic basis during construction and operation phase of the project. Any deviations in the parameters shall be given adequate care with suitable measures to conserve the marine environment and its resources.	As per the stipulated condition mentioned in the EC & CRZ Clearance accorded by the MoEF&CC,GoI dated 19/12/2016 (Development of 7 Integrated Facilities), DPT had entrusted the work to M/s GUIDE,Bhuj for continuous monitoring of Marine Ecology since the year 2017 and up to 2021 and the reports in this regard are being submitted from time to time to the Regional Office, MoEF&CC,GoI,Bhopal& to the MoEF&CC,GoI, New Delhi along with six monthly compliance reports submitted. A copy of the Final report submitted by GUIDE,Bhuj for 2020-21 was communicated vide compliance report submitted vide letter **dated 13 /07 /2021.** Further, it is once again to submit here that, DPT assigned work to M/s GUIDE,Bhuj vide work order dated 3/5/2021 **(Copy – Annexure V)** for ***"Regular Monitoring of Marine Ecology in and around the Deendayal Port Trust 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, as per the requirements of EC & CRZ Clearances*** reg. (for three years (2021-2024)). The work is in progress. Inception report

		submitted by M/s GUIDE, Bhuj is attached herewith as **Annexure VI**.
xx	Continuous online monitoring of for air and water covering the total area shall be carried out and the compliance report of the same shall be submitted along with the 6 monthly compliance report to the regional office of MOEF&CC.	DPT already carried out monitoring of environmental parameters (including water pollution monitoring) through M/s Detox Corporation, Surat, since the year 2016. Latest Monitoring reports are attached herewith as **Annexure VII**. DPT already invited tender for Continuous Ambient Air Quality Monitoring System (CAAQMS) and the same is under evaluation stage.
xxi	Ambient air quality shall be maintained at prescribed levels. The existing ambient air quality stations shall have a system of reporting exceedances separately to the Pollution Control Board.	DPT already carried out monitoring of environmental parameters (including water pollution monitoring) through M/s Detox Corporation, Surat, since the year 2016. Latest Monitoring reports are attached herewith as **Annexure VII**.
xxii	The project configuration should integrate and dovetail with the State Plan and not implemented unless the state plan is prepared and dovetailing ratified.	The Gujarat Coastal Zone Management Authority had already recommended the proposal vide letter dated 29/6/2016 and based on the same, the MoEF&CC, GoI has issued EC & CRZ Clearance for the subject proposal of DPT.
xxiii	Marine ecology shall be monitored regularly also in terms of sea weeds, sea grasses, mudflats, sand dunes, fisheries, echinoderms, shrimps, turtles, corals, coastal vegetation, mangroves and other marine biodiversity components as part of the management plan. Marine ecology shall be monitored regularly also in terms of all micro, macro and megafloral and faunal componentsof marine biodiversity	As per the stipulated condition mentioned in the EC & CRZ Clearance accorded by the MoEF&CC, GoI dated 19/12/2016 (Development of 7 Integrated Facilities), DPT had entrusted the work to M/s GUIDE, Bhuj for continuous monitoring of Marine Ecology since the year 2017 and up to 2021 and the reports in this regard are being submitted from time to time to the Regional Office, MoEF&CC, GoI, Bhopal& to the MoEF&CC, GoI, New Delhi along with six monthly compliance reports submitted. A copy of the Final report submitted by GUIDE, Bhuj for 2020-21 was communicated vide earlier compliance report submitted vide letter dated 13/07/2021. Recently, DPT assigned work to M/s GUIDE, Bhuj vide work order dated 3/5/2021 **(Copy – Annexure V)** for ***"Regular Monitoring of Marine Ecology in and around the Deendayal Port Trust 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, as per***

		the requirements of EC & CRZ Clearances reg. (for three years (2021-2024)). Inception report submitted by M/s GUIDE, bhuj is attached herewith as **Annexure VI**.
xxiv	Spillage of fuel I 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 totrap the spillage.	DPT is already having Oil Spill contingency plan & accordingly, necessary precautions will be taken to prevent spillage of Fuel/Engine oil and lubricants.
xxv	The handling of Hazardous Cargo should follow the provisions of theMSIHC Rules1989 as amended. An onsite management plan shall be drawn up and integratedwith that off site management plan. This shall be to the satisfaction of the statepollution control board, the Factory Department and the District Management.	Used oil/ Waste residue containing oil has been disposed off through CPCB, GPCB authorized vendor. Further, DPT is already having Disaster management Plan **(Annexure VIII).**
xxvi	Necessary arrangements for the treatment of the effluents and solid wastes/ facilitation of reception facilities under MARPOL must be made and it must be ensured that they conform to the standards laid down by the competent authorities including the Central or State Pollution Control Board and under the Environment (Protection) Act, 1986. The provisions of Solid Waste Management Rules, 2016.E• waste Management Rules, 2016, and Plastic Waste Management Rules, 2016 shall be followed	DPT is already having STP of capacity 1.5 MLD for treatment of domestic sewage. Hazardous waste and solid waste generated are being disposed off through authorized CPCB/GPCB firms. DPT had already issued circulars vide dated 3/9/2019 **(Copies – Annexure III**) regarding Plastic Waste Management & C and D Waste Management for strict implementation in DPT. Further, DPT is in process of preparing waste management plan covering all aspects viz. Plastic Wastes, Solid waste including C&D wastes, E-wastes, Hazardous wastes including Biomedical and Non-hazardous waste in the Deendayal Port Trust Area.
xxvii	Compliance to Energy Conservation Building (ECBC-2017) shall be ensured for all the building complexes. Solar/wind or other renewable energy shall be installed to meet energy demand of 1 % equivalent.	It is assured that DPT will comply with the Energy Conservation Building (ECBC 2017) code.
xxviii	All the recommendations mentioned in the rapid risk assessment report, disaster management plan and safety guidelines shall be implemented.	The available Safety Measures implemented at Deendayal Port to overcome any unpredictable hazards are attached herewith as **Annexure VIII**. Further, It is assured that all the recommendations mentioned in the Rapid Risk Assessment Report, Disaster Management Plan & safety Guidelines will be implemented**.**

xxix	Measures should be taken to contain, control and recover the accidental spills of fuel and cargo handle.	DPT is already having in place Oil Spill Contingency Plan to meet with the any accidental spills. Accordingly, in case of any accidental spills w.r.t. these three project activities, DPT will take necessary measures.
xxx	Necessary arrangement for general safety and occupational health of people should be done in letter and spirit.	Point Noted for compliance
xxxi	KPT shall take up massive greenbelt development activities in and around Kandla and also within the KPT limits.	DPT had already taken up the Green belt Development activity through Forest Department, GoG at the cost of 352.32 lakhs (Green Belt development in DPT area in an area of 31.942 Ha.)
xxxii	All the mitigation measures submitted in the EIA report shall be prepared in a matrix format and the compliance for each mitigation plan shall be submitted to the Regional Office, MoEF&CC along with half yearly compliance report.	• CSR activities are being carried out by DPT as per the guidelines issued by the Ministry of Shipping, GoI. (**Details – Annexure IX).** • DPT appointed M/s Detox Corporation, Surat for regular monitoring of Environmental Parameters viz. Noise, Air, water etc and reports are being submitted regularly to the Regional Office as well as to the MoEF&CC,Goi,New Delhi along with compliance reports submitted. • DPT already implemented mangrove Plantation in an area of 1500 Ha. since the year 2005-06. • Due care will be taken for carrying out dredging activities and dredged material shall be disposed off at the location identified by the CWPRS. • DPT is already having Oil Spill Contingency plan to meet with any accidental spill. • DPT also implemented dust mitigation measures as per Ministry vide Notification GSR 94 (E) dated 25/1/2018.
xxxiii	As per the Ministry's Office Memorandum F.No. 22-65/2017-IA.III dated 1st May2018, an amount of Rs. 8.04 Crore (@0.25% of project Cost) shall be earmarked under Corporate Environment Responsibility (CER) for the activities such as drinking water, sanitation, health, education, skill development, roads, solar power, rain water harvesting, avenue plantation and plantation in the community areas. The activities proposed under CER shall be restricted to the affected area around the project. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half yearly compliance	As per the Guidelines issued by the Ministry of Ports, Shipping &Waterways, Government of India, the CSR activities are being carried out by the DPT **(Details attached- Annexure IX).** It is submitted that, out of total 3 projects, 2 projects viz Port Craft jetty & shifting of SNA Section and Railway Line from NH 8A to Tuna) are completed but major project of container terminal (3097 crores estimated cost) is still under appraisal/approval stage by the MoPSW, GoI & will be implemented on BOT basis by the successful BOT operator and no activities have been started yet on site. Therefore, time targeted

	report, and to the District Collector. It should be posted on the website of the project proponent.	action plan will be submitted in due course.
xxxiv	The project is recommended for grant of Environmental and CRZ Clearance subject to final outcome/legal opinion on the Order dated 22nd November, 2017 of Hon'ble NGT in the Original Application No. 424 of 2016 (Earlier O.A. No. 169 of 2015) and Original Application No. 11 of 2014 in the matter of M/s. Mehdad&Anr. Vs. Ministry of Environment, Forests & Climate Change &Ors. and ShamsunderShridharDalvi&Ors. Vs. Govt. of India &Ors.	The MoEF&CC, GoI accorded approval to the CZMP's (Kutch District). Subsequently, the MoEF&CC, GoI accorded EC & CRZ Clearance for the subject proposal of DPT dated 18/2/2020. Accordingly, implementation of the projects taken up as per the EC & CRZ Clearance accorded by the MoEF&CC,Goi.
B	**GENERAL CONDITIONS:**	
i	Appropriate measures must be taken while undertaking digging activities to avoid any likely degradation of water quality.	No digging activity involved.
ii	Full support shall be extended to the officers of this Ministry/Regional Office at Bhopal by the project proponent during inspection of the project for monitoring purposes by furnishing full details and action plan including action taken reports in respect of mitigation measures and other environmental protection activities.	It is assured that full support will be extended to the officers of this Ministry/Regional Office at Bhopal by the project proponent during inspection of the project for monitoring purposes.
iii	A six-Monthly monitoring report shall need to be submitted by the project proponents to the Regional Office of this Ministry at Bhopal regarding the implementation of the stipulated conditions	It is assured that, DPT will submit six monthly monitoring report regarding implementation of the stipulated conditions, regularly.
iv	Ministry of Environment, Forest and Climate Change or any other competent authority may stipulate any additional conditions or modify the existing ones, if necessary in the interest of environment and the same shall be complied with	Point Noted.
v	The Ministry reserves the right to revoke this clearance if any of the conditions stipulated are not complied with the satisfaction of the Ministry	----------
vi	In the event of a change in project profile or change in theimplementation agency, a fresh reference shall be made to the Ministry of Environment, Forest and Climate Change.	Point Noted for compliance.
vii	The project proponents shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.	Point Noted for compliance.
viii	A copy of this clearance lettershall also be displayed on the website of the concernedState Pollution Control Board.	--------
7	All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Forest Conservation Act,	Point Noted for compliance

	1980 and Wildlife (Protection) Act, 1972 etc. shall be obtained, as applicable by project proponents from the respective competent authorities	
8	The project proponent shall advertise in at least two local Newspapers widely circulated in the region, one of which shall be in the vernacular language informing that the project has been accorded Environmental and CRZ Clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen on the website of the Ministry of Environment, Forest and Climate Change at http://www.envfor.nic.in.The advertisement should be made within Seven days from the date of receipt of the Clearance letter and a copy of the same should be forwarded to the Regional off1ce of this Ministry at Bhopal. The Clearance letter shall also be displayed at the Regional Off1ce, District Industries Centre and Collector's Office/ Tehsildar's office for 30days.	DPT has already given advertisement in two local news papers viz.KUTCHMITRA (In Gujarati) dated 23/2/2020 and in the Indian Express (In English) dated 22/02/2020and also forwarded to the Regional Office, MoEF&CC, Bhopal vide letter dated 27/2/2020 **(Copy – Annexure X)**.
9	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, ZillaParisad/Municipal Corporation, Urban Local Body and the Local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the company by theproponent.	The EC & CRZ clearance dated 18/2/2020, has already been uploaded in the website of DPT.
10	This clearance is subject to final order of the Hon'ble Supreme Court of India in the matter of Goa Foundation Vs. Union of India in Writ Petition (Civil) No.460 of 2004 as may beapplicable to this project	Point Noted.
11	Any appeal against this clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National GreenTribunal Act, 2010.	---------
12	Status of compliance to the various stipulated environmental conditions and environmental safeguards will be uploaded by the project proponent in its website.	Point Noted for compliance.
13	The proponent shall upload the status of compliance of the stipulated Clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF&CC, therespective Zonal Officeof CPCB and the SPCB.	It is assured that, DPT will comply with the condition.
14	The project proponent shall also submit six monthly reports on the status of compliance of the stipulated Clearance conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional Office of MoEF&CC, therespective Zonal Office of CPCB and the	It is assured that, DPT will comply with the condition.

	SPCB	
15	The environmental statement for each financial year ending 31" March in Form-Vas is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status ofcompliance of Clearance conditions and shall also be sent to the respective Regional Officeof MoEF&CC by e-mail	Point Noted for compliance.
16	The above stipulations would be enforced among others under the provisions of Water (Prevention and Control of Pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981, the Environment (Protection) Act, 1986, the Public liability (Insurance) Act, 1991 and EIA Notification 1994, including the amendments and rules made thereafter	It is assured that, DPT will comply with the condition.

Annexure -I

DEENDAYAL PORT TRUST

ERSTWHILE KANDLA PORT TRUST

Administrative Office Building
Post Box NO. 50
GANDHIDHAM (Kutch).
Gujarat: 370 201.
Fax: (02836) 220050
Ph.: (02836) 233192

www.deendayalport.gov.in

EG/WK/4751/Part (Remaining 3 facilities) /911

Dated : 22/11/2018
03/12/2018

To,
Dr. TEJINDER SINGH, IFS,
Additional Principal Chief Conservator of Forests (C),
Ministry of Environment Forests & Climate change,
Regional Office (WZ),
E-5, Kendriya Paryavaran Bhawan,
E-5 Arera Colony, Link Road-3,
Ravishankar Nagar, Bhopal – 462016
Tel. No. 0755- 2465054, 2465496, 2466525
Fax No. 0755- 2302432, 2463102
Email: rowz[dot]bpl-mef[at]nic[dot]in

Sub: Development of 3 remaining integrated facilities (Stage I) within the existing Deendayal Port rust at Gandhidham, Kutch, Gujarat by Deendayal Port Trust (Erstwhile: Kandla Port Trust)- Environmental & CRZ Clearance- **Submission of Requisite Documents reg.**
(MoEF&CC,Goi Proposal No. : IA/GJ/MIS/61975/2017; F. No. 10-9/2017-IA-III)

Ref: Minutes of 33rd meeting of the Expert Appraisal Committee (Infra-2) held on 10/08/2018 (Agenda Item no. 33.4.12).

Sir,

Kindly refer to the above cited reference for the said subject.

In this regard, it is to mention here that, the Expert Appraisal Committee (Infra.2) in its meeting held on 10/08/2018 (Agenda Item no. 33.4.12) has recommended the subject proposal for grant of Environmental and CRZ Clearance subject to the submission of the certain documents (Copy of Minutes relevant pages Annexure A).

Further, in the minutes, it is also mentioned that "The project proponent shall obtain all the documents/certificate and submitted/uploaded online to the Ministry's Regional Office, Bhopal before starting implementation of the project".

Accordingly, the Point wise submission is mentioned as under: -

1) 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 Poilution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.**

Consent to Establish for the Project has already been issued by the GPCB, Gandhinagar vide letter no. PC/CCA-Kutch-1231(2)/GPCB ID 44000, dated 04.12.2017 (Copy enclosed at **Annexure B**).

26/12/18

पर्यावरण एवं वन मंत्रालय
Ministry of Environment & forest
क्षेत्रीय कार्यालय (पश्चिम क्षेत्र)
Regional Offoce (Western Reginal)
"केन्द्रिय पर्यावरण भवन",
"Kendriye Paryavaran Bhawan
लिंक रोड नं.3/ Link Road No.3
ई-5, रविशंकर नगर
E-5, Ravishankar Nagar
भोपाल/Bhopal-462016

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2) **The project proponents will submit a declaration under Oath that the Railway line will not pass through mangrove area.**

The CRZ Mapping of the projects (all three projects including Railway line) have been carried out by IRS, Anna University, Chennai (one of the MoEF&CC,GoI authorized agency) which includes demarcation of HTL/LTL, CRZ Boundary, Mangrove area & its buffer and other land use classes. Based on the said CRZ Maps, the Gujarat Coastal Zone Management Authority had issued CRZ Recommendation reg. letter dated 29/6/2016 for all three projects. Further, it is also relevant to mention here that, said CRZ Maps have also been submitted to the MoEF&CC, GoI in compliance of the observation of the EAC in its meeting held on 25/1/2018 and accordingly, the EAC recommended the proposal for grant of EC & CRZ Clearance in its meeting held on 10/8/2018. The said CRZ Maps of all three projects including railway line & CRZ recommendation letter issued by the GCZMA are enclosed herewith as **Annexure C & D**, respectively.

Further to above, it is also relevant to mention here that, as per the directions of the Gujarat Costal Zone Management Authority, DPT had undertaken study for Scientific study on preservation of existing mangrove through the renowned agency in the field i.e. M/s GUIDE, Bhuj **(Copy- Annexure E).** As per the directives, till date, DPT has undertaken mangrove plantation in an area of 1300 Ha and further 100 Ha. Mangrove plantation is in progress.

Deendayal Port Trust is equally concerned about the protection of Coastal Environment & Mangroves and would ensure , being a responsible Government Organization, that, we have abide by the extant provision of law and rules.

3) **A detailed traffic management and traffic decongestion plan to ensure that the current level of service of the roads within a 05 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 05 Kms radius of the site in different scenarios of space and time and the traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D. and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.**

It is submitted that, these three integrated facilities are expansion of existing Deendayal Port Trust. While establishing Truck parking facilities for Deendayal Port Area, the necessary traffic study has already been done (considering existing facilities and proposed facilities) through expertise agency and accordingly. M/s WAPCOS has submitted detailed report including management plan during the year Oct 2016 . As the entire area of DPT comes under the jurisdiction of DPT, there is no need to obtain validation from state urban development dept and the PWD . Further, for smooth evacuation of cargo and to avoid traffic congestion, DPT has already planned to construct RoB near Kutch salt junction, in consultation with the National Highways Authority. Necessary Environmental and CRZ Clearance for proposed RoB is expected soon from the SEIAA, Gujarat. A copy of Plan prepared by M/s WAPCOS is enclosed herewith as **Annexure F.**

4) **A detailed marine biodiversity impact assessment report and plan shall be drawn up and implemented to the satisfaction of the State Biodiversity Board and the CRZ authority. This shall be prepared through the NIOS or any other institute of repute on marine, brackish water and fresh water ecology and biodiversity. The report shall be based on a study of the impact of the project activities on the intertidal biotopes, corals and coral communities, molluscs, sea grasses, sea weeds, sub-tidal habitats, fishes, other marine and aquatic micro, macro and mega flora and fauna including benthos, plankton, turtles, birds etc. as also the productivity. The data collection and impact assessment shall be as per standards survey methods and include underwater photography.**

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A copy of report "Holistic Marine Ecological Monitoring of Deendayal Port Environment with Special Reference to Biodiversity and Preparation of Management Plan" prepared by M/s GUIDE, Bhuj (reknowned agency in the field) is enclosed herewith as **Annexure F**.

In light of the above submission, it is requested that, the above submission of Deendayal Port Trust may kindly be considered in compliance of the requirement mentioned in the minutes of the EAC (Infra.2) meeting held on 10/8/2018.

Thanking You,

Encl: As above

Yours Faithfully,

Chief Engineer
Deendayal Port Trust

Copy to :

Shri Kushal Vashist,
Director & Member Secretary (EAC-Infra.2),
Indira Paryavaran Bhavan,
Ministry of Environment, Forest and Climate Change
Jor Bagh Road, Aliganj,
New Delhi-110003.

With a request to kindly accord EC & CRZ Clearance at the earliest please.

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Annexure -II

DEENDAYAL PORT TRUST

ISO 9001:2015 & ISO 14001:2015 certified Port

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

www.deendayalport.gov.in

EG/WK/4751/Part (remaining 3 facilities)/1150 Dated 08/02/2022

The Additional Secretary & Director (Environment),
Govt. of Gujarat,
Forest & Environment Department,
Block No.14, 8th floor,
Sachivalaya,
Gandhinagar – 382 010.

Sub: CRZ Clearance for proposed for "Developing Integrated facility (Phase-I) – Remaining three facilities within the existing Kandla Port at Kandla, Dist.: Kutch by M/s Deendayal Port Trust (Erstwhile: Kandla Port Trust) – **Compliances of the stipulated conditions in CRZ Recommendations reg.**

Ref.: 1) Letter No. ENV-I0-2015-248-E (T-Cell) dated 29/6/2016 of Director (Environment) & Additional Secretary, Forest & Environment Department, GoG.
2) DPT letter no. EG/WK/4751/Part (remaining 3 facilities)/78 dated 22 (24)/12/2020 alongwith point-wise compliance report of the stipulated conditions mentioned in the CRZ Recommendation letter dated 29/6/2016.
3) DPT letter no. EG/WK/4751/Part (remaining 3 facilities)/40 Dated 13/07/2021

Sir,

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

In this connection, it is to state that, the Gujarat Coastal Zone Management Authority vide above referred letter dated 29/6/2016 had recommended remaining 3 project activities (Phase I) of Deendayal Port Trust. Subsequently, the MoEF&CC, GoI had accorded the Environmental & CRZ Clearance vide letter dated 18/2/2020. In this regard, DPT submitted compliance report vide letters dt. 22(24)/12/2020 and 13/07/2021(for period upto May, 2021) of the stipulated conditions mentioned in the CRZ Recommendation letter 29/6/2016.

Now, as directed under Specific Condition No. 28 mentioned in the CRZ Clearance letter dated 29/6/2016 i.e. ***A six-monthly report on compliance of the conditions mentioned in this letter shall have to be furnished by the DPT on a regular basis to this Department /MoEF&CC, GoI***, please find enclosed herewith compliance report (For Period upto November 2021) of stipulated conditions along with necessary annexure, for kind information & record please **(Annexure I).**

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

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

Yours faithfully,

24/2/22

Superintending Engineer (PL) & EMC (I/c)
Deendayal Port Trust

Copy to:

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

Name of Work: CRZ Clearance for proposed for Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Trust (Erstwhile : Kandla Port Trust) at Gandhidham, Kutch, Gujarat".

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

CURRENT STATUS OF WORK

Sr.No.	Name of Project	Status
1	**Development of Container Terminal at Tuna off-Tekra on BOT Basis:** *(Jetty: T-shape 1100m X 54m, Capacity: 2.19 Million TEUs/Annum, Capital Dredging: 13,56,000 M3, Maintenance Dredging 271200 M3/year , Land Area req.: 84 ha, Break water: Length of 1400 m, with 20 m of height, Estimated Cost: 3097 cr.).*	The Feasibility Report has been approved by the Board of DPT in its meeting held on 19.02.2021. PPPAC memo along with Bidding documents sent to the Ministry of Ports, Shipping & Waterways, Government of India on 26.02.2021. Tariff Authority of Major Ports has approved the Tariff for the Project on 24.03.2021. The project under appraisal/approval stage by the MoPSW,GoI. **No construction activity started yet.**
2	**Providing Railway Line from NH 8A to Tuna Port.** *(Length – 11 km, Estimated cost: 94 cr.)*	DPT signed the Concession Agreement with M/s. Adani Kandla Bulk Terminal Pvt. Ltd to develop a Dry Bulk Terminal at Tuna Tekra. The commercial operation of this project has already been started by M/s Adani Kandla Bulk Terminal Pvt.Ltd. during February, 2015. The 11 km railway line is essential for operation of this Project because about 70% of the cargo (about 9.8 Million Metric Tonnes per annum out of total 14. 11 MMTPA) will be evacuated through Railway. As per the Concession Agreement, it is the obligation of KPT to provide railway connectivity to M/s. Adani Kandla Bulk Terminal Pvt. Ltd.Therefore, in order to fulfill contractual obligation, DPT taken up the project. **Work completed.**
3	**Construction of Port Craft Jetty & Shifting of SNA Section.**	Since the establishment of KPT, Signal and Navigational Aid (SNA) Section and Port Craft Parking Jetty have been operated from the Bunder Basin area. These structures were

	(Dredging : 27357.00 m3, Estimated Cost: 23.17 cr.)	badly damaged in the Cyclone of 1998 and the Earthquake during 2001. This necessitated re-location of SNA Section and Port Craft Jetty from the safety point of view and also for smooth functioning of port operations. **Work completed.**

STATUS OF COMPLIENCE OF THE CONDITIONS STIPULATED BY GUJARAT STATE COASTAL ZONE MANAGEMENT AUTHORITY, GANDHINAGAR IN CRZ RECOMMENDATIONS LETTER.

Sr. No.	Conditions in CRZ Recommendation Letter	Compliance
	Specific Conditions	
1	The provisions of the CRZ notification of 2011 shall be strictly adhered to by the KPT. No activity in contradiction to the Provisions of the CRZ Notification shall be carried out by the KPT.	Construction activities will be carried out as per the EC & CRZ Clearance accorded by the MoEF&CC,GoI dated 18/2/2020. Further, it is also assured that, no activity other than those permissible in Coastal Regulation Notification shall be carried out in CRZ area.
2	All necessary permissions, under various laws/Rules/Notifications issued there under from different Government Departments/agencies shall be obtained by M/s KPT before commencing any enabling activities for proposed project.	DPT obtained CTE/NOC from the GPCB vide No. PC.CCA-KUTGH-1231(2)I GPCB ID 44000 dated 4/12/2017 **(Copy – Annexure A).**
3	The KPT shall have to ensure that there shall not be any damage to the existing mangrove area.	Construction activities will be carried out as per the EC & CRZ Clearance accorded by the MoEF&CC, GoI dated 18/2/2020. Further, it is also hereby assured that due care shall be taken for protection of existing mangrove area.
4	The KPT shall effectively implement the Mangrove Development, Protection & Management Plan for control of indirect impact on mangrove habitat.	Till date, DPT has undertaken mangrove plantation in an area of 1500 Ha. since the year 2005-06 through various agencies. Further, the Study on present Status, Conservation and Management Plan for Mangroves of Kandla Port region submitted by M/s GUIDE, Bhuj had already been communicated to the GCZMA & to the MoEF&CC, GoI.
5	The KPT shall have to make a provision that mangrove areas get proper flushing water and free flow of water shall not be obstructed.	The necessary arrangement had already been made in compliance of the condition. Further, it is hereby assured that, due care shall be taken in future also for compliance of the condition.
6	The KPT shall have to abide by	The GCZMA vide letter dated 29/6/2016 had

	whatever decision taken by the GCZMA for violation of CRZ Notification.	already issued CRZ Clearance reg. letter.
7	No dredging, reclamation or any other project related activities shall be carried out in the CRZ area categorized as CRZ I (i) and it shall have to be ensured that the mangrove habitats and other ecologically important and significant areas, if any, in the region are not affected due to any of the project activity.	It is hereby assured that, DPT will undertake only activities recommended by the GCZMA vide letter dated 29/6/2016 and EC & CRZ Clearance accorded by the MoEF&CC, GoI vide letter dated 18/2/2020. DPT has already prepared mangrove preservation plan for entire Kandla area.
8	The KPT shall participate financially for installing and operating the Vessel Traffic Management System in the Gulf of Kachchh and shall also take lead in preparing and operational sing and updating regularly after getting it vetted by the Indian Coast Guard.	Deendayal Port Trust had already contributed an amount of Rs. 41.25 crores i.e 25% of the total project cost of 165 crores for installing and operating the VTMS in Gulf of Kachchh.
9	The KPT shall strictly ensure that no creeks or rivers are blocked due to any activity at Kandla.	Construction activities will be carried out as per the EC & CRZ Clearance accorded by the MoEF&CC,GoI dated 18/2/2020. Further, it is hereby assured that, no creeks or rivers are blocked due to any activity at Kandla.
10	Mangrove plantation in an area of 50 ha. Shall be carried out by the KPT within 2 years in time bound manner on Gujarat coastline either within or outside the Kandla port Trust area and six monthly compliance report along with the satellite images shall be submitted to the Ministry of Environment and Forest as well as to this Department without fail.	Till date, DPT has undertaken mangrove plantation in an area of 1500 Ha. since the year 2005-06 through various agencies. Further, the Study on present Status, Conservation and Management Plan for Mangroves of Kandla Port region submitted by M/s GUIDE, Bhuj had already been communicated to the GCZMA & to the MoEF&CC, GoI.
11	No activities other than those permitted by the competent authority under the CRZ Notification shall be carried out in the CRZ area.	The construction activities will be carried out as per the EC & CRZ Clearance dated 18/2/2020 accorded by the MoEF&CC, GoI for 3 project activities. Further, it is here by assured that, only permitted activities shall be carried out in the CRZ area.
12	No ground water shall be tapped for any purpose during the proposed expansion modernization activities.	It is here by assured that, No ground water shall be tapped for water requirement.
13	All necessary permissions from different Government Departments /	The necessary Environmental & CRZ Clearance had already been obtained by DPT for 3 project

	agencies shall be obtained by the KPT before commencing the expansion activities.	activities dated 18/2/2020. Further, Consent to Establish from GPCB had already been obtained from GPCB for these 3 project activities.
14	No effluent or sewage shall be discharged into sea/creek or in the CRZ area and it shall be treated to conform to the norms prescribed by the GPCB and would be reused /recycled within the plant premises.	DPT is already having Sewage Treatment Plant of capacity 1.5 MLD for treatment of domestic sewage. Further, BOT Operator will also provide necessary arrangement for sewage treatment facility.
15	All the recommendations and suggestion given by the Mantec Consultants Pvt.Ltd. in their Comprehensive Environment Impact Assessment report for conservation / protection and betterment of environment shall be implemented strictly by the KPT.	It is assured that, DPT will strictly follow the recommendations and suggestion given by the Mantec Consultants Pvt. Ltd. in their Comprehensive Environment Impact Assessment report for conservation / protection and betterment of environment.
16	The construction and operational activities shall be carried out in such a way that there is no negative impact on mangroves and other coastal /marine habitats. The construction activities and dredging shall be carried out only under the constant supervision and guidelines of the Institute of National repute like NIOT.	It is hereby assured that, due care shall be taken for carrying out construction activities/operational activities, so that; there is no negative impact on mangroves and other coastal /marine habitats. Further, the dredging material shall be disposed off at the site identified by the CWPRS, Pune.
17	The KPT shall contribute financially for any common study or project that may be proposed by this Department for environmental management / conservation / improvement for the Gulf of Kutch.	Point noted. It is hereby assured that DPT will contribute financially for any common study or project that may be proposed by your Department for environmental management / conservation / improvement for the Gulf of Kutch.
18	The construction debris and / or any other of waste shall not be disposed of into the sea, creek or the CRZ areas. The debris shall be removed from the construction site immediately after the construction is over.	It is here by assured that, the debris shall not be disposed of into the sea, creek or the CRZ area & shall be removed immediately after the construction work is over.
19	The construction camps shall be located outside the CRZ area and the construction labour shall be provided with the necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by the construction labours.	It is hereby assured that, Construction camps with necessary amenities shall be located in the already nearby developed areas. Further, due care shall be taken so that the environmental conditions are not deteriorated by the construction labours.

20	The KPT shall regularly updates its Local Oil Spill Contingency and Disaster management Plan in accordance with the National Oil Spill and Disaster Contingency Plan and shall submit the same to the MoEF,GoI and this department after having it vetted through the Indian Coast Guard.	Point noted. ▪ Deendayal Port is already having updated Disaster Management Plan **(Copy – Annexure B).** ▪ Further, Local Oil Spill Contingency Plan already available with Deendayal Port Trust. ▪ DPT has also executed MOU with Oil Companies i.e. IOCL, HPCL, BPCL etc. for Setting up of Tier I facility for combating Oil Spill at Kandla
21	The KPT shall bear the cost of the external agency that may be appointed by this Department for supervision / monitoring of proposed activities and the environmental impacts of the proposed activities.	Agreed with the condition.
22	The KPT shall take up massive greenbelt development activities in and around Kandla and also within the KPT limits.	*DPT* have planted about one lakhs trees in road side dividers, colony areas at Kandla and Gopalpuri, in green belt area of Gandhidham & Adipur Township, Sewage Treatment Plants at Gopalpuri & Kandla and some green belt development plans initiated at different locations in Town ship areas. DPT entrusted work of green belt development in and around Port area to the Forest Department, Gujarat at a cost of Rs. 352 lakhs (Area 32 hectares) and the work is completed.
23	The KPT shall have to contribute financially for talking up the socio-economic upliftment activities in this region in construction with the Forest and Environment Department and the District Collector/District Development Officer.	Already CSR works are being attended by DPT. The details of CSR activities undertaken/to be undertaken by DPT is placed at **Annexure C.**
24	A separate budget shall be earmarked for environmental management and socioeconomic activities and details there of shall be furnished to this Department as well as the MoEF, GOI. The details with respect to the expenditure from this budget head shall also be furnished.	DPT has already kept Rs. 266 lakhs in B.E. 2021-22 under the scheme "Environmental Services & Clearance thereof".
25	A separate environmental management cell with qualified personnel shall be created for environmental monitoring and management during construction and operational phases of the project.	DPT is already having Environment Management cell. Further, DPT has also appointed expert agency for providing Environmental Experts from time to time. The process for appointing firm for providing experts is in progress.

		Further, DPT appointed M/s Detox Corporation, Surat for Environmental Monitoring & Management.
26	An Environmental reports indicating the changes, if any, with respect to the baseline environmental quality in the coastal and marine environment shall be submitted every year by the KPT to this Department as well as to the MoEF&CC,GOI.	Agreed with the condition. Further, DPT appointed M/s Detox Corporation, Surat for Environmental Monitoring & Management. A copy of monitoring report is attached herewith as **Annexure D.**
27	The KPT shall have to contribute financially to support the National Green Corps Scheme being implemented in Gujarat by the GEER Foundation, Gandhinagar, in construction with Forests and Environment Department.	Agreed with the condition.
28	A six monthly reports on compliance of the conditions mentioned in this letter shall have to be furnished by the KPT on regular basis to this department/MoEF, GOI.	Point Noted. DPT will submit regularly six monthly compliance report of the stipulated conditions. Last Compliance submitted vide letter dated 13/07/2021
29	Any other condition that may be stipulated by this department from time to time for environmental protection/management purpose shall also have to be complied with by the KPT.	Agreed with the condition.

Annexure -III

Annexure B
199

DEENDAYAL PORT TRUST

Office of the Chief Engineer
A.O. Building,
Gandhidham (Kutch)

No.EG/WK/4751/Part 243(B)

Dated : 03/09/2019

CIRCULAR

The Ministry of Environment, Forest & Climate Change, GoI vide G.S.R. 317 (E) dated 29/3/2016 had issued Notification to address in detail the management of Construction & Demolition Waste. In order to implement the said rules issued by the MoEF&CC,GoI in the Deendayal Port Trust, following instructions may kindly be followed:

- Proper management of Construction & demolition waste in accordance with the provisions of Construction and Demolition of Waste Management Rules, 2016.
- Records of generation and disposal of the waste is required to be maintained by the contractor/Lessees at source.
- All trucks before leaving the storage yards shall be covered with tarpaulin and not over loaded as well as there shall not be spillage during transportation.
- Appropriate containers shall be placed for collection of waste, removal at regular intervals, transportation to appropriate sites for processing and disposal.

This is issued with the approval of Competent Authority in DPT.

Chief Engineer
Deendayal Port Trust

1. All HoD's – For information and necessary action
2. Sr. PS to Chairman – For kind information of Chairman
3. PS to Dy. Chairman – For kind information of Dy. Chairman

Annexure -IV

DEENDAYAL PORT TRUST

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Gujarat: 370 201.
Fax: (02836) 220050
Ph.:(02836)220038

www.deendayalport.gov.in

EG/WK/4751/Part (EC- Shoreline study)/98 Dated: 12/10/2021

To,
The Director,
National Centre for Sustainable Coastal Management,
(Ministry of Environment, Forest & Climate Change),
Anna University Campus,
Chennai – 600025, Tamil Nadu, India.
Phone : 044-22200600/22200900 & Fax: 044- 22200700.

Sub : Shoreline Change Study for Deendayal Port Trust , Kandla, Kachchh District, Gujarat, to Study the Effect of Dumping, if any reg.

Ref.: 1) DPT request letter vide no. EG/WK/4751/Part (EC-Shoreline Study)/65 dated 16 (17)/8/2021.
2) Offer submitted by the NCSCM,Chennai vide no. NCSCM/CZM/Gujarat/21-0254/EDC dated 8/9/2021.

Sir,

Your offer for the subject work as per reference at (2) above amounting to Rs. 13,29,860.00 inclusive of 18% GST (Rupees Thirteen lakh twenty nine thousand eight hundred sixty only), has been accepted, with following terms & conditions:-

1. Scope of work : Shoreline Change study (during the period 2009-2021) for Deendayal Port Trust, Kandla, to study the effect of dumping, if any (three dumping locations), in compliance of stipulated conditions mentioned in the EC & CRZ Clearance granted by the MoEF&CC,GoI to the various projects of DPT (Ref.: specific condition no. iv of EC dated 19/12/2016, specific condition no. ix of EC dated 19/2/2020, specific condition no. xiv of EC dated 18/2/2020 & standard conditions, VI, subpara II of EC dated 20/11/2020).

2. Obligation of DPT :

- Dates of dumping and the quantities of material, at three dumping sites.
- Other secondary data available, as required for the studies.

3. Deliverables : Hard copies and pdf copies of Shoreline Change Maps on 1:10000 scale, for the entire shoreline covering all the 3 locations of dumping, depicting the erosion, accreditation and other categories as mentioned in the table 2 of Annexure 1 of the offer submitted by NCSCM,Chennai dated 8/9/2021.

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4. Time Period : Total duration 6 months from: **1**. Date of advance payment to NCSCM, Chennai amounting to Rs.13,29,860.00 (inclusive of 18% GST) AND **2**. Date of providing information to NCSCM as per para 2 above.

5. The terms of payment : Advance payment of Rs.13,29,860.00 (including 18 % GST). Payment shall be made through RTGS/NEFT.

6. Kindly send the acknowledgement of this work order.

Thanking you.

Yours faithfully,

12/10/21

Superintending Engineer (PL) & EMC (I/c)
Deendayal Port Trust

Annexure -V

DEENDAYAL PORT TRUST
(Erstwhile: KANDLA PORT TRUST)

Administrative Office Building
Post Box NO. 50
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Fax: (02836) 220050
Ph.: (02836) 220038

www.deendayalport.gov.in

NO.EG/WK/4751/Part (Marine Ecology Monitoring)/11 Dated : 3/5/2021

M/S 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 Trust 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, as per the requirements of EC & CRZ Clearances accorded by the MoEF&CC,GoI to the various projects of the Deendayal Port Trust (for three years (2021-2024)) reg.

Ref.: 1) DPT request vide email dated 10/4/2021.
2) M/s GUIDE,Bhuj letter no. GUIDE/DPT/Offer/Mar. Ecol. & Cont. Monit. Prog./18 /2021-22 dated 16/4/2021.

Sir,

Your offer for the subject work submitted vide above referred letter dated 16/4/2021 amounting to Rs. 1,41,57,000.00 + 18% GST (for three years i.e. 2021-2024) - per year cost Rs.47,19,000.00) (Rupees One crore forty one lakh and fifty seven thousand only plus eighteen percent GST) including all terms & conditions mentioned in the offer letter, has been accepted.

..... cont.....

2. The terms of payment:

For the period (2021-22) (Monitoring Period 24/5/2021 to 23/5/2022):

1) 20% of the project budget (Rs.47,19,000.00 /year) should be paid within 15 days from the date of submission of Inception report by GUIDE.
2) 20% of the project budget (Rs.47,19,000.00 /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.47,19,000.00 /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.47,19,000.00 /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.47,19,000.00 /year) should be paid within 15 days from the date of submission of Final report by GUIDE.

For the period (2022-23) (Monitoring Period 24/5/2022 to 23/5/2023):

1) 20% of the project budget (Rs.47,19,000.00 /year) should be paid within 15 days from the date of submission of Inception report by GUIDE.
2) 20% of the project budget (Rs.47,19,000.00 /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.47,19,000.00 /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.47,19,000.00 /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.47,19,000.00 /year) should be paid within 15 days from the date of submission of Final report by GUIDE.

For the period (2023-24) (Monitoring Period 24/5/2023 to 23/5/2024) :

1) 20% of the project budget (Rs.47,19,000.00 /year) should be paid within 15 days from the date of submission of Inception report by GUIDE.
2) 20% of the project budget (Rs.47,19,000.00 /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.47,19,000.00 /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.47,19,000.00 /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.47,19,000.00 /year) should be paid within 15 days from the date of submission of Final report by GUIDE.

.....Cont.....

3. Scope of work :

1) Regular Monitoring of Marine Ecology in terms of sea weeds, sea grasses, mudflats, sand dunes, fisheries, echinoderms, shrimps, turtles, corals, coastal vegetation, mangroves and other marine biodiversity components as part of the management plan. Marine ecology shall be monitored regularly also in terms of all micro, macro and mega floral and faunal components of marine biodiversity.

   Ref.: (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).**

2) A continuous monitoring programme covering all the seasons on various aspects of the coastal environs need to be undertaken. The monitoring should cover various physico-chemical parameters coupled with biological indices such as sand dune vegetation, mangroves, sea grasses, macrophytes and phytoplankton on a periodic basis during construction and operation phase of the project. Additionally primary productivity will also be carried out. Any deviations in the parameters shall be given adequate care with suitable measures to conserve the marine environment and its resources.

   Ref.: (i) EC & CRZ Clearance granted by the MoEF&CC,GoI dated dated 18/2/2020 – Dev. Remaining 3 integrated facilities - **Specific Condition xix.**
   (ii) EC & CRZ Clearance granted by the MoEF&CC,GoI dated dated 19/2/2020 – Dev. Integrated facilities (Stage II- 5 projects) - **Specific Condition xiv.**

4. Obligation of KPT :

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

5. Time Period : Three years i.e. 2021-24 (per year three monitoring all three seasons).

.....Cont.....

6. Kindly send the acknowledgement of this work order & start the work w.e.f. 24/5/2021.

Thanking you.

Yours faithfully,

Superintending Engineer (PL)& EMC (i/c)
Deendayal Port Trust

Annexure -VI

INCEPTION REPORT

For the project entitled

Regular Monitoring of Marine Ecology in and around the Deendayal Port Trust and Continuous Monitoring Programme

DPT work Order: WK/4751/Part/ (Marine Ecology Monitoring)/11

Submitted to

DEENDAYL PORT TRUST

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

JULY 2021

Project Team

Project Co-coordinator: Dr. V. Vijay Kumar, Director

S. No	Name of the expert	Designation	Area of specialization
1.	Dr. K. Prabhu, Ph.D.	Project Scientist	Mangrove Ecology and associated fauna. Mangrove carbon sequestration
2.	Dr. L. Prabha Devi, Ph.D.	Advisor	Planktonology
3.	Dr. Durga Prasad Behera, Ph.D.	Project Scientist	Marine ecology, Macrofauna diversity
4.	Dr. Nikunj B. Gajera, Ph.D.	Scientist	Avifauna
5.	Dr. S. Sivaraj, Ph.D.	Project Scientist	Marine Benthic Ecology
6.	Mr. Dayesh Parmar, M.Sc.,	Scientific Officer	GIS & Remote sensing

1. INTRODUCTION

Deendayal Port in Kachchh District of Gujarat operated by Deendayal Port Trust (DPT) is a gateway Port to the hinterland in western and northern states of India. Around 95% of India's trading by volume and 70% by value is carried out through maritime transport with a major share contributed by DPT. It is one of the 12 major ports of India situated at latitude 23° 1' N and longitude 70° 13' E on Kandla creek at the inner end of Gulf of Kachchh (GoK), Gujarat. Since its formation in the 1950s, the Deendayal Port caters the maritime trade requirements of states such as Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana and Gujarat. Because of its proximity to the Gulf countries, large quantities of crude petroleum are imported through this port. About 35% of the country's total export takes place through the ports of Gujarat in which the Deendayal port has a considerable contribution.

An assortment of liquid and dry cargo is being handled at DPT Port. The dry cargo includes fertilizers, iron and steel, food grains, metal products, ores, cement, coal, machinery, sugar, wooden logs, etc. The liquid cargo includes edible oil, crude oil and other petroleum products. Cargo handling has increased from 41.55 million tons to 117.5 MMT during 2020-2021. Presently, the Port has total 1-16 dry cargo berths for handling dry cargo, 6 oil jetties, one barge jetty at Bunder basin, dry bulk terminal at Tuna Tekra, barge jetty at Tuna and two SPMs at Vadinar for handling oil. Regular expansion or developmental activities such as the addition of jetties, allied SIPC and ship bunkering facilities are underway in order to cope with the increasing cargo handling demand in the recent times.

A developmental initiative of this magnitude is going on since the past 7 decades, which will have its own environmental repercussions. Being located at the inner end of Gulf of Kachchh, Deendayal Port encompasses a number of fragile marine ecosystems that includes a vast expanse of mangroves, mudflats, creek systems and associated biota. Deendayal Port is a natural harbor located on the eastern bank of North-South trending Kandla creek at an aerial distance of 90 km from the mouth of 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. Coastal belt in and around the port has an irregular and dissected configuration. Due to its location at the inner end of 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. Commensurate with the increasing tidal amplitude, vast intertidal expanse are present in and around the port environment. Thus the occurrences of mudflats on the intertidal zone enable mangrove formation to extent to a wide area. Contrary to the southern coast of Gulf of Kachchh, coral formations, seaweed and seagrass beds are absent due to high turbulence induced suspended sediment load in the water column, a factor again induced due to the conical Gulf geomorphology and surging tides towards its inner end.

1.1. Rationale of the present study

As part of its ongoing developmental activities, DPT authorities intend to develop seven (7) integrated facilities which include development of oil jetty and ship bunkering terminal at old Kandla, a multi-purpose oil terminal near Tuna, up-gradation of barge handling facility at Kandla, construction of one rail over bridge and strengthening of existing oil jetties. While according environmental clearance to these developmental initiatives, MoEF & CC, among other conditions, stipulated the following: ***"Marine Ecology shall be monitored Regularly also in terms of Seaweeds, Sea grasses, Mudflats, Fisheries, Echinoderms, Shrimps, Turtles, Corals, Coastal vegetation, Mangroves and other Biodiversity components as a part of the management plan. Marine ecology shall be monitored regularly also in terms of all Micro, Macro and Mega floral and faunal components of marine biodiversity".***

In accordance with MoEF & CC directive, DPT has assigned the task of carrying out a holistic marine ecological monitoring study to Gujarat Institute of Desert Ecology (GUIDE), Bhuj during May 2018-21. Further, marine ecological components should be studied regularly as specified by the Ministry, DPT authorities approached GUIDE to continue the study for another three years, i.e. 2021 – 2024. The present study is designed considering the scope of work given in the EC conditions.

1.2. Scope of the Work

The scope of the present investigation includes different physcio-chemical and marine biological components as mentioned in the stipulations of MoEF & CC EC & CRZ clearance dated 18th and

19th February 2020 with specific conditions xxiii, xv, iv, xix and xiv respectively. A detailed holistic approach to different components of marine physico-chemical parameters of water and soil and marine biodiversity within the Deendayal Port area will be carried out. Based on the results obtained during the project period, a detailed management plan will be drawn at the end of the project period. The biological and physico-chemical variables will be investigated during the present study on seasonal basis i.e. monsoon, post monsoon and pre-monsoon as follows:

- Physico-chemical characteristics of water and sediment /soil.
- Detailed assessment of mangrove vegetation structure including density, diversity, height, canopy and other vegetation characteristics.
- GIS and RS studies to assess different ecological sensitive land use and land cover categories within the Port area such as the extent of dense and sparse mangroves, mudflats, creek systems and other land cover categories within the port limits.
- Quantitative and qualitative assessment of the intertidal fauna, composition, distribution, diversity, density and other characteristics.
- Data collection on the species composition, distribution, diversity and density of sub-tidal benthic fauna.
- Estimation of Plankton and productivity at the selected sampling sites located in around DPT area.
- Investigate the species composition, distribution, density and diversity of phytoplankton and zooplankton.
- Recording the occurrence, distribution and diversity distribution of halophytes, sea grasses, seaweeds and other coastal flora.
- Investigations on the Avifaunal Density, diversity, composition, habitat, threatened and endangered species and characters.
- Fishery Resources - Common fishes available, composition, diversity, Catch Per Unit Effort (CPUE) and other socio-economic information.

This study in short attempts the following, i). Developing a strong baseline of the port marine environment from the biological perspective which could be used to monitor changes in the future, and ii) formulating a management plan based on the baseline data in order to ensure long-

term ecological health of the port environment. A better understanding of the marine ecology of the port and its processes will be attempted in this study which will assist in formulating better management and conservation decisions to promote marine environmental health within the port limits.

1.3. Study Area

The coastal belt in and around DPT 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 forms the major land components. 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 the west and north and creek system, mangrove formations and mudflats in the east and south. The nearest major habitation is Gandhidham town about 12 km west with a population of 2, 48,705 (as per 2011 census).

Table 1. Sampling locations (2021-2024)

Locations	GPS coordination	
	Latitude	Longitude
S1	22.9410	70.1358
S2	22.9616	70.1244
S3	22.9876	70.2345
S4	23.0285	70.2331
S5	23.0804	70.2245
S6	23.1622	70.3951
S7	22.9771	70.2125
S8	23.0378	70.4070
S9	22.9960	70.3932
S10	23.1007	70.2961
S11	23.1608	70.4948
S12	22.9446	70.1062
S13	22.9067	70.0002
S14	22.8959	70.0745
S15	23.0654	70.2172

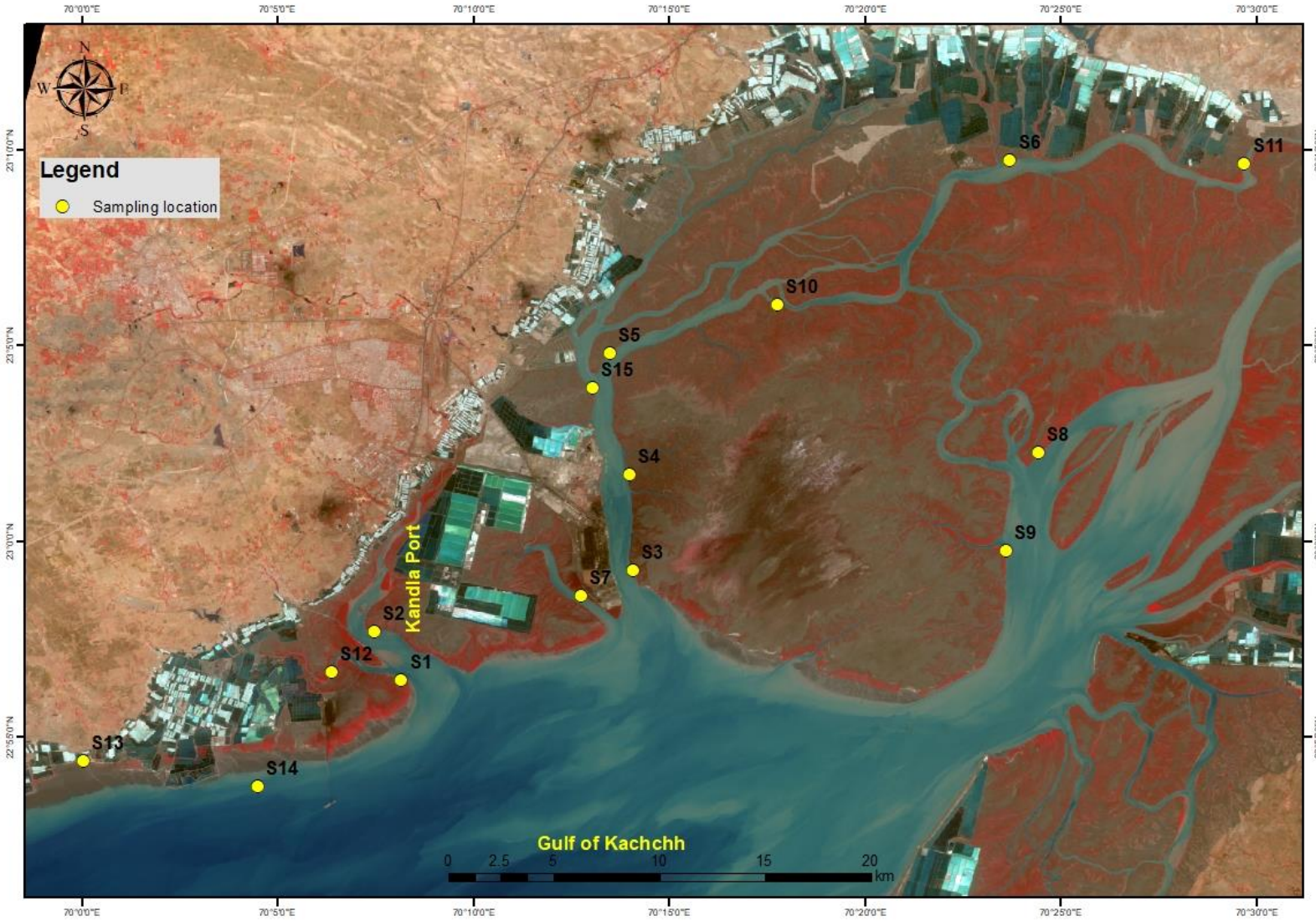

Fig.1. Map showing the proposed sampling locations for the period 2021-2024

2. Sampling Parameters

Samplings will be carried out for the surface water and sediment for the determination of physical and chemical characteristics of coastal water from the prefixed sampling sites. The biological parameters (benthic and pelagic fauna & flora, productivity) will also be included. The following table shows the parameters planned to be undertaken.

Table 2: Parameters to be study

<table>
<tr><th colspan="3">Parameters</th></tr>
<tr><th>Water Quality</th><th>Mangrove</th><th>Intertidal fauna</th></tr>
<tr><td>• pH
• Temperature
• Salinity (ppt)
• Petroleum Hydrocarbon-PHc
• Dissolved oxygen
• Total Suspended Solids (TSS)
• Total Dissolved solids (TDS)</td><td rowspan="8">Mangrove- vegetation structure including density, diversity, height, canopy and other vegetation characteristics.

Halophytes: occurrence, distribution and diversity

Sea grasses and Seaweeds: occurrence, distribution, and diversity.</td><td rowspan="8">Intertidal faun: composition, distribution, diversity, density and other characteristics.

Avifauna: Density, diversity, composition, habitat, threatened and endangered species and characters</td></tr>
<tr><td>Nutrients</td></tr>
<tr><td>• Nitrate (NO_3)
• Nitrite (NO_2)
• Total Phosphorus
• Silicate
• Ammonia (NH_4)
• Total Nitrogen</td></tr>
<tr><td>Sediment Quality</td></tr>
<tr><td>• Texture
• Total organic carbon (TOC)
• Total Nitrogen
• Total Phosphorus
• Petroleum Hydrocarbon-PHc</td></tr>
<tr><td>Biological Parameters</td></tr>
<tr><td>• Phytoplankton – Species, abundance, diversity and biomass
• Productivity-Chlorophyll a
• Zooplankton – Species, abundance, diversity and biomass
• Macrobenthos - Species, abundance, diversity
• Fishery Resources - Common fishes available, composition, diversity, Catch Per Unit Effort (CPUE)</td></tr>
</table>

3. Working Methodology

3.1. Water Quality

The water samples will be collected from each pre-designated sites in pre-cleaned polyethylene bottles. Prior to sampling, the bottles will be rinsed with samples to be collected. The collected samples will be stored in an ice box and transferred to laboratory and refrigerated at 4°C till further analysis. The analysis of the water quality parameters will be carried out by following standard methods (APHA, 2017). All extracting reagents will be prepared using metal-free, AnalaR grade chemicals (Qualigens Fine Chemicals Division of Glaxo SmithKline Pharmaceuticals Limited, Mumbai) and double distilled water prepared from quartz double distillation assembly.

3.1.1. **Temperature:** Temperature will be recorded using a mercury thermometer with an accuracy of ± 0.1°C.

3.1.2. **pH:** pH will be measured on a microprocessor controlled pH analyzer. The instrument will be calibrated with standard buffers before use.

3.1.3. **Suspended Solids (SS):** A known volume of water will be filtered through a pre-weighed 0.45 micron membrane filter paper (Millipore), dried and weighed again.

3.1.4. **Turbidity:** Turbidity will be measured in a calibrated Nephelometer (Hanna make) and the results will be expressed in Nephelometer Turbidity Unit (NTU).

3.1.5. **Salinity:** A suitable volume of the sample will be titrated against Silver nitrate (25g/l) with Potassium chromate as indicator. Standardization of Silver nitrate will be done using standard seawater (IAPSO, OSIL, UK).

3.1.6. **Dissolved oxygen (DO):** DO will be determined by Winkler's method.

3.1.7. **Phosphate:** Acidified Molybdate reagent will be added to the sample to yield a phosphomolybdate complex that will be reduced with Ascorbic acid to a highly coloured blue compound, which is measured at the wavelength of 690 nm in Spectrophotometer (Shimadzu UV 5040).

3.1.8. **Total phosphorus:** Phosphorus compounds in the sample will be oxidized to phosphate with alkaline Potassium per sulphate at high temperature and pressure. The resulting phosphate will be analysed and described as total phosphorous.

3.1.9. **Nitrite:** Nitrite in water sample will be allowed to react with Sulphanilamide in acid

solution. The resulting diazo compound will be reacted with N-1-Naphthyl ethylenediamine dihydrochloride to form a highly coloured azo-dye. The light absorbance will be measured at the wavelength of 543 nm in Spectrophotometer (Shimatzu UV 5040).

3.1.10. **Nitrate:** Nitrate will be determined as nitrite (as mentioned above) after its reduction by passing the sample through a column packed with amalgamated Cadmium.

3.1.11. **Ammonia:** Ammonium compounds (NH_3^+ NH_4^+) in water will be reacted with Phenol in the presence of hypochlorite to give a blue colour of indophenol. The absorbance will be measured at the wavelength of 630 nm.

3.1.12. **Total nitrogen:** Nitrogen compounds in the sample will be oxidized to nitrate by autoclaving with alkaline per sulphate. The solution will be neutralized and nitrate will be estimated and described as total Nitrogen.

3.1.13. **Petroleum Hydrocarbons (PHC):** Water sample (2.5 l) will be extracted with hexane and the organic layer will be separated, dried over anhydrous Sodium sulphate and reduced to 10 ml at 30^{o}C under low pressure. Fluorescence of the extract will be measured at 360 nm (excitation at 310 nm) with Saudi Arabian crude residue as a standard. The residue will be obtained by evaporating lighter fractions of the crude oil at 100°C.

6. Sediment Quality

Sediment analyses will be carried out using standard methodologies. Sediment samples will be collected in prefixed stations by using a Van Veen grab or by a non-metallic plastic spatula. In each location (grid), sediment samples will be collected from three different locations and will be pooled together to make a composite sample, representative of a particular site. The collected samples will be air dried and used for further analysis.

6.1. Sediment Texture

For texture analysis, specified unit of sediment samples will be sieved using sieves of different mesh size as per Unified Soil Classification System (USCS). Cumulative weight retained in each sieve will be calculated starting from the largest sieve size and adding subsequent sediment weights from the smaller size sieves. The percentage of the various fractions will be calculated

from the weight retained and the total weight of the sample. The cumulative percentage will be calculated by sequentially subtracting percent retained from 100%.

6.2. Total Phosphorus

The phosphate in sediment solution reacts with Ammonium molybdate and form Molybido phosphoric acid, which gets reduced to a complex of blue colour in the presence of stannous chloride. The absorption of light by this solution will be measured at 690nm to calculate the phosphate concentration.

6.3. Total Nitrogen

Total Nitrogen present in the sediment samples will be measured following the Kjeldahl Method.

6.4. Organic carbon

Percentage of organic carbon in the dry sediment will be determined by oxidizing the organic matter in the sample by Chromic acid and estimating the excess Chromic acid by titrating against ferrous ammonium sulphate with Ferroin as an indicator (Walkley and Black, 1934).

6.5. Petroleum Hydrocarbon-PHc

For estimating Petroleum hydrocarbon (PHc) in sediment, the sample will be reflexed with KOH-Methanol mixture and extracted with Hexane. After removal of excess Hexane, the residue will be subjected to silica gel chromatography and PHC and the florescence will be estimated at 360 nm (APHA, 2017).

7. Mangrove assessment

A total of fifteen (15) sites will be primarily considered, which will be widely distributed and covered the entire DPT jurisdiction. The mangrove sites will be named Tuna, Jangi, Kandla, Phan, Vira coast and Navlakhi based on their closeness to the respective creek system. The vegetation structural attributes of all the mangrove stands will be accounted based on Point Centered Quadrate Method (PCQM) or quadrate or transect. The methodology and measurement accuracy of Cintron and Novelli (1984) will be adopted to study both measurements of density, height variations and basal area at each stand. A transect of around 200 m (maximum) will be laid out either perpendicular or parallel to the creek and sampling points at an interval of 10 m will be fixed to record the vegetation structure of the stand. Along the transects, sub-plots of 1×1

m^2 and 2×2 m^2 will be laid randomly to enumerate regeneration and recruitment class, respectively. Seedlings with a height of <50 cm will be considered as regeneration class, while recruitment class will be well-established saplings >50cm in height.

8. Intertidal Fauna, Marine Mammals and Reptiles: Sample collection and assessment of intertidal communities will be done in the intertidal zone during the low tide period. At each site, 1 m^2 quadrates will be placed randomly and all visible macro-faunal organisms encountered inside the quadrate will be identified, counted and recorded. At each site along the transects which run perpendicular to the waterfront, three to six replicate quadrate samples will be assessed for the variability in macro-faunal population structure and the density will be averaged for the entire intertidal belt. Unidentified species will be preserved in 5% formaldehyde, and later identified using standard identification keys (Abott, 1954; Chapgar, 1957; Apte, 1998). The mean density will be calculated as No/m^2.

9. Subtidal Macro Benthic Fauna: For studying the benthic organisms, triplicate samples will be collected at each station using Van Veen grab having an area of 0.04m^2. The wet sediment will be passed through a sieve of mesh size 0.5 mm for segregating the organisms. The organisms retained in the sieve will be fixed in 5-7% Formalin and stained further with Rose Bengal solution for the ease of spotting at the time of sorting. The number of organisms in each grab sample will be expressed as No./m^2. All the species will be sorted, enumerated and identified by following available literature. The works of Fauvel (1953), and Day (1967) will be referred for polychaetes; Barnes (1980) and Lyla *et al*. (1999) for crustaceans; Subba Rao *et al.* (1991) and Ramakrishna (2003) for molluscs. Further, the data will be treated with Univariate statistical methods in PRIMER (Ver. 6.) statistical software (Clark & Warwick, 2001) for the determination of various diversity indices.

10. Phytoplankton and Zooplankton: Plankton samples will be collected from prefixed 15 sampling sites from the coastal water in and around DPT location. Plankton samples will be collected using standard plankton net with a mesh size of 51µm and 200µm and a mouth area of 0.1256 m^2 (20 cm radius). The net fitted with a flow meter (Hydrobios) will be towed from a motorized boat at 2 nautical miles/hr. Plankton adhering to the net will be concentrated in the net bucket by splashing seawater. The plankton retained will be transferred to a pre-cleaned and rinsed container and preserved with 5% neutralized formaldehyde and appropriately labelled

indicating the details of the collection and transferred to the laboratory for further analysis.

The Quantitative analysis of phytoplankton (cell count) and zooplankton (No/l) will be carried out using a Sedge wick-Rafter counting chamber.

The density (No/l) will be calculated using the formula: $N=n\times v/V$

(Where, N is the total No/liter, n is average no of cells in 1 ml, v is the volume of concentrate; V is the total volume of water filtered.

11. Marine Fishery: Fishery resources and diversity will be assessed from the selected sampling sites. Samples of finfish and shell fish will be collected using a gill net with 10 mm mesh size. The net will be operated onto the water from a canoe or by a person standing in waist deep water during the high tide start using a cast net. For effective sampling, sampling points will be fixed at regular distance within the 15 sites from where water, plankton and sub-tidal fauna will be collected. In each sampling point, the fishing nets will be deployed 5 times and the CPUE (Catch per Unit Effort) will be estimated per hour. The collected specimens will be segregated into groups, weighed and preserved in 10% neutralized formalin solution. Finfishes will be identified following Fischer & Bianchi (1984), Masuda *et al*. (1984), de Bruin *et al*. (1995) and Mohsin & Ambiak (1996). Relevant secondary information pertaining to fishery resources of Deendayal Port creek systems will be gathered through technical reports, district fisheries department, Government gazette and other research publications

12. Halophytes: To quantify and document the halophytes at Deendayal Port region, quadrate method will be followed. At each sampling location quadrates of various sizes will be laid during every seasonal sampling for trees, quadrates of 10 x 10 m will be laid. Quadrates of 5 x 5 m and 1 x 1 m will be laid within each tree quadrate to record shrubs and herbs, respectively (Misra, 1968; Bonham, 1989). Four quadrates each for shrubs and herbs will be laid in each tree quadrate to assess the halophytes in the study area. To enrich the species inventory, areas falling outside the quadrates will be also explored and the observed species will be recorded and photographed. Specimens of species will be collected to know more information on habitat and for preparation of herbarium specimens. The species will be identified using standard keys.

13. Avifauna: The mangrove habitat along the Gulf of Kachchh will be delineated into 15 major sites based on the subjective magnitude of anthropogenic pressure. In each project site

creeks will be of varying length from 2 to 5 km. These creeks will be surveyed by using boat and adopting "line transect" method. A total of 15 transect (one at each site) will be placed to count the birds. Survey will be done in both terrestrial habitats like natural mangrove and plantation adjoining the mudflats and wasteland, and aquatic habitats like creek area, rivers and wetland.

14. Data Analysis

Data collected *in situ* and through laboratory analysis of samples will be subjected to descriptive statistical analysis (PAST) for mean, range and distribution of different variables from the 15 selected sites.

Table 2: Timeline – Organization of work (Yearly)

Project Activities	**1st Quarter (June- Oct.)**	**2nd Quarter (Nov.- Feb.**	**3rd Quarter (March-May)**
Review of literature related to study Permission related to field work Planning and orientation of project objectives Initiation of inception study Submission of inception report **Monsoon sample collection**			
Sample analysis First interim report			
Post-monsoon season sample collection Sample analysis Second interim report Submission			
Pre-monsoon season sample collection Sample analysis			
Annual draft Report Submission			
Final Report Submission			

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Annexure -VII

ENVIRONMENTAL MONITORING REPORT
FOR
DEENDAYAL PORT TRUST

REPORT NO.	:	DCPL/DPT/20-21/14
Month	:	June 2021
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Introduction

Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the national standards and any other relevant standards by GBCB/CPCB/MoEF to identify non conformities in the Environment of the Deendayal Port. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port.

The environmental monitoring is carried out as per the Environment Management and Monitoring Plan submitted by Detox Corporation Pvt. Ltd.

1. Ambient Air Quality Monitoring

As per the Environmental Monitoring Plan of Deendayal Port Trust, Air monitoring was carried out at six identified locations at Deendayal Port and two locations at Vadinar Port.

1.1 Air Quality Monitoring Methodology

Air quality is measured in all the stations, for 24 hour for Total Suspended Particulate Matter (TSPM), PM_{10}, $PM_{2.5}$, SO_2, NO_X, NH_3 & Benzene, and Grab-sampling for CO & CO_2 measurements. The Air samplers are operated for a period of 24 hours and after a continuous operation of 8 hours of the sampler, the reagents were replaced to obtain 3 samples per day for each parameter namely, SO_2, NO_X. The EPM 2000 filter paper and PTFE Membrane bound filter paper are used for a period of 24 hours to obtain one sample each of TSPM, PM_{10} & $PM_{2.5}$.

The AAQ samples are collected twice a week from all the eight locations as per the EMP.

1.2 Results

The ambient air quality monitoring data for six stations, viz. Marine Bhavan, Oil Jetty, Port Colony,Gopalpuri Hospital,Tuna Port and Nr. Coal Storage Area for the month of June 2021 are given in Tables 1A to 6B. The ambient air quality monitoring data for two stations at Vadinar (Nr. Admin Building &Nr. Signal Building) are given in Tables 7A to 8B.

Location 1: Marine Bhavan (AL1)

Table 1 : Results of Air Pollutant Concentration at Marine Bhavan

Parameter	Date	TSPM [µg/m3]	PM10 [µg/m3]	PM2.5 [µg/m3]	SO2 [µg/m3]		NOx [µg/m3]		NH3 [µg/m3]	
Sampling Period	-	24hr	24hr	24hr	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)
NAAQMS limit	-	NS	100 µg/m3	60 µg/m3		80 µg/m3		80 µg/m3		400 µg/m3
AL1 – 1	02-06-2021	447	107	53	14.07	9.23	23.50	24.14	12.51	11.83
					9.23		20.33		10.72	
					4.40		28.58		12.25	
AL1 – 2	04-06-2021	399	135	46	12.75	11.28	20.33	22.87	12.51	11.74
					11.87		24.77		12.00	
					9.23		23.50		10.72	
AL1 – 3	09-06-2021	423	204	172	13.63	14.95	24.77	19.27	7.40	7.06
					18.46		17.15		7.91	
					12.75		15.88		5.87	
AL1 – 4	11-06-2021	223	58	149	5.71	6.59	16.51	13.76	9.19	9.62
					5.71		14.61		8.93	
					8.35		10.16		10.72	
AL1 – 5	16-06-2021	476	103	203	17.14	16.56	18.42	16.51	7.15	6.81
					14.07		16.51		6.89	
					18.46		14.61		6.38	
AL1 - 6	18-06-2021	268	111	116	9.23	10.55	26.68	25.41	12.00	12.42
					9.67		27.95		12.51	
					12.75		21.60		12.76	
AL1 - 7	23-06-2021	415	179	65	5.71	6.74	26.68	26.68	6.89	7.83
					6.15		28.58		5.87	
					8.35		24.77		10.72	
AL1 – 8	25-06-2021	341	141	57	11.87	13.48	17.15	23.29	10.98	10.98
					17.14		20.33		12.00	
					11.43		32.39		9.96	
Monthly Average		374	130	108		11.17		21.49		9.79
Standard Deviation		89	46	61		3.65		4.53		2.28

NS: Not Specified

Table 1B : Results of Air Pollutant Concentration at Marine Bhavan					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC* ppm**	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL1 – 1	02/06/2021	1.2	BDL	1.46	510
AL1 – 2	04/06/2021	1.23	BDL	1.3	519
AL1 – 3	09/06/2021	1.07	BDL	1.86	495
AL1 – 4	11/06/2021	1.06	BDL	1.84	476
AL1 – 5	16/06/2021	1.06	BDL	1.75	490
AL1 - 6	18/06/2021	1.11	BDL	1.62	489
AL1 – 7	23/06/2021	1	BDL	1.8	480
AL1 – 8	25/06/2021	1.07	BDL	1.71	476
Monthly Average		**1.10**	-	**1.67**	**492**
Standard Deviation		**0.08**	-	**0.20**	**16**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5ppm)

NS -Not Specified

At Marine Bhavan, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_X and NH_3 is attributed mainly by motor vehicle emission produced from various types of automobiles (both diesel and petrol driven). Moreover, the loading and unloading of Food Grains and Timber at Jetty no. 1 and 2 also contributes to the high levels of TSPM and PM_{10}. The mean TSPM value at Marine Bhavan was 374 µg/m^3, The mean PM_{10} values were 130.0 µg/m^3, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 108 µg/m^3). The average values of SO_2, NO_x and NH_3 were within the permissible limit. The average values of SO_2, NO_x and NH3 were 11.17 µg/ m^3, 21.49 µg/ m^3 & 9.79 µg/ m^3 respectively.These were within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Marine Bhavan. The mean Benzene concentration was 1.10 µg/m^3,well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and CarbonMonoxide concentration was 1.67 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 2: Oil Jetty (AL2)

Table 2 : Results of Air Pollutant Concentration at Oil Jetty										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL2 - 1	02-06-2021	283	68	120	9.23	11.72	20.33	23.08	13.27	10.47
					13.19		25.41		10.72	
					12.75		23.50		7.40	
AL2 - 2	04-06-2021	353	108	210	9.23	11.14	18.42	17.15	10.72	10.89
					14.07		14.61		11.23	
					10.11		18.42		10.72	
AL2 - 3	09-06-2021	275	42	137	17.58	13.19	17.15	20.54	9.96	8.25
					12.74		24.14		7.91	
					9.23		20.33		6.89	
AL2 - 4	11-06-2021	257	37	145	5.27	5.42	23.50	19.27	3.32	5.87
					5.71		18.42		4.85	
					5.27		15.88		9.45	
AL2 - 5	16-06-2021	532	84	117	12.75	12.02	17.15	18.21	7.15	6.98
					9.23		20.33		7.40	
					14.07		17.15		6.38	
AL2 - 6	18-06-2021	192	111	65	11.87	7.91	26.68	28.58	10.72	11.40
					8.35		27.95		12.51	
					3.52		31.12		10.98	
AL2 - 7	23-06-2021	346	79	80	5.71	6.30	15.88	16.73	9.45	8.85
					7.91		17.15		9.70	
					5.28		17.15		7.40	
AL2 - 8	25-06-2021	256	125	31	11.87	15.09	18.42	18.84	3.83	7.83
					13.63		18.42		8.93	
					19.78		19.69		10.72	
Monthly Average		312	82	113		10.35		20.30		8.82
Standard Deviation		103	32	55		3.43		3.90		1.97

NS: Not Specified

Table 2B : Results of Air Pollutant Concentration at Oil Jetty					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC* ppm**	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL2 -1	02/06/2021	1.11	BDL	1.78	482
AL2 -2	04/06/2021	1.06	BDL	1.77	496
AL2 -3	09/06/2021	1.22	BDL	1.8	480
AL2 -4	11/06/2021	1.05	BDL	1.75	484
AL2 – 5	16/06/2021	1.02	BDL	1.81	515
AL2 – 6	18/06/2021	1.07	BDL	1.78	496
AL2 -7	23/06/2021	1.09	BDL	1.88	491
AL2 – 8	25/06/2021	1.06	BDL	1.64	470
Monthly Average		**1.09**	**-**	**1.78**	**489**
Standard Deviation		**0.06**	**-**	**0.07**	**14**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Oil Jetty area was mainly by motor vehicle emission produced from various types of vehicles Oil Jetty Area. The mean TSPM values at Oil Jetty were 312 µg/m^3 The mean PM_{10} values were 82 µg/m^3, which is below the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 113 µg/m^3).The average values of SO_2, NO_x and NH_3 were within the permissible limit; The mean concentration of SO_2, NO_x and NH3 were 10.35 µg/m^3, 20.30 µg/m^3 and 8.82 µg/m^3 respectively.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Oil Jetty. The mean Benzene concentration was 1.09 µg/m^3 .Well below the permissible limit of 5.0 µg/m^3. , HC's were below the detectable limit and Carbon Monoxide concentration was 1.78 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 3: Kandla Colony – Estate Office (AL-3)

Table 3 : Results of Air Pollutant Concentration at Estate Office										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL3 – 1	02-06-2021	151	18	41	3.96	6.01	18.42	16.51	4.85	8.42
					5.28		17.15		6.89	
					8.79		13.97		13.53	
AL3 – 2	04-06-2021	232	63	12	10.11	11.58	17.15	18.00	6.89	9.19
					12.75		19.69		8.17	
					11.87		17.15		12.51	
AL3 – 3	09-06-2021	290	98	55	12.75	10.84	20.33	20.11	10.98	10.47
					9.67		24.77		12.25	
					10.11		15.24		8.17	
AL3 – 4	11-06-2021	235	61	128	1.76	2.34	20.33	20.54	6.89	6.13
					2.20		23.50		5.87	
					3.08		17.78		5.62	
AL3 – 5	16-06-2021	231	66	139	5.71	10.84	26.68	22.02	13.53	9.28
					12.75		20.96		7.40	
					14.07		18.42		6.89	
AL3 – 6	18-06-2021	463	76	37	10.11	11.43	20.33	22.23	7.91	8.00
					13.63		22.87		9.96	
					10.55		23.50		6.13	
AL3 – 7	23-06-2021	382	70	35	11.87	13.33	8.26	13.97	9.96	8.68
					14.07		15.24		10.72	
					14.07		18.42		5.36	
AL3 – 8	25-06-2021	148	99	42	12.75	12.16	19.69	19.69	7.15	7.91
					12.31		22.23		9.19	
					11.43		17.15		7.40	
Monthly Average		267	69	61		9.82		19.13		8.51
Standard Deviation		109	25	46		3.70		2.83		1.27

NS: Not Specified

Table 3B : Results of Air Pollutant Concentration at Kandla Port Colony					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC***	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL3 -1	02/06/2021	1.07	BDL	1.72	489
AL3 -2	04/06/2021	1.1	BDL	1.82	502
AL3 -3	09/06/2021	1.07	BDL	1.74	482
AL3 -4	11/06/2021	1.16	BDL	1.61	480
AL3 – 5	16/06/2021	1.17	BDL	1.69	475
AL3 – 6	18/06/2021	1.1	BDL	1.7	489
AL3 – 7	23/06/2021	1.04	BDL	1.96	486
AL3 – 8	25/06/2021	1.04	BDL	1.59	464
Monthly Average		**1.09**		**1.73**	**483**
Standard Deviation		**0.05**		**0.12**	**11**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Kandla Port Colony was attributed by vehicle emission produced from trucks and heavy duty vehicles that pass through the road outside Kandla Port Colony. The mean TSPMvalues at Oil Jetty were 267 µg/m^3, The mean PM_{10} values were 69µg/m^3, which is below the permissible limit. $PM_{2.5}$ values were slightly above the permissible limit (mean = 61 µg/m^3). The average values of SO_2, NO_x and NH3 were 9.82 µg/m^3, 19.13 µg/m^3 and 8.51 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Kandla Port Colony. The mean Benzene concentration was 1.09 µg/m^3, well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and Carbon Monoxide concentration was 1.73 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 4: Gopalpuri Hospital (AL-4)

Table 4 : Results of Air Pollutant Concentration at Gopalpuri Hospital										
Parameter	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL4 -1	02-06-2021	115	40	15	3.96	2.64	13.34	15.46	5.11	5.28
					3.08		14.61		4.85	
					0.88		18.42		5.87	
AL4 -2	04-06-2021	144	43	13	8.79	7.33	14.61	17.57	6.89	7.49
					5.71		19.69		7.40	
					7.47		18.42		8.17	
AL4 -3	09-06-2021	157	49	34	2.64	3.37	14.61	20.96	6.89	7.40
					3.52		29.85		7.40	
					3.96		18.42		7.91	
AL4 -4	11-06-2021	122	29	46	9.23	7.47	5.08	6.99	3.06	4.60
					9.23		7.62		4.85	
					3.96		8.26		5.87	
AL4 – 5	16-06-2021	156	35	21	3.96	3.96	10.80	12.49	10.72	11.40
					3.52		12.07		10.98	
					4.40		14.61		12.51	
AL4 – 6	18-06-2021	207	72	108	9.23	8.65	13.34	18.42	7.40	7.57
					8.79		24.77		9.96	
					7.91		17.15		5.36	
AL4 – 7	23-06-2021	263	36	13	0.88	3.08	11.43	13.97	10.98	10.30
					3.96		13.34		12.00	
					4.40		17.15		7.91	
AL4 – 8	25-06-2021	216	111	14	3.52	4.54	12.70	11.86	7.40	7.06
					4.84		12.07		7.15	
					5.28		10.80		6.64	
Monthly Average		173	52	33		5.13		14.71		7.64
Standard Deviation		51	27	33		2.33		4.39		2.28

NS: Not Specified

Table 4B : Results of Air Pollutant Concentration at Gopalpuri Hospital					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC***	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL4 -1	02/06/2021	1.07	BDL	1.68	482
AL4 -2	04/06/2021	1.06	BDL	1.7	488
AL4 -3	09/06/2021	1.11	BDL	1.9	478
AL4 -4	11/06/2021	1.1	BDL	1.54	470
AL4 – 5	16/06/2021	1.21	BDL	1.58	455
AL4 – 6	18/06/2021	1.2	BDL	1.78	460
AL4 – 7	23/06/2021	1.19	BDL	1.94	481
AL4 – 8	25/06/2021	1.13	BDL	1.91	475
Monthly Average		**1.13**		**1.75**	**474**
Standard Deviation		**0.06**		**0.15**	**11**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Gopalpuri Hospital was attributed by vehicle emission produced from light motor vehicles of the colony residents. The mean TSPMvalues at Oil Jetty were 173 µg/m^3, The mean PM_{10} values were 52 µg/m^3, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean= 33 µg/m^3). The average values of SO_2, NO_x and NH_3 were 5.13 µg/m^3, 14.71 µg/m^3 and 7.64 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Gopalpuri Hospital. The mean Benzene concentration was 1.13 µg/m^3, well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and Carbon Monoxide concentration was 1.75 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 5: Coal Storage Area (AL-5)

Table 5 : Results of Air Pollutant Concentration at Coal Storage Area										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL5 – 1	02-06-2021	829	78	60	9.23	9.23	26.04	26.47	13.27	13.96
					12.75		28.58		15.32	
					5.71		24.77		13.27	
AL5 – 2	04-06-2021	332	104	97	5.71	7.77	20.33	21.60	12.51	12.00
					8.79		24.77		12.51	
					8.79		19.69		10.98	
AL5 – 3	09-06-2021	289	185	154	10.11	13.48	18.42	18.84	10.72	11.83
					12.75		17.78		12.51	
					17.58		20.33		12.25	
AL5 – 4	11-06-2021	280	70	162	9.23	13.19	12.07	13.55	10.98	10.64
					13.19		13.34		10.72	
					17.14		15.24		10.21	
AL5 – 5	16-06-2021	944	148	150	3.96	10.99	14.61	18.84	2.30	5.45
					19.78		10.80		6.89	
					9.23		31.12		7.15	
AL5 – 6	18-06-2021	603	145	234	10.11	9.23	26.68	24.56	13.53	13.96
					7.47		22.87		13.27	
					10.11		24.14		15.06	
AL5 – 7	23-06-2021	766	181	152	11.87	12.75	12.70	21.17	12.51	10.47
					14.07		17.15		10.72	
					12.31		33.66		8.17	
AL5 – 8	25-06-2021	728	208	94	13.63	11.72	18.42	15.03	12.51	9.53
					10.55		17.78		9.19	
					10.99		8.89		6.89	
Monthly Average		596	140	138		11.04		20.01		10.98
Standard Deviation		263	51	54		2.11		4.40		2.74

NS: Not Specified

Table 5B : Results of Air Pollutant Concentration at Coal Storage Area					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC***	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL5 – 1	02/06/2021	1.08	BDL	1.78	482
AL5 – 2	04/06/2021	1.1	BDL	1.68	490
AL5 – 3	09/06/2021	1.24	BDL	1.64	462
AL5 – 4	11/06/2021	1.28	BDL	1.66	464
AL5 – 5	16/06/2021	1.31	BDL	1.66	460
AL5 – 6	18/06/2021	1.2	BDL	1.7	490
AL5 – 7	23/06/2021	1.33	BDL	1.74	464
AL5 – 8	25/06/2021	1.11	BDL	1.91	484
Monthly Average		**1.21**	**-**	**1.72**	**475**
Standard Deviation		**0.10**	**-**	**0.09**	**13**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Coal Storage Area was comparatively highest among all the locations of Air Quality monitoring in Kandla Port. High values of TSPM, $_{PM10,}$ $PM_{2.5}$, SO_2, NO_X at this location was due to lifting of coal with grab and other coal handling processes near Berth no. 6 & 7. Moreover, the traffic was also heavy around this place for transport of coal thus emissions produced from heavy vehicles. The mean TSPMvalues at Coal storage were 596 µg/m^3. The mean PM_{10} values were 140 µg/m^3, which is well above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 138 µg/m^3). The average values of SO_2, NO_x and NH_3 were 11.04 µg/m^3, 20.01 µg/m^3 and 10.98 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Coal Storage Area. The mean Benzene concentration was 1.21 µg/m^3, well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and Carbon Monoxide concentration was 1.72 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 6: Tuna Port (AL-6)

Table 6 : Results of Air Pollutant Concentration at Tuna Port										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL6 -1	02-06-2021	72	72	37	0.44	1.76	17.15	16.73	4.60	6.72
					1.32		13.34		8.17	
					3.52		19.69		7.40	
AL6 – 2	04-06-2021	80	42	39	4.84	6.01	24.77	18.84	7.40	8.76
					3.96		13.34		9.45	
					9.23		18.42		9.45	
AL6 – 3	09-06-2021	122	38	31	9.23	12.45	17.78	16.94	7.40	8.76
					18.90		14.61		8.17	
					9.23		18.42		10.72	
AL6 – 4	11-06-2021	72	25	44	3.52	2.93	10.80	14.61	3.32	4.25
					1.32		14.61		4.85	
					3.96		18.42		4.60	
AL6 – 5	16-06-2021	86	78	12	8.79	11.72	15.24	19.69	9.45	9.19
					13.63		20.33		9.96	
					12.75		23.50		8.17	
AL6 – 6	18-06-2021	187	32	66	11.87	6.74	19.69	18.00	5.62	6.30
					3.96		17.78		6.13	
					4.40		16.51		7.15	
AL6 – 7	23-06-2021	261	73	8	11.87	12.75	20.33	18.42	8.17	9.87
					12.75		26.68		10.72	
					13.63		8.26		10.72	
AL6 – 8	25-06-2021	123	109	26	8.35	10.26	11.43	10.16	9.96	8.25
					9.23		6.99		9.45	
					13.19		12.07		5.36	
Monthly Average		125	59	33		8.08		16.67		7.76
Standard Deviation		67	29	18		4.33		3.06		1.86

NS: Not Specified

Table 6B : Results of Air Pollutant Concentration at Tuna Port					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC***	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL6 -1	02/06/2021	1.2	BDL	1.72	489
AL6 – 2	04/06/2021	1.12	BDL	1.65	479
AL6 – 3	09/06/2021	1.03	BDL	1.71	466
AL6 – 4	11/06/2021	1.14	BDL	1.74	469
AL6 – 5	16/06/2021	1.05	BDL	1.71	490
AL6 – 6	18/06/2021	1.12	BDL	1.72	472
AL6 – 7	23/06/2021	1.29	BDL	1.7	470
AL6 – 8	25/06/2021	1.27	BDL	1.88	480
Monthly Average		**1.15**	**-**	**1.73**	**477**
Standard Deviation		**0.09**	**-**	**0.07**	**9**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The mean TSPM values at Tuna Port were 125 µg/m^3, The mean PM_{10} values were 59 µg/m^3, which is below the permissible limit. $PM_{2.5}$ values were within the permissible limit (mean = 33 µg/m^3 µg/m^3). The average values of SO_2, NO_x and NH_3 were 8.08 µg/m^3, 16.67 µg/m^3 and 7.76 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Tuna Port. The mean Benzene concentration was 1.15 µg/m^3, well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and Carbon Monoxide concentration was 1.73 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 7: Signal Building (Vadinar) (AL-7)

Table 7 : Results of Air Pollutant Concentration at Signal Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL7 -1	02-06-2021	56	27	27	3.517	4.396	10.98	9.96	17.15	17.57
					5.715		10.47		19.69	
					3.956		8.42		15.88	
AL7 -2	04-06-2021	59	16	29	3.517	2.051	7.91	10.13	10.80	12.70
					1.319		10.98		12.07	
					1.319		11.49		15.24	
AL7 -3	09-06-2021	51	41	26	2.198	1.905	6.13	6.30	10.80	14.19
					1.319		3.32		12.70	
					2.198		9.45		19.05	
AL7 -4	11-06-2021	49	38	63	3.956	3.077	7.15	9.53	9.53	10.80
					3.077		9.96		10.80	
					2.198		11.49		12.07	
AL7 -5	16-06-2021	62	51	24	1.758	3.810	10.98	9.10	10.80	11.43
					2.198		11.49		11.43	
					7.473		4.85		12.07	
AL7 -6	18-06-2021	68	29	58	11.869	6.447	6.89	13.96	15.88	16.94
					3.956		21.44		17.78	
					3.517		13.53		17.15	
AL7 -7	23-06-2021	63	41	24	10.110	10.843	3.318611	9.28	8.892276	10.37
					10.990		11.4875		10.79776	
					11.429		13.01917		11.43293	
AL7 -8	25-06-2021	66	23	55	0.879	1.612	6.8925	7.23	24.77134	22.44
					1.758		7.913611		23.50102	
					2.198		6.8925		19.05488	
Monthly Average		**59**	**33**	**38**		**4.268**		**9**		**15**
Standard Deviation		**7**	**11**	**17**		**3.098**		**2**		**4**

NS: Not Specified

Table 7B : Results of Air Pollutant Concentration at Signal Building					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC***	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL7 -1	02/06/2021	1.06	BDL	1.68	472
AL7 – 2	04/06/2021	1.11	BDL	1.72	468
AL7 – 3	09/06/2021	1.23	BDL	1.55	482
AL7 – 4	11/06/2021	1.07	BDL	1.69	492
AL7 – 5	16/06/2021	1.23	BDL	1.78	466
AL7 – 6	18/06/2021	1.21	BDL	1.92	478
AL7 – 7	23/06/2021	1.18	BDL	1.88	485
AL7 – 8	25/06/2021	1.14	BDL	1.68	488
Monthly Average		**1.15**	**-**	**1.74**	**479**
Standard Deviation		**0.07**	**-**	**0.12**	**10**

* NMHC- Non- Methane Hydrocarbons
BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)
NS_ Not Specified

The mean TSPM values at Vadinar Port were 59 µg/m^3. The mean PM_{10} values were 33 µg/m^3, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 38 µg/m^3 µg/m^3). The average values of SO_2, NO_x and NH_3 were 4.26 µg/m^3, 9 µg/m^3 and 15 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.15 µg/m^3, well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and Carbon Monoxide concentration was 1.74 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 8: Admin Building (Vadinar) (AL-8)

Table 8 : Results of Air Pollutant Concentration at Admin Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL8 -1	02-06-2021	54	16	27	0.879	1.905	8.257	8.469	6.893	6.637
					1.758		8.257		7.148	
					3.077		8.892		5.871	
AL8 -2	04-06-2021	58	19	23	0.879	1.172	19.690	16.514	5.361	4.850
					1.758		17.149		4.850	
					0.879		12.703		4.340	
AL8 -3	09-06-2021	70	63	23	2.198	1.612	14.609	12.915	1.276	1.106
					1.319		8.257		1.021	
					1.319		15.879		1.021	
AL8 -4	11-06-2021	53	47	28	1.758	2.198	17.149	17.996	2.298	4.340
					2.198		13.338		6.382	
					2.638		23.501		4.340	
AL8 -5	16-06-2021	57	12	14	2.198	2.638	17.149	12.915	3.319	3.234
					2.638		12.703		3.063	
					3.077		8.892		3.319	
AL8 -6	18-06-2021	59	28	19	1.319	1.758	9.527	9.527	4.850	4.340
					1.758		8.257		4.340	
					2.198		10.798		3.829	
AL8 -5	23-06-2021	56	29	15	0.879	1.758	6.352	8.892	3.829	5.191
					1.319		9.527		4.340	
					3.077		10.798		7.403	
AL8-6	25-06-2021	73	51	28	0.440	0.733	13.974	15.667	7.914	8.084
					0.879		15.244		10.466	
					0.879		17.785		5.871	
Monthly Average		60	33	22		1.7217		12.862		4.72
Standard Deviation		7	18	6		0.5848		3.660		2.10

NS: Not Specified

Table 8B : Results of Air Pollutant Concentration at Admin Building					
Parameter	**Date**	**C_6H_6 [µg/m^3]**	**HC***	**CO [mg/m^3]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m^3**	**NS**	**4.0 mg/m^3**	**NS**
AL8 -1	02/06/2021	1.21	BDL	1.78	496
AL8-2	04/06/2021	1.18	BDL	1.92	477
AL8 -3	09/06/2021	1.23	BDL	1.68	468
AL8-4	11/06/2021	1.16	BDL	1.77	484
AL8 -5	16/06/2021	1.25	BDL	1.84	477
AL8-6	18/06/2021	1.22	BDL	1.68	485
AL8-7	23/06/2021	1.16	BDL	1.62	476
AL8-8	25/06/2021	1.12	BDL	1.77	466
Monthly Average		**1.19**	**-**	**1.76**	**479**
Standard Deviation		**0.04**	**-**	**0.10**	**10**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Admin Building Vadinar was comparatively low among all the locations of Air Quality monitoring in Kandla Port and Vadinar Port. The mean TSPMvalues at Vadinar Port were 60 µg/m^3. The mean PM_{10} values were 33 µg/m^3, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 22.0 µg/m^3). The average values of SO_2, NO_x and NH_3 were 1.72 µg/m^3, 12.86 µg/m^3 and 4.72 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Admin Building, Vadinar Port. The mean Benzene concentration was 1.19 µg/m^3, well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and Carbon Monoxide concentration was 1.76 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

1.4 Observations and Conclusion

During the monitoring period, the overall Ambient Air Quality of the port area was found to be well within the desired levels for various pollutants. However, Near Coal storage area, Marine Bhavan and Oil Jetty area, PM_{10} values was above the permissible standards. All other pollutants were recorded well below the prescribed limits.

2. Drinking Water Quality Monitoring

Drinking Water Quality Monitoring was carried out at twenty stations at Kandla, Vadinar & Township Area of Deendayal Port.

2.1 Drinking Water Monitoring Methodology

Drinking water samples were collected from 20 locations as prescribed in the tender document. Samples for physico-chemical analysis were collected in 1 liter carboys and samples for microbiological parameters were collected in sterilized bottles. These samples were then analyzed in laboratory for various drinking water parameters at Kandla Lab/Surat.

The Sampling and Analysis was done as per standard methods - CPCB/GPCB Guidelines and Standard Methods -APHA. The water samples were analyzed for various parameters, viz. Color , Odor, Turbidity , Conductivity , pH , Chlorides , TDS, Total Hardness, Iron , Sulphate , Salinity , DO, BOD, Na, K, Ca, Mg, F, NO_3, NO_2, Mn, Cr-6, Cu, Cd, As, Hg, Pb, Zn, Bacterial Count (cfu) .

2.2 Results

The Drinking Water Quality monitoring data for 20 stations are given in below from table No. 9 to Table No. 15

Table 9: Drinking Water Quality Monitoring Parameters for Nirman Building 1, P & C building & Main Gate (North) at Kandla

Sr. No.	Parameter	Unit	Nirman Building 1	P & C building	Main Gate North	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.1	7.3	7.8	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	570	590	610	500	2000
3	Turbidity	NTU	1	1	0	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	1243.0	1150.0	1190.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2.0	<2.0	<2.0	NS*	NS*
8	Chloride as Cl	mg/l	513.19	457.02	561.25	250.0	1000.0
9	Ca as Ca	mg/l	48.10	44.09	48.10	75.0	200.0
10	Mg as Mg	mg/l	82.62	87.48	89.91	30.0	100.0
11	Total Hardness	mg/l	460.0	470.0	490.0	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.30	0.47	0.24	1.0	1.5
14	Sulphate as SO4	mg/l	232.8	180	258	200.0	400
15	Nitrite as NO2	mg/l	0.04	0.05	0.05	NS*	NS*
16	Nitrate as NO3	mg/l	0.77	9.15	28.16	45.0	No Relaxation
17	Salinity	%	0.93	0.83	1.01	NS*	NS*
18	Sodium as Na	mg/l	322.0	315.0	342.0	NS*	NS*
19	Potassium as K	mg/l	3.44	3.21	4.08	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 10: Drinking Water Quality Monitoring Parameters for Canteen, West Gate – I & Wharf Area at Kandla

Sr. No.	Parameter	Unit	Canteen	West Gate - I	Wharf Area	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.0	7.6	7.4	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	910.0	960.0	870.0	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	1703.0	1753.0	1630.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2.0	<2.0	<2.0	NS*	NS*
8	Chloride as Cl	mg/l	613.86	620.88	658.46	250.0	1000.0
9	Ca as Ca	mg/l	52.10	52.10	44.09	75.0	200.0
10	Mg as Mg	mg/l	72.90	80.19	77.76	30.0	100.0
11	Total Hardness	mg/l	430.0	460.0	430.0	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<.0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.47	0.32	0.42	1.0	1.5
14	Sulphate as SO4	mg/l	156.0	300.0	366.0	200.0	400
15	Nitrite as NO2	mg/l	0.03	<0.01	0.03	NS*	NS*
16	Nitrate as NO3	mg/l	24.64	10.56	12.67	45.0	No Relaxation
17	Salinity	%	1.11	1.12	1.19	NS*	NS*
18	Sodium as Na	mg/l	333.0	362.0	412.0	NS*	NS*
19	Potassium as K	mg/l	3.78	3.99	4.11	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 11: Drinking Water Quality Monitoring Parameters for Sewa sadan – 3, Workshop I & Custom Building at Kandla

Sr. No.	Parameter	Unit	SewaSadan – 3	Workshop	Custom Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.3	7.4	7.8	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1090.0	830.0	935.0	500	2000
3	Turbidity	NTU	1	0	1	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	1910.0	1600.0	1820.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2.0	<2.0	<2.0	NS*	NS*
8	Chloride	mg/l	743.65	571.77	550.72	250.0	1000.0
9	Ca as Ca	mg/l	52.10	56.11	48.10	75.0	200.0
10	Mg as Mg	mg/l	82.62	85.05	80.19	30.0	100.0
11	Total Hardness	mg/l	470.0	490.0	450.0	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.32	0.93	0.30	1.0	1.5
14	Sulphate	mg/l	190.8	172.8	195.6	200.0	400
15	Nitrite	mg/l	0.01	0.03	0.05	NS*	NS*
16	Nitrate	mg/l	13.37	6.33	12.67	45.0	No Relaxation
17	Salinity	%	1.34	1.03	0.99	NS*	NS*
18	Sodium as Na	mg/l	333.0	342.	392.0	NS*	NS*
19	Potassium as K	mg/l	3.88	3.71	4.12	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 12: Drinking Water Quality Monitoring Parameters for Port Colony Kandla, Hospital Kandla & A.O. Building at Gandhidham

Sr. No.	Parameter	Unit	Port Colony Kandla	Hospital Kandla	A.O. Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.2	7	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1200.0	1400.0	1090.0	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	2512.0	2830.0	1920.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2.0	<2.0	<2.0	NS*	NS*
8	Chloride	mg/l	763.70	794.77	838.86	250.0	1000.0
9	Ca as Ca	mg/l	56.11	48.10	60.12	75.0	200.0
10	Mg as Mg	mg/l	77.76	80.19	77.76	30.0	100.0
11	Total Hardness	mg/l	460.0	450.0	470.0	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.77	0.12	0.21	1.0	1.5
14	Sulphate	mg/l	202.8	261.6	372	200.0	400
15	Nitrite	mg/l	0.05	0.05	0.06	NS*	NS*
16	Nitrate	mg/l	5.63	12.67	16.89	45.0	No Relaxation
17	Salinity	%	1.38	1.44	1.52	NS*	NS*
18	Sodium as Na	mg/l	322.0	373.0	432.0	NS*	NS*
19	Potassium as K	mg/l	3.61	3.81	4.45	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 13: Drinking Water Quality Monitoring Parameters for School Gopalpuri, Guest House & E - Type Quarter at Gopalpuri, Gandhidham

Sr. No.	Parameter	Unit	School Gopalpuri	Guest House	E - Type Quarter	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.1	7.3	7.4	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	970.0	1010.0	1135.0	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	1850.0	1920.0	2210.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2.0	<2.0	<2.0	NS*	NS*
8	Chloride	mg/l	708.58	615.87	845.88	250.0	1000.0
9	Ca as Ca	mg/l	56.11	52.10	56.11	75.0	200.0
10	Mg as Mg	mg/l	82.62	85.05	85.05	30.0	100.0
11	Total Hardness	mg/l	480.0	480.0	490.0	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	1.37	0.89	0.33	1.0	1.5
14	Sulphate	mg/l	369.6	384	376.8	200.0	400
15	Nitrite	mg/l	0.04	0.06	0.04	NS*	NS*
16	Nitrate	mg/l	7.74	6.33	12.67	45.0	No Relaxation
17	Salinity	%	1.28	1.11	1.53	NS*	NS*
18	Sodium as Na	mg/l	392.0	320.0	332.0	NS*	NS*
19	Potassium as K	mg/l	4.11	3.11	3.29	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 14: Drinking Water Quality Monitoring Parameters for F - Type Quarter, Hospital Gopalpuri & Tuna Port

Sr. No.	Parameter	Unit	F - Type Quarter	Hospital Gopalpuri	Tuna Port	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7	7.3	7.38	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	890.0	950.0	1030.0	500	2000
3	Turbidity	NTU	1	0	0	1.0	5.0
4	Odor	-	Odourless	Odourless	Odorless	Agreeable	Agreeable
5	Color	Hazen Unit	Colourless	Colourless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1700.0	2030.0	1920.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2.0	<2.0	<2	NS*	NS*
8	Chloride	mg/l	706.57	545.21	692.0	250.0	1000.0
9	Ca as Ca	mg/l	52.10	56.11	69.74	75.0	200.0
10	Mg as Mg	mg/l	85.05	85.05	38.39	30.0	100.0
11	Total Hardness	mg/l	480	490	332.0	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.65	1.00	0.39	1.0	1.5
14	Sulphate	mg/l	358.8	378	112.8	200.0	400
15	Nitrite	mg/l	0.06	0.04	<0.01	NS*	NS*
16	Nitrate	mg/l	9.856	11.264	1.42	45.0	No Relaxation
17	Salinity	%	1.28	0.98	1.23	NS*	NS*
18	Sodium as Na	mg/l	373.0	351.0	344	NS*	NS*
19	Potassium as K	mg/l	4.07	3.87	3.4	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 15: Drinking Water Quality Monitoring Parameters for Vadinar Jetty & Port Colony at Vadinar

Sr. No.	Parameter	Unit	Vadinar Jetty	Port Colony Vadinar	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.3	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	990.0	1010.0	500	2000
3	Turbidity	NTU	0.00	1.00	1.0	5.0
4	Odor	-	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	1830.0	1990.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2.0	<2.0	NS*	NS*
8	Chloride	mg/l	445.99	496.10	250.0	1000.0
9	Ca as Ca	mg/l	52.104	56.11	75.0	200.0
10	Mg as Mg	mg/l	80.19	80.19	30.0	100.0
11	Total Hardness	mg/l	460.0	470.0	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.82	0.94	1.0	1.5
14	Sulphate	mg/l	30.00	34.80	200.0	400
15	Nitrite	mg/l	0.04	0.04	NS*	NS*
16	Nitrate	mg/l	4.93	4.79	45.0	No Relaxation
17	Salinity	%	0.81	0.90	NS*	NS*
18	Sodium as Na	mg/l	311.0	306.0	NS*	NS*
19	Potassium as K	mg/l	4.3	4.9	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent

*NS: Not Specified

2.3 Results & Discussion

The colour of all drinking water samples was < 5 Hazen unit and odour of the samples was also agreeable. All parameters are found to be within the specified limit of the Drinking water Standard.

pH

The limit of pH value for drinking water is specified as 6.5 to 8.5. pH value in the studied area varied from 6.9 to 7.8 pH unit. All the sampling points showed pH values within the prescribed limit by Indian Standards.

Total Dissolved Solids (TDS)

TDS values in the studied area varied between 600 -1800 mg/l. None of the sampling points showed higher TDS values than the prescribed limit by Indian standards .

Conductivity

Electrical Conductivity is the ability of a solution to transfer (conduct) electric current. Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The conductivity in the samples collected during the month of June ranged from 2000-3800 µs/cm. Electrical conductivity standards do not appear in BIS standards for drinking water.

BOD

BOD value in the studied area was less than 2.0 mg/L. Indian standards does not show any standard values for BOD in drinking water.

Chlorides

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. Chloride value in the studied area varied between 380-960 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.

Calcium

Calcium value in the studied area varied between 60 - 90 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. If calcium is present beyond the maximum acceptable limit, it causes incrustation of pipes.

Magnesium

Magnesium value in the studied area varied between 25 – 90 mg/l. All the locations had Magnesium within the prescribed limits of 30-100 mg/L.

Total Hardness

Hardness value in the studied area varied between 312-520 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.The prescribed limit by Indian Standards is 200-600 mg/L.

Iron

Iron value in the studied area was below 0.01mg/L and hence well below the permissible limit as per Indian Standards is 0.3 mg/L. The excess amount of iron causes slight toxicity; gives stringent taste to water.

Fluoride

Fluoride value in the studied area varied between 0.1 – 1.0 mg/l and hence well below the permissible limit as per Indian Standards is 1.0-1.5 mg/L. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems.

Sulphates

Sulphate value in the studied area varied between 100 – 330 mg/l. All the sampling points showed sulphate values within the prescribed limits by Indian Standards (200-400 mg/L). Sulphate content in drinking water exceeding the 400 mg/L imparts bitter taste.

Nitrites (NO_2) and Nitrates (NO_3)

Nitrite values in all the water samples were <0.1. There are no specified standard values for Nitrites in Drinking water. The mean Nitrate values in drinking water of KPT was 4.10 mg/l which is well within the permissible limit of the Drinking water Standard.

Salinity

Salinity in drinking water in the present samples collected ranged from 0.6 to 1.8 % . There are no prescribed Indian standards for salinity in Drinking water**.**

Sodium and Potassium Salts

Sodium values in the samples collected ranged from 80 - 460 mg/l and Potassium salts ranged from 2.8 to 4.6 mg/l. There are no prescribed limits of Sodium and Potassium in Indian standards for Drinking water**.**

Heavy Metals in Drinking Water

In the present study period drinking water samples were analyzed for Mn, Cr, Cu, Cd, As, Hg, Pb and Zn. All these heavy metals were well below the permissible limits prescribed by the Indian Standards.

Bacteriological Study

Analysis of the bacteriological parameter at all location shows that Bacteria is not present and hence Bacterial count is in line with the permissible limit of drinking water. This shows that all the drinking water samples were safe from any bacteriological contamination.

2.4 Conclusions

These results are compared with acceptable limits as prescribed in IS 10500:2012 – Drinking Water Specification. It is seen from the analysis data that during the study period the water was safe for human consumption at all drinking water monitoring stations.

3. Noise Level Monitoring

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. Noise Monitoring was done at 13 stations at Kandla, Vadinar and Township area.

3.1 Method of Monitoring

Sampling was done at all stations for 24 hour period. Data was recorded using automated sound level meter. The intensity of sound was measured in sound pressure level (SPL) and common unit of measurement is decibel (Db).

3.2 Results

Table 16: Noise Monitoring data for ten locations of Deendayal Port and two locations of Vadinar Port

Sr. No.	Location	Day Time Average Noise Level (SPL) in dB(A)	Night Time Average Noise Level (SPL) in dB(A)
	Sampling Time	**6:00 am to 10:00 PM**	**10:00PM to 6:00 AM**
1	Marine Bhavan	63.40	57.1
2	Nirman Building 1	57.8	53.9
3	Tuna Port	55.8	47.1
4	Main Gate North	57.1	52.8
5	West Gate I	62.1	54.6
6	Canteen Area	57.1	49.6
7	Main Road	60.0	57.8
8	ATM Building	63.5	56.2
9	Wharf Area /Jetty Area	67.1	57.8
10	Port & Custom Office	55.5	52.7
	Vadinar Port		
11	Entrance Gate of Vadinar Port	57.1	54.6
12	Nr. Port Colony, Vadinar	56.2	56.2
13	Nr. Vadinar Jetty	59.6	55.8

3.3 Conclusions- Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Average Noise Level (SPL)in all ten locations at Deendayal Port ranged from 56.25 dB(A) to 69.51 dB(A) and it was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all ten locations of Deendayal Port ranged from 48.28 dB to 62.33 dB(A) and it was within the permissible limits of 70 dB(A) for the industrial area for the night time.

4. Soil Monitoring

Sampling and analysis of soil samples were undertaken at six locations within the study area (Deendayal Port and Vadinar Port) as a part of EMP. The soil sampling locations are initially decided based on the locations as provided in the tender document of the Deendayal Port.

4.1 Methodology

The soil samples were collected in the month of June 2021. The samples collected from the all locations are homogeneous representative of each location. At random locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

4.2 Results

Table-17: Chemical Characteristics of Soil in the Study Area

Sr. No.	Parameter	Unit	Station Name					
			SL1	SL2	SL3	SL4	SL5	SL6
			Tuna Port	IFFCO Plant	Khori Creek	Nakti Creek	KPT Admin Site	KPT Colony
			Near main gate of Port	10 m away from main gate	Sand from creek at low tide		Vadinar	
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	pH	-	7.30	8.16	8.36	8.26	7.27	7.82
3	Electrical Conductivity	µs/cm	33400.0	48500.0	21800.0	37200.0	511.0	464.0
4	Moisture	%	21.45	13.94	18.82	14.26	6.28	4.56
5	Total Organic Carbon	%	0.31	0.19	0.26	0.24	0.15	0.11
6	Alkalinity	mg/kg	100.1	140.14	80.08	140.14	60.06	100.1
7	Total Nitrogen	%	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
8	Chloride	mg/kg	6228.7	6032.5	2550.3	7160.6	68.66	78.47
9	Sulphate	mg/kg	2056.4	75.86	292.0	87.84	14.37	13.58
10	Phosphorus	mg/kg	0.97	1.41	0.79	1.59	0.97	0.97
11	Potassium	mg/kg	1161.0	592.2	700.2	765.0	626.4	876.4
12	Calcium	mg/kg	641.3	561.12	701.4	661.32	124.2	172.3
13	Sodium	mg/kg	10821.6	2992.8	3164.4	3736.8	2116.8	2565.0
14	Copper as Cu	mg/kg	11.21	27.22	28.20	31.78	82.66	72.42
15	Lead as Pb	mg/kg	3.10	6.20	23.0	11.4	ND	ND
16	Nickel as Ni	mg/kg	20.71	1823	7.80	15.10	25.46	27.73
17	Zinc as Zn	mg/kg	32.26	72.62	65.90	77.21	23.46	43.20
18	Cadmium as Cd	mg/kg	ND	ND	ND	ND	ND	ND

4.3 Discussion

- The data shows that value of pH ranges from 8.68at Nakti Creek to 9.02 at Tuna Creek indicating that all soil sample sare neutral to basic. Iffco plant samples howed maximum conductivity of 36,200µmhos/cm, while Nakti Creek location showed minimum conductivity of 4790µmhos/cm. Conductivity at Vadinar Port was 439 and 634 µmhos/cm at Admin site and Vadinar Port colony respectively.
- Total organic Carbon ranged from 0.7 % to 2.3 at Deendayal Port. At Vadinar Port, organic carbon content ranged from 0.8 % to 1.04 %.
- The concentration of Phosphorus and Potassium in the soil samples varies from 34.0 to 53.0mg/kg and 700.0 to 1100 mg/kg respectively at Deendayal Port. The mean concentration of Phosphorous at Vadinar site was 6.82 mg/kg and mean concentration of Potassium at Vadinar site was 176.5 mg/kg.

These differences in NPK in soil at different locations are due to the dissimilar nature of soil at each of the locations. Samples SL3 & SL4 (Khori Creek & Nakti Creek) are of saline nature as they are coastal soil; where as other locations are inland locations and have different chemical properties.

Heavy Metals in the Soil

Traces of Copper, Lead, Nickel, Zinc were observed in the soil samples collected from all the four locations of Deendayal Port and two locations of Vadinar Port. Cadmium metal was not detected in the Soil.

4.4 Conclusion

The soils of Deendayal Port and Vadinar Port appears to be neutral to basic with varying levels of Chloride, Sulphate, NPK and Calcium. As the nature of soil at different locations are different with respect to its proximity to the sea, the samples showed high degree of variations in their chemical properties.

5. Sewage Treatment Plant Monitoring

This involves safe collection of waste water (spent/used water) from wash areas, bathroom, industrial units, etc., waste from toilets of various buildings and its conveyance to the treatment plant and final disposal in conformity with the requirement and guide lines of State Pollution Control Board and other statutory bodies.

5.1 Methodology for STP Monitoring

To monitor the working efficiency of Sewage Treatment Plant (STP), STP Inlet and Outlet Samples were collected once a week. Locations selected are namely Gopalpuri Township, Deendayal Port and Vadinar. Samples were collected in 1 lit. carboys and were analyzed in laboratory for various parameters.

5.2 Results

- **Kandla STP**

Table 18: Sewage Water Monitoring at Kandla STP (1st Week)

Date of Sampling	05.06.21

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.62	7.23
2	Total Suspended Solids	mg/l	450	38.2
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	494.9	40.4
5	BOD @ 27 °C	mg/l	152.0	12.0
Aeration Tank				
6	MLSS	mg/l	40.0	
7	MLVSS	%	82.0	

Table 19: Sewage Water Monitoring at Kandla STP (2nd Week)

Date of Sampling	10.06.21

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.93	7.13
2	Total Suspended Solids	mg/l	268.3	58.3
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	289.87	63.63
5	BOD @ 27 °C	mg/l	94.0	16.0
Aeration Tank				
6	MLSS	mg/l	36.0	
7	MLVSS	%	74.0	

Table 20: Sewage Water Monitoring at Kandla STP (3rd Week)

Date of Sampling	15.06.21

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.43	7.23
2	Total Suspended Solids	mg/l	210.5	99
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	259.57	31.31
5	BOD @ 27 °C	mg/l	72.0	8.0
Aeration Tank				
6	MLSS	mg/l	36.0	
7	MLVSS	%	78.0	

Table 21: Sewage Water Monitoring at Kandla STP (4th Week)

Date of Sampling	21.06.21

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.71	7.02
2	Total Suspended Solids	mg/l	226.1	18.3
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	303.0	96.0
5	BOD @ 27 °C	mg/l	110.0	18.0
Aeration Tank				
6	MLSS	mg/l	20.0	
7	MLVSS	%	96.0	

- **Gopalpuri Colony STP**

Table 22: Sewage Water Monitoring at Gopalpuri STP (1st Week)

Date of Sampling	05.06.21

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.21	7.09
2	Total Suspended Solids	mg/l	166.7	54.9
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	383.8	84.4
5	BOD @ 27 °C	mg/l	124.0	16.0
Aeration Tank				
6	MLSS	mg/l	28.0	
7	MLVSS	%	86.0	

Table 23: Sewage Water Monitoring at Gopalpuri STP (2nd Week)

Date of Sampling	10.06.21

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.7	7.26
2	Total Suspended Solids	mg/l	95.21	41.9
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	431.27	109.8
5	BOD @ 27 °C	mg/l	138.0	19.0
Aeration Tank				
6	MLSS	mg/l	18.0	
7	MLVSS	%	96.0	

Table 24: Sewage Water Monitoring at Gopalpuri STP (3rd Week)

Date of Sampling	15.06.21

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.53	7.29
2	Total Suspended Solids	mg/l	52.9	20.1
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	230.28	57.57
5	BOD @ 27 °C	mg/l	76.0	15.0
Aeration Tank				
6	MLSS	mg/l	12.0	
7	MLVSS	%	92.0	

Table 25: Sewage Water Monitoring at Gopalpuri STP (4th Week)

Date of Sampling	21.06.21

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.25	7.12
2	Total Suspended Solids	mg/l	183.8	89
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	202	20.2
5	BOD @ 27 °C	mg/l	68.0	6.0
Aeration Tank				
6	MLSS	mg/l	38.0	
7	MLVSS	%	98.0	

- **Vadinar STP**

Table 26: Sewage Water Monitoring at Vadinar STP (1st Week)

Date of Sampling	05.06.21

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.26	NOT WORKING
2	Total Suspended Solids	mg/l	139.5	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	222.2	
5	BOD @ 27 °C	mg/l	86.0	

Table 27: Sewage Water Monitoring at Vadinar STP (2nd Week)

Date of Sampling	05.06.21

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.36	NOT WORKING
2	Total Suspended Solids	mg/l	108.8	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	353.5	
5	BOD @ 27 °C	mg/l	108.0	

Table 28: Sewage Water Monitoring at Vadinar STP (3rd Week)

Date of Sampling	15.06.21

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.14	NOT WORKING
2	Total Suspended Solids	mg/l	166.7	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	171.7	
5	BOD @ 27 °C	mg/l	52.0	

Table 29: Sewage Water Monitoring at Vadinar STP (4th Week)

Date of Sampling	21.06.21

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/l
1	pH	pH unit	7.26	Not working
2	Total Suspended Solids	mg/l	203.5	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	90.9	
5	BOD @ 27 °C	mg/l	28.0	

5.3 Conclusions:

The GPCB standards of BOD, TSS and Residual Chlorine for STP outlet are 20 mg/lit, 30 mg/lit & 0.5 mg/lit respectively. It is suggested to do treatment on regular basis to avoid flow of contaminated/polluted water into the sea. Also, the STP at Vadinar is also non-functional and thus, steps should be taken to commission the STP at Vadinar Port. Hence, currently only inlet samples are collected and analysed.

6. Marine Water Monitoring

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992) aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

Marine Environment

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations

The monitoring of marine environment for the study of biological and ecological parameters was carried out on 10th& 11th June -2021 in harbor regions of KPT and on 10th June-2021 at Vadinar during spring tide period of New moon phase of Lunar Cycle. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 18th& 19th June 2021 in harbor regions of KPT. 18th June -2021 in Vadinar during Neap tide period first quarter of Lunar Cycle..

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and two stations in Nakti creek and one station in Khori creek. The same sampling schedule was repeated during consecutive spring tide and neap tide in same month. Plankton samples from sub surface layer was collected both during high tide period and low tide period from 1 water quality monitoring stations near Vadinar jetty area during spring tide and neap tide in this month .Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

Sampling Locations

Offshore monitoring requirement	Number of locations
Offshore Installations	3 in Kandla creek 2 in Nakti creek 1 in Khori creek 1 near Vadinar Jetty 1 near 1st SBM
Total Number of locations	**8**

6.1 Marine Water Quality

Marine water quality of marine waters of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month.

The results of marine water quality and Marine sediments are as below;

Table 30: Marine Water Quality Monitoring Parameters for location near KPT colony

Sr. No.	Parameters	Unit	Kandla Creek Near KPT colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.21	7.35	7.18	7.14
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.7	32.1	32.8	
5	Turbidity	NTU	29	28	28	24
6	Total Dissolved Solids	mg/l	31107.0	35947.0	37797.0	33665.0
7	Total Suspended Solids	mg/l	377.4	359.9	714.2	412.4
8	Total Solids	mg/l	31560.0	36800.0	38860.0	34260.0
9	DO	mg/l	4.9	4.6	3.5	3.3
10	COD	mg/l	78.0	82.0	72.0	76.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.23	0.25	0.56	0.38
13	Phosphate	mg/l	0.35	0.36	0.27	0.24
14	Sulphate	mg/l	3360	3156	2628	3216
15	Nitrate	mg/l	1.97	2.35	2.14	2.78
16	Nitrite	mg/l	<0.01	<0.01	<0.01	<0.01
17	Calcium	mg/l	561.12	641.28	641.28	521.04
18	Magnesium	mg/l	1676.7	1676.7	1555.2	1725.3
19	Sodium	mg/l	11220.0	12080.0	8194.0	7418.0
20	Potassium	mg/l	380.0	390.0	372.0	414.0
21	Iron	mg/l	1.48	1.66	1.76	1.92
22	Chromium	mg/l	0.11	0.13	0.12	0.13
23	Copper	mg/l	0.05	0.06	0.06	0.07
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.08	0.05	0.06
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.15	0.17	0.16	0.18
28	Zinc	mg/l	0.06	0.07	0.05	0.06

Table 31: Marine Water Quality Monitoring Parameters for location near passenger Jetty One at Kandla

Sr. No.	Parameters	Unit	Near passenger Jetty One (2)			
			23° 0'18 "N 70°13'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.5	7.5	7.28	7.15
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.0	32.1	32.6	32.1
5	Turbidity	NTU	29	31	39	29
6	Total Dissolved Solids	mg/l	39865.0	39935.0	41765.0	36900.0
7	Total Suspended Solids	mg/l	366.8	414.5	404.0	477.9
8	Total Solids	mg/l	40212.0	40500.0	46018.0	37338.0
9	DO	mg/l	5.1	5.0	3.5	3.5
10	COD	mg/l	82.0	92.0	78.0	80.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.25	0.27	0.81	0.32
13	Phosphate	mg/l	0.35	0.32	0.20	0.33
14	Sulphate	mg/l	3120.0	3708.0	3336.0	2880.0
15	Nitrate	mg/l	6.0	2.54	1.35	4.33
16	Nitrite	mg/l	<0.01	<0.01	<0.01	<0.01
17	Calcium	mg/l	721.44	601.2	681.36	561.12
18	Magnesium	mg/l	1701.0	1603.8	1676.7	1725.3
19	Sodium	mg/l	11460.0	13211.0	9929.0	10111.0
20	Potassium	mg/l	390.0	382.0	471.0	381.0
21	Iron	mg/l	1.76	1.56	1.72	1.80
22	Chromium	mg/l	0.13	0.11	0.14	0.12
23	Copper	mg/l	0.06	0.07	0.08	0.07
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.05	0.06	0.06	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.18	0.16	0.17	0.16
28	Zinc	mg/l	0.06	0.06	0.07	0.07

Table 32: Marine Water Quality Monitoring Parameters for location Near Coal Berth

Sr. No.	Parameters	Unit	Near Coal Berth			
			22°59'12"N 70°13'40"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.3	7.21	7.2	7.5
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.0	32.2	32.0	32.3
5	Turbidity	NTU	33.0	31.0	31.8	32.0
6	Total Dissolved Solids	mg/l	34545.0	37030.0	35312.0	35363.0
7	Total Suspended Solids	mg/l	275.3	344.5	563.5	603.2
8	Total Solids	mg/l	35266.0	38080.0	36540	36100.0
9	DO	mg/l	4.8	4.6	4.2	4.3
10	COD	mg/l	86.0	92.0	101.0	100.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.27	0.20	0.38	0.22
13	Phosphate	mg/l	0.28	0.30	0.22	0.21
14	Sulphate	mg/l	1344	1500	2436	3240
15	Nitrate	mg/l	5.56	5.70	2.45	2.27
16	Nitrite	mg/l	0.028	0.02	0.04	0.02
17	Calcium	mg/l	641.28	681.36	601.2	641.28
18	Magnesium	mg/l	1555.2	1676.7	1652.4	1725.3
19	Sodium	mg/l	12015.0	11852.0	9320.0	9481.0
20	Potassium	mg/l	343.0	355.0	491.0	512.0
21	Iron	mg/l	1.44	1.23	1.64	1.34
22	Chromium	mg/l	0.12	0.10	0.12	0.13
23	Copper	mg/l	0.06	0.05	0.06	0.06
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.05	0.06	0.06	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.18	0.12	0.16	0.14
28	Zinc	mg/l	0.06	0.06	0.05	0.06

Table 33: Marine Water Quality Monitoring Parameters for location Khori creek at Kandla

Sr. No.	Parameters	Unit	KPT 4			
			Near 15/16 Berth			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.43	7.59	7.21	7.39
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.2	33.1	31.8	31.6
5	Turbidity	NTU	37	35	25	47
6	Total Dissolved Solids	mg/l	40837.0	45070.0	33588.0	33133.0
7	Total Suspended Solids	mg/l	299.2	315.5	407.3	438.9
8	Total Solids	mg/l	42994.0	46208.0	34336.0	34040.0
9	DO	mg/l	4.7	4.5	4.4	3.6
10	COD	mg/l	86.0	92.0	78.0	80.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.24	2.34	0.63	0.41
13	Phosphate	mg/l	0.28	0.32	0.26	0.28
14	Sulphate	mg/l	2628	2124	2988	2148
15	Nitrate	mg/l	7.25	2.64	4.67	7.08
16	Nitrite	mg/l	0.02	0.02	0.02	0.02
17	Calcium	mg/l	641.28	601.2	641.28	601.2
18	Magnesium	mg/l	1628.1	1749.6	1676.7	1652.4
19	Sodium	mg/l	10920.0	10962.0	9381.0	9252.0
20	Potassium	mg/l	344.0	352.0	366.0	488.0
21	Iron	mg/l	1.72	1.49	1.56	1.66
22	Chromium	mg/l	0.12	0.11	0.12	0.10
23	Copper	mg/l	0.05	0.05	0.06	0.05
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.07	0.08	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.18	0.16	0.15	0.14
28	Zinc	mg/l	0.06	0.05	0.05	0.06

Table 34: Marine Water Quality Monitoring Parameters for location Nakti Creek near Tuna Port

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.39	7.21	7.73	7.7
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.2	31.8	32.4	31.6
5	Turbidity	NTU	34	60	39	49
6	Total Dissolved Solids	mg/l	48922.0	26656.0	39244.0	26963.0
7	Total Suspended Solids	mg/l	287.3	243.68	326.4	214.2
8	Total Solids	mg/l	49728.0	27300.0	40996.0	27294.0
9	DO	mg/l	4.6	4.9	4.2	3.5
10	COD	mg/l	96.0	98.0	88.0	82.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.28	0.29	0.61	0.74
13	Phosphate	mg/l	0.35	0.37	0.18	0.18
14	Sulphate	mg/l	3480	2868	2316	3480
15	Nitrate	mg/l	5.28	2.80	4.50	4.58
16	Nitrite	mg/l	0.02	<0.01	<0.01	0.03
17	Calcium	mg/l	601.2	721.44	521.04	601.2
18	Magnesium	mg/l	1749.6	1628.1	1773.9	1773.9
19	Sodium	mg/l	12126.0	12102.0	10821.0	10728.0
20	Potassium	mg/l	352.0	372.0	521.0	510.0
21	Iron	mg/l	1.52	1.42	1.56	1.59
22	Chromium	mg/l	0.16	0.14	0.13	0.15
23	Copper	mg/l	0.07	0.08	0.07	0.07
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.08	0.07	0.07	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.14	0.12	0.12	0.13
28	Zinc	mg/l	0.05	0.06	0.06	0.07

Table 35: Marine Water Quality Monitoring Parameters for location Nakti Creek Near NH-8A at Kandla

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.3	Sampling not possible during Low Tide	7.51	Sampling not possible during Low Tide
2	Color	-	Colorless		Colorless	
3	Odor	-	Odorless		Odorless	
4	Salinity	ppt	32.2		32.8	
5	Turbidity	NTU	37		38	
6	Total Dissolved Solids	mg/l	34970		35210.0	
7	Total Suspended Solids	mg/l	736.8		318.3	
8	Total Solids	mg/l	36048.0		36110.0	
9	DO	mg/l	5.1		3.9	
10	COD	mg/l	98.0		110.0	
11	BOD	mg/l	<2.0		<2.0	
12	Silica	mg/l	0.31		0.98	
13	Phosphate	mg/l	0.28		0.29	
14	Sulphate	mg/l	3720		2220	
15	Nitrate	mg/l	5.45		3.62	
16	Nitrite	mg/l	0.03		0.04	
17	Calcium	mg/l	721.44		681.36	
18	Magnesium	mg/l	1506.6		1749.6	
19	Sodium	mg/l	11622.0		10303.0	
20	Potassium	mg/l	486.0		495.0	
21	Iron	mg/l	1.49		1.62	
22	Chromium	mg/l	0.13		0.14	
23	Copper	mg/l	0.08		0.08	
24	Arsenic	mg/l	<0.01		<0.01	
25	Cadmium	mg/l	0.05		0.07	
26	Mercury	mg/l	<0.001		<0.001	
27	Lead	mg/l	0.19		0.14	
28	Zinc	mg/l	0.07		0.06	

Table 36: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar Jetty

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.25	7.36	7.26	7.21
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.8	32.2	31.2	32.0
5	Turbidity	NTU	5	9	21	15
6	Total Dissolved Solids	mg/l	34444	31931	37088	41030
7	Total Suspended Solids	mg/l	258	482	405.5	399.5
8	Total Solids	mg/l	34948.0	32054.0	37892.0	41410.0
9	DO	mg/l	3.8	4.2	1.9	2.8
10	COD	mg/l	86.0	88.0	72.0	68.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.21	0.30	0.45	0.39
13	Phosphate	mg/l	0.28	0.30	0.16	0.14
14	Sulphate	mg/l	3012	3192	2388	1980
15	Nitrate	mg/l	5.7376	4.32256	0.07744	3.4496
16	Nitrite	mg/l	0.02	0.02	0.02	<0.01
17	Calcium	mg/l	561.12	521.04	561.12	521.04
18	Magnesium	mg/l	1409.4	1603.8	1579.5	1676.7
19	Sodium	mg/l	11720.0	12118.0	10062.0	10080.0
20	Potassium	mg/l	458.0	456.0	406.0	412.0
21	Iron	mg/l	1.77	1.56	1.66	1.62
22	Chromium	mg/l	0.13	0.12	0.16	0.15
23	Copper	mg/l	0.07	0.06	0.05	0.06
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.04	0.05	0.05
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.18	0.19	0.17	0.16
28	Zinc	mg/l	0.08	0.08	0.06	0.07

6.1.1 Marine Sediments

Sediment samples were collected with Van Veen Grab from the six locations in Kandla Port Waters and two locations in Vadinar Port. Samples were collected and preserved in silver foil in ice box to prevent the contamination/decaying of the samples.

6.2 Results

The Sediment Quality results are given in below from table no. 33

Table 34A: Results of Analysis of Sediment of Kandla & Vadinar Port (Spring Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 3	Khori - 1	Nakti Creek Near Tuna Port	Nakti - 1 (Near NH-8A)	Jetty
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.20	1.88	1.20	1.30	1.76	1.88	1.56
3	Organic Carbon	mg/kg	0.80	0.96	0.87	0.87	0.69	0.78	0.78
4	Inorganic Phosphate	mg/kg	132.0	126.0	156.0	177.0	167.0	182.0	175.0
5	Moisture	%	24.96	26.86	21.33	16.64	26.33	22.78	23.01
6	Aluminium	mg/kg	ND	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	23.0	22.0	26.0	28.0	32.0	36.0	40.0
8	Phosphate	mg/kg	10.80	11.50	11.77	12.71	9.24	9.88	10.20
9	Sulphate	mg/kg	218.0	252.0	138.0	225.2	239.0	280.0	252.0
10	Nitrite	mg/kg	0.1	0.12	0.13	0.12	0.13	0.12	0.13
11	Nitrate	mg/kg	9.20	7.22	10.42	8.88	8.02	7.89	6.88
12	Calcium	mg/kg	861.0	1102.0	801.0	862.0	922.0	1082.0	802.0
13	Magnesium	mg/kg	437.0	851.0	693.0	765.0	449.0	522.0	422.0
14	Sodium	mg/kg	2083.0	2387.0	1937.0	1859.0	2857.0	2034.0	2185.0
15	Potassium	mg/kg	707.0	918.0	954.0	774.0	1058.0	779.0	792.0
16	Chromium	mg/kg	123.0	180.0	140.0	138.2	146.0	92.0	145.0
17	Nickel	mg/kg	26.0	23.2	28.9	26.2	32.6	33.6	37.7
18	Copper	mg/kg	46	42.7	21.20	36.0	37.2	29.6	26.8
19	Zinc	mg/kg	32.35	38.30	36.70	40.	41.00	39.00	40.00
20	Cadmium	mg/kg	ND	ND	ND	ND	ND	ND	ND
21	Lead	mg/kg	2.86	2.8	5.2	5.0	4.2	5.6	7.2
22	Mercury	mg/kg	ND	ND	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND	ND	ND

*Grab samples could not be collected due high current at Vadinar SBM

Table 34B: Results of Analysis of Sediment of Kandla & Vadinar Port (Neap Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 3	Khori - 1	Nakti Creek Near Tuna Port	Nakti – 1 (Near NH-8A)	Jetty
1	Texture		Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
2	Organic Matter	mg/kg	1.46	1.22	1.66	1.55	1.46	1.35
3	Organic Carbon	mg/kg	0.84	0.69	0.48	0.90	0.96	0.78
4	Inorganic Phosphate	mg/kg	155.0	148.0	162.0	149.0	164.0	166.0
5	Moisture	%	24.9	22.05	28.4	30.08	28.62	20.30
6	Aluminium	mg/kg	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	23.8	22.5	21.82	33.6	32.8	26.0
8	Phosphate	mg/kg	8.53	7.97	9.80	8.62	9.88	11.06
9	Sulphate	mg/kg	196.6	163.89	184.45	140.0	152.0	171.88
10	Nitrite	mg/kg	0.11	0.13	0.14	0.12	0.14	0.12
11	Nitrate	mg/kg	6.42	7.77	6.88	6.89	7.02	8.88
12	Calcium	mg/kg	288.6	212.0	232.4	284.0	296.0	224.0
13	Magnesium	mg/kg	177.4	177.0	170.76	197.2	188.0	535.0
14	Sodium	mg/kg	2662.0	1216.0	990.0	828.0	910.0	1150.0
15	Potassium	mg/kg	200.0	106.0	50.2	79.0	89.0	110.0
16	Chromium	mg/kg	145.0	133.0	146.0	126.0	101.0	166.0
17	Nickel	mg/kg	31.2	26.6	20.3	28.2	27.8	20.9
18	Copper	mg/kg	54.2	26.5	16.2	12.10	11.02	42.0
19	Zinc	mg/kg	23.0	31.0	24.62	29.42	33.36	42.52
20	Cadmium	mg/kg	ND	ND	ND	ND	ND	ND
21	Lead	mg/kg	ND	4.2	4.0	4.2	4.2	3.8
22	Mercury	mg/kg	ND	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND	ND

*Grab samples could not be collected due high current at KPT 2, Vadinar Jetty and Vadinar SBM

REPORT

ON

ECOLOGICAL MONITORING

OF MARINE ENVIRONMENT

IN

DPT HARBOURAREA, NEAR BY CREEKS

For

DEENDAYAL PORT TRUST

JUNE, 2021

INTRODUCTION:

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992)aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

MARINE ENVIRONMENT:

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations:

The monitoring of marine environment for the study of biological and ecological Parameters was carried out on 10th June, 2021 in in harbour region of DPT, and on 11thJune, 2021 in creeks near by the port during spring tide .The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 18th June, 2021 in harbour region of DPT and on19thJune, 2021 in creeks near by the port during neap tidal condition .

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of DPT harbour area andone stations in Nakti creek and one station in Khori creek. Sampling at second sampling station of Nakti creek was possible only during high tide period. Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

TABLE #1 SAMPLING LOCATIONS

monitoring requirement	**Number of locations**
Kandla creek Nakti creek Khori Creek	3 in Kandla creek 2 in Nakti creek 1 in Khori creek
Total Number of locations	**6**

Sampling methodology adopted:

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.

50 litters of the water sample were collected from Sub surface by using bucket. From the collected water sample 1 litter of water sample were taken in an opaque plastic bottle for chlorophyll estimation, thereafter plankton samples were collected by using filtration assembly with nilyobolt cloth of 20µm mesh size.

Samples Processing for chlorophyll estimation:

Samples for the 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 litter of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm. By using corrected optical density, Chlorophyll-a value was calculated as given in (APHA, 1998).

PLANKTON:

The entire area open water in the sea is the pelagic realm. Pelagic organisms live in the open sea. In contrast to the pelagic realm, the benthic realm comprises organisms and zone of the bottom of the sea. Vertically the pelagic realm can be dividing into two zones based on light penetration; upper photic or euphotic zone and lower dark water mass, aphotic zone below the photic zone.

The term plankton is general term for organisms have such limited powers of locomotion that they are at the mercy of the prevailing water movement. Plankton is subdivided to phytoplankton and zooplankton. Phytoplankton is free floating organisms that are capable of photosynthesis and zooplankton is the various free floating animals.

Pelagic zone, represents the entire ocean water column from the surface to the deepest depths, is home to a diverse community of organisms. Differences in their locomotive ability categorize the organisms in the pelagic realm into two, ***plankton*** and ***nekton*** (Lalli and Parsons, 1997). ***Plankton*** consists of all organisms drifting in the water and is unable to swim against water currents, whereas ***Nekton*** includes organisms having strong locomotive power. Ecological studies on the plankton community, which form the base of the aquatic food chain, help in the better understanding of the dynamics and functioning of the marine ecosystem. The term 'Plankton' first coined by Victor Hensen (1887), Plankton, (Greek word: *planktos*meaning "passively drifting or wandering") is defined as drifting or free-floating organisms that inhabit the pelagic zone of water. Based on their mode of nutrition planktonic organisms are categorised into phytoplankton (organisms having an autotrophic mode of nutrition) and zooplankton (organisms having a heterotrophic mode of nutrition).

Phytoplankton in the marine environment:

Phytoplankton is 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).The phytoplankton those normally captured in the net from the Gulf of Kutch is normally dominated by these two major groups; diatoms and dinoflagellates. Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as and Cyanophytes (blue-green 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 in the marine environment:

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 is 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, 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 (Beaugrand et al., 2004). Zooplankton grazing in the marine environment controls the primaryProduction and helps in determining the pelagic ecosystem (Banse, 1995). 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.

Based on the duration of planktonic life, zooplankton are categorised into Holoplankton (organisms which complete their entire lifecycle as plankton) and Meroplankton (organisms which are planktonic during the early part of their lives such as the larval stages of benthic and nektonic organisms). Tychoplankton are organisms which live a brief planktonic life, such as the benthic crustaceans (cumaceans, mysids, isopods) which ascend to the water column at night for feeding and certain ectoparasitic copepods, they leave the host and spend their life as plankton during their breeding cycle.

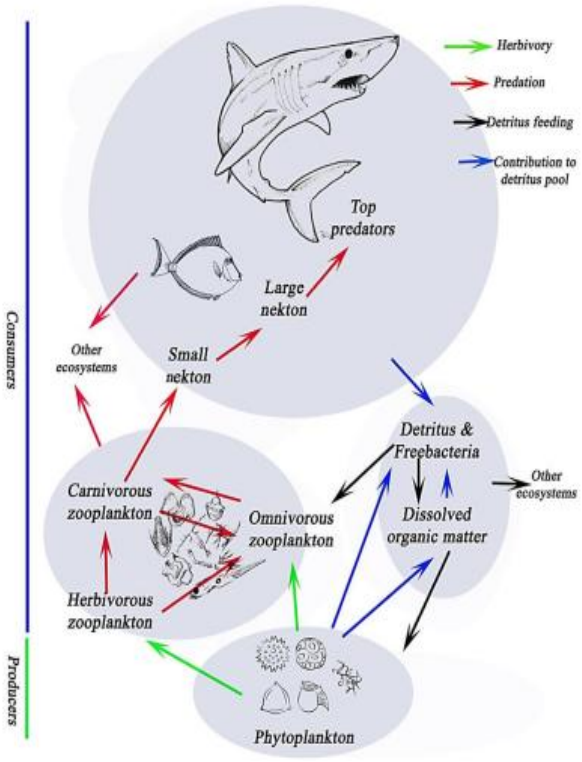
Zooplankton can be subdivided into holoplankton, i.e., permanent members of the plankton (e.g., Calanoid copepods), and meroplankton, i.e., temporary members in the plankton e.g., larvae of

fish, shrimp, and crab). The meroplankton group consists of larval and young stages of animals that will adopt a different lifestyle once they mature. In contrast to phytoplankton which consist of a relatively smaller variety of organisms, Zooplankton are extremely divers, consist of a host of larval and adult forms representing many animal phylum.

Among the zooplankton one group always dominate than others; members of sub class copepods (Phylum Athropoda), and Tintinids (Phylum Protozoa) among the net planktons. These small animals are of vital importance in marine ecosystem as one of the primary herbivores animals in the sea, and it is they provide vital link between primary producer (autotrophs) and numerous small and large marine consumers.

As their community structure and function are highly susceptible to changes in the environmental conditions regular monitoring of their distribution as well as their interactions with various physicochemical parameters is inevitable for the sustainable management of the ecosystem (Kusum et al., 2014). Of all the marine zooplankton groups, copepods mainly calanoid copepods are the dominant groups in marine subtropical and tropical waters and exhibit considerable diversity in morphology and habitats they occupy (Madhupratap, 1991;)

It has been well established that potential of pelagic fishes viz. finfishes, crustaceans, molluscs and marine mammals either directly or indirectly depend on zooplankton. The herbivorous zooplankton is efficient grazers of the phytoplankton and is referred to as living machines transforming plant material into animal tissue. Hence they play an essential role as the intermediaries for nutrients/energy transfer between primary and tertiary trophic levels. Due to their large density, shorter lifespan, drifting nature, high group/species diversity and different tolerance to the stress, they used as the indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem (Ghajbhiye, 2002).



Simplified marine food web

Spatial distribution of Plankton:

A characteristic of plankton population is that they tend to occur in patches, which are varying spatially on a scale of few meters to far as few kilometres in distance. They also vary in time scale, season as well as vertically in the water column. It is this patchiness and its constant changes in time and spot, that has made it so difficult for plankton biologist to learn about the ecology of plankton. The biological factors that causes this patchiness is due to the ability of zooplankton to migrate vertically and graze out the phytoplankton at a rapid rate that can create patchiness. Similarly the active swimming ability by certain zooplankton organisms can cause to aggregate in dense group.

At its most extreme, because the water in which plankton is suspended is constantly moving, each sample taken by the plankton biologists remain a different volume of water, so each sample is unique and replicate does not exist.

Plankton June also exhibit vertical patchiness. Physical factors contribute to this type of patchiness include light intensity, nutrients and density gradients in the water column.

Phytoplankton in particular tends to be unequally distributed vertically, which leads to the existence of different concentration of a chlorophyll value between photic zone and below the photic zone.

Methodology adopted for Plankton sampling:

Mixed plankton sample were obtained from the sub surface layer at each sampling locations by towing the net horizontally with the weight .After the tow of about 15-30minutes, plankton net was pulled up and washed down to the tail and collected the plankton adhered to plankton net in the collection bucket at the bottom by springing outer and inner surface of the net with sea water, while the net was hanging with the mouth upward. For quantitative evaluation 50 L water samples were collected from subsurface layer and filtered through 20µm mesh size net by using bucket and filtration assembly.

Preservation and storage:

Both filtered plankton and those collected from the plankton net were preserved with 5% buffered formalin and stored in 1L plastic container for further processing in the laboratory.

Sample concentration:

The collected plankton samples were concentrated by using centrifuge and made up to 50 ml with 5% formalin -Glycerine mixture.

Taxonomic evaluation:

Before processing, the sample was mixed carefully and a subsample was taken with a calibrated Stempel-pipette. 1 ml of the concentrated plankton samples were transferred on a glass slide with automatic pipette. The plankton sample on the glass slides were stained by using Lugol's iodine and added glycerine to avoid drying while observation. The plankton samples were identified by using Labex triangular Research microscope with photographic attachment. Microphotographs of the plankton samples were taken for record as well as for confirming the identification. The bigger sized zooplankton was observed through dissecting stereomicroscope with magnification of 20-30 x. Plankton organisms in the whole slide were identified to the lowest axon possible. A thorough literature search was conducted for the identification of the different groups of zooplankton that were encountered

Cell counts by drop count method:

The common glass slide mounted with a 1ml of concentrated phytoplankton/zooplankton sample in glycerol and covered with cover slip 22x 60mm was placed under the compound microscope provided with a mechanical stage. The plankton was then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton

in each microscopic field was thus counted. When first microscopic field row was finished the next consecutive row was adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted. From this total number in 1ml of the concentrated plankton, total number of plankton in the original volume of sample filtered was calculated as units/L.

BENTHIC ORGANISMS:

Benthos is those organisms that are associated with the sea bed or benthic habitats. Epi- benthic organisms live attached to a hard substratum or rooted to a shallow depth below the surface. In fauna organisms live below the sediment–water interface. Interstitial organisms live and move in pore water among sedimentary grains.

Because the benthic organisms are often collected and separated on sieves, a classification based on the overall size is used. Macro benthos include organisms whose shortest dimension is greater than or equal to 0.5 mm. Meio benthos are smaller than 0.5mm but larger than 42µ in size.

The terms such as macro fauna and Meio fauna generally have little relevance with taxonomic classification. The terms Meio fauna and macro fauna depend on the size. Meio fauna were considered as good bioassay of community health and rather sensitive indicators of environmental changes

SAMPLING METHODOLOGY ADOPTED FOR SUB TIDAL REGION:

Van veen sampler (0.09m^2) was used for sampling bottom sediments. Two sets of sediments were sampled from each location, one for macro fauna and other for Meio fauna. The macro fauna in the sediments were sieved on board to separate out the organisms. The fixation of Meio fauna is normally done by bulk fixation of the sediment sample. The bulk fixation is done by using 10% formalin (Buffered with borate). The organisms were preserved with seawater as diluting agent.

Sample sieving:

Sediments samples were sieved to extract the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. The large portion of the sediment was split in to smaller portions and mixed with sea water in a bucket. The cohesive lumps were broken down by continuous stirring. The disaggregated sediments were then passed through the sieves.

Sample staining:

Sorting of the Meio fauna from the sieve is difficult task especially in the preserved material, because organisms are not easily detectable. To facilitate the animal detection the entire sample retained on the sieve after sieving operation were stained by immersing the sieve in a flat bottom

tub with 1% Rose Bangal stain; a protein stain. A staining period of 10-30 minutes is sufficient for sample detection.

DIVERSITY INDICES:

On the whole, diversity indices provide more information about community composition than simply species richness (number of species present); they also, take the relative abundances of different species into account. Based on this fact, diversity indices therefore depend not only on species richness but on the evenness, or equitability, with which individuals are distributed among the different species (Magurram, A. E. (1988)

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.

The basic idea of diversity 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 (Carol H.R. *etal*. 1998). Biodiversity is commonly expressed through indices based on species richness and species abundances (Whittaker 1972, Lande 1996, Purvis and Hector 2000). 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.

A diversity Index is a single statistic that incorporates in formation on richness and evenness. The diversity measures that incorporate the two concepts may be termed heterogeneity measures (Magurran, 2004).

Any study intended to interpret causes and effect of adverse impact on Biodiversity of communities require suitable measures to evaluate specie richness and Diversity. The former is number of species in community, while latter is a function of relative frequency of different species. Species richness is the iconic measure of biological diversity (Magurran, 2004). Several indices have been created to measure the diversity of species; however, the most widely used in the last decades are the Shannon (1948) and Simpson (1949) (Buzas and Hayek 1996; Gorelick 2006), with the components of diversity: richness (*S)* and evenness (*J)*

Simpson's diversity index

Simpson's index (**D**) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present.. The Simson index is one of the meaningful and robust biodiversity measures available.(Magurran ,2004).

The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and, 1, no diversity. When D increases diversity decreases. Simpson's index is therefore usually expressed as 1-D or 1/D. (Magurran, 2004)

Low species diversity suggests:

- relatively few successful species in the habitat
- the environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment
- food webs which are relatively simple
- change in the environment would probably have quite serious effects

High species diversity suggests:

- a greater number of successful species and a more stable ecosystem
- more ecological niches are available and the environment is less likely to be hostile complex food webs
- environmental change is less likely to be damaging to the ecosystem as a whole

Species richness indices

The species richness***(S)*** is simply the number of species present in an ecosystem. Species richness Indices of species richness are widely used to quantify or monitor the effects of anthropogenic disturbance. A decline in species richness may be concomitant with severe or chronic human-induced perturbation (Fair Fair weather 1990,) Species richness measures have traditionally been the mainstay in assessing the effects of environmental degradation on the biodiversity of natural assemblages of organisms (Clarke &Warwick, 2001)

Species richness is the iconic measure of biological diversity (Magurran, 2004). The species richness***(S)*** is simply the number of species present in an ecosystem. This index makes no use of

relative abundances. The term species richness was coined by McIntosh (1967) and oldest and most intuitive measure of biological diversity (Magurran, 2004).

Margalef's diversity index is a species richness index. Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, were derived.

The value of a diversity index increases both when the number of types increases and when evenness increases. For a given number of types, the value of diversity index is maximised when all types are equally abundant (Rosenzweig, M. L. (1995).

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 (Odum 1971 and Reish 1984). Shannon-Wiener's index **(H**) reproduce community parameters to a single numberby using an equation.

Shannon and Weiner index represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxa. It varies from 0 for communities with only single taxa to high values for community with many taxa each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range of polluted and unpolluted ecosystems, Wilham and Dorris (1968) concluded that the values of the index greater than 3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln\left(\frac{n_j}{N}\right)$$

RESULTS:

CHLOROPHYLL-a:

Water Samples for the chlorophyll estimation were collected from sub surface layer during high tide and low tide period of the tidal cycle for each sampling locations and analysed for Chlorophyll -a and after acidification for Pheophytin –a. Chlorophyll- a value was used as algal biomass indicator (APHA,1998) Algal biomass was estimated by converting Chlorophyll value.

In the sub surface water chlorophyll-a was varying from 0.314 -0.468mg/m^3.in harbour region of DPT during sampling done in spring tide period of June, 2021. In the nearby creeks chlorophyll-a was varying from 0.329-0.739 mg/m^3.Pheophytin –a level was below detectable limit- the all the sampling stations during spring in the harbour region of DPT.

In the sub surface water chlorophyll-a was varying from 0.527 -0.765 mg/m^3.in harbour region of DPT during sampling done in neap tide period of June, 2021 . In the nearby creeks chlorophyll-a was varying from 0.425- 0.850 mg/m^3. Pheophytin –a level was below detectable limit- the all the sampling stations during spring in the harbour region of DPT

TABLE #2 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JUNE,2021

Sr.No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREA					
1	KPT1	High tide	0.381	BDL	25.53
		Low tide	0.440	BDL	29.48
2	KPT 2	High tide	0.314	BDL	21.04
		Low tide	0.417	BDL	27.94
3	KPT 3	High tide	0.468	BDL	31.36
		Low tide	0.424	BDL	28.41
CREEKS					
4	KPT-4 Khori-I	High tide	0.739	BDL	49.51
		Low tide	0.578	BDL	38.73
5	KPT-5 Nakti-I	High tide	0.637	BDL	42.68
		Low tide	0.409	BDL	27.40
6	KPT-5 Nakti-II	High tide	0.329	BDL	22.04

BDL: Below Detectable Limit.

TABLE #3 VARIATIONS IN CHLOROPHYLL –aPHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN JUNE,2021

Sr.No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREA					
1	KPT1	High tide	0.631	BDL	42.28
		Low tide	0.765	BDL	51.25
2	KPT 2	High tide	0.731	BDL	48.98
		Low tide	0.614	BDL	41.14
3	KPT 3	High tide	0.527	BDL	35.31
		Low tide	0.615	BDL	41.21
CREEKS					
4	KPT-4 Khori-I	High tide	0.748	BDL	50.12
		Low tide	0.850	BDL	56.95
5	KPT-5 Nakti-I	High tide	0.715	BDL	47.90
		Low tide	0.715	BDL	47.90
6	KPT-5 Nakti-II	High tide	0.425	BDL	28.47

BDL: Below Detectable Limit.

PHYTOPLANKTON POPULATION:

For the evaluation of the Phytoplankton population in DPT harbour area and within the immediate surroundings of the port, sampling was conducted from 5 sampling locations (3 in harbour area and two in Nakti creek) during high tide period and low tide period of spring tide. The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by,Diatoms and dinoflagellates during spring tide period.Diatoms were represented by 14 genera. Dinoflagellates wererepresented by onegenera .during the sampling conducted in spring tide in June,2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 112-216 units/ L during high tide period and 147-172 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by Diatoms and dinoflagellates during spring tide period.Diatoms were represented by 15genera and Dinoflagellateswere represented onegenera during the sampling conducted in Neap tide in June, 2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 72-293 units/ L during high tide period and 202-375 units/ L during low tide of Neap Tide.

Species Richness Indices and Diversity Indices :

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 1.907-2.660 with an average of 2.381during the sampling conducted in High tide period of spring tide While .Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla Harbour region and nearby creeks was varying from. 1.603-2.395 with an average of 2.140 during the consecutive in low tide period .

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 1.775-2.614 with an average of 2.212 during the sampling conducted in High tide period of Neaptide While .Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla Harbour region and nearby creeks was varying from. 1.695-2.193 with an average of 1.966 during the consecutive in low tide period .

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.794-0.908 (H'(log10)) between selected sampling stations with an average value of 0.844. during high tide period of spring tide .Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.788-0.845 (H'(log10)) between selected sampling stations with an average value of 0.813 during consecutive lowtide. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.722-0.883 (H'(log10)) between selected sampling stations with an average value of 0.814. during high tide period of neap tide . Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.723-0.883 (H'(log10)) between selected sampling stations with an average value of 0.813 during consecutive low tide. Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of phytoplankton of Kandla Harbour region and nearby creeks is less but with abundant population of few, with relatively few ecological niches and only very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran,2004).

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.796- 0.840 between selected sampling stations with an average of 0.815 during high tide period of spring tide . Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.790- 0.821 between selected sampling stations with an average of 0.803 during consecutive low tide . Low species diversity suggests a relatively few successful species in this habitat. The environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in Kandla Harbour region and nearby creeks, during high tide period and low tide period during neap tide also, which was varying from 0.741-0.831 with an average value of 0.800

between selected sampling stations during high tide period and varying from 0.719-0.808 with an average value of 0.758 between selected sampling stations duringconsecutive low tide period Low species diversity suggests a relatively few successful species in this habitat.

Table # 4PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JUNE,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	158	14/15	93.33	2.568	0.89	0.8401
	2	151	14/15	93.33	2.591	0.8397	0.8165
	3	170	12/15	80	2.142	0.7942	0.7962
	4	216	14/15	93.33	2.418	0.8223	0.8042
	5	193	15/15	100	2.66	0.9078	0.8326
	6	112	10/15	66.66	1.907	0.8103	0.8029
LOW TIDE	1	156	13/15	86.66	2.376	0.8446	0.8209
	2	147	9/15	60	1.603	0.7909	0.8148
	3	152	12/15	80	2.19	0.8051	0.791
	4	172	12/15	80	2.137	0.788	0.7904
	5	150	13/15	86.66	2.395	0.8371	0.7996

Table # 5 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN JUNE,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	240	15/16	93.75	2.554	0.883	0.8308
	2	248	12/16	75	1.995	0.7916	0.7925
	3	212	15/16	93.75	2.614	0.8664	0.8285
	4	293	15/16	93.75	2.465	0.8666	0.8224
	5	280	11/16	68.75	1.775	0.7227	0.7413
	6	72	9/16	56.25	1.871	0.7522	0.7891
LOW TIDE	1	278	11/16	68.75	1.777	0.7379	0.7658
	2	206	12/16	75	2.065	0.7625	0.784
	3	202	10/16	62.50	1.695	0.7941	0.8008
	4	375	14/16	87.5	2.193	0.7182	0.7189
	5	303	13/16	81.25	2.1	0.7164	0.7232

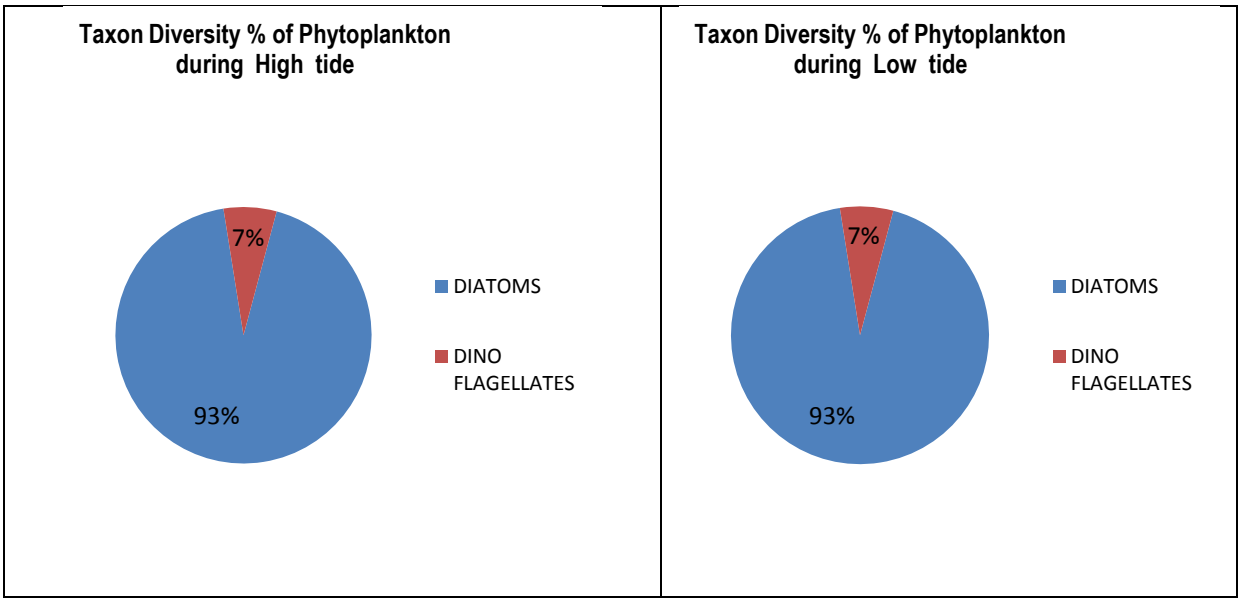
Table # 6 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING SPRING TIDE IN JUNE,2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	112-214	14/15	93.33
			DINO FLAGELLATES	0-2	1/15	6.67
			TOTAL PHYTO PLANKTON	112-216	15	-
LOW TIDE	Sub surface	5	DIATOMS	147-171	14/15	93.33
			DINO FLAGELLATES	0-2	1/15	6.67
			TOTAL PHYTO PLANKTON	147-172	15	-

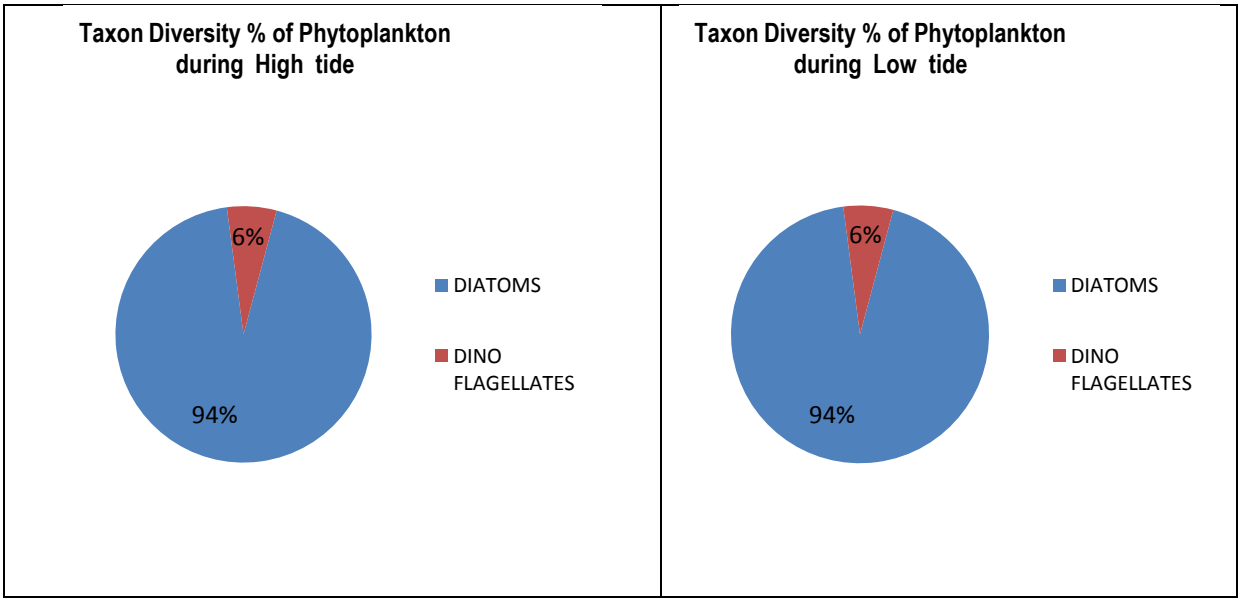
Table # 7 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING NEAP TIDE IN JUNE, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	72-291	15/16	93.75
			DINO FLAGELLATES	0-2	1/16	6.25
			TOTAL PHYTO PLANKTON	72-293	16	-
LOW TIDE	Sub surface	5	DIATOMS	202-374	15/16	93.75
			DINO FLAGELLATES	0-1	1/16	6.25
			TOTAL PHYTO PLANKTON	202-375	16	

Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide



Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide



ZOOPLANKTON POPULATION:

For the evaluation of the Zooplankton population in DPT harbour area and within the immediate surroundings of the port sampling was conducted from 6 sampling locations (3 in harbour area and two in Nakti creek and one in Khoricreek) during high tide period and low tide period of spring tide and Neap tide in June 2021 . The Zooplankton community of the sub surface water in the harbour and nearby creeks during spring tide was represented by mainly four groups, Tintinids, Copepods,Foraminiferans and larval forms of Crustacea, Molluscans. The Zooplankton

community of the sub surface water in the harbour and nearby creeks during neap tide was represented by mainly five groups, Tintinids, Copepods, Arrow worms, Mysids and larval forms of Crustacea and Polychates,.

Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 61-138x10^3 N/ m^3 during high tide and 78-112x10^3 N/ m^3during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 47-176 x10^3 N/ m^3 during high tide and80-157 N/ L during low tide of Neap Tide period.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the stations Kandla Harbour region and nearby creeks was varying from 2.563-3.067 with an average of 2.804 during the sampling conducted in High tide period.Margalef's diversity index (Species Richness) S of Zooplankton communities varying from.2.136-2.875 with an average of 2.485 during the sampling conducted in low tide period during Spring tide.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the Kandla Harbour region and nearby creeks sampling stations was varying from3.610-453 with an average of 4.016 during the sampling conducted in high tide and varying from. 2.755-4.747 with an average of 3.779 during the sampling conducted in low tide during Neap tide period.**Shannon-Wiener's index:**

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.912-1.017 (H'(log10)) between selected sampling stations with an average value of 0.947 (H'(log10)) during high tide period of spring tide .Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.872-0.939 (H'(log10)) between selected sampling stations with an average value of 0.908 (H'(log10)) during consecutive low tide period .

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.962-1.143 (H'(log10)) between selected

sampling stations with an average value of 1.071 (H'(log10)) during high tide period of Neap tide . Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.952-1.168(H'(log10)) between selected sampling stations with an average value of 1.051 (H'(log10)) during consecutive low tide period .Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of Zooplankton of Kandla Harbour region and nearby creeks stations is slightly high with very minimum diverse population but very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran, 2004).

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeksduring high tide and low tide of spring tide period except few during high tide period, which was varying from 0.838-0.904 between selected sampling stations with an average of 0.862 during high tide period and was varying from 0.838-0.865 with an average value of 0.849 between selected sampling stations during low tide

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks during high tide and except one duringhigh tide of Neap tide, which was varying from 0.853-0.905 between selected sampling stations with an average of 0.886 during high tide period and was varying from 0.840- 0.909 with an average value of 0.881 between selected sampling stations during consecutive low tide

This low species diversity suggests a relatively low number of successful species in this habitat. Environment is quite stressful with relatively few ecological niches and only few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Table # 8 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JUNE,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	96 $X10^3$	15/17	88.24	3.067	1.01	0.8836
	2	77 $X10^3$	13/17	76.47	2.763	0.9118	0.8506
	3	92 $X10^3$	14/17	82.35	2.875	0.9144	0.8385
	4	138 $X10^3$	14/17	82.35	2.638	0.9177	0.8445
	5	108 $X10^3$	13/17	76.47	2.563	0.9144	0.852
	6	61 $X10^3$	13/17	76.47	2.919	1.017	0.9038
LOW TIDE	1	78 $X10^3$	11/17	64.70	2.295	0.8723	0.8382
	2	92 $X10^3$	14/17	82.35	2.875	0.9395	0.8538
	3	105 $X10^3$	12/17	70.58	2.364	0.8972	0.8443
	4	112 $X10^3$	14/17	82.35	2.755	0.9159	0.8468
	5	108 $X10^3$	11/17	64.70	2.136	0.9189	0.8654

Table # 9 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN JUNE,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	111 $X10^3$	18/26	69.23	3.61	0.9985	0.8526
	2	100 $X10^3$	19/26	73.07	3.909	1.068	0.8846
	3	103 $X10^3$	22/26	84.61	4.531	1.129	0.905
	4	176 $X10^3$	24/26	92.31	4.448	1.143	0.904
	5	155 $X10^3$	21/26	80.77	3.966	1.13	0.9041
	6	47 $X10^3$	15/26	57.69	3.636	0.9622	0.8668
LOW TIDE	1	80 $X10^3$	16/26	61.54	3.423	1	0.8684
	2	103 $X10^3$	17/26	65.38	3.452	0.9526	0.8401
	3	112 $X10^3$	14/26	53.85	2.755	1.005	0.8795
	4	157 $X10^3$	25/26	96.15	4.747	1.168	0.9082
	5	130 $X10^3$	23/26	88.46	4.52	1.131	0.9095

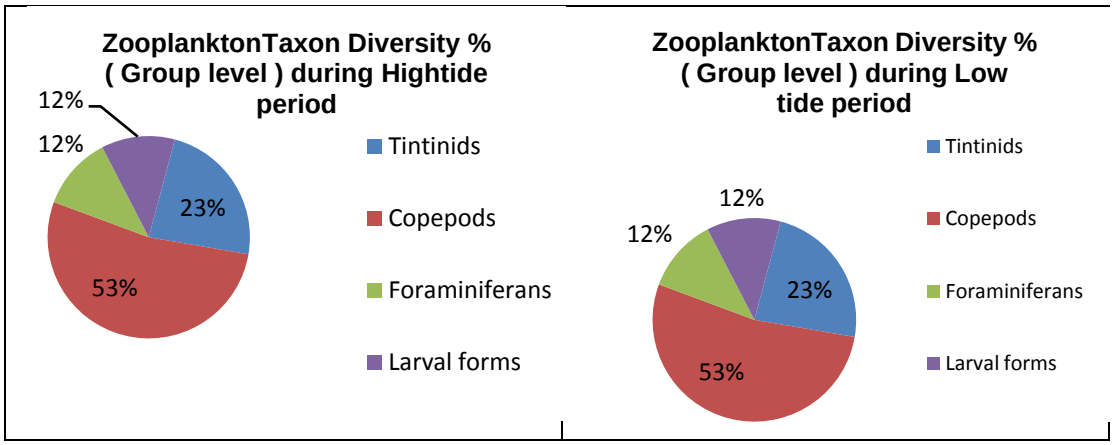
Table # 10 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JUNE,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	10-16	4/17	23.53
			Copepods	31-72	9/17	52.95
			Foraminiferans	0-4	2/17	11.76
			Larval forms	15-50	2/17	11.76
			TOTAL ZOOPLANKTON NO/L	**61-138**	**17**	-
LOW TIDE	Sub surface	5	Tintinids	8-15	4/17	23.53
			Copepods	45-57	9/17	52.95
			Foraminiferans	0-2	2/17	11.76
			Larval forms	25-43	2/17	11.76
			TOTAL ZOOPLANKTON NO/L	**78-112**	**17**	-

Table # 11 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA , NEAR BY CREEKS DURING NEAP TIDE IN JUNE,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	4-15	6/26	23.07
			Copepods	25-98	10/26	38.46
			Mysids	1-2	1/26	3.85
			Arrow worms	1-2	1/26	3.85
			Foraminiferans	0-2	1/26	3.85
			Larval forms	17-59	7/26	26.92
			TOTAL ZOOPLANKTON NO/L	**47-176**	**26**	-
LOW TIDE	Sub surface	5	Tintinids	4-15	6/26	23.07
			Copepods	38-85	10/26	38.46
			Mysids	0-2	1/26	3.85
			Arrow worms	0-2	1/26	3.85
			Foraminiferans	0-1	1/26	3.85
			Larval forms	37-52	7/26	26.92
			TOTAL ZOOPLANKTON NO/L	**80-157**	**26**	-

Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide



Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide

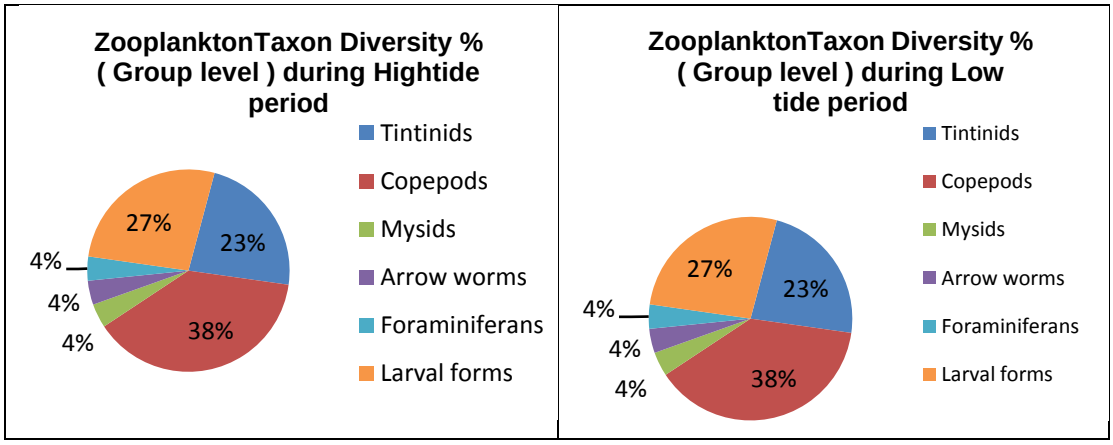


TABLE # 12 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURINGSPRING TIDE OF JUNE,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Abundant
			Triceratiales	Triceratiaceae	*Odontellasp*	D3	Rare
					*Triceratium*sp.	D4	Occasional
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Frequent
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D6	Occasional
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D7	Occasional
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D8	Dominant
			Thalassiosirales	Thalassiosiraceae	*Thalassiosira*sp	D9	Rare
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D10	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D11	Frequent
					Thalassionema sp.	D12	Rare
			Fragilariales	Fragilariaceae	*Fragilaria*sp	D13	Occasional
					*Synedra*sp	D14	Frequent
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF1	Rare

TABLE # 12 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURING AND NEAP TIDE OF JUNE,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Occasional
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Dominant
			Triceratiales	Triceratiaceae	*Triceratiumsp*	D3	Occasional
					Odontellasp	D4	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Abundant
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D6	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D7	Rare
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D8	Abundant
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D9	Occasional
			Bacillariales	Bacillariaceae	*Bacillaria* sp.	D10	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D11	Frequent
					Thalassionema sp.	D12	Rare
			Fragilariales	Fragilariaceae	*Fragilaria*sp	D13	Rare
					*Synedra*sp	D14	Frequent
					*Asterionella*sp	D15	Occasional
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Rare

TABLE #13 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING SPRING TIDE OF JUNE,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Occasional
				Codonellidae	*Tintinnopsisfailakkaensis*	T2	Occasional
					Tintinnopsisgracilis	T3	Occasional
					Tintinnopsis radix	T4	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Frequent
					Bestiolina sp.	C2	Rare
					Parvocalanus sp.	C3	Occasional
				Eucalanidae	*Pareucalanus sp.*	C4	Rare
				Clausocalanidae	*Clausocalanus sp.*	C5	Occasional
				Temoridae	*Temora sp.*	C6	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C7	Abundant
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C8	Frequent
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C9	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L2	Occasional
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Globigerinidae	*Globigerina* sp.	F1	Rare
				Rotalliidae	*Rotalia* sp.	F2	Rare

TABLE # 13 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING NEAP TIDE OF JUNE,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Rare
				Codonellidae	*Tintinnopsisaccuminata*	T2	Occasional
					Tintinnopsisfailakkaensis	T3	Occasional
					Tintinnopsisgracilis	T4	Rare
					Tintinnopsis radix	T5	Rare
				Codonellopsidae	*Codonellopsis* sp.	T6	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Abundant
					Parvocalanus sp.	C2	Rare
				Eucalanidae	*Pareucalanus sp.*	C3	Frequent
					Subeucalanus sp.	C4	Occasional
				Temoridae	*Temora sp.*	C5	Frequent
				Acartiidae	*Acartia sp.*	C6	Occasional
			Cyclopoida	Oithonidae	*Oithona sp.*	C7	Frequent
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C8	Frequent
				Euterpinidae	*Euterpina sp.*	C9	Frequent
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C10	Rare
ARROW WORMS	CHAETOGNATHA	Sagittoideae	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Rare
MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Penaeidae	*Metapenaeussp.*	M1	Rare

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
POLYCHAETE LARVA	ANNELIDA	Polychaeta			Trochophore larvae	L2	Occasional

BENTHIC ORGANISMS:

No Benthic organism was observed in the collected sediments by using the Van-veen grabs during the sampling conducted during spring tide periodfrom DPT harbour region and nearby creek except few dead shells. Benthic organisms form the sample collected during Neap tide is represented by mainly Polychates ,*Pontodora*sp. *Paronis* sp. and *Phalacophorus*sp and few Amphipods. The benthic organisms at subtidal region of harbour region and creek varies from 30-100 N/m^2

Table # 14 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPT HARBOUR AREA CREEKS DURING NEAP TIDE IN JUNE,2021

	ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS REPRESENTATION BY GROUP						
	DPT HARBOUR			**CREEKS**			
Benthic fauna							
POLYCHATES	KPT-1	KPT-2	KPT-3	KPT-4	KPT-5	KPT-6	
Family : Iospilidae *Pondodora sp.*	10	NS	0	20	30	NS	
Family : Syllidae *Syllis sp*.	20	NS	10	30	10	NS	
Family Glyceredae *Glycerasp.*	30	NS	0	0	0	NS	
Total Polychates N/M^2		NS				NS	
Un identified Nematode worms		NS		0		NS	
Amhipods Un identified	0	NS	0	50	0	NS	
TOTAL Benthic Fauna NUMBER/ M^2	60	NS	10	100	30	NS	

NS : No sample

7. Meteorological Data

Automatic Weather station have been installed in SevaSadan -3 at the Deendayal Port which records the data on Temperature (°C), Humidity (%),Wind (mph), Dew Point (°C), Wind Direction (°), Pressure, Solar radiation, heat Index and UVI.

Temperature

The mean day time temperature for Deendayal Port was 29.77 °C. The day-time maximum temperature was 34.1 °C. The mean night time temperature was 32.53 °C. The minimum mean night time temperature recorded was 28.2 °C.

Air Pressure

The mean absolute air pressure for the month of June was 1004.93 hpa, whereas the mean relative pressure was 1005.03 hpa. The maximum absolute air pressure recorded for the month of June was 1008.9 hpa.

Heat Index

The mean day-time heat index for the month of June was 35.20 ^{o}C. The maximum heat index recorded was 44^{o}C.

Solar Radiation

The mean Solar Radiation in June was 208.28 w/m^2. The maximum solar radiation recorded in the month of June was 654.8 w/m^2.

Humidity

The mean day-time humidity was 76.42 % for the month of June and mean night time humidity was 65.97%. Maximum humidity recorded during day-time was 84.0 % and maximum humidity recorded during night-time was 82.0%.

Wind Velocity and Wind Direction

The mean wind velocity for the entire month of June was 9.72 km/hour (i.e. 2.7 mtr/sec). Maximum wind velocity recorded was 46.8 Km/hr (13 mtr/sec). The wind direction was mostly S to SW.

Conclusive Summary and Remedial measures Suggested

- The AAQ monitoring at six locations of Deendayal Port indicates that the mean PM_{10} values at four locations viz. Coal storage area, Marine Bhavan and Oil Jetty area were found above the permissible standards (100 µg/m^3)and$PM_{2.5}$was above permissible limits at Coal storage location(Limit 60 µg/m^3).

- Drinking water at all the twenty locations was found potable and was within permissible limits of BIS standards (IS 10500).

- Noise quality was also within the set permissible standards of an Industrial Area. The noise level observed during day time was >75 dB (A) and at night time was >70 dB (A) during the entire monitoring period.

- The sewage treated water of Deendayal Port Colony (Gopalpuri) was in line with the standards set by the Gujarat Pollution Control Board. The STP at Deendayal Port is not fully operational and STP at Vadinar Port was found non-operational.

Reasons for higher Values of PM_{10}

- Large amount of coal is handled at Berth No. 6, 7, 8 and 9. The unloading of coal directly in the truck, using grabs cause coal to spread in air as well as coal dust to fall on ground. This settled coal dust again mixes with the air while trucks travel through it.

- Also, the coal laden trucks are not always covered with tarpaulin sheets, and these results in spillage of coal from trucks/dumpers during its transit from vessel to yard or storage site. This also increased PM values around marine Bhavan & Coal storage area.

Remedial Measures

The values of PM_{10} during the month of June, 2021 were observed beyond the permissible limit at four locations mentioned above. Given below are the remedial measures suggest to minimize the Air pollution at Deendayal Port.

- Guidelines for Coal Handling by GPCB should be strictly followed. (http://gpcb.gov.in/pdf/coal-handling-guidelines.pdf)

- Sewage Treatment Plan at Vadinar Port is not working. Hence, it is recommended to commission the sewage treatment plant at Vadinar immediately.

- Except for the higher values of PM_{10} at Coal storage site, Oil Jetty, Tuna Port and Marine Bhavan locations, the monitoring results for the present month suggest that the overall Environment Quality of Deendayal Port is satisfactory.

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ENVIRONMENTAL MONITORING REPORT
FOR
DEENDAYAL PORT TRUST

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Prepared by	:	**DETOX CORPORATION PVT. LTD., SURAT**

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Introduction

Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the national standards and any other relevant standards by GBCB/CPCB/MoEF to identify non conformities in the Environment of the Deendayal Port. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port.

The environmental monitoring is carried out as per the Environment Management and Monitoring Plan submitted by Detox Corporation Pvt. Ltd.

1. Ambient Air Quality Monitoring

As per the Environmental Monitoring Plan of Deendayal Port Trust, Air monitoring was carried out at six identified locations at Deendayal Port and two locations at Vadinar Port.

1.1 Air Quality Monitoring Methodology

Air quality is measured in all the stations, for 24 hour for Total Suspended Particulate Matter (TSPM), PM_{10}, $PM_{2.5}$, SO_2, NO_X, NH_3 & Benzene, and Grab-sampling for CO & CO_2 measurements. The Air samplers are operated for a period of 24 hours and after a continuous operation of 8 hours of the sampler, the reagents were replaced to obtain 3 samples per day for each parameter namely, SO_2, NO_X. The EPM 2000 filter paper and PTFE Membrane bound filter paper are used for a period of 24 hours to obtain one sample each of TSPM, PM_{10} & $PM_{2.5}$.

The AAQ samples are collected twice a week from all the eight locations as per the EMP.

1.2 Results

The ambient air quality monitoring data for six stations, viz. Marine Bhavan, Oil Jetty, Port Colony,Gopalpuri Hospital,Tuna Port and Nr. Coal Storage Area for the month of July 2021 are given in Tables 1A to 6B. The ambient air quality monitoring data for two stations at Vadinar (Nr. Admin Building &Nr. Signal Building) are given in Tables 7A to 8B.

Location 1: Marine Bhavan (AL1)

Table 1 : Results of Air Pollutant Concentration at Marine Bhavan

Parameter	Date	TSPM [µg/m3]	PM10 [µg/m3]	PM2.5 [µg/m3]	SO2 [µg/m3]		NOx [µg/m3]		NH3 [µg/m3]	
Sampling Period	-	24hr	24hr	24hr	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)
NAAQMS limit	-	NS	100 µg/m3	60 µg/m3		80 µg/m3		80 µg/m3		400 µg/m3
AL1 – 1	01.07.2021	417	302	96	3.08	2.78	59.07	48.70	13.53	15.32
					3.52		55.26		16.08	
					1.76		31.76		16.34	
AL1 – 2	05.07.2021	875	776	40	6.59	5.71	57.16	52.51	15.83	12.34
					5.71		47.64		10.21	
					4.84		52.72		10.98	
AL1 – 3	09.07.2021	769	693	11	8.79	7.62	33.03	34.30	13.79	13.87
					8.35		31.76		13.53	
					5.71		38.11		14.30	
AL1 – 4	14.07.2021	267	257	31	2.64	4.69	14.61	24.98	19.15	10.21
					5.28		28.58		5.11	
					6.15		31.76		6.38	
AL1 – 5	16.07.2021	234	143	8	10.55	10.11	13.34	20.11	9.19	12.34
					13.19		22.87		14.04	
					6.59		24.14		13.79	
AL1 - 6	21.07.2021	314	257	202	4.84	2.93	13.34	13.76	7.66	12.17
					1.32		15.24		12.25	
					2.64		12.70		16.59	
AL1 - 7	23.07.2021	387	256	163	1.76	3.08	38.11	28.16	16.34	61.10
					3.52		27.31		13.79	
					3.96		19.05		153.17	
AL1 – 8	27.07.2021	471	299	163	6.15	6.01	12.70	16.09	137.85	53.78
					6.59		18.42		10.98	
					5.28		17.15		12.51	
Monthly Average		467	373	89		5.37		29.83		23.89
Standard Deviation		234	230	78		2.58		14.43		20.85

NS: Not Specified

Table 1B : Results of Air Pollutant Concentration at Marine Bhavan					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL1 – 1	01.07.2021	1.13	BDL	1.46	508
AL1 – 2	05.07.2021	1.1	BDL	1.52	489
AL1 – 3	09.07.2021	1.04	BDL	1.36	512
AL1 – 4	14.07.2021	1.14	BDL	1.48	562
AL1 – 5	16.07.2021	1.12	BDL	1.52	496
AL1 - 6	21.07.2021	1.05	BDL	1.48	485
AL1 – 7	23.07.2021	1.04	BDL	1.78	508
AL1 – 8	27.07.2021	1.1	BDL	1.69	495
Monthly Average		**1.09**	**-**	**1.54**	**507**
Standard Deviation		**0.04**	**-**	**0.13**	**24**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5ppm)

NS -Not Specified

At Marine Bhavan, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_X and NH_3 is attributed mainly by motor vehicle emission produced from various types of automobiles (both diesel and petrol driven). Moreover, the loading and unloading of Food Grains and Timber at Jetty no. 1 and 2 also contributes to the high levels of TSPM and PM_{10}. The mean TSPM value at Marine Bhavan was 467 µg/m³, The mean PM_{10} values were 373.0 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 89 µg/m³). The average values of SO_2, NO_x and NH_3 were within the permissible limit. The average values of SO_2, NO_x and NH3 were 5.37 µg/ m³, 29.83 µg/ m³ & 23.89 µg/ m³ respectively. These were within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Marine Bhavan. The mean Benzene concentration was 1.09 µg/m³,well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.54 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 2: Oil Jetty (AL2)

Table 2 : Results of Air Pollutant Concentration at Oil Jetty										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL2 – 1	01.07.2021	265	392	127	2.20	1.47	55.26	45.94	7.66	9.96
					0.88		52.72		10.98	
					1.32		29.85		11.23	
AL2 – 2	05.07.2021	812	737	42	0.88	2.93	44.46	47.64	13.53	13.96
					2.64		47.64		13.53	
					5.28		50.81		14.81	
AL2 – 3	09.07.2021	807	707	35	5.28	8.35	17.15	24.56	7.91	10.98
					10.11		24.77		12.76	
					9.67		31.76		12.25	
AL2 – 4	14.07.2021	602	280	5	3.08	3.37	19.05	20.33	15.32	16.59
					2.64		17.15		16.08	
					4.40		24.77		18.38	
AL2 – 5	16.07.2021	578	539	6	4.40	4.10	16.51	17.15	6.13	6.98
					3.52		17.15		5.11	
					4.40		17.78		9.70	
AL2 – 6	21.07.2021	867	772	10	4.84	5.13	29.22	28.16	10.98	13.36
					4.40		32.39		12.76	
					6.15		22.87		16.34	
AL2 – 7	23.07.2021	244	194	76	2.20	2.20	23.50	26.25	13.79	15.40
					1.76		26.68		15.83	
					2.64		28.58		16.59	
AL2 – 8	27.07.2021	448	350	76	6.15	6.45	23.50	18.84	12.00	12.59
					7.03		14.61		13.02	
					6.15		18.42		12.76	
Monthly Average		578	496	47		4.25		28.61		12.48
Standard Deviation		244	224	43		2.30		11.83		3.10

NS: Not Specified

Table 2B : Results of Air Pollutant Concentration at Oil Jetty					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL2 -1	01.07.2021	1.12	BDL	1.76	512
AL2 -2	05.07.2021	1.16	BDL	1.85	498
AL2 -3	09.07.2021	1.06	BDL	1.77	506
AL2 -4	14.07.2021	1.15	BDL	1.54	489
AL2 – 5	16.07.2021	1.14	BDL	1.78	490
AL2 – 6	21.07.2021	1.19	BDL	1.62	506
AL2 -7	23.07.2021	1.72	BDL	1.82	515
AL2 – 8	27.07.2021	1.58	BDL	1.78	510
Monthly Average		**1.27**	**-**	**1.74**	**503**
Standard Deviation		**0.24**	**-**	**0.11**	**10**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Oil Jetty area was mainly by motor vehicle emission produced from various types of vehicles Oil Jetty Area. The mean TSPM values at Oil Jetty were 578 µg/m³ The mean PM_{10} values were 496 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were below the permissible limit (mean = 47 µg/m³).The average values of SO_2, NO_x and NH_3 were within the permissible limit; The mean concentration of SO_2, NO_x and NH3 were 4.25 µg/m³, 28.61 µg/m³ and 12.48 µg/m³ respectively.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Oil Jetty. The mean Benzene concentration was 1.27 µg/m³ .Well below the permissible limit of 5.0 µg/m³. , HC's were below the detectable limit and Carbon Monoxide concentration was 1.74 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 3: Kandla Colony – Estate Office (AL-3)

Table 3 : Results of Air Pollutant Concentration at Estate Office										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL3 – 1	01.07.2021	168	153	55	3.52	3.81	20.96	21.38	14.30	10.21
					5.28		27.31		9.45	
					2.64		15.88		6.89	
AL3 – 2	05.07.2021	467	373	21	3.52	2.49	21.60	23.50	14.04	15.91
					1.32		18.42		15.83	
					2.64		30.49		17.87	
AL3 – 3	09.07.2021	297	139	37	3.08	4.98	23.50	24.77	9.19	7.66
					6.15		29.85		6.38	
					5.71		20.96		7.40	
AL3 – 4	14.07.2021	292	121	80	4.84	5.86	21.60	19.27	14.55	72.33
					5.71		18.42		186.35	
					7.03		17.78		16.08	
AL3 – 5	16.07.2021	629	566	96	17.58	10.11	17.15	14.82	13.53	12.00
					7.91		15.24		9.70	
					4.84		12.07		12.76	
AL3 – 6	21.07.2021	721	668	57	3.96	2.49	6.99	14.82	20.42	18.98
					1.32		15.88		21.44	
					2.20		21.60		15.06	
AL3 – 7	23.07.2021	490	406	51	2.64	2.49	22.87	23.29	11.23	11.91
					3.08		19.69		9.70	
					1.76		27.31		14.81	
AL3 – 8	27.07.2021	640	500	51	1.76	3.66	20.96	18.00	11.23	10.04
					4.40		17.15		8.17	
					4.84		15.88		10.72	
Monthly Average		463	366	56		4.49		19.98		19.88
Standard Deviation		196	210	23		2.59		3.89		21.49

NS: Not Specified

Table 3B : Results of Air Pollutant Concentration at Kandla Port Colony					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL3 -1	01.07.2021	1.12	BDL	1.78	510
AL3 -2	05.07.2021	1.22	BDL	1.84	526
AL3 -3	09.07.2021	1.16	BDL	1.96	520
AL3 -4	14.07.2021	1.26	BDL	1.88	542
AL3 – 5	16.07.2021	1.18	BDL	1.78	533
AL3 – 6	21.07.2021	1.26	BDL	1.6	525
AL3 – 7	23.07.2021	1.21	BDL	1.58	542
AL3 – 8	27.07.2021	1.11	BDL	1.78	502
Monthly Average		**1.19**	**-**	**1.78**	**525**
Standard Deviation		**0.06**	**-**	**0.13**	**14**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Kandla Port Colony was attributed by vehicle emission produced from trucks and heavy duty vehicles that pass through the road outside Kandla Port Colony. The mean TSPM values at Oil Jetty were 463 µg/m³, The mean PM_{10} values were 366 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were slightly above the permissible limit (mean = 56 µg/m³). The average values of SO_2, NO_x and NH3 were 4.49 µg/m³, 19.98 µg/m³ and 19.88 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Kandla Port Colony. The mean Benzene concentration was 1.19 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.78 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 4: Gopalpuri Hospital (AL-4)

Table 4 : Results of Air Pollutant Concentration at Gopalpuri Hospital										
Parameter	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL4 -1	01.07.2021	148	138	21	1.32	2.20	12.70	13.34	3.57	5.36
					2.20		13.34		7.40	
					3.08		13.97		5.11	
AL4 -2	05.07.2021	313	277	115	3.52	1.76	24.14	19.48	5.36	6.72
					1.32		13.34		8.42	
					0.44		20.96		6.38	
AL4 -3	09.07.2021	287	152	40	1.32	2.49	12.70	30.06	5.87	5.79
					2.64		22.23		5.11	
					3.52		55.26		6.38	
AL4 -4	14.07.2021	143	77	8	1.32	0.88	13.34	11.64	11.74	9.19
					0.88		11.43		8.17	
					0.44		10.16		7.66	
AL4 – 5	16.07.2021	196	119	83	1.32	2.93	20.33	15.24	5.62	7.49
					3.52		13.34		9.45	
					3.96		12.07		7.40	
AL4 – 6	21.07.2021	228	128	100	2.64	1.90	22.87	17.57	7.15	6.89
					1.32		13.34		7.40	
					1.76		16.51		6.13	
AL4 – 7	23.07.2021	338	200	109	0.88	1.32	19.05	26.25	7.15	9.36
					1.32		28.58		9.70	
					1.76		31.12		11.23	
AL4 – 8	27.07.2021	806	746	27	1.76	2.49	19.05	16.94	6.89	6.47
					2.20		14.61		6.38	
					3.52		17.15		6.13	
Monthly Average		307	230	63		2.00		18.82		7.16
Standard Deviation		214	217	43		0.67		6.34		1.46

NS: Not Specified

Table 4B : Results of Air Pollutant Concentration at Gopalpuri Hospital					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL4 -1	01.07.2021	1.22	BDL	1.62	502
AL4 -2	05.07.2021	1.16	BDL	1.48	499
AL4 -3	09.07.2021	1.32	BDL	1.62	501
AL4 -4	14.07.2021	1.28	BDL	1.78	489
AL4 – 5	16.07.2021	1.25	BDL	1.46	496
AL4 – 6	21.07.2021	1.18	BDL	1.62	510
AL4 – 7	23.07.2021	1.14	BDL	1.78	502
AL4 – 8	27.07.2021	1.23	BDL	1.48	496
Monthly Average		**1.22**	**-**	**1.61**	**499**
Standard Deviation		**0.06**	**-**	**0.13**	**6**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Gopalpuri Hospital was attributed by vehicle emission produced from light motor vehicles of the colony residents. The mean TSPMvalues at Oil Jetty were 307 µg/m³, The mean PM_{10} values were 230 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were slight above the permissible limit (mean= 63 µg/m³). The average values of SO_2, NO_x and NH_3 were 2.00 µg/m³, 18.82 µg/m³ and 7.16 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Gopalpuri Hospital. The mean Benzene concentration was 1.22 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.61 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 5: Coal Storage Area (AL-5)

Table 5 : Results of Air Pollutant Concentration at Coal Storage Area										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL5 – 1	01.07.2021	428	158	47	3.08	3.37	42.56	48.70	15.83	14.04
					4.84		50.81		12.76	
					2.20		52.72		13.53	
AL5 – 2	05.07.2021	496	150	44	9.67	6.01	57.16	54.84	10.21	14.98
					4.84		49.54		13.53	
					3.52		57.80		21.19	
AL5 – 3	09.07.2021	222	135	76	9.67	7.62	60.98	50.60	16.85	17.44
					3.52		57.16		18.89	
					9.67		33.66		16.59	
AL5 – 4	14.07.2021	349	309	21	17.58	9.23	22.87	31.97	9.45	15.32
					4.84		32.39		21.70	
					5.28		40.65		14.81	
AL5 – 5	16.07.2021	264	123	12	9.67	11.87	16.51	21.38	12.00	14.21
					13.19		22.23		14.04	
					12.75		25.41		16.59	
AL5 – 6	21.07.2021	358	303	33	4.40	5.28	22.87	19.69	16.85	18.47
					6.15		19.05		16.34	
					5.28		17.15		22.21	
AL5 – 7	23.07.2021	268	194	45	4.40	5.28	27.95	23.71	12.76	16.76
					5.28		20.96		16.59	
					6.15		22.23		20.93	
AL5 – 8	27.07.2021	446	273	45	6.15	6.89	14.61	17.15	10.21	13.19
					7.03		22.23		14.04	
					7.47		14.61		15.32	
Monthly Average		354	206	40		6.94		33.50		15.55
Standard Deviation		98	77	19		2.65		15.50		1.84

NS: Not Specified

Table 5B : Results of Air Pollutant Concentration at Coal Storage Area					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL5 – 1	01.07.2021	1.28	BDL	1.82	526
AL5 – 2	05.07.2021	1.11	BDL	1.78	522
AL5 – 3	09.07.2021	1.16	BDL	1.88	520
AL5 – 4	14.07.2021	1.32	BDL	1.78	530
AL5 – 5	16.07.2021	1.28	BDL	1.82	536
AL5 – 6	21.07.2021	1.22	BDL	1.77	522
AL5 – 7	23.07.2021	1.18	BDL	1.86	526
AL5 – 8	27.07.2021	1.26	BDL	1.9	530
Monthly Average		**1.23**	**-**	**1.83**	**527**
Standard Deviation		**0.07**	**-**	**0.05**	**5**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Coal Storage Area was comparatively highest among all the locations of Air Quality monitoring in Kandla Port. High values of TSPM, $_{PM10,}$ $PM_{2.5}$, SO_2, NO_X at this location was due to lifting of coal with grab and other coal handling processes near Berth no. 6 & 7. Moreover, the traffic was also heavy around this place for transport of coal thus emissions produced from heavy vehicles. The mean TSPM values at Coal storage were 354 µg/m³. The mean PM_{10} values were 206 µg/m³, which is well above the permissible limit. $PM_{2.5}$ values were below the permissible limit (mean = 40 µg/m³). The average values of SO_2, NO_x and NH_3 were 6.94 µg/m³, 33.50 µg/m³ and 15.55 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Coal Storage Area. The mean Benzene concentration was 1.23 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.83 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 6: Tuna Port (AL-6)

Table 6 : Results of Air Pollutant Concentration at Tuna Port										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL6 -1	01.07.2021	149	97	39	0.88	2.20	16.51	15.24	5.87	7.32
					2.20		17.15		7.91	
					3.52		12.07		8.17	
AL6 – 2	05.07.2021	270	169	97	2.20	2.20	13.97	17.36	12.76	12.00
					1.32		14.61		11.74	
					3.08		23.50		11.49	
AL6 – 3	09.07.2021	513	198	86	5.71	4.98	21.60	20.96	6.89	7.06
					6.15		17.15		6.64	
					3.08		24.14		7.66	
AL6 – 4	14.07.2021	230	97	98	2.20	3.08	8.26	9.53	7.40	8.76
					2.64		9.53		8.93	
					4.40		10.80		9.96	
AL6 – 5	16.07.2021	554	484	18	1.76	2.20	14.61	12.07	10.72	10.89
					3.52		12.07		10.98	
					1.32		9.53		10.98	
AL6 – 6	21.07.2021	405	302	98	2.20	2.64	6.35	9.95	16.34	14.89
					1.76		10.80		15.57	
					3.96		12.70		12.76	
AL6 – 7	23.07.2021	211	128	12	1.32	2.05	21.60	19.05	10.98	11.83
					2.20		13.34		13.27	
					2.64		22.23		11.23	
AL6 – 8	27.07.2021	645	524	12	0.88	2.05	14.61	18.84	10.21	9.36
					2.64		17.15		8.68	
					2.64		24.77		9.19	
Monthly Average		372	250	58		2.67		15.38		10.26
Standard Deviation		183	171	41		1.00		4.40		2.65

NS: Not Specified

Table 6B : Results of Air Pollutant Concentration at Tuna Port					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL6 -1	01.07.2021	1.2	BDL	1.79	510
AL6 – 2	05.07.2021	1.11	BDL	1.84	502
AL6 – 3	09.07.2021	1.19	BDL	1.72	511
AL6 – 4	14.07.2021	1.15	BDL	1.69	496
AL6 – 5	16.07.2021	1.06	BDL	1.88	499
AL6 – 6	21.07.2021	1.11	BDL	1.87	502
AL6 – 7	23.07.2021	1.06	BDL	1.74	506
AL6 – 8	27.07.2021	1.15	BDL	1.7	512
Monthly Average		**1.13**	**-**	**1.78**	**505**
Standard Deviation		**0.05**	**-**	**0.08**	**6**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The mean TSPM values at Tuna Port were 372 µg/m³, The mean PM_{10} values were 250 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were within the permissible limit (mean = 58 µg/m³ µg/m³). The average values of SO_2, NO_x and NH_3 were 2.63 µg/m³, 15.38 µg/m³ and 10.26 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Tuna Port. The mean Benzene concentration was 1.13 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.78 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 7: Signal Building (Vadinar) (AL-7)

Table 7 : Results of Air Pollutant Concentration at Signal Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL7 -1	01.07.2021	119	72	37	3.20	3.08	8.05	8.26	4.41	4.34
					2.97		8.49		4.42	
					3.06		8.24		4.19	
AL7 -2	05.07.2021	104	81	30	3.40	3.52	13.07	12.70	5.45	5.36
					3.18		12.38		5.29	
					3.99		12.65		5.35	
AL7 -3	09.07.2021	62	73	42	4.28	3.96	6.35	6.35	6.09	5.87
					3.60		6.50		5.82	
					4.01		6.20		5.69	
AL7 -4	14.07.2021	104	74	110	4.18	3.96	6.24	6.35	18.21	17.88
					3.87		6.47		17.45	
					3.84		6.34		17.97	
AL7 -5	16.07.2021	96	63	40	2.82	2.64	20.65	20.33	9.23	8.93
					2.65		19.80		8.86	
					2.45		20.54		8.69	
AL7 -6	21.07.2021	102	68	12	8.02	7.47	5.73	5.72	2.71	2.81
					7.18		6.03		2.59	
					7.22		5.40		3.13	
AL7 -7	23.07.2021	143	95	35	5.17	4.84	33.65	33.57	3.29	3.57
					5.10		33.82		3.8	
					4.26		33.23		3.62	
AL7 -8	27.07.2021	107	74	18	7.26	7.46	31.49	31.46	4.5	4.45
					7.49		31.78		4.75	
					7.62		31.12		4.1	
Monthly Average		105	75	40		5		16		7
Standard Deviation		23	10	30		2		12		5

NS: Not Specified

Table 7B : Results of Air Pollutant Concentration at Signal Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL7 -1	01.07.2021	1.1	BDL	1.56	489
AL7 – 2	05.07.2021	1.06	BDL	1.66	488
AL7 – 3	09.07.2021	1.02	BDL	1.72	479
AL7 – 4	14.07.2021	1.1	BDL	1.62	496
AL7 – 5	16.07.2021	1.11	BDL	1.68	488
AL7 – 6	21.07.2021	1.16	BDL	1.58	490
AL7 – 7	23.07.2021	1.12	BDL	1.66	481
AL7 – 8	27.07.2021	1.1	BDL	1.6	475
Monthly Average		**1.10**	**-**	**1.64**	**486**
Standard Deviation		**0.04**	**-**	**0.05**	**7**

* NMHC- Non- Methane Hydrocarbons
BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)
NS_ Not Specified

The mean TSPM values at Vadinar Port were 105 µg/m³. The mean PM_{10} values were 75 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 40 µg/m³ µg/m³). The average values of SO_2, NO_x and NH_3 were 5.0 µg/m³, 16.0 µg/m³ and 7.0 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.10 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.64 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 8: Admin Building (Vadinar) (AL-8)

Table 8 : Results of Air Pollutant Concentration at Admin Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL8 -1	01.07.2021	172	96	25	2.71	2.64	10.75	10.80	3.42	3.57
					2.64		10.55		3.71	
					2.58		11.09		3.58	
AL8 -2	05.07.2021	121	100	16	4.05	3.96	8.89	8.89	4.51	4.85
					3.95		8.81		5.18	
					3.88		8.96		4.86	
AL8 -3	09.07.2021	108	88	14	5.02	4.84	5.80	5.72	9.48	9.19
					4.79		5.70		8.94	
					4.72		5.67		9.15	
AL8 -4	14.07.2021	169	68	84	6.74	6.59	5.76	5.72	22.65	22.61
					6.16		5.52		23.06	
					6.88		5.89		22.12	
AL8 -5	16.07.2021	136	85	37	1.40	1.32	18.40	18.42	23.67	22.98
					1.23		18.53		22.46	
					1.32		18.33		22.81	
AL8 -6	21.07.2021	140	65	87	9.58	9.67	9.04	8.89	6.65	6.63
					9.80		8.86		6.72	
					9.62		8.76		6.52	
AL8 -5	23.07.2021	168	96	47	6.10	6.15	44.85	44.46	9.23	8.93
					6.24		44.21		8.46	
					6.10		44.32		9.1	
AL8-6	27.07.2021	153	53	40	3.46	3.52	45.00	44.46	3.95	4.08
					3.72		44.05		4.09	
					3.38		44.32		4.2	
Monthly Average		146	81	44		5		18		10
Standard Deviation		24	17	28		3		17		8

NS: Not Specified

Table 8B : Results of Air Pollutant Concentration at Admin Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL8 -1	01.07.2021	1.1	BDL	1.56	489
AL8-2	05.07.2021	1.06	BDL	1.66	488
AL8 -3	09.07.2021	1.02	BDL	1.72	479
AL8-4	14.07.2021	1.1	BDL	1.62	496
AL8 -5	16.07.2021	1.11	BDL	1.68	488
AL8-6	21.07.2021	1.16	BDL	1.58	490
AL8-7	23.07.2021	1.12	BDL	1.66	481
AL8-8	27.07.2021	1.1	BDL	1.6	475
Monthly Average		**1.10**	**-**	**1.64**	**486**
Standard Deviation		**0.04**	**-**	**0.05**	**7**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Admin Building Vadinar was comparatively low among all the locations of Air Quality monitoring in Kandla Port and Vadinar Port. The mean TSPM values at Vadinar Port were 146 µg/m³. The mean PM_{10} values were 81 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 44.0 µg/m³). The average values of SO_2, NO_x and NH_3 were 5.0µg/m³, 18.0 µg/m³ and 10.0 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Admin Building, Vadinar Port. The mean Benzene concentration was 1.10 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.64 mg/m³, well below the permissible limit of 4.0 mg/m³.

1.4 Observations and Conclusion

During the monitoring period, the overall Ambient Air Quality of the port area was found to be well within the desired levels for various pollutants. However, Near Coal storage area, Marine Bhavan and Oil Jetty area, PM_{10} values was above the permissible standards. All other pollutants were recorded well below the prescribed limits.

2. Drinking Water Quality Monitoring

Drinking Water Quality Monitoring was carried out at twenty stations at Kandla, Vadinar & Township Area of Deendayal Port.

2.1 Drinking Water Monitoring Methodology

Drinking water samples were collected from 20 locations as prescribed in the tender document. Samples for physico-chemical analysis were collected in 1 liter carboys and samples for microbiological parameters were collected in sterilized bottles. These samples were then analyzed in laboratory for various drinking water parameters at Kandla Lab/Surat.

The Sampling and Analysis was done as per standard methods - IS 10500:2012. The water samples were analyzed for various parameters, viz. Color , Odor, Turbidity , Conductivity , pH , Chlorides , TDS, Total Hardness, Iron , Sulphate , Salinity , DO, BOD, Na, K, Ca, Mg, F, NO_3, NO_2, Mn, Cr-6, Cu, Cd, As, Hg, Pb, Zn, Bacterial Count (cfu) .

2.2 Results

The Drinking Water Quality monitoring data for 20 stations are given in below from table No. 9 to Table No. 15

Table 9: Drinking Water Quality Monitoring Parameters for Nirman Building 1, P & C building & Main Gate (North) at Kandla

Sr. No.	Parameter	Unit	Nirman Building 1	P & C building	Main Gate North	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.7	7.4	7.6	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1290	1530	1180	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	2500	3010	2200	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	416	436	451	250.0	1000.0
9	Ca as Ca	mg/l	72.14	52.10	64.13	75.0	200.0
10	Mg as Mg	mg/l	51.03	68.04	65.61	30.0	100.0
11	Total Hardness	mg/l	390	410	430	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.26	0.47	0.21	1.0	1.5
14	Sulphate as SO4	mg/l	140.52	166.8	156	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	10.21	8.45	7.74	45.0	No Relaxation
17	Salinity	%	0.75	0.79	0.81	NS*	NS*
18	Sodium as Na	mg/l	170	168	148	NS*	NS*
19	Potassium as K	mg/l	2.2	2.3	2.8	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 10: Drinking Water Quality Monitoring Parameters for Canteen, West Gate – I & Wharf Area at Kandla

Sr. No.	Parameter	Unit	Canteen	West Gate - I	Wharf Area	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.3	7.6	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1590	1190	1670	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	3110	2330	3300	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	411	416	426	250.0	1000.0
9	Ca as Ca	mg/l	56.11	64.13	52.10	75.0	200.0
10	Mg as Mg	mg/l	60.75	48.60	63.18	30.0	100.0
11	Total Hardness	mg/l	390	360	390	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.18	0.53	1.05	1.0	1.5
14	Sulphate as SO4	mg/l	166.8	165.6	226.8	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	10.56	11.97	7.53	45.0	No Relaxation
17	Salinity	%	0.74	0.75	0.77	NS*	NS*
18	Sodium as Na	mg/l	133	168	156	NS*	NS*
19	Potassium as K	mg/l	3	2.2	2.4	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 11: Drinking Water Quality Monitoring Parameters for Sewa sadan – 3, Workshop I & Custom Building at Kandla

Sr. No.	Parameter	Unit	SewaSadan – 3	Workshop	Custom Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.7	7.9	7.3	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1490	1090	1330	500	2000
3	Turbidity	NTU	1	0	0	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	2990	2090	2680	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	451	456	461	250.0	1000.0
9	Ca as Ca	mg/l	60.12	56.11	64.13	75.0	200.0
10	Mg as Mg	mg/l	60.75	63.18	53.46	30.0	100.0
11	Total Hardness	mg/l	400	400	380	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.93	0.70	1.45	1.0	1.5
14	Sulphate	mg/l	156	171.6	195.6	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	14.78	16.83	9.50	45.0	No Relaxation
17	Salinity	%	0.81	0.82	0.83	NS*	NS*
18	Sodium as Na	mg/l	162	152	162	NS*	NS*
19	Potassium as K	mg/l	2.3	2.4	2.8	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 12: Drinking Water Quality Monitoring Parameters for Port Colony Kandla, Hospital Kandla & A.O. Building at Gandhidham

Sr. No.	Parameter	Unit	Port Colony Kandla	Hospital Kandla	A.O. Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.8	7.7	7.0	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1210	1450	1010	500	2000
3	Turbidity	NTU	1	2	2	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	2370	2880	2030	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	526	541	491	250.0	1000.0
9	Ca as Ca	mg/l	52.10	52.10	48.10	75.0	200.0
10	Mg as Mg	mg/l	58.32	68.04	75.33	30.0	100.0
11	Total Hardness	mg/l	370	410	430	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	1.05	1.16	0.93	1.0	1.5
14	Sulphate	mg/l	204	214.8	147.6	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.01	9.72	9.15	45.0	No Relaxation
17	Salinity	%	0.95	0.98	0.89	NS*	NS*
18	Sodium as Na	mg/l	178	160	180	NS*	NS*
19	Potassium as K	mg/l	2.7	2.3	2.8	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 13: Drinking Water Quality Monitoring Parameters for School Gopalpuri, Guest House & E - Type Quarter at Gopalpuri, Gandhidham

Sr. No.	Parameter	Unit	School Gopalpuri	Guest House	E - Type Quarter	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.1	7.3	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	990	1410	1330	500	2000
3	Turbidity	NTU	1	0	1	1.0	5.0
4	Odor	-	Odourless	Odourless	Odourless	Agreeable	Agreeable
5	Color	Hazen Units	Colourless	Colourless	Colourless	5.0	15.0
6	Conductivity	µs/cm	1900	2900	2660	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	526	476	516	250.0	1000.0
9	Ca as Ca	mg/l	60.12	56.11	68.14	75.0	200.0
10	Mg as Mg	mg/l	55.89	53.46	53.46	30.0	100.0
11	Total Hardness	mg/l	380	360	390	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	1.08	0.82	1.14	1.0	1.5
14	Sulphate	mg/l	183.6	157.2	150	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	10.35	11.48	10.35	45.0	No Relaxation
17	Salinity	%	0.95	0.86	0.93	NS*	NS*
18	Sodium as Na	mg/l	196	203	200	NS*	NS*
19	Potassium as K	mg/l	2.4	2.3	2.6	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 14: Drinking Water Quality Monitoring Parameters for F - Type Quarter, Hospital Gopalpuri & Tuna Port

Sr. No.	Parameter	Unit	F - Type Quarter	Hospital Gopalpuri	Tuna Port	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.2	7.3	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1100	1020	1050	500	2000
3	Turbidity	NTU	1	1	0	1.0	5.0
4	Odor	-	Odourless	Odourless	Odorless	Agreeable	Agreeable
5	Color	Hazen Unit	Colourless	Colourless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2200	2050	1940	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	506	546	592	250.0	1000.0
9	Ca as Ca	mg/l	64.13	72.14	72.14	75.0	200.0
10	Mg as Mg	mg/l	65.61	43.74	36.45	30.0	100.0
11	Total Hardness	mg/l	430	360	330	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.94	1.02	0.46	1.0	1.5
14	Sulphate	mg/l	165.6	159.6	120	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	10.63	9.36	1.33	45.0	No Relaxation
17	Salinity	%	0.91	0.99	0.92	NS*	NS*
18	Sodium as Na	mg/l	180	180	188	NS*	NS*
19	Potassium as K	mg/l	2.5	2.4	2.6	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 15: Drinking Water Quality Monitoring Parameters for Vadinar Jetty & Port Colony at Vadinar

Sr. No.	Parameter	Unit	Vadinar Jetty	Port Colony Vadinar	Acceptable Limits as per IS 10500 : 2012	Permissible Limits as per IS 10500 : 2012
1	pH	pH Unit	7.9	7.6	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	950.0	620.0	500	2000
3	Turbidity	NTU	ND	ND	1.0	5.0
4	Odor	-	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1580.0	1030.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	NS*	NS*
8	Chloride	mg/l	445.99	466.04	250.0	1000.0
9	Ca as Ca	mg/l	60.12	52.10	75.0	200.0
10	Mg as Mg	mg/l	63.18	60.75	30.0	100.0
11	Total Hardness	mg/l	410	380	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.99	0.94	1.0	1.5
14	Sulphate	mg/l	16.80	17.64	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	11.48	9.50	45.0	No Relaxation
17	Salinity	%	0.81	0.84	NS*	NS*
18	Sodium as Na	mg/l	142.0	156.0	NS*	NS*
19	Potassium as K	mg/l	2.3	2.4	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent

*NS: Not Specified

2.3 Results & Discussion

The colour of all drinking water samples was < 5 Hazen unit and odour of the samples was also agreeable. All parameters are found to be within the specified limit of the Drinking water Standard.

pH

The limit of pH value for drinking water is specified as 6.5 to 8.5. pH value in the studied area varied from 7.0 to 7.9 pH unit. All the sampling points showed pH values within the prescribed limit by Indian Standards.

Total Dissolved Solids (TDS)

TDS values in the studied area varied between 600 -1800 mg/l. None of the sampling points showed higher TDS values than the prescribed limit by Indian standards .

Conductivity

Electrical Conductivity is the ability of a solution to transfer (conduct) electric current. Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The conductivity in the samples collected during the month of July ranged from 1000-3300 µs/cm. Electrical conductivity standards do not appear in BIS standards for drinking water.

BOD

BOD value in the studied area was less than 2.0 mg/L. Indian standards does not show any standard values for BOD in drinking water.

Chlorides

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. Chloride value in the studied area varied between 400-600 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.

Calcium

Calcium value in the studied area varied between 45 - 80 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. If calcium is present beyond the maximum acceptable limit, it causes incrustation of pipes.

Magnesium

Magnesium value in the studied area varied between 30 – 80 mg/l. All the locations had Magnesium within the prescribed limits of 30-100 mg/L.

Total Hardness

Hardness value in the studied area varied between 330-430 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.The prescribed limit by Indian Standards is 200-600 mg/L.

Iron

Iron value in the studied area was below 0.01mg/L and hence well below the permissible limit as per Indian Standards is 0.3 mg/L. The excess amount of iron causes slight toxicity; gives stringent taste to water.

Fluoride

Fluoride value in the studied area varied between 0.1 – 1.4 mg/l and hence well below the permissible limit as per Indian Standards is 1.0-1.5 mg/L. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems.

Sulphates

Sulphate value in the studied area varied between 100 – 330 mg/l. All the sampling points showed sulphate values within the prescribed limits by Indian Standards (200-400 mg/L). Sulphate content in drinking water exceeding the 400 mg/L imparts bitter taste.

Nitrites (NO_2) and Nitrates (NO_3)

Nitrite values in all the water samples were <0.1. There are no specified standard values for Nitrites in Drinking water. The mean Nitrate values in drinking water of KPT was 4.10 mg/l which is well within the permissible limit of the Drinking water Standard.

Salinity

Salinity in drinking water in the present samples collected ranged from 0.6 to 0.9 %. There are no prescribed Indian standards for salinity in Drinking water**.**

Sodium and Potassium Salts

Sodium values in the samples collected ranged from 100 - 2000 mg/l and Potassium salts ranged from 2.2 to 3.0 mg/l. There are no prescribed limits of Sodium and Potassium in Indian standards for Drinking water**.**

Heavy Metals in Drinking Water

In the present study period drinking water samples were analyzed for Mn, Cr, Cu, Cd, As, Hg, Pb and Zn. All these heavy metals were well below the permissible limits prescribed by the Indian Standards.

Bacteriological Study

Analysis of the bacteriological parameter at all location shows that Bacteria is not present and hence Bacterial count is in line with the permissible limit of drinking water. This shows that all the drinking water samples were safe from any bacteriological contamination.

2.4 Conclusions

These results are compared with acceptable limits as prescribed in IS 10500:2012 – Drinking Water Specification. It is seen from the analysis data that during the study period the water was safe for human consumption at all drinking water monitoring stations.

3. Noise Level Monitoring

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. Noise Monitoring was done at 13 stations at Kandla, Vadinar and Township area.

3.1 Method of Monitoring

Sampling was done at all stations for 24 hour period. Data was recorded using automated sound level meter. The intensity of sound was measured in sound pressure level (SPL) and common unit of measurement is decibel (Db).

3.2 Results

Table 16: Noise Monitoring data for ten locations of Deendayal Port and two locations of Vadinar Port

Sr. No.	Location	Day Time Average Noise Level (SPL) in dB(A)	Night Time Average Noise Level (SPL) in dB(A)
	Sampling Time	**6:00 am to 10:00 PM**	**10:00PM to 6:00 AM**
1	Marine Bhavan	60.71	55.49
2	Nirman Building 1	58.02	52.12
3	Tuna Port	53.16	46.37
4	Main Gate North	56.47	53.21
5	West Gate I	61.41	53.6
6	Canteen Area	56.78	48.45
7	Main Road	59.41	56.44
8	ATM Building	63.81	55.02
9	Wharf Area /Jetty Area	65.66	56.59
10	Port & Custom Office	53.59	49.22
	Vadinar Port		
11	Entrance Gate of Vadinar Port	56.32	54.2
12	Nr. Port Colony, Vadinar	55.5	54.8
13	Nr. Vadinar Jetty	58.76	55.4

3.3 Conclusions- Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Average Noise Level (SPL)in all ten locations at Deendayal Port ranged from 56.25 dB(A) to 69.51 dB(A) and it was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all ten locations of Deendayal Port ranged from 48.28 dB to 62.33 dB(A) and it was within the permissible limits of 70 dB(A) for the industrial area for the night time.

4. Soil Monitoring

Sampling and analysis of soil samples were undertaken at six locations within the study area (Deendayal Port and Vadinar Port) as a part of EMP. The soil sampling locations are initially decided based on the locations as provided in the tender document of the Deendayal Port.

4.1 Methodology

The soil samples were collected in the month of July 2021. The samples collected from the all locations are homogeneous representative of each location. At random locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

4.2 Results

Table-17: Chemical Characteristics of Soil in the Study Area

Sr. No.	Parameter	Unit	Station Name					
			SL1	SL2	SL3	SL4	SL5	SL6
			Tuna Port	IFFCO Plant	Khori Creek	Nakti Creek	KPT Admin Site	KPT Colony
			Near main gate of Port	10 m away from main gate	Sand from creek at low tide		Vadinar	
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	pH	-	8.56	8.11	8.38	8.33	8.12	8.42
3	Electrical Conductivity	µs/cm	26,800.0	23,800.0	23,700.0	16,260.0	509.0	419.0
4	Moisture	%	23.66	22.09	24.41	23.65	9.44	7.59
5	Total Organic Carbon	%	0.16	0.24	0.32	0.10	0.20	0.12
6	Alkalinity	mg/kg	140.14	140.14	100.10	80.08	100.10	60.06
7	Total Nitrogen	%	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
8	Chloride	mg/kg	3,908.6	4,309.5	6,114.0	3,959.0	39.3	68.7
9	Sulphate	mg/kg	203.0	177.9	113.8	93.8	13.4	15.5
10	Phosphorus	mg/kg	0.97	0.80	1.24	1.77	0.80	0.97
11	Potassium	mg/kg	779.4	644.4	1,135.8	766.8	129.6	180.0
12	Sodium	mg/kg	2,241.0	3,556.8	3,981.6	3,038.4	1,220.0	1,445.4
13	Calcium	mg/kg	144.29	128.22	168.30	224.40	104.20	56.11
14	Copper as Cu	mg/kg	42.6	61.2	38.2	22.6	16.2	23
15	Lead as Pb	mg/kg	4.2	3.2	3.6	3.8	ND	ND
16	Nickel as Ni	mg/kg	36.2	31.6	39.4	22.6	18.3	21.2
17	Zinc as Zn	mg/kg	58.60	39.25	52.4	46.60	46.80	38.20
18	Cadmium as Cd	mg/kg	ND	ND	ND	ND	ND	ND

4.3 Discussion

- The data shows that value of pH ranges from 8.11 at Nakti Creek to 8.56 at Tuna Creek indicating that all soil samples are neutral to slight basic. Tuna port samples howed maximum conductivity of 26,800µmhos/cm, while Nakti Creek location showed minimum conductivity of 16,260 µmhos/cm. Conductivity at Vadinar Port was 509 and 419 µmhos/cm at Admin site and Vadinar Port colony respectively.
- Total organic Carbon ranged from 0.1 % to 0.3 at Deendayal Port. At Vadinar Port, organic carbon content ranged from 0.1 % to 0.2 %.
- The concentration of Phosphorus and Potassium in the soil samples varies from 0.8 to 1.77 mg/kg and 600.0 to 1150 mg/kg respectively at Deendayal Port. The mean concentration of Phosphorous at Vadinar site was 0.89 mg/kg and mean concentration of Potassium at Vadinar site was 154.8 mg/kg.

These differences in NPK in soil at different locations are due to the dissimilar nature of soil at each of the locations. Samples SL3 & SL4 (Khori Creek & Nakti Creek) are of saline nature as they are coastal soil; where as other locations are inland locations and have different chemical properties.

Heavy Metals in the Soil

Traces of Copper, Lead, Nickel and Zinc were observed in the soil samples collected from all the four locations of Deendayal Port and two locations of Vadinar Port. Cadmium metal was not detected in the Soil.

4.4 Conclusion

The soils of Deendayal Port and Vadinar Port appears to be neutral to basic with varying levels of Chloride, Sulphate, NPK and Calcium. As the nature of soil at different locations are different with respect to its proximity to the sea, the samples showed high degree of variations in their chemical properties.

5. Sewage Treatment Plant Monitoring

This involves safe collection of waste water (spent/used water) from wash areas, bathroom, industrial units, etc., waste from toilets of various buildings and its conveyance to the treatment plant and final disposal in conformity with the requirement and guide lines of State Pollution Control Board and other statutory bodies.

5.1 Methodology for STP Monitoring

To monitor the working efficiency of Sewage Treatment Plant (STP), STP Inlet and Outlet Samples were collected once a week. Locations selected are namely Gopalpuri Township, Deendayal Port and Vadinar. Samples were collected in 1 lit. Carboys and were analyzed in laboratory for various parameters.

5.2 Results

- **Kandla STP**

Table 18: Sewage Water Monitoring at Kandla STP (1st Week)

Date of Sampling	05.07.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.5	7.8
2	Total Suspended Solids	mg/l	125.4	64.3
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	333.3	102
5	BOD @ 27 °C	mg/l	110.0	26.0
Aeration Tank				
6	MLSS	mg/l	18.0	
7	MLVSS	%	88.0	

Table 19: Sewage Water Monitoring at Kandla STP (2nd Week)

Date of Sampling	15.07.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.6	7.68
2	Total Suspended Solids	mg/l	350	46
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	585	98
5	BOD @ 27 °C	mg/l	196.0	26.0
Aeration Tank				
6	MLSS	mg/l	24.0	
7	MLVSS	%	82.0	

Table 20: Sewage Water Monitoring at Kandla STP (3rd Week)

Date of Sampling	20.07.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.73	7.61
2	Total Suspended Solids	mg/l	192.6	62
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	222	20
5	BOD @ 27 °C	mg/l	68.0	8.0
Aeration Tank				
6	MLSS	mg/l	16.0	
7	MLVSS	%	86.0	

Table 21: Sewage Water Monitoring at Kandla STP (4th Week)

Date of Sampling	26.07.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	Plant was not working	
2	Total Suspended Solids	mg/l		
3	Residual Chlorine	mg/l		
4	COD	mg/l		
5	BOD @ 27 °C	mg/l		
Aeration Tank				
6	MLSS	mg/l	-	
7	MLVSS	%	-	

- **Gopalpuri Colony STP**

Table 22: Sewage Water Monitoring at Gopalpuri STP (1st Week)

Date of Sampling	05.07.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.7	7.63
2	Total Suspended Solids	mg/l	408.3	38.3
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	262.6	102
5	BOD @ 27 °C	mg/l	82.0	28.0
Aeration Tank				
6	MLSS	mg/l	12.0	
7	MLVSS	%	92.0	

Table 23: Sewage Water Monitoring at Gopalpuri STP (2nd Week)

Date of Sampling	15.07.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.3	7.43
2	Total Suspended Solids	mg/l	333	69
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	444.4	103
5	BOD @ 27 °C	mg/l	142.0	28.0
Aeration Tank				
6	MLSS	mg/l	16.0	
7	MLVSS	%	89.0	

Table 24: Sewage Water Monitoring at Gopalpuri STP (3rd Week)

Date of Sampling	20.07.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.39	7.43
2	Total Suspended Solids	mg/l	166.6	36.7
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	230	58
5	BOD @ 27 °C	mg/l	70.0	19.0
Aeration Tank				
6	MLSS	mg/l	12.0	
7	MLVSS	%	92.0	

Table 25: Sewage Water Monitoring at Gopalpuri STP (4th Week)

Date of Sampling	26.07.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.28	7.4
2	Total Suspended Solids	mg/l	160	38
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	210	62
5	BOD @ 27 °C	mg/l	62.0	19.0
Aeration Tank				
6	MLSS	mg/l	11.0	
7	MLVSS	%	96.0	

- **Vadinar STP**

Table 26: Sewage Water Monitoring at Vadinar STP (1st Week)

Date of Sampling	05.07.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.23	NOT WORKING
2	Total Suspended Solids	mg/l	8	
3	Residual Chlorine	mg/l	70.0	
4	COD	mg/l	86.0	
5	BOD @ 27 °C	mg/l	27.0	

Table 27: Sewage Water Monitoring at Vadinar STP (2nd Week)

Date of Sampling	15.07.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.22	NOT WORKING
2	Total Suspended Solids	mg/l	62	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	82.0	
5	BOD @ 27 °C	mg/l	27.0	

Table 28: Sewage Water Monitoring at Vadinar STP (3rd Week)

Date of Sampling	20.07.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.22	NOT WORKING
2	Total Suspended Solids	mg/l	62	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	82.0	
5	BOD @ 27 °C	mg/l	27.0	

Table 29: Sewage Water Monitoring at Vadinar STP (4th Week)

Date of Sampling	26.07.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.18	NOT WORKING
2	Total Suspended Solids	mg/l	72	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	80.0	
5	BOD @ 27 °C	mg/l	26.0	

5.3 Conclusions:

The GPCB standards of BOD, TSS and Residual Chlorine for STP outlet are 20 mg/lit, 30 mg/lit & 0.5 mg/lit respectively. It is suggested to do treatment on regular basis to avoid flow of contaminated/polluted water into the sea. Also, the STP at Vadinar is also non-functional and thus, steps should be taken to commission the STP at Vadinar Port. Hence, currently only inlet samples are collected and analysed. And the sample of kandla stp was not collected in the last week of July 2021 as plant was not working.

6. Marine Water Monitoring

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992) aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

Marine Environment

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations

The monitoring of marine environment for the study of biological and ecological parameters was carried out on 10th& 12th July -2021 in harbor regions of KPT and on 10th July-2021 at Vadinar during spring tide period of New moon phase of Lunar Cycle. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 17th& 19th July 2021 in harbor regions of KPT. 17th July -2021 in Vadinar during Neap tide period first quarter of Lunar Cycle..

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and two stations in Nakti creek and one station in Khori creek. The same sampling schedule was repeated during consecutive spring tide and neap tide in same month. Plankton samples from sub surface layer was collected both during high tide period and low tide period from 1 water quality monitoring stations near Vadinar jetty area during spring tide and neap tide in this month .Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

Sampling Locations

Offshore monitoring requirement	Number of locations
Offshore Installations	3 in Kandla creek 2 in Nakti creek 1 in Khori creek 1 near Vadinar Jetty 1 near 1st SBM
Total Number of locations	**8**

6.1 Marine Water Quality

Marine water quality of marine waters of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month.

The results of marine water quality and Marine sediments are as below;

Table 30: Marine Water Quality Monitoring Parameters for location near KPT colony

Sr. No.	Parameters	Unit	Kandla Creek Near KPT colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.29	7.25	7.13	7.15
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.0	31.8	32.1	32.6
5	Turbidity	NTU	30	28	35	27
6	Total Dissolved Solids	mg/l	37802.0	23743	43720.0	43881.0
7	Total Suspended Solids	mg/l	624	412	409	261
8	Total Solids	mg/l	38426.2	24155.4	44129.0	44142.0
9	DO	mg/l	4.5	5	4.9	5.3
10	COD	mg/l	72.0	68.0	74.0	76.0
11	BOD	mg/l	<2	<2	<2	<2
12	Silica	mg/l	0.23	0.38	0.30	0.48
13	Phosphate	mg/l	0.31	0.28	0.19	0.35
14	Sulphate	mg/l	2856	2556	2076	2160
15	Nitrate	mg/l	2.10	2.04	2.40	2.04
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	521.04	561.12	521.04	440.88
18	Magnesium	mg/l	1798.2	1798.2	1773.9	1871.1
19	Sodium	mg/l	14122.0	14820.0	10110.0	10872.0
20	Potassium	mg/l	325.0	289.0	321.0	289.0
21	Iron	mg/l	1.12	1.42	1.52	1.45
22	Chromium	mg/l	0.12	0.13	0.12	0.11
23	Copper	mg/l	0.12	0.19	0.06	0.08
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.07	0.06	0.05	0.06
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.20	0.19	0.11	0.12
28	Zinc	mg/l	0.05	0.06	0.06	0.07

Table 31: Marine Water Quality Monitoring Parameters for location near passenger Jetty One at Kandla

Sr. No.	Parameters	Unit	Near passenger Jetty One (2)			
			23° 0'18 "N 70°13'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	5.3	4.7	7.3	7.27
2	Color	-	80.0	76.0	Colorless	Colorless
3	Odor	-	<2	<2	Odorless	Odorless
4	Salinity	ppt	0.32	0.68	33.0	32.6
5	Turbidity	NTU	0.32	0.26	22	28
6	Total Dissolved Solids	mg/l	2976	2748	46102.0	47052.0
7	Total Suspended Solids	mg/l	2.25	2.03	211	312
8	Total Solids	mg/l	<0.05	<0.05	46313.0	47364.0
9	DO	mg/l	521.04	521.04	4.6	4.9
10	COD	mg/l	1846.8	1773.9	86.0	79.0
11	BOD	mg/l	11052.0	13425.0	<2	<2
12	Silica	mg/l	325.0	306.0	0.39	0.72
13	Phosphate	mg/l	1.55	1.62	0.34	0.30
14	Sulphate	mg/l	0.12	0.14	1956	2520
15	Nitrate	mg/l	0.18	0.16	1.74	2.52
16	Nitrite	mg/l	<0.01	<0.01	<0.05	<0.05
17	Calcium	mg/l	0.07	0.05	480.96	480.96
18	Magnesium	mg/l	<0.001	<0.001	1822.5	1822.5
19	Sodium	mg/l	0.28	0.16	11011.0	10452.0
20	Potassium	mg/l	0.05	0.06	333.0	315.0
21	Iron	mg/l	5.3	4.7	1.56	1.89
22	Chromium	mg/l	80.0	76.0	0.16	0.14
23	Copper	mg/l	<2	<2	0.09	0.08
24	Arsenic	mg/l	0.32	0.68	<0.01	<0.01
25	Cadmium	mg/l	0.32	0.26	0.06	0.07
26	Mercury	mg/l	2976	2748	<0.001	<0.001
27	Lead	mg/l	2.25	2.03	0.16	0.19
28	Zinc	mg/l	<0.05	<0.05	0.06	0.08

Table 32: Marine Water Quality Monitoring Parameters for location Near Coal Berth

Sr. No.	Parameters	Unit	Near Coal Berth			
			22°59'12"N 70°13'40"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.51	7.30	7.29	7.5
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.6	32.8	32.4	33.1
5	Turbidity	NTU	35	47	35	47
6	Total Dissolved Solids	mg/l	40788	35363	41086.0	42830.0
7	Total Suspended Solids	mg/l	563	601	215	161
8	Total Solids	mg/l	41351.3	35964.2	41301.0	42991.0
9	DO	mg/l	4.8	5	4.8	5
10	COD	mg/l	88.0	70.0	90.0	79.0
11	BOD	mg/l	<2	<2	<2	<2
12	Silica	mg/l	0.30	0.34	0.42	0.36
13	Phosphate	mg/l	0.28	0.32	0.35	0.38
14	Sulphate	mg/l	2580	3444	3156	3240
15	Nitrate	mg/l	1.93	2.10	2.56	2.46
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	561.12	480.96	561.12	601.2
18	Magnesium	mg/l	1725.3	1798.2	1725.3	1725.3
19	Sodium	mg/l	15555.0	13252.0	11052.0	11412.0
20	Potassium	mg/l	389.0	296.0	315.0	296.0
21	Iron	mg/l	1.47	2.02	2.10	2.02
22	Chromium	mg/l	0.19	0.15	0.12	0.20
23	Copper	mg/l	0.14	0.12	0.06	0.10
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.06	0.08	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.20	0.18	0.10	0.12
28	Zinc	mg/l	0.08	0.06	0.07	0.06

Table 33: Marine Water Quality Monitoring Parameters for location Khori creek at Kandla

Sr. No.	Parameters	Unit	KPT 4			
			Near 15/16 Berth			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.25	7.20	7.39	7.45
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.4	32.8	32.4	32.2
5	Turbidity	NTU	50	29	51	55
6	Total Dissolved Solids	mg/l	35588	33113	43563.0	44059.0
7	Total Suspended Solids	mg/l	407	420	213	265
8	Total Solids	mg/l	35995.3	33533.4	43776.0	44324.0
9	DO	mg/l	5.2	4.8	5.3	4.7
10	COD	mg/l	68.0	79.0	76.0	86.0
11	BOD	mg/l	<2	<2	<2	<2
12	Silica	mg/l	0.81	0.29	0.79	0.37
13	Phosphate	mg/l	0.26	0.34	0.43	0.42
14	Sulphate	mg/l	2388	2652	2280	2376
15	Nitrate	mg/l	1.74	1.96	2.10	2.57
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	601.20	561.12	601.2	561.12
18	Magnesium	mg/l	1749.6	1822.5	1725.3	1798.2
19	Sodium	mg/l	10026.0	11252.0	10512.0	9899.0
20	Potassium	mg/l	302.0	378.0	266.0	275.0
21	Iron	mg/l	1.66	1.48	1.45	1.60
22	Chromium	mg/l	0.16	0.16	0.18	0.16
23	Copper	mg/l	0.15	0.10	0.12	0.10
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.07	0.06	0.06	0.05
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.16	0.2	0.08	0.10
28	Zinc	mg/l	0.07	0.08	0.05	0.05

Table 34: Marine Water Quality Monitoring Parameters for location Nakti Creek near Tuna Port

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.29	7.35	7.2	7.28
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.6	33.2	33.6	33.0
5	Turbidity	NTU	35	29	29	29
6	Total Dissolved Solids	mg/l	38200	18212	46852.0	47695.0
7	Total Suspended Solids	mg/l	324	214	200	196
8	Total Solids	mg/l	38524.4	18426.2	47052.0	47891.0
9	DO	mg/l	5.1	5.1	4.9	5
10	COD	mg/l	80.0	68.0	89.0	78.0
11	BOD	mg/l	<2	<2	<2	<2
12	Silica	mg/l	0.26	0.29	0.62	0.30
13	Phosphate	mg/l	0.28	0.26	0.31	0.38
14	Sulphate	mg/l	2964	3408	3240	3156
15	Nitrate	mg/l	1.95	2.18	2.56	2.49
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	561.12	521.04	601.2	440.88
18	Magnesium	mg/l	1822.5	1749.6	1798.2	1822.5
19	Sodium	mg/l	11256.0	12625.0	11021.0	11425.0
20	Potassium	mg/l	302.0	366.0	396.0	378.0
21	Iron	mg/l	1.83	1.76	2.02	2.11
22	Chromium	mg/l	0.15	0.18	0.20	0.18
23	Copper	mg/l	0.12	0.11	0.16	0.10
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.06	0.07	0.08
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.18	0.19	0.12	0.16
28	Zinc	mg/l	0.06	0.05	0.06	0.07

Table 35: Marine Water Quality Monitoring Parameters for location Nakti Creek Near NH-8A at Kandla

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.37	Sampling not possible during Low Tide	7.37	Sampling not possible during Low Tide
2	Color	-	Colorless		Colorless	
3	Odor	-	Odorless		Odorless	
4	Salinity	ppt	33.4		32.4	
5	Turbidity	NTU	27		33	
6	Total Dissolved Solids	mg/l	35166		42125.0	
7	Total Suspended Solids	mg/l	180		164.3	
8	Total Solids	mg/l	35346.3		42289.3	
9	DO	mg/l	5		5.5	
10	COD	mg/l	72.0		79.0	
11	BOD	mg/l	<2		<2	
12	Silica	mg/l	0.61		0.62	
13	Phosphate	mg/l	0.30		0.39	
14	Sulphate	mg/l	2988		3036	
15	Nitrate	mg/l	2.43		2.72	
16	Nitrite	mg/l	<0.05		<0.05	
17	Calcium	mg/l	601.20		521.04	
18	Magnesium	mg/l	1749.6		1749.6	
19	Sodium	mg/l	14485.0		11528.0	
20	Potassium	mg/l	396.0		311.0	
21	Iron	mg/l	1.52		2.06	
22	Chromium	mg/l	0.16		0.19	
23	Copper	mg/l	0.16		0.11	
24	Arsenic	mg/l	<0.01		<0.01	
25	Cadmium	mg/l	0.04		0.06	
26	Mercury	mg/l	<0.001		<0.001	
27	Lead	mg/l	0.17		0.10	
28	Zinc	mg/l	0.06		0.07	

Table 36: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar Jetty

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.60	7.45	7.5	7.8
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	33.2	32.6	33.0	33.1
5	Turbidity	NTU	32	28	35	25
6	Total Dissolved Solids	mg/l	37530	35780	43940.0	46623.0
7	Total Suspended Solids	mg/l	327	417	405.5	399.5
8	Total Solids	mg/l	37856.5	36197.4	44345.5	47022.5
9	DO	mg/l	5.2	5.1	5.2	5.1
10	COD	mg/l	68.0	72.0	78.0	79.0
11	BOD	mg/l	<2	<2	<2	<2
12	Silica	mg/l	0.32	0.31	0.42	0.62
13	Phosphate	mg/l	0.26	0.26	0.35	0.33
14	Sulphate	mg/l	2136	2352	2220	2304
15	Nitrate	mg/l	2.72	2.80	2.09	2.44
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	480.96	561.12	561.12	521.04
18	Magnesium	mg/l	1749.6	1749.6	1579.5	1555.2
19	Sodium	mg/l	16458.0	15555.0	11425.0	12021.0
20	Potassium	mg/l	345.0	388.0	316.0	296.0
21	Iron	mg/l	2.06	2.10	2.45	2.3
22	Chromium	mg/l	0.16	0.20	0.15	0.16
23	Copper	mg/l	0.17	0.18	0.09	0.08
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.05	0.06	0.05	0.06
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.14	0.13	0.10	0.10
28	Zinc	mg/l	0.08	0.09	0.05	0.06

6.1.1 Marine Sediments

Sediment samples were collected with Van Veen Grab from the six locations in Kandla Port Waters and two locations in Vadinar Port. Samples were collected and preserved in silver foil in ice box to prevent the contamination/decaying of the samples.

6.2 Results

The Sediment Quality results are given in below from table no. 34 A & B.

Table 34A: Results of Analysis of Sediment of Kandla & Vadinar Port (Spring Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	Khori - 1	Nakti - 1 (Near NH-8A)	Jetty
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	0.64	1.12	0.39	1.03	1.06
3	Organic Carbon	mg/kg	0.37	0.65	0.22	0.60	0.52
4	Inorganic Phosphate	mg/kg	126.0	125.0	136.0	146.0	152.0
5	Moisture	%	11.70	18.10	6.60	26.1	23.50
6	Aluminium	mg/kg	ND	ND	ND	ND	ND
7	Silica	mg/kg	26.0	24.0	42.0	49.0	41.2
8	Phosphate	mg/kg	9.88	7.82	8.80	9.70	18.00
9	Sulphate	mg/kg	170.0	192.0	259.0	259.0	362.0
10	Nitrite	mg/kg	0.12	0.13	0.11	0.11	0.11
11	Nitrate	mg/kg	9.23	7.82	9.25	9.25	7.52
12	Calcium	mg/kg	144.3	148.0	132.0	124.0	169.0
13	Magnesium	mg/kg	165.2	214.0	122.0	136.0	162.0
14	Sodium	mg/kg	2221.0	1686.0	1882.0	1775.0	3785.0
15	Potassium	mg/kg	641.0	542.0	738.0	562.0	658.0
16	Chromium	mg/kg	123	145	126	130	162
17	Nickel	mg/kg	24.8	22.5	18.9	26.02	38
18	Copper	mg/kg	48	42	20.6	27.5	23.6
19	Zinc	mg/kg	32.60	36.00	30.40	36.00	32.00
20	Cadmium	mg/kg	ND	ND	ND	ND	ND
21	Lead	mg/kg	2.8	1.8	1.2	4.5	5.8
22	Mercury	mg/kg	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND

*Grab samples could not be collected due high current at KPT 3, Natki Creek Near Tuna port & Vadinar SBM

Table 34B: Results of Analysis of Sediment of Kandla & Vadinar Port (Neap Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	Jetty
1	Texture	-	Sandy loam	Sandy loam	Sandy loam
2	Organic Matter	mg/kg	0.74	1.10	1.10
3	Organic Carbon	mg/kg	0.52	0.62	0.63
4	Inorganic Phosphate	mg/kg	162.0	142.0	162.0
5	Moisture	%	15.62	14.20	21.52
6	Aluminium	mg/kg	ND	ND	ND
7	Silica	mg/kg	16.60	20.30	39.2
8	Phosphate	mg/kg	9.8	7.26	16.66
9	Sulphate	mg/kg	342.0	280.0	289.0
10	Nitrite	mg/kg	0.10	0.11	0.1
11	Nitrate	mg/kg	10.6	9.8	8.02
12	Calcium	mg/kg	141.0	152.0	178.0
13	Magnesium	mg/kg	156.0	214.0	206.0
14	Sodium	mg/kg	2210.0	1786.0	3682.0
15	Potassium	mg/kg	590.0	562.0	666.0
16	Chromium	mg/kg	136	149	158
17	Nickel	mg/kg	26.2	23.5	32
18	Copper	mg/kg	52	46	18.2
19	Zinc	mg/kg	33.20	34.00	22.00
20	Cadmium	mg/kg	ND	ND	ND
21	Lead	mg/kg	2.4	2.2	4.6
22	Mercury	mg/kg	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND

*Grab samples could not be collected due high current at KPT 3,Khori, Natki Creek Near Tuna Port, Vadinar Jetty and Vadinar SBM

REPORT

ON

ECOLOGICAL MONITORING

OF MARINE ENVIRONMENT

IN

DPT HARBOUR AREA, NEAR BY CREEKS

For

DEENDAYAL PORT TRUST

JULY, 2021

***INTRODUCTION*:**

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992)aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

***MARINE ENVIRONMENT*:**

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations:

The monitoring of marine environment for the study of biological and ecological Parameters was carried out on 10th July, 2021 in in harbour region of DPT, and on 12thJuly, 2021 in creeks near by the port during spring tide .The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 17th July, 2021 in harbour region of DPT and on 19thJuly, 2021 in creeks near by the port during neap tidal condition.

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of DPT harbour area andone stations in Nakti creek and one station in Khori creek. Sampling at second sampling station of Nakti creek was possible only during high tide period. Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons(density and their population).

TABLE #1 SAMPLING LOCATIONS

monitoring requirement	**Number of locations**
Kandla creek Nakti creek Khori Creek	3 in Kandla creek 2 in Nakti creek 1 in Khori creek
Total Number of locations	**6**

Sampling methodology adopted:

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.

50 litters of the water sample were collected from Sub surface by using bucket. From the collected water sample 1 litter of water sample were taken in an opaque plastic bottle for chlorophyll estimation, thereafter plankton samples were collected by using filtration assembly with nilyobolt cloth of 20µm mesh size.

Samples Processing for chlorophyll estimation:

Samples for the 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 litter of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm. By using corrected optical density, Chlorophyll-a value was calculated as given in (APHA, 1998).

PLANKTON:

The entire area open water in the sea is the pelagic realm. Pelagic organisms live in the open sea. In contrast to the pelagic realm, the benthic realm comprises organisms and zone of the bottom of the sea. Vertically the pelagic realm can be dividing into two zones based on light penetration; upper photic or euphotic zone and lower dark water mass, aphotic zone below the photic zone.

The term plankton is general term for organisms have such limited powers of locomotion that they are at the mercy of the prevailing water movement. Plankton is subdivided to phytoplankton and

zooplankton. Phytoplankton is free floating organisms that are capable of photosynthesis and zooplankton is the various free floating animals.

Pelagic zone, represents the entire ocean water column from the surface to the deepest depths, is home to a diverse community of organisms. Differences in their locomotive ability categorize the organisms in the pelagic realm into two, ***plankton*** and ***nekton*** (Lalli and Parsons, 1997). ***Plankton*** consists of all organisms drifting in the water and is unable to swim against water currents, whereas ***Nekton*** includes organisms having strong locomotive power. Ecological studies on the plankton community, which form the base of the aquatic food chain, help in the better understanding of the dynamics and functioning of the marine ecosystem. The term 'Plankton' first coined by Victor Hensen (1887), Plankton, (Greek word: *planktos*meaning "passively drifting or wandering") is defined as drifting or free-floating organisms that inhabit the pelagic zone of water. Based on their mode of nutrition planktonic organisms are categorised into phytoplankton (organisms having an autotrophic mode of nutrition) and zooplankton (organisms having a heterotrophic mode of nutrition).

Phytoplankton in the marine environment:

Phytoplankton is 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).The phytoplankton those normally captured in the net from the Gulf of Kutch is normally dominated by these two major groups; diatoms and dinoflagellates. Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as and Cyanophytes (blue-green 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 in the marine environment:

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 is 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, 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 (Beaugrand et al., 2004). Zooplankton grazing in the marine environment controls the primaryProduction and helps in determining the pelagic ecosystem (Banse, 1995). 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.

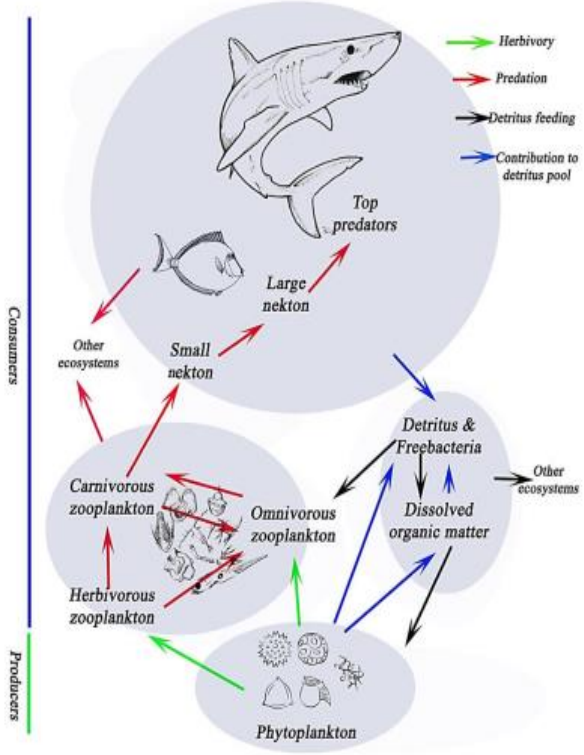
Based on the duration of planktonic life, zooplankton are categorised into Holoplankton (organisms which complete their entire lifecycle as plankton) and Meroplankton (organisms which are planktonic during the early part of their lives such as the larval stages of benthic and nektonic organisms). Tychoplankton are organisms which live a brief planktonic life, such as the benthic crustaceans (cumaceans, mysids, isopods) which ascend to the water column at night for feeding and certain ectoparasitic copepods, they leave the host and spend their life as plankton during their breeding cycle.

Zooplankton can be subdivided into holoplankton, i.e., permanent members of the plankton (e.g., Calanoid copepods), and meroplankton, i.e., temporary members in the plankton e.g., larvae of fish, shrimp, and crab). The meroplankton group consists of larval and young stages of animals that will adopt a different lifestyle once they mature. In contrast to phytoplankton which consist of a relatively smaller variety of organisms, Zooplankton are extremely divers, consist of a host of larval and adult forms representing many animal phylum.

Among the zooplankton one group always dominate than others; members of sub class copepods (Phylum Athropoda), and Tintinids (Phylum Protozoa) among the net planktons. These small animals are of vital importance in marine ecosystem as one of the primary herbivores animals in the sea, and it is they provide vital link between primary producer (autotrophs) and numerous small and large marine consumers.

As their community structure and function are highly susceptible to changes in the environmental conditions regular monitoring of their distribution as well as their interactions with various physicochemical parameters is inevitable for the sustainable management of the ecosystem (Kusum et al., 2014). Of all the marine zooplankton groups, copepods mainly calanoid copepods are the dominant groups in marine subtropical and tropical waters and exhibit considerable diversity in morphology and habitats they occupy (Madhupratap, 1991;)

It has been well established that potential of pelagic fishes viz. finfishes, crustaceans, molluscs and marine mammals either directly or indirectly depend on zooplankton. The herbivorous zooplankton is efficient grazers of the phytoplankton and is referred to as living machines transforming plant material into animal tissue. Hence they play an essential role as the intermediaries for nutrients/energy transfer between primary and tertiary trophic levels. Due to their large density, shorter lifespan, drifting nature, high group/species diversity and different tolerance to the stress, they used as the indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem (Ghajbhiye, 2002).



Simplified marine food web

Spatial distribution of Plankton:

A characteristic of plankton population is that they tend to occur in patches, which are varying spatially on a scale of few meters to far as few kilometres in distance. They also vary in time scale, season as well as vertically in the water column. It is this patchiness and its constant changes in time and spot, that has made it so difficult for plankton biologist to learn about the ecology of plankton. The biological factors that causes this patchiness is due to the ability of zooplankton to migrate vertically and graze out the phytoplankton at a rapid rate that can create patchiness. Similarly the active swimming ability by certain zooplankton organisms can cause to aggregate in dense group.

At its most extreme, because the water in which plankton is suspended is constantly moving, each sample taken by the plankton biologists remain a different volume of water, so each sample is unique and replicate does not exist.

Plankton may also exhibit vertical patchiness. Physical factors contribute to this type of patchiness include light intensity, nutrients and density gradients in the water column.

Phytoplankton in particular tends to be unequally distributed vertically, which leads to the existence of different concentration of a chlorophyll value between photic zone and below the photic zone.

Methodology adopted for Plankton sampling:

Mixed plankton sample were obtained from the sub surface layer at each sampling locations by towing the net horizontally with the weight .After the tow of about 15-30minutes, plankton net was pulled up and washed down to the tail and collected the plankton adhered to plankton net in the collection bucket at the bottom by springing outer and inner surface of the net with sea water, while the net was hanging with the mouth upward. For quantitative evaluation 50 L water samples were collected from subsurface layer and filtered through 20µm mesh size net by using bucket and filtration assembly.

Preservation and storage:

Both filtered plankton and those collected from the plankton net were preserved with 5% buffered formalin and stored in 1L plastic container for further processing in the laboratory.

Sample concentration:

The collected plankton samples were concentrated by using centrifuge and made up to 50 ml with 5% formalin -Glycerine mixture.

Taxonomic evaluation:

Before processing, the sample was mixed carefully and a subsample was taken with a calibrated Stempel-pipette. 1 ml of the concentrated plankton samples were transferred on a glass slide with automatic pipette. The plankton sample on the glass slides were stained by using Lugol's iodine and added glycerine to avoid drying while observation. The plankton samples were identified by using Labex triangular Research microscope with photographic attachment. Microphotographs of the plankton samples were taken for record as well as for confirming the identification. The bigger sized zooplankton was observed through dissecting stereomicroscope with magnification of 20-30 x. Plankton organisms in the whole slide were identified to the lowest axon possible. A thorough literature search was conducted for the identification of the different groups of zooplankton that were encountered

Cell counts by drop count method:

The common glass slide mounted with a 1ml of concentrated phytoplankton/zooplankton sample in glycerol and covered with cover slip 22x 60mm was placed under the compound microscope provided with a mechanical stage. The plankton was then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton in each microscopic field was thus counted. When first microscopic field row was finished the next

consecutive row was adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted. From this total number in 1ml of the concentrated plankton, total number of plankton in the original volume of sample filtered was calculated as units/L.

BENTHIC ORGANISMS:

Benthos is those organisms that are associated with the sea bed or benthic habitats. Epi- benthic organisms live attached to a hard substratum or rooted to a shallow depth below the surface. In fauna organisms live below the sediment–water interface. Interstitial organisms live and move in pore water among sedimentary grains.

Because the benthic organisms are often collected and separated on sieves, a classification based on the overall size is used. Macro benthos include organisms whose shortest dimension is greater than or equal to 0.5 mm. Meio benthos are smaller than 0.5mm but larger than 42µ in size.

The terms such as macro fauna and Meio fauna generally have little relevance with taxonomic classification. The terms Meio fauna and macro fauna depend on the size. Meio fauna were considered as good bioassay of community health and rather sensitive indicators of environmental changes

SAMPLING METHODOLOGY ADOPTED FOR SUB TIDAL REGION:

Van veen sampler (0.09m^2) was used for sampling bottom sediments. Two sets of sediments were sampled from each location, one for macro fauna and other for Meio fauna. The macro fauna in the sediments were sieved on board to separate out the organisms. The fixation of Meio fauna is normally done by bulk fixation of the sediment sample. The bulk fixation is done by using 10% formalin (Buffered with borate). The organisms were preserved with seawater as diluting agent.

Sample sieving:

Sediments samples were sieved to extract the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. The large portion of the sediment was split in to smaller portions and mixed with sea water in a bucket. The cohesive lumps were broken down by continuous stirring. The disaggregated sediments were then passed through the sieves.

Sample staining:

Sorting of the Meio fauna from the sieve is difficult task especially in the preserved material, because organisms are not easily detectable. To facilitate the animal detection the entire sample retained on the sieve after sieving operation were stained by immersing the sieve in a flat bottom

tub with 1% Rose Bangal stain; a protein stain. A staining period of 10-30 minutes is sufficient for sample detection.

DIVERSITY INDICES:

On the whole, diversity indices provide more information about community composition than simply species richness (number of species present); they also, take the relative abundances of different species into account. Based on this fact, diversity indices therefore depend not only on species richness but on the evenness, or equitability, with which individuals are distributed among the different species (Magurram, A. E. (1988)

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.

The basic idea of diversity 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 (Carol H.R. *etal*. 1998). Biodiversity is commonly expressed through indices based on species richness and species abundances (Whittaker 1972, Lande 1996, Purvis and Hector 2000). 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.

A diversity Index is a single statistic that incorporates in formation on richness and evenness. The diversity measures that incorporate the two concepts may be termed heterogeneity measures (Magurran, 2004).

Any study intended to interpret causes and effect of adverse impact on Biodiversity of communities require suitable measures to evaluate specie richness and Diversity. The former is number of species in community, while latter is a function of relative frequency of different species. Species richness is the iconic measure of biological diversity (Magurran, 2004). Several indices have been created to measure the diversity of species; however, the most widely used in the last decades are the Shannon (1948) and Simpson (1949) (Buzas and Hayek 1996; Gorelick 2006), with the components of diversity: richness (*S)* and evenness (*J)*

Simpson's diversity index

Simpson's index (**D**) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present.. The Simson index is one of the meaningful and robust biodiversity measures available.(Magurran ,2004).

The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and, 1, no diversity. When D increases diversity decreases. Simpson's index is therefore usually expressed as 1-D or 1/D. (Magurran, 2004)

Low species diversity suggests:

- relatively few successful species in the habitat
- the environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment
- food webs which are relatively simple
- change in the environment would probably have quite serious effects

High species diversity suggests:

- a greater number of successful species and a more stable ecosystem
- more ecological niches are available and the environment is less likely to be hostile complex food webs
- environmental change is less likely to be damaging to the ecosystem as a whole

Species richness indices

The species richness***(S)*** is simply the number of species present in an ecosystem. Species richness Indices of species richness are widely used to quantify or monitor the effects of anthropogenic disturbance. A decline in species richness may be concomitant with severe or chronic human-induced perturbation (Fair Fair weather 1990,) Species richness measures have traditionally been the mainstay in assessing the effects of environmental degradation on the biodiversity of natural assemblages of organisms (Clarke &Warwick, 2001)

Species richness is the iconic measure of biological diversity (Magurran, 2004). The species richness***(S)*** is simply the number of species present in an ecosystem. This index makes no use of

relative abundances. The term species richness was coined by McIntosh (1967) and oldest and most intuitive measure of biological diversity (Magurran, 2004).

Margalef's diversity index is a species richness index. Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, were derived.

The value of a diversity index increases both when the number of types increases and when evenness increases. For a given number of types, the value of diversity index is maximised when all types are equally abundant (Rosenzweig, M. L. (1995).

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 (Odum 1971 and Reish 1984). Shannon-Wiener's index **(H**) reproduce community parameters to a single numberby using an equation.

Shannon and Weiner index represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxa. It varies from 0 for communities with only single taxa to high values for community with many taxa each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range of polluted and unpolluted ecosystems, Wilham and Dorris (1968) concluded that the values of the index greater than 3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln\left(\frac{n_j}{N}\right)$$

RESULTS:

CHLOROPHYLL-a:

Water Samples for the chlorophyll estimation were collected from sub surface layer during high tide and low tide period of the tidal cycle for each sampling locations and analysed for Chlorophyll -a and after acidification for Pheophytin –a. Chlorophyll- a value was used as algal biomass indicator (APHA,1998) Algal biomass was estimated by converting Chlorophyll value.

In the sub surface water chlorophyll-a was varying from 0.511 -0.921mg/m^3.in harbour region of DPT during sampling done in spring tide period of July, 2021. In the nearby creeks chlorophyll-a was

varying from 0.173-0.980 mg/m^3.Pheophytin –a level was below detectable limit- the all the sampling stations during spring in the harbour region of DPT.

In the sub surface water chlorophyll-a was varying from 0.391 -0.835mg/m^3.in harbour region of DPT during sampling done in neap tide period of July, 2021 . In the nearby creeks chlorophyll-a was varying from 0.308-0.991 mg/m^3. Pheophytin –a level was below detectable limit- the all the sampling stations during spring in the harbour region ofDPT

TABLE #2 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JULY,2021

Sr.No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREA					
1	KPT1	High tide	0.629	BDL	42.14
		Low tide	0.921	BDL	61.71
2	KPT 2	High tide	0.745	BDL	49.92
		Low tide	0.558	BDL	37.39
3	KPT 3	High tide	0.511	BDL	34.24
		Low tide	0.598	BDL	40.06
CREEKS					
4	KPT-4 Khori-I	High tide	0.425	BDL	28.48
		Low tide	0.473	BDL	31.69
5	KPT-5 Nakti-I	High tide	0.714	BDL	47.84
		Low tide	0.980	BDL	65.66
6	KPT-5 Nakti-II	High tide	0.173	BDL	11.59

BDL: Below Detectable Limit.

TABLE #3 VARIATIONS IN CHLOROPHYLL –aPHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN JULY,2021

Sr.No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREA					
1	KPT1	High tide	0.730	BDL	48.91
		Low tide	0.835	BDL	55.94
2	KPT 2	High tide	0.391	BDL	26.20
		Low tide	0.484	BDL	32.43
3	KPT 3	High tide	0.612	BDL	41.00
		Low tide	0.513	BDL	34.37
CREEKS					
4	KPT-4 Khori-I	High tide	0.385	BDL	25.80
		Low tide	0.497	BDL	33.30
5	KPT-5 Nakti-I	High tide	0.991	BDL	66.39
		Low tide	0.692	BDL	46.36
6	KPT-5 Nakti-II	High tide	0.308	BDL	20.64

BDL: Below Detectable Limit.

PHYTOPLANKTON POPULATION:

For the evaluation of the Phytoplankton population in DPT harbour area and within the immediate surroundings of the port, sampling was conducted from 5 sampling locations (3 in harbour area and two in Nakti creek) during high tide period and low tide period of spring tide. The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by,Diatoms andblue green algae during spring tide period.Diatoms were represented by 14 genera. Blue green wererepresented by onegenera .during the sampling conducted in spring tide in July,2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 68 -196 units/ L during high tide period and 171-212 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by Diatoms andBlue green algae during spring tide period.Diatoms were represented by 14genera and Blue green algae were represented two genera during the sampling conducted in Neap tide in July , 2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 86-224 units/ L during high tide period and 222-254 units/ L during low tide of Neap Tide.

Species Richness Indices and Diversity Indices :

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 1.896 -2.495 with an average of 2.315during the sampling conducted in High tide period of spring tide.While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla Harbour region and nearby creeks was varying from. 2.054-2.334 with an average of 2.170 during the consecutive in low tide period .

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 2.245-2.630 with an average of 2.495 during the sampling conducted in High tide period of Neaptide While .Margalef's diversity index (Species Richness) S ofphytoplankton communities in the Kandla Harbour region and nearby creeks was varying from. 2.003-2.709 with an average of 2.232 during the consecutive in low tide period .

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.878-0.959 (H'(log10)) between selected sampling stations with an average value of 0.905 during high tide period of spring tide .Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.863-0.904 (H'(log10)) between selected sampling stations with an average value of 0.892 during consecutive lowtide. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.960-1.025 (H'(log10)) between selected sampling stations with an average value of 0.990. during high tide period of neap tide . Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.969-1.008 (H'(log10)) between selected sampling stations with an average value of 0.990 during consecutive low tide. Typical values are generally between 1.5 and 3.5 in most ecological

studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of phytoplankton of Kandla Harbour region and nearby creeks is less but with abundant population of few, with relatively few ecological niches and only very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran,2004).

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.837- 0.878 between selected sampling stations with an average of 0.855 during high tide period of spring tide . Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.840- 0.856 between selected sampling stations with an average of 0.849 during consecutive low tide . Low species diversity suggests a relatively few successful species in this habitat. The environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in Kandla Harbour region and nearby creeks, during high tide period and low tideperiod during neap tide also, which was varying from 0.872-0.891 with an average value of 0.881 between selected sampling stations during high tide period and varying from 0.882-0.889 with an average value of 0.885 between selected sampling stations during consecutive low tide period Low species diversity suggests a relatively few successful species in this habitat.

Table # 4PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JULY,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	183	14/15	93.33	2.495	0.906	0.8502
	2	154	13/15	86.66	2.382	0.8957	0.8537
	3	159	13/15	86.66	2.367	0.8948	0.8424
	4	188	13/15	86.66	2.292	0.8783	0.8372
	5	196	14/15	93.33	2.463	0.9587	0.8667
	6	68	9/15	60	1.896	0.899	0.8784
LOW TIDE	1	171	13/15	86.66	2.334	0.9041	0.8535
	2	212	12/15	80	2.054	0.8992	0.8565
	3	197	13/15	86.66	2.271	0.89	0.8406
	4	203	12/15	80	2.07	0.8634	0.8401
	5	179	12/15	80	2.121	0.9037	0.856

Table # 5 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN JULY2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	205	15/16	93.75	2.63	1.002	0.8735
	2	184	14/16	87.5	2.493	0.9603	0.872
	3	221	14/16	87.5	2.408	0.9762	0.8773
	4	213	15/16	93.75	2.611	1.025	0.8905
	5	224	15/16	93.75	2.587	1.011	0.8859
	6	86	11/16	68.75	2.245	0.9685	0.8914
LOW TIDE	1	243	12/16	75	2.003	0.9696	0.8823
	2	222	12/16	75	2.036	0.9893	0.8893
	3	222	13/16	81.25	2.221	1.001	0.8872
	4	254	16/16	100	2.709	1.008	0.883
	5	239	13/16	81.25	2.191	0.985	0.8864

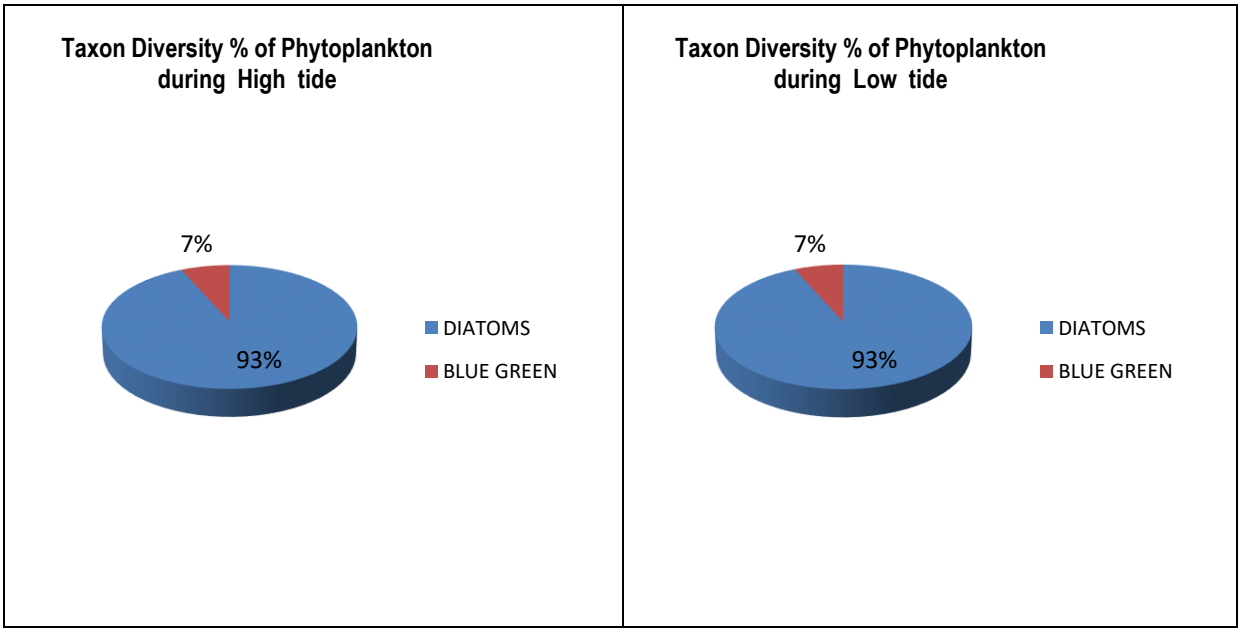
Table # 6 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING SPRING TIDE IN JULY,2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	68-194	14/15	93.33
			BLUE GREEN	0-2	1/15	6.67
			TOTAL PHYTO PLANKTON	68-196	15	-
LOW TIDE	Sub surface	5	DIATOMS	170-211	14/15	93.33
			BLUE GREEN	0-1	1/15	6.67
			TOTAL PHYTO PLANKTON	171-212	15	-

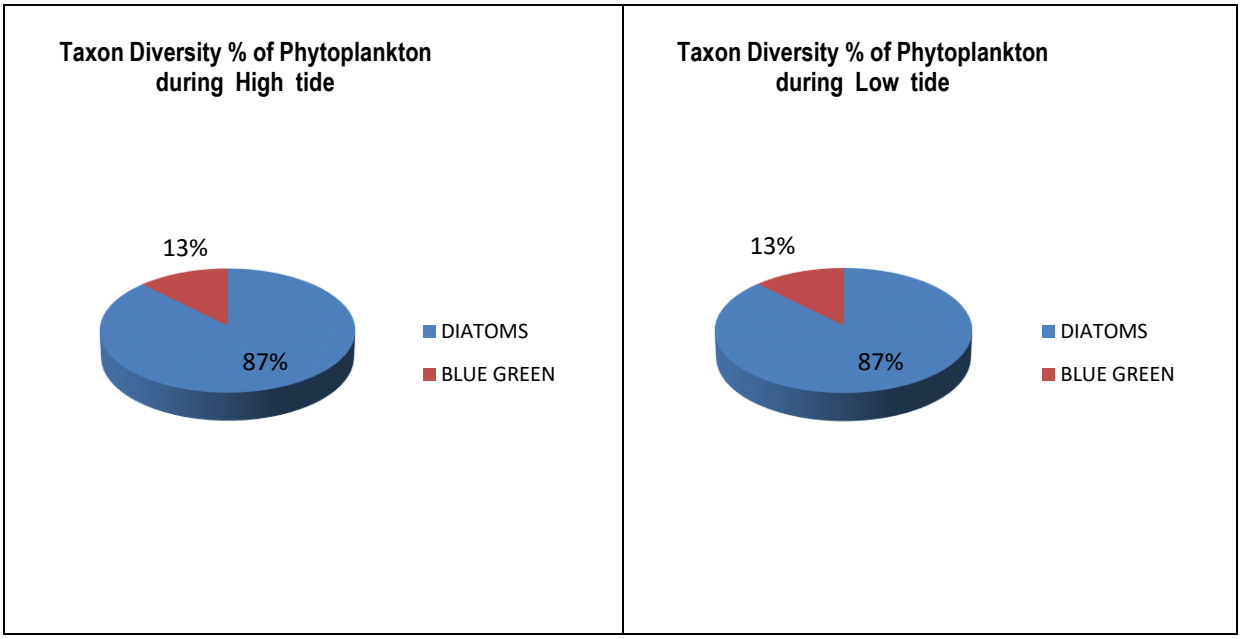
Table # 7 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING NEAP TIDE IN JULY,2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	74-202	14/16	87.5
			BLUE GREEN	12-26	2/16	12.5
			TOTAL PHYTO PLANKTON	86-224	16	-
LOW TIDE	Sub surface	5	DIATOMS	201-236	14/16	87.5
			BLUE GREEN	16-21	2/16	12.5
			TOTAL PHYTO PLANKTON	222-254	16	-

Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide



Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide



ZOOPLANKTON POPULATION:

For the evaluation of the Zooplankton population in DPT harbour area and within the immediate surroundings of the port sampling was conducted from 6 sampling locations (3 in harbour area and two in Nakti creek and one in Khoricreek) during high tide period and low tide period of spring tide and Neap tide in July 2021 . The Zooplankton community of the sub surface water in the harbour

and nearby creeks during spring tide was represented by mainly four groups, Tintinids, Copepods,Foraminiferans and larval forms of Crustacea, Molluscans and Polychates. The Zooplankton community of the sub surface water in the harbour and nearby creeks during neap tide was represented by mainly five groups, Tintinids, Copepods, Arrow worms, Mysids and larval forms of Crustaceans , Mollusacansand Polychates,.

Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 59-142x10^3 N/ m^3 during high tide and 123 -147x10^3 N/ m^3during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 59-147x10^3 N/ m^3 during high tide and 141-164 N/ L during low tide of Neap Tide period.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the stations Kandla Harbour region and nearby creeks was varying from 2.850 -3.366 with an average of 3.040 during the sampling conducted in High tide period.Margalef's diversity index (Species Richness) S of Zooplankton communities varying from.2.263-2.701 with an average of 2.562 during the sampling conducted in low tide period during Spring tide.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the Kandla Harbour region and nearby creeks sampling stations was varying from3.188-4. 133 with an average of 3.754 during the sampling conducted in high tide and varying from.2.802 -4.314 with an average of 3.548 during the sampling conducted in low tide during Neap tide period**Shannon-Wiener's index:**

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 1.011-1.080 (H'(log10)) between selected sampling stations with an average value of 1.050 (H'(log10)) during high tide period of spring tide .Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.953 -1.011 (H'(log10)) between selected sampling stations with an average value of 0.988 (H'(log10)) during consecutive low tide period .

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.884-1.145 (H'(log10)) between selected sampling

stations with an average value of 1.075 (H'(log10)) during high tide period of Neap tide. Shannon-Wiener's Index (H) of Zooplankton communities in the samplingstations in Kandla Harbour region and nearby creeks was in the range of 1.004- 1.177 (H'(log10)) between selected sampling stations with an average value of 1.056 (H'(log10)) during consecutive low tide period .Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of Zooplankton of Kandla Harbour region and nearby creeks stations is slightly high with very minimum diverse population but very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran, 2004).

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 most of sampling stations except few in the Kandla Harbour region and nearby creeksduring high tide and low tide of spring tide period, which was varying from 0.882-0.911between selected sampling stations with an average of 0.899 during high tide period and was varying from 0.875- 0.888 with an average value of 0.882 between selected sampling stations during low tide

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks during high tide and low tide period except few, which was varying from 0.829-0.907 between selected sampling stations with an average of 0.887 during high tide period and was varying from 0.872- 0.913 with an average value of 0.886 between selected sampling stations during consecutive low tide

This low species diversity suggests a relatively low number of successful species in this habitat. Environment is quite stressful with relatively few ecological niches and only few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Table # 8 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JULY,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	125 $X10^3$	15/19	78.95	2.9	1.02	0.8906
	2	116 $X10^3$	16/19	84.21	3.156	1.08	0.9076
	3	116 $X10^3$	17/19	89.47	3.366	1.076	0.8961
	4	142 $X10^3$	16/19	84.21	3.027	1.011	0.8821
	5	136 $X10^3$	15/19	78.95	2.85	1.077	0.9077
	6	59 $X10^3$	13/19	68.42	2.943	1.037	0.9112
LOW TIDE	1	129 $X10^3$	12/19	63.16	2.263	0.9534	0.8751
	2	123 $X10^3$	14/19	73.68	2.701	0.9887	0.8835
	3	145 $X10^3$	14/19	73.68	2.612	1.011	0.8879
	4	147 $X10^3$	14/19	73.68	2.605	0.9919	0.8823
	5	140 $X10^3$	14/19	73.68	2.631	0.9951	0.8808

Table # 9 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN JULY,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	162 $X10^3$	19/23	82.61	3.538	1.094	0.895
	2	152 X10	20/23	86.96	3.782	1.088	0.8906
	3	146 X10	20/23	86.96	3.812	1.106	0.9011
	4	174 X10	22/23	95.65	4.071	1.134	0.9015
	5	161 X10	22/23	95.65	4.133	1.145	0.9069
	6	59 X10	14/23	60.86	3.188	0.8842	0.8299
LOW TIDE	1	141 X10	17/23	73.91	3.233	1.004	0.8719
	2	142 X10	18/23	78.26	3.43	1.022	0.8797
	3	148 X10	15/23	65.22	2.802	1.034	0.8911
	4	164 X10	23/23	100	4.314	1.177	0.9134
	5	156 X10	21/23	91.30	3.961	1.046	0.8781

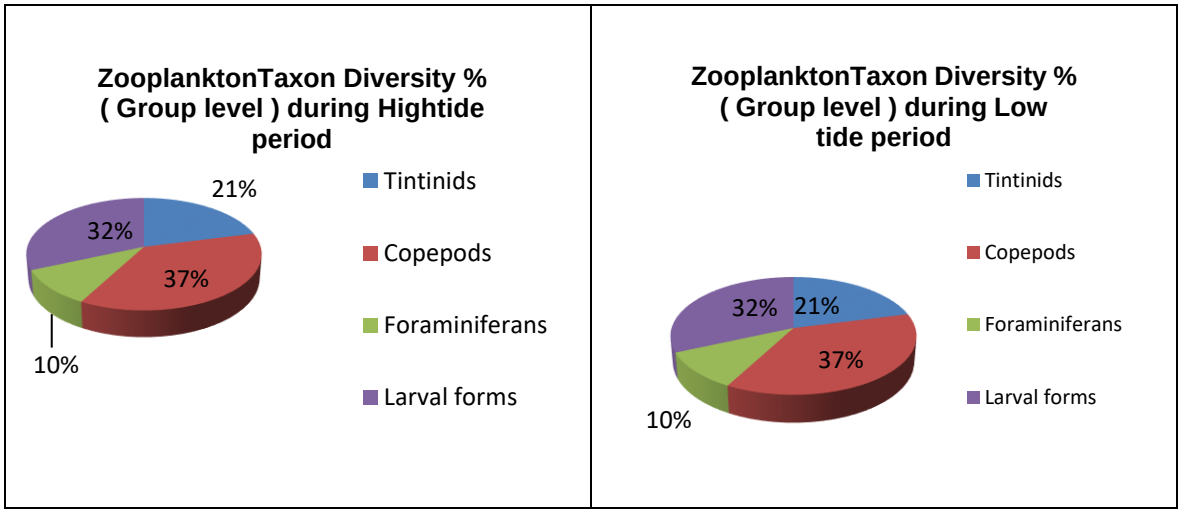
Table # 10 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN JULY2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	3-10	4/19	21.05
			Copepods	34-77	7/19	36.84
			Foraminiferans	2-6	2/19	10.53
			Larval forms	20-57	6/19	31.58
			TOTAL ZOOPLANKTON NO/L	**59-142**	**19**	-
LOW TIDE	Sub surface	5	Tintinids	3-8	4/19	21.05
			Copepods	76-80	7/19	36.84
			Foraminiferans	0-2	2/19	10.53
			Larval forms	40-63	6/19	31.58
			TOTAL ZOOPLANKTON NO/L	**123-147**	**19**	-

Table # 11 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA , NEAR BY CREEKS DURING NEAPTIDE IN JULY,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	4-13	4/23	17.39
			Copepods	37-83	8/23	34.78
			Mysids	0-2	1/23	4.35
			Arrow worms	1-2	1/23	4.35
			Foraminiferans	0-4	1/23	4.35
			Larval forms	17-74	8/23	34.78
			TOTAL ZOOPLANKTON NO/L	**59-173**	**23**	-
LOW TIDE	Sub surface	5	Tintinids	3-13	4/23	17.39
			Copepods	70-84	8/23	34.78
			Mysids	0-2	1/23	4.35
			Arrow worms	0-2	1/23	4.35
			Foraminiferans	0-2	1/23	4.35
			Larval forms	60-70	8/23	34.78
			TOTAL ZOOPLANKTON NO/L	**140-164**	**23**	

Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide



Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide

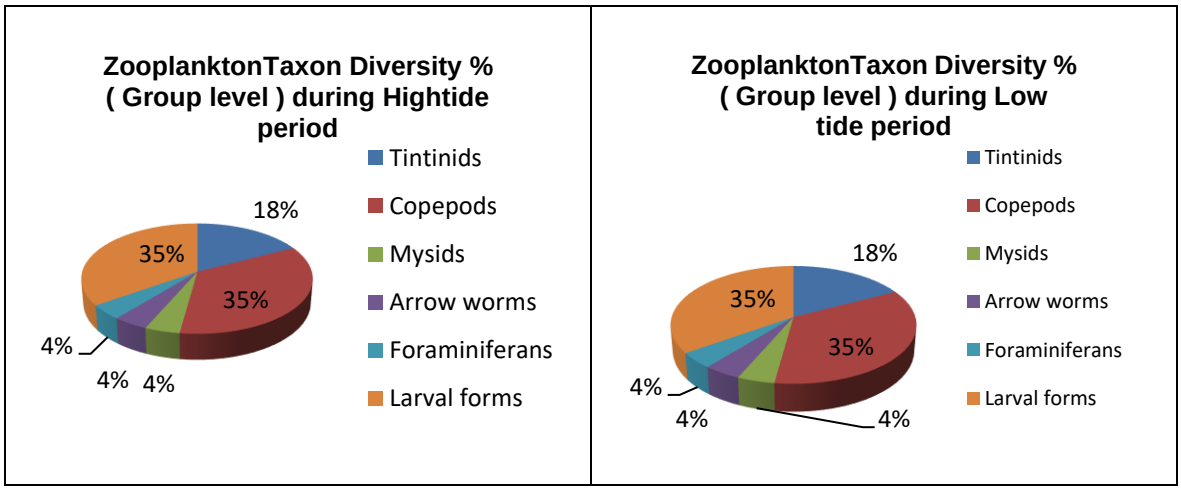


TABLE # 12 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURINGSPRING TIDE OF JUlY,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALAGE	Cynophyta	Cynophyceae	Stigonematales	Stigonemataceae	*Stigonema*sp	**B1**	Rare
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Abundant
					*Palmeria*sp	D3	Occasional
			Triceratiales	Triceratiaceae	*Odontellasp*	D4	Frequent
					*Triceratium*sp.	D5	Frequent
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D6	Abundant
			Hemiaulales	Bellerocheaceae	Bellerocheasp	D7	Occasional
				Hemiaulaceae	*Eucampia*sp	D8	Rare
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D9	Frequent
			Thalassiosirales	Thalassiosiraceae	*Thalassiosira*sp	D10	Rare
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D11	Rare
			Bacillariales	Bacillariaceae	*Nitzschia*sp	D12	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D13	Dominant
			Fragilariales	Fragilariaceae	*Synedra*sp	D14	Occasional

TABLE # 12 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURING AND NEAP TIDE OF JULY,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALAGE	Cynophyta	Cynophyceae	Chlorococcales	Chroococcaceae	*Microcystis* sp.	B1	Occasional
			Stigonematales	Stigonemataceae	*Stigonema*sp	B2	Frequent
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Abundant
					Palmeriasp	D3	Occasional
			Triceratiales	Triceratiaceae	*Odontellasp*	D4	Frequent
					*Triceratium*sp.	D5	Abundant
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D6	Dominant
			Hemiaulales	Bellerocheaceae	Bellerocheasp	D7	Occasional
				Hemiaulaceae	*Eucampia*sp	D8	Rare
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D9	Abundant
			Thalassiosirales	Thalassiosiraceae	*Thalassiosira*sp	D10	Frequent
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D11	Rare
			Bacillariales	Bacillariaceae	*Nitzschia*sp	D12	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D13	Frequent
			Fragilariales	Fragilariaceae	*Synedra*sp	D14	Frequent

TABLE #13 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING SPRING TIDE OF JULY,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Rare
				Codonellidae	*Tintinnopsisfailakkaensis*	T2	Rare
					Tintinnopsisgracilis	T3	Rare
					Tintinnopsis radix	T4	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Abundant
					Bestiolina sp.	C2	Rare
					Parvocalanus sp.	C3	Occasional
				Temoridae	*Temora sp.*	C4	Frequent
			Cyclopoida	Oithonidae	*Oithona sp.*	C5	Frequent
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C6	Abundant
				Euterpinidae	*Euterpina*	C7	Occasional
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
(Brachyuraian LARVAE	ARTHROPODA CRUSTACEA	DECAPODA (BRACHYURA)			Zoea larvae	L2	Rare
CYPHONAUTES LARVAE	BRYOZOA				Cyphonautes larvae	L3	Occasional
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L4	Rare
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L5	Rare
POLYCHAETE LARVAE	ANNELIDA				Trochophore larvae	L6	Frequent
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Globigerinidae	*Globigerina* sp.	F1	Rare
				Rotalliidae	*Rotalia* sp.	F2	Rare

TABLE # 13 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING NEAP TIDE OF JULY,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Rare
				Codonellidae	*Tintinnopsisfailakkaensis*	T2	Occasional
					Tintinnopsisgracilis	T3	Occasional
					Tintinnopsis radix	T4	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Abundant
					Parvocalanus sp.	C2	Rare
				Eucalanidae	*Subeucalanus sp.*	C3	Frequent
				Temoridae	*Temora sp.*	C5	Frequent
				Acartiidae	*Acartia sp.*	C6	Occasional
			Cyclopoida	Oithonidae	*Oithona sp.*	C7	Frequent
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C8	Abundant
				Euterpinidae	*Euterpina sp.*	C9	Frequent
ARROW WORMS	CHAETOGNATHA	Sagittoideae	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Rare
MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Penaeidae	*Metapenaeus sp.*	M1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
POLYCHAETE LARVA	ANNELIDA	Polychaeta			Trochophore larvae	L2	Occasional
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L3	Rare
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L4	Occasional

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L5	Rare
BRACHYURAIAN LARVAE	ARTHROPODA CRUSTACEA	DECAPODA (BRACHYURA)			Zoea larvae	L6	Occasional
CYPHONAUTES LARVAE	BRYOZOA				Cyphonautes larvae	L7	Occasional
ECHINODERMATA larvae	ECHINODERMATA	Ophiuroidea			Ophiopluetus larvae	L8	Occasional
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Rotalliidae	*Rotalia* sp.	F1	Rare

BENTHIC ORGANISMS:

No Benthic organisms were observed in the collected sediments by using the Van-veen grabs during the sampling conducted IN spring tide period as well as Neap tide period from DPT harbour region and nearby creek except few dead shells.

7. Meteorological Data

Automatic Weather station have been installed in SevaSadan -3 at the Deendayal Port which records the data on Temperature (°C), Humidity (%),Wind (mph), Dew Point (°C), Wind Direction (°), Pressure, Solar radiation, heat Index and UVI.

Temperature

The mean day time temperature for Deendayal Port was 28.5 °C. The day-time maximum temperature was 32.1 °C. The mean night time temperature was 30.3 °C. The minimum mean night time temperature recorded was 27.8 °C.

Air Pressure

The mean absolute air pressure for the month of July was 1002.4 hpa, whereas the mean relative pressure was 1000.2 hpa. The maximum absolute air pressure recorded for the month of July was 1004.1 hpa.

Heat Index

The mean day-time heat index for the month of July was 36.1 ^{o}C. The maximum heat index recorded was 43^{o}C.

Solar Radiation

The mean Solar Radiation in July was 158.4 w/m^2. The maximum solar radiation recorded in the month of July was 751.7 w/m^2.

Humidity

The mean day-time humidity was 80.3 % for the month of July and mean night time humidity was 71.2%. Maximum humidity recorded during day-time was 89.0 % and maximum humidity recorded during night-time was 85.0%.

Wind Velocity and Wind Direction

The mean wind velocity for the entire month of July was 11.72 km/hour (i.e. 2.7 mtr/sec). Maximum wind velocity recorded was 47.2 Km/hr (13 mtr/sec). The wind direction was mostly S to SW.

Rainfall

The mean Rainfall in July was 58.1 mm. The maximum Rainfall recorded in the month of July was 132.7 mm.

Conclusive Summary and Remedial measures Suggested

- The AAQ monitoring at six locations of Deendayal Port indicates that the mean PM_{10} values at four locations viz. Coal storage area, Marine Bhavan and Oil Jetty area were found above the permissible standards (100 µg/m^3)and$PM_{2.5}$was above permissible limits at Coal storage location(Limit 60 µg/m^3).

- Drinking water at all the twenty locations was found potable and was within permissible limits of BIS standards (IS 10500).

- Noise quality was also within the set permissible standards of an Industrial Area. The noise level observed during day time was >75 dB (A) and at night time was >70 dB (A) during the entire monitoring period.

- The sewage treated water of Deendayal Port Colony (Gopalpuri) was in line with the standards set by the Gujarat Pollution Control Board. The STP at Deendayal Port is not fully operational and STP at Vadinar Port was found non-operational.

Reasons for higher Values of PM_{10}

- Large amount of coal is handled at Berth No. 6, 7, 8 and 9. The unloading of coal directly in the truck, using grabs cause coal to spread in air as well as coal dust to fall on ground. This settled coal dust again mixes with the air while trucks travel through it.

- Also, the coal laden trucks are not always covered with tarpaulin sheets and these results in spillage of coal from trucks/dumpers during its transit from vessel to yard or storage site. This also increased PM values around marine Bhavan & Coal storage area.

Remedial Measures

The values of PM_{10} during the month of July, 2021 were observed beyond the permissible limit at four locations mentioned above. Given below are the remedial measures suggest to minimize the Air pollution at Deendayal Port.

- Guidelines for Coal Handling by GPCB should be strictly followed. (http://gpcb.gov.in/pdf/coal-handling-guidelines.pdf)

- Sewage Treatment Plan at Vadinar Port is not working. Hence, it is recommended to commission the sewage treatment plant at Vadinar immediately.

- Except for the higher values of PM_{10} at Coal storage site, Oil Jetty, Tuna Port and Marine Bhavan locations, the monitoring results for the present month suggest that the overall Environment Quality of Deendayal Port is satisfactory.

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ENVIRONMENTAL MONITORING REPORT
FOR
DEENDAYAL PORT TRUST

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Introduction

Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the national standards and any other relevant standards by GBCB/CPCB/MoEF to identify non conformity in the Environment of the Deendayal Port. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port.

The environmental monitoring is carried out as per the Environment Management and Monitoring Plan submitted by Detox Corporation Pvt. Ltd.

1. Ambient Air Quality Monitoring

As per the Environmental Monitoring Plan of Deendayal Port Trust, Air monitoring was carried out at six identified locations at Deendayal Port and two locations at Vadinar Port.

1.1 Air Quality Monitoring Methodology

Air quality is measured in all the stations, for 24 hour for Total Suspended Particulate Matter (TSPM), PM_{10}, $PM_{2.5}$, SO_2, NO_X, NH_3 & Benzene, and Grab-sampling for CO & CO_2 measurements. The Air samplers are operated for a period of 24 hours and after a continuous operation of 8 hours of the sampler, the reagents were replaced to obtain 3 samples per day for each parameter namely, SO_2, NO_X. The EPM 2000 filter paper and PTFE Membrane bound filter paper are used for a period of 24 hours to obtain one sample each of TSPM, PM_{10} & $PM_{2.5}$.

The AAQ samples are collected twice a week from all the eight locations as per the EMP.

1.2 Results

The ambient air quality monitoring data for six stations, viz. Marine Bhavan, Oil Jetty, Port Colony,Gopalpuri Hospital,Tuna Port and Nr. Coal Storage Area for the month of August 2021 are given in Tables 1A to 6B. The ambient air quality monitoring data for two stations at Vadinar (Nr. Admin Building &Nr. Signal Building) are given in Tables 7A to 8B.

Location 1: Marine Bhavan (AL1)

Table 1 : Results of Air Pollutant Concentration at Marine Bhavan

Parameter	Date	TSPM [µg/m3]	PM10 [µg/m3]	PM2.5 [µg/m3]	SO2 [µg/m3]		NOx [µg/m3]		NH3 [µg/m3]	
Sampling Period	-	24hr	24hr	24hr	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)
NAAQMS limit	-	NS	100 µg/m3	60 µg/m3		80 µg/m3		80 µg/m3		400 µg/m3
AL1 – 1	04.08.2021	328	179	68	2.64	2.40	20.33	21.17	9.45	9.87
					0.62		19.05		9.70	
					3.96		24.14		10.47	
AL1 – 2	06.08.2021	659	211	75	7.03	6.15	14.61	20.11	13.79	13.70
					5.71		15.88		13.53	
					5.71		29.85		13.79	
AL1 – 3	11.08.2021	813	247	70	8.35	7.03	29.85	27.10	12.00	11.49
					7.91		31.76		13.02	
					4.84		19.69		9.45	
AL1 – 4	13.08.2021	549	272	89	2.20	2.05	18.42	17.15	14.55	15.68
					1.76		15.88		17.69	
					2.20		17.15		14.81	
AL1 – 5	18.08.2021	442	300	45	3.96	3.66	19.69	21.38	5.36	9.62
					4.40		20.33		12.00	
					2.64		24.14		11.49	
AL1 - 6	20.08.2021	360	299	88	3.08	3.22	17.78	16.51	10.47	6.13
					4.40		21.60		5.36	
					2.20		10.16		2.55	
AL1 - 7	25.08.2021	340	290	72	2.64	2.64	13.34	18.00	14.81	11.57
					3.52		22.23		10.47	
					1.76		18.42		9.45	
AL1 – 8	27.08.2021	471	299	63	3.08	2.93	27.31	26.25	10.98	7.83
					1.76		30.49		5.62	
					3.96		20.96		6.89	
Monthly Average		495	262	71		3.76		20.96		10.74
Standard Deviation		171	46	14		1.83		3.96		3.08

NS: Not Specified

Table 1B : Results of Air Pollutant Concentration at Marine Bhavan					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL1 – 1	04.08.2021	1.06	BDL	1.86	488
AL1 – 2	06.08.2021	1.22	BDL	1.74	496
AL1 – 3	11.08.2021	1.28	BDL	1.7	499
AL1 – 4	13.08.2021	1.2	BDL	1.68	501
AL1 – 5	18.08.2021	1.21	BDL	1.72	490
AL1 - 6	20.08.2021	1.06	BDL	1.62	497
AL1 – 7	25.08.2021	1.12	BDL	1.52	488
AL1 – 8	27.08.2021	1.06	BDL	1.72	496
Monthly Average		**1.15**	**-**	**1.70**	**494**
Standard Deviation		**0.09**	**-**	**0.10**	**5**

* NMHC- Non- Methane Hydrocarbons
BDL- Below Detection Limit (Detection Limit – NMHC: 0.5ppm)
NS -Not Specified

At Marine Bhavan, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_X and NH_3 is attributed mainly by motor vehicle emission produced from various types of automobiles (both diesel and petrol driven). Moreover, the loading and unloading of Food Grains and Timber at Jetty no. 1 and 2 also contributes to the high levels of TSPM and PM_{10}. The mean TSPM value at Marine Bhavan was 495 µg/m³, The mean PM_{10} values were 262.0 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were slightly above the permissible limit (mean = 71 µg/m³). The average values of SO_2, NO_x and NH_3 were within the permissible limit. The average values of SO_2, NO_x and NH3 were 3.76 µg/ m³, 20.96 µg/ m³ & 10.74 µg/ m³ respectively. These were within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Marine Bhavan. The mean Benzene concentration was 1.15 µg/m³,well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.70 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 2: Oil Jetty (AL2)

Table 2 : Results of Air Pollutant Concentration at Oil Jetty										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL2 – 1	04.08.2021	299	222	55	3.52	3.81	18.42	16.30	13.53	14.81
					4.84		12.70		14.81	
					3.08		17.78		16.08	
AL2 – 2	06.08.2021	837	394	89	1.32	3.08	12.07	12.28	7.40	10.47
					3.08		10.80		11.74	
					4.84		13.97		12.25	
AL2 – 3	11.08.2021	403	350	49	8.35	9.38	33.66	25.62	4.08	6.89
					8.79		19.05		6.89	
					10.99		24.14		9.70	
AL2 – 4	13.08.2021	511	327	82	3.08	2.05	17.78	16.30	7.15	9.10
					1.76		15.88		10.72	
					1.32		15.24		9.45	
AL2 – 5	18.08.2021	567	281	75	3.08	2.20	17.15	18.63	9.70	7.83
					1.32		26.04		5.36	
					2.20		12.70		8.42	
AL2 – 6	20.08.2021	728	490	90	6.15	5.86	22.87	15.88	5.36	8.00
					7.91		8.89		8.42	
					3.52		15.88		10.21	
AL2 – 7	25.08.2021	344	237	67	0.88	1.17	24.14	20.75	9.96	10.38
					0.88		15.88		12.76	
					1.76		22.23		8.42	
AL2 – 8	27.08.2021	475	278	76	1.32	2.20	15.88	17.78	5.87	8.51
					1.76		24.14		9.19	
					3.52		13.34		10.47	
Monthly Average		520	322	73		3.72		17.94		9.50
Standard Deviation		186	88	15		2.70		3.95		2.47

NS: Not Specified

Table 2B : Results of Air Pollutant Concentration at Oil Jetty					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL2 -1	04.08.2021	1.22	BDL	1.86	492
AL2 -2	06.08.2021	1.06	BDL	1.72	496
AL2 -3	11.08.2021	1.26	BDL	1.76	489
AL2 -4	13.08.2021	1.23	BDL	1.66	500
AL2 – 5	18.08.2021	1.2	BDL	1.84	496
AL2 – 6	20.08.2021	1.16	BDL	1.74	489
AL2 -7	25.08.2021	1.18	BDL	1.76	476
AL2 – 8	27.08.2021	1.23	BDL	1.7	490
Monthly Average		**1.19**	**-**	**1.76**	**491**
Standard Deviation		**0.06**	**-**	**0.07**	**7**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Oil Jetty area was mainly by motor vehicle emission produced from various types of vehicles Oil Jetty Area. The mean TSPM values at Oil Jetty were 520 µg/m³ .The mean PM_{10} values were 322 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were slightly above the permissible limit (mean = 73 µg/m³).The average values of SO_2, NO_x and NH_3 were within the permissible limit; The mean concentration of SO_2, NO_x and NH3 were 3.72 µg/m³, 17.94 µg/m³ and 9.50 µg/m³ respectively.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Oil Jetty. The mean Benzene concentration was 1.19 µg/m³ .Well below the permissible limit of 5.0 µg/m³. , HC's were below the detectable limit and Carbon Monoxide concentration was 1.76 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 3: Kandla Colony – Estate Office (AL-3)

Table 3 : Results of Air Pollutant Concentration at Estate Office										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL3 – 1	04.08.2021	159	97	35	1.32	2.05	25.41	23.92	14.04	16.68
					2.20		33.66		17.36	
					2.64		12.70		18.64	
AL3 – 2	06.08.2021	473	176	60	3.96	9.96	12.70	13.13	8.68	7.40
					21.98		10.80		7.15	
					3.96		15.88		6.38	
AL3 – 3	11.08.2021	379	253	74	3.96	4.25	15.24	20.75	8.42	6.47
					5.28		20.96		7.15	
					3.52		26.04		3.83	
AL3 – 4	13.08.2021	652	331	67	4.84	2.49	9.53	9.32	12.76	9.62
					1.76		9.53		9.70	
					0.88		8.89		6.38	
AL3 – 5	18.08.2021	643	457	92	4.84	3.52	24.14	24.77	9.70	38.21
					3.52		34.30		10.47	
					2.20		15.88		94.45	
AL3 – 6	20.08.2021	721	389	75	4.84	4.25	20.96	20.96	10.21	8.25
					2.20		15.88		9.45	
					5.71		26.04		5.11	
AL3 – 7	25.08.2021	298	208	68	4.40	3.22	22.23	19.05	12.00	11.66
					3.52		17.78		12.00	
					1.76		17.15		10.98	
AL3 – 8	27.08.2021	574	300	96	2.64	2.93	16.51	17.57	11.49	8.76
					4.40		17.15		9.45	
					1.76		19.05		5.36	
Monthly Average		488	276	71		4.08		18.68		13.38
Standard Deviation		196	117	19		2.50		5.26		10.53

NS: Not Specified

Table 3B : Results of Air Pollutant Concentration at Kandla Port Colony					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL3 -1	04.08.2021	1.12	BDL	1.84	480
AL3 -2	06.08.2021	1.16	BDL	1.76	488
AL3 -3	11.08.2021	1.22	BDL	1.8	496
AL3 -4	13.08.2021	1.26	BDL	1.74	490
AL3 – 5	18.08.2021	1.2	BDL	1.79	496
AL3 – 6	20.08.2021	1.06	BDL	1.82	499
AL3 – 7	25.08.2021	1.11	BDL	1.8	500
AL3 – 8	27.08.2021	1.07	BDL	1.76	490
Monthly Average		**1.15**	**-**	**1.79**	**492**
Standard Deviation		**0.07**	**-**	**0.03**	**7**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Kandla Port Colony was attributed by vehicle emission produced from trucks and heavy duty vehicles that pass through the road outside Kandla Port Colony. The mean TSPM values at Oil Jetty were 488 µg/m³, The mean PM_{10} values were 276 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were slightly above the permissible limit (mean = 71 µg/m³). The average values of SO_2, NO_x and NH3 were 4.08 µg/m³, 18.68 µg/m³ and 13.38 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Kandla Port Colony. The mean Benzene concentration was 1.15 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.79 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 4: Gopalpuri Hospital (AL-4)

Table 4 : Results of Air Pollutant Concentration at Gopalpuri Hospital										
Parameter	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL4 -1	04.08.2021	128	77	28	3.08	3.08	7.62	12.70	9.70	8.76
					2.64		17.15		10.21	
					3.52		13.34		6.38	
AL4 -2	06.08.2021	180	115	38	3.52	2.05	6.35	10.16	5.36	5.02
					0.88		11.43		5.11	
					1.76		12.70		4.60	
AL4 -3	11.08.2021	228	110	48	1.76	3.08	11.43	9.95	4.34	4.85
					3.96		6.35		5.36	
					3.52		12.07		4.85	
AL4 -4	13.08.2021	327	260	60	3.08	3.08	11.43	9.74	7.15	5.62
					3.52		10.80		4.08	
					2.64		6.99		5.62	
AL4 – 5	18.08.2021	269	156	70	2.20	3.08	15.88	14.61	5.36	6.89
					3.96		8.89		8.93	
					3.08		19.05		6.38	
AL4 – 6	20.08.2021	228	113	86	3.52	2.34	13.97	12.91	5.36	9.02
					2.20		8.89		9.70	
					1.32		15.88		12.00	
AL4 – 7	25.08.2021	222	116	49	2.20	2.78	19.05	17.15	6.89	6.72
					3.52		14.61		8.42	
					2.64		17.78		4.85	
AL4 – 8	27.08.2021	249	119	30	2.64	3.08	12.07	12.07	7.91	8.93
					3.08		12.70		9.19	
					3.52		11.43		9.70	
Monthly Average		229	133	51		2.82		12.41		6.98
Standard Deviation		59	56	20		0.41		2.56		1.75

NS: Not Specified

Table 4B : Results of Air Pollutant Concentration at Gopalpuri Hospital					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL4 -1	04.08.2021	1.12	BDL	1.88	490
AL4 -2	06.08.2021	1.18	BDL	1.76	488
AL4 -3	11.08.2021	1.26	BDL	1.72	496
AL4 -4	13.08.2021	1.21	BDL	1.8	500
AL4 – 5	18.08.2021	1.28	BDL	1.79	482
AL4 – 6	20.08.2021	1.2	BDL	1.84	493
AL4 – 7	25.08.2021	1.18	BDL	1.86	498
AL4 – 8	27.08.2021	1.16	BDL	1.8	490
Monthly Average		**1.20**	**-**	**1.81**	**492**
Standard Deviation		**0.05**	**-**	**0.05**	**6**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Gopalpuri Hospital was attributed by vehicle emission produced from light motor vehicles of the colony residents. The mean TSPMvalues at Oil Jetty were 229 µg/m³, The mean PM_{10} values were 133 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were slightly above the permissible limit (mean= 51 µg/m³). The average values of SO_2, NO_x and NH_3 were 2.82 µg/m³, 12.41 µg/m³ and 6.98 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Gopalpuri Hospital. The mean Benzene concentration was 1.20 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.81 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 5: Coal Storage Area (AL-5)

Table 5 : Results of Air Pollutant Concentration at Coal Storage Area										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL5 – 1	04.08.2021	312	167	69	3.08	3.66	22.23	22.23	9.45	9.53
					3.52		23.50		7.15	
					4.40		20.96		12.00	
AL5 – 2	06.08.2021	530	333	77	9.23	6.15	20.96	20.11	16.59	17.02
					5.71		24.77		17.87	
					3.52		14.61		16.59	
AL5 – 3	11.08.2021	759	394	92	10.99	9.23	24.14	27.74	8.42	7.74
					7.47		25.41		7.15	
					9.23		33.66		7.66	
AL5 – 4	13.08.2021	813	435	94	1.76	1.61	17.78	18.84	13.02	10.30
					1.32		19.05		8.93	
					1.76		19.69		8.93	
AL5 – 5	18.08.2021	700	471	79	4.40	3.96	21.60	22.02	12.00	11.66
					4.40		19.05		10.47	
					3.08		25.41		12.51	
AL5 – 6	20.08.2021	566	427	80	3.08	3.96	16.51	18.00	16.85	15.66
					3.52		15.24		16.34	
					5.28		22.23		13.79	
AL5 – 7	25.08.2021	456	224	76	3.96	4.10	13.97	17.15	10.47	7.04
					4.40		19.69		9.70	
					3.96		17.78		0.94	
AL5 – 8	27.08.2021	249	164	70	4.40	3.66	23.50	27.52	11.49	13.44
					3.52		28.58		14.04	
					3.08		30.49		14.81	
Monthly Average		548	327	80		4.54		21.70		11.55
Standard Deviation		204	125	9		2.26		4.07		3.60

NS: Not Specified

Table 5B : Results of Air Pollutant Concentration at Coal Storage Area					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL5 – 1	04.08.2021	1.06	BDL	1.96	460
AL5 – 2	06.08.2021	1.11	BDL	1.88	458
AL5 – 3	11.08.2021	1.26	BDL	1.9	456
AL5 – 4	13.08.2021	1.3	BDL	1.82	460
AL5 – 5	18.08.2021	1.26	BDL	1.96	456
AL5 – 6	20.08.2021	1.22	BDL	1.93	474
AL5 – 7	25.08.2021	1.38	BDL	1.89	470
AL5 – 8	27.08.2021	1.30	BDL	1.9	468
Monthly Average		**1.24**	**-**	**1.91**	**463**
Standard Deviation		**0.11**	**-**	**0.05**	**7**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Coal Storage Area was comparatively highest among all the locations of Air Quality monitoring in Kandla Port. High values of TSPM, $_{PM10,}$ $PM_{2.5}$, SO_2, NO_X at this location was due to lifting of coal with grab and other coal handling processes near Berth no. 6 & 7. Moreover, the traffic was also heavy around this place for transport of coal thus emissions produced from heavy vehicles. The mean TSPM values at Coal storage were 548 µg/m³. The mean PM_{10} values were 327 µg/m³, which is well above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 80 µg/m³). The average values of SO_2, NO_x and NH_3 were 4.54 µg/m³, 21.70 µg/m³ and 11.55 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Coal Storage Area. The mean Benzene concentration was 1.24 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.91 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 6: Tuna Port (AL-6)

Table 6 : Results of Air Pollutant Concentration at Tuna Port										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL6 -1	04.08.2021	133	75	26	3.96	2.93	22.23	15.46	15.06	12.17
					2.64		13.34		12.25	
					2.20		10.80		9.19	
AL6 – 2	06.08.2021	203	149	67	2.20	2.05	8.26	9.10	5.87	6.81
					2.20		10.16		6.38	
					1.76		8.89		8.17	
AL6 – 3	11.08.2021	316	166	44	5.28	4.40	17.78	18.63	6.89	6.47
					4.84		22.23		4.60	
					3.08		15.88		7.91	
AL6 – 4	13.08.2021	530	342	83	3.08	2.05	5.72	7.83	5.36	6.55
					1.32		9.53		7.91	
					1.76		8.26		6.38	
AL6 – 5	18.08.2021	468	291	84	0.88	2.05	20.96	17.15	12.76	12.08
					1.76		12.70		12.25	
					3.52		17.78		11.23	
AL6 – 6	20.08.2021	319	181	63	4.40	3.08	33.03	28.58	10.47	12.93
					1.32		22.87		15.57	
					3.52		29.85		12.76	
AL6 – 7	25.08.2021	256	156	58	3.08	3.22	15.88	17.15	9.96	10.21
					2.64		17.78		9.45	
					3.96		17.78		11.23	
AL6 – 8	27.08.2021	554	375	80	2.64	3.08	17.15	16.30	10.47	9.96
					3.08		12.07		8.42	
					3.52		19.69		10.98	
Monthly Average		347	217	63		2.86		16.28		9.65
Standard Deviation		155	106	20		0.81		6.35		2.71

NS: Not Specified

Table 6B : Results of Air Pollutant Concentration at Tuna Port					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL6 -1	04.08.2021	1.11	BDL	1.74	460
AL6 – 2	06.08.2021	1.26	BDL	1.89	470
AL6 – 3	11.08.2021	1.2	BDL	1.88	472
AL6 – 4	13.08.2021	1.16	BDL	1.9	466
AL6 – 5	18.08.2021	1.07	BDL	1.97	460
AL6 – 6	20.08.2021	1.11	BDL	1.89	451
AL6 – 7	25.08.2021	1.2	BDL	1.8	460
AL6 – 8	27.08.2021	1.21	BDL	1.82	470
Monthly Average		**1.17**	**-**	**1.86**	**464**
Standard Deviation		**0.06**	**-**	**0.07**	**7**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The mean TSPM values at Tuna Port were 347 µg/m³, The mean PM_{10} values were 217 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were slightly the permissible limit (mean = 63 µg/m³). The average values of SO_2, NO_x and NH_3 were 2.86 µg/m³, 16.28 µg/m³ and 9.65 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Tuna Port. The mean Benzene concentration was 1.17 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.86 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 7: Signal Building (Vadinar) (AL-7)

Table 7 : Results of Air Pollutant Concentration at Signal Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL7 -1	04.08.2021	144	97	30	3.08	3.08	7.62	11.86	7.66	5.53
					2.64		14.61		5.36	
					3.52		13.34		3.57	
AL7 -2	06.08.2021	180	120	38	3.96	4.98	28.58	17.78	4.60	6.55
					4.84		14.61		10.47	
					6.15		10.16		4.60	
AL7 -3	11.08.2021	148	85	29	2.20	2.34	8.89	16.51	5.36	8.68
					3.08		26.04		11.49	
					1.76		14.61		9.19	
AL7 -4	13.08.2021	165	115	32	2.64	2.07	20.33	14.19	9.19	6.47
					0.48		13.34		3.57	
					3.08		8.89		6.64	
AL7 -5	18.08.2021	151	99	35	4.84	3.96	14.61	16.30	8.93	7.49
					3.08		21.60		6.38	
					3.96		12.70		7.15	
AL7 -6	20.08.2021	173	104	64	3.96	3.81	9.53	11.22	4.85	4.68
					3.08		8.89		3.57	
					4.40		15.24		5.62	
AL7 -7	25.08.2021	168	114	44	3.96	1.67	13.34	13.55	16.85	10.89
					0.44		6.99		12.00	
					0.62		20.33		3.83	
AL7 -8	27.08.2021	113	54	37	6.15	2.78	7.62	12.70	9.70	8.76
					1.76		17.15		9.45	
					0.44		13.34		7.15	
Monthly Average		155	98	39		3.1		14.3		7.4
Standard Deviation		21	21	11		1.1		2.4		2.0

NS: Not Specified

Table 7B : Results of Air Pollutant Concentration at Signal Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL7 -1	04.08.2021	1.11	BDL	1.9	460
AL7 – 2	06.08.2021	1.2	BDL	1.86	472
AL7 – 3	11.08.2021	1.18	BDL	1.79	460
AL7 – 4	13.08.2021	1.08	BDL	1.86	461
AL7 – 5	18.08.2021	1.12	BDL	1.96	456
AL7 – 6	20.08.2021	1.2	BDL	1.9	460
AL7 – 7	25.08.2021	1.18	BDL	1.88	470
AL7 – 8	27.08.2021	1.1	BDL	1.82	465
Monthly Average		**1.15**	**-**	**1.87**	**463**
Standard Deviation		**0.05**	**-**	**0.05**	**6**

* NMHC- Non- Methane Hydrocarbons
BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)
NS_ Not Specified

The mean TSPM values at Vadinar Port were 155 µg/m³. The mean PM_{10} values were 98 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 39 µg/m³). The average values of SO_2, NO_x and NH_3 were 3.1 µg/m³, 14.3 µg/m³ and 7.4 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.15 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.87 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 8: Admin Building (Vadinar) (AL-8)

Table 8 : Results of Air Pollutant Concentration at Admin Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL8 -1	04.08.2021	119	55	28	4.84	3.52	19.05	18.42	7.15	6.30
					2.64		22.87		6.64	
					3.08		13.34		5.11	
AL8 -2	06.08.2021	111	56	47	17.58	6.30	17.78	16.73	7.91	8.00
					0.44		19.05		5.62	
					0.88		13.34		10.47	
AL8 -3	11.08.2021	180	100	56	1.76	2.78	15.24	15.24	4.34	5.19
					3.52		22.87		4.85	
					3.08		7.62		6.38	
AL8 -4	13.08.2021	130	77	42	3.96	4.54	13.97	11.86	8.17	7.15
					6.15		10.16		10.47	
					3.52		11.43		2.81	
AL8 -5	18.08.2021	100	68	29	3.96	2.64	7.62	8.89	7.40	7.40
					0.88		8.89		9.45	
					3.08		10.16		5.36	
AL8 -6	20.08.2021	160	97	58	3.52	4.98	12.70	12.70	8.93	8.42
					5.28		10.80		9.19	
					6.15		14.61		7.15	
AL8 -5	25.08.2021	143	65	49	3.52	3.96	6.99	12.49	12.00	8.42
					3.96		17.15		4.34	
					4.40		13.34		8.93	
AL8-6	27.08.2021	160	100	53	2.20	2.93	7.62	11.43	8.17	6.30
					3.08		19.05		4.60	
					3.52		7.62		6.13	
Monthly Average		138	77	45		4.0		13.5		7.1
Standard Deviation		28	19	12		1.3		3.1		1.2

NS: Not Specified

Table 8B : Results of Air Pollutant Concentration at Admin Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL8 -1	04.08.2021	1.12	BDL	1.96	460
AL8-2	06.08.2021	1.06	BDL	1.86	456
AL8 -3	11.08.2021	1.11	BDL	1.88	466
AL8-4	13.08.2021	1.18	BDL	1.9	470
AL8 -5	18.08.2021	1.26	BDL	1.92	466
AL8-6	20.08.2021	1.16	BDL	1.96	460
AL8-7	25.08.2021	1.2	BDL	1.86	456
AL8-8	27.08.2021	1.26	BDL	1.8	462
Monthly Average		**1.17**	**-**	**1.89**	**462**
Standard Deviation		**0.07**	**-**	**0.05**	**5**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Admin Building Vadinar was comparatively low among all the locations of Air Quality monitoring in Kandla Port and Vadinar Port. The mean TSPM values at Vadinar Port were 138 µg/m³. The mean PM_{10} values were 77 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 45.0 µg/m³). The average values of SO_2, NO_x and NH_3 were 4.0µg/m³, 13.5 µg/m³ and 7.1 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Admin Building, Vadinar Port. The mean Benzene concentration was 1.17 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.89 mg/m³, well below the permissible limit of 4.0 mg/m³.

1.4 Observations and Conclusion

During the monitoring period, the overall Ambient Air Quality of the port area was found to be well within the desired levels for various gaseous pollutants. However, Particulate matter as PM_{10} and $PM_{2.5}$ was found to exceed the limits at locations like Near Coal storage area, Marine Bhavan, Estate Office , Tuna Port and Oil Jetty area.

2. Drinking Water Quality Monitoring

Drinking Water Quality Monitoring was carried out at twenty stations at Kandla, Vadinar & Township Area of Deendayal Port.

2.1 Drinking Water Monitoring Methodology

Drinking water samples were collected from 20 locations as prescribed in the tender document. Samples for physico-chemical analysis were collected in 1 liter carboys and samples for microbiological parameters were collected in sterilized bottles. These samples were then analyzed in laboratory for various drinking water parameters at Kandla Lab/Surat.

The Sampling and Analysis was done as per standard methods - IS 10500:2012. The water samples were analyzed for various parameters, viz. Color , Odor, Turbidity , Conductivity , pH , Chlorides , TDS, Total Hardness, Iron , Sulphate , Salinity , DO, BOD, Na, K, Ca, Mg, F, NO_3, NO_2, Mn, Cr-6, Cu, Cd, As, Hg, Pb, Zn, Bacterial Count (cfu) .

2.2 Results

The Drinking Water Quality monitoring data for 20 stations are given in below from table No. 9 to Table No. 15

Table 9: Drinking Water Quality Monitoring Parameters for Nirman Building 1, P & C building & Main Gate (North) at Kandla

Sr. No.	Parameter	Unit	Nirman Building 1	P & C building	Main Gate North	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.4	7.3	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	930	1250	890	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1850	2460	1700	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	626	656	541	250.0	1000.0
9	Ca as Ca	mg/l	68.14	60.12	76.15	75.0	200.0
10	Mg as Mg	mg/l	58.32	72.90	68.04	30.0	100.0
11	Total Hardness	mg/l	390	410	430	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.34	0.41	0.13	1.0	1.5
14	Sulphate as SO4	mg/l	290.4	175.2	200.4	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	6.27	8.10	13.38	45.0	No Relaxation
17	Salinity	%	1.13	1.19	0.98	NS*	NS*
18	Sodium as Na	mg/l	160	178	150	NS*	NS*
19	Potassium as K	mg/l	2.2	2.3	2.8	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 10: Drinking Water Quality Monitoring Parameters for Canteen, West Gate – I &Wharf Area at Kandla

Sr. No.	Parameter	Unit	Canteen	West Gate – I	Wharf Area	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.6	7.3	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1320	990	1030	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2590	1890	2010	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	717	596	616	250.0	1000.0
9	Ca as Ca	mg/l	64.13	60.12	56.11	75.0	200.0
10	Mg as Mg	mg/l	72.90	70.47	68.04	30.0	100.0
11	Total Hardness	mg/l	390	360	390	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.44	0.49	0.51	1.0	1.5
14	Sulphate as SO4	mg/l	190.8	198	289.2	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	8.80	10.42	9.50	45.0	No Relaxation
17	Salinity	%	1.29	1.08	1.11	NS*	NS*
18	Sodium as Na	mg/l	130	168	158	NS*	NS*
19	Potassium as K	mg/l	3	2.2	2.4	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 11: Drinking Water Quality Monitoring Parameters for Sewa sadan – 3, Workshop I &Custom Building at Kandla

Sr. No.	Parameter	Unit	SewaSadan – 3	Workshop	Custom Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.3	7.8	7.4	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	950	1050	1100	500	2000
3	Turbidity	NTU	1	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1890	2080	2150	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	742	692	576	250.0	1000.0
9	Ca as Ca	mg/l	76.15	60.12	52.10	75.0	200.0
10	Mg as Mg	mg/l	58.32	68.04	68.04	30.0	100.0
11	Total Hardness	mg/l	400	400	380	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.88	0.59	0.59	1.0	1.5
14	Sulphate	mg/l	219.6	207.6	174	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	13.73	10.21	12.88	45.0	No Relaxation
17	Salinity	%	1.34	1.25	1.04	NS*	NS*
18	Sodium as Na	mg/l	148	150	166	NS*	NS*
19	Potassium as K	mg/l	2.3	2.4	2.8	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 12: Drinking Water Quality Monitoring Parameters for Port Colony Kandla, Hospital Kandla & A.O. Building at Gandhidham

Sr. No.	Parameter	Unit	Port Colony Kandla	Hospital Kandla	A.O. Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.4	7.1	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1080	1350	950	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2100	2670	1890	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	767	712	641	250.0	1000.0
9	Ca as Ca	mg/l	60.12	64.13	56.11	75.0	200.0
10	Mg as Mg	mg/l	70.47	72.90	82.62	30.0	100.0
11	Total Hardness	mg/l	370	410	430	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.85	0.65	0.93	1.0	1.5
14	Sulphate	mg/l	178.8	202.8	207.6	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.50	10.21	11.62	45.0	No Relaxation
17	Salinity	%	1.39	1.29	1.16	NS*	NS*
18	Sodium as Na	mg/l	170	164	178	NS*	NS*
19	Potassium as K	mg/l	2.7	2.3	2.8	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 13: Drinking Water Quality Monitoring Parameters for School Gopalpuri, Guest House & E - Type Quarter at Gopalpuri, Gandhidham

Sr. No.	Parameter	Unit	School Gopalpuri	Guest House	E - Type Quarter	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.5	7.4	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1010	1350	1080	500	2000
3	Turbidity	NTU	1	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1990	2670	2120	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	697	496	586	250.0	1000.0
9	Ca as Ca	mg/l	56.11	64.13	72.14	75.0	200.0
10	Mg as Mg	mg/l	70.47	53.46	58.32	30.0	100.0
11	Total Hardness	mg/l	380	360	390	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.58	0.80	1.05	1.0	1.5
14	Sulphate	mg/l	175.2	170.4	165.6	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.50	10.70	9.50	45.0	No Relaxation
17	Salinity	%	1.26	0.90	1.06	NS*	NS*
18	Sodium as Na	mg/l	190	186	189	NS*	NS*
19	Potassium as K	mg/l	2.4	2.3	2.6	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 14: Drinking Water Quality Monitoring Parameters for F - Type Quarter, Hospital Gopalpuri & Tuna Port

Sr. No.	Parameter	Unit	F - Type Quarter	Hospital Gopalpuri	Tuna Port	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.7	7.5	7.32	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1050	1080	1020	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Unit	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1990	2150	2000	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	626	641	604	250.0	1000.0
9	Ca as Ca	mg/l	76.15	80.16	80.16	75.0	200.0
10	Mg as Mg	mg/l	51.03	60.75	60.75	30.0	100.0
11	Total Hardness	mg/l	430	360	330	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	1.05	0.92	0.46	1.0	1.5
14	Sulphate	mg/l	138	190.8	180	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	10.00	7.96	8.2	45.0	No Relaxation
17	Salinity	%	1.13	1.16	1.09	NS*	NS*
18	Sodium as Na	mg/l	190	186	188	NS*	NS*
19	Potassium as K	mg/l	2.5	2.4	2.6	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 15: Drinking Water Quality Monitoring Parameters for Vadinar Jetty & Port Colony at Vadinar

Sr. No.	Parameter	Unit	Vadinar Jetty	Port Colony Vadinar	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.6	7.4	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1010	990	500	2000
3	Turbidity	NTU	ND	ND	1.0	5.0
4	Odor	-	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	210.0	990.0	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	NS*	NS*
8	Chloride	mg/l	476	491	250.0	1000.0
9	Ca as Ca	mg/l	64.13	56.11	75.0	200.0
10	Mg as Mg	mg/l	75.33	68.04	30.0	100.0
11	Total Hardness	mg/l	470	420	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.99	0.94	1.0	1.5
14	Sulphate	mg/l	16.80	17.64	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	11.48	9.50	45.0	No Relaxation
17	Salinity	%	0.86	0.89	NS*	NS*
18	Sodium as Na	mg/l	140.0	146.0	NS*	NS*
19	Potassium as K	mg/l	2.2	2.3	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent

*NS: Not Specified

2.3 Results & Discussion

The colour of all drinking water samples was < 5 Hazen unit and odour of the samples was also agreeable. All parameters are found to be within the specified limit of the Drinking water Standard.

pH

The limit of pH value for drinking water is specified as 6.5 to 8.5. pH value in the studied area varied from 7.0 to 8.0 pH unit. All the sampling points showed pH values within the prescribed limit by Indian Standards.

Total Dissolved Solids (TDS)

TDS values in the studied area varied between 600 -1800 mg/l. None of the sampling points showed higher TDS values than the prescribed limit by Indian standards .

Conductivity

Electrical Conductivity is the ability of a solution to transfer (conduct) electric current. Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The conductivity in the samples collected during the month of August ranged from 1000-3300 µs/cm. Electrical conductivity standards do not appear in BIS standards for drinking water.

BOD

BOD value in the studied area was less than 2.0 mg/L. Indian standards does not show any standard values for BOD in drinking water.

Chlorides

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. Chloride value in the studied area varied between 400-800 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.

Calcium

Calcium value in the studied area varied between 45 - 80 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. If calcium is present beyond the maximum acceptable limit, it causes incrustation of pipes.

Magnesium

Magnesium value in the studied area varied between 30 – 85 mg/l. All the locations had Magnesium within the prescribed limits of 30-100 mg/L.

Total Hardness

Hardness value in the studied area varied between 330-470 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. The prescribed limit by Indian Standards is 200-600 mg/L.

Iron

Iron value in the studied area was below 0.01mg/L and hence well below the permissible limit as per Indian Standards is 0.3 mg/L. The excess amount of iron causes slight toxicity; gives stringent taste to water.

Fluoride

Fluoride value in the studied area varied between 0.1 – 1.0 mg/l and hence well below the permissible limit as per Indian Standards is 1.0-1.5 mg/L. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems.

Sulphates

Sulphate value in the studied area varied between 10 – 300 mg/l. All the sampling points showed sulphate values within the prescribed limits by Indian Standards (200-400 mg/L). Sulphate content in drinking water exceeding the 400 mg/L imparts bitter taste.

Nitrites (NO_2) and Nitrates (NO_3)

Nitrite values in all the water samples were <0.1. There are no specified standard values for Nitrites in Drinking water. The mean Nitrate values in drinking water of KPT was 6.27 mg/l which is well within the permissible limit of the Drinking water Standard.

Salinity

Salinity in drinking water in the present samples collected ranged from 0.8 to 1.3 %. There are no prescribed Indian standards for salinity in Drinking water**.**

Sodium and Potassium Salts

Sodium values in the samples collected ranged from 100 - 2000 mg/l and Potassium salts ranged from 2.2 to 3.0 mg/l. There are no prescribed limits of Sodium and Potassium in Indian standards for Drinking water**.**

Heavy Metals in Drinking Water

In the present study period drinking water samples were analyzed for Mn, Cr, Cu, Cd, As, Hg, Pb and Zn. All these heavy metals were well below the permissible limits prescribed by the Indian Standards.

Bacteriological Study

Analysis of the bacteriological parameter at all location shows that Bacteria is not present and hence Bacterial count is in line with the permissible limit of drinking water. This shows that all the drinking water samples were safe from any bacteriological contamination.

2.4 Conclusions

These results are compared with acceptable limits as prescribed in IS 10500:2012 – Drinking Water Specification. It is seen from the analysis data that during the study period the water was safe for human consumption at all drinking water monitoring stations.

3. Noise Level Monitoring

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. Noise Monitoring was done at 13 stations at Kandla, Vadinar and Township area.

3.1 Method of Monitoring

Sampling was done at all stations for 24 hour period. Data was recorded using automated sound level meter. The intensity of sound was measured in sound pressure level (SPL) and common unit of measurement is decibel (Db).

3.2 Results

Table 16: Noise Monitoring data for ten locations of Deendayal Port and two locations of Vadinar Port

Sr. No.	Location	Day Time Average Noise Level (SPL) in dB(A)	Night Time Average Noise Level (SPL) in dB(A)
	Sampling Time	**6:00 am to 10:00 PM**	**10:00PM to 6:00 AM**
1	Marine Bhavan	52.0	48.9
2	Nirman Building 1	52.7	46.9
3	Tuna Port	56.2	49.8
4	Main Gate North	66.8	60.7
5	West Gate I	70.4	63.0
6	Canteen Area	54.8	44.7
7	Main Road	65.9	51.1
8	ATM Building	66.4	56.6
9	Wharf Area /Jetty Area	72.2	67.7
10	Port & Custom Office	51.5	46.3
	Vadinar Port		
11	Entrance Gate of Vadinar Port	66.8	53.7
12	Nr. Port Colony, Vadinar	60.4	52.8
13	Nr. Vadinar Jetty	72.5	63.7

3.3 Conclusions- Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Average Noise Level (SPL)in all ten locations at Deendayal Port ranged from 52.0 dB(A) to 72.2 dB(A) and it was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all ten locations of Deendayal Port ranged from 44.7 dB to 67.7 dB(A) and it was within the permissible limits of 70 dB(A) for the industrial area for the night time.

4. Soil Monitoring

Sampling and analysis of soil samples were undertaken at six locations within the study area (Deendayal Port and Vadinar Port) as a part of EMP. The soil sampling locations are initially decided based on the locations as provided in the tender document of the Deendayal Port.

4.1 Methodology

The soil samples were collected in the month of August 2021. The samples collected from the all locations are homogeneous representative of each location. At random locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

4.2 Results

Table-17: Chemical Characteristics of Soil in the Study Area

Sr. No.	Parameter	Unit	Station Name					
			SL1	SL2	SL3	SL4	SL5	SL6
			Tuna Port	IFFCO Plant	Khori Creek	Nakti Creek	KPT Admin Site	KPT Colony
			Near main gate of Port	10 m away from main gate	Sand from creek at low tide		Vadinar	
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	pH	-	8.60	8.10	8.42	8.30	8.09	8.32
3	Electrical Conductivity	µs/cm	23,400.0	20,420.0	23,700.0	17,200.0	510.0	400.0
4	Moisture	%	20.42	21.16	23.22	20.12	9.04	8.22
5	Total Organic Carbon	%	0.18	0.18	0.25	0.11	0.21	0.16
6	Alkalinity	mg/kg	60.06	140.04	140.04	60.06	100.10	80.04
7	Total Nitrogen	%	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
8	Chloride	mg/kg	4,010.0	4,324.0	5,982.0	4,001.0	42.2	67.8
9	Sulphate	mg/kg	188.0	179.2	110.0	100.0	14.0	16.2
10	Phosphorus	mg/kg	0.90	0.86	1.04	1.62	0.78	0.88
11	Potassium	mg/kg	786.0	656.0	1,162.0	780.0	130.0	182.0
12	Sodium	mg/kg	2,341.0	3,618.0	4,220.0	3,122.0	1,224.0	1,400.0
13	Calcium	mg/kg	160.00	130.00	170.00	220.00	110.00	68.00
14	Copper as Cu	mg/kg	32.2	58.2	42.2	23.4	17.4	23
15	Lead as Pb	mg/kg	3.8	3.8	3.6	4.1	BQL	BQL
16	Nickel as Ni	mg/kg	37.2	32.4	41.2	24.5	19.3	20.4
17	Zinc as Zn	mg/kg	59.36	38.32	53.4	48.50	49.20	40.40
18	Cadmium as Cd	mg/kg	ND	ND	ND	ND	ND	ND

4.3 Discussion

- The data shows that value of pH ranges from 8.42 at Nakti Creek to 8.60 at Tuna Creek indicating that all soil samples are neutral to slight basic. Tuna port samples showed maximum conductivity of 23,400µmhos/cm, while Nakti Creek location showed minimum conductivity of 17,200 µmhos/cm. Conductivity at Vadinar Port was 510 and 400 µmhos/cm at Admin site and Vadinar Port colony respectively.
- Total organic Carbon ranged from 0.1 % to 0.3 at Deendayal Port. At Vadinar Port, organic carbon content ranged from 0.1 % to 0.2 %.
- The concentration of Phosphorus and Potassium in the soil samples varies from 0.8 to 1.62 mg/kg and 600.0 to 1170 mg/kg respectively at Deendayal Port. The mean concentration of Phosphorous at Vadinar site was 0.80 mg/kg and mean concentration of Potassium at Vadinar site was 156 mg/kg.

These differences in NPK in soil at different locations are due to the dissimilar nature of soil at each of the locations. Samples SL3 & SL4 (Khori Creek & Nakti Creek) are of saline nature as they are coastal soil; where as other locations are inland locations and have different chemical properties.

Heavy Metals in the Soil

Traces of Copper, Lead, Nickel and Zinc were observed in the soil samples collected from all the four locations of Deendayal Port and two locations of Vadinar Port. Cadmium metal was not detected in the Soil.

4.4 Conclusion

The soils of Deendayal Port and Vadinar Port appears to be neutral to basic with varying levels of Chloride, Sulphate, NPK and Calcium. As the nature of soil at different locations are different with respect to its proximity to the sea, the samples showed high degree of variations in their chemical properties.

5. Sewage Treatment Plant Monitoring

This involves safe collection of waste water (spent/used water) from wash areas, bathroom, industrial units, etc., waste from toilets of various buildings and its conveyance to the treatment plant and final disposal in conformity with the requirement and guide lines of State Pollution Control Board and other statutory bodies.

5.1 Methodology for STP Monitoring

To monitor the working efficiency of Sewage Treatment Plant (STP), STP Inlet and Outlet Samples were collected once a week. Locations selected are namely Gopalpuri Township, Deendayal Port and Vadinar. Samples were collected in 1 lit. Carboys and were analyzed in laboratory for various parameters.

5.2 Results

- **Kandla STP**

Table 18: Sewage Water Monitoring at Kandla STP (1st Week)

Date of Sampling	05.08.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.9	7.5
2	Total Suspended Solids	mg/l	107	101
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	334	108
5	BOD @ 27 °C	mg/l	118.0	27.0
Aeration Tank				
6	MLSS	mg/l	12.0	
7	MLVSS	%	88.0	

Table 19: Sewage Water Monitoring at Kandla STP (2nd Week)

Date of Sampling	12.08.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.6	7.68
2	Total Suspended Solids	mg/l	193	101
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	414	104
5	BOD @ 27 °C	mg/l	136.0	27.0
Aeration Tank				
6	MLSS	mg/l	9.0	
7	MLVSS	%	97.0	

Table 20: Sewage Water Monitoring at Kandla STP (3rd Week)

Date of Sampling	19.08.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.86	7.48
2	Total Suspended Solids	mg/l	204	104
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	261	70
5	BOD @ 27 °C	mg/l	87.0	20.0
Aeration Tank				
6	MLSS	mg/l	10.0	
7	MLVSS	%	90.0	

Table 21: Sewage Water Monitoring at Kandla STP (4th Week)

Date of Sampling	23.08.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.43	7.16
2	Total Suspended Solids	mg/l	403.3	150.4
3	Residual Chlorine	mg/l	<1.0	<1.0
4	COD	mg/l	313.1	151.5
5	BOD @ 27 °C	mg/l	106.0	52.0
6.	Fecal Coliform	MPN Index / 100 ml	-	>1600
Aeration Tank				
7.	MLSS	mg/l	33.0	
8	MLVSS	%	81.0	

- **Gopalpuri Colony STP**

Table 22: Sewage Water Monitoring at Gopalpuri STP (1st Week)

Date of Sampling	05.08.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.76	7.34
2	Total Suspended Solids	mg/l	98.1	62.4
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	324	102
5	BOD @ 27 °C	mg/l	110.0	28.0
Aeration Tank				
6	MLSS	mg/l	12.0	
7	MLVSS	%	92.0	

Table 23: Sewage Water Monitoring at Gopalpuri STP (2nd Week)

Date of Sampling	12.08.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.72	7.37
2	Total Suspended Solids	mg/l	406	107
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	320	103
5	BOD @ 27 °C	mg/l	110.0	26.0
Aeration Tank				
6	MLSS	mg/l	14.0	
7	MLVSS	%	90.0	

Table 24: Sewage Water Monitoring at Gopalpuri STP (3rd Week)

Date of Sampling	19.08.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.71	7.34
2	Total Suspended Solids	mg/l	404	107
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	351	101
5	BOD @ 27 °C	mg/l	115.0	23.0
Aeration Tank				
6	MLSS	mg/l	16.0	
7	MLVSS	%	88.0	

Table 25: Sewage Water Monitoring at Gopalpuri STP (4th Week)

Date of Sampling	23.08.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.7	7.35
2	Total Suspended Solids	mg/l	405	107
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	242	101
5	BOD @ 27 °C	mg/l	80.0	23.0
6.	Fecal Coliform	MPN Index / 100 ml	-	>1600
Aeration Tank				
7.	MLSS	mg/l	18.0	
8.	MLVSS	%	88.0	

- **Vadinar STP**

Table 26: Sewage Water Monitoring at Vadinar STP (1st Week)

Date of Sampling	05.08.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.23	NOT WORKING
2	Total Suspended Solids	mg/l	18	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	89.0	
5	BOD @ 27 °C	mg/l	28.0	

Table 27: Sewage Water Monitoring at Vadinar STP (2nd Week)

Date of Sampling	12.08.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.28	NOT WORKING
2	Total Suspended Solids	mg/l	60	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	78.0	
5	BOD @ 27 °C	mg/l	28.0	

Table 28: Sewage Water Monitoring at Vadinar STP (3rd Week)

Date of Sampling	19.08.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.32	NOT WORKING
2	Total Suspended Solids	mg/l	60	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	80.0	
5	BOD @ 27 °C	mg/l	26.0	

Table 29: Sewage Water Monitoring at Vadinar STP (4th Week)

Date of Sampling	23.08.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.18	NOT WORKING
2	Total Suspended Solids	mg/l	72	
3	Residual Chlorine	mg/l	<1.0	
4	COD	mg/l	80.0	
5	BOD @ 27 °C	mg/l	26.0	

5.3 Conclusions:

The GPCB standards of BOD, TSS and Residual Chlorine for STP outlet are 20 mg/lit, 30 mg/lit & 0.5 mg/lit respectively. It is suggested to do treatment on regular basis to avoid flow of contaminated/polluted water into the sea. Also, the STP at Vadinar is also non-functional and thus, steps should be taken to commission the STP at Vadinar Port. Hence, currently only inlet samples are collected and analysed.

6. Marine Water Monitoring

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992) aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

Marine Environment

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations

The monitoring of marine environment for the study of biological and ecological parameters was carried out on 9th& 10th August-2021 in harbor regions of KPT and on 9th August-2021 at Vadinar during spring tide period of New moon phase of Lunar Cycle. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 16th& 17th August 2021 in harbor regions of KPT. 16th August -2021 in Vadinar during Neap tide period first quarter of Lunar Cycle..

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and two stations in Nakti creek and one station in Khori creek. The same sampling schedule was repeated during consecutive spring tide and neap tide in same month. Plankton samples from sub surface layer was collected both during high tide period and low tide period from 1 water quality monitoring stations near Vadinar jetty area during spring tide and neap tide in this month .Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

Sampling Locations

Offshore monitoring requirement	Number of locations
Offshore Installations	3 in Kandla creek 2 in Nakti creek 1 in Khori creek 1 near Vadinar Jetty 1 near 1st SBM
Total Number of locations	**8**

6.1 Marine Water Quality

Marine water quality of marine waters of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month.

The results of marine water quality and Marine sediments are as below;

Table 30: Marine Water Quality Monitoring Parameters for location near KPT colony

Sr. No.	Parameters	Unit	Kandla Creek Near KPT colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.16	7.14	7.3	7.26
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.2	32.0	32.0	31.8
5	Turbidity	NTU	39	28	32	29
6	Total Dissolved Solids	mg/l	42660	41056	37802.0	43665.0
7	Total Suspended Solids	mg/l	675	979	614.2	372.4
8	Total Solids	mg/l	46346	44350	46346.0	44369.4
9	DO	mg/l	4.5	3.9	4.6	5.1
10	COD	mg/l	80.0	78.0	78.0	80.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	7.82	6.09	0.49	0.73
13	Phosphate	mg/l	0.57	0.14	0.16	0.17
14	Sulphate	mg/l	2628	1656	2352	2076
15	Nitrate	mg/l	2.22	2.03	2.53	3.77
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	1322.64	1242.48	601.2	480.96
18	Magnesium	mg/l	1239.3	1336.5	1749.6	1773.9
19	Sodium	mg/l	11012.0	10828.0	11022.0	10202.0
20	Potassium	mg/l	340.0	300.0	320.0	302.0
21	Iron	mg/l	1.32	1.40	1.20	1.30
22	Chromium	mg/l	0.16	0.14	0.12	0.11
23	Copper	mg/l	0.06	0.07	0.14	0.18
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.05	0.06	0.07	0.06
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.11	0.12	0.18	0.19
28	Zinc	mg/l	0.08	0.06	0.07	0.06

Table 31: Marine Water Quality Monitoring Parameters for location near passenger Jetty One at Kandla

Sr. No.	Parameters	Unit	Near passenger Jetty One (2)			
			23° 0'18 "N 70°13'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.28	7.25	7.39	7.42
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.7	32.6	32.0	32.2
5	Turbidity	NTU	37	27	42	47
6	Total Dissolved Solids	mg/l	41612	45181	41735.0	36900.0
7	Total Suspended Solids	mg/l	717	808	414	432.9
8	Total Solids	mg/l	47224	44028	37224.0	44028.0
9	DO	mg/l	4.4	4.1	5.4	4.8
10	COD	mg/l	90.0	86.0	86.0	82.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	9.44	7.84	0.53	0.64
13	Phosphate	mg/l	0.06	0.11	0.18	0.19
14	Sulphate	mg/l	2760	1572	2652	2616
15	Nitrate	mg/l	2.36	2.25	3.45	4.29
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	1202.40	1122.24	561.12	480.96
18	Magnesium	mg/l	1336.5	1385.1	1798.2	1749.6
19	Sodium	mg/l	11752.0	10652.0	11120.0	12120.0
20	Potassium	mg/l	306.0	290.0	289.0	322.0
21	Iron	mg/l	1.56	1.66	1.50	1.40
22	Chromium	mg/l	0.13	0.12	0.10	0.12
23	Copper	mg/l	0.08	0.09	0.15	0.16
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.07	0.07	0.08
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.10	0.09	0.18	0.17
28	Zinc	mg/l	0.07	0.06	0.08	0.06

Table 32: Marine Water Quality Monitoring Parameters for location Near Coal Berth

Sr. No.	Parameters	Unit	Near Coal Berth			
			22°59'12"N 70°13'40"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.30	7.51	7.53	7.32
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.0	32.5	32.0	31.8
5	Turbidity	NTU	33	25	37	45
6	Total Dissolved Solids	mg/l	48590	39430	45812.0	35363.0
7	Total Suspended Solids	mg/l	555	809	587.3	591.2
8	Total Solids	mg/l	45108	41100	41720.0	40200.0
9	DO	mg/l	3.8	4	4.9	5.1
10	COD	mg/l	88.0	90.0	90.0	82.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	5.98	3.98	0.42	0.85
13	Phosphate	mg/l	0.10	0.08	0.15	0.19
14	Sulphate	mg/l	2856	2988	2736	2208
15	Nitrate	mg/l	2.73	2.33	4.75	3.79
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	1362.72	1322.64	480.96	601.2
18	Magnesium	mg/l	1190.7	1239.3	1822.5	1846.8
19	Sodium	mg/l	11452.0	10890.0	11125.0	10890.0
20	Potassium	mg/l	311.0	269.0	345.0	400.0
21	Iron	mg/l	1.80	1.92	1.30	2.01
22	Chromium	mg/l	0.11	0.12	0.18	0.19
23	Copper	mg/l	0.07	0.06	0.18	0.16
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.05	0.06	0.06	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.10	0.11	0.20	0.19
28	Zinc	mg/l	0.08	0.06	0.07	0.06

Table 33: Marine Water Quality Monitoring Parameters for location Khori creek at Kandla

Sr. No.	Parameters	Unit	KPT 4			
			Near 15/16 Berth			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.37	7.42	7.26	7.22
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.6	31.6	31.8	31.6
5	Turbidity	NTU	45	37	52	28
6	Total Dissolved Solids	mg/l	42420	38440	33550.0	33133.0
7	Total Suspended Solids	mg/l	654	624	701.5	490.4
8	Total Solids	mg/l	44940	40080	44940.0	40080.0
9	DO	mg/l	4.4	4.3	5.3	5.9
10	COD	mg/l	92.0	88.0	88.0	92.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	2.45	7.45	0.69	0.51
13	Phosphate	mg/l	0.10	0.02	0.24	0.16
14	Sulphate	mg/l	1668	2268	2616	2580
15	Nitrate	mg/l	1.96	1.53	3.34	4.86
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	1242.48	1282.56	521.04	480.96
18	Magnesium	mg/l	1287.9	1336.5	1725.3	1725.3
19	Sodium	mg/l	12152.0	13020.0	12162.0	11782.0
20	Potassium	mg/l	288.0	316.0	389.0	380.0
21	Iron	mg/l	1.60	1.55	1.48	1.38
22	Chromium	mg/l	0.15	0.16	0.20	0.18
23	Copper	mg/l	0.08	0.10	0.15	0.11
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.08	0.06	0.08	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.09	0.11	0.18	0.17
28	Zinc	mg/l	0.07	0.05	0.08	0.06

Table 34: Marine Water Quality Monitoring Parameters for location Nakti Creek near Tuna Port

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.18	7.30	7.3	7.37
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.6	33.0	31.8	31.6
5	Turbidity	NTU	36	48	36	28
6	Total Dissolved Solids	mg/l	47540	37880	38200.0	37205.0
7	Total Suspended Solids	mg/l	885	852	332.5	474
8	Total Solids	mg/l	46280	38780	38280.0	49040.0
9	DO	mg/l	4.2	4.3	5.3	5.2
10	COD	mg/l	76.0	78.0	90.0	92.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	4.33	2.45	0.91	0.73
13	Phosphate	mg/l	0.08	0.10	0.18	0.18
14	Sulphate	mg/l	2052	4500	2628	2268
15	Nitrate	mg/l	2.17	2.47	5.14	5.70
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	1362.72	1282.56	561.12	561.12
18	Magnesium	mg/l	1215	1239.3	1773.9	1773.9
19	Sodium	mg/l	11582.0	11262.0	10589.0	10110.0
20	Potassium	mg/l	326.0	366.0	347.0	311.0
21	Iron	mg/l	2.02	2.00	1.60	1.58
22	Chromium	mg/l	0.20	0.19	0.16	0.15
23	Copper	mg/l	0.10	0.08	0.12	0.10
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.07	0.08	0.06
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.11	0.12	0.32	0.62
28	Zinc	mg/l	0.06	0.07	0.07	0.06

Table 35: Marine Water Quality Monitoring Parameters for location Nakti Creek Near NH-8A at Kandla

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.39	Sampling not possible during Low Tide	7.39	Sampling not possible during Low Tide
2	Color	-	Colorless		Colorless	
3	Odor	-	Odorless		Odorless	
4	Salinity	ppt	32.9		31.8	
5	Turbidity	NTU	36		35	
6	Total Dissolved Solids	mg/l	36020		35465.0	
7	Total Suspended Solids	mg/l	666		380.3	
8	Total Solids	mg/l	44660		46002.0	
9	DO	mg/l	4.7		5.5	
10	COD	mg/l	80.0		88.0	
11	BOD	mg/l	<2.0		<2.0	
12	Silica	mg/l	7.73		0.45	
13	Phosphate	mg/l	0.08		0.17	
14	Sulphate	mg/l	3660		2280	
15	Nitrate	mg/l	2.74		4.15	
16	Nitrite	mg/l	<0.05		<0.05	
17	Calcium	mg/l	1402.80		561.12	
18	Magnesium	mg/l	1190.7		1773.9	
19	Sodium	mg/l	13030.0		11120.0	
20	Potassium	mg/l	348.0		320.0	
21	Iron	mg/l	1.89		1.50	
22	Chromium	mg/l	0.17		0.17	
23	Copper	mg/l	0.09		0.11	
24	Arsenic	mg/l	<0.01		<0.01	
25	Cadmium	mg/l	0.08		0.07	
26	Mercury	mg/l	<0.001		<0.001	
27	Lead	mg/l	0.09		0.2	
28	Zinc	mg/l	0.08		0.08	

Table 36: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar Jetty

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.60	7.90	7.38	7.25
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	33.0	32.5	32.0	32.0
5	Turbidity	NTU	48	37	47	40
6	Total Dissolved Solids	mg/l	38810	36220	37902.0	35080.0
7	Total Suspended Solids	mg/l	405	380	456.9	395.5
8	Total Solids	mg/l	42180	42020	38990.0	38620.0
9	DO	mg/l	4.3	4.7	4.5	4.9
10	COD	mg/l	90.0	88.0	82.0	78.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	6.00	7.65	0.76	0.93
13	Phosphate	mg/l	0.56	0.68	0.20	0.17
14	Sulphate	mg/l	2628	2268	2520	2376
15	Nitrate	mg/l	2.05	2.15	3.03	3.04
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	1242.48	1362.72	641.28	521.04
18	Magnesium	mg/l	1239.3	1239.3	1798.2	1798.2
19	Sodium	mg/l	14025.0	13879.0	11012.0	11212.0
20	Potassium	mg/l	326.0	300.0	342.0	333.0
21	Iron	mg/l	1.88	1.79	1.60	1.30
22	Chromium	mg/l	0.18	0.18	0.18	0.12
23	Copper	mg/l	0.08	0.08	0.18	0.20
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.07	0.06	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.10	0.09	0.16	0.2
28	Zinc	mg/l	0.06	0.06	0.06	0.07

6.1.1 Marine Sediments

Sediment samples were collected with Van Veen Grab from the six locations in Kandla Port Waters and two locations in Vadinar Port. Samples were collected and preserved in silver foil in ice box to prevent the contamination/decaying of the samples.

6.2 Results

The Sediment Quality results are given in below from table no. 34 A & B.

Table 34A: Results of Analysis of Sediment of Kandla & Vadinar Port (Spring Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT – 3	KPT - 5	Jetty
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.20	1.08	1.20	1.86	1.46
3	Organic Carbon	mg/kg	0.70	0.96	0.87	0.65	0.68
4	Inorganic Phosphate	mg/kg	120.0	132.0	142.0	162.0	160.0
5	Moisture	%	20.20	23.10	21.88	21.2	23.80
6	Aluminium	mg/kg	ND	ND	ND	ND	ND
7	Silica	mg/kg	28.0	21.0	24.0	36.0	23.0
8	Phosphate	mg/kg	10.50	11.20	9.80	9.60	10.20
9	Sulphate	mg/kg	210.0	242.0	160.0	170.0	140.0
10	Nitrite	mg/kg	0.11	0.12	0.1	0.11	0.12
11	Nitrate	mg/kg	9.80	7.44	10.80	9.20	8.40
12	Calcium	mg/kg	342.0	270.0	325.0	309.0	322.0
13	Magnesium	mg/kg	186.0	145.0	178.0	152.0	202.0
14	Sodium	mg/kg	8824.0	7242.0	9452.0	7122.0	8777.0
15	Potassium	mg/kg	396.0	388.0	460.0	680.0	780.0
16	Chromium	mg/kg	88	60	72.2	68.8	70.2
17	Nickel	mg/kg	20.4	30.4	19.5	21.3	30
18	Copper	mg/kg	60	34	21.5	18.2	23.4
19	Zinc	mg/kg	30.20	32.50	33.20	40.00	28.00
20	Cadmium	mg/kg	ND	ND	ND	ND	ND
21	Lead	mg/kg	2.8	2.4	3.9	5.2	3.8
22	Mercury	mg/kg	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND

*Grab samples could not be collected due high current at KPT 3, Natki Creek Near Tuna port & Vadinar SBM

Table 34B: Results of Analysis of Sediment of Kandla & Vadinar Port (Neap Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 3	KPT - 4	KPT - 5	Jetty
1	Texture	-	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
2	Organic Matter	mg/kg	1.20	1.12	1.20	1.80	1.62	1.10
3	Organic Carbon	mg/kg	0.69	0.65	0.69	1.04	0.94	0.64
4	Inorganic Phosphate	mg/kg	120.0	142.0	116.0	136.0	142.0	152.0
5	Moisture	%	20.08	21.52	23.05	24.55	28.88	22.02
6	Aluminium	mg/kg	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	21.20	18.88	21.0	18.8	16.20	13.60
8	Phosphate	mg/kg	8.8	8.9	7.70	8.20	8.40	6.2
9	Sulphate	mg/kg	180.0	196.0	142.0	166.0	120.0	210.0
10	Nitrite	mg/kg	0.1	0.11	0.1	0.12	0.11	0.13
11	Nitrate	mg/kg	9.80	6.89	8.99	8.80	7.93	10
12	Calcium	mg/kg	322.0	266.0	320.0	296.0	300.0	288.0
13	Magnesium	mg/kg	180.0	145.0	180.0	142.0	212.0	196.0
14	Sodium	mg/kg	8242.0	7002.0	8942.0	6641.0	8041.0	9424.0
15	Potassium	mg/kg	380.0	396.0	422.0	644.0	621.0	386.0
16	Chromium	mg/kg	79	54	74.2	64.7	58.4	66
17	Nickel	mg/kg	18.2	28.2	20.6	19.4	28.4	18.8
18	Copper	mg/kg	54	20	22.5	16.8	18.6	74.2
19	Zinc	mg/kg	28.20	18.80	28.40	34.50	18.60	75.00
20	Cadmium	mg/kg	ND	ND	ND	ND	ND	ND
21	Lead	mg/kg	2	2.1	2.8	3.8	2.4	ND
22	Mercury	mg/kg	ND	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND	ND

REPORT

ON

ECOLOGICAL MONITORING

OF MARINE ENVIRONMENT

IN

DPTHARBOURAREA, NEAR BY CREEKS

For

DEENDAYAL PORT TRUST

AUGUST,2021

Sampling Stations:

The monitoring of marine environment for the study of biological and ecological Parameters was carried out on9th August, 2021 in harbour region of DPT, and on 10thAugust,2021 in creeks near by the port during spring tide. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 15thAugust, 2021 in harbour region of DPT and on 16thAugust, 2021 in creeks near by the port during neap tidal condition.

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of DPT harbour area andone stations in Nakti creek and one station in Khori creek. Sampling at second sampling station of Nakti creek was possible only during high tide period. Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons(density and their population).

TABLE #1 SAMPLING LOCATIONS

monitoring requirement	Number of locations
Kandla creek Nakti creek Khori Creek	3 in Kandla creek 2 in Nakti creek 1 in Khori creek
Total Number of locations	**6**

Sampling methodology adopted:

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.

50 litres of the water sample were collected from Sub surface by using bucket. From the collected water sample 1 litres of water sample were taken in an opaque plastic bottle for chlorophyll estimation, thereafter plankton samples were collected by using filtration assembly with nilyobolt cloth of 20µm mesh size.

Samples Processing for chlorophyll estimation:

Samples for the 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 litres of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm. By using corrected optical density, Chlorophyll-a value was calculated as given in (APHA, 1998).

PLANKTON:

The entire area open water in the sea is the pelagic realm. Pelagic organisms live in the open sea. In contrast to the pelagic realm, the benthic realm comprises organisms and zone of the bottom of the sea. Vertically the pelagic realm can be dividing into two zones based on light penetration; upper photic or euphotic zone and lower dark water mass, aphotic zone below the photic zone.

The term plankton is general term for organisms have such limited powers of locomotion that they are at the mercy of the prevailing water movement. Plankton is subdivided to phytoplankton and zooplankton. Phytoplankton is free floating organisms that are capable of photosynthesis and zooplankton is the various free floating animals.

Pelagic zone, represents the entire ocean water column from the surface to the deepest depths, is home to a diverse community of organisms. Differences in their locomotive ability categorize the organisms in the pelagic realm into two, ***plankton*** and ***nekton*** (Lalli and Parsons, 1997). ***Plankton*** consists of all organisms drifting in the water and is unable to swim against water currents, whereas ***Nekton*** includes organisms having strong locomotive power. Ecological studies on the plankton community, which form the base of the aquatic food chain, help in the better understanding of the dynamics and functioning of the marine ecosystem. The term 'Plankton' first coined by Victor Hensen (1887), Plankton, (Greek word: *planktos*meaning "passively drifting or wandering") is defined as drifting or free-floating organisms that inhabit the pelagic zone of water. Based on their mode of nutrition planktonic organisms are categorised into phytoplankton (organisms having an autotrophic mode of nutrition) and zooplankton (organisms having a heterotrophic mode of nutrition).

Phytoplankton in the marine environment:

Phytoplankton is 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).The phytoplankton those normally captured in the net from the Gulf of Kutch is normally dominated by these two major groups; diatoms and dinoflagellates. Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as and Cyanophytes (blue-green 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 in the marine environment:

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, 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 (Beaugrand et al., 2004). Zooplankton grazing in the marine environment controls the primaryProduction and helps in determining the pelagic ecosystem (Banse, 1995). 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.

Based on the duration of planktonic life, zooplankton are categorised into Holoplankton (organisms which complete their entire lifecycle as plankton) and Meroplankton (organisms which are planktonic during the early part of their lives such as the larval stages of benthic and nektonic organisms). Tychoplankton are organisms which live a brief planktonic life, such as the benthic crustaceans (cumaceans, mysids, isopods) which ascend to the water column at night for feeding and certain ectoparasitic copepods, they leave the host and spend their life as plankton during their breeding cycle.

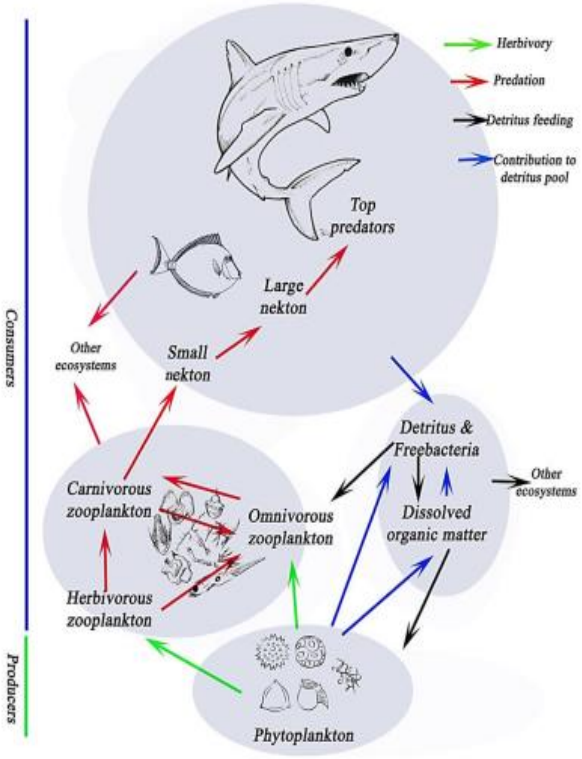
Zooplankton can be subdivided into holoplankton, i.e., permanent members of the plankton (e.g., Calanoid copepods), and meroplankton, i.e., temporary members in the plankton e.g., larvae of fish,

shrimp, and crab). The meroplankton group consists of larval and young stages of animals that will adopt a different lifestyle once they mature. In contrast to phytoplankton which consist of a relatively smaller variety of organisms, Zooplankton are extremely divers, consist of a host of larval and adult forms representing many animal phylum.

Among the zooplankton one group always dominate than others; members of sub class copepods (Phylum Athropoda), and Tintinids (Phylum Protozoa) among the net planktons. These small animals are of vital importance in marine ecosystem as one of the primary herbivores animals in the sea, and it is they provide vital link between primary producer (autotrophs) and numerous small and large marine consumers.

As their community structure and function are highly susceptible to changes in the environmental conditions regular monitoring of their distribution as well as their interactions with various physicochemical parameters is inevitable for the sustainable management of the ecosystem (Kusum et al., 2014). Of all the marine zooplankton groups, copepods mainly calanoid copepods are the dominant groups in marine subtropical and tropical waters and exhibit considerable diversity in morphology and habitats they occupy (Madhupratap, 1991;)

It has been well established that potential of pelagic fishes viz. finfishes, crustaceans, molluscs and marine mammals either directly or indirectly depend on zooplankton. The herbivorous zooplankton is efficient grazers of the phytoplankton and is referred to as living machines transforming plant material into animal tissue. Hence they play an essential role as the intermediaries for nutrients/energy transfer between primary and tertiary trophic levels. Due to their large density, shorter lifespan, drifting nature, high group/species diversity and different tolerance to the stress, they used as the indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem (Ghajbhiye, 2002).



Simplified marine food web

Spatial distribution of Plankton:

A characteristic of plankton population is that they tend to occur in patches, which are varying spatially on a scale of few meters to far as few kilometres in distance. They also vary in time scale, season as well as vertically in the water column. It is this patchiness and its constant changes in time and spot, that has made it so difficult for plankton biologist to learn about the ecology of plankton. The biological factors that causes this patchiness is due to the ability of zooplankton to migrate vertically and graze out the phytoplankton at a rapid rate that can create patchiness. Similarly the active swimming ability by certain zooplankton organisms can cause to aggregate in dense group.

At its most extreme, because the water in which plankton is suspended is constantly moving, each sample taken by the plankton biologists remain a different volume of water, so each sample is unique and replicate does not exist.

Plankton may also exhibit vertical patchiness. Physical factors contribute to this type of patchiness include light intensity, nutrients and density gradients in the water column.

Phytoplankton in particular tends to be unequally distributed vertically, which leads to the existence of different concentration of a chlorophyll value between photic zone and below the photic zone.

Methodology adopted for Plankton sampling:

Mixed plankton sample were obtained from the sub surface layer at each sampling locations by towing the net horizontally with the weight .After the tow of about 15-30minutes, plankton net was pulled up and washed down to the tail and collected the plankton adhered to plankton net in the collection bucket at the bottom by springing outer and inner surface of the net with sea water, while the net was hanging with the mouth upward. For quantitative evaluation 50 L water samples were collected from subsurface layer and filtered through 20µm mesh size net by using bucket and filtration assembly.

Preservation and storage:

Both filtered plankton and those collected from the plankton net were preserved with 5% buffered formalin and stored in 1L plastic container for further processing in the laboratory.

Sample concentration:

The collected plankton samples were concentrated by using centrifuge and made up to 50 ml with 5% formalin -Glycerine mixture.

Taxonomic evaluation:

Before processing, the sample was mixed carefully and a subsample was taken with a calibrated Stempel-pipette. 1 ml of the concentrated plankton samples were transferred on a glass slide with automatic pipette. The plankton sample on the glass slides were stained by using Lugol's iodine and added glycerine to avoid drying while observation. The plankton samples were identified by using Labex triangular Research microscope with photographic attachment. Microphotographs of the plankton samples were taken for record as well as for confirming the identification. The bigger sized zooplankton was observed through dissecting stereomicroscope with magnification of 20-30 x. Plankton organisms in the whole slide were identified to the lowest axon possible. A thorough literature search was conducted for the identification of the different groups of zooplankton that were encountered

Cell counts by drop count method:

The common glass slide mounted with a 1ml of concentrated phytoplankton/zooplankton sample in glycerol and covered with cover slip 22x 60mm was placed under the compound microscope provided with a mechanical stage. The plankton was then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton in each microscopic field was thus counted. When first microscopic field row was finished the next consecutive row was adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted. From this total number in 1ml of the concentrated

plankton, total number of plankton in the original volume of sample filtered was calculated as units/L.

BENTHIC ORGANISMS:

Benthos is those organisms that are associated with the sea bed or benthic habitats. Epi- benthic organisms live attached to a hard substratum or rooted to a shallow depth below the surface. In fauna organisms live below the sediment–water interface. Interstitial organisms live and move in pore water among sedimentary grains.

Because the benthic organisms are often collected and separated on sieves, a classification based on the overall size is used. Macro benthos include organisms whose shortest dimension is greater than or equal to 0.5 mm. Meio benthos are smaller than 0.5mm but larger than 42µ in size.

The terms such as macro fauna and Meio fauna generally have little relevance with taxonomic classification. The terms Meio fauna and macro fauna depend on the size. Meio fauna were considered as good bioassay of community health and rather sensitive indicators of environmental changes

SAMPLING METHODOLOGY ADOPTED FOR SUB TIDAL REGION:

Van veen sampler (0.09m^2) was used for sampling bottom sediments. Two sets of sediments were sampled from each location, one for macro fauna and other for Meio fauna. The macro fauna in the sediments were sieved on board to separate out the organisms. The fixation of Meio fauna is normally done by bulk fixation of the sediment sample. The bulk fixation is done by using 10% formalin (Buffered with borate). The organisms were preserved with seawater as diluting agent.

Sample sieving:

Sediments samples were sieved to extract the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. The large portion of the sediment was split in to smaller portions and mixed with sea water in a bucket. The cohesive lumps were broken down by continuous stirring. The disaggregated sediments were then passed through the sieves.

Sample staining:

Sorting of the Meio fauna from the sieve is difficult task especially in the preserved material, because organisms are not easily detectable. To facilitate the animal detection the entire sample retained on the sieve after sieving operation were stained by immersing the sieve in a flat bottom tub with 1% Rose Bangal stain; a protein stain. A staining period of 10-30 minutes is sufficient for sample detection.

DIVERSITY INDICES:

On the whole, diversity indices provide more information about community composition than simply species richness (number of species present); they also, take the relative abundances of different species into account. Based on this fact, diversity indices therefore depend not only on species richness but on the evenness, or equitability, with which individuals are distributed among the different species (Magurram, A. E. (1988)

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.

The basic idea of diversity 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 (Carol H.R. *etal*. 1998). Biodiversity is commonly expressed through indices based on species richness and species abundances (Whittaker 1972, Lande 1996, Purvis and Hector 2000). 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.

A diversity Index is a single statistic that incorporates in formation on richness and evenness. The diversity measures that incorporate the two concepts may be termed heterogeneity measures (Magurran, 2004).

Any study intended to interpret causes and effect of adverse impact on Biodiversity of communities require suitable measures to evaluate specie richness and Diversity. The former is number of species in community, while latter is a function of relative frequency of different species. Species richness is the iconic measure of biological diversity (Magurran, 2004). Several indices have been created to measure the diversity of species; however, the most widely used in the last decades are the Shannon (1948) and Simpson (1949) (Buzas and Hayek 1996; Gorelick 2006), with the components of diversity: richness (*S)* and evenness (*J)*

Simpson's diversity index

Simpson's index (**D**) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present.. The Simson index is one of the meaningful and robust biodiversity measures available.(Magurran ,2004).

The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and, 1, no diversity. When D increases diversity decreases. Simpson's index is therefore usually expressed as 1-D or 1/D. (Magurran, 2004)

Low species diversity suggests:

- relatively few successful species in the habitat
- the environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment
- food webs which are relatively simple
- change in the environment would probably have quite serious effects

High species diversity suggests:

- a greater number of successful species and a more stable ecosystem
- more ecological niches are available and the environment is less likely to be hostile complex food webs
- environmental change is less likely to be damaging to the ecosystem as a whole

Species richness indices

The species richness***(S)*** is simply the number of species present in an ecosystem. Species richness Indices of species richness are widely used to quantify or monitor the effects of anthropogenic disturbance. A decline in species richness may be concomitant with severe or chronic human-induced perturbation (Fair Fair weather 1990,) Species richness measures have traditionally been the mainstay in assessing the effects of environmental degradation on the biodiversity of natural assemblages of organisms (Clarke &Warwick, 2001)

Species richness is the iconic measure of biological diversity (Magurran, 2004). The species richness***(S)*** is simply the number of species present in an ecosystem. This index makes no use of relative abundances. The term species richness was coined by McIntosh (1967) and oldest and most intuitive measure of biological diversity (Magurran, 2004).

Margalef's diversity index is a species richness index. Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, were derived.

The value of a diversity index increases both when the number of types increases and when evenness increases. For a given number of types, the value of diversity index is maximised when all types are equally abundant (Rosenzweig, M. L. (1995).

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 (Odum 1971 and Reish 1984). Shannon-Wiener's index **(H**) reproduce community parameters to a single numberby using an equation.

Shannon and Weiner index represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxa. It varies from 0 for communities with only single taxa to high values for community with many taxa each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range of polluted and unpolluted ecosystems, Wilham and Dorris (1968) concluded that the values of the index greater than 3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln\left(\frac{n_j}{N}\right)$$

RESULTS:

CHLOROPHYLL-a:

Water Samples for the chlorophyll estimation were collected from sub surface layer during high tide and low tide period of the tidal cycle for each sampling locations and analysed for Chlorophyll -a and after acidification for Pheophytin –a. Chlorophyll- a value was used as algal biomass indicator (APHA,1998) Algal biomass was estimated by converting Chlorophyll value.

In the sub surface water chlorophyll-a was varying from 0.305 -0.543mg/m^3.in harbour region of DPT during sampling done in spring tide period of August, 2021. In the nearby creeks chlorophyll-a was varying from 0.290-0.732 mg/m^3.Pheophytin –a level was below detectable limit- the all the sampling stations during springtide in the harbour region of DPT.

In the sub surface water chlorophyll-a was varying from 0.220 -0.748mg/m^3.in harbour region of DPT during sampling done in neap tide period of August, 2021 . In the nearby creeks chlorophyll-a was varying from BDL-0.862 mg/m^3. Pheophytin –a level was below detectable limit- the all the sampling stations during neap tide in the harbour region of DPT.

TABLE #2 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN AUGUST,2021

Sr. No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREA					
1	KPT1	High tide	0.425	BDL	28.48
		Low tide	0.307	BDL	20.57
2	KPT 2	High tide	0.305	BDL	20.43
		Low tide	0.543	BDL	36.38
3	KPT 3	High tide	0.527	BDL	35.31
		Low tide	0.425	BDL	28.47
CREEKS					
4	KPT-4 Khori-I	High tide	0.543	BDL	36.38
		Low tide	0.527	BDL	35.31
5	KPT-5 Nakti-I	High tide	0.409	BDL	27.40
		Low tide	0.732	BDL	49.04
6	KPT-5 Nakti-II	High tide	0.290	BDL	19.43

BDL: Below Detectable Limit.

TABLE #3 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN AUGUST,2021

Sr. No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREA					
1	KPT1	High tide	0.220	BDL	14.74
		Low tide	0.308	BDL	20.64
2	KPT 2	High tide	0.748	BDL	50.11
		Low tide	0.731	BDL	48.98
3	KPT 3	High tide	0.307	BDL	20.56
		Low tide	0.221	BDL	14.81
CREEKS					
4	KPT-4 Khori-I	High tide	0.543	BDL	36.38
		Low tide	0.221	BDL	14.81
5	KPT-5 Nakti-I	High tide	0.862	BDL	57.75
		Low tide	0.216	BDL	14.47
6	KPT-5 Nakti-II	High tide	BDL	BDL	-

BDL: Below Detectable Limit.

PHYTOPLANKTON POPULATION:

For the evaluation of the Phytoplankton population in DPT harbour area and within the immediate surroundings of the port, sampling was conducted from 5 sampling locations (3 in harbour area and two in Nakti creek) during high tide period and low tide period of spring tide and neap tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by,Diatoms blue green algae and dinoflagellates during spring tide period.Diatoms were represented by 14genera. Blue green were represented by threegenera and two genera of Dinoflagellates during the sampling conducted in spring tide in August,2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 98-226 units/ L during high tide period and 191-259 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by Diatoms ,Blue green algae and Dinoflagellates duringNeap tide period.Diatoms were represented by 15genera and Blue green algae were represented two genera and Dinoflagellates were represented by three genera during the sampling conducted in Neap tide in August, 2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from65-307units/ L during high tide period and 238-281 units/ L during low tide of Neap Tide.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 1.527-3.091 with an average of 2.420during the sampling conducted in High tide period of spring tide.While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla Harbour region and nearby creeks was varying from 1.679-2.621 with an average of 2.225 during the consecutive low tide period.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 2.344 -3.188 with an average of 2.887 during the sampling conducted in High tide period of Neaptide While .Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla Harbour region and nearby creeks was varying from. 2.526-3. 246with an average of 2.887 during the consecutive low tide period.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.728 -0.860 (H'(log10)) between selected sampling stations with an average value of 0.807 during high tide period of spring tide .Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.726-0.836 (H'(log10)) between selected sampling stations with an average value of 0.773 during consecutive lowtide. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.880-0.959 (H'(log10)) between selected sampling stations with an average value of 0.909 during high tide period of neap tide. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.819-0.911 (H'(log10)) between selected sampling stations with an average value of 0.887 during consecutive low tide. Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of phytoplankton of Kandla Harbour region and nearby creeks is less but with abundant population of few, with relatively few ecological niches and only very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran,2004).

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.785- 0.823 between selected sampling stations with an average of 0.801 during high tide period of spring tide . Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.770- 0.820 between selected sampling stations with an average of 0.787 during consecutive low tide . Low species diversity suggests a relatively few successful species in this habitat. The environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in Kandla Harbour region and nearby creeks, during high tide period and low tide period during neap tide also, which was varying from 0.811-0.886 with an average value of 0.836 between selected sampling stations during high tide period and varying from 0.774-0.826 with an average

value of 0.813 between selected sampling stations during consecutive low tide period Low species diversity suggests a relatively few successful species in this habitat.

Table # 4PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN AUGUST,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	210	14/19	73.68	2.431	0.7923	0.7938
	2	177	17/19	89.47	3.091	0.8603	0.8182
	3	226	12/19	63.16	2.029	0.7883	0.7853
	4	221	17/19	89.47	2.964	0.8243	0.7993
	5	190	14/19	73.68	2.478	0.8531	0.8227
	6	98	8/19	42.11	1.527	0.7279	0.7886
LOW TIDE	1	191	13/19	68.42	2.285	0.7812	0.7901
	2	233	13/19	68.42	2.201	0.7658	0.7795
	3	209	15/19	78.94	2.621	0.8367	0.8208
	4	213	10/19	52.63	1.679	0.7264	0.7732
	5	259	14/19	73.68	2.339	0.7547	0.7702

Table # 5 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN AUGUST,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	221	18/20	90	3.149	0.9462	0.8522
	2	283	19/20	95	3.188	0.8844	0.811
	3	268	17/20	85	2.862	0.899	0.8255
	4	256	14/20	70	2.344	0.8803	0.8328
	5	307	19/20	95	3.143	0.8857	0.8113
	6	65	12/20	60	2.635	0.9594	0.8861
LOW TIDE	1	238	15/20	75	2.558	0.8192	0.7738
	2	281	19/20	95	3.192	0.9106	0.8188
	3	256	19/20	95	3.246	0.9023	0.8241
	4	242	17/20	85	2.915	0.9102	0.8263
	5	255	15/20	75	2.526	0.8939	0.824

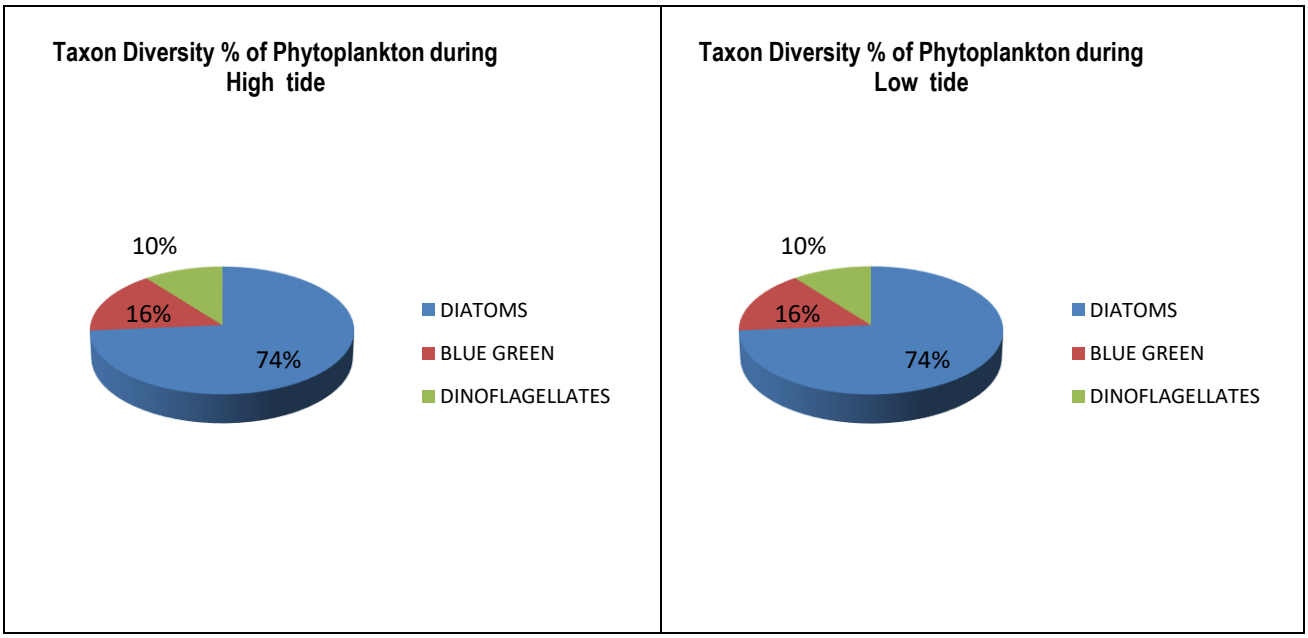
Table # 6 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING SPRING TIDEIN AUGUST, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	94-215	14/19	73.68
			BLUE GREEN	4-13	3/19	15.79
			DINOFLAGELLATES	0-1	2/19	10.53
			TOTAL PHYTO PLANKTON	98-226	19	-
LOW TIDE	Sub surface	5	DIATOMS	182-250	14/19	73.68
			BLUE GREEN	8-12	3/19	15.79
			DINOFLAGELLATES	0-1	2/19	10.53
			TOTAL PHYTO PLANKTON	191-259	19	-

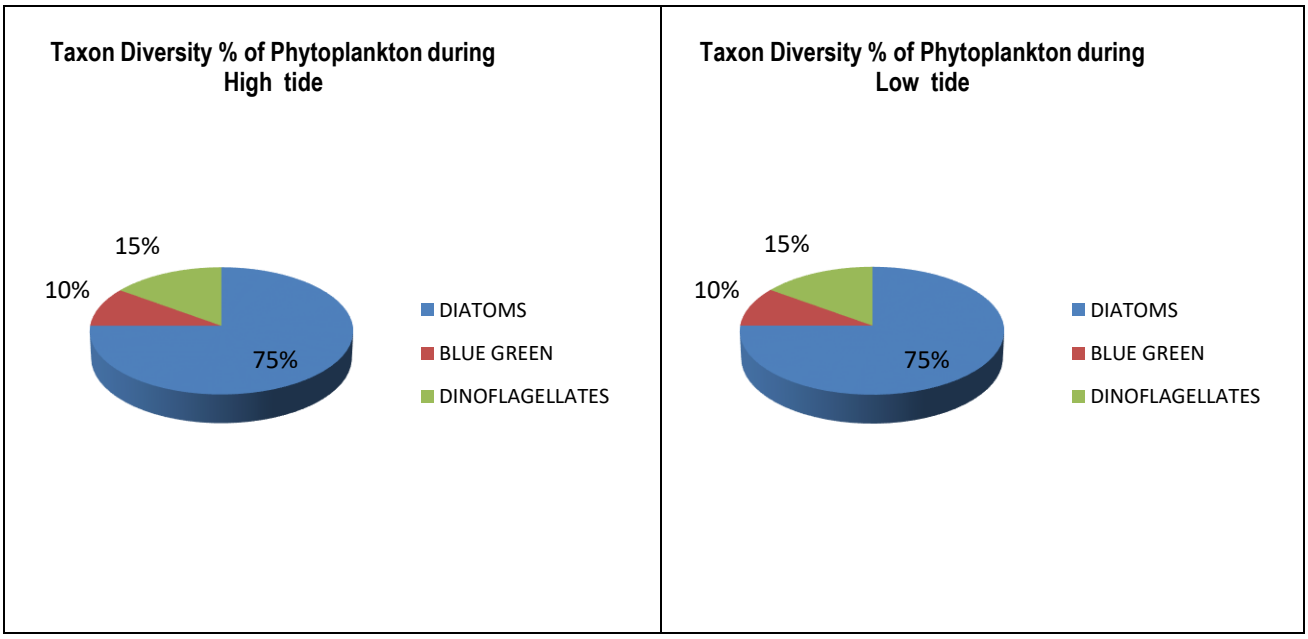
Table # 7 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING NEAP TIDE IN AUGUST,2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	64-298	15/20	75
			BLUE GREEN	0-6	2/20	10
			DINOFLAGELLATES	0-5	3/20	15
			TOTAL PHYTO PLANKTON	65-307	20	-
LOW TIDE	Sub surface	5	DIATOMS	236-274	15/20	75
			BLUE GREEN	1-5	2/20	10
			DINOFLAGELLATES	0-4	3/20	15
			TOTAL PHYTO PLANKTON	238-281	20	-

Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide



Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide



ZOOPLANKTON POPULATION:

For the evaluation of the Zooplankton population in DPT harbour area and within the immediate surroundings of the port sampling was conducted from 6 sampling locations (3 in harbour area and two in Nakti creek and one in Khoricreek) during high tide period and low tide period of spring tide and Neap tide in August,2021. The Zooplankton community of the sub surface water in the harbour and nearby creeks during spring tide was represented by mainly five groups, Tintinids, Copepods,

Ciliates Foraminiferans and larval forms of Crustacea, Molluscans and Polychaetes. The Zooplankton community of the sub surface water in the harbour and nearby creeks during neap tide was represented by mainly four groups, Tintinids, Copepods, Mysids and larval forms of Crustaceans , Molluscansand Polychaetes,.

Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 34-109x10^3 N/ m^3 during high tide and 109-123 x10^3 N/ m^3during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 23-109 x10^3 N/ m^3 during high tide and86-103x10^3 N/ m^3during low tide of Neap Tide period.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the stations Kandla Harbour region and nearby creeks was varying from 2.269-3.505 with an average of 3.009 during the sampling conducted in High tide period.Margalef's diversity index (Species Richness) S of Zooplankton communities varying from.2.701-3.354 with an average of 3.033 during the sampling conducted in low tide period during Spring tide.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the Kandla Harbour region and nearby creeks sampling stations was varying from1.914- 3.962 with an average of 2.754 during the sampling conducted in high tide and varying from. 1.972-3.236 with an average of 2.640 during the sampling conducted in low tide during Neap tide period**Shannon-Wiener's index:**

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.813-1.052 (H'(log10)) between selected sampling stations with an average value of 0.995 (H'(log10)) during high tide period of spring tide . Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.991-1.067(H'(log10)) between selected sampling stations with an average value of 1.035 (H'(log10)) during consecutive low tide period .

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.696-1.007 (H'(log10)) between selected sampling stations with an average value of 0.897 (H'(log10)) during high tide period of Neap tide. Shannon-

Wiener's Index (H) of Zooplankton communities in the samplingstations in Kandla Harbour region and nearby creeks was in the range of 0.785-0.983 (H'(log10)) between selected sampling stations with an average value of 0.883 (H'(log10)) during consecutive low tide period .Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of Zooplankton of Kandla Harbour region and nearby creeks stations is slightly high with very minimum diverse population but very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran, 2004).

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 most of sampling stations in the Kandla Harbour region and nearby creeksduring high tide and low tide of spring tide period, which was varying from 0.839-0.899between selected sampling stations with an average of 0.884 during high tide period and was varying from 0.887- 0.908 with an average value of 0.897 between selected sampling stations during low tide

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks during high tide and low tide period except few, which was varying from 0.771-0.869 between selected sampling stations with an average of 0.833 during high tide period and was varying from 0.787- 0.863with an average value of 0.826 between selected sampling stations during consecutive low tide

This low species diversity suggests a relatively low number of successful species in this habitat. Environment is quite stressful with relatively few ecological niches and only few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Table # 8 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN AUGUST,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	93 $X10^3$	16/19	84.21	3.309	1.052	0.8955
	2	96 $X10^3$	17/19	89.47	3.505	1.032	0.8899
	3	105 $X10^3$	15/19	78.95	3.008	1.031	0.8958
	4	109 $X10^3$	15/19	78.95	2.984	1.037	0.8991
	5	109 $X10^3$	15/19	78.95	2.984	1.008	0.8865
	6	34 $X10^3$	9/19	47.37	2.269	0.8131	0.8396
LOW TIDE	1	110 $X10^3$	15/19	78.95	2.978	1.001	0.8881
	2	118 $X10^3$	17/19	89.47	3.354	1.067	0.8984
	3	123 $X10^3$	14/19	73.68	2.701	0.9911	0.887
	4	117 $X10^3$	16/19	84.21	3.15	1.065	0.9088
	5	109 $X10^3$	15/19	78.95	2.984	1.051	0.904

Table # 9 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN AUGUST,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	99 $X10^3$	14/20	70	2.829	0.9755	0.8695
	2	94 $X10^3$	19/20	95	3.962	1.007	0.8646
	3	91 $X10^3$	13/20	65	2.66	0.9544	0.8698
	4	101 $X10^3$	14/20	70	2.817	0.8993	0.8176
	5	109 $X10^3$	12/20	60	2.345	0.8501	0.8089
	6	23 $X10^3$	7/20	35	1.914	0.6965	0.7708
LOW TIDE	1	89 $X10^3$	11/20	55	2.228	0.8172	0.7878
	2	103 $X10^3$	16/20	80	3.236	0.9831	0.8633
	3	96 $X10^3$	14/20	70	2.848	0.92	0.8412
	4	86 $X10^3$	14/20	70	2.918	0.9071	0.8375
	5	96 $X10^3$	10/20	50	1.972	0.7875	0.7987

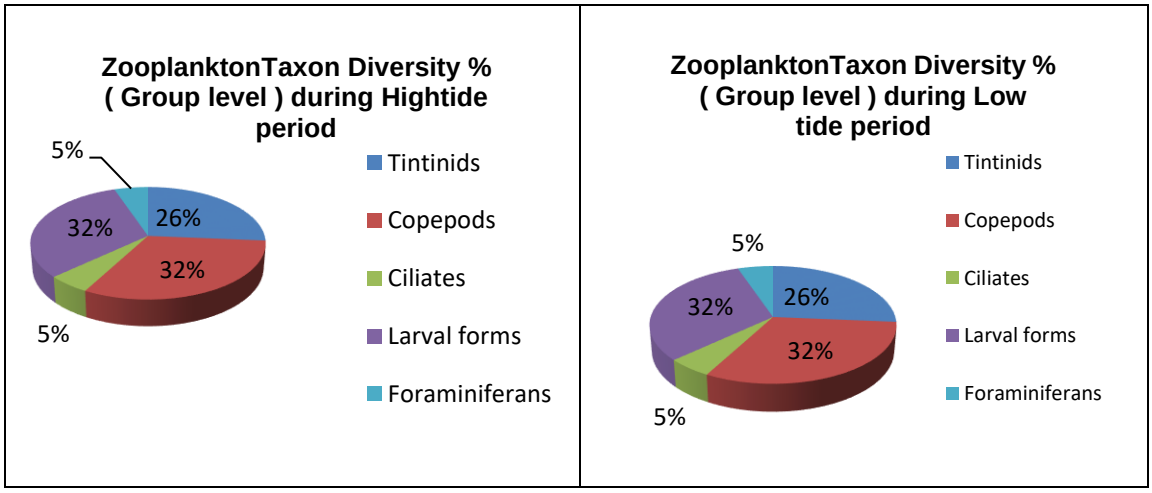
Table # 10 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN AUGUST,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	1-28	5/19	26.32
			Copepods	17-49	6/19	31.58
			Ciliates	1-6	1/19	5.26
			Larval forms	9-46	6/19	31.58
			Foraminiferans	0-2	1/19	5.26
			TOTAL ZOOPLANKTON NO/L	**34-109**	**19**	
LOW TIDE	Sub surface	5	Tintinids	20-27	5/19	26.32
			Copepods	39-55	6/19	31.58
			Ciliates	1-7	1/19	5.26
			Larval forms	40-46	6/19	31.58
			Foraminiferans	0-1	1/19	5.26
			TOTAL ZOOPLANKTON NO/L	**109-123**	**19**	

Table # 11 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA , NEAR BY CREEKS DURING NEAPTIDE IN AUGUST,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	1-11	5/20	25
			Copepods	7-26	6/20	30
			Mysids	0-6	2/20	10
			Larval forms	15-84	7/20	35
			TOTAL ZOOPLANKTON NO/L	**23-109**	**20**	-
LOW TIDE	Sub surface	5	Tintinids	6-12	5/20	25
			Copepods	5-23	6/20	30
			Mysids	1-4	2/20	10
			Larval forms	57-74	7/20	35
			TOTAL ZOOPLANKTON NO/L	**86-103**	**20**	-

Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide



Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide

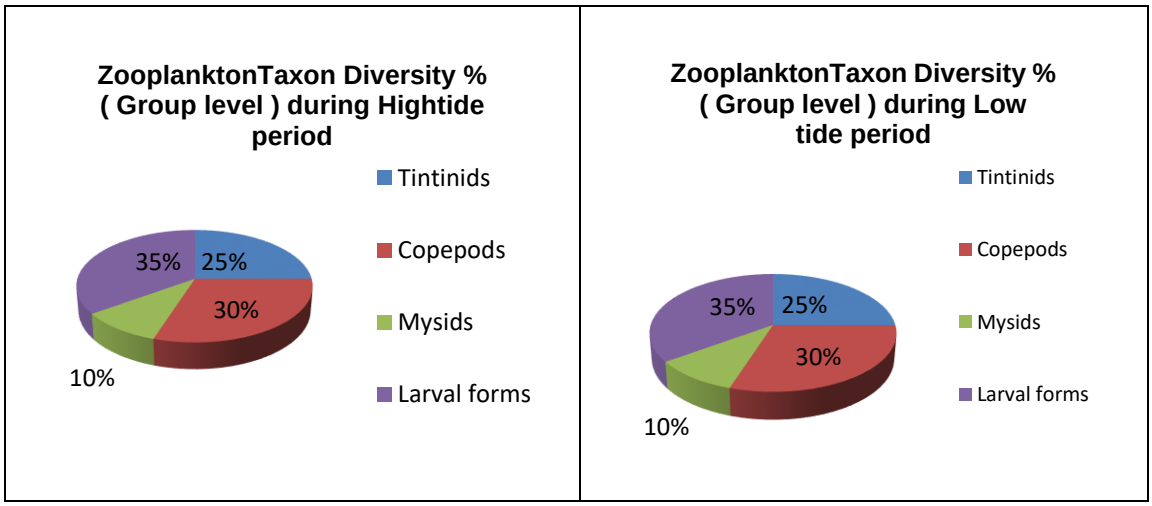


TABLE # 12 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURINGSPRING TIDE OF AUGUST, 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Arthospira*sp.	B1	Rare
					Lyngbya sp.	B2	Rare
			Stigonematales	Stigonemataceae	*Stigonema sp.*	B3	Occasional
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Abundant
			Triceratiales	Triceratiaceae	*Odontellasp*	D3	Occasional
					*Triceratium*sp.	D4	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Dominant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D6	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetocero*ssp	D7	Occasional
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D8	Abundant
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D9	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D10	Abundant
					Thalassionema sp.	D11	Rare
			Fragilariales	Fragilariaceae	*Asterionelopsis sp..*	D12	Rare
					*Fragilaria*sp	D13	Occasional
					*Synedra*sp	D14	Rare
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Rare
			Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF2	Rare

TABLE # 12 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURING AND NEAP TIDE OF AUGUST,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Rare
			Stigonematales	Stigonemataceae	*Stigonema sp.*	B2	Rare
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D1	Dominant
			Triceratiales	Triceratiaceae	*Odontellasp*	D2	Occasional
					*Triceratium*sp.	D3	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D4	Abundant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D5	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D6	Occasional
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D7	Occasional
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D8	Abundant
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D9	Occasional
				Pinnulariaceae	*Pinnulariasp*	D10	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D11	Dominant
					Thalassionema sp.	D12	Rare
			Fragilariales	Fragilariaceae	*Asterionella sp.*	D13	Occasional
					*Fragilaria*sp	D14	Frequent
					*Synedra*sp	D15	Rare
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Rare
			Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF2	Rare
					Ceratiumtripos	DF3	Rare

TABLE #13 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING SPRING TIDE OF AUGUST,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Frequent
				Codonellidae	*Tintinnopsisaccuminata*	T2	Rare
					Tintinnopsisfailakkaensis	T3	Rare
					Tintinnopsisgracilis	T4	Occasional
					Tintinnopsis radix	T5	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Frequent
				Temoridae	*Temora sp.*	C2	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C3	Frequent
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C4	Abundant
				Euterpinidae	*Euterpina sp.*	C5	Rare
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C6	Rare
CILIATES	CILIOPHORA	Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamniumsp.*	CI1	Occasional
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L2	Occasional
POLYCHAETE LARVA	ANNELIDA	Polychaeta			Trochophore larvae	L3	Occasional
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L4	Rare
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L5	Occasional
BRYOZOA					Cyphonautes larvae	L6	Occasional
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Rotalliidae	*Rotalia* sp.	F1	Rare

TABLE # 13 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING NEAP TIDE OF AUGUST,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Occasional
				Codonellidae	*Tintinnopsisaccuminata*	T2	Rare
					Tintinnopsisfailakkaensis	T3	Rare
					Tintinnopsisgracilis	T4	Occasional
					Tintinnopsis radix	T5	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Frequent
				Temoridae	*Temora sp.*	C2	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C3	Occasional
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C4	Occasional
				Euterpinidae	*Euterpina sp.*	C5	Rare
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C6	Rare
MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Solenoceridae	*Solenocerasp.*	M1	Rare
				Penaeidae	*Metapenaeussp.*	M2	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L2	Occasional
POLYCHAETE LARVA	ANNELIDA	Polychaeta			Trochophore larvae	L3	Occasional
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L4	Rare
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L5	Abundant
CYPHONAUTES LARVAE	BRYOZOA				Cyphonautes larvae	L6	Occasional
ECHINODERMATA larave	ECHINODERMATA	Ophiuroidea			Ophiopluetus larvae	L7	Rare

BENTHIC ORGANISMS:

Few Benthic organisms were observed in the collected sediments by using the Van-veen grabs during the sampling conducted during spring tide period and Neap tide period from DPT harbour region and nearby creek.The benthic organisms during spring tide were represented by Polychaetes, Nematodes and Amphipods. The polychaetes were represented by *Syllis sp.* *Polydorasp* , and*Pondodorasp,* during spring tide sampling. The benthic organisms in the collected samples were varying from 0-300 N/M ^{2} during spring tide and 10-140 NO/M ^{2} during neap tide sampling

Table # 14 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPT HARBOUR AREA CREEKS DURING NEAP TIDE IN AUGUST ,2021

Benthic fauna	ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS REPRESENTATION BY GROUP						
	DPT HARBOUR			CREEKS			
POLYCHATES	KPT-1	KPT-2	KPT-3	KPT-4	KPT-5	KPT-6	
Family : Iospilidae *Pondodora sp.*	0	70	0	0	0	NS	
Family : Spionidae *Polydora sp..*	10	10	0	20	0	NS	
Family : Syllidae *Syllis sp.*	0	10	0	10	0	NS	
Total Polychates N/M^2	10	90	0	30	0	NS	
Un identified Nematode worms	40	200	0	10	30	NS	
Amhipods	0	10	0	10	0	NS	
TOTAL Benthic Fauna NUMBER/ M^2	50	300	0	50	30	NS	

NS : No sample

Table # 15BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPT HARBOUR AREA CREEKS DURING NEAP TIDE IN AUGUST ,2021

Benthic fauna	ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS REPRESENTATION BY GROUP						
	DPT HARBOUR			CREEKS			
POLYCHATES	KPT-1	KPT-2	KPT-3	KPT-4	KPT-5	KPT-6	
Family : Spionidae *Polydora sp..*	20	10	0	40	20	NS	
Family : Syllidae *Syllis sp.*	10	10	0	20	60	NS	
Total Polychates N/M^2	30	20	0	60	80	NS	
Un identified Nematode worms	40	30	10	40	40	NS	
Amhipods	10	10	0	10	20	NS	
TOTAL Benthic Fauna NUMBER/ M^2	80	60	10	110	140	NS	

NS : No sample

7. Meteorological Data

Automatic Weather station have been installed in SevaSadan -3 at the Deendayal Port which records the data on Temperature (°C), Humidity (%),Wind (mph), Dew Point (°C), Wind Direction (°), Pressure, Solar radiation, heat Index and UVI.

Temperature

The mean day time temperature for Deendayal Port was 30.5 °C. The day-time maximum temperature was 34.1 °C. The mean night time temperature was 27.4 °C. The minimum mean night time temperature recorded was 26.1 °C.

Air Pressure

The mean absolute air pressure for the month of August was 1004.7 hpa, whereas the mean relative pressure was 1001.2 hpa. The maximum absolute air pressure recorded for the month of August was 1008.3 hpa.

Heat Index

The mean day-time heat index for the month of August was 34.7 ^{o}C. The maximum heat index recorded was 42^{o}C.

Solar Radiation

The mean Solar Radiation in August was 232.4 w/m^2. The maximum solar radiation recorded in the month of August was 682.8 w/m^2.

Humidity

The mean day-time humidity was 73.0 % for the month of August and mean night time humidity was 83.2%. Maximum humidity recorded during day-time was 88.0 % and maximum humidity recorded during night-time was 90.0%.

Wind Velocity and Wind Direction

The mean wind velocity for the entire month of August was 10.8 km/hour. Maximum wind velocity recorded was 34.9 Km/hr . The wind direction was mostly S to SW.

Conclusive Summary and Remedial measures Suggested

- The AAQ monitoring at six locations of Deendayal Port indicates that the mean PM_{10} values at four locations viz. Coal storage area, Marine Bhavan and Oil Jetty area were found above the permissible standards (100 µg/m^3)and$PM_{2.5}$was above permissible limits at Coal storage location(Limit 60 µg/m^3).

- Drinking water at all the twenty locations was found potable and was within permissible limits of BIS standards (IS 10500).

- Noise quality was also within the set permissible standards of an Industrial Area. The noise level observed during day time was >75 dB (A) and at night time was >70 dB (A) during the entire monitoring period.

- The sewage treated water of Deendayal Port Colony (Gopalpuri) was in line with the standards set by the Gujarat Pollution Control Board. The STP at Deendayal Port is not fully operational and STP at Vadinar Port was found non-operational.

Reasons for higher Values of PM_{10}

- Large amount of coal is handled at Berth No. 6, 7, 8 and 9. The unloading of coal directly in the truck, using grabs cause coal to spread in air as well as coal dust to fall on ground. This settled coal dust again mixes with the air while trucks travel through it.

- Also, the coal laden trucks are not always covered with tarpaulin sheets and these results in spillage of coal from trucks/dumpers during its transit from vessel to yard or storage site. This also increased PM values around marine Bhavan & Coal storage area.

Remedial Measures

The values of PM_{10} during the month of August, 2021 were observed beyond the permissible limit at four locations mentioned above. Given below are the remedial measures suggest to minimize the Air pollution at Deendayal Port.

- Guidelines for Coal Handling by GPCB should be strictly followed. (http://gpcb.gov.in/pdf/coal-handling-guidelines.pdf)

- Sewage Treatment Plan at Vadinar Port is not working. Hence, it is recommended to commission the sewage treatment plant at Vadinar immediately.

- Except for the higher values of PM_{10} at Coal storage site, Oil Jetty, Tuna Port and Marine Bhavan locations, the monitoring results for the present month suggest that the overall Environment Quality of Deendayal Port is satisfactory.

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ENVIRONMENTAL MONITORING REPORT
FOR
DEENDAYAL PORT TRUST

REPORT NO.	:	DCPL/DPT/20-21/17
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Prepared by	:	DETOX CORPORATION PVT. LTD., SURAT

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Introduction

Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the national standards and any other relevant standards by GBCB/CPCB/MoEF to identify non conformity in the Environment of the Deendayal Port. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port.

The environmental monitoring is carried out as per the Environment Management and Monitoring Plan submitted by Detox Corporation Pvt. Ltd.

1. Ambient Air Quality Monitoring

As per the Environmental Monitoring Plan of Deendayal Port Trust, Air monitoring was carried out at six identified locations at Deendayal Port and two locations at Vadinar Port.

1.1 Air Quality Monitoring Methodology

Air quality is measured in all the stations, for 24 hour for Total Suspended Particulate Matter (TSPM), PM_{10}, $PM_{2.5}$, SO_2, NO_X, NH_3 & Benzene, and Grab-sampling for CO & CO_2 measurements. The Air samplers are operated for a period of 24 hours and after a continuous operation of 8 hours of the sampler, the reagents were replaced to obtain 3 samples per day for each parameter namely, SO_2, NO_X. The EPM 2000 filter paper and PTFE Membrane bound filter paper are used for a period of 24 hours to obtain one sample each of TSPM, PM_{10} & $PM_{2.5}$.

The AAQ samples are collected twice a week from all the eight locations as per the EMP.

1.2 Results

The ambient air quality monitoring data for six stations, viz. Marine Bhavan, Oil Jetty, Port Colony,Gopalpuri Hospital,Tuna Port and Nr. Coal Storage Area for the month of September 2021 are given in Tables 1A to 6B. The ambient air quality monitoring data for two stations at Vadinar (Nr. Admin Building &Nr. Signal Building) are given in Tables 7A to 8B.

Location 1: Marine Bhavan (AL1)

Table 1 : Results of Air Pollutant Concentration at Marine Bhavan

Parameter	Date	TSPM [µg/m3]	PM10 [µg/m3]	PM2.5 [µg/m3]	SO2 [µg/m3]		NOx [µg/m3]		NH3 [µg/m3]	
Sampling Period	-	24hr	24hr	24hr	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)
NAAQMS limit	-	NS	100 µg/m3	60 µg/m3		80 µg/m3		80 µg/m3		400 µg/m3
AL1 – 1	03.09.2021	412	314	76	3.96	5.13	10.80	29.22	5.36	9.53
					6.59		32.39		13.02	
					4.84		44.46		10.21	
AL1 – 2	08.09.2021	673	579	50	3.52	3.81	13.34	26.25	12.25	12.85
					3.08		49.54		12.76	
					4.84		15.88		13.53	
AL1 – 3	10.09.2021	706	552	53	3.08	4.25	11.43	17.78	15.32	16.17
					6.15		17.15		14.55	
					3.52		24.77		18.64	
AL1 – 4	15.09.2021	357	260	82	6.15	4.84	17.78	39.80	18.12	15.06
					3.52		52.72		16.34	
					4.84		48.91		10.72	
AL1 – 5	17.09.2021	297	178	89	1.76	4.40	17.78	28.58	16.34	15.49
					5.28		24.77		15.57	
					6.15		43.19		14.55	
AL1 - 6	22.09.2021	387	309	72	3.52	3.08	40.02	38.53	5.36	9.53
					3.96		45.10		11.23	
					1.76		30.49		12.00	
AL1 - 7	24.09.2021	288	176	67	3.08	3.52	12.70	19.27	20.42	21.95
					4.84		23.50		22.46	
					2.64		21.60		22.98	
AL1 – 8	28.09.2021	471	299	163	17.14	13.48	27.95	27.31	20.68	21.53
					18.90		33.66		19.66	
					4.40		20.33		24.25	
Monthly Average		449	333	81		5.31		28.34		15.26
Standard Deviation		160	153	36		3.37		7.89		4.73

NS: Not Specified

Table 1B : Results of Air Pollutant Concentration at Marine Bhavan					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL1 – 1	03.09.2021	1.11	BDL	1.89	492
AL1 – 2	08.09.2021	1.2	BDL	1.92	499
AL1 – 3	10.09.2021	1.3	BDL	1.9	486
AL1 – 4	15.09.2021	1.22	BDL	1.86	496
AL1 – 5	17.09.2021	1.27	BDL	1.88	501
AL1 - 6	22.09.2021	1.16	BDL	1.79	492
AL1 – 7	24.09.2021	1.18	BDL	1.86	496
AL1 – 8	28.09.2021	1.22	BDL	1.92	488
Monthly Average		**1.21**	**-**	**1.88**	**494**
Standard Deviation		**0.06**	**-**	**0.04**	**5**

* NMHC- Non- Methane Hydrocarbons
BDL- Below Detection Limit (Detection Limit – NMHC: 0.5ppm)
NS -Not Specified

At Marine Bhavan, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_X and NH_3 is attributed mainly by motor vehicle emission produced from various types of automobiles (both diesel and petrol driven). Moreover, the loading and unloading of Food Grains and Timber at Jetty no. 1 and 2 also contributes to the high levels of TSPM and PM_{10}. The mean TSPM value at Marine Bhavan was 449 µg/m³, The mean PM_{10} values were 333.0 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 81 µg/m³). The average values of SO_2, NO_x and NH_3 were within the permissible limit. The average values of SO_2, NO_x and NH3 were 5.31 µg/ m³, 28.34 µg/ m³ & 15.26 µg/ m³ respectively. These were within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Marine Bhavan. The mean Benzene concentration was 1.21 µg/m³,well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.88 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 2: Oil Jetty (AL2)

Table 2 : Results of Air Pollutant Concentration at Oil Jetty										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL2 – 1	03.09.2021	645	423	158	6.15	4.84	23.50	16.30	17.87	14.72
					3.52		13.34		16.08	
					4.84		12.07		10.21	
AL2 – 2	08.09.2021	697	594	45	4.40	4.40	12.07	37.26	13.53	13.87
					5.28		45.73		10.21	
					3.52		53.99		17.87	
AL2 – 3	10.09.2021	673	561	62	3.52	4.25	28.58	18.84	9.45	10.81
					4.40		21.60		13.02	
					4.84		6.35		9.96	
AL2 – 4	15.09.2021	604	481	103	2.20	3.52	28.58	42.56	16.59	16.93
					3.08		46.37		17.87	
					5.28		52.72		16.34	
AL2 – 5	17.09.2021	616	571	38	6.15	3.81	46.37	38.53	11.74	8.34
					3.08		55.89		6.13	
					2.20		13.34		7.15	
AL2 – 6	22.09.2021	673	563	102	2.20	4.54	57.16	51.66	10.47	9.02
					5.28		45.10		9.70	
					6.15		52.72		6.89	
AL2 – 7	24.09.2021	245	159	71	6.15	3.52	23.50	38.11	10.47	14.81
					3.08		50.81		15.32	
					1.32		40.02		18.64	
AL2 – 8	28.09.2021	280	178	82	4.40	8.94	15.88	18.42	13.02	15.06
					8.79		13.34		8.42	
					13.63		26.04		23.74	
Monthly Average		554	442	83		4.73		32.71		12.94
Standard Deviation		183	177	39		1.77		13.12		3.14

NS: Not Specified

Table 2B : Results of Air Pollutant Concentration at Oil Jetty					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL2 -1	03.09.2021	1.12	BDL	1.56	490
AL2 -2	08.09.2021	1.16	BDL	1.62	488
AL2 -3	10.09.2021	1.06	BDL	1.66	496
AL2 -4	15.09.2021	1.13	BDL	1.72	501
AL2 – 5	17.09.2021	1.23	BDL	1.76	490
AL2 – 6	22.09.2021	1.06	BDL	1.7	488
AL2 -7	24.09.2021	1.19	BDL	1.68	486
AL2 – 8	28.09.2021	1.22	BDL	1.74	493
Monthly Average		**1.15**	**-**	**1.68**	**492**
Standard Deviation		**0.07**	**-**	**0.07**	**5**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Oil Jetty area was mainly by motor vehicle emission produced from various types of vehicles Oil Jetty Area. The mean TSPM values at Oil Jetty were 554 µg/m³ .The mean PM_{10} values were 442 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 83 µg/m³).The average values of SO_2, NO_x and NH_3 were within the permissible limit; The mean concentration of SO_2, NO_x and NH3 were 4.73 µg/m³, 32.71 µg/m³ and 12.94 µg/m³ respectively.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Oil Jetty. The mean Benzene concentration was 1.15 µg/m³ .Well below the permissible limit of 5.0 µg/m³. , HC's were below the detectable limit and Carbon Monoxide concentration was 1.68 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 3: Kandla Colony – Estate Office (AL-3)

Table 3 : Results of Air Pollutant Concentration at Estate Office										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL3 – 1	03.09.2021	239	162	61	3.96	4.54	41.29	37.69	9.45	11.49
					4.40		38.11		11.49	
					5.28		33.66		13.53	
AL3 – 2	08.09.2021	412	288	97	2.64	3.37	20.96	35.36	12.00	12.59
					4.40		40.02		15.57	
					3.08		45.10		10.21	
AL3 – 3	10.09.2021	248	121	41	5.28	4.69	17.78	23.08	15.06	15.57
					5.71		28.58		16.08	
					3.08		22.87		15.57	
AL3 – 4	15.09.2021	195	123	68	4.40	3.08	15.88	17.15	12.00	9.36
					1.76		11.43		7.15	
					3.08		24.14		8.93	
AL3 – 5	17.09.2021	256	194	55	3.08	3.22	32.39	31.55	16.59	14.81
					2.20		30.49		16.85	
					4.40		31.76		10.98	
AL3 – 6	22.09.2021	554	153	39	3.52	3.52	24.14	35.78	18.12	15.06
					3.08		40.02		12.25	
					3.96		43.19		14.81	
AL3 – 7	24.09.2021	467	399	52	2.64	3.08	27.31	34.72	5.36	6.72
					1.76		32.39		6.38	
					4.84		44.46		8.42	
AL3 – 8	28.09.2021	355	253	64	8.79	16.41	7.62	14.19	14.04	10.55
					34.73		14.61		6.13	
					5.71		20.33		11.49	
Monthly Average		341	211	60		5.24		28.69		12.02
Standard Deviation		128	96	18		4.56		9.22		3.11

NS: Not Specified

Table 3B : Results of Air Pollutant Concentration at Kandla Port Colony					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL3 -1	03.09.2021	1.1	BDL	1.77	492
AL3 -2	08.09.2021	1.06	BDL	1.82	480
AL3 -3	10.09.2021	1.11	BDL	1.86	479
AL3 -4	15.09.2021	1.16	BDL	1.8	482
AL3 – 5	17.09.2021	1.18	BDL	1.92	477
AL3 – 6	22.09.2021	1.26	BDL	1.96	486
AL3 – 7	24.09.2021	1.22	BDL	1.86	478
AL3 – 8	28.09.2021	1.21	BDL	1.78	482
Monthly Average		**1.16**	**-**	**1.85**	**482**
Standard Deviation		**0.07**	**-**	**0.07**	**5**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Kandla Port Colony was attributed by vehicle emission produced from trucks and heavy duty vehicles that pass through the road outside Kandla Port Colony. The mean TSPM values at Oil Jetty were 341 µg/m³, The mean PM_{10} values were 211 µg/m³, which is above the permissible limit. $PM_{2.5}$ values within the permissible limit (mean = 60 µg/m³). The average values of SO_2, NO_x and NH3 were 5.24 µg/m³, 28.69 µg/m³ and 12.02 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Kandla Port Colony. The mean Benzene concentration was 1.16 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.85 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 4: Gopalpuri Hospital (AL-4)

Table 4 : Results of Air Pollutant Concentration at Gopalpuri Hospital										
Parameter	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL4 -1	03.09.2021	167	118	37	4.40	3.52	13.34	14.40	8.42	6.30
					2.64		23.50		5.36	
					3.52		6.35		5.11	
AL4 -2	08.09.2021	256	178	63	3.08	3.66	13.34	21.17	8.42	8.85
					1.76		36.84		5.36	
					6.15		13.34		12.76	
AL4 -3	10.09.2021	165	122	26	1.32	2.34	30.49	30.06	12.25	9.36
					3.96		36.20		8.17	
					1.76		23.50		7.66	
AL4 -4	15.09.2021	189	124	54	3.08	4.54	48.91	41.29	5.62	8.59
					4.40		40.02		9.45	
					6.15		34.93		10.72	
AL4 – 5	17.09.2021	185	104	48	2.20	4.40	11.43	24.56	12.00	11.15
					6.15		22.23		7.91	
					4.84		40.02		13.53	
AL4 – 6	22.09.2021	249	101	45	1.76	3.08	17.15	14.40	9.19	8.59
					3.08		12.07		6.89	
					4.40		13.97		9.70	
AL4 – 7	24.09.2021	167	116	43	2.20	2.49	24.14	16.94	9.70	11.83
					0.88		15.88		13.53	
					4.40		10.80		12.25	
AL4 – 8	28.09.2021	177	122	48	0.88	0.88	5.08	6.14	5.87	5.87
					1.32		5.72		7.15	
					0.44		7.62		4.60	
Monthly Average		194	123	46		3.11		21.12		8.82
Standard Deviation		37	24	11		1.20		10.89		2.07

NS: Not Specified

Table 4B : Results of Air Pollutant Concentration at Gopalpuri Hospital					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL4 -1	03.09.2021	1.01	BDL	1.76	485
AL4 -2	08.09.2021	1.1	BDL	1.62	480
AL4 -3	10.09.2021	1.06	BDL	1.7	490
AL4 -4	15.09.2021	1.11	BDL	1.59	494
AL4 – 5	17.09.2021	1.18	BDL	1.7	486
AL4 – 6	22.09.2021	1.16	BDL	1.81	490
AL4 – 7	24.09.2021	1.08	BDL	1.79	487
AL4 – 8	28.09.2021	1.06	BDL	1.73	497
Monthly Average		**1.10**	**-**	**1.71**	**489**
Standard Deviation		**0.06**	**-**	**0.08**	**5**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Gopalpuri Hospital was attributed by vehicle emission produced from light motor vehicles of the colony residents. The mean TSPM values at Oil Jetty were 194 µg/m³, The mean PM_{10} values were 123 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were in within the permissible limit (mean= 46 µg/m³). The average values of SO_2, NO_x and NH_3 were 3.11 µg/m³, 21.12 µg/m³ and 8.82 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Gopalpuri Hospital. The mean Benzene concentration was 1.10 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.71 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 5: Coal Storage Area (AL-5)

Table 5 : Results of Air Pollutant Concentration at Coal Storage Area										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL5 – 1	03.09.2021	380	115	86	3.52	4.10	32.39	30.28	13.79	14.30
					3.96		37.47		12.25	
					4.84		20.96		16.85	
AL5 – 2	08.09.2021	275	176	80	2.64	4.40	18.42	30.06	6.38	5.79
					6.59		33.66		5.11	
					3.96		38.11		5.87	
AL5 – 3	10.09.2021	302	225	74	2.20	3.66	52.72	48.91	9.45	10.64
					4.84		31.12		6.38	
					3.96		62.88		16.08	
AL5 – 4	15.09.2021	378	242	97	3.08	4.98	13.34	31.33	9.70	10.72
					5.28		50.81		12.76	
					6.59		29.85		9.70	
AL5 – 5	17.09.2021	210	138	70	4.84	4.10	12.07	27.31	9.70	10.98
					3.52		48.91		10.21	
					3.96		20.96		13.02	
AL5 – 6	22.09.2021	402	305	92	5.28	5.71	19.05	28.37	14.55	12.08
					6.15		26.04		12.25	
					5.71		40.02		9.45	
AL5 – 7	24.09.2021	268	151	73	2.64	4.69	32.39	33.66	18.64	17.61
					4.84		31.76		16.08	
					6.59		36.84		18.12	
AL5 – 8	28.09.2021	375	248	70	5.71	6.15	26.04	18.00	15.32	16.00
					6.15		5.72		19.91	
					6.59		22.23		12.76	
Monthly Average		324	200	80		4.73		30.99		12.26
Standard Deviation		69	65	10		0.96		8.61		3.69

NS: Not Specified

Table 5B : Results of Air Pollutant Concentration at Coal Storage Area					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL5 – 1	03.09.2021	1.22	BDL	1.9	489
AL5 – 2	08.09.2021	1.26	BDL	1.86	499
AL5 – 3	10.09.2021	1.3	BDL	1.79	501
AL5 – 4	15.09.2021	1.22	BDL	1.88	486
AL5 – 5	17.09.2021	1.21	BDL	1.86	488
AL5 – 6	22.09.2021	1.35	BDL	1.8	492
AL5 – 7	24.09.2021	1.34	BDL	1.92	496
AL5 – 8	28.09.2021	1.30	BDL	1.93	502
Monthly Average		**1.28**	**-**	**1.87**	**494**
Standard Deviation		**0.06**	**-**	**0.05**	**6**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Coal Storage Area was comparatively highest among all the locations of Air Quality monitoring in Kandla Port. High values of TSPM, $PM_{10,}$ $PM_{2.5}$, SO_2, NO_X at this location was due to lifting of coal with grab and other coal handling processes near Berth no. 6 & 7. Moreover, the traffic was also heavy around this place for transport of coal thus emissions produced from heavy vehicles. The mean TSPM values at Coal storage were 324 µg/m³. The mean PM_{10} values were 200 µg/m³, which is well above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 80 µg/m³). The average values of SO_2, NO_x and NH_3 were 4.73 µg/m³, 30.99 µg/m³ and 12.26 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Coal Storage Area. The mean Benzene concentration was 1.28 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.87 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 6: Tuna Port (AL-6)

Table 6 : Results of Air Pollutant Concentration at Tuna Port										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL6 -1	03.09.2021	186	104	52	7.03	5.13	12.70	38.11	14.30	16.34
					4.40		57.16		16.85	
					3.96		44.46		17.87	
AL6 – 2	08.09.2021	253	123	75	4.40	4.69	11.43	17.36	6.38	10.64
					6.15		18.42		14.04	
					3.52		22.23		11.49	
AL6 – 3	10.09.2021	214	128	57	3.52	3.66	25.41	23.29	9.96	13.87
					5.28		32.39		21.70	
					2.20		12.07		9.96	
AL6 – 4	15.09.2021	166	108	49	2.20	4.54	30.49	20.96	9.70	9.70
					4.84		19.05		9.19	
					6.59		13.34		10.21	
AL6 – 5	17.09.2021	253	177	50	3.08	4.69	52.72	45.52	12.25	12.51
					4.84		45.10		15.57	
					6.15		38.74		9.70	
AL6 – 6	22.09.2021	441	135	49	1.32	3.22	27.31	31.97	13.02	13.79
					3.08		38.74		15.57	
					5.28		29.85		12.76	
AL6 – 7	24.09.2021	216	130	46	3.08	3.81	33.66	40.44	16.08	12.00
					5.28		44.46		10.47	
					3.08		43.19		9.45	
AL6 – 8	28.09.2021	179	106	62	1.76	3.37	13.34	7.20	5.87	7.23
					3.96		4.45		5.36	
					4.40		3.81		10.47	
Monthly Average		238	126	55		4.14		28.11		12.01
Standard Deviation		88	24	10		0.71		13.08		2.82

NS: Not Specified

Table 6B : Results of Air Pollutant Concentration at Tuna Port					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL6 -1	03.09.2021	1.19	BDL	1.86	478
AL6 – 2	08.09.2021	1.16	BDL	1.92	492
AL6 – 3	10.09.2021	1.21	BDL	1.78	486
AL6 – 4	15.09.2021	1.06	BDL	1.92	482
AL6 – 5	17.09.2021	1.1	BDL	1.86	478
AL6 – 6	22.09.2021	1.02	BDL	1.8	492
AL6 – 7	24.09.2021	1.21	BDL	1.79	488
AL6 – 8	28.09.2021	1.2	BDL	1.86	478
Monthly Average		**1.14**	**-**	**1.85**	**484**
Standard Deviation		**0.07**	**-**	**0.05**	**6**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)

NS- Not Specified

The mean TSPM values at Tuna Port were 238 µg/m³, The mean PM_{10} values were 126 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were within the permissible limit (mean = 55 µg/m³). The average values of SO_2, NO_x and NH_3 were 4.14 µg/m³, 28.11 µg/m³ and 12.01 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Tuna Port. The mean Benzene concentration was 1.14 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.85 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 7: Signal Building (Vadinar) (AL-7)

Table 7 : Results of Air Pollutant Concentration at Signal Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL7 -1	03.09.2021	158	88	43	3.96	12.60	9.53	10.80	5.62	6.21
					30.77		8.89		4.60	
					3.08		13.97		8.42	
AL7 -2	08.09.2021	158	93	59	3.96	3.52	13.97	14.61	9.96	9.28
					4.40		17.78		6.64	
					2.20		12.07		11.23	
AL7 -3	10.09.2021	180	108	53	3.08	3.22	19.05	12.28	5.62	4.51
					3.52		10.80		4.85	
					3.08		6.99		3.06	
AL7 -4	15.09.2021	169	102	33	5.28	4.25	13.97	12.70	6.13	8.85
					3.52		10.16		9.96	
					3.96		13.97		10.47	
AL7 -5	17.09.2021	160	87	27	5.28	3.66	10.80	9.74	8.42	5.87
					2.64		8.26		5.62	
					3.08		10.16		3.57	
AL7 -6	22.09.2021	177	95	64	3.52	4.40	13.97	8.79	10.47	9.87
					3.96		10.80		9.96	
					5.71		1.59		9.19	
AL7 -7	24.09.2021	139	94	32	2.20	3.52	13.97	12.91	6.38	6.72
					4.40		12.70		8.42	
					3.96		12.07		5.36	
AL7 -8	28.09.2021	168	107	43	2.64	3.08	14.61	12.49	8.68	7.40
					3.08		8.89		6.13	
					3.52		13.97		7.40	
Monthly Average		164	97	44		5		12		7
Standard Deviation		13	8	13		3		2		2

NS: Not Specified

Table 7B : Results of Air Pollutant Concentration at Signal Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL7 -1	03.09.2021	1.12	BDL	1.8	456
AL7 – 2	08.09.2021	1.06	BDL	1.78	462
AL7 – 3	10.09.2021	1.11	BDL	1.86	470
AL7 – 4	15.09.2021	1.18	BDL	1.8	455
AL7 – 5	17.09.2021	1.25	BDL	1.72	469
AL7 – 6	22.09.2021	1.16	BDL	1.68	460
AL7 – 7	24.09.2021	1.2	BDL	1.77	463
AL7 – 8	28.09.2021	1.26	BDL	1.7	460
Monthly Average		**1.17**	**-**	**1.76**	**462**
Standard Deviation		**0.07**	**-**	**0.06**	**5**

* NMHC- Non- Methane Hydrocarbons
BDL- Below Detection Limit (Detection Limit – NMHC : 0.5 ppm)
NS_ Not Specified

The mean TSPM values at Vadinar Port were 164 µg/m³. The mean PM_{10} values were 97 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 44 µg/m³). The average values of SO_2, NO_x and NH_3 were 5.0 µg/m³, 12.0 µg/m³ and 7.0 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.17 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.76 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 8: Admin Building (Vadinar) (AL-8)

Table 8 : Results of Air Pollutant Concentration at Admin Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL8 -1	03.09.2021	164	83	24	3.96	4.25	13.34	12.28	5.87	4.77
					3.96		12.07		5.87	
					4.84		11.43		2.55	
AL8 -2	08.09.2021	198	130	35	4.40	5.28	20.96	20.54	5.11	5.70
					6.15		17.78		4.85	
					5.28		22.87		7.15	
AL8 -3	10.09.2021	177	86	64	2.64	3.81	8.89	12.91	8.42	8.34
					3.96		13.97		9.19	
					4.84		15.88		7.40	
AL8 -4	15.09.2021	150	78	25	2.64	2.07	20.96	16.94	8.42	6.98
					3.08		17.78		4.08	
					0.48		12.07		8.42	
AL8 -5	17.09.2021	156	84	46	2.20	3.52	247.71	91.46	5.62	6.72
					3.96		12.70		6.89	
					4.40		13.97		7.66	
AL8 -6	22.09.2021	198	123	55	3.52	4.10	11.43	13.97	4.60	4.85
					4.40		14.61		4.34	
					4.40		15.88		5.62	
AL8 -5	24.09.2021	172	101	54	3.08	2.34	9.53	9.10	8.68	7.83
					3.52		6.99		11.23	
					0.44		10.80		3.57	
AL8-6	28.09.2021	135	79	34	4.84	5.57	7.62	9.95	3.57	6.30
					5.71		9.53		5.62	
					6.15		12.70		9.70	
Monthly Average		169	95	42		4		23		6
Standard Deviation		22	20	15		1		28		1

NS: Not Specified

Table 8B : Results of Air Pollutant Concentration at Admin Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL8 -1	03.09.2021	1.06	BDL	1.78	460
AL8-2	08.09.2021	1.1	BDL	1.8	472
AL8 -3	10.09.2021	1.02	BDL	1.68	460
AL8-4	15.09.2021	1.1	BDL	1.72	461
AL8 -5	17.09.2021	1.17	BDL	1.81	452
AL8-6	22.09.2021	1.06	BDL	1.76	460
AL8-7	24.09.2021	1.1	BDL	1.66	470
AL8-8	28.09.2021	1.11	BDL	1.6	465
Monthly Average		**1.09**	**-**	**1.73**	**463**
Standard Deviation		**0.04**	**-**	**0.07**	**6**

* NMHC- Non- Methane Hydrocarbons

BDL- Below Detection Limit (Detection Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Admin Building Vadinar was comparatively low among all the locations of Air Quality monitoring in Kandla Port and Vadinar Port. The mean TSPM values at Vadinar Port were 169 µg/m³. The mean PM_{10} values were 95 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 42.0 µg/m³). The average values of SO_2, NO_x and NH_3 were 4.0 µg/m³, 23.0 µg/m³ and 6.0 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Admin Building, Vadinar Port. The mean Benzene concentration was 1.09 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.73 mg/m³, well below the permissible limit of 4.0 mg/m³.

1.4 Observations and Conclusion

During the monitoring period, the overall Ambient Air Quality of the port area was found to be well within the desired levels for various gaseous pollutants. However, Particulate matter as PM_{10} and $PM_{2.5}$ was found to exceed the limits at locations like Near Coal storage area, Marine Bhavan, Estate Office , Tuna Port and Oil Jetty area.

2. Drinking Water Quality Monitoring

Drinking Water Quality Monitoring was carried out at twenty stations at Kandla, Vadinar & Township Area of Deendayal Port.

2.1 Drinking Water Monitoring Methodology

Drinking water samples were collected from 20 locations as prescribed in the tender document. Samples for physico-chemical analysis were collected in 1 liter carboys and samples for microbiological parameters were collected in sterilized bottles. These samples were then analyzed in laboratory for various drinking water parameters at Kandla Lab/Surat.

The Sampling and Analysis was done as per standard methods - IS 10500:2012. The water samples were analyzed for various parameters, viz. Color , Odor, Turbidity , Conductivity , pH , Chlorides , TDS, Total Hardness, Iron , Sulphate , Salinity , DO, BOD, Na, K, Ca, Mg, F, NO_3, NO_2, Mn, Cr-6, Cu, Cd, As, Hg, Pb, Zn, Bacterial Count (cfu) .

2.2 Results

The Drinking Water Quality monitoring data for 20 stations are given in below from table No. 9 to Table No. 15

Table 9: Drinking Water Quality Monitoring Parameters for Nirman Building 1, P & C building & Main Gate (North) at Kandla

Sr. No.	Parameter	Unit	Nirman Building 1	P & C building	Main Gate North	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.36	7.31	7.4	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1343	1312	1350	500	2000
3	Turbidity	NTU	0	1	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2630	2600	2690	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	420.94	365.81	370.82	250.0	1000.0
9	Ca as Ca	mg/l	72.14	56.11	52.10	75.0	200.0
10	Mg as Mg	mg/l	85.05	72.90	65.61	30.0	100.0
11	Total Hardness	mg/l	350	300	270	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.35	0.54	0.21	1.0	1.5
14	Sulphate as SO4	mg/l	228	210	258	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	6.27	8.10	13.38	45.0	No Relaxation
17	Salinity	%	0.76	0.66	0.67	NS*	NS*
18	Sodium as Na	mg/l	301	243	265	NS*	NS*
19	Potassium as K	mg/l	3.24	3.68	3.51	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 10: Drinking Water Quality Monitoring Parameters for Canteen, West Gate – I &Wharf Area at Kandla

Sr. No.	Parameter	Unit	Canteen	West Gate – I	Wharf Area	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.55	7.6	7.83	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1390	1360	1500	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2700	2680	2950	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	430.96	360.80	380.85	250.0	1000.0
9	Ca as Ca	mg/l	60.12	56.11	60.12	75.0	200.0
10	Mg as Mg	mg/l	63.18	80.19	85.05	30.0	100.0
11	Total Hardness	mg/l	260	330	350	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.58	0.79	0.25	1.0	1.5
14	Sulphate as SO4	mg/l	164.4	282	276	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	8.80	10.42	9.50	45.0	No Relaxation
17	Salinity	%	0.78	0.65	0.69	NS*	NS*
18	Sodium as Na	mg/l	274	251	263	NS*	NS*
19	Potassium as K	mg/l	4.23	3.88	4.21	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 11: Drinking Water Quality Monitoring Parameters for Sewa sadan – 3, Workshop I &Custom Building at Kandla

Sr. No.	Parameter	Unit	SewaSadan – 3	Workshop	Custom Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.61	7.57	7.45	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1326	1320	1520	500	2000
3	Turbidity	NTU	2	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2650	2610	3010	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	410.91	320.71	425.95	250.0	1000.0
9	Ca as Ca	mg/l	48.10	56.11	48.10	75.0	200.0
10	Mg as Mg	mg/l	77.76	82.62	77.76	30.0	100.0
11	Total Hardness	mg/l	320	340	320	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.16	0.20	0.77	1.0	1.5
14	Sulphate	mg/l	213.6	195.6	276	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	13.73	10.21	12.88	45.0	No Relaxation
17	Salinity	%	0.74	0.58	0.77	NS*	NS*
18	Sodium as Na	mg/l	215	206	166	NS*	NS*
19	Potassium as K	mg/l	3.87	3.73	3.56	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 12: Drinking Water Quality Monitoring Parameters for Port Colony Kandla, Hospital Kandla & A.O. Building at Gandhidham

Sr. No.	Parameter	Unit	Port Colony Kandla	Hospital Kandla	A.O. Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.53	7.56	7.59	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1370	1350	1450	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2690	2700	2990	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	335.75	375.84	821.83	250.0	1000.0
9	Ca as Ca	mg/l	76.15	52.10	72.14	75.0	200.0
10	Mg as Mg	mg/l	87.48	70.47	92.34	30.0	100.0
11	Total Hardness	mg/l	360	290	380	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.48	0.14	0.81	1.0	1.5
14	Sulphate	mg/l	336	228	237.6	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.50	10.21	11.62	45.0	No Relaxation
17	Salinity	%	0.61	0.68	1.48	NS*	NS*
18	Sodium as Na	mg/l	211	196	202	NS*	NS*
19	Potassium as K	mg/l	4.08	4.01	3.99	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 13: Drinking Water Quality Monitoring Parameters for School Gopalpuri, Guest House & E - Type Quarter at Gopalpuri, Gandhidham

Sr. No.	Parameter	Unit	School Gopalpuri	Guest House	E - Type Quarter	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.64	7.61	7.69	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1400	1850	1190	500	2000
3	Turbidity	NTU	2	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2780	3670	2310	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	410.91	471.05	385.86	250.0	1000.0
9	Ca as Ca	mg/l	64.13	76.15	44.09	75.0	200.0
10	Mg as Mg	mg/l	85.05	99.63	80.19	30.0	100.0
11	Total Hardness	mg/l	350	410	330	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.34	0.22	0.48	1.0	1.5
14	Sulphate	mg/l	252	284.4	303.6	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.50	10.70	9.50	45.0	No Relaxation
17	Salinity	%	0.74	0.85	0.70	NS*	NS*
18	Sodium as Na	mg/l	202	184	192	NS*	NS*
19	Potassium as K	mg/l	3.49	3.50	3.56	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 14: Drinking Water Quality Monitoring Parameters for F - Type Quarter, Hospital Gopalpuri & Tuna Port

Sr. No.	Parameter	Unit	F - Type Quarter	Hospital Gopalpuri	Tuna Port	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.56	7.42	7.32	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1230	1590	1020	500	2000
3	Turbidity	NTU	1	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Unit	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2450	3150	2000	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	375.84	511.14	604	250.0	1000.0
9	Ca as Ca	mg/l	40.08	60.12	80.16	75.0	200.0
10	Mg as Mg	mg/l	85.05	97.20	60.75	30.0	100.0
11	Total Hardness	mg/l	350	400	330	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.59	0.36	0.46	1.0	1.5
14	Sulphate	mg/l	260.4	174	180	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	10.00	7.96	8.2	45.0	No Relaxation
17	Salinity	%	0.68	0.92	1.09	NS*	NS*
18	Sodium as Na	mg/l	162	206	210	NS*	NS*
19	Potassium as K	mg/l	2.18	4.01	2.6	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 15: Drinking Water Quality Monitoring Parameters for Vadinar Jetty & Port Colony at Vadinar

Sr. No.	Parameter	Unit	Vadinar Jetty	Port Colony Vadinar	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.4	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1160	1150	500	2000
3	Turbidity	NTU	ND	ND	1.0	5.0
4	Odor	-	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2390	2300	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	NS*	NS*
8	Chloride	mg/l	425.95	415.92	250.0	1000.0
9	Ca as Ca	mg/l	56.11	64.13	75.0	200.0
10	Mg as Mg	mg/l	75.33	70.47	30.0	100.0
11	Total Hardness	mg/l	310	290	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.71	0.62	1.0	1.5
14	Sulphate	mg/l	30.60	28.80	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.85	9.71	45.0	No Relaxation
17	Salinity	%	0.76	0.75	NS*	NS*
18	Sodium as Na	mg/l	192.0	183.0	NS*	NS*
19	Potassium as K	mg/l	2.2	2.7	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent

*NS: Not Specified

2.3 Results & Discussion

The colour of all drinking water samples was < 5 Hazen unit and odour of the samples was also agreeable. All parameters are found to be within the specified limit of the Drinking water Standard.

pH

The limit of pH value for drinking water is specified as 6.5 to 8.5. pH value in the studied area varied from 7.0 to 8.0 pH unit. All the sampling points showed pH values within the prescribed limit by Indian Standards.

Total Dissolved Solids (TDS)

TDS values in the studied area varied between 1000 -1800 mg/l. None of the sampling points showed higher TDS values than the prescribed limit by Indian standards .

Conductivity

Electrical Conductivity is the ability of a solution to transfer (conduct) electric current. Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The conductivity in the samples collected during the month of September ranged from 2000-3700 µs/cm. Electrical conductivity standards do not appear in BIS standards for drinking water.

BOD

BOD value in the studied area was less than 2.0 mg/L. Indian standards does not show any standard values for BOD in drinking water.

Chlorides

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. Chloride value in the studied area varied between 400-900 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.

Calcium

Calcium value in the studied area varied between 40 - 80 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. If calcium is present beyond the maximum acceptable limit, it causes incrustation of pipes.

Magnesium

Magnesium value in the studied area varied between 60 – 99 mg/l. All the locations had Magnesium within the prescribed limits of 30-100 mg/L.

Total Hardness

Hardness value in the studied area varied between 260-410 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. The prescribed limit by Indian Standards is 200-600 mg/L.

Iron

Iron value in the studied area was below 0.01mg/L and hence well below the permissible limit as per Indian Standards is 0.3 mg/L. The excess amount of iron causes slight toxicity; gives stringent taste to water.

Fluoride

Fluoride value in the studied area varied between 0.1 – 1.0 mg/l and hence well below the permissible limit as per Indian Standards is 1.0-1.5 mg/L. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems.

Sulphates

Sulphate value in the studied area varied between 30 – 350 mg/l. All the sampling points showed sulphate values within the prescribed limits by Indian Standards (200-400 mg/L). Sulphate content in drinking water exceeding the 400 mg/L imparts bitter taste.

Nitrites (NO_2) and Nitrates (NO_3)

Nitrite values in all the water samples were <0.1. There are no specified standard values for Nitrites in Drinking water. The mean Nitrate values in drinking water of KPT was 6.27 mg/l which is well within the permissible limit of the Drinking water Standard.

Salinity

Salinity in drinking water in the present samples collected ranged from 0.5 to 1.4 %. There are no prescribed Indian standards for salinity in Drinking water**.**

Sodium and Potassium Salts

Sodium values in the samples collected ranged from 100 - 300 mg/l and Potassium salts ranged from 2.2 to 4.0 mg/l. There are no prescribed limits of Sodium and Potassium in Indian standards for Drinking water**.**

Heavy Metals in Drinking Water

In the present study period drinking water samples were analyzed for Mn, Cr, Cu, Cd, As, Hg, Pb and Zn. All these heavy metals were well below the permissible limits prescribed by the Indian Standards.

Bacteriological Study

Analysis of the bacteriological parameter at all location shows that Bacteria is not present and hence Bacterial count is in line with the permissible limit of drinking water. This shows that all the drinking water samples were safe from any bacteriological contamination.

2.4 Conclusions

These results are compared with acceptable limits as prescribed in IS 10500:2012 – Drinking Water Specification. It is seen from the analysis data that during the study period the water was safe for human consumption at all drinking water monitoring stations.

3. Noise Level Monitoring

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. Noise Monitoring was done at 13 stations at Kandla, Vadinar and Township area.

3.1 Method of Monitoring

Sampling was done at all stations for 24 hour period. Data was recorded using automated sound level meter. The intensity of sound was measured in sound pressure level (SPL) and common unit of measurement is decibel (Db).

3.2 Results

Table 16: Noise Monitoring data for ten locations of Deendayal Port and two locations of Vadinar Port

Sr. No.	Location	Day Time Average Noise Level (SPL) in dB(A)	Night Time Average Noise Level (SPL) in dB(A)
	Sampling Time	**6:00 am to 10:00 PM**	**10:00PM to 6:00 AM**
1	Marine Bhavan	58.0	50.4
2	Nirman Building 1	55.3	49.1
3	Tuna Port	52.8	46.5
4	Main Gate North	60.3	55.2
5	West Gate I	67.2	60.6
6	Canteen Area	58.7	50.9
7	Main Road	70.5	59.5
8	ATM Building	69.2	62.3
9	Wharf Area /Jetty Area	73.7	65.4
10	Port & Custom Office	55.2	49.6
	Vadinar Port		
11	Entrance Gate of Vadinar Port	69.6	58.4
12	Nr. Port Colony, Vadinar	61.3	55.8
13	Nr. Vadinar Jetty	68.2	61.5

3.3 Conclusions- Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Average Noise Level (SPL)in all 13 locations at Deendayal Port ranged from 52.0 dB(A) to 73.7 dB(A) and it was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all 13 locations of Deendayal Port ranged from 46.5 dB to 65.4 dB(A) and it was within the permissible limits of 70 dB(A) for the industrial area for the night time.

4. Soil Monitoring

Sampling and analysis of soil samples were undertaken at six locations within the study area (Deendayal Port and Vadinar Port) as a part of EMP. The soil sampling locations are initially decided based on the locations as provided in the tender document of the Deendayal Port.

4.1 Methodology

The soil samples were collected in the month of September 2021. The samples collected from the all locations are homogeneous representative of each location. At random locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

4.2 Results

Table-17: Chemical Characteristics of Soil in the Study Area

Sr. No.	Parameter	Unit	Station Name					
			SL1	SL2	SL3	SL4	SL5	SL6
			Tuna Port	IFFCO Plant	Khori Creek	Nakti Creek	KPT Admin Site	KPT Colony
			Near main gate of Port	10 m away from main gate	Sand from creek at low tide		Vadinar	
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	pH	-	8.58	8.16	8.46	8.26	8.02	8.56
3	Electrical Conductivity	µs/cm	18,400.0	25,620.0	17,880.0	16,520.0	523.0	420.0
4	Moisture	%	21.00	22.20	24.10	18.80	8.66	9.02
5	Total Organic Carbon	%	0.48	1.24	0.48	3.93	0.18	0.21
6	Alkalinity	mg/kg	72.07	36.04	190.19	90.09	60.06	100.10
7	Total Nitrogen	%	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
8	Chloride	mg/kg	1,506.6	6,381.0	1,701.0	1,878.9	52.0	67.8
9	Sulphate	mg/kg	202.0	196.0	112.0	112.0	12.0	18.0
10	Phosphorus	mg/kg	0.89	0.92	1.05	1.10	0.78	0.86
11	Potassium	mg/kg	386.0	820.0	345.0	422.0	110.0	172.0
12	Sodium	mg/kg	1,585.0	3,386.0	2,303.0	1,990.0	990.0	810.0
13	Calcium	mg/kg	228.46	741.50	248.50	468.94	118.00	72.00
14	Copper as Cu	mg/kg	52.2	78.2	46.2	33.8	18.6	28
15	Lead as Pb	mg/kg	4.9	5.6	3.2	4.8	3.2	1.1
16	Nickel as Ni	mg/kg	46.2	28	33.2	26.1	18.2	16.2
17	Zinc as Zn	mg/kg	66.20	41.60	68	49.55	24.00	38.50
18	Cadmium as Cd	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL

4.3 Discussion

- The data shows that value of pH ranges from 8.02 at Nakti Creek to 8.58 at Tuna Creek indicating that all soil samples are neutral to slight basic. Iffco Plant samples showed maximum conductivity of 25,620µmhos/cm, while Nakti Creek location showed minimum conductivity of 16,520 µmhos/cm. Conductivity at Vadinar Port was 523 and 420 µmhos/cm at Admin site and Vadinar Port colony respectively.
- Total organic Carbon ranged from 0.1 % to 3.9 at Deendayal Port. At Vadinar Port, organic carbon content ranged from 0.1 % to 0.2 %.
- The concentration of Phosphorus and Potassium in the soil samples varies from 0.8 to 1.10 mg/kg and 300.0 to 800 mg/kg respectively at Deendayal Port. The mean concentration of Phosphorous at Vadinar site was 0.82 mg/kg and mean concentration of Potassium at Vadinar site was 145 mg/kg.

These differences in NPK in soil at different locations are due to the dissimilar nature of soil at each of the locations. Samples SL3 & SL4 (Khori Creek & Nakti Creek) are of saline nature as they are coastal soil; where as other locations are inland locations and have different chemical properties.

Heavy Metals in the Soil

Traces of Copper, Lead, Nickel and Zinc were observed in the soil samples collected from all the four locations of Deendayal Port and two locations of Vadinar Port. Cadmium metal was not detected in the Soil.

4.4 Conclusion

The soils of Deendayal Port and Vadinar Port appears to be neutral to basic with varying levels of Chloride, Sulphate, NPK and Calcium. As the nature of soil at different locations are different with respect to its proximity to the sea, the samples showed high degree of variations in their chemical properties.

5. Sewage Treatment Plant Monitoring

This involves safe collection of waste water (spent/used water) from wash areas, bathroom, industrial units, etc., waste from toilets of various buildings and its conveyance to the treatment plant and final disposal in conformity with the requirement and guide lines of State Pollution Control Board and other statutory bodies.

5.1 Methodology for STP Monitoring

To monitor the working efficiency of Sewage Treatment Plant (STP), STP Inlet and Outlet Samples were collected once a week. Locations selected are namely Gopalpuri Township, Deendayal Port and Vadinar. Samples were collected in 1 lit. Carboys and were analyzed in laboratory for various parameters.

5.2 Results

- **Kandla STP**

Table 18: Sewage Water Monitoring at Kandla STP (1st Week)

Date of Sampling	04.09.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.56	7.44
2	Total Suspended Solids	mg/l	64.2	26.6
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	424.2	103.0
5	BOD @ 27 °C	mg/l	141.0	29.0
6.	Fecal Coliform	MPN Index / 100 ml	-	20.0
Aeration Tank				
7.	MLSS	mg/l	6.0	
8.	MLVSS	%	93.0	

Table 19: Sewage Water Monitoring at Kandla STP (2nd Week)

Date of Sampling	09.09.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.6	7.2
2	Total Suspended Solids	mg/l	152.2	72.4
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	384	103.0
5	BOD @ 27 °C	mg/l	120.0	24.0
6.	Fecal Coliform	MPN Index / 100 ml	-	31.0
Aeration Tank				
7.	MLSS	mg/l	9.0	
8.	MLVSS	%	89.0	

Table 20: Sewage Water Monitoring at Kandla STP (3rd Week)

Date of Sampling	16.09.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.71	7.18
2	Total Suspended Solids	mg/l	417.8	159.8
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	383.8	102
5	BOD @ 27 °C	mg/l	128.0	23.0
6.	Fecal Coliform	MPN Index / 100 ml	-	<1.8
Aeration Tank				
7.	MLSS	mg/l	9.0	
8.	MLVSS	%	89.0	

Table 21: Sewage Water Monitoring at Kandla STP (4th Week)

Date of Sampling	21.09.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.53	7.32
2	Total Suspended Solids	mg/l	172.4	75.9
3	Residual Chlorine	mg/l	<1.0	<1.0
4	COD	mg/l	151.5	102.0
5	BOD @ 27 °C	mg/l	106.0	52.0
6.	Fecal Coliform	MPN Index / 100 ml	-	110.0
Aeration Tank				
7.	MLSS	mg/l	16.0	
8	MLVSS	%	82.0	

- **Gopalpuri Colony STP**

Table 22: Sewage Water Monitoring at Gopalpuri STP (1st Week)

Date of Sampling	04.09.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.35	7.21
2	Total Suspended Solids	mg/l	108.8	26
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	316.0	98.0
5	BOD @ 27 °C	mg/l	110.0	28.0
6.	Fecal Coliform	MPN Index / 100 ml	-	>1600.0
Aeration Tank				
7.	MLSS	mg/l	11.0	
8	MLVSS	%	87.0	

Table 23: Sewage Water Monitoring at Gopalpuri STP (2nd Week)

Date of Sampling	09.09.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.6	7.41
2	Total Suspended Solids	mg/l	406	107.4
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	414.1	101
5	BOD @ 27 °C	mg/l	139.0	28.0
6.	Fecal Coliform	MPN Index / 100 ml	-	>1600.0
Aeration Tank				
7.	MLSS	mg/l	14.0	
8	MLVSS	%	90.0	

Table 24: Sewage Water Monitoring at Gopalpuri STP (3rd Week)

Date of Sampling	16.09.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.7	7.36
2	Total Suspended Solids	mg/l	276.6	92.1
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	373.7	104
5	BOD @ 27 °C	mg/l	125.0	28.0
6.	Fecal Coliform	MPN Index / 100 ml	-	>1600.0
Aeration Tank				
7.	MLSS	mg/l	12.0	
8	MLVSS	%	86.0	

Table 25: Sewage Water Monitoring at Gopalpuri STP (4th Week)

Date of Sampling	05.09.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.4	7.22
2	Total Suspended Solids	mg/l	182.4	117.8
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	171.7	101
5	BOD @ 27 °C	mg/l	80.0	23.0
6.	Fecal Coliform	MPN Index / 100 ml	-	920.0
Aeration Tank				
7.	MLSS	mg/l	12.0	
8.	MLVSS	%	88.0	

- **Vadinar STP**

Table 26: Sewage Water Monitoring at Vadinar STP (1st Week)

Date of Sampling	05.09.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.22	7.10
2	Total Suspended Solids	mg/l	62	28.0
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	88.0	56.0
5	BOD @ 27 °C	mg/l	26.0	15.0

Table 27: Sewage Water Monitoring at Vadinar STP (2nd Week)

Date of Sampling	09.09.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.33	7.10
2	Total Suspended Solids	mg/l	72	24.0
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	88.0	60.0
5	BOD @ 27 °C	mg/l	29.0	18.0

Table 28: Sewage Water Monitoring at Vadinar STP (3rd Week)

Date of Sampling	16.09.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.32	7.12
2	Total Suspended Solids	mg/l	60	58.0
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	80.0	55.0
5	BOD @ 27 °C	mg/l	26.0	16.0

Table 29: Sewage Water Monitoring at Vadinar STP (4th Week)

Date of Sampling	21.09.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.18	7.10
2	Total Suspended Solids	mg/l	72	42.0
3	Residual Chlorine	mg/l	<1.0	<0.5
4	COD	mg/l	80.0	58.0
5	BOD @ 27 °C	mg/l	26.0	12.0

5.3 Conclusions:

The GPCB standards of BOD, TSS and Residual Chlorine for STP outlet are 20 mg/lit, 30 mg/lit & 0.5 mg/lit respectively. It is suggested to do treatment on regular basis to avoid flow of contaminated/polluted water into the sea.

6. Marine Water Monitoring

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992) aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

Marine Environment

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations

The monitoring of marine environment for the study of biological and ecological parameters was carried out on 7th& 8th September-2021 in harbor regions of KPT and on 7th September-2021 at Vadinar during spring tide period of New moon phase of Lunar Cycle. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 14th& 15th September 2021 in harbor regions of KPT. 15th September -2021 in Vadinar during Neap tide period first quarter of Lunar Cycle..

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and two stations in Nakti creek and one station in Khori creek. The same sampling schedule was repeated during consecutive spring tide and neap tide in same month. Plankton samples from sub surface layer was collected both during high tide period and low tide period from 1 water quality monitoring stations near Vadinar jetty area during spring tide and neap tide in this month .Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

Sampling Locations

Offshore monitoring requirement	Number of locations
Offshore Installations	3 in Kandla creek 2 in Nakti creek 1 in Khori creek 1 near Vadinar Jetty 1 near 1st SBM
Total Number of locations	**8**

6.1 Marine Water Quality

Marine water quality of marine waters of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month.

The results of marine water quality and Marine sediments are as below;

Table 30: Marine Water Quality Monitoring Parameters for location near KPT colony

Sr. No.	Parameters	Unit	Kandla Creek Near KPT colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.20	7.35	7.31	7.27
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.6	32.0	31.0	31.8
5	Turbidity	NTU	37	35	32	28
6	Total Dissolved Solids	mg/l	59704	58025	34000.0	37060.0
7	Total Suspended Solids	mg/l	282	357	382	303.5
8	Total Solids	mg/l	59986	58382	34382.0	37363.5
9	DO	mg/l	4.5	4.7	4.7	5.3
10	COD	mg/l	78.0	82.0	80.0	86.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	6.09	7.49	0.53	0.42
13	Phosphate	mg/l	0.17	0.16	0.18	0.18
14	Sulphate	mg/l	2640	2280	2808	2568
15	Nitrate	mg/l	2.60	1.43	2.26	2.29
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	761.52	921.84	521.04	721.44
18	Magnesium	mg/l	1409.4	1263.6	1749.6	1749.6
19	Sodium	mg/l	11280.0	10920.0	11360.0	11062.0
20	Potassium	mg/l	289.0	320.0	296.0	310.0
21	Iron	mg/l	1.95	1.89	1.85	1.79
22	Chromium	mg/l	0.11	0.13	0.11	0.12
23	Copper	mg/l	0.07	0.08	0.08	0.07
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.05	0.04	0.05
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.17	0.18	0.13	0.14
28	Zinc	mg/l	0.05	0.06	0.05	0.07

Table 31: Marine Water Quality Monitoring Parameters for location near passenger Jetty One at Kandla

Sr. No.	Parameters	Unit	Near passenger Jetty One (2)			
			23° 0'18 "N 70°13'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.40	7.28	7.4	7.43
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.8	31.6	32.5	32.0
5	Turbidity	NTU	26	27	36	27
6	Total Dissolved Solids	mg/l	55555	51116	34060.0	33780.0
7	Total Suspended Solids	mg/l	363	174	242	582.9
8	Total Solids	mg/l	55918	51290	34302.0	34362.9
9	DO	mg/l	4.9	5.2	5.5	4.6
10	COD	mg/l	96.0	90.0	90.0	88.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	5.16	6.84	0.67	0.71
13	Phosphate	mg/l	0.20	0.18	0.16	0.19
14	Sulphate	mg/l	2820	2376	2832	2496
15	Nitrate	mg/l	2.36	2.89	4.00	3.37
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	721.44	961.92	601.2	681.36
18	Magnesium	mg/l	1409.4	1215	1822.5	1773.9
19	Sodium	mg/l	11862.0	11060.0	11652.0	11110.0
20	Potassium	mg/l	290.0	312.0	299.0	310.0
21	Iron	mg/l	1.96	1.93	1.86	1.93
22	Chromium	mg/l	0.13	0.13	0.13	0.14
23	Copper	mg/l	0.09	0.08	0.06	0.05
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.05	0.06	0.04
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.19	0.16	0.17	0.18
28	Zinc	mg/l	0.08	0.08	0.07	0.06

Table 32: Marine Water Quality Monitoring Parameters for location Near Coal Berth

Sr. No.	Parameters	Unit	Near Coal Berth			
			22°59'12"N 70°13'40"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.19	7.38	7.53	7.34
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.5	32.2	32.6	31.6
5	Turbidity	NTU	35	36	34	33
6	Total Dissolved Solids	mg/l	48086	54880	41460.0	39690.0
7	Total Suspended Solids	mg/l	220	220	376.6	359.9
8	Total Solids	mg/l	48306	55100	41836.6	40049.9
9	DO	mg/l	5.0	5.1	4.8	5.2
10	COD	mg/l	89.0	92.0	81.0	78.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	4.67	4.95	0.47	0.71
13	Phosphate	mg/l	0.16	0.21	0.18	0.19
14	Sulphate	mg/l	2376	2964	2376	2352
15	Nitrate	mg/l	2.04	2.26	4.82	4.60
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	801.60	921.84	440.88	521.04
18	Magnesium	mg/l	1336.5	1287.9	1701	1773.9
19	Sodium	mg/l	12042.0	11910.0	12150.0	11956.0
20	Potassium	mg/l	366.0	372.0	358.0	376.0
21	Iron	mg/l	2.11	2.30	1.96	2.01
22	Chromium	mg/l	0.12	0.15	0.12	0.16
23	Copper	mg/l	0.07	0.09	0.08	0.07
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.07	0.05	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.19	0.19	0.17	0.2
28	Zinc	mg/l	0.07	0.07	0.05	0.07

Table 33: Marine Water Quality Monitoring Parameters for location Khori creek at Kandla

Sr. No.	Parameters	Unit	KPT 4			
			Near 15/16 Berth			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.40	7.38	7.27	7.22
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.4	31.8	31.8	31.6
5	Turbidity	NTU	27	23	39	45
6	Total Dissolved Solids	mg/l	53390	47930	42746.0	35470.0
7	Total Suspended Solids	mg/l	262	354	561.7	520.9
8	Total Solids	mg/l	53652	48284	43307.7	35990.9
9	DO	mg/l	4.8	4.9	5.5	4.7
10	COD	mg/l	78.0	80.0	86.0	82.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	6.98	6.35	0.98	0.85
13	Phosphate	mg/l	0.23	0.21	0.21	0.19
14	Sulphate	mg/l	2220	2268	2412	2568
15	Nitrate	mg/l	2.87	2.03	2.81	3.32
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	801.60	881.76	601.2	480.96
18	Magnesium	mg/l	1312.2	1360.8	1773.9	1773.9
19	Sodium	mg/l	12220.0	12052.0	12012.0	12110.0
20	Potassium	mg/l	300.0	278.0	289.0	280.0
21	Iron	mg/l	2.31	2.22	1.88	2.02
22	Chromium	mg/l	0.16	0.14	0.18	0.16
23	Copper	mg/l	0.06	0.08	0.06	0.05
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.08	0.06	0.07
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.19	0.17	0.19	0.16
28	Zinc	mg/l	0.09	0.07	0.06	0.08

Table 34: Marine Water Quality Monitoring Parameters for location Nakti Creek near Tuna Port

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.47	7.45	7.22	7.39
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.6	31.9	32.0	31.9
5	Turbidity	NTU	35	37	36	48
6	Total Dissolved Solids	mg/l	52041	55010	35620.0	38755.0
7	Total Suspended Solids	mg/l	360	425	387.9	525.7
8	Total Solids	mg/l	52401	55435	36007.9	39280.7
9	DO	mg/l	4.5	4.7	5.4	5.1
10	COD	mg/l	86.0	82.0	92.0	90.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	8.67	9.40	0.82	0.53
13	Phosphate	mg/l	0.17	0.18	0.22	0.18
14	Sulphate	mg/l	2820	2844	2268	2136
15	Nitrate	mg/l	2.56	1.91	2.42	3.81
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	761.52	721.44	521.04	601.2
18	Magnesium	mg/l	1409.4	1458	1676.7	1749.6
19	Sodium	mg/l	11958.0	11628.0	11990.0	11558.0
20	Potassium	mg/l	366.0	376.0	360.0	320.0
21	Iron	mg/l	2.35	2.36	2.05	2.10
22	Chromium	mg/l	0.19	0.20	0.18	0.16
23	Copper	mg/l	0.08	0.09	0.05	0.06
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.06	0.08	0.05	0.08
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.19	0.21	0.17	0.18
28	Zinc	mg/l	0.09	0.08	0.07	0.08

Table 35: Marine Water Quality Monitoring Parameters for location Nakti Creek Near NH-8A at Kandla

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.36	Sampling not possible during Low Tide	7.39	Sampling not possible during Low Tide
2	Color	-	Colorless		Colorless	
3	Odor	-	Odorless		Odorless	
4	Salinity	ppt	31.6		31.8	
5	Turbidity	NTU	38		37	
6	Total Dissolved Solids	mg/l	54144		35040.0	
7	Total Suspended Solids	mg/l	394		327	
8	Total Solids	mg/l	54538		35367.0	
9	DO	mg/l	4.9		5.6	
10	COD	mg/l	78.0		90.0	
11	BOD	mg/l	<2.0		<2.0	
12	Silica	mg/l	6.96		0.67	
13	Phosphate	mg/l	0.19		0.20	
14	Sulphate	mg/l	2964		2340	
15	Nitrate	mg/l	2.21		25.70	
16	Nitrite	mg/l	<0.05		<0.05	
17	Calcium	mg/l	921.84		641.28	
18	Magnesium	mg/l	1263.6		1725.3	
19	Sodium	mg/l	13125.0		13052.0	
20	Potassium	mg/l	360.0		388.0	
21	Iron	mg/l	2.41		2.30	
22	Chromium	mg/l	0.20		0.19	
23	Copper	mg/l	0.09		0.08	
24	Arsenic	mg/l	<0.01		<0.01	
25	Cadmium	mg/l	0.08		0.07	
26	Mercury	mg/l	<0.001		<0.001	
27	Lead	mg/l	0.18		0.2	
28	Zinc	mg/l	0.09		0.05	

Table 36: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar Jetty

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.72	7.56	7.4	7.52
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.6	32.0	32.0	32.0
5	Turbidity	NTU	33	34	35	31
6	Total Dissolved Solids	mg/l	41457	45920	34437.0	38630.0
7	Total Suspended Solids	mg/l	299	267	512.6	396
8	Total Solids	mg/l	41756	46187	34949.6	39026.0
9	DO	mg/l	4.7	4.8	5.5	4.8
10	COD	mg/l	90.0	86.0	86.0	89.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	7.27	8.55	0.78	0.77
13	Phosphate	mg/l	0.17	0.18	0.19	0.20
14	Sulphate	mg/l	2316	2388	2388	2532
15	Nitrate	mg/l	3.03	3.15	3.32	2.59
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	841.68	961.92	561.12	601.2
18	Magnesium	mg/l	1385.1	1263.6	1846.8	1822.5
19	Sodium	mg/l	13820.0	13962.0	13762.0	13888.0
20	Potassium	mg/l	310.0	285.0	316.0	296.0
21	Iron	mg/l	1.96	1.99	1.89	2.00
22	Chromium	mg/l	0.19	0.21	0.17	0.16
23	Copper	mg/l	0.08	0.07	0.07	0.06
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.07	0.05	0.07	0.06
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.21	0.16	0.17	0.18
28	Zinc	mg/l	0.08	0.07	0.06	0.05

6.1.1 Marine Sediments

Sediment samples were collected with Van Veen Grab from the six locations in Kandla Port Waters and two locations in Vadinar Port. Samples were collected and preserved in silver foil in ice box to prevent the contamination/decaying of the samples.

6.2 Results

The Sediment Quality results are given in below from table no. 34 A & B.

Table 34A: Results of Analysis of Sediment of Kandla & Vadinar Port (Spring Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 4	KPT - 5	Jetty
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.16	1.12	0.83	0.75	0.86
3	Organic Carbon	mg/kg	0.67	0.65	0.48	0.44	0.50
4	Inorganic Phosphate	mg/kg	111.0	126.0	132.0	142.0	175.0
5	Moisture	%	26.00	27.20	42.60	41	28.20
6	Aluminium	mg/kg	ND	ND	ND	ND	ND
7	Silica	mg/kg	18.0	16.0	13.0	16.0	20.0
8	Phosphate	mg/kg	9.20	10.60	10.66	8.40	8.60
9	Sulphate	mg/kg	219.0	253.0	189.0	211.0	186.0
10	Nitrite	mg/kg	0.12	0.13	0.11	0.12	0.13
11	Nitrate	mg/kg	10.20	8.88	9.25	8.69	9.74
12	Calcium	mg/kg	362.0	322.0	410.0	365.0	310.0
13	Magnesium	mg/kg	210.0	192.0	265.0	196.0	188.0
14	Sodium	mg/kg	3824.0	4012.0	2611.0	2978.0	3777.0
15	Potassium	mg/kg	240.0	202.0	160.0	145.0	178.0
16	Chromium	mg/kg	42.5	16	79	19.2	28.7
17	Nickel	mg/kg	24	20.4	16.9	11	19.3
18	Copper	mg/kg	31.8	36.4	34.2	16.8	31.2
19	Zinc	mg/kg	37.10	32.60	28.00	10.20	24.00
20	Cadmium	mg/kg	ND	ND	ND	ND	ND
21	Lead	mg/kg	3.2	3.9	4.8	3	ND
22	Mercury	mg/kg	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND

*Grab samples could not be collected due high at KPT – 3 & Vadinar SBM location.

Table 34B: Results of Analysis of Sediment of Kandla & Vadinar Port (Neap Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 3	KPT - 4	KPT - 5	Jetty
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.78	0.90	1.03	2.03	0.81	1.31
3	Organic Carbon	mg/kg	1.03	0.52	0.60	1.18	0.47	0.76
4	Inorganic Phosphate	mg/kg	116.0	136.0	142.0	146.0	149.0	166.0
5	Moisture	%	27.00	19.00	27.0	19.0	27.00	19.00
6	Aluminium	mg/kg	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	22.20	19.62	18.0	20.2	18.00	16.66
8	Phosphate	mg/kg	7.6	8.2	8.90	10.60	11.20	9.8
9	Sulphate	mg/kg	234.0	268.0	245.0	210.0	265.0	206.0
10	Nitrite	mg/kg	0.11	0.13	0.12	0.1	0.11	0.12
11	Nitrate	mg/kg	8.88	9.20	7.66	9.75	8.88	7.82
12	Calcium	mg/kg	378.0	325.0	389.0	378.0	378.0	296.0
13	Magnesium	mg/kg	216.0	206.0	233.0	186.0	210.0	198.0
14	Sodium	mg/kg	4428.0	3971.0	4554.0	2491.0	3036.0	3798.0
15	Potassium	mg/kg	221.0	152.0	167.0	149.0	116.0	160.30
16	Chromium	mg/kg	38.5	12.1	34.9	77.8	18.7	29.4
17	Nickel	mg/kg	27.3	20.4	36.9	21.6	13.1	19.3
18	Copper	mg/kg	11.8	33.5	40.7	20.2	11	41.2
19	Zinc	mg/kg	47.10	61.00	64.10	38.70	5.20	24.00
20	Cadmium	mg/kg	ND	ND	ND	ND	ND	ND
21	Lead	mg/kg	4.4	4.4	5.6	5.7	2.8	ND
22	Mercury	mg/kg	ND	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND	ND

REPORT

ON

ECOLOGICAL MONITORING

OF MARINE ENVIRONMENT

IN

DPTHARBOURAREA, NEAR BY CREEKS

For

DEENDAYAL PORT TRUST

SEPTEMBER,2021

INTRODUCTION:

Sampling Stations:

The monitoring of marine environment for the study of biological and ecological Parameters was carried out on8thSeptember 2021 in harbour region of DPT, and on 9thSeptember2021 in creeks near by the port during spring tide. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 14thSeptember 2021 in harbour region of DPT and on 15thSeptember 2021 in creeks near by the port during neap tidal condition.

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of DPT harbour area andone stations in Nakti creek and one station in Khori creek. Sampling at second sampling station of Nakti creek was possible only during high tide period. Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons(density and their population).

TABLE #1 SAMPLING LOCATIONS

monitoring requirement	**Number of locations**
Kandla creek Nakti creek Khori Creek	3 in Kandla creek 2 in Nakti creek 1 in Khori creek
Total Number of locations	**6**

Sampling methodology adopted:

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.

50 litres of the water sample were collected from Sub surface by using bucket. From the collected water sample 1 litres of water sample were taken in an opaque plastic bottle for chlorophyll estimation, thereafter plankton samples were collected by using filtration assembly with nilyobolt cloth of 20µm mesh size.

Samples Processing for chlorophyll estimation:

Samples for the chlorophyll estimation were preserved in ice box on board in darkness to avoid degradation in opaque container covered with aluminium foil. Immediately after reaching the shore after sampling, 1 litre of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm. By using corrected optical density, Chlorophyll-a value was calculated as given in (APHA, 1998).

PLANKTON:

The entire area open water in the sea is the pelagic realm. Pelagic organisms live in the open sea. In contrast to the pelagic realm, the benthic realm comprises organisms and zone of the bottom of the sea. Vertically the pelagic realm can be dividing into two zones based on light penetration; upper photic or euphotic zone and lower dark water mass, aphotic zone below the photic zone.

The term plankton is general term for organisms have such limited powers of locomotion that they are at the mercy of the prevailing water movement. Plankton is subdivided to phytoplankton and zooplankton. Phytoplankton is free floating organisms that are capable of photosynthesis and zooplankton is the various free floating animals.

Pelagic zone, represents the entire ocean water column from the surface to the deepest depths, is home to a diverse community of organisms. Differences in their locomotive ability categorize the organisms in the pelagic realm into two, ***plankton*** and ***nekton*** (Lalli and Parsons, 1997). ***Plankton*** consists of all organisms drifting in the water and is unable to swim against water currents, whereas ***Nekton*** includes organisms having strong locomotive power. Ecological studies on the plankton community, which form the base of the aquatic food chain, help in the better understanding of the dynamics and functioning of the marine ecosystem. The term 'Plankton' first coined by Victor Hensen (1887), Plankton, (Greek word: *planktos* meaning "passively drifting or wandering") is defined as drifting or free-floating organisms that inhabit the pelagic zone of water. Based on their mode of nutrition planktonic organisms are categorised into phytoplankton (organisms having an autotrophic mode of nutrition) and zooplankton (organisms having a heterotrophic mode of nutrition).

Phytoplankton in the marine environment:

Phytoplankton is 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).The phytoplankton those normally captured in the net from the Gulf of Kutch is normally dominated by these two major groups; diatoms and dinoflagellates. Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as and Cyanophytes (blue-green 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 in the marine environment:

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, 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 (Beaugrand et al., 2004). Zooplankton grazing in the marine environment controls the primaryproduction and helps in determining the pelagic ecosystem (Banse, 1995). 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.

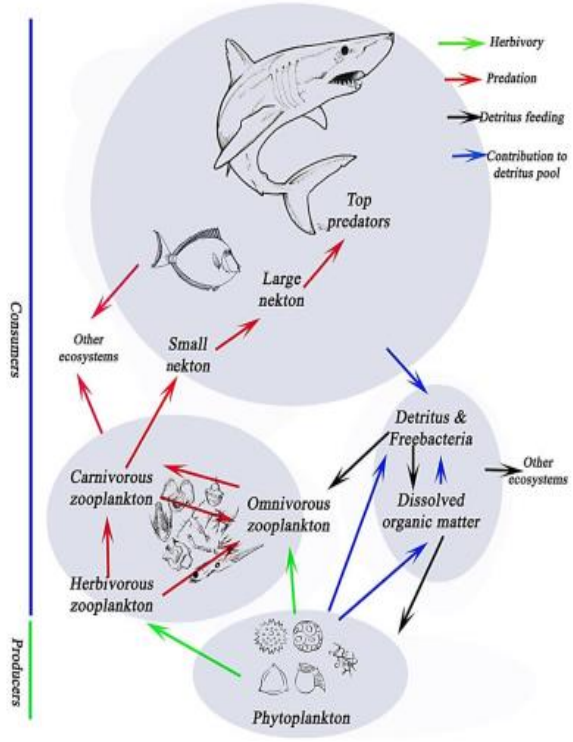
Based on the duration of planktonic life, zooplankton are categorised into Holoplankton (organisms which complete their entire lifecycle as plankton) and Meroplankton (organisms which are planktonic during the early part of their lives such as the larval stages of benthic and nektonic organisms). Tychoplankton are organisms which live a brief planktonic life, such as the benthic crustaceans (cumaceans, mysids, isopods) which ascend to the water column at night for feeding and certain ectoparasitic copepods, they leave the host and spend their life as plankton during their breeding cycle.

Zooplankton can be subdivided into holoplankton, i.e., permanent members of the plankton (e.g., Calanoid copepods), and meroplankton, i.e., temporary members in the plankton e.g., larvae of fish, shrimp, and crab). The meroplankton group consists of larval and young stages of animals that will adopt a different lifestyle once they mature. In contrast to phytoplankton which consist of a relatively smaller variety of organisms, Zooplankton are extremely divers, consist of a host of larval and adult forms representing many animal phylum.

Among the zooplankton one group always dominate than others; members of sub class copepods (Phylum Athropoda) and Tintinids (Phylum Protozoa) among the net planktons. These small animals are of vital importance in marine ecosystem as one of the primary herbivores animals in the sea, and it is they provide vital link between primary producer (autotrophs) and numerous small and large marine consumers.

As their community structure and function are highly susceptible to changes in the environmental conditions regular monitoring of their distribution as well as their interactions with various physicochemical parameters is inevitable for the sustainable management of the ecosystem (Kusum et al., 2014). Of all the marine zooplankton groups, copepods mainly calanoid copepods are the dominant groups in marine subtropical and tropical waters and exhibit considerable diversity in morphology and habitats they occupy (Madhupratap, 1991;)

It has been well established that potential of pelagic fishes viz. finfishes, crustaceans, molluscs and marine mammals either directly or indirectly depend on zooplankton. The herbivorous zooplankton is efficient grazers of the phytoplankton and is referred to as living machines transforming plant material into animal tissue. Hence they play an essential role as the intermediaries for nutrients/energy transfer between primary and tertiary trophic levels. Due to their large density, shorter lifespan, drifting nature, high group/species diversity and different tolerance to the stress, they used as the indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem (Ghajbhiye, 2002).



Simplified marine food web

Spatial distribution of Plankton:

A characteristic of plankton population is that they tend to occur in patches, which are varying spatially on a scale of few meters to far as few kilometres in distance. They also vary in time scale, season as well as vertically in the water column. It is this patchiness and its constant changes in time and spot, that has made it so difficult for plankton biologist to learn about the ecology of plankton. The biological factors that causes this patchiness is due to the ability of zooplankton to migrate vertically and graze out the phytoplankton at a rapid rate that can create patchiness. Similarly the active swimming ability by certain zooplankton organisms can cause to aggregate in dense group.

At its most extreme, because the water in which plankton is suspended is constantly moving, each sample taken by the plankton biologists remain a different volume of water, so each sample is unique and replicate does not exist.

Plankton may also exhibit vertical patchiness. Physical factors contribute to this type of patchiness include light intensity, nutrients and density gradients in the water column.

Phytoplankton in particular tends to be unequally distributed vertically, which leads to the existence of different concentration of a chlorophyll value between photic zone and below the photic zone.

Methodology adopted for Plankton sampling:

Mixed plankton sample were obtained from the sub surface layer at each sampling locations by towing the net horizontally with the weight .After the tow of about 10-15 minutes, plankton net was pulled up and washed down to the tail and collected the plankton adhered to plankton net in the collection bucket at the bottom by springing outer and inner surface of the net with sea water, while the net was hanging with the mouth upward. For quantitative evaluation 50 L water samples were collected from subsurface layer and filtered through 20µm mesh size net by using bucket and filtration assembly.

Preservation and storage:

Both filtered plankton and those collected from the plankton net were preserved with 5% buffered formalin and stored in 1L plastic container for further processing in the laboratory.

Sample concentration:

The collected plankton samples were concentrated by using centrifuge and made up to 50 ml with 5% formalin -Glycerine mixture.

Taxonomic evaluation:

Before processing, the sample was mixed carefully and a subsample was taken with a calibrated Stempel-pipette. 1 ml of the concentrated plankton samples were transferred on a glass slide with automatic pipette. The plankton sample on the glass slides were stained by using Lugol's iodine and added glycerine to avoid drying while observation. The plankton samples were identified by using Labex triangular Research microscope with photographic attachment. Microphotographs of the plankton samples were taken for record as well as for confirming the identification. The bigger sized zooplankton was observed through dissecting stereomicroscope with magnification of 20-30 x. Plankton organisms in the whole slide were identified to the lowest axon possible. A thorough literature search was conducted for the identification of the different groups of zooplankton that were encountered

Cell counts by drop count method:

The common glass slide mounted with a 1ml of concentrated phytoplankton/zooplankton sample in glycerol and covered with cover slip 22x 60mm was placed under the compound microscope provided with a mechanical stage. The plankton was then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton in each microscopic field was thus counted. When first microscopic field row was finished the next consecutive row was adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted. From this total number in 1ml of the concentrated

plankton, total number of plankton in the original volume of sample filtered was calculated as units/L.

BENTHIC ORGANISMS:

Benthos is those organisms that are associated with the sea bed or benthic habitats. Epi- benthic organisms live attached to a hard substratum or rooted to a shallow depth below the surface. In fauna organisms live below the sediment–water interface. Interstitial organisms live and move in pore water among sedimentary grains.

Because the benthic organisms are often collected and separated on sieves, a classification based on the overall size is used. Macro benthos include organisms whose shortest dimension is greater than or equal to 0.5 mm. Meio benthos are smaller than 0.5mm but larger than 42µ in size.

The terms such as macro fauna and Meio fauna generally have little relevance with taxonomic classification. The terms Meio fauna and macro fauna depend on the size. Meio fauna were considered as good bioassay of community health and rather sensitive indicators of environmental changes

SAMPLING METHODOLOGY ADOPTED FOR SUB TIDAL REGION:

Van veen sampler (0.09m^2) was used for sampling bottom sediments. Two sets of sediments were sampled from each location, one for macro fauna and other for Meio fauna. The macro fauna in the sediments were sieved on board to separate out the organisms. The fixation of Meio fauna is normally done by bulk fixation of the sediment sample. The bulk fixation is done by using 10% formalin (Buffered with borate). The organisms were preserved with seawater as diluting agent.

Sample sieving:

Sediments samples were sieved to extract the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. The large portion of the sediment was split in to smaller portions and mixed with sea water in a bucket. The cohesive lumps were broken down by continuous stirring. The disaggregated sediments were then passed through the sieves.

Sample staining:

Sorting of the Meio fauna from the sieve is difficult task especially in the preserved material, because organisms are not easily detectable. To facilitate the animal detection the entire sample retained on the sieve after sieving operation were stained by immersing the sieve in a flat bottom tub with 1% Rose Bangal stain; a protein stain. A staining period of 10-30 minutes is sufficient for sample detection.

DIVERSITY INDICES:

On the whole, diversity indices provide more information about community composition than simply species richness (number of species present); they also, take the relative abundances of different

species into account. Based on this fact, diversity indices therefore depend not only on species richness but on the evenness, or equitability, with which individuals are distributed among the different species (Magurram, A. E. (1988)

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.

The basic idea of diversity 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 (Carol H.R. *etal*. 1998). Biodiversity is commonly expressed through indices based on species richness and species abundances (Whittaker 1972, Lande 1996, Purvis and Hector 2000). 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.

A diversity Index is a single statistic that incorporates in formation on richness and evenness. The diversity measures that incorporate the two concepts may be termed heterogeneity measures (Magurran, 2004).

Any study intended to interpret causes and effect of adverse impact on Biodiversity of communities require suitable measures to evaluate specie richness and Diversity. The former is number of species in community, while latter is a function of relative frequency of different species. Species richness is the iconic measure of biological diversity (Magurran, 2004). Several indices have been created to measure the diversity of species; however, the most widely used in the last decades are the Shannon (1948) and Simpson (1949) (Buzas and Hayek 1996; Gorelick 2006), with the components of diversity: richness (*S)* and evenness (*J)*

Simpson's diversity index

Simpson's index (**D**) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present.. The Simson index is one of the meaningful and robust biodiversity measures available.(Magurran ,2004).

The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and, 1, no diversity. When D increases diversity decreases. Simpson's index is therefore usually expressed as 1-D or 1/D. (Magurran, 2004)

Low species diversity suggests:

- relatively few successful species in the habitat
- the environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment
- food webs which are relatively simple
- change in the environment would probably have quite serious effects

High species diversity suggests:

- a greater number of successful species and a more stable ecosystem
- more ecological niches are available and the environment is less likely to be hostile complex food webs
- environmental change is less likely to be damaging to the ecosystem as a whole

Species richness indices

The species richness***(S)*** is simply the number of species present in an ecosystem. Species richness Indices of species richness are widely used to quantify or monitor the effects of anthropogenic disturbance. A decline in species richness may be concomitant with severe or chronic human-induced perturbation (Fair Fair weather 1990,) Species richness measures have traditionally been the mainstay in assessing the effects of environmental degradation on the biodiversity of natural assemblages of organisms (Clarke &Warwick, 2001)

Species richness is the iconic measure of biological diversity (Magurran, 2004). The species richness***(S)*** is simply the number of species present in an ecosystem. This index makes no use of relative abundances. The term species richness was coined by McIntosh (1967) and oldest and most intuitive measure of biological diversity (Magurran, 2004).

Margalef's diversity index is a species richness index. Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, were derived.

The value of a diversity index increases both when the number of types increases and when evenness increases. For a given number of types, the value of diversity index is maximised when all types are equally abundant (Rosenzweig, M. L. (1995).

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 (Odum 1971 and Reish 1984). Shannon-Wiener's index **(H**) reproduce community parameters to a single numberby using an equation.

Shannon and Weiner index represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxa. It varies from 0 for communities with only single taxa to high values for community with many taxa each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range of polluted and unpolluted ecosystems, Wilham and Dorris (1968) concluded that the values of the index greater than 3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln\left(\frac{n_j}{N}\right)$$

RESULTS:

CHLOROPHYLL-a:

Water Samples for the chlorophyll estimation were collected from sub surface layer during high tide and low tide period of the tidal cycle for each sampling locations and analysed for Chlorophyll -a and after acidification for Pheophytin –a. Chlorophyll- a value was used as algal biomass indicator (APHA,1998) Algal biomass was estimated by converting Chlorophyll value.

In the sub surface water chlorophyll-a was varying from 0.366 -0.613mg/m^3.in harbour region of DPT during sampling done in spring tide period of September 2021. In the nearby creeks chlorophyll-a was varying from 0.101-0.851mg/m^3.Pheophytin –a level was below detectable limit- the all the sampling stations during springtide in the harbour region of DPT.

In the sub surface water chlorophyll-a was varying from 0.322 -0.645mg/m^3.in harbour region of DPT during sampling done in neap tide period of September 2021 . In the nearby creeks chlorophyll-a was varying from 0.291-0.614 mg/m^3.Pheophytin –a level was below detectable limit- the all the sampling stations during neap tide in the harbour region of DPT.

TABLE #2 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN SEPTEMBER,2021

Sr. No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPT HARBOUR AREA					
1	KPT1	High tide	0.410	BDL	27.47
		Low tide	0.366	BDL	24.52
2	KPT 2	High tide	0.409	BDL	27.40
		Low tide	0.467	BDL	31.29
3	KPT 3	High tide	0.512	BDL	34.30
		Low tide	0.613	BDL	41.07
CREEKS					
4	KPT-4 Khori-I	High tide	0.645	BDL	43.22
		Low tide	0.748	BDL	50.12
5	KPT-5 Nakti-I	High tide	0.818	BDL	54.81
		Low tide	0.851	BDL	57.02
6	KPT-5 Nakti-II	High tide	0.101	BDL	6.76

BDL: Below Detectable Limit.

TABLE #3 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN SEPTEMBER,2021

Sr. No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPT HARBOUR AREA					
1	KPT1	High tide	0.322	BDL	21.57
		Low tide	0.323	BDL	21.64
2	KPT 2	High tide	0.630	BDL	42.21
		Low tide	0.615	BDL	41.21
3	KPT 3	High tide	0.527	BDL	35.31
		Low tide	0.645	BDL	43.22
CREEKS					
4	KPT-4 Khori-I	High tide	0.511	BDL	34.24
		Low tide	0.599	BDL	40.13
5	KPT-5 Nakti-I	High tide	0.529	BDL	35.44
		Low tide	0.614	BDL	41.14
6	KPT-5 Nakti-II	High tide	0.291	BDL	19.50

BDL: Below Detectable Limit.

PHYTOPLANKTON POPULATION:

For the evaluation of the Phytoplankton population in DPT harbour area and within the immediate surroundings of the port, sampling was conducted from 5 sampling locations (3 in harbour area and two in Nakti creek) during high tide period and low tide period of spring tide and neap tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by,Diatoms andblue green algae during spring tide period.Diatoms were represented by 18 genera. Blue green were represented by 3 generaduring the sampling conducted in spring tide in September,2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 85-116 units/ L during high tide period and103-133 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by Diatoms andBlue green algae duringNeap tide period.Diatoms were represented by 15genera and Blue green algae were represented 3 genera during the sampling conducted in Neap tide in September, 2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from45 -155 units/ L during high tide period and 131-182 units/ L during low tide of Neap Tide.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 1.801-3.197 with an average of 2.642 during the sampling conducted in High tide period of spring tide.While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla Harbour region and nearby creeks was varying from 12.458-2.904 with an average of 2.697 during the consecutive low tide period .

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 1.808-2.461 with an average of 2.087 during the sampling conducted in High tide period of Neaptide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla Harbour region and nearby creeks was varying from. 1.961-2.882 with an average of 2.371 during the consecutive low tide period.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.771-0.988 (H'(log10)) between selected sampling stations with an average value of 0.934during high tide period of spring tide. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.893-0.932 (H'(log10)) between selected sampling stations with an average value of 0.916 during consecutive lowtide. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.781-0.911 (H'(log10)) between selected sampling stations with an average value of 0.862 during high tide period of neap tide. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.823-0.969 (H'(log10)) between selected sampling stations with an average value of 0.904during consecutive low tide. Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of phytoplankton of Kandla Harbour region and nearby creeks is less but with abundant population of few, with relatively few ecological niches and only very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran,2004).

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.797- 0.882 between selected sampling stations with an average of 0.862 during high tide period of spring tide . Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.845- 0.867 between selected sampling stations with an average of 0.854during consecutive low tide . Low species diversity suggests a relatively few successful species in this habitat. The environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in Kandla Harbour region and nearby creeks, during high tide period and low tide period during neap tide also, which was varying from 0.821-0.857 with an average value of 0.845 between selected sampling stations during high tide period and varying from 0.824-0.870 with an average

value of 0.853 between selected sampling stations during consecutive low tide period Low species diversity suggests a relatively few successful species in this habitat.

Table # 4PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN SEPTEMBER,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	109	16/21	76.19	3.197	0.9854	0.8739
	2	110	13/21	61.90	2.553	0.9544	0.8754
	3	107	13/21	61.90	2.568	0.9737	0.8824
	4	105	14/21	66.66	2.793	0.9885	0.8811
	5	116	15/21	71.43	2.945	0.9317	0.8627
	6	85	9/21	42.86	1.801	0.7711	0.7978
LOW TIDE	1	103	13/21	61.90	2.589	0.9277	0.8667
	2	132	13/21	61.90	2.458	0.9324	0.8648
	3	124	15/21	71.43	2.904	0.91	0.8451
	4	130	14/21	66.66	2.671	0.8926	0.8458
	5	133	15/21	71.43	2.863	0.9185	0.8479

Table # 5 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN SEPTEMBER,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	131	13/18	72.22	2.461	0.881	0.8452
	2	144	12/18	66.66	2.213	0.8693	0.8503
	3	145	10/18	55.55	1.808	0.8678	0.8511
	4	155	11/18	61.11	1.983	0.8653	0.8484
	5	153	12/18	66.66	2.187	0.911	0.8573
	6	42	8/18	44.44	1.873	0.7809	0.8211
LOW TIDE	1	131	11/18	61,11	2.051	0.8234	0.8243
	2	153	12/18	66.66	2.187	0.8951	0.8542
	3	182	16/18	88.88	2.882	0.9697	0.8703
	4	155	15/18	83.33	2.776	0.9374	0.8618
	5	164	11/18	61.11	1.961	0.8971	0.8564

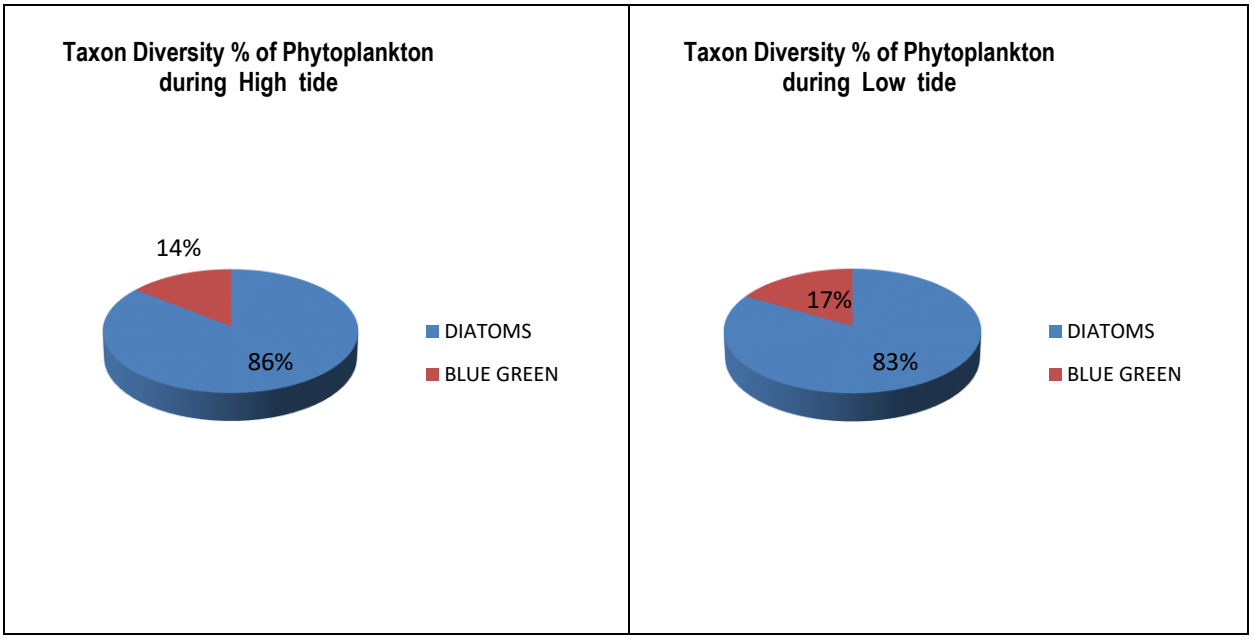
Table # 6 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING SPRING TIDE IN SEPTEMBER, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	83-110	18/21	85.71
			BLUE GREEN	2-12	3/21	14.29
			TOTAL PHYTO PLANKTON	**85-116**	**21**	-
LOW TIDE	Sub surface	5	DIATOMS	93-129	18/21	85.71
			BLUE GREEN	4-13	3/12	14.29
			TOTAL PHYTO PLANKTON	103-133	**21**	-

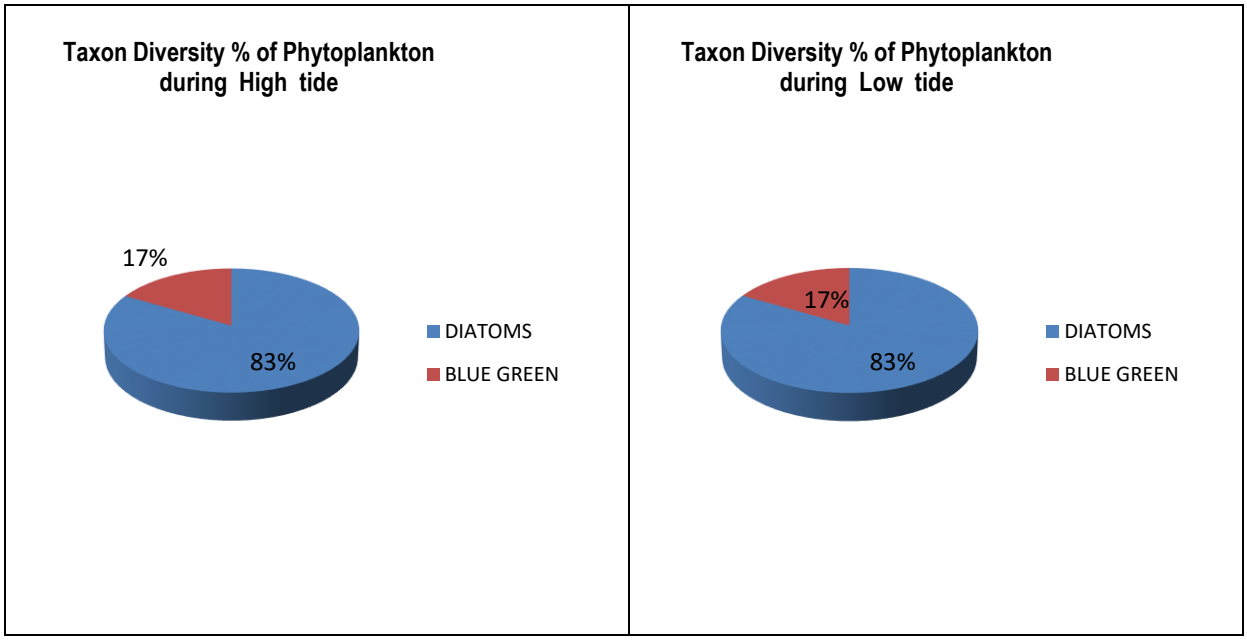
Table # 7 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING NEAP TIDE IN SEPTEMBER,2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	38-154	15/18	83.33
			BLUE GREEN	1-4	3/18	16.67
			TOTAL PHYTO PLANKTON	**42-155**	**18**	-
LOW TIDE	Sub surface	5	DIATOMS	131-177	15/18	83.33
			BLUE GREEN	0-5	3/18	16.67
			TOTAL PHYTO PLANKTON	**131-182**	**18**	-

Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide



Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide



ZOOPLANKTON POPULATION:

For the evaluation of the Zooplankton population in DPT harbour area and within the immediate surroundings of the port sampling was conducted from 6 sampling locations (3 in harbour area and two in Nakti creek and one in Khori creek) during high tide period and low tide period of spring tide and Neap tide in September,2021. The Zooplankton community of the sub surface water in the harbour and nearby creeks during spring tide was represented by mainly five groups, Tintinids, Copepods, Ciliates ,Foraminiferans and larval forms of Crustacea, Molluscans and Polychaetes. The Zooplankton community of the sub surface water in the harbour and nearby creeks during neap tide was represented by mainly Seven groups, Tintinids, Copepods, Arrow worms , Ciliates ,Mysids,Foraminiferans and larval forms of Crustaceans , Molluscansand Polychaetes,.

Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 32-86x10^3 N/ m^3 during high tide and 64-100 x103 N/ m^3during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 43-173 x103 N/ m^3 during high tide and115-184x10^3 N/ m^3during low tide of Neap Tide period.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the stations Kandla Harbour region and nearby creeks was varying from 2.825-3.507 with an average of 3.009during the sampling conducted in High tide period.Margalef's diversity index (Species Richness) S of Zooplankton communities varying from. 2.645-3.423 with an average of 3.020 during the sampling conducted in low tide period during Spring tide.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the Kandla Harbour region and nearby creeks sampling stations was varying from3.722- 4.463with an average of 4.061 during the sampling conducted in high tide and varying from. 4.163-4.647 with an average of 4.458 during the sampling conducted in low tide during Neap tide period **Shannon-Wiener's index:**

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.909-1.014 (H'(log10)) between selected sampling stations with an average value of 0.966 (H'(log10)) during high tide period of spring tide. Shannon-

Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.929-0.989(H'(log10)) between selected sampling stations with an average value of 0.963 (H'(log10)) during consecutive low tide period .

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.925-1.248 (H'(log10)) between selected sampling stations with an average value of 1.155 (H'(log10)) during high tide period of Neap tide. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 1.185-1.254 (H'(log10)) between selected sampling stations with an average value of 1.214 (H'(log10)) during consecutive low tide period .Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of Zooplankton of Kandla Harbour region and nearby creeks stations is slightly high with very minimum diverse population but very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran, 2004).

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 most of sampling stations in the Kandla Harbour region and nearby creeksduring high tide and low tide of spring tide period, which was varying from 0.849-0.889between selected sampling stations with an average of 0.872 during high tide period and was varying from 0.845- 0.880 with an average value of 0.868 between selected sampling stations during low tide

Simpson diversity index (1-D) of Zooplankton communities was above 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks except few during high tide and low tide period, which was varying from 0.834-0.939between selected sampling stations with an average of 0.914 during high tide period and was varying from 0.920- 0.939 with an average value of 0.929 between selected sampling stations during consecutive low tide

This high species diversity suggests a relatively more number of successful species in this habitat during September ,2021 sampling.

Table # 8 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN SEPTEMBER,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	72 $X10^3$	16/23	69.56	3.507	0.9864	0.8725
	2	70 $X10^3$	13/23	56.52	2.825	0.9094	0.8584
	3	81 $X10^3$	14/23	60.87	2.958	0.9324	0.8494
	4	82 $X10^3$	15/23	65.22	3.177	1.014	0.8871
	5	86 $X10^3$	14/23	60.87	2.918	1.008	0.8892
	6	32 $X10^3$	12/23	52.17	3.174	0.9456	0.875
LOW TIDE	1	80 $X10^3$	16/23	69.56	3.423	0.9692	0.8661
	2	64 $X10^3$	12/23	52.17	2.645	0.9299	0.873
	3	70 $X10^3$	13/23	56.52	2.825	0.9384	0.8451
	4	82 $X10^3$	14/23	60.87	2.95	0.9894	0.8802
	5	100 $X10^3$	16/23	69.56	3.257	0.9872	0.8772

Table # 9 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING NEAP TIDE IN SEPTEMBER,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	107 $X10^3$	21/29	72.41	4.28	1.16	0.9185
	2	123 $X10^3$	19/29	65.52	3.741	1.19	0.9315
	3	168 $X10^3$	22/29	75.86	4.098	1.205	0.9328
	4	173 $X10^3$	24/29	82.76	4.463	1.248	0.9389
	5	137 $X10^3$	21/29	72.41	4.065	1.203	0.9342
	6	43 $X10^3$	15/29	51.72	3.722	0.9255	0.8339
LOW TIDE	1	115 $X10^3$	22/29	75.86	4.426	1.185	0.9202
	2	122 $X10^3$	21/29	72.41	4.163	1.19	0.9252
	3	175 $X10^3$	25/29	86.21	4.647	1.254	0.9395
	4	184 $X10^3$	25/29	86.21	4.602	1.23	0.9342
	5	140 $X10^3$	23/29	79.31	4.452	1.21	0.9274

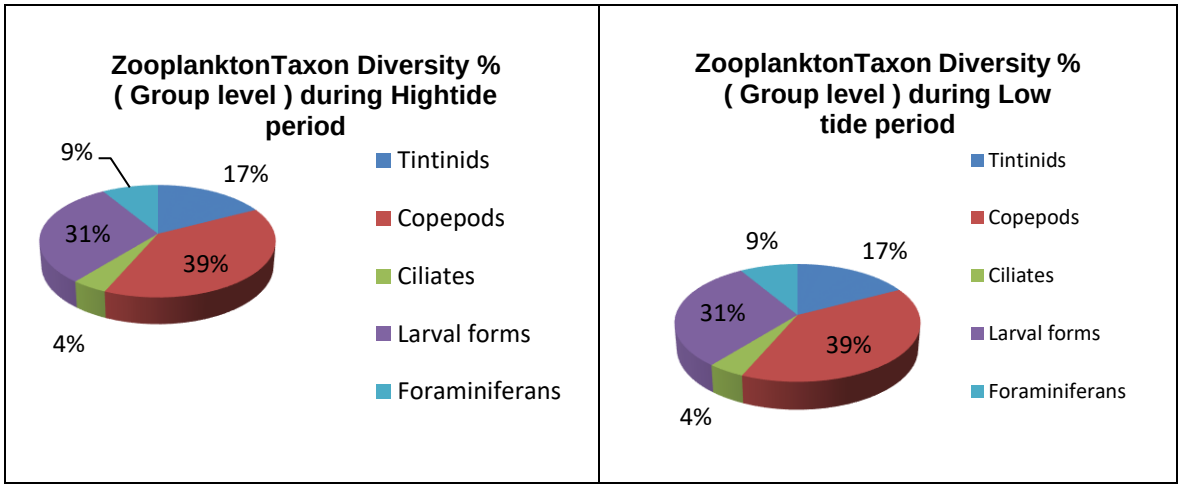
Table # 10 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS DURING SPRING TIDE IN SEPTEMBER,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	0-8	4/23	17.39
			Copepods	16-51	9/23	39.13
			Ciliates	0-1	1/23	4.35
			Larval forms	14-35	7/23	30.44
			Foraminiferans	0-3	2/23	8.69
			TOTAL ZOOPLANKTON NO/L	**32-86**	**23**	**23**
LOW TIDE	Sub surface	5	Tintinids	2-6	4/23	17.39
			Copepods	29-53	9/23	39.13
			Ciliates	0-1	1/23	4.35
			Larval forms	26-39	7/23	30.44
			Foraminiferans	1-4	2/23	8.69
			TOTAL ZOOPLANKTON NO/M3	**64-100**	**23**	**23**

Table # 11 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA, NEAR BY CREEKS DURING NEAP TIDE IN SEPTEMBER, 2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	1-8	4/29	13.79
			Copepods	17-71	13/29	44.83
			Arrow worms	0-1	1/29	3.45
			Ciliates	1-7	1/29	3.45
			Mysids	0-4	1/29	3.45
			Larval forms	22-87	8/29	27.58
			Foraminiferans	0-2	1/29	3.45
			TOTAL ZOOPLANKTON	**43-173**	**29**	-
LOW TIDE	Sub surface	5	Tintinids	2-8	4/29	13.79
			Copepods	38-70	13/29	44.83
			Arrow worms	0-1	1/29	3.45
			Ciliates	3-7	1/29	3.45
			Mysids	1-4	1/29	3.45
			Larval forms	67-106	8/29	27.58
			Foraminiferans	**0-1**	1/29	3.45
			TOTAL ZOOPLANKTON NO/M3	**115-184**	**29**	-

Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide



Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide

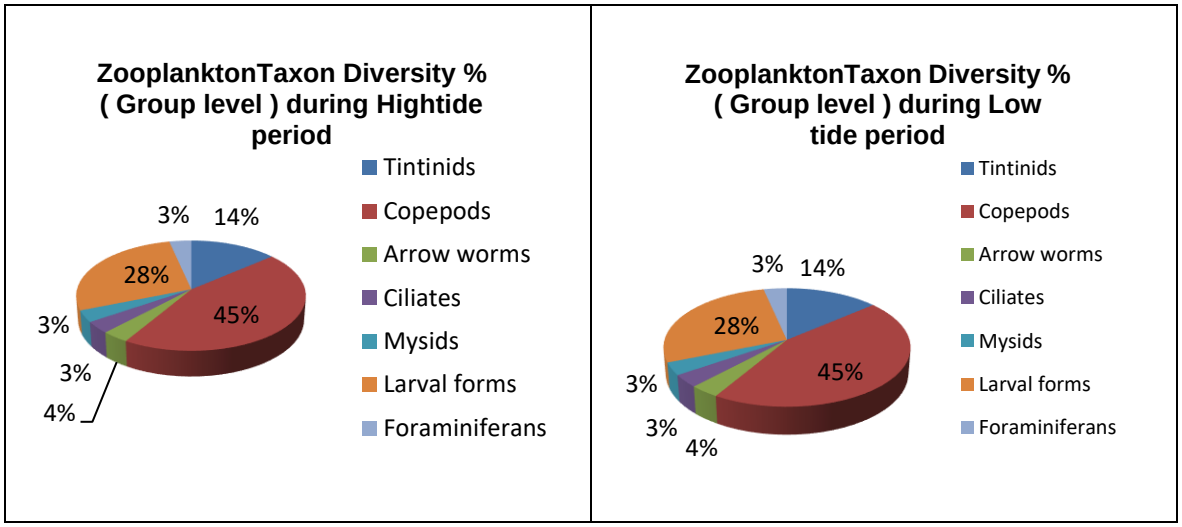


TABLE # 12 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURINGSPRING TIDE OF SEPTEMBER 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Occasional
					Arthrospira sp.	B2	Rare
			Stigonematales	Stigonemataceae	*Stigonema sp.*	B3	Rare
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Occasional
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Abundant
			Triceratiales	Triceratiaceae	*Odontella sp*	D3	Frequent
					Triceratium sp.	D4	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Dominant
			Hemiaulales	Bellerocheaceae	*Bellerochea* sp	D6	Rare
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D7	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros* sp	D8	Occasional
			Lithodesmiales	Lithodesmiaceae	*Ditylum sp*	D9	Abundant
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma* sp	D10	Rare
					Navicula sp	D11	Rare
			Surirellales	*Surirellaceae*	*Surirella* sp	D12	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D13	Frequent
					Thalassionema sp.	D14	Rare
			Fragilariales	Fragilariaceae	*Asterionellopsis sp.*	D15	Rare
					Fragilaria sp	D16	Occasional
					*Synedra*sp	D17	Rare
			Tabellariales	Tabellariaceae	*Tabellaria* sp	D18	Rare

TABLE # 13 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AND NEARBY CREEKS DURING AND NEAP TIDE OF SEPTEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Rare
					Arthrospira sp.	B2	Rare
			Stigonematales	Stigonemataceae	*Stigonema sp.*	B3	Occasional
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Abundant
			Triceratiales	Triceratiaceae	*Odontella sp*	D3	Frequent
					Triceratium sp.	D4	Occasional
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Dominant
			Hemiaulales	Bellerocheaceae	*Bellerochea* sp	D6	Occasional
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros* sp	D7	Rare
			Lithodesmiales	Lithodesmiaceae	*Ditylum sp*	D8	Abundant
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma* sp	D9	Occasional
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D10	Abundant
					Thalassionema sp.	D11	Rare
			Fragilariales	Fragilariaceae	*Asterionellopsis sp.*	D12	Rare
					Fragilaria sp	D13	Occasional
					*Synedra*sp	D14	Frequent
			Tabellariales	Tabellariaceae	*Tabellaria* sp	D15	Rare

TABLE #14 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING SPRING TIDE OF SEPTEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnus sp.*	T1	Rare
				Codonellidae	*Tintinnopsis gracilis*	T2	Occasional
					Tintinnopsis radix	T3	Rare
					Tintinnopsis tocantinensis	T4	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Abundant
				Eucalanidae	*Pareucalanus sp.*	C2	Rare
				Clausocalanidae	*Clausocalanus sp.*	C3	Occasional
				Acartiidae	*Acartia sp.*	C4	Rare
				Temoridae	*Temora sp.*	C5	Occasional
			Cyclopoida	Oithonidae	*Oithona sp.*	C6	Frequent
			Harpacticoida	Ectinosomatidae	*Microsetella* sp.	C7	Frequent
				Euterpinidae	*Euterpina sp.*	C8	Rare
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C9	Rare
CILIATES	CILIOPHORA	Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamnium sp.*	CI1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L2	Occasional
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L3	Rare
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L4	Rare
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda,Streptoneura			Opisthobranchia larvae	L5	Occasional
CYPHONAUTES LARVAE	BRYOZOA				Cyphonautes larvae	L6	Rare
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L7	Rare
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Globigerinidae	*Globigerina* sp.	F1	Rare
				Rotalliidae	*Rotalia* sp.	F2	Rare

TABLE # 15 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS IN DPT HARBOUR AREA, AND NEAR BY CREEKS DURING NEAP TIDE OF SEPTEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnus sp.*	T1	Rare
				Codonellidae	*Tintinnopsis gracilis*	T2	Occasional
					Tintinnopsis radix	T3	Rare
					Tintinnopsis failakkaensis	T4	Rare
COPEPODS	ATHROPODA	Crustacea Sub class copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Frequent
					Parvocalanus sp.	C2	Rare
				Eucalanidae	*Pareucalanus sp.*	C3	Rare
					Subeucalanus sp.	C4	Rare
				Clausocalanidae	*Clausocalanus sp.*	C5	Occasional
				Centropagidae	*Centropages sp.*	C6	Rare
				Tortanidae	*Tortanus sp.*	C7	Rare
				Acartiidae	*Acartia sp.*	C8	Frequent
				Temoridae	*Temora sp.*	C9	Occasional
			Cyclopoida	Oithonidae	*Oithona sp.*	C10	Abundant
			Harpacticoida	Ectinosomatidae	*Microsetella* sp.	C11	Frequent
				Euterpinidae	*Euterpina sp.*	C12	Occasional
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C13	Rare
ARROW WORMS	CHAETOGNATHA	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Rare
CILIATES	CILIOPHORA	Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamnium sp.*	CI1	Occasional
MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Penaeidae	*Penaeus sp.*	M1	Occasional
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L2	Abundant

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L3	Frequent
CYPHONAUTES LARVAE	BRYOZOA				Cyphonautes larvae	L4	Occasional
ECHINODERMATA LARVAE	ECHINODERMATA				Ophipluutes larvae/ Echinoplutes larvae	L5	Occasional
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L6	Occasional
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L7	Frequent
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L8	Frequent
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Rotalliidae	*Rotalia* sp.	F1	Rare

BENTHIC ORGANISMS:

Few Benthic organismswere observed in the collected sediments by using the Van-veen grabs during the sampling conducted during spring tide period and while no benthic organisms were observed during sampling conducted in Neap tide period from DPT harbour region and nearby creek except few dead shells.The meiobenthic organisms during spring tide were represented by Polychaetes,and Nematodes. The polychaetes were represented by *Scyphoproctus sp*. and *Branchiocapitelida* sp*s,*during spring tide sampling. The meiobenthic organisms in the collected samples were varying from 0-80N/M ^{2}.

Table # 16 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPT HARBOUR AREA CREEKS DURING SPRING TIDE IN SEPTEMBER ,2021

Benthic fauna	ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS REPRESENTATION BY GROUP						
	DPT HARBOUR			CREEKS			
POLYCHAETES	KPT-1	KPT-2	KPT-3	KPT-4	KPT-5	KPT-6	
Family : Capitellidae Scyphoproctus *sp.*	40	0	0	0	0	NS	
Family : Capitellidae Branchiocapitelida *sp.*	0	20	0	0	0		
Total Polychates N/M^2	40	20	0	00	0	NS	
Un identified Nematode worms	40	20	0	10	0	NS	
TOTAL Benthic Fauna NUMBER/ M^2	80	40	0	10	0	-	

NS : No sample

7. Meteorological Data

Automatic Weather station have been installed in SevaSadan -3 at the Deendayal Port which records the data on Temperature (°C), Humidity (%),Wind (mph), Dew Point (°C), Wind Direction (°), Pressure, Solar radiation, heat Index and UVI.

Temperature

The mean day time temperature for Deendayal Port was 29.0 °C. The day-time maximum temperature was 36.2 °C. The mean night time temperature was 26.7 °C. The minimum mean night time temperature recorded was 29.4 °C.

Air Pressure

The mean absolute air pressure for the month of September was 1003.7 hpa, whereas the mean relative pressure was 1002.3 hpa. The maximum absolute air pressure recorded for the month of September was 1010.1 hpa.

Heat Index

The mean day-time heat index for the month of September was 33.5 ^{o}C. The maximum heat index recorded was 49^{o}C.

Solar Radiation

The mean Solar Radiation in September was 136.4 w/m^2. The maximum solar radiation recorded in the month of September was 808.9 w/m^2.

Humidity

The mean day-time humidity was 83.5 % for the month of September and mean night time humidity was 98.0%. Maximum humidity recorded during day-time was 90.3 % and maximum humidity recorded during night-time was 96.0%.

Wind Velocity and Wind Direction

The mean wind velocity for the entire month of September was 6.88 km/hour. Maximum wind velocity recorded was 43.2 Km/hr . The wind direction was mostly S to SW.

Conclusive Summary and Remedial measures Suggested

- The AAQ monitoring at six locations of Deendayal Port indicates that the mean PM_{10} values at four locations viz. Coal storage area, Marine Bhavan and Oil Jetty area were found above the permissible standards (100 µg/m^3)and$PM_{2.5}$was above permissible limits at Coal storage location(Limit 60 µg/m^3).

- Drinking water at all the twenty locations was found potable and was within permissible limits of BIS standards (IS 10500).

- Noise quality was also within the set permissible standards of an Industrial Area. The noise level observed during day time was >75 dB (A) and at night time was >70 dB (A) during the entire monitoring period.

- The sewage treated water of Deendayal Port Colony (Gopalpuri) was in line with the standards set by the Gujarat Pollution Control Board. The STP at Deendayal Port is not fully operational and STP at Vadinar Port was found non-operational.

Reasons for higher Values of PM_{10}

- Large amount of coal is handled at Berth No. 6, 7, 8 and 9. The unloading of coal directly in the truck, using grabs cause coal to spread in air as well as coal dust to fall on ground. This settled coal dust again mixes with the air while trucks travel through it.

- Also, the coal laden trucks are not always covered with tarpaulin sheets and these results in spillage of coal from trucks/dumpers during its transit from vessel to yard or storage site. This also increased PM values around marine Bhavan & Coal storage area.

Remedial Measures

The values of PM_{10} during the month of September, 2021 were observed beyond the permissible limit at four locations mentioned above. Given below are the remedial measures suggest to minimize the Air pollution at Deendayal Port.

- Guidelines for Coal Handling by GPCB should be strictly followed. (http://gpcb.gov.in/pdf/coal-handling-guidelines.pdf)
- Except for the higher values of PM_{10} at Coal storage site, Oil Jetty, Tuna Port and Marine Bhavan locations, the monitoring results for the present month suggest that the overall Environment Quality of Deendayal Port is satisfactory.

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ENVIRONMENTAL MONITORING REPORT
FOR
DEENDAYAL PORT TRUST

REPORT NO.	:	DCPL/DPT/20-21/18
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Introduction

Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the national standards and any other relevant standards by GBCB/CPCB/MoEF to identify non conformity in the Environment of the Deendayal Port. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port.

The environmental monitoring is carried out as per the Environment Management and Monitoring Plan submitted by Detox Corporation Pvt. Ltd.

1. Ambient Air Quality Monitoring

As per the Environmental Monitoring Plan of Deendayal Port Trust, Air monitoring was carried out at six identified locations at Deendayal Port and two locations at Vadinar Port.

1.1 Air Quality Monitoring Methodology

Air quality is measured in all the stations, for 24 hour for Total Suspended Particulate Matter (TSPM), PM_{10}, $PM_{2.5}$, SO_2, NO_X, NH_3 & Benzene, and Grab-sampling for CO & CO_2 measurements. The Air samplers are operated for a period of 24 hours and after a continuous operation of 8 hours of the sampler, the reagents were replaced to obtain 3 samples per day for each parameter namely, SO_2, NO_X. The EPM 2000 filter paper and PTFE Membrane bound filter paper are used for a period of 24 hours to obtain one sample each of TSPM, PM_{10} & $PM_{2.5}$.

The AAQ samples are collected twice a week from all the eight locations as per the EMP.

1.2 Results

The ambient air quality monitoring data for six stations, viz. Marine Bhavan, Oil Jetty, Port Colony,Gopalpuri Hospital,Tuna Port and Nr. Coal Storage Area for the month of October 2021 are given in Tables 1A to 6B. The ambient air quality monitoring data for two stations at Vadinar (Nr. Admin Building &Nr. Signal Building) are given in Tables 7A to 8B.

Location 1: Marine Bhavan (AL1)

Table 1 : Results of Air Pollutant Concentration at Marine Bhavan

Parameter	Date	TSPM [µg/m3]	PM10 [µg/m3]	PM2.5 [µg/m3]	SO2 [µg/m3]		NOx [µg/m3]		NH3 [µg/m3]	
Sampling Period	-	24hr	24hr	24hr	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)
NAAQMS limit	-	NS	100 µg/m3	60 µg/m3		80 µg/m3		80 µg/m3		400 µg/m3
AL1 – 1	06.10.2021	349	165	80	2.20	2.64	26.04	25.19	12.76	13.44
					3.96		24.14		12.25	
					1.76		25.41		15.32	
AL1 – 2	08.10.2021	474	229	103	4.40	3.22	15.24	19.27	12.51	13.02
					3.08		16.51		13.02	
					2.20		26.04		13.53	
AL1 – 3	13.10.2021	280	162	58	7.47	7.33	28.58	26.04	10.72	10.81
					8.79		31.12		12.51	
					5.71		18.42		9.19	
AL1 – 4	15.10.2021	404	227	95	3.08	2.49	16.51	15.24	13.79	14.89
					2.64		13.97		15.83	
					1.76		15.24		15.06	
AL1 – 5	20.10.2021	336	156	73	3.52	3.96	18.42	20.54	5.87	9.28
					4.84		20.96		10.72	
					3.52		22.23		11.23	
AL1 - 6	22.10.2021	453	267	85	2.64	3.52	15.88	15.67	10.72	6.47
					5.28		19.69		5.62	
					2.64		11.43		3.06	
AL1 - 7	27.10.2021	338	163	76	3.52	3.37	12.07	16.73	10.47	10.55
					3.96		20.96		11.49	
					2.64		17.15		9.70	
AL1 – 8	29.10.2021	275	152	88	2.64	3.08	24.14	25.19	12.51	9.02
					2.20		29.22		6.64	
					4.40		22.23		7.91	
Monthly Average		364	190	82		3.70		20.48		10.93
Standard Deviation		74	44	14		1.54		4.50		2.75

NS: Not Specified

Table 1B : Results of Air Pollutant Concentration at Marine Bhavan					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL1 – 1	06.10.2021	1.12	BQL	1.89	492
AL1 – 2	08.10.2021	1.11	BQL	1.75	489
AL1 – 3	13.10.2021	1.32	BQL	1.82	499
AL1 – 4	15.10.2021	1.15	BQL	1.76	492
AL1 – 5	20.10.2021	1.13	BQL	1.84	493
AL1 - 6	22.10.2021	1.15	BQL	1.86	501
AL1 – 7	27.10.2021	1.21	BQL	1.88	488
AL1 – 8	29.10.2021	1.13	BQL	1.95	511
Monthly Average		**1.17**	**-**	**1.84**	**496**
Standard Deviation		**0.07**	**-**	**0.07**	**8**

* NMHC- Non- Methane Hydrocarbons

BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

NS -Not Specified

At Marine Bhavan, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_X and NH_3 is attributed mainly by motor vehicle emission produced from various types of automobiles (both diesel and petrol driven). Moreover, the loading and unloading of Food Grains and Timber at Jetty no. 1 and 2 also contributes to the high levels of TSPM and PM_{10}. The mean TSPM value at Marine Bhavan was 364 µg/m³, The mean PM_{10} values were 190.0 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 82 µg/m³). The average values of SO_2, NO_x and NH_3 were within the permissible limit. The average values of SO_2, NO_x and NH3 were 3.70 µg/ m³, 20.48 µg/ m³ & 10.93 µg/ m³ respectively. These were within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Marine Bhavan. The mean Benzene concentration was 1.17 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.84 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 2: Oil Jetty (AL2)

Table 2 : Results of Air Pollutant Concentration at Oil Jetty										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL2 – 1	06.10.2021	380	162	82	4.40	5.28	33.66	33.66	8.93	9.96
					5.28		36.84		10.21	
					6.15		30.49		10.72	
AL2 – 2	08.10.2021	486	284	103	1.76	3.96	8.89	11.01	6.38	9.62
					4.84		9.53		10.98	
					5.28		14.61		11.49	
AL2 – 3	13.10.2021	451	300	89	7.47	9.52	32.39	24.35	3.57	6.30
					9.23		18.42		6.13	
					11.87		22.23		9.19	
AL2 – 4	15.10.2021	480	335	100	2.20	2.05	16.51	14.82	7.40	8.93
					2.64		14.61		10.47	
					1.32		13.34		8.93	
AL2 – 5	20.10.2021	464	190	76	2.64	2.49	20.33	19.48	9.19	7.32
					1.76		24.77		4.85	
					3.08		13.34		7.91	
AL2 – 6	22.10.2021	509	280	100	4.84	5.28	20.96	14.82	5.62	8.00
					7.03		10.16		7.91	
					3.96		13.34		10.47	
AL2 – 7	27.10.2021	448	215	71	1.76	1.76	22.87	19.48	9.19	10.04
					1.32		14.61		12.51	
					2.20		20.96		8.42	
AL2 – 8	29.10.2021	504	204	92	1.32	2.49	14.61	17.36	6.38	9.10
					2.20		22.87		9.96	
					3.96		14.61		10.98	
Monthly Average		465	246	89		4.10		19.37		8.66
Standard Deviation		41	61	12		2.59		7.01		1.34

NS: Not Specified

Table 2B : Results of Air Pollutant Concentration at Oil Jetty					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL2 -1	06.10.2021	1.11	BQL	1.88	499
AL2 -2	08.10.2021	1.21	BQL	1.78	495
AL2 -3	13.10.2021	1.26	BQL	1.86	468
AL2 -4	15.10.2021	1.11	BQL	1.83	466
AL2 – 5	20.10.2021	1.22	BQL	1.89	458
AL2 – 6	22.10.2021	1.18	BQL	1.87	488
AL2 -7	27.10.2021	1.01	BQL	1.77	498
AL2 – 8	29.10.2021	1.14	BQL	1.82	501
Monthly Average		**1.16**	**-**	**1.84**	**484**
Standard Deviation		**0.08**	**-**	**0.05**	**17**

* NMHC- Non- Methane Hydrocarbons

BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Oil Jetty area was mainly by motor vehicle emission produced from various types of vehicles Oil Jetty Area. The mean TSPM values at Oil Jetty were 465 µg/m³ .The mean PM_{10} values were 246 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 89 µg/m³).The average values of SO_2, NO_x and NH_3 were within the permissible limit, The mean concentration of SO_2, NO_x and NH3 were 4.10 µg/m³, 19.37 µg/m³ and 8.66 µg/m³ respectively.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Oil Jetty. The mean Benzene concentration was 1.16 µg/m³ .Well below the permissible limit of 5.0 µg/m³. , HC's were below the detectable limit and Carbon Monoxide concentration was 1.84 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 3: Kandla Colony – Estate Office (AL-3)

Table 3 : Results of Air Pollutant Concentration at Estate Office										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL3 – 1	06.10.2021	355	161	79	4.84	3.37	12.70	23.08	14.30	12.00
					3.52		24.14		12.25	
					1.76		32.39		9.45	
AL3 – 2	08.10.2021	280	121	76	3.96	2.64	13.34	12.49	10.47	9.10
					1.32		9.53		11.49	
					2.64		14.61		5.36	
AL3 – 3	13.10.2021	420	282	98	3.08	3.52	13.97	19.48	7.91	5.87
					4.84		19.69		6.38	
					2.64		24.77		3.32	
AL3 – 4	15.10.2021	530	287	101	4.40	2.93	8.89	8.05	12.25	9.10
					2.64		8.26		9.19	
					1.76		6.99		5.87	
AL3 – 5	20.10.2021	401	239	98	5.28	3.66	18.42	23.50	8.93	9.19
					3.08		32.39		9.70	
					2.64		19.69		8.93	
AL3 – 6	22.10.2021	381	244	93	5.28	4.40	18.42	19.27	10.47	8.25
					1.76		14.61		8.93	
					6.15		24.77		5.36	
AL3 – 7	27.10.2021	466	194	90	4.84	2.93	19.69	17.36	11.23	10.81
					2.64		16.51		10.72	
					1.32		15.88		10.47	
AL3 – 8	29.10.2021	380	222	87	1.76	2.93	15.88	16.94	12.00	9.10
					4.40		15.24		9.70	
					2.64		19.69		5.62	
Monthly Average		402	219	90		3.30		17.52		9.18
Standard Deviation		74	58	9		0.56		5.20		1.79

NS: Not Specified

Table 3B : Results of Air Pollutant Concentration at Kandla Port Colony					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL3 -1	06.10.2021	1.01	BQL	1.85	489
AL3 -2	08.10.2021	1.12	BQL	1.98	496
AL3 -3	13.10.2021	1.02	BQL	1.79	488
AL3 -4	15.10.2021	1.11	BQL	1.81	499
AL3 – 5	20.10.2021	1.06	BQL	1.88	480
AL3 – 6	22.10.2021	1.18	BQL	1.79	485
AL3 – 7	27.10.2021	1.26	BQL	1.96	472
AL3 – 8	29.10.2021	1.14	BQL	1.88	498
Monthly Average		**1.11**	**-**	**1.87**	**488**
Standard Deviation		**0.08**	**-**	**0.07**	**9**

* NMHC- Non- Methane Hydrocarbons

BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Kandla Port Colony was attributed by vehicle emission produced from trucks and heavy duty vehicles that pass through the road outside Kandla Port Colony. The mean TSPM values at Oil Jetty were 402 µg/m³, The mean PM_{10} values were 219 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 90 µg/m³). The average values of SO_2, NO_x and NH3 were 3.30 µg/m³, 17.52 µg/m³ and 9.18 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Kandla Port Colony. The mean Benzene concentration was 1.11 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.87 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 4: Gopalpuri Hospital (AL-4)

Table 4 : Results of Air Pollutant Concentration at Gopalpuri Hospital										
Parameter	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL4 -1	06.10.2021	158	96	40	6.15	4.40	18.42	25.83	3.83	5.87
					3.96		25.41		7.40	
					3.08		33.66		6.38	
AL4 -2	08.10.2021	246	115	77	3.96	5.28	12.70	10.37	4.85	5.70
					5.28		9.53		5.11	
					6.59		8.89		7.15	
AL4 -3	13.10.2021	302	129	66	2.20	2.64	10.16	11.22	3.83	4.25
					3.08		12.70		4.85	
					2.64		10.80		4.08	
AL4 -4	15.10.2021	414	267	89	2.20	2.20	10.16	8.68	6.38	5.45
					2.64		9.53		4.60	
					1.76		6.35		5.36	
AL4 – 5	20.10.2021	268	128	90	2.64	2.64	14.61	14.61	4.85	6.64
					3.08		9.53		8.42	
					2.20		19.69		6.64	
AL4 – 6	22.10.2021	219	114	93	2.64	2.49	13.34	12.49	4.85	8.51
					3.08		9.53		9.19	
					1.76		14.61		11.49	
AL4 – 7	27.10.2021	274	132	84	2.64	3.08	17.78	15.88	6.38	6.55
					3.08		13.34		7.91	
					3.52		16.51		5.36	
AL4 – 8	29.10.2021	311	142	96	2.20	3.22	13.34	12.70	7.40	8.25
					3.52		13.97		8.42	
					3.96		10.80		8.93	
Monthly Average		274	140	79		3.24		13.97		6.40
Standard Deviation		75	53	18		1.06		5.30		1.43

NS: Not Specified

Table 4B : Results of Air Pollutant Concentration at Gopalpuri Hospital					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL4 -1	06.10.2021	1.02	BQL	1.88	496
AL4 -2	08.10.2021	1.11	BQL	1.68	482
AL4 -3	13.10.2021	1.32	BQL	1.65	501
AL4 -4	15.10.2021	1.25	BQL	1.79	499
AL4 – 5	20.10.2021	1.52	BQL	1.65	501
AL4 – 6	22.10.2021	1.32	BQL	1.82	508
AL4 – 7	27.10.2021	1.23	BQL	1.7	487
AL4 – 8	29.10.2021	1.58	BQL	1.76	496
Monthly Average		**1.29**	**-**	**1.74**	**496**
Standard Deviation		**0.19**	**-**	**0.08**	**8**

* NMHC- Non- Methane Hydrocarbons

BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Gopalpuri Hospital was attributed by vehicle emission produced from light motor vehicles of the colony residents. The mean TSPM values at Oil Jetty were 274 µg/m³, The mean PM_{10} values were 140 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean= 79 µg/m³). The average values of SO_2, NO_x and NH_3 were 3.24 µg/m³, 13.97 µg/m³ and 6.40 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Gopalpuri Hospital. The mean Benzene concentration was 1.29 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.74 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 5: Coal Storage Area (AL-5)

Table 5 : Results of Air Pollutant Concentration at Coal Storage Area										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL5 – 1	06.10.2021	266	122	92	4.40	5.71	44.46	49.33	15.32	14.04
					6.15		49.54		13.53	
					6.59		53.99		13.27	
AL5 – 2	08.10.2021	360	208	79	3.96	3.96	20.33	18.84	15.57	16.25
					2.64		22.23		17.61	
					5.28		13.97		15.57	
AL5 – 3	13.10.2021	647	226	110	10.11	8.65	22.23	22.87	7.91	7.32
					6.15		26.04		6.13	
					9.67		20.33		7.91	
AL5 – 4	15.10.2021	760	217	118	1.32	2.93	16.51	18.84	12.51	9.62
					3.52		19.69		8.42	
					3.96		20.33		7.91	
AL5 – 5	20.10.2021	597	244	110	4.84	4.25	19.69	20.75	10.72	11.32
					4.40		17.78		10.98	
					3.52		24.77		12.25	
AL5 – 6	22.10.2021	647	206	106	3.52	4.54	14.61	17.15	14.30	14.47
					3.96		15.88		15.06	
					6.15		20.96		14.04	
AL5 – 7	27.10.2021	614	249	107	4.40	4.25	13.34	16.51	9.96	9.36
					4.84		17.78		9.19	
					3.52		18.42		8.93	
AL5 – 8	29.10.2021	324	151	117	4.84	4.10	22.87	25.41	12.51	14.04
					3.96		27.95		14.30	
					3.52		25.41		15.32	
Monthly Average		527	203	105		4.80		23.71		12.05
Standard Deviation		182	44	13		1.73		10.76		3.11

NS: Not Specified

Table 5B : Results of Air Pollutant Concentration at Coal Storage Area					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL5 – 1	06.10.2021	1.22	BQL	1.85	498
AL5 – 2	08.10.2021	1.32	BQL	1.86	488
AL5 – 3	13.10.2021	1.22	BQL	1.89	485
AL5 – 4	15.10.2021	1.16	BQL	1.84	501
AL5 – 5	20.10.2021	1.33	BQL	1.86	496
AL5 – 6	22.10.2021	1.24	BQL	1.9	500
AL5 – 7	27.10.2021	1.15	BQL	1.84	490
AL5 – 8	29.10.2021	1.18	BQL	1.98	498
Monthly Average		**1.23**	**-**	**1.88**	**495**
Standard Deviation		**0.07**	**-**	**0.05**	**6**

* NMHC- Non- Methane Hydrocarbons

BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Coal Storage Area was comparatively highest among all the locations of Air Quality monitoring in Kandla Port. High values of TSPM, $PM_{10,}$ $PM_{2.5}$, SO_2, NO_X at this location was due to lifting of coal with grab and other coal handling processes near Berth no. 6 & 7. Moreover, the traffic was also heavy around this place for transport of coal thus emissions produced from heavy vehicles. The mean TSPM values at Coal storage were 527µg/m³. The mean PM_{10} values were 203 µg/m³, which is well above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 105 µg/m³). The average values of SO_2, NO_x and NH_3 were 4.80 µg/m³, 23.71 µg/m³ and 12.05 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Coal Storage Area. The mean Benzene concentration was 1.23 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.88 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 6: Tuna Port (AL-6)

Table 6 : Results of Air Pollutant Concentration at Tuna Port										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL6 -1	06.10.2021	280	134	98	4.40	4.10	15.88	29.85	5.62	7.40
					6.15		33.66		7.66	
					1.76		40.02		8.93	
AL6 – 2	08.10.2021	293	130	92	1.76	3.22	13.34	12.49	13.53	11.49
					3.08		13.97		12.25	
					4.84		10.16		8.68	
AL6 – 3	13.10.2021	438	251	103	6.15	4.69	16.51	16.94	6.38	5.96
					5.71		20.96		4.08	
					2.20		13.34		7.40	
AL6 – 4	15.10.2021	466	153	100	2.20	1.76	5.08	6.78	5.62	6.47
					1.76		8.26		7.15	
					1.32		6.99		6.64	
AL6 – 5	20.10.2021	480	180	94	1.32	2.64	20.33	16.94	12.25	11.57
					2.64		13.97		11.49	
					3.96		16.51		10.98	
AL6 – 6	22.10.2021	310	123	88	4.84	3.22	32.39	27.31	9.96	12.76
					2.20		20.96		15.57	
					2.64		28.58		12.76	
AL6 – 7	27.10.2021	275	140	93	2.20	2.49	15.24	15.88	9.19	9.36
					1.76		16.51		8.42	
					3.52		15.88		10.47	
AL6 – 8	29.10.2021	352	191	98	2.20	2.93	15.88	15.03	10.72	10.30
					2.64		10.80		8.93	
					3.96		18.42		11.23	
Monthly Average		362	163	96		3.13		17.65		9.41
Standard Deviation		86	43	5		0.92		7.54		2.55

NS: Not Specified

Table 6B : Results of Air Pollutant Concentration at Tuna Port					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL6 -1	06.10.2021	1.03	BQL	1.79	510
AL6 – 2	08.10.2021	1.11	BQL	1.84	502
AL6 – 3	13.10.2021	1.14	BQL	1.72	511
AL6 – 4	15.10.2021	1.11	BQL	1.69	496
AL6 – 5	20.10.2021	1.18	BQL	1.88	499
AL6 – 6	22.10.2021	1.06	BQL	1.87	502
AL6 – 7	27.10.2021	1.10	BQL	1.74	506
AL6 – 8	29.10.2021	1.01	BQL	1.7	512
Monthly Average		**1.09**	**-**	**1.78**	**505**
Standard Deviation		**0.06**	**-**	**0.08**	**6**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS- Not Specified

The mean TSPM values at Tuna Port were 362 µg/m³, The mean PM_{10} values were 163 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 96 µg/m³). The average values of SO_2, NO_x and NH_3 were 3.13 µg/m³, 17.65 µg/m³ and 9.41 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Tuna Port. The mean Benzene concentration was 1.09 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.78 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 7: Signal Building (Vadinar) (AL-7)

Table 7 : Results of Air Pollutant Concentration at Signal Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	-	**80 µg/m3**	-	**80 µg/m3**	-	**400 µg/m3**
AL7 -1	06.10.2021	115	73	30	4.40	3.52	19.69	18.63	6.89	6.21
					3.52		22.23		6.38	
					2.64		13.97		5.36	
AL7 -2	08.10.2021	111	62	34	3.96	2.78	16.51	16.94	8.42	8.42
					1.76		20.33		6.13	
					2.64		13.97		10.72	
AL7 -3	13.10.2021	198	107	52	3.08	3.08	16.51	16.51	4.60	5.45
					3.96		23.50		5.11	
					2.20		9.53		6.64	
AL7 -4	15.10.2021	146	72	50	3.96	4.40	15.24	12.91	7.91	7.06
					5.28		11.43		9.96	
					3.96		12.07		3.32	
AL7 -5	20.10.2021	171	85	44	3.08	2.64	8.89	9.32	6.89	7.23
					2.20		8.26		8.93	
					2.64		10.80		5.87	
AL7 -6	22.10.2021	178	88	71	3.08	4.54	14.61	12.49	8.42	8.17
					4.84		9.53		8.68	
					5.71		13.34		7.40	
AL7 -7	27.10.2021	160	80	52	3.08	3.81	6.35	11.22	10.98	8.25
					2.64		15.24		5.36	
					5.71		12.07		8.42	
AL7 -8	29.10.2021	177	89	56	2.20	3.52	9.53	10.16	8.42	5.96
					3.96		12.07		3.32	
					4.40		8.89		6.13	
Monthly Average		157	82	49		3.5		13.5		7.1
Standard Deviation		31	14	13		0.7		3.4		1.1

NS: Not Specified

Table 7B : Results of Air Pollutant Concentration at Signal Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL7 -1	06.10.2021	1.10	BQL	1.71	466
AL7 – 2	08.10.2021	1.13	BQL	1.62	488
AL7 – 3	13.10.2021	1.06	BQL	1.66	479
AL7 – 4	15.10.2021	1.11	BQL	1.72	480
AL7 – 5	20.10.2021	1.16	BQL	1.59	486
AL7 – 6	22.10.2021	1.17	BQL	1.66	477
AL7 – 7	27.10.2021	1.04	BQL	1.79	468
AL7 – 8	29.10.2021	1.10	BQL	1.64	470
Monthly Average		**1.11**	**-**	**1.67**	**477**
Standard Deviation		**0.04**	**-**	**0.06**	**8**

*NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS_ Not Specified

The mean TSPM values at Vadinar Port were 157 µg/m³. The mean PM_{10} values were 82 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 49 µg/m³). The average values of SO_2, NO_x and NH_3 were 3.5 µg/m³, 13.5 µg/m³ and 7.1 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.11 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.67 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 8: Admin Building (Vadinar) (AL-8)

Table 8 : Results of Air Pollutant Concentration at Admin Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	-	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	-	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL8 -1	06.10.2021	221	113	82	2.64	3.22	8.89	12.28	7.40	5.79
					3.08		14.61		5.87	
					3.96		13.34		4.08	
AL8 -2	08.10.2021	218	126	73	4.40	5.42	27.95	18.21	4.08	6.81
					5.28		15.88		10.72	
					6.59		10.80		5.62	
AL8 -3	13.10.2021	197	104	72	3.08	3.22	10.16	17.57	5.87	9.02
					3.96		26.68		11.74	
					2.64		15.88		9.45	
AL8 -4	15.10.2021	227	111	75	2.20	3.37	20.96	15.24	8.42	6.30
					4.40		14.61		4.08	
					3.52		10.16		6.38	
AL8 -5	20.10.2021	185	88	54	4.40	3.52	15.24	16.73	8.42	6.98
					2.64		20.96		6.64	
					3.52		13.97		5.87	
AL8 -6	22.10.2021	248	121	94	3.96	3.81	8.89	10.37	5.36	5.19
					2.20		8.26		4.08	
					5.28		13.97		6.13	
AL8 -5	27.10.2021	210	138	62	3.08	3.66	13.97	13.76	15.06	10.64
					1.32		6.35		11.49	
					6.59		20.96		5.36	
AL8-6	29.10.2021	186	128	50	3.08	3.23	15.88	11.01	4.08	5.53
					2.20		8.89		5.87	
					4.40		8.26		6.64	
Monthly Average		211	116	70		3.7		14.4		7.0
Standard Deviation		22	16	15		0.7		3.0		1.9

NS: Not Specified

Table 8B : Results of Air Pollutant Concentration at Admin Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL8 -1	06.10.2021	1.30	BQL	1.86	451
AL8-2	08.10.2021	1.09	BQL	1.79	450
AL8 -3	13.10.2021	1.20	BQL	1.71	462
AL8-4	15.10.2021	1.11	BQL	1.82	455
AL8 -5	20.10.2021	1.16	BQL	1.69	469
AL8-6	22.10.2021	1.06	BQL	1.77	470
AL8-7	27.10.2021	1.30	BQL	1.82	459
AL8-8	29.10.2021	1.10	BQL	1.74	466
Monthly Average		**1.17**	**-**	**1.78**	**460**
Standard Deviation		**0.09**	**-**	**0.06**	**8**

* NMHC- Non- Methane Hydrocarbons

BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)

NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Admin Building Vadinar was comparatively low among all the locations of Air Quality monitoring in Kandla Port and Vadinar Port. The mean TSPM values at Vadinar Port were 211 µg/m³. The mean PM_{10} values were 116 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 70.0 µg/m³). The average values of SO_2, NO_x and NH_3 were 3.7 µg/m³, 14.4 µg/m³ and 7.0 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Admin Building, Vadinar Port. The mean Benzene concentration was 1.17 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.78 mg/m³, well below the permissible limit of 4.0 mg/m³.

1.4 Observations and Conclusion

During the monitoring period, the overall Ambient Air Quality of the port area was found to be well within the desired levels for various gaseous pollutants. However, Particulate matter as PM_{10} and $PM_{2.5}$ was found to exceed the limits at locations like Near Coal storage area, Marine Bhavan, Estate Office, Tuna Port and Oil Jetty area.

2. Drinking Water Quality Monitoring

Drinking Water Quality Monitoring was carried out at twenty stations at Kandla, Vadinar & Township Area of Deendayal Port.

2.1 Drinking Water Monitoring Methodology

Drinking water samples were collected from 20 locations as prescribed in the tender document. Samples for physico-chemical analysis were collected in 1 liter carboys and samples for microbiological parameters were collected in sterilized bottles. These samples were then analyzed in laboratory for various drinking water parameters at Kandla Lab/Surat.

The Sampling and Analysis was done as per standard methods - IS 10500:2012. The water samples were analyzed for various parameters, viz. Color , Odor, Turbidity , Conductivity , pH , Chlorides , TDS, Total Hardness, Iron , Sulphate , Salinity , DO, BOD, Na, K, Ca, Mg, F, NO_3, NO_2, Mn, Cr-6, Cu, Cd, As, Hg, Pb, Zn, Bacterial Count (cfu) .

2.2 Results

The Drinking Water Quality monitoring data for 20 stations are given in below from table No. 9 to Table No. 15

Table 9: Drinking Water Quality Monitoring Parameters for Nirman Building 1, P & C building & Main Gate (North) at Kandla

Sr. No.	Parameter	Unit	Nirman Building 1	P & C building	Main Gate North	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.3	7.4	7.3	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	970	1310	1250	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1860	2560	2430	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	476.06	440.98	506.13	250.0	1000.0
9	Ca as Ca	mg/l	64.13	68.14	72.14	75.0	200.0
10	Mg as Mg	mg/l	63.18	70.47	65.61	30.0	100.0
11	Total Hardness	mg/l	420	460	450	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.32	0.35	0.17	1.0	1.5
14	Sulphate as SO4	mg/l	286.8	289.2	194.4	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	6.41	7.88	13.02	45.0	No Relaxation
17	Salinity	%	0.86	0.80	0.91	NS*	NS*
18	Sodium as Na	mg/l	199	193	258	NS*	NS*
19	Potassium as K	mg/l	3.24	3.68	3.51	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 10: Drinking Water Quality Monitoring Parameters for Canteen, West Gate – I &Wharf Area at Kandla

Sr. No.	Parameter	Unit	Canteen	West Gate – I	Wharf Area	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.7	7.4	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1340	980	1040	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2600	1940	2040	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride as Cl	mg/l	526.17	496.10	481.07	250.0	1000.0
9	Ca as Ca	mg/l	60.12	64.13	56.11	75.0	200.0
10	Mg as Mg	mg/l	70.47	65.61	70.47	30.0	100.0
11	Total Hardness	mg/l	440	430	430	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides as F	mg/l	0.46	0.50	0.52	1.0	1.5
14	Sulphate as SO4	mg/l	186	194.4	288	200.0	400
15	Nitrite as NO2	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate as NO3	mg/l	8.59	10.21	9.22	45.0	No Relaxation
17	Salinity	%	0.95	0.90	0.87	NS*	NS*
18	Sodium as Na	mg/l	215	209	231	NS*	NS*
19	Potassium as K	mg/l	4.23	3.88	4.21	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 11: Drinking Water Quality Monitoring Parameters for Sewa sadan – 3, Workshop I &Custom Building at Kandla

Sr. No.	Parameter	Unit	SewaSadan – 3	Workshop	Custom Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.4	7.8	7.5	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1190	1420	1160	500	2000
3	Turbidity	NTU	1	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1920	2870	2180	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	616.37	591.31	491.09	250.0	1000.0
9	Ca as Ca	mg/l	64.13	68.14	60.12	75.0	200.0
10	Mg as Mg	mg/l	68.04	58.32	65.61	30.0	100.0
11	Total Hardness	mg/l	440	410	420	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.90	0.57	0.63	1.0	1.5
14	Sulphate	mg/l	217.2	205.2	289.2	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	13.52	9.93	12.74	45.0	No Relaxation
17	Salinity	%	1.11	1.07	0.89	NS*	NS*
18	Sodium as Na	mg/l	265	218	323	NS*	NS*
19	Potassium as K	mg/l	3.87	3.73	3.56	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 12: Drinking Water Quality Monitoring Parameters for Port Colony Kandla, Hospital Kandla & A.O. Building at Gandhidham

Sr. No.	Parameter	Unit	Port Colony Kandla	Hospital Kandla	A.O. Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.3	7.6	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1090	1460	940	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2090	2850	1860	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	445.99	466.04	496.10	250.0	1000.0
9	Ca as Ca	mg/l	56.11	68.14	60.12	75.0	200.0
10	Mg as Mg	mg/l	75.33	72.90	80.19	30.0	100.0
11	Total Hardness	mg/l	450	470	480	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.87	0.68	0.92	1.0	1.5
14	Sulphate	mg/l	294	318	210	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.29	10.14	11.69	45.0	No Relaxation
17	Salinity	%	0.81	0.84	0.90	NS*	NS*
18	Sodium as Na	mg/l	101	221	402	NS*	NS*
19	Potassium as K	mg/l	4.08	4.01	3.99	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 13: Drinking Water Quality Monitoring Parameters for School Gopalpuri, Guest House & E - Type Quarter at Gopalpuri, Gandhidham

Sr. No.	Parameter	Unit	School Gopalpuri	Guest House	E - Type Quarter	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.4	7.4	7.3	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1020	1340	1100	500	2000
3	Turbidity	NTU	1	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2010	2660	2140	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	466.04	506.13	466.04	250.0	1000.0
9	Ca as Ca	mg/l	52.10	72.14	68.14	75.0	200.0
10	Mg as Mg	mg/l	77.76	55.89	63.18	30.0	100.0
11	Total Hardness	mg/l	450	410	430	200.0	600.0
12	Iron as Fe	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.60	0.81	1.08	1.0	1.5
14	Sulphate	mg/l	291.6	294	283.2	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.29	10.63	9.36	45.0	No Relaxation
17	Salinity	%	0.84	0.91	0.84	NS*	NS*
18	Sodium as Na	mg/l	275	300	130	NS*	NS*
19	Potassium as K	mg/l	3.49	3.50	3.56	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 14: Drinking Water Quality Monitoring Parameters for F - Type Quarter, Hospital Gopalpuri & Tuna Port

Sr. No.	Parameter	Unit	F - Type Quarter	Hospital Gopalpuri	Tuna Port	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.7	7.4	7.38	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1120	1090	1080	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Unit	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2210	2190	2160	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	<2	NS*	NS*
8	Chloride	mg/l	576.28	521.16	520	250.0	1000.0
9	Ca as Ca	mg/l	72.14	76.15	78.56	75.0	200.0
10	Mg as Mg	mg/l	55.89	65.61	54.92	30.0	100.0
11	Total Hardness	mg/l	410	460	422	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	1.05	0.93	0.46	1.0	1.5
14	Sulphate	mg/l	265.2	238.8	180	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	9.86	7.88	8.2	45.0	No Relaxation
17	Salinity	%	1.04	0.94	0.98	NS*	NS*
18	Sodium as Na	mg/l	235	235	260	NS*	NS*
19	Potassium as K	mg/l	2.18	4.01	2.6	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

Table 15: Drinking Water Quality Monitoring Parameters for Vadinar Jetty & Port Colony at Vadinar

Sr. No.	Parameter	Unit	Vadinar Jetty	Port Colony Vadinar	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.6	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1030	1010	500	2000
3	Turbidity	NTU	ND	ND	1.0	5.0
4	Odor	-	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2020	1960	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<2	<2	NS*	NS*
8	Chloride	mg/l	425.95	415.92	250.0	1000.0
9	Ca as Ca	mg/l	60.12	52.10	75.0	200.0
10	Mg as Mg	mg/l	75.33	94.26	30.0	100.0
11	Total Hardness	mg/l	460	440	200.0	600.0
12	Iron as Fe+3	mg/l	<0.01	<0.01	0.3	No Relaxation
13	Fluorides	mg/l	0.92	0.67	1.0	1.5
14	Sulphate	mg/l	22.44	22.20	200.0	400
15	Nitrite	mg/l	<0.01	<0.01	NS*	NS*
16	Nitrate	mg/l	7.39	9.99	45.0	No Relaxation
17	Salinity	%	0.90	0.92	NS*	NS*
18	Sodium as Na	mg/l	51.1	44.1	NS*	NS*
19	Potassium as K	mg/l	2.2	<2.0	NS*	NS*
20	Manganese	mg/l	<0.04	<0.04	0.1	0.3
21	Hexavalent Chromium	mg/l	<0.03	<0.03	NS*	NS*
22	Copper	mg/l	<0.05	<0.05	0.05	1.5
23	Cadmium	mg/l	<0.002	<0.002	0.003	0.003
24	Arsenic	mg/l	<0.01	<0.01	0.01	0.05
25	Mercury	mg/l	<0.001	<0.001	0.001	0.001
26	Lead	mg/l	<0.01	<0.01	0.01	0.01
27	Zinc	mg/l	<0.1	<0.1	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent

*NS: Not Specified

2.3 Results & Discussion

The colour of all drinking water samples was < 5 Hazen unit and odour of the samples was also agreeable. All parameters are found to be within the specified limit of the Drinking water Standard.

pH

The limit of pH value for drinking water is specified as 6.5 to 8.5. pH value in the studied area varied from 7.0 to 8.0 pH unit. All the sampling points showed pH values within the prescribed limit by Indian Standards.

Total Dissolved Solids (TDS)

TDS values in the studied area varied between 900 -1500 mg/l. None of the sampling points showed higher TDS values than the prescribed limit by Indian standards.

Conductivity

Electrical Conductivity is the ability of a solution to transfer (conduct) electric current. Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The conductivity in the samples collected during the month of October ranged from 1800-3000 µs/cm. Electrical conductivity standards do not appear in BIS standards for drinking water.

BOD

BOD value in the studied area was less than 2.0 mg/L. Indian standards does not show any standard values for BOD in drinking water.

Chlorides

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. Chloride value in the studied area varied between 400-650 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.

Calcium

Calcium value in the studied area varied between 50 - 80 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. If calcium is present beyond the maximum acceptable limit, it causes incrustation of pipes.

Magnesium

Magnesium value in the studied area varied between 50 – 99 mg/l. All the locations had Magnesium within the prescribed limits of 30-100 mg/L.

Total Hardness

Hardness value in the studied area varied between 400-480 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. The prescribed limit by Indian Standards is 200-600 mg/L.

Iron

Iron value in the studied area was below 0.01mg/L and hence well below the permissible limit as per Indian Standards is 0.3 mg/L. The excess amount of iron causes slight toxicity; gives stringent taste to water.

Fluoride

Fluoride value in the studied area varied between 0.1 – 1.0 mg/l and hence well below the permissible limit as per Indian Standards is 1.0-1.5 mg/L. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems.

Sulphates

Sulphate value in the studied area varied between 20 – 350 mg/l. All the sampling points showed sulphate values within the prescribed limits by Indian Standards (200-400 mg/L). Sulphate content in drinking water exceeding the 400 mg/L imparts bitter taste.

Nitrites (NO_2) and Nitrates (NO_3)

Nitrite values in all the water samples were <0.1. There are no specified standard values for Nitrites in Drinking water. The mean Nitrate values in drinking water of KPT was 6.41 mg/l which is well within the permissible limit of the Drinking water Standard.

Salinity

Salinity in drinking water in the present samples collected ranged from 0.5 to 1.4 %. There are no prescribed Indian standards for salinity in Drinking water**.**

Sodium and Potassium Salts

Sodium values in the samples collected ranged from 50 - 400 mg/l and Potassium salts ranged from 2.0 to 4.5 mg/l. There are no prescribed limits of Sodium and Potassium in Indian standards for Drinking water**.**

Heavy Metals in Drinking Water

In the present study period drinking water samples were analyzed for Mn, Cr, Cu, Cd, As, Hg, Pb and Zn. All these heavy metals were well below the permissible limits prescribed by the Indian Standards.

Bacteriological Study

Analysis of the bacteriological parameter at all location shows that Bacteria is not present and hence Bacterial count is in line with the permissible limit of drinking water. This shows that all the drinking water samples were safe from any bacteriological contamination.

2.4 Conclusions

These results are compared with acceptable limits as prescribed in IS 10500:2012 – Drinking Water Specification. It is seen from the analysis data that during the study period the water was safe for human consumption at all drinking water monitoring stations.

3. Noise Level Monitoring

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. Noise Monitoring was done at 13 stations at Kandla, Vadinar and Township area.

3.1 Method of Monitoring

Sampling was done at all stations for 24 hour period. Data was recorded using automated sound level meter. The intensity of sound was measured in sound pressure level (SPL) and common unit of measurement is decibel (Db).

3.2 Results

Table 16: Noise Monitoring data for ten locations of Deendayal Port and two locations of Vadinar Port

Sr. No.	Location	Day Time Average Noise Level (SPL) in dB(A)	Night Time Average Noise Level (SPL) in dB(A)
	Sampling Time	**6:00 am to 10:00 PM**	**10:00PM to 6:00 AM**
1	Marine Bhavan	73.9	53.4
2	Nirman Building 1	62.3	51.0
3	Tuna Port	57.2	50.9
4	Main Gate North	67.0	61.8
5	West Gate I	70.5	65.1
6	Canteen Area	64.5	51.0
7	Main Road	68.4	51.5
8	ATM Building	80.4	57.3
9	Wharf Area /Jetty Area	72.9	68.1
10	Port & Custom Office	67.8	41.8
	Vadinar Port		
11	Entrance Gate of Vadinar Port	66.4	53.2
12	Nr. Port Colony, Vadinar	60.7	54.1
13	Nr. Vadinar Jetty	72.4	66.5

3.3 Conclusions- Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Average Noise Level (SPL)in all 13 locations at Deendayal Port ranged from 57.0 dB(A) to 73.9 dB(A) and it was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all 13 locations of Deendayal Port ranged from 41.8 dB to 68.4 dB(A) and it was within the permissible limits of 70 dB(A) for the industrial area for the night time.

4. Soil Monitoring

Sampling and analysis of soil samples were undertaken at six locations within the study area (Deendayal Port and Vadinar Port) as a part of EMP. The soil sampling locations are initially decided based on the locations as provided in the tender document of the Deendayal Port.

4.1 Methodology

The soil samples were collected in the month of October 2021. The samples collected from the all locations are homogeneous representative of each location. At random locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

4.2 Results

Table-17: Chemical Characteristics of Soil in the Study Area

Sr. No.	Parameter	Unit	Station Name					
			SL1	SL2	SL3	SL4	SL5	SL6
			Tuna Port	IFFCO Plant	Khori Creek	Nakti Creek	KPT Admin Site	KPT Colony
			Near main gate of Port	10 m away from main gate	Sand from creek at low tide		Vadinar	
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	pH	-	8.62	8.10	8.75	8.33	8.10	8.22
3	Electrical Conductivity	µs/cm	16,200.0	26,820.0	16,252.0	17,520.0	560.0	480.0
4	Moisture	%	17.00	18.20	19.10	20.22	7.26	8.22
5	Total Organic Carbon	%	0.52	1.02	0.62	3.10	0.12	0.20
6	Alkalinity	mg/kg	60.06	80.44	140.20	80.44	60.06	80.44
7	Total Nitrogen	%	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
8	Chloride	mg/kg	1,620.0	5,380.0	1,820.0	2,078.0	62.0	77.0
9	Sulphate	mg/kg	230.0	198.0	120.0	118.0	16.0	20.0
10	Phosphorus	mg/kg	0.90	0.82	0.96	1.02	0.80	0.72
11	Potassium	mg/kg	396.0	810.0	366.0	460.0	120.0	160.0
12	Sodium	mg/kg	1,620.0	3,400.0	2,122.0	2,012.0	910.0	888.0
13	Calcium	mg/kg	230.32	722.20	252.00	470.42	110.00	82.00
14	Copper as Cu	mg/kg	17.40	38.80	21.20	35.10	16.6	17.0
15	Lead as Pb	mg/kg	6.40	7.90	29.10	7.60	4.8	2.0
16	Nickel as Ni	mg/kg	33.50	13.90	34.50	13.20	13.2	12.2
17	Zinc as Zn	mg/kg	55.90	91.90	77.9	81.90	28.00	36.22
18	Cadmium as Cd	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL

4.3 Discussion

- The data shows that value of pH ranges from 8.10 at IFFCO Plant to 8.75 at Khori Creek indicating that all soil samples are neutral to slight basic. Iffco Plant samples showed maximum conductivity of 26,820 µmhos/cm, while Tuna Port location showed minimum conductivity of 16,200 µmhos/cm. Conductivity at Vadinar Port was 560 and 480 µmhos/cm at Admin site and Vadinar Port colony respectively.
- Total organic Carbon ranged from 0.5 % to 3.1 at Deendayal Port. At Vadinar Port, organic carbon content ranged from 0.1 % to 0.2 %.
- The concentration of Phosphorus and Potassium in the soil samples varies from 0.7 to 1.0 mg/kg and 300.0 to 800 mg/kg respectively at Deendayal Port. The mean concentration of Phosphorous at Vadinar site was 0.76 mg/kg and mean concentration of Potassium at Vadinar site was 140 mg/kg.

These differences in NPK in soil at different locations are due to the dissimilar nature of soil at each of the locations. Samples SL3 & SL4 (Khori Creek & Nakti Creek) are of saline nature as they are coastal soil; where as other locations are inland locations and have different chemical properties.

Heavy Metals in the Soil

Traces of Copper, Lead, Nickel and Zinc were observed in the soil samples collected from all the four locations of Deendayal Port and two locations of Vadinar Port. Cadmium metal was not detected in the Soil.

4.4 Conclusion

The soils of Deendayal Port and Vadinar Port appears to be neutral to basic with varying levels of Chloride, Sulphate, NPK and Calcium. As the nature of soil at different locations are different with respect to its proximity to the sea, the samples showed high degree of variations in their chemical properties.

5. Sewage Treatment Plant Monitoring

This involves safe collection of waste water (spent/used water) from wash areas, bathroom, industrial units, etc., waste from toilets of various buildings and its conveyance to the treatment plant and final disposal in conformity with the requirement and guide lines of State Pollution Control Board and other statutory bodies.

5.1 Methodology for STP Monitoring

To monitor the working efficiency of Sewage Treatment Plant (STP), STP Inlet and Outlet Samples were collected once a week. Locations selected are namely Gopalpuri Township, Deendayal Port and Vadinar. Samples were collected in 1 lit. Carboys and were analyzed in laboratory for various parameters.

5.2 Results

- **Kandla STP**

Table 18: Sewage Water Monitoring at Kandla STP (1st Week)

Date of Sampling	08.10.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.62	7.4
2	Total Suspended Solids	mg/l	99.2	64.7
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	424.2	98.0
5	BOD @ 27 °C	mg/l	141.0	23.0
6.	Fecal Coliform	MPN Index / 100 ml	-	79.0
Aeration Tank				
7.	MLSS	mg/l	6.0	
8.	MLVSS	%	93.0	

Table 19: Sewage Water Monitoring at Kandla STP (2nd Week)

Date of Sampling	12.10.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.6	7.2
2	Total Suspended Solids	mg/l	152.2	72.4
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	384	103.0
5	BOD @ 27 °C	mg/l	120.0	24.0
6.	Fecal Coliform	MPN Index / 100 ml	-	8.0
Aeration Tank				
7.	MLSS	mg/l	12.0	
8.	MLVSS	%	84.0	

Table 20: Sewage Water Monitoring at Kandla STP (3rd Week)

Date of Sampling	21.10.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.65	7.41
2	Total Suspended Solids	mg/l	223.4	99.8
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	181.8	101
5	BOD @ 27 °C	mg/l	68.0	24.0
6.	Fecal Coliform	MPN Index / 100 ml	-	11.0
Aeration Tank				
7.	MLSS	mg/l	9.0	
8.	MLVSS	%	87.0	

Table 21: Sewage Water Monitoring at Kandla STP (4th Week)

Date of Sampling	25.10.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.72	7.5
2	Total Suspended Solids	mg/l	284.6	113.6
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	212	101.0
5	BOD @ 27 °C	mg/l	98.0	26.0
6.	Fecal Coliform	MPN Index / 100 ml	-	3.6
Aeration Tank				
7.	MLSS	mg/l	14.0	
8	MLVSS	%	84.0	

- **Gopalpuri Colony STP**

Table 22: Sewage Water Monitoring at Gopalpuri STP (1st Week)

Date of Sampling	08.10.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.6	7.4
2	Total Suspended Solids	mg/l	195.6	84.0
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	304.0	104.0
5	BOD @ 27 °C	mg/l	120.0	26.0
6.	Fecal Coliform	MPN Index / 100 ml	-	49.0
Aeration Tank				
7.	MLSS	mg/l	10.0	
8	MLVSS	%	87.0	

Table 23: Sewage Water Monitoring at Gopalpuri STP (2nd Week)

Date of Sampling	12.10.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.7	7.5
2	Total Suspended Solids	mg/l	388	131.8
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	414.1	106.00
5	BOD @ 27 °C	mg/l	139.0	28.0
6.	Fecal Coliform	MPN Index / 100 ml	-	6.0
Aeration Tank				
7.	MLSS	mg/l	14.0	
8	MLVSS	%	90.0	

Table 24: Sewage Water Monitoring at Gopalpuri STP (3rd Week)

Date of Sampling	21.10.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.52	7.21
2	Total Suspended Solids	mg/l	354.2	103.3
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	161.6	90.9
5	BOD @ 27 °C	mg/l	80.0	26.0
6.	Fecal Coliform	MPN Index / 100 ml	-	46.0
Aeration Tank				
7.	MLSS	mg/l	14.0	
8	MLVSS	%	84.0	

Table 25: Sewage Water Monitoring at Gopalpuri STP (4th Week)

Date of Sampling	25.10.2021

Sr. No.	Parameters	Unit	Results	
			Gopalpuri STP I/L	Gopalpuri STP O/L
1	pH	pH unit	7.45	7.19
2	Total Suspended Solids	mg/l	345.8	105
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	232	106
5	BOD @ 27 °C	mg/l	82.0	28.0
6.	Fecal Coliform	MPN Index / 100 ml	-	32.0
Aeration Tank				
7.	MLSS	mg/l	10.0	
8.	MLVSS	%	89.0	

- **Vadinar STP**

Table 26: Sewage Water Monitoring at Vadinar STP (1st Week)

Date of Sampling	08.10.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.62	7.4
2	Total Suspended Solids	mg/l	99.2	64.7
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	88.0	60.0
5	BOD @ 27 °C	mg/l	32.0	16.0

Table 27: Sewage Water Monitoring at Vadinar STP (2nd Week)

Date of Sampling	12.10.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.7	7.5
2	Total Suspended Solids	mg/l	133.5	59.9
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	188.0	60.0
5	BOD @ 27 °C	mg/l	60.0	16.0

Table 28: Sewage Water Monitoring at Vadinar STP (3rd Week)

Date of Sampling	21.10.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.7	7.5
2	Total Suspended Solids	mg/l	105	38
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	161.6	70.7
5	BOD @ 27 °C	mg/l	62.0	20.0

Table 29: Sewage Water Monitoring at Vadinar STP (4th Week)

Date of Sampling	25.10.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.7	7.2
2	Total Suspended Solids	mg/l	105	58.8
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	202	80.8
5	BOD @ 27 °C	mg/l	60.0	20.0

5.3 Conclusions:

The GPCB standards of BOD, TSS and Residual Chlorine for STP outlet are 20 mg/lit, 30 mg/lit & 0.5 mg/lit respectively. It is suggested to do treatment on regular basis to avoid flow of contaminated/polluted water into the sea.

6. Marine Water Monitoring

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992) aimed at "integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

Marine Environment

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations

The monitoring of marine environment for the study of biological and ecological parameters was carried out on 6th& 7th October-2021 in harbor regions of KPT and on 7th October-2021 at Vadinar during spring tide period of New moon phase of Lunar Cycle. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 13th& 14th October 2021 in harbor regions of KPT. 14th October -2021 in Vadinar during Neap tide period first quarter of Lunar Cycle..

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and two stations in Nakti creek and one station in Khori creek. The same sampling schedule was repeated during consecutive spring tide and neap tide in same month. Plankton samples from sub surface layer was collected both during high tide period and low tide period from 1 water quality monitoring stations near Vadinar jetty area during spring tide and neap tide in this month .Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

Sampling Locations

Offshore monitoring requirement	Number of locations
Offshore Installations	3 in Kandla creek 2 in Nakti creek 1 in Khori creek 1 near Vadinar Jetty 1 near 1st SBM
Total Number of locations	**8**

6.1 Marine Water Quality

Marine water quality of marine waters of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month.

The results of marine water quality and Marine sediments are as below;

Table 30: Marine Water Quality Monitoring Parameters for location near KPT colony

Sr. No.	Parameters	Unit	Kandla Creek Near KPT colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.14	7.16	7.42	7.36
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.5	32.0	32.6	32.0
5	Turbidity	NTU	38	29	36	31
6	Total Dissolved Solids	mg/l	42450	39030	42122.0	41187.0
7	Total Suspended Solids	mg/l	685	950	764.9	558.1
8	Total Solids	mg/l	43135	39980	42886.9	41745.1
9	DO	mg/l	4.1	4	4.3	4.2
10	COD	mg/l	78.0	80.0	80.0	78.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.75	0.64	0.65	0.53
13	Phosphate	mg/l	0.36	0.26	0.16	0.18
14	Sulphate	mg/l	3060	2892	2256	2532
15	Nitrate	mg/l	2.89	2.46	2.50	3.48
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	601.20	521.04	561.12	521.04
18	Magnesium	mg/l	1628.1	1603.8	0	0
19	Sodium	mg/l	9473.0	8438.0	9368	8523
20	Potassium	mg/l	362.1	314.0	360.8	302.8
21	Iron	mg/l	1.63	1.34	1.35	1.24
22	Chromium	mg/l	0.11	0.13	0.12	0.13
23	Copper	mg/l	0.06	0.05	0.06	0.06
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.05	0.04	0.04
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.09	0.11	0.11	0.09
28	Zinc	mg/l	0.07	0.06	0.06	0.05

Table 31: Marine Water Quality Monitoring Parameters for location near passenger Jetty One at Kandla

Sr. No.	Parameters	Unit	Near passenger Jetty One (2)			
			23° 0'18 "N 70°13'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.25	7.21	7.51	7.1
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.8	31.9	31.8	31.9
5	Turbidity	NTU	36	25	39	45
6	Total Dissolved Solids	mg/l	33930	47550	40323.0	40031.0
7	Total Suspended Solids	mg/l	658	769	569.8	528.6
8	Total Solids	mg/l	34588	48319	40892.8	40559.6
9	DO	mg/l	4.4	3.8	4.4	4.1
10	COD	mg/l	82.0	86.0	88.0	80.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.51	0.60	0.80	0.75
13	Phosphate	mg/l	0.23	0.26	0.18	0.19
14	Sulphate	mg/l	2784	3252	2388	2652
15	Nitrate	mg/l	3.03	3.59	2.89	4.04
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	561.12	641.28	480.96	561.12
18	Magnesium	mg/l	1555.2	1628.1	0	0
19	Sodium	mg/l	9670.0	9156.0	9686	9192
20	Potassium	mg/l	380.0	326.1	354.2	278.2
21	Iron	mg/l	1.90	1.73	1.68	1.33
22	Chromium	mg/l	0.13	0.11	0.11	0.15
23	Copper	mg/l	0.07	0.05	0.07	0.07
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.05	0.04	0.04	0.05
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.12	0.12	0.09	0.11
28	Zinc	mg/l	0.05	0.06	0.08	0.09

Table 32: Marine Water Quality Monitoring Parameters for location Near Coal Berth

Sr. No.	Parameters	Unit	Near Coal Berth			
			22°59'12"N 70°13'40"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.40	7.52	7.2	7.41
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.2	32.0	32.0	31.7
5	Turbidity	NTU	36	28	33	41
6	Total Dissolved Solids	mg/l	45010	41120	40162.0	42404.0
7	Total Suspended Solids	mg/l	586	838	492.9	627.8
8	Total Solids	mg/l	45596	41958	40654.9	43031.8
9	DO	mg/l	4.1	5	4.5	5.2
10	COD	mg/l	88.0	90.0	79.0	74.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.69	0.76	0.53	0.71
13	Phosphate	mg/l	0.27	0.37	0.16	0.19
14	Sulphate	mg/l	3300	1872	2688	2256
15	Nitrate	mg/l	3.87	4.36	2.96	2.59
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	601.20	681.36	521.04	480.96
18	Magnesium	mg/l	1676.7	1652.4	0	0
19	Sodium	mg/l	9421.0	8958.0	9328	8688
20	Potassium	mg/l	354.2	343.7	283.8	332.6
21	Iron	mg/l	1.56	1.88	1.93	1.57
22	Chromium	mg/l	0.14	0.14	0.14	0.11
23	Copper	mg/l	0.06	0.07	0.06	0.06
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.05	0.04	0.06	0.05
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.13	0.10	0.08	0.10
28	Zinc	mg/l	0.07	0.08	0.06	0.07

Table 33: Marine Water Quality Monitoring Parameters for location Khori creek at Kandla

Sr. No.	Parameters	Unit	KPT 4			
			Near 15/16 Berth			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.28	7.40	7.3	7.4
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.5	32.6	32.4	32.0
5	Turbidity	NTU	46	36	50	30
6	Total Dissolved Solids	mg/l	42910	48900	40963.0	41643.0
7	Total Suspended Solids	mg/l	660	562	711.1	509.7
8	Total Solids	mg/l	43570	49462	41674.1	42152.7
9	DO	mg/l	4.7	4.6	5.8	5.6
10	COD	mg/l	72.0	76.0	82.0	78.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.73	0.62	0.65	0.49
13	Phosphate	mg/l	0.28	0.24	0.22	0.19
14	Sulphate	mg/l	1500	3336	2412	2124
15	Nitrate	mg/l	1.76	2.89	2.78	2.02
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	521.04	601.20	440.88	601.2
18	Magnesium	mg/l	1676.7	1555.2	0	0
19	Sodium	mg/l	9979.0	9708.0	9808	9629
20	Potassium	mg/l	373.2	343.9	327.8	305.6
21	Iron	mg/l	1.73	1.67	1.02	1.68
22	Chromium	mg/l	0.15	0.17	0.09	0.09
23	Copper	mg/l	0.05	0.08	0.07	0.07
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.03	0.06	0.07	0.04
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.09	0.01	0.09	0.08
28	Zinc	mg/l	0.06	0.08	0.07	0.05

Table 34: Marine Water Quality Monitoring Parameters for location Nakti Creek near Tuna Port

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.20	7.40	7.2	7.4
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.1	31.9	31.6	31.2
5	Turbidity	NTU	34	46	33	29
6	Total Dissolved Solids	mg/l	48700	49900	40306.0	38117.0
7	Total Suspended Solids	mg/l	867	848	441.1	513
8	Total Solids	mg/l	49567	50748	40747.1	38630.0
9	DO	mg/l	4.2	4.8	4.8	4.7
10	COD	mg/l	96.0	98.0	90.0	92.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.53	0.84	0.73	0.60
13	Phosphate	mg/l	0.25	0.24	0.20	0.17
14	Sulphate	mg/l	3504	3780	2772	2364
15	Nitrate	mg/l	3.24	3.59	2.74	4.60
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	521.04	601.20	480.96	521.04
18	Magnesium	mg/l	1652.4	1676.7	0	0
19	Sodium	mg/l	10156.0	10254.0	10268	10438
20	Potassium	mg/l	336.9	336.4	278.6	297.8
21	Iron	mg/l	1.54	1.83	1.55	1.50
22	Chromium	mg/l	0.12	0.11	0.14	0.16
23	Copper	mg/l	0.08	0.07	0.05	0.05
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.06	0.06	0.04
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.12	0.13	0.11	0.13
28	Zinc	mg/l	0.08	0.09	0.05	0.09

Table 35: Marine Water Quality Monitoring Parameters for location Nakti Creek Near NH-8A at Kandla

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.50	Sampling not possible during Low Tide	7.5	Sampling not possible during Low Tide
2	Color	-	Colorless		Colorless	
3	Odor	-	Odorless		Odorless	
4	Salinity	ppt	31.8		31.0	
5	Turbidity	NTU	34		34	
6	Total Dissolved Solids	mg/l	43730		40522.0	
7	Total Suspended Solids	mg/l	635		432.9	
8	Total Solids	mg/l	44365		40954.9	
9	DO	mg/l	4.6		5.2	
10	COD	mg/l	98.0		90.0	
11	BOD	mg/l	<2.0		<2.0	
12	Silica	mg/l	1.00		0.51	
13	Phosphate	mg/l	0.24		0.17	
14	Sulphate	mg/l	3576		2352	
15	Nitrate	mg/l	3.03		3.37	
16	Nitrite	mg/l	<0.05		<0.05	
17	Calcium	mg/l	561.12		601.2	
18	Magnesium	mg/l	1725.3		0	
19	Sodium	mg/l	10760.0		10536	
20	Potassium	mg/l	335.1		335.1	
21	Iron	mg/l	1.80		1.33	
22	Chromium	mg/l	0.16		0.10	
23	Copper	mg/l	0.07		0.06	
24	Arsenic	mg/l	<0.01		<0.01	
25	Cadmium	mg/l	0.03		0.05	
26	Mercury	mg/l	<0.001		<0.001	
27	Lead	mg/l	0.12		0.11	
28	Zinc	mg/l	0.09		0.07	

Table 36: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar Jetty

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.50	7.80	7.54	7.45
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.0	32.0	32.1	31.9
5	Turbidity	NTU	46	36	46	42
6	Total Dissolved Solids	mg/l	47700	46610	37421.0	38258.0
7	Total Suspended Solids	mg/l	483	476	553.6	490
8	Total Solids	mg/l	48183	47086	37974.6	38748.0
9	DO	mg/l	4.3	4.5	4.6	4.8
10	COD	mg/l	86.0	88.0	88.0	86.0
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.85	0.93	0.71	0.89
13	Phosphate	mg/l	0.23	0.25	0.18	0.17
14	Sulphate	mg/l	2784	2556	2532	2448
15	Nitrate	mg/l	2.46	2.89	3.60	3.37
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	641.28	561.12	561.12	521.04
18	Magnesium	mg/l	1506.6	1579.5	0	0
19	Sodium	mg/l	10233.0	10490.0	10860.0	10880.0
20	Potassium	mg/l	331.3	363.9	336.0	333.0
21	Iron	mg/l	1.38	1.69	1.34	1.2
22	Chromium	mg/l	0.15	0.19	0.11	0.12
23	Copper	mg/l	0.06	0.08	0.06	0.06
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.04	0.06	0.05
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.11	0.11	0.09	0.09
28	Zinc	mg/l	0.06	0.08	0.06	0.05

Table 36 (a): Marine Water Quality Monitoring Parameters for locations Nr. Vadinar SPM

Sr. No.	Parameters	Unit	Nr.Vadinar SPM			
			22°30'56.15"N 69°42'12.07"E			
			Spring Tide		Neap Tide	
	Tide →		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.70	7.50	7.42	7.36
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.5	32.6	32.0	31.8
5	Turbidity	NTU	34	32	38	44
6	Total Dissolved Solids	mg/l	40230	39870	40119.0	40011.0
7	Total Suspended Solids	mg/l	470	447	496.1	457.4
8	Total Solids	mg/l	40700	40317	40615.1	40468.4
9	DO	mg/l	4.2	4.1	4.4	4.5
10	COD	mg/l	88.0	90	88.0	86
11	BOD	mg/l	<2.0	<2.0	<2.0	<2.0
12	Silica	mg/l	0.82	0.93	0.62	0.76
13	Phosphate	mg/l	0.24	0.25	0.17	0.17
14	Sulphate	mg/l	2688	2340	2352	2472
15	Nitrate	mg/l	2.68	2.82	3.27	3.60
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	601.20	641.28	0	0
18	Magnesium	mg/l	1579.5	1652.4	0	0
19	Sodium	mg/l	10575	10639	10936.0	10886.0
20	Potassium	mg/l	370.1	367.9	331	402
21	Iron	mg/l	1.57	1.81	1.07	1.63
22	Chromium	mg/l	0.17	0.18	0.09	0.11
23	Copper	mg/l	0.06	0.08	0.06	0.04
24	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
25	Cadmium	mg/l	0.04	0.05	0.04	0.06
26	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001
27	Lead	mg/l	0.13	0.12	0.08	0.08
28	Zinc	mg/l	0.06	0.07	0.07	0.08

6.1.1 Marine Sediments

Sediment samples were collected with Van Veen Grab from the six locations in Kandla Port Waters and two locations in Vadinar Port. Samples were collected and preserved in silver foil in ice box to prevent the contamination/decaying of the samples.

6.2 Results

The Sediment Quality results are given in below from table no. 34 A & B.

Table 34A: Results of Analysis of Sediment of Kandla & Vadinar Port (Spring Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 3	KPT - 4	KPT - 5	Jetty	SPM
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.10	1.08	1.01	1.02	0.98	2.03	0.81
3	Organic Carbon	mg/kg	0.65	0.52	0.60	0.56	0.56	1.08	0.47
4	Inorganic Phosphate	mg/kg	110.0	131.0	132.0	145.0	145.0	132.0	149.0
5	Moisture	%	18.96	19.65	21.0	22.10	23.5	17.7	27.00
6	Aluminium	mg/kg	ND	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	16.5	15.6	12.0	16.3	15.5	18.7	18.00
8	Phosphate	mg/kg	8.02	10.99	7.22	11.00	7.65	9.52	11.20
9	Sulphate	mg/kg	205.0	265.0	266.0	198.0	221.0	197.6	265.0
10	Nitrite	mg/kg	0.1	0.15	0.11	0.13	0.13	0.09	0.11
11	Nitrate	mg/kg	9.35	7.32	7.06	8.65	8.99	7.65	8.88
12	Calcium	mg/kg	325.0	306.0	396.0	388.0	324.0	324.0	378.0
13	Magnesium	mg/kg	195.0	185.0	243.0	244.0	188.0	175.0	210.0
14	Sodium	mg/kg	3745.0	3945.0	4660.0	2566.0	2899.0	2253.0	2854.0
15	Potassium	mg/kg	238.0	194.0	186.0	178.0	138.0	152.0	110.0
16	Chromium	mg/kg	8.1	48.3	30.7	40.3	23.3	36.4	6.6
17	Nickel	mg/kg	16.4	31.8	22.9	25.8	14	46.6	3.7
18	Copper	mg/kg	27.7	36.9	8.7	14.3	4.2	19.2	1.9
19	Zinc	mg/kg	32.40	40.50	35.10	36.20	21.20	21.30	5.00
20	Cadmium	mg/kg	ND	ND	ND	ND	ND	ND	ND
21	Lead	mg/kg	3.8	5.8	3.3	4.4	4.9	ND	1.2
22	Mercury	mg/kg	ND	ND	ND	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND	ND	ND	ND

*ND - Not Detected

Table 34B: Results of Analysis of Sediment of Kandla & Vadinar Port (Neap Tide)

Sr. No.	Parameters	Unit	KPT – 1	KPT - 2	KPT - 4	SPM
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.99	0.85	1.11	1.08
3	Organic Carbon	mg/kg	1.12	0.41	0.65	0.65
4	Inorganic Phosphate	mg/kg	120.0	130.0	148.0	152.0
5	Moisture	%	19.20	18.50	17.7	17.56
6	Aluminium	mg/kg	ND	ND	ND	ND
7	Silica	mg/kg	21.88	18.00	17.5	14.72
8	Phosphate	mg/kg	5.62	8	7.65	8.65
9	Sulphate	mg/kg	225.0	240.0	211.5	195.0
10	Nitrite	mg/kg	0.1	0.11	0.09	0.1
11	Nitrate	mg/kg	7.66	8.11	6.65	6.85
12	Calcium	mg/kg	321.0	310.0	345.0	265.0
13	Magnesium	mg/kg	205.0	197.0	202.0	169.0
14	Sodium	mg/kg	4120.0	3842.0	4465.0	3589.0
15	Potassium	mg/kg	201.0	147.0	154.0	154.00
16	Chromium	mg/kg	13.3	10.5	13	16.8
17	Nickel	mg/kg	8.8	6	8.2	10.5
18	Copper	mg/kg	4.3	2	2.2	5.5
19	Zinc	mg/kg	18.20	9.90	10.30	12.10
20	Cadmium	mg/kg	ND	ND	ND	ND
21	Lead	mg/kg	2.1	2.5	2.8	1.8
22	Mercury	mg/kg	ND	ND	ND	ND
23	Arsenic	mg/kg	ND	ND	ND	ND

*Grab samples could not be collected due high current at KPT – 3,KPT – 5 Location.
*ND - Not Detected

REPORT

ON

ECOLOGICAL MONITORING

OF MARINE ENVIRONMENT

IN

DPT HARBOUR AREA, NEAR BY CREEKS

AND

VADINAR JETTY AND SPM

FOR

DEENDAYAL PORT TRUST

OCTOBER, 2021

INTRODUCTION:

Sampling Stations:

The monitoring of marine environment for the study of biological and ecological Parameters was carried out on6thOctober, 2021 in harbour region of DPT at Kandla Creek, and on 7thOctober,2021 in creeks near by the port during spring tide. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 13thOctober ,2021 in harbour region of DPT at Kandla Creek and on 14thOctober 2021 in creeks near by the port during neap tidal condition.

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and one stations in Nakti creek and one station in Khori creek. Sampling at second sampling station of Nakti creek was possible only during high tide period. The same sampling schedule was repeated during consecutive Neap tide and spring tide in same month.

Plankton samples from sub surface layer were collected during high tide period and low tide period from monitoring station near Vadinar jetty at Path Finder Creek during spring tide period and during neap tide. Sampling was conducted at only during Neap tide period nearSPM both during High tide period and low tide period. Collected water samples were processed for estimation of Chlorophyll-a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

TABLE #1 SAMPLING LOCATIONS

monitoring requirement	**Number of locations**
Kandla creek	3 in Kandla creek
Nakti creek	2 in Nakti creek
Khori Creek	1 in Khori creek
Vadinar jetty	1 near Vadinar Jetty
SPM	1 near I stSPM
Total Number of locations	**8**

Sampling methodology adopted:

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.

50 litres of the water sample were collected from Sub surface by using bucket. From the collected water sample 1 litres of water sample were taken in an opaque plastic bottle for chlorophyll estimation, thereafter plankton samples were collected by using filtration assembly with nilyobolt cloth of 20µm mesh size.

Samples Processing for chlorophyll estimation:

Samples for the chlorophyll estimation were preserved in ice box on board in darkness to avoid degradation in opaque container covered with aluminium foil. Immediately after reaching the shore after sampling, 1 litre of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm. By using corrected optical density, Chlorophyll-a value was calculated as given in (APHA, 1998).

PLANKTON:

The entire area open water in the sea is the pelagic realm. Pelagic organisms live in the open sea. In contrast to the pelagic realm, the benthic realm comprises organisms and zone of the bottom of the sea. Vertically the pelagic realm can be dividing into two zones based on light penetration; upper photic or euphotic zone and lower dark water mass, aphotic zone below the photic zone.

The term plankton is general term for organisms have such limited powers of locomotion that they are at the mercy of the prevailing water movement. Plankton is subdivided to phytoplankton and zooplankton. Phytoplankton is free floating organisms that are capable of photosynthesis and zooplankton is the various free floating animals.

Pelagic zone, represents the entire ocean water column from the surface to the deepest depths, is home to a diverse community of organisms. Differences in their locomotive ability categorize the organisms in the pelagic realm into two, ***plankton*** and ***nekton*** (Lalli and Parsons, 1997). ***Plankton*** consists of all organisms drifting in the water and is unable to swim against water currents, whereas ***Nekton*** includes organisms having strong locomotive power. Ecological studies on the plankton community, which form the base of the aquatic food chain, help in the better understanding of the dynamics and functioning of the marine ecosystem. The term 'Plankton' first coined by Victor Hensen (1887), Plankton, (Greek word: *planktos*meaning "passively drifting or wandering") is defined as drifting or free-floating organisms that inhabit the pelagic zone of water. Based on their mode of nutrition planktonic organisms are categorised into phytoplankton (organisms having an autotrophic mode of nutrition) and zooplankton (organisms having a heterotrophic mode of nutrition).

Phytoplankton in the marine environment:

Phytoplankton is 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).The phytoplankton those normally captured in the net from the Gulf of Kutch is normally dominated by these two major groups; diatoms and dinoflagellates. Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as and Cyanophytes (blue-green 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 in the marine environment:

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 (Beaugrand et al., 2004). Zooplankton grazing in the marine environment controls the primaryProduction and helps in determining the pelagic ecosystem (Banse, 1995). 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.

Based on the duration of planktonic life, zooplankton are categorised into Holoplankton (organisms which complete their entire lifecycle as plankton) and Meroplankton (organisms which are planktonic during the early part of their lives such as the larval stages of benthic and nektonic organisms). Tychoplankton are organisms which live a brief planktonic life, such as the benthic crustaceans (Cumaceans, mysids, isopods) which ascend to the water column at night for feeding and certain ectoparasitic copepods, they leave the host and spend their life as plankton during their breeding cycle.

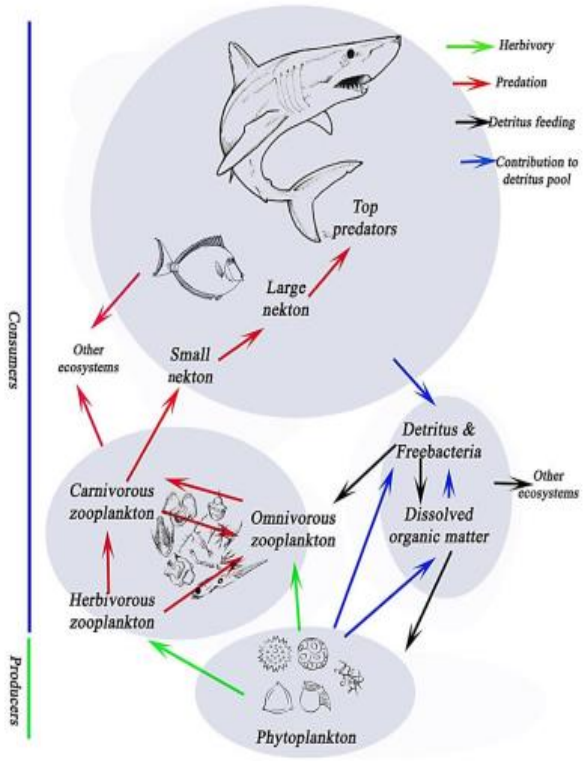
Zooplankton can be subdivided into holoplankton, i.e., permanent members of the plankton (e.g., Calanoid copepods), and meroplankton, i.e., temporary members in the plankton e.g., larvae of fish,

shrimp, and crab). The meroplankton group consists of larval and young stages of animals that will adopt a different lifestyle once they mature. In contrast to phytoplankton which consist of a relatively smaller variety of organisms, Zooplankton are extremely divers, consist of a host of larval and adult forms representing many animal phylum.

Among the zooplankton one group always dominate than others; members of sub class copepods (Phylum Athropoda) and Tintinids (Phylum Protozoa) among the net planktons. These small animals are of vital importance in marine ecosystem as one of the primary herbivores animals in the sea, and it is they provide vital link between primary producer (autotrophs) and numerous small and large marine consumers.

As their community structure and function are highly susceptible to changes in the environmental conditions regular monitoring of their distribution as well as their interactions with various physicochemical parameters is inevitable for the sustainable management of the ecosystem (Kusum et al., 2014). Of all the marine zooplankton groups, copepods mainly Calanoid copepods are the dominant groups in marine subtropical and tropical waters and exhibit considerable diversity in morphology and habitats they occupy (Madhupratap, 1991;)

It has been well established that potential of pelagic fishes viz. finfishes, crustaceans, molluscs and marine mammals either directly or indirectly depend on zooplankton. The herbivorous zooplankton is efficient grazers of the phytoplankton and is referred to as living machines transforming plant material into animal tissue. Hence they play an essential role as the intermediaries for nutrients/energy transfer between primary and tertiary trophic levels. Due to their large density, shorter lifespan, drifting nature, high group/species diversity and different tolerance to the stress, they used as the indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem (Ghajbhiye, 2002).



Simplified marine food web

Spatial distribution of Plankton:

A characteristic of plankton population is that they tend to occur in patches, which are varying spatially on a scale of few meters to far as few kilometres in distance. They also vary in time scale, season as well as vertically in the water column. It is this patchiness and its constant changes in time and spot, that has made it so difficult for plankton biologist to learn about the ecology of plankton. The biological factors that causes this patchiness is due to the ability of zooplankton to migrate vertically and graze out the phytoplankton at a rapid rate that can create patchiness. Similarly the active swimming ability by certain zooplankton organisms can cause to aggregate in dense group.

At its most extreme, because the water in which plankton is suspended is constantly moving, each sample taken by the plankton biologists remain a different volume of water, so each sample is unique and replicate does not exist.

Plankton may also exhibit vertical patchiness. Physical factors contribute to this type of patchiness include light intensity, nutrients and density gradients in the water column.

Phytoplankton in particular tends to be unequally distributed vertically, which leads to the existence of different concentration of a chlorophyll value between photic zone and below the photic zone.

Methodology adopted for Plankton sampling:

Mixed plankton sample were obtained from the sub surface layer at each sampling locations by towing the net horizontally with the weight .After the tow of about 15-30minutes, plankton net was pulled up and washed down to the tail and collected the plankton adhered to plankton net in the collection bucket at the bottom by springing outer and inner surface of the net with sea water, while the net was hanging with the mouth upward. For quantitative evaluation 50 L water samples were collected from subsurface layer and filtered through 20µm mesh size net by using bucket and filtration assembly.

Preservation and storage:

Both filtered plankton and those collected from the plankton net were preserved with 5% buffered formalin and stored in 1L plastic container for further processing in the laboratory.

Sample concentration:

The collected plankton samples were concentrated by using centrifuge and made up to 50 ml with 5% formalin -Glycerine mixture.

Taxonomic evaluation:

Before processing, the sample was mixed carefully and a subsample was taken with a calibrated Stempel-pipette. 1 ml of the concentrated plankton samples were transferred on a glass slide with automatic pipette. The plankton sample on the glass slides were stained by using Lugol's iodine and added glycerine to avoid drying while observation. The plankton samples were identified by using Labex triangular Research microscope with photographic attachment. Microphotographs of the plankton samples were taken for record as well as for confirming the identification. The bigger sized zooplankton was observed through dissecting stereomicroscope with magnification of 20-30 x. Plankton organisms in the whole slide were identified to the lowest axon possible. A thorough literature search was conducted for the identification of the different groups of zooplankton that were encountered

Cell counts by drop count method:

The common glass slide mounted with a 1ml of concentrated phytoplankton/zooplankton sample in glycerol and covered with cover slip 22x 60mm was placed under the compound microscope provided with a mechanical stage. The plankton was then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton in each microscopic field was thus counted. When first microscopic field row was finished the next consecutive row was adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted. From this total number in 1ml of the concentrated

plankton, total number of plankton in the original volume of sample filtered was calculated as units/L.

BENTHIC ORGANISMS:

Benthos is those organisms that are associated with the sea bed or benthic habitats. Epi- benthic organisms live attached to a hard substratum or rooted to a shallow depth below the surface. In fauna organisms live below the sediment–water interface. Interstitial organisms live and move in pore water among sedimentary grains.

Because the benthic organisms are often collected and separated on sieves, a classification based on the overall size is used. Macro benthos include organisms whose shortest dimension is greater than or equal to 0.5 mm. Meio benthos are smaller than 0.5mm but larger than 42µ in size.

The terms such as macro fauna and Meio fauna generally have little relevance with taxonomic classification. The terms Meio fauna and macro fauna depend on the size. Meio fauna were considered as good bioassay of community health and rather sensitive indicators of environmental changes

SAMPLING METHODOLOGY ADOPTED FOR SUB TIDAL REGION:

Van veen sampler (0.09m^2) was used for sampling bottom sediments. Two sets of sediments were sampled from each location, one for macro fauna and other for Meio fauna. The macro fauna in the sediments were sieved on board to separate out the organisms. The fixation of Meio fauna is normally done by bulk fixation of the sediment sample. The bulk fixation is done by using 10% formalin (Buffered with borate). The organisms were preserved with seawater as diluting agent.

Sample sieving:

Sediments samples were sieved to extract the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. The large portion of the sediment was split in to smaller portions and mixed with sea water in a bucket. The cohesive lumps were broken down by continuous stirring. The disaggregated sediments were then passed through the sieves.

Sample staining:

Sorting of the Meio fauna from the sieve is difficult task especially in the preserved material, because organisms are not easily detectable. To facilitate the animal detection the entire sample retained on the sieve after sieving operation were stained by immersing the sieve in a flat bottom tub with 1% Rose Bangal stain; a protein stain. A staining period of 10-30 minutes is sufficient for sample detection.

DIVERSITY INDICES:

On the whole, diversity indices provide more information about community composition than simply species richness (number of species present); they also, take the relative abundances of different

species into account. Based on this fact, diversity indices therefore depend not only on species richness but on the evenness, or equitability, with which individuals are distributed among the different species (Magurram, A. E. (1988)

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.

The basic idea of diversity 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 (Carol H.R. *etal*. 1998). Biodiversity is commonly expressed through indices based on species richness and species abundances (Whittaker 1972, Lande 1996, Purvis and Hector 2000). 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.

A diversity Index is a single statistic that incorporates in formation on richness and evenness. The diversity measures that incorporate the two concepts may be termed heterogeneity measures (Magurran, 2004).

Any study intended to interpret causes and effect of adverse impact on Biodiversity of communities require suitable measures to evaluate specie richness and Diversity. The former is number of species in community, while latter is a function of relative frequency of different species. Species richness is the iconic measure of biological diversity (Magurran, 2004). Several indices have been created to measure the diversity of species; however, the most widely used in the last decades are the Shannon (1948) and Simpson (1949) (Buzas and Hayek 1996; Gorelick 2006), with the components of diversity: richness (*S)* and evenness (*J)*

Simpson's diversity index

Simpson's index (**D**) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present.. The Simson index is one of the meaningful and robust biodiversity measures available.(Magurran ,2004).

The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and, 1, no diversity. When D increases diversity decreases. Simpson's index is therefore usually expressed as 1-D or 1/D. (Magurran, 2004)

Low species diversity suggests:

- relatively few successful species in the habitat
- the environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment
- food webs which are relatively simple
- change in the environment would probably have quite serious effects

High species diversity suggests:

- a greater number of successful species and a more stable ecosystem
- more ecological niches are available and the environment is less likely to be hostile complex food webs
- environmental change is less likely to be damaging to the ecosystem as a whole

Species richness indices

The species richness***(S)*** is simply the number of species present in an ecosystem. Species richness Indices of species richness are widely used to quantify or monitor the effects of anthropogenic disturbance. A decline in species richness may be concomitant with severe or chronic human-induced perturbation (Fair Fair weather 1990,) Species richness measures have traditionally been the mainstay in assessing the effects of environmental degradation on the biodiversity of natural assemblages of organisms (Clarke &Warwick, 2001)

Species richness is the iconic measure of biological diversity (Magurran, 2004). The species richness***(S)*** is simply the number of species present in an ecosystem. This index makes no use of relative abundances. The term species richness was coined by McIntosh (1967) and oldest and most intuitive measure of biological diversity (Magurran, 2004).

Margalef's diversity index is a species richness index. Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, were derived.

The value of a diversity index increases both when the number of types increases and when evenness increases. For a given number of types, the value of diversity index is maximised when all types are equally abundant (Rosenzweig, M. L. (1995).

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 (Odum 1971 and Reish 1984). Shannon-Wiener's index **(H**) reproduces community parameters to a single numberby using an equation.

Shannon and Weiner index represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxa. It varies from 0 for communities with only single taxa to high values for community with many taxa each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range of polluted and unpolluted ecosystems, Wilham and Dorris (1968) concluded that the values of the index greater than 3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln\left(\frac{n_j}{N}\right)$$

RESULTS:

CHLOROPHYLL-a:

Water Samples for the chlorophyll estimation were collected from sub surface layer during high tide and low tide period of the tidal cycle for each sampling locations and analysed for Chlorophyll -a and after acidification for Pheophytin –a. Chlorophyll- a value was used as algal biomass indicator (APHA,1998) Algal biomass was estimated by converting Chlorophyll value.

In the sub surface water chlorophyll-a was varying from 0.615 -1.459mg/m^3.in harbour region of DPT in Kandla Creek during sampling done in spring tide period of October, 2021. In the nearby creeks chlorophyll-a was varying from 0.153 -1.497mg/m^3.Pheophytin –a level was below detectable limit-the all the sampling stations during springtide except at KPT-I in the harbour region of DPT.

In the sub surface water chlorophyll-a was varying from 0.204 -0.749mg/m^3.in harbour region of DPT in Kandla Creek during sampling done in neap tide period of October , 2021 . In the nearby creeks chlorophyll-a was varying from 0.184-0.610 mg/m^3.·Pheophytin –a level was below detectable limit-the all the sampling stations during neap tide in the harbour region of DPT.

In the sub surface water chlorophyll-a was varying from 0.527 -0.733 mg/m^3.in harbour region of DPT OOT in path finder Creek during sampling done in spring tide period of October, 2021. In the sub surface water chlorophyll-a was varying from 0.750 -1.175 mg/m^3.in harbour region of DPT OOT in path finder Creek during sampling done in Neap Tide period of October, 2021

TABLE #2 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA IN KANDLA CREEK ,NEAR BY CREEKS AND DPT OOT JETTY IN PATH FINDER CREEK AND SPM NEAR VADINAR DURING SPRING TIDE IN OCTOBER,2021

Sr.No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREAKANDLA CREEK					
1	KPT1	High tide	1.459	0.821	97.75
		Low tide	1.187	0.661	79.53
2	KPT 2	High tide	0.765	BQL	51.25
		Low tide	0.852	BQL	57.08
3	KPT 3	High tide	0.968	BQL	64.85
		Low tide	0.615	BQL	41.20
CREEKS					
4	KPT-4 Khori-I	High tide	1.056	BQL	70.75
		Low tide	1.497	BQL	100.2
5	KPT-5 Nakti-I	High tide	0.764	BQL	51.19
		Low tide	0.612	BQL	41.00
6	KPT-5 Nakti-II	High tide	0.153	BQL	10.24
PATHFINDER CREEK VADINAR					
7	VADINAR-I jetty	Low tide	0.527	BQL	35.31
8		High tide	0.733	BQL	49.11
9	SPM	High tide	No sample	--	--
10	SPM	Low tide	No sample	-	--

BDL: Below Quantification Limit.

TABLE #3 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA ,NEAR BY CREEKS AND DPT OOT JETTY IN PATH FINDER CREEK AND SPM NEAR VADINAR DURING NEAP TIDE IN OCTOBER,2021

Sr.No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin- a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPTHARBOUR AREA KANDLA CREEK					
1	KPT1	High tide	0.307	BQL	20.57
		Low tide	0.529	BQL	35.44
2	KPT 2	High tide	0.749	BQL	50.18
		Low tide	0.614	BQL	41.14
3	KPT 3	High tide	0.204	BQL	13.67
		Low tide	0.542	BQL	36.31
CREEKS					
4	KPT-4 Khori-I	High tide	0.441	BQL	29.54
		Low tide	0.426	BQL	28.54
5	KPT-5 Nakti-I	High tide	0.610	BQL	40.87
		Low tide	0.441	BQL	29.55
6	KPT-5 Nakti-II	High tide	0.184	BQL	12.33
PATHFINDER CREEK VADINAR					
7	VADINAR-I jetty	Low tide	0.750	0.435	50.25
8		High tide	0.820	0.484	54.94
9	SPM	High tide	1.071	0.610	71.76
10	SPM	Low tide	1.175	0.680	78.73

BDL: Below Quantification Limit.

PHYTOPLANKTON POPULATION:

For the evaluation of the Phytoplankton population in DPT harbour area and within the immediate surroundings of the port, sampling was conducted from 5 sampling locations (3 in harbour area and two in Nakti creek) during high tide period and low tide period of spring tide and neap tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by,Diatoms blue green algae and dinoflagellatesduring spring tide period.Diatoms were represented by 19genera. Blue green were represented by 3 genera and dinoflagellates were represented by two generaduring the sampling conducted in spring tide in OCTOBER,2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 46-209units/ L during high tide period and183-229 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by Diatoms.Blue green algae and Dinoflagellates duringNeap tide period.Diatoms were represented by 20genera Blue green algae were represented 3 genera and dinoflagellates with two genera during the sampling conducted in Neap tide in October,2021. Phytoplankton of the sampling

stations at sub surface layer in the harbour area and nearby creeks was varying from88-170units/ L during high tide period and 120-157 units/ L during low tide of Neap Tide.

For the evaluation of the Phytoplankton population in DPT OOT jetty area in Path Finder creek sampling was conducted from one sampling locations ; jetty area during high tide period and low tide of spring tide. For the evaluation of the Phytoplankton population in DPT OOT jetty area in Path Finder creek in Vadinar sampling was conducted from 2 sampling locations ; jetty area and one near SPM during high tide period and low tide of Neap tide.

The phytoplankton community of the sub surface water in the path finder creeks was represented by only Diatoms spring tide period.Diatoms were represented by 9 genera during the sampling conducted in spring tide in October, 2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from 131 units/ L during high tide period and 147 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the path finder creeks was represented by Diatoms, Blue green algae and Dinoflagellatesduring Neap tide period.Diatoms were represented by 10 genera Blue green algae were represented single genera and dinoflagellates by four genera during the sampling conducted in Neap tide in October, 2021. Phytoplankton of the sampling stations at sub surface path finder creek was varying from 203-427 units/ L during high tide period and 544-744 units/ L during low tide of Neap Tide.

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla creek and nearby creeks sampling stations was varying from 2.059-3.212 with an average of 2.632during the sampling conducted in High tide period of spring tide.While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla creek region and nearby creeks was varying from2.687-3.144 with an average of 2.923 during the consecutive low tide period.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations in Kandla creek and nearby creeks was varying from 1.582-3.384 with an average of 2.477 during the sampling conducted in High tide period of Neaptide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla creek region and nearby creeks was varying from1.582-3.040 with an average of 2.141 during consecutive low tide.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was 1.641 during the sampling conducted in High tide period of spring tide at Path Finder Creek, Vadinar . While Margalef's diversity index (Species Richness) S of phytoplankton communities in the path finder creek was1.603 during the consecutive low tide period at Path Finder Creek, Vadinar .

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was varying from 1.981-2.064 during the sampling conducted in consecutive High tide period and low tide period of Neap Tide at jetty area of Path finder Creek. While Margalef's diversity index (Species Richness) S of phytoplankton communities near the SPM was varying from 2.259- 1.512 during the consecutive high tide and low tide period of Neap tide.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.802- 0.935 (H'(log10)) between selected sampling stations with an average value of 0.860 during high tide period of spring tide at Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.858-0.979 (H'(log10)) between selected sampling stations with an average value of 0.909 during consecutive lowtide at Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.774 -0.934 (H'(log10)) between selected sampling stations with an average value of 0.868 during high tide period of neap tide at Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.773 -0.927 (H'(log10)) between selected sampling stations with an average value of 0.842during consecutive low tideat Kandla creek and nearby creeks.

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations in the stations was 0.684 during the sampling conducted in High tide period of spring tide at Path Finder Creek, Vadinar. Shannon-Wiener's Index (H)of phytoplankton communities in the path finder creek was 0.695 during the consecutive low tide period at Path Finder Creek, Vadinar .

Shannon-Wiener's Index (H) of phytoplankton communities in the stations was varying from 0.356-0.255 during the sampling conducted in consecutive High tide period and low tide period of Neap Tide at jetty area of Path finder Creek. While Shannon-Wiener's Index (H) of phytoplankton communities near the SPM was varying from 0.508-0.234 during the consecutive high tide and low tide period of Neap tide.

Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of phytoplankton of Kandla Harbour region

and nearby creeks is less but with abundant population of few, with relatively few ecological niches and only very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran,2004).

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.809- 0.852 between selected sampling stations with an average of 0.827 during high tide period of spring tide. Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks, which was varying from 0.819- 0.865 between selected sampling stations with an average of 0.840during consecutive low tide .

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in Kandla Harbour region and nearby creeks, during high tide period and low tide period during neap tide also, which was varying from 0.809-0.853 with an average value of 0.835 between selected sampling stations during high tide period and varying from 0.809-0.852 with an average value of 0.831 between selected sampling stations during consecutive low tide period Low species diversity suggests a relatively few successful species in this habitat.

Low species diversity suggests a relatively few successful species in this habitat. The environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in path finder Creek, which was 0-720 during high tide period and 0.751 during low tide period of spring tide at Jetty region . Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the in path finder Creek, which was varying from 0.720-0.751 at jetty region of path finder creek during consecutive high tide and low tide period of Spring Tide and recorded below 9 at SPM during consecutive high tide and low tide period of Neap tide also , 0.329 - 0.499 during high tide and 0.218-0.201 during low tide

Table # 4PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND ,NEAR BY CREEKS DURING SPRING TIDE IN OCTOBER,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	199	18/24	75	3.212	0.9355	0.8519
	2	209	12/24	50	2.059	0.8018	0.8091
	3	204	14/24	58.3	2.444	0.8451	0.8244
	4	204	17/24	70.83	3.009	0.9095	0.837
	5	199	14/24	58.3	2.456	0.8497	0.8167
	6	46	11/24	45.83	2.612	0.8208	0.8232
LOW TIDE	1	223	18/24	75	3.144	0.9797	0.8653
	2	214	17/24	70.83	2.982	0.9126	0.8446
	3	193	17/24	70.83	3.04	0.919	0.8416
	4	229	16/24	66.66	2.761	0.8806	0.8312
	5	183	15/24	62.5	2.687	0.858	0.8193

Table # 5 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND ,NEAR BY CREEKS DURING NEAP TIDE IN OCTOBER,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	170	18/25	72	3.31	0.9214	0.8451
	2	133	14/25	56	2.658	0.8621	0.8308
	3	142	11/25	44	2.018	0.8693	0.847
	4	152	18/25	72	3.384	0.9173	0.8463
	5	128	12/25	48	2.267	0.8398	0.828
	6	88	14/25	56	2.904	0.9345	0.8406
LOW TIDE	1	143	11/25	44	2.015	0.8355	0.832
	2	149	13/25	52	2.398	0.8822	0.842
	3	139	16/25	64	3.04	0.9274	0.8526
	4	157	9/25	36	1.582	0.7937	0.8176
	5	120	9/25	36	1.671	0.7738	0.8094

Table # 6 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND , NEAR BY CREEKS DURING SPRING TIDE IN OCTOBER, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	39-204	19/24	79.2
			BLUE GREEN	3-8	3/24	12.5
			DINOFLAGELLATES	2-9	2/24	8.3
			TOTAL PHYTO PLANKTON	**46-209**	**24**	-
LOW TIDE	Sub surface	5	DIATOMS	176-222	19/24	79.2
			BLUE GREEN	3-8	3/24	12.5
			DINOFLAGELLATES	2-6	2/24	8.3
			TOTAL PHYTO PLANKTON	183-229	**24**	-

Table # 7 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND , NEAR BY CREEKS DURING NEAP TIDE IN OCTOBER,2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	81-164	20/25	80
			BLUE GREEN	1-6	3/25	12
			DINOFLAGELLATES	0-4	2/25	8
			TOTAL PHYTO PLANKTON	**88-170**		
LOW TIDE	Sub surface	5	DIATOMS	117-157	20/25	80
			BLUE GREEN	0-7	3/25	12
			DINOFLAGELLATES	0-4	2/25	8
			TOTAL PHYTO PLANKTON	**120-157**		

Table # 8 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOTAT PATH FINDER CREEK , VADINAR &NEAR BY SPM, DURING SPRING TIDE IN OCTOBER, 2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	jetty	131	9/9	100	1.641	0.6874	0.7201
LOW TIDE	jetty	147	9/9	100	1.603	0.6956	0.7508

Table # 9 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOTAT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING NEAP TIDE IN OCTOBER, 2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	jetty	427	13/15	86.67	1.981	0.3559	0.3291
	SPM	203	13/15	86.67	2.259	0.5079	0.499
LOW TIDE	jetty	544	14/15	93.33	2.064	0.2555	0.2188
	SPM	744	11/15	73.33	1.512	0.2343	0.2011

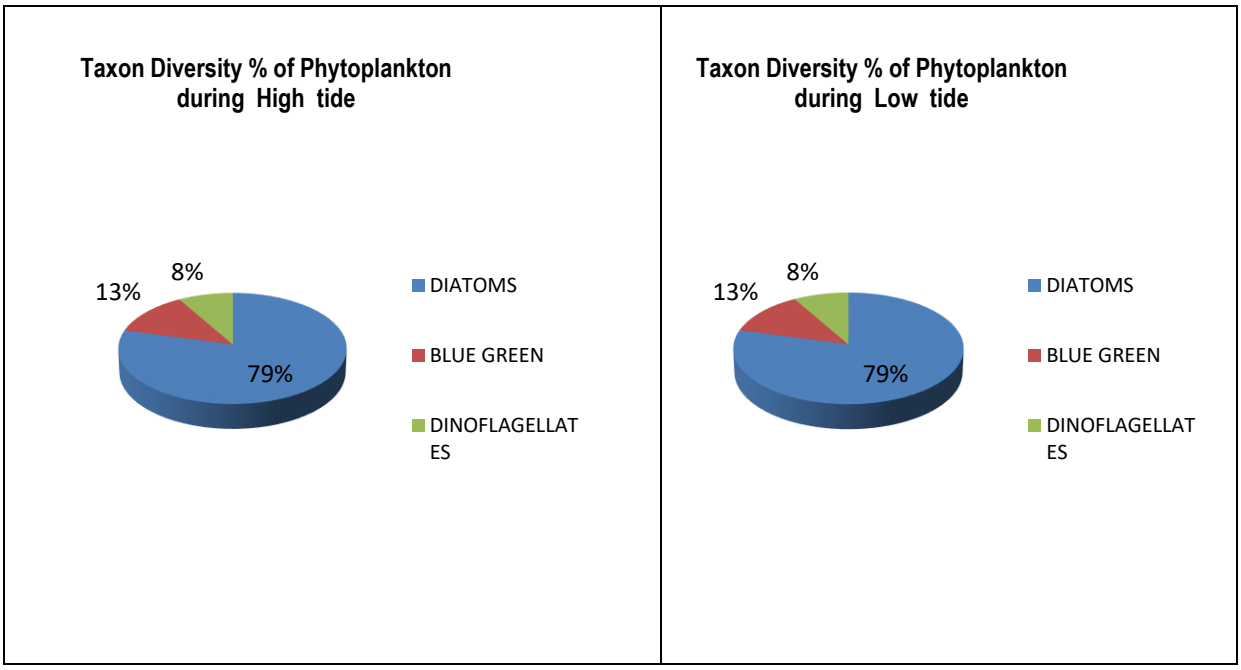
Table # 10 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT DPTOOT AT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING SPRING TIDE IN OCTOBER, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	1	DIATOMS	131	9/9	100
			TOTAL PHYTO PLANKTON	**131**	**9**	
LOW TIDE	Sub surface	1	DIATOMS	147	9/9	100
			TOTAL PHYTO PLANKTON	147	**9**	

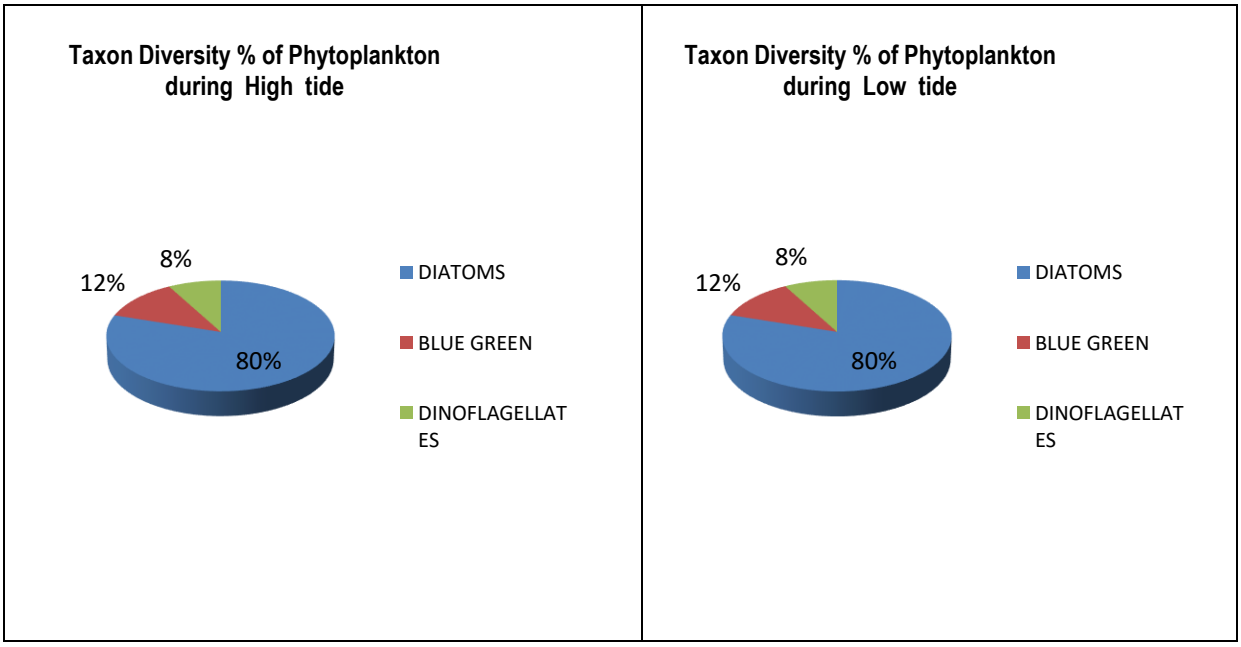
Table # 11 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT DPTOOT AT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING NEAP TIDE IN OCTOBER, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	DIATOMS	189-424	10/15	66.5
			BLUE GREEN	1-4	1/15	7.5
			DINOFLAGELLATES	4-10	4/15	26.0
			TOTAL PHYTO PLANKTON	**203-427**		
LOW TIDE	Sub surface	2	DIATOMS	480-664		
			BLUE GREEN	2	10/15	66.5
			DINOFLAGELLATES	5-10	1/15	7.5
			TOTAL PHYTO PLANKTON	544-744	4/15	26.0

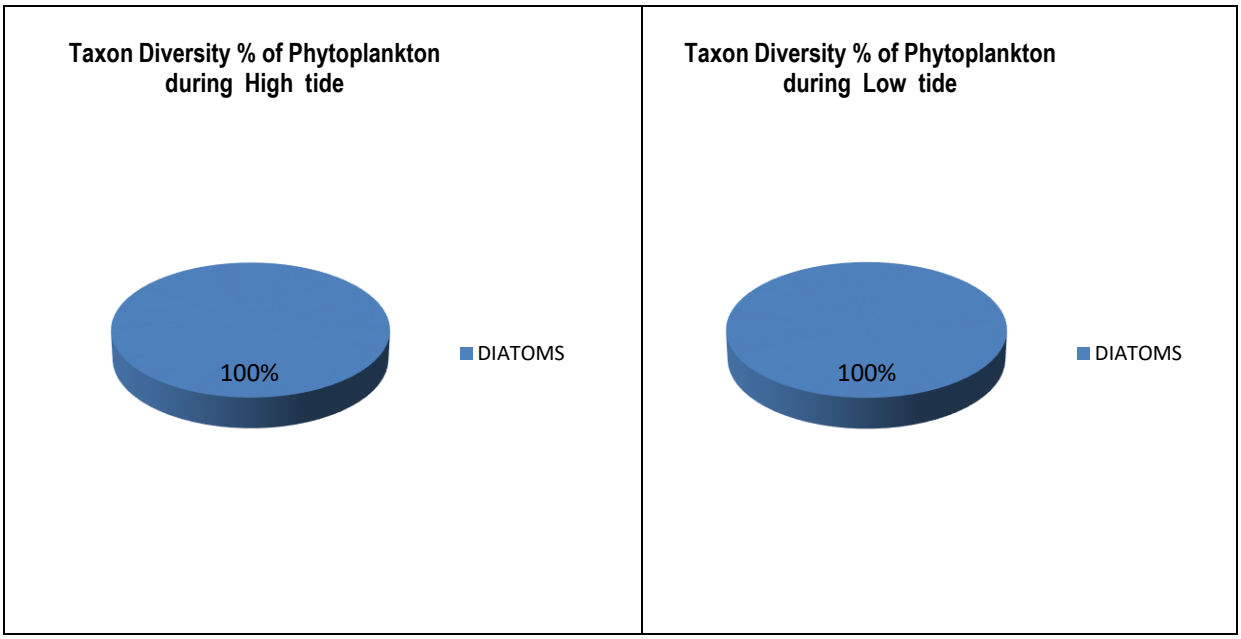
Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide in Kandala creek and nearby creeks



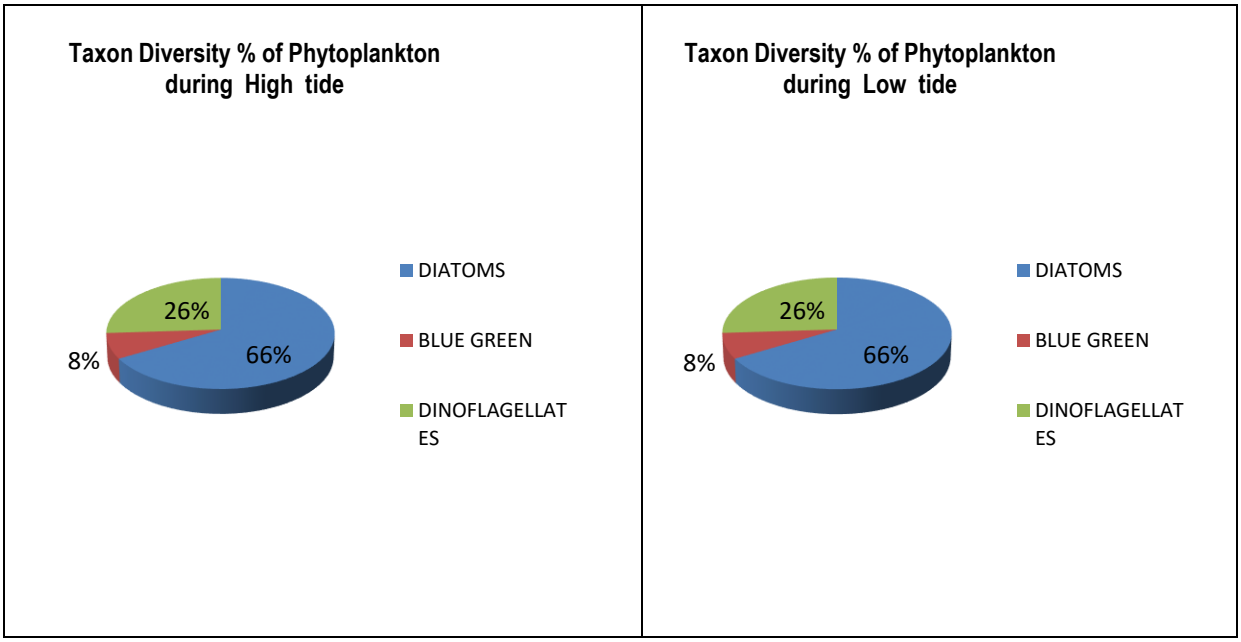
Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide inKandala creek and nearby creeks



Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide in Path Finder Creek, Vadinar



Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide in Path Finder Creek, Vadinar



ZOOPLANKTON POPULATION:

For the evaluation of the Zooplankton population in DPT harbour area and within the immediate surroundings of the port sampling was conducted from 6 sampling locations (3 in harbour area and two in Nakti creek and one in Khoricreek) during high tide period and low tide period of spring tide

and Neap tide in October,2021. The Zooplankton community of the sub surface water in the harbour and nearby creeks during spring tide was represented by mainly 9 groups, and 7 larval forms; Tintinids, Copepods,Rotifers, Arrow worms, Mysids, Urochordates ,Ciliates ,Unidentified medusa and Foraminiferans.Larval forms represented from the group of Crustacea, Molluscansand Polychaetes. The Zooplankton community of the sub surface water in the harbour and nearby creeks during neap tide was represented by mainly 9groups, and Eight larval forms . The major zooplankton group was Tintinids, Copepods, Rotifers, Arrow worms ,Mysids, Urochordata, Ciliates , Medusa and Foraminiferans . Larval forms were represented from the group of Crustaceans ,Echinodermata, Bryozoans , Molluscansand Polychaetes,

Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 33-132 x10^3 N/ m^3 during high tide and 81-107x10^3 N/ m^3during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 47-167x10^3 N/ m^3 during high tide and9-112x10^3 N/ m^3during low tide of Neap Tide period.

For the evaluation of the Zoo plankton population in DPT OOT jetty area in Path Finder creek and SPM in Vadinar selected 2 sampling locations (1 in jetty area and one near SPM) Duringspring tide sampling plankton sample were collected only at Jetty area during consecutive high tide period and low tide period. During Neap tide sampling Plankton samples were collected from jetty area and SPM during consecutive high tide period and low tide period.

The Zooplankton community of the sub surface water in the path finder creek creeks during spring tide was represented by mainly two groups, Tintinids, Copepods, and larval forms of Crustacea and Molluscans. The Zooplankton community of the sub surface water in the path Finder creeks at Jetty region and SPM during neap tide was represented by mainly Five groups, Tintinids, Copepods, Arrow worms , Urochordata and ,Mysids .Larval forms were represented from the major group of Crustaceans , Molluscans , Echinodremataand Polychaetes,.

Zooplankton of the sampling stations at sub surface layer in the DPT OOTjetty area of path finder creek was 76 x10^3 N/ m^3 during high tide and 74 x10^3 N/ m^3 during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT OOTjetty area in path finder creekwas recorded 54x10^3 N/ m^3during high tide and 73 x10^3 N/ m^3 during consecutive low tide period of Neap . Zooplankton of the sampling stations at sub surface layer in the DPT SPM area in path finder creek was recorded 78 x10^3 N/ m^3during high tide and 82 x10^3 N/ m^3 during consecutive low tide period of Neap Tide .

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the stations Kandla creek region and nearby creeks was varying from 3.146-4.804 with an average of 3.874during the sampling conducted in High tide period.Margalef's diversity index (Species Richness) S of Zooplankton communities varying from.2.842-4.280 with an average of 3.393 during the sampling conducted in low tide period during Spring tide.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the Kandla creek region and nearby creeks sampling stations was varying from3.117- 6.839 with an average of 5.036 during the sampling conducted in high tide and varying from. 3.034 -4.570 with an average of 3.769 during the sampling conducted in low tide during Neap tide period

Margalef's diversity index (Species Richness) S of Zooplankton communities in the sampling stationnear jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 1.847 and 1. 859 respectively..

Margalef's diversity index (Species Richness) S of Zooplankton communities in the two stations at Path finder creek was varying from 3.259-3.443 during the sampling conducted in High tide period of Neap tide. While Margalef's diversity index (Species Richness) S of Zooplankton communities in the two stations at Path finder creekwas varying from 2.797-4.085 during the consecutive low tide period.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.912 -1.060 (H'(log10)) between selected sampling stations with an average value of 0.992 (H'(log10)) during high tide period of spring tide. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.844-0.965(H'(log10)) between selected sampling stations with an average value of 0.894 (H'(log10)) during consecutive low tide period .

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.834 -1.336 (H'(log10)) between selected sampling stations with an average value of 1.146 (H'(log10)) during high tide period of Neap tide. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region

and nearby creeks was in the range of 0.949-1.139 (H'(log10)) between selected sampling stations with an average value of 1.043 (H'(log10)) during consecutive low tide period.

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.775 and 0.822 respectively..

Shannon-Wiener's Index (H)of Zooplankton communities in the two stations at Path finder creek was varying from 0.991-0.927 during the sampling conducted in High tide period of Neap tide. While Shannon-Wiener's Index (H)of Zooplankton communities in the two stations at Path finder creek was varying from 0.815-1.004 during the consecutive low tide period.

Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of Zooplankton of Kandla Harbour region and nearby creeks stations is slightly high with very minimum diverse population but very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran, 2004).

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 most of sampling stations in the Kandla Harbour region and nearby creeksduring high tide and low tide of spring tide period, which was varying from 0.848-0.881between selected sampling stations with an average of 0.865 during high tide period and was varying from 0.812- 0.845 with an average value of 0.827 between selected sampling stations during low tide

Simpson diversity index (1-D) of Zooplankton communities was blow 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks except few during high tide and low tide period, which was varying from 0.793- 0.937 between selected sampling stations with an average of 0.894 during high tide period and was varying from 0.861- 0.910 with an average value of 0.884 between selected sampling stations during consecutive low tide

This high species diversity suggests a relatively more number of successful species in this habitat during October ,2021 sampling.

Simpson diversity index (1-D) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.800 and 0.827 respectively..

Simpson diversity index (1-D) of Zooplankton communities in the two stations at Path finder creek was varying from 0.884 -0.838 during the sampling conducted in High tide period of Neap tide. While Shannon-Wiener's Index (H)of Zooplankton communities in the two stations at Path finder creek was varying from 0.816 -0.863 during the consecutive low tide period.

Table # 12 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND NEAR BY CREEKS DURING SPRING TIDE IN OCTOBER,2021

Tide	Sampling Station	Abundance In N / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	120 x10^3	24/32	75	4.804	1.06	0.8695
	2	105 x10^3	21/32	65.62	4.297	1.045	0.8753
	3	132 x10^3	18/32	56.25	3.482	0.9555	0.8523
	4	117 x10^3	18/32	56.25	3.57	1.032	0.8811
	5	123 x10^3	20/32	62.50	3.948	0.9513	0.8481
	6	33 x10^3	12/32	37.5	3.146	0.9125	0.8636
LOW TIDE	1	97 x10^3	14/32	43.75	2.842	0.8439	0.8174
	2	107 x10^3	21/32	65.63	4.28	0.9654	0.8455
	3	81 x10^3	15/32	46.87	3.186	0.9009	0.8315
	4	93 x10^3	16/32	50	3.309	0.8669	0.8125
	5	88 x10^3	16/32	50	3.35	0.8971	0.8325

Table # 13 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREAAT KANDLA CREEK AND NEAR BY CREEKS DURING NEAP TIDE IN OCTOBER,2021

Tide	Sampling Station	Abundance In No / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	167 x10^3	36/37	97.30	6.839	1.336	0.9367
	2	124 x10^3	28/37	75.68	5.601	1.282	0.9373
	3	133 x10^3	24/37	64.86	4.703	1.163	0.9108
	4	144 x10^3	29/37	78.38	5.634	1.19	0.8993
	5	102 x10^3	21/37	56.75	4.324	1.075	0.8893
	6	47 x10^3	13/37	35.13	3.117	0.834	0.7928
LOW TIDE	1	112 x10^3	18/37	48.65	3.603	0.9973	0.8637
	2	90 x10^3	19/37	51.35	4	1.065	0.8974
	3	99 x10^3	22/37	59.46	4.57	1.139	0.9105
	4	107 x10^3	18/37	48.65	3.638	1.068	0.8889
	5	101 x10^3	15/37	40.54	3.034	0.9498	0.861

Table # 14 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREAATKANDLA CREEK AND ,NEAR BY CREEKS DURING SPRING TIDE IN OCTOBER,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	3-21	6/32	18.75
			Copepods	13-68	10/32	31.25
			Rotifers	0-4	1/32	3.13
			Arrow worms	0-2	1/32	3.13
			Mysids	0-2	2/32	6.25
			Urochordata	0-1	1/32	3.12
			Ciliates	1-7	1/32	3.12
			Medusa	0-1	1/32	3.12
			Larval forms	11-43	7/32	21.88
			Foraminiferans	0-1	2/32	6.25
			TOTAL ZOOPLANKTON N/ M^3	**33-132**	**32**	
LOW TIDE	Sub surface	5	Tintinids	4-15	6/32	18.75
			Copepods	45-59	10/32	31.25
			Rotifers	0-1	1/32	3.13
			Arrow worms	0-1	1/32	3.13
			Mysids	0-1	2/32	6.25
			Urochordata	0-1	1/32	3.12
			Ciliates	1-6	1/32	3.12
			Medusa	0	1/32	3.12
			Larval forms	22-33	7/32	21.88
			Foraminiferans	0-2	2/32	6.25
			TOTAL ZOOPLANKTON N/M^3	**81-107**	**32**	

Table # 15 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA IN KANDLA CREEK AND , NEAR BY CREEKS DURING NEAP TIDE IN OCTOBER, 2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton x10^3 Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	2-26	6/37	16.22
			Copepods	18-76	11/37	29.73
			Rotifers	0-2	1/37	2.70
			Mysids	0-6	4/37	10.81
			Arrow worms	0-4	1/37	2.70
			Urochordata	0-4	1/37	2.70
			Ciliates	0-8	1/37	2.70
			Medusa	0-4	1/37	2.70
			Larval forms	20-46	9/37	24.32
			Foraminiferans	0-6	2/37	5.42
			TOTAL ZOOPLANKTON N/M^3	**47-165**		
LOW TIDE	Sub surface	5	Tintinids	13-22	6/37	16.22
			Copepods	42-47	11/37	29.73
			Rotifers	0	1/37	2.70
			Mysids	0-4	4/37	10.81
			Arrow worms	0-1	1/37	2.70
			Urochordata	0-2	1/37	2.70
			Ciliates	1-5	1/37	2.70
			Medusa	0	1/37	2.70
			Larval forms	21-40	9/37	24.32
			Foraminiferans	**0-5**	2/37	5.42
			TOTAL ZOOPLANKTON N/M^3	**89-112**		

Table # 16 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURING SPRING TIDE IN OCTOBER,2021

Tide	Sampling Station	Abundance In N / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	76 x10^3	9/9	100	1.847	0.7749	0.8004
LOW TIDE	Jetty	74 x10^3	9/9	100	1.859	0.8222	0.8278

Table # 17 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURING NEAP TIDE IN OCTOBER,2021

Tide	Sampling Station	Abundance In N / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	54 $x10^3$	14/23	60.87	3.259	0.9911	0.884
	SPM	78 $x10^3$	16/23	69.56	3.443	0.9276	0.8385
LOW TIDE	Jetty	73 $x10^3$	13/23	56.52	2.797	0.8156	0.8166
	SPM	82 $x10^3$	19/23	82.61	4.085	1.004	0.863

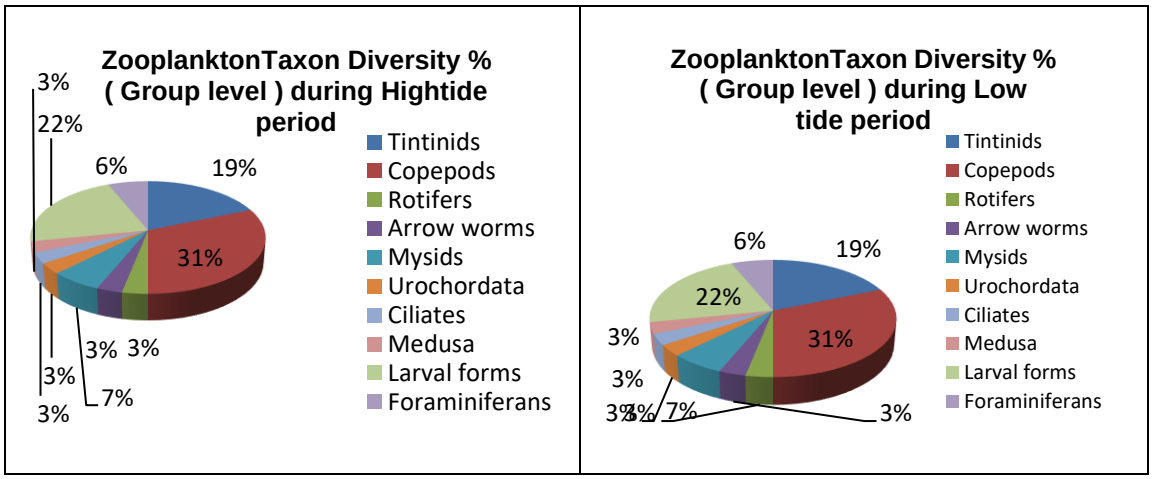
Table # 18 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT OOT AREAAT PATH FINDER CREEK AND NEAR BY SPM DURING SPRING TIDE IN OCTOBER,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	1	Tintinids	40	5/9	55.56
			Copepods	18	2/9	22.22
			Larval forms	18	2/9	22.22
			TOTAL ZOOPLANKTON NO/L	**76**	**9**	
LOW TIDE	Sub surface	1	Tintinids	38	5/9	55.56
			Copepods	16	2/9	22.22
			Larval forms	20	2/9	22.22
			TOTAL ZOOPLANKTON NO/M3	**74**	**9**	

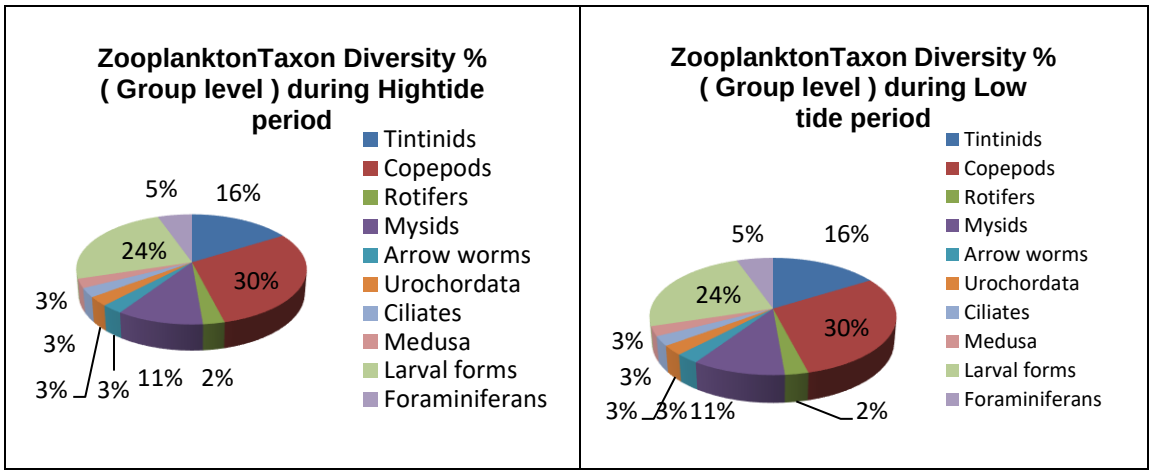
Table # 19 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT OOT AREAAT PATH FINDER CREEK AND NEAR BY SPM DURING NEAP TIDE IN OCTOBER, 2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton x10^3 Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	Tintinids	1-2	2/23	8.70
			Copepods	30-45	8/23	34.78
			Arrow worms	0-1	1/23	4.35
			Mysids	4-9	4/23	17.39
			Urochordata	2-4	1/23	4.35
			Larval forms	12-22	7/23	30.43
			TOTAL ZOOPLANKTON	**41-60**		
LOW TIDE	Sub surface	2	Tintinids	1-2	2/23	8.70
			Copepods	49-53	8/23	34.78
			Arrow worms	1	1/23	4.35
			Mysids	2-5	4/23	17.39
			Urochordata	1	1/23	4.35
			Larval forms	19-20	7/23	30.43
			TOTAL ZOOPLANKTON NO/M3	**73-82**		

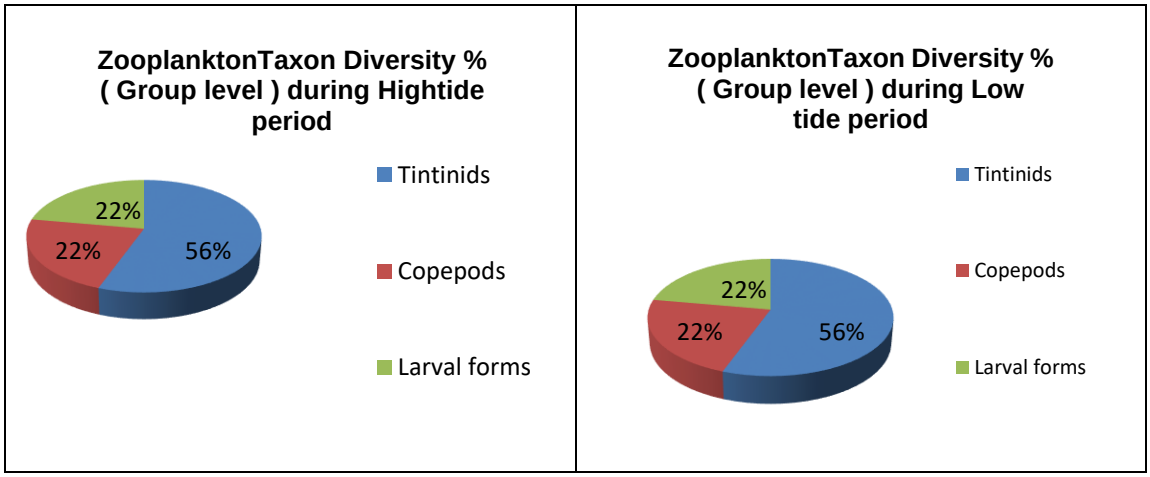
Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide In Kandla Creek and nearby Creeks



Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide In Kandla Creek and nearby Creeks



Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide In Path Finder Creek and near Jetty



Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide In Path Finder Creek near jetty and nearby SPM

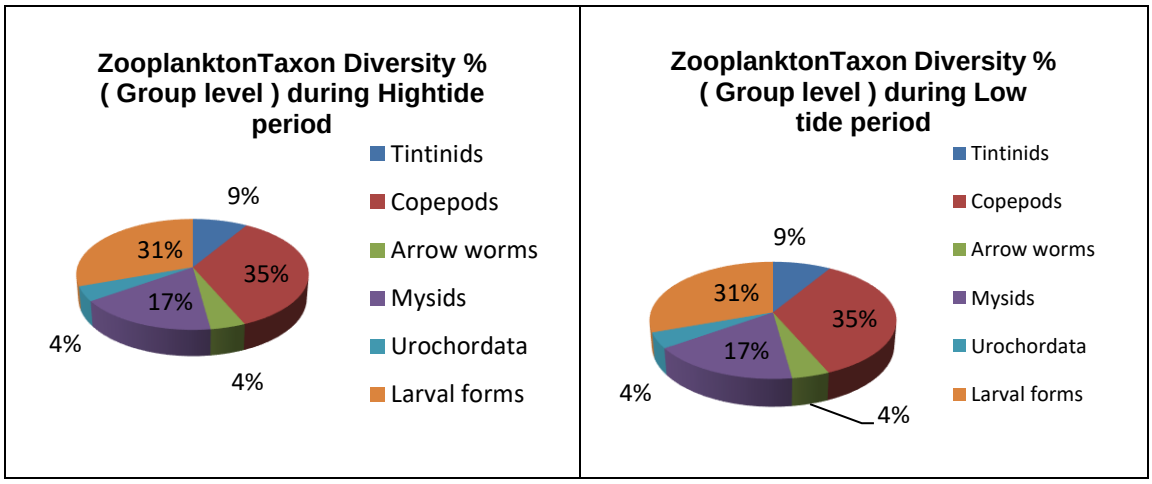


TABLE # 20SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKS DURINGSPRING TIDE OF OCTOBER 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Occasional
					Arthrospira sp.	B2	Rare
			Stigonematales	Stigonemataceae	*Stigonema sp.*	B3	Occasional
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Occasional
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Dominant
			Triceratiales	Triceratiaceae	*Odontellasp*	D3	Occasional
					*Triceratium*sp.	D4	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Abundant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D6	Rare
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D7	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D8	Frequent
			Leptocylindrales	Leptocylindraceae	*Leptocylindrussp*	D9	Occasional
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D10	Dominant
			Melosirales	Melosiraceae	*Melosirasp*	D11	Rare
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D12	Rare
			Surirellales	Surirellaceae	*Surirella*sp	D13	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D14	Abundant
					Thalassionema sp.	D15	Rare
			Fragilariales	Fragilariaceae	*Asterionellopsis sp.*	D16	Occasional
					*Fragilaria*sp	D17	Frequent
					*Synedra*sp	D18	Rare
			Tabellariales	Tabellariaceae	*Tabellaria*sp	D19	Rare
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Rare
			Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF2	Occasional

TABLE # 21 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKS DURING AND NEAP TIDE OF OCTOBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Rare
					Arthrospira sp.	B2	Rare
			Stigonematales	Stigonemataceae	*Stigonema sp.*	B3	Rare
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Occasional
					Thalassiosirasp	D2	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D3	Dominant
			Triceratiales	Triceratiaceae	*Odontellasp*	D4	Occasional
					*Triceratium*sp.	D5	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D6	Abundant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D7	Rare
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D8	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D9	Frequent
			Leptocylindrales	Leptocylindraceae	*Leptocylindrussp*	D10	Occasional
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D11	Dominant
		Bacillariophyceae	Naviculales	Naviculaceae	*Naviculasp*	D12	Rare
				Pleurosigmataceae	*Gyrosigmasp*	D13	Rare
					*Pleurosigma*sp	D14	Rare
			Surirellales	Surirellaceae	*Surirella*sp	D15	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D16	Abundant
					Thalassionema sp.	D17	Rare
			Fragilariales	Fragilariaceae	*Fragilaria*sp	D18	Frequent
					*Synedra*sp	D19	Rare
			Tabellariales	Tabellariaceae	*Tabellaria*sp	D20	Rare
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Rare
			Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF2	Occasional

TABLE # 22 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING SPRING TIDE OF OCTOBER 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D1	Occasional
			Triceratiales	Triceratiaceae	*Triceratium*sp.	D2	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D3	Rare
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D4	Rare
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D5	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D6	Dominant
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D7	Occasional
			Bacillariales	Bacillariaceae	*Pseudo-Nitzschia*sp	D8	Abundant
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D9	Frequent

TABLE # 23 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING AND NEAP TIDE OF OCTOBER, 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Rare
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Occasional
				Lauderiaceae	*Lauderia*sp	D2	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D3	Abundant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D4	Occasional
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D5	Rare
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D6	Dominant
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D7	Occasional
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D8	Rare
			Bacillariales	Bacillariaceae	*Pseudo-Nitzschia*sp	D9	Frequent
			Fragilariales	Fragilariaceae	*Synedra*sp	D10	Rare

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Rare
			Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF2	Occasional
					Ceratiumfusus	DF3	Rare
					Ceratiumtripos	DF4	Rare

TABLE #24 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKSDURING SPRING TIDE OF OCTOBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Occasional
				Codonellidae	*Tintinnopsisdadayi*	T2	Rare
					Tintinnopsisgracilis	T3	Occasional
					Tintinnopsis radix	T4	Rare
					Tintinnopsisfailakkaensis	T5	Occasional
				Xystonellidae	*Favella* sp.	T6	Rare
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Abundant
					Bestiolina sp.	C2	Rare
				Eucalanidae	*Subeucalanus sp.*	C3	Rare
				Clausocalanidae	*Clausocalanus sp.*	C4	Occasional
				Centropagidae	*Centropages sp.*	C5	Rare
				Acartiidae	*Acartia sp.*	C6	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C7	Dominant
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C8	Rare
				Euterpinidae	*Euterpina sp.*	C9	Frequent
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C10	Rare
ROTIFERS	ROTIFERA	Rotifera Subclass: Eurotatoria	Superorder: Monogononta Order:Ploimida	Brachionidae	*Brachionusplicatilis*	R1	Rare
ARROW WORMS	CHAETOGNATHA	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Rare
MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Penaeidae	*Metapenaeussp.*	M1	Rare
					Penaeussp.	M2	Rare

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
UROCHORDATA	CHORDATA SUB PHYLUM UROCHORDATA	Appendicularia		Oikopleuridae	*Oikopleura sp.*	U1	Rare
CILIATES	CILIOPHORA	Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamniumsp.*	CI1	Occasional
MEDUSA	PHYLUM CNIDARIA	Hydrozoa			Unidentified medusa	ME1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L2	Rare
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L3	Rare
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L4	Rare
CHORDATA	VERTEBRATA	Pisces			Fish larvae	L5	Rare
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L6	Occasional
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L7	Rare
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Globigerinidae	*Globigerina* sp.	F1	Rare
				Rotalliidae	*Rotalia* sp.	F2	Rare

TABLE # 25 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKSDURING NEAP TIDE OF OCTOBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Frequent
				Codonellidae	*Tintinnopsisdadayi*	T2	Rare
					Tintinnopsisgracilis	T3	Rare
					Tintinnopsis radix	T4	Occasional
					Tintinnopsisfailakkaensis	T5	Rare
				Codonellopsidae	*Codonellopsis* sp.	T6	Rare
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Abundant
				Eucalanidae	*Pareucalanus sp.*	C2	Rare
					Subeucalanus sp.	C3	Rare
				Clausocalanidae	*Clausocalanus sp.*	C4	Occasional
				Centropagidae	*Centropages sp.*	C5	Rare
				Temoridae	*Temora sp.*	C6	Rare
				Acartiidae	*Acartia sp.*	C7	Occasional
			Cyclopoida	Oithonidae	*Oithona sp.*	C8	Abundant
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C9	Occasional
				Euterpinidae	*Euterpina sp.*	C10	Frequent
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C11	Rare
ROTIFERS	ROTIFERA	Rotifera Subclass: Eurotatoria	Superorder: Monogononta Order:Ploimida	Brachionidae	*Brachionusplicatilis*	R1	Rare
ARROW WORMS	CHAETOGNATHA	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Rare
MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Solenoceridae	*Solenocerasp.*	M1	Rare
				Penaeidae	*Metapenaeussp.*	M2	Rare
					Penaeussp.	M3	Rare
				Luciferidae	*Lucifer sp.*	M4	Rare
UROCHORDATA	CHORDATA SUB PHYLUM UROCHORDATA	Appendicularia		Oikopleuridae	*Oikopleura sp.*	U1	Rare
CILIATES	CILIOPHORA	Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamniumsp.*	CI1	Occasional

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
MEDUSA	PHYLUM CNIDARIA	Hydrozoa			Unidentified medusa	ME1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L2	Occasional
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L3	Rare
CYPHONAUTES LARVAE	BRYOZOA				Cyphonautes larvae	L4	Occasional
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L5	Rare
ECHINODERMATA LARVAE	ECHINODERMATA				Ophipluutes larvae/ Echinoplutes larvae	L6	Rare
CHORDATA	VERTEBRATA	Pisces			Fish larvae	L7	Rare
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L8	Occasional
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L9	Rare
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Globigerinidae	*Globigerina* sp.	F1	Occasional
				Rotalliidae	*Rotalia* sp.	F2	Rare

TABLE # 26 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING SPRING TIDE OF OCTOBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Dominant
				Codonellidae	*Tintinnopsisgracilis*	T2	Occasional
					Tintinnopsis radix	T3	Occasional
					Tintinnopsistocantinensis	T4	Occasional
				Xystonellidae	*Favella* sp.	T5	Rare
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Occasional
			Cyclopoida	Oithonidae	*Oithona sp.*	C2	Frequent
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Abundant
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L2	Rare

TABLE # 27 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING NEAP TIDE OF OCTOBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Rare
				Xystonellidae	*Favella* sp.	T2	Rare
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Dominant
				Eucalanidae	*Pareucalanus sp.*	C2	Rare
					Subeucalanus sp.	C3	Rare
				Clausocalanidae	*Clausocalanus sp.*	C4	Occasional
				Tortanidae	*Tortanus sp.*	C5	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C6	Abundant
			Harpacticoida	Euterpinidae	*Euterpina sp.*	C7	Frequent
			Poicilostomatatoida	Corycaeidae	*Corycaeus sp.*	C8	Rare

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
ARROW WORMS	CHAETOGNATHA	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Rare
MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Solenoceridae	*Solenocerasp.*	M1	Rare
				Penaeidae	*Metapenaeussp.*	M2	Rare
					Penaeussp.	M3	Rare
				Luciferidae	*Lucifer sp.*	M4	Rare
UROCHORDATA	CHORDATA SUB PHYLUM UROCHORDATA	Appendicularia		Oikopleuridae	*Oikopleura sp.*	U1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Frequent
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L2	Rare
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L3	Rare
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L4	Rare
ECHINODERMATA LARVAE	ECHINODERMATA				Ophipluutes larvae/ Echinoplutes larvae	L5	Rare
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L6	Occasional
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L7	Rare

BENTHIC ORGANISMS:

Few Benthic organismswere observed in the collected sediments by using the Van-veen grabs during the sampling conducted during spring tide period and while no Benthic organisms were observed during sampling conducted in Neap tide period from DPT harbour region and nearby creek except few dead shells.The meiobenthic organisms during spring tide were represented by Polychaetes,and Nematodes. The polychaetes were represented by *Scyphoproctus sp*. ,during spring tide sampling.The meiobenthic organisms in the collected samples were varying from 40-60N/M ^{2}during spring tide

Table # 28BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPT HARBOUR AREA CREEKS DURING NEAP TIDE IN OCTOBER ,2021

Benthic fauna	ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS REPRESENTATION BY GROUP						
	DPT HARBOUR			CREEKS			
POLYCHAETES	KPT-1	KPT-2	KPT-3	KPT-4	KPT-5	KPT-6	
Family : Capitellidae Scyphoproctus *sp.*	20	40	20	20	20	NS	
Total Polychates N/M^2	20	40	20	20	20	NS	
Un identified Nematode worms	40	20	20	40	20	NS	
TOTAL Benthic Fauna NUMBER/ M^2	60	60	40	60	40	-	

NS : No sample

7. Meteorological Data

Automatic Weather station have been installed in Seva Sadan -3 at the Deendayal Port which records the data on Temperature (°C), Humidity (%),Wind (mph), Dew Point (°C), Wind Direction (°), Pressure, Solar radiation, heat Index and UVI.

Temperature

The mean day time temperature for Deendayal Port was 30.3 °C. The day-time maximum temperature was 38.6 °C. The mean night time temperature was 26.5 °C. The minimum mean night time temperature recorded was 30.6 °C.

Air Pressure

The mean absolute air pressure for the month of October was 1009.9 hpa, whereas the mean relative pressure was 1009.3 hpa. The maximum absolute air pressure recorded for the month of October was 1016.5 hpa.

Heat Index

The mean day-time heat index for the month of October was 33.8 ^{o}C. The maximum heat index recorded was 55^{o}C.

Solar Radiation

The mean Solar Radiation in October was 252.2 w/m^2. The maximum solar radiation recorded in the month of October was 746.6 w/m^2.

Humidity

The mean day-time humidity was 60.0 % for the month of October and mean night time humidity was 72.4%. Maximum humidity recorded during day-time was 94.0 % and maximum humidity recorded during night-time was 93.0%.

Wind Velocity and Wind Direction

The mean wind velocity for the entire month of October was 4.6 km/hour. Maximum wind velocity recorded was 29.2 Km/hr . The wind direction was mostly S to N.

Conclusive Summary and Remedial measures Suggested

- The AAQ monitoring at six locations of Deendayal Port indicates that the mean PM_{10} values at four locations viz. Coal storage area, Marine Bhavan and Oil Jetty area were found above the permissible standards (100 µg/m^3)and$PM_{2.5}$was above permissible limits at Coal storage location(Limit 60 µg/m^3).

- Drinking water at all the twenty locations was found potable and was within permissible limits of BIS standards (IS 10500).

- Noise quality was also within the set permissible standards of an Industrial Area. The noise level observed during day time was >75 dB (A) and at night time was >70 dB (A) during the entire monitoring period.

- The sewage treated water of Deendayal Port Colony (Gopalpuri) was in line with the standards set by the Gujarat Pollution Control Board. The STP at Deendayal Port is not fully operational and STP at Vadinar Port was found non-operational.

Reasons for higher Values of PM_{10}

- Large amount of coal is handled at Berth No. 6, 7, 8 and 9. The unloading of coal directly in the truck, using grabs cause coal to spread in air as well as coal dust to fall on ground. This settled coal dust again mixes with the air while trucks travel through it.

- Also, the coal laden trucks are not always covered with tarpaulin sheets and these results in spillage of coal from trucks/dumpers during its transit from vessel to yard or storage site. This also increased PM values around marine Bhavan & Coal storage area.

Remedial Measures

The values of PM_{10} during the month of October, 2021 were observed beyond the permissible limit at four locations mentioned above. Given below are the remedial measures suggest to minimize the Air pollution at Deendayal Port.

- Guidelines for Coal Handling by GPCB should be strictly followed. (http://gpcb.gov.in/pdf/coal-handling-guidelines.pdf)
- Except for the higher values of PM_{10} at Coal storage site, Oil Jetty, Tuna Port and Marine Bhavan locations, the monitoring results for the present month suggest that the overall Environment Quality of Deendayal Port is satisfactory.

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ENVIRONMENTAL MONITORING REPORTFOR

DEENDAYAL PORT TRUST

REPORT	**:**	**DCPL/DPT/20-21/19**
Mont	**:**	**November**
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Prepare	**:**	**DETOX CORPORATION PVT. LTD., SURAT**

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Introduction

Monitoring of various environmental aspects of the Deendayal port by M/s Detox Corporation Pvt. Ltd. has been carried out through collection of samples, analysis of the same, comparing results with respect to the national standards and any other relevant standards by GBCB/CPCB/MoEF to identify non conformity in the Environment of the Deendayal Port. The results shall address the identified impacts and suggest measures to minimize the environmental impact due to various operations at Deendayal Port.

The environmental monitoring is carried out as per the Environment Management and Monitoring Plan submitted by Detox Corporation Pvt. Ltd.

1. Ambient Air Quality Monitoring

As per the Environmental Monitoring Plan of Deendayal Port Trust, Air monitoring was carried out at six identified locations at Deendayal Port and two locations at Vadinar Port.

1.1 Air Quality Monitoring Methodology

Air quality is measured in all the stations, for 24 hour for Total Suspended Particulate Matter (TSPM), PM_{10}, $PM_{2.5}$, SO_2, NO_X, NH_3 & Benzene, and Grab-sampling for CO & CO_2 measurements. The Air samplers are operated for a period of 24 hours and after a continuous operation of 8 hours of the sampler, the reagents were replaced to obtain 3 samples per day for each parameter namely, SO_2, NO_X. The EPM 2000 filter paper and PTFE Membrane bound filter paper are used for a period of 24 hours to obtain one sample each of TSPM, PM_{10} & $PM_{2.5}$. The AAQ samples are collected twice a week from all the eight locations as per the EMP.

1.2 Results

The ambient air quality monitoring data for six stations, viz. Marine Bhavan, Oil Jetty, Port Colony,Gopalpuri Hospital,Tuna Port and Nr. Coal Storage Area for the month of November 2021 are given in Tables 1A to 6B. The ambient air quality monitoring data for two stations at Vadinar (Nr. Admin Building &Nr. Signal Building) are given in Tables 7A to 8B.

Location 1: Marine Bhavan (AL1)

Table 1 : Results of Air Pollutant Concentration at Marine Bhavan										
Parameter	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m 3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**		**80 µg/m3**		**80 µg/m3**		**400 µg/m3**
AL1 – 1	01.11.21	326	193	86	3.52 4.84 3.52	3.96	22.23 19.69 22.87	21.60	9.70 9.96 10.98	10.21
AL1 – 2	09.11.21	303	156	90	5.71 6.15 6.59	6.15	15.88 17.15 28.58	20.54	13.02 12.76 14.30	13.36
AL1 – 3	12.11.21	402	191	96	7.47 7.03 5.71	6.74	28.58 32.39 20.96	27.31	11.49 13.27 9.70	11.49
AL1 – 4	17.11.21	438	180	90	3.08 2.20 2.64	2.64	19.69 14.61 15.88	16.73	15.57 18.12 14.30	16.00
AL1 – 5	19.11.21	530	156	88	4.40 5.28 3.52	4.40	20.96 18.42 22.23	20.54	5.62 11.49 10.47	9.19
AL1 - 6	24.11.21	468	182	90	2.64 5.28 2.64	3.52	14.61 20.96 13.34	16.30	10.98 6.64 4.85	7.49
AL1 - 7	26.11.21	597	274	92	3.52 3.08 2.20	2.93	14.61 19.69 19.05	17.78	14.30 9.96 8.42	10.89
AL1 – 8	29.11.21	613	210	90	2.20 2.64 3.52	2.78	26.04 29.22 19.69	24.98	10.47 6.38 7.15	8.00
Monthly Average		460	193	90		4.14		20.72		10.83
Standard Deviation		116	38	3		1.55		3.90		2.82

NS: Not Specified

Table 1B : Results of Air Pollutant Concentration at Marine Bhavan					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL1 – 1	1.11.21	1.27	BQL	2.15	581
AL1 – 2	9.11.21	1.12	BQL	1.9	497
AL1 – 3	12.11.21	1.11	BQL	1.94	361
AL1 – 4	17.11.21	1.05	BQL	2.04	357
AL1 – 5	19.11.21	1.12	BQL	1.85	541
AL1 - 6	24.11.21	1.38	BQL	1.91	561
AL1 – 7	26.11.21	1.07	BQL	1.98	567
AL1 – 8	29.11.21	1.14	BQL	2.21	541
Monthly Average		**1.16**	**-**	**2.00**	**501**
Standard Deviation		**0.11**	**-**	**0.13**	**91**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS -Not Specified

At Marine Bhavan, the overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_X and NH_3 is attributed mainly by motor vehicle emission produced from various types of automobiles (both diesel and petrol driven). Moreover, the loading and unloading of Food Grains and Timber at Jetty no. 1 and 2 also contributes to the high levels of TSPM and PM_{10}. The mean TSPM value at Marine Bhavan was 460 µg/m³, The mean PM_{10} values were 193.0 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean 90.0 µg/m³). The average values of SO_2, NO_x and NH_3 were within the permissible limit. The average values of SO_2, NO_x and NH3 were 4.14 µg/ m³, 20.72 µg/ m³ & 10.83 µg/ m³ respectively. These were within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Marine Bhavan. The mean Benzene concentration was 1.16 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 2.0 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 2: Oil Jetty (AL2)

Table 2 : Results of Air Pollutant Concentration at Oil Jetty										
Parameters	**Date**	**TSPM** [µg/m3]	**PM10** [µg/m3]	**PM2.5** [µg/m3]	**SO2** [µg/m3]		**NOx** [µg/m3]		**NH3** [µg/m3]	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL2 – 1	01.11.21	421	151	92	3.96 4.40 2.64	3.66	17.15 13.34 16.51	15.67	13.79 15.06 15.57	14.81
AL2 – 2	09.11.21	532	176	89	1.76 2.64 4.40	2.93	13.34 11.43 12.70	12.49	6.13 11.23 11.74	9.70
AL2 – 3	12.11.21	539	180	96	7.03 9.23 10.11	8.79	32.39 20.96 22.23	25.19	4.85 7.91 9.19	7.32
AL2 – 4	17.11.21	510	200	101	3.96 2.20 2.64	2.93	15.88 16.51 13.34	15.24	7.91 11.49 9.96	9.79
AL2 – 5	19.11.21	407	234	98	3.52 2.20 1.76	2.49	17.78 24.77 15.88	19.48	9.19 5.87 8.93	8.00
AL2 – 6	24.11.21	520	152	100	7.03 8.35 3.96	6.45	20.96 11.43 15.24	15.88	5.87 8.93 10.47	8.42
AL2 – 7	26.11.21	434	150	98	1.32 1.76 2.64	1.90	22.87 15.24 20.96	19.69	9.19 13.02 7.91	10.04
AL2 – 8	29.11.21	551	278	100	2.20 2.64 3.96	2.93	16.51 22.87 15.88	18.42	6.64 9.45 10.98	9.02
Monthly Average		489	190	97		4.01		17.76		9.64
Standard Deviation		59	46	4		2.37		3.86		2.29

NS: Not Specified

Table 2B : Results of Air Pollutant Concentration at Oil Jetty					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC* ppm**	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL2 -1	1.11.21	1.12	BQL	2	618
AL2 -2	9.11.21	1.09	BQL	1.91	583
AL2 -3	12.11.21	1.07	BQL	2.08	509
AL2 -4	17.11.21	1.19	BQL	2.04	487
AL2 – 5	19.11.21	1.27	BQL	2.07	590
AL2 – 6	24.11.21	1.16	BQL	2.05	549
AL2 -7	26.11.21	1.17	BQL	1.99	578
AL2 – 8	29.11.21	1.09	BQL	1.98	624
Monthly Average		**1.15**	**-**	**2.02**	**567**
Standard Deviation		**0.07**	**-**	**0.06**	**49**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Oil Jetty area was mainly by motor vehicle emission produced from various types of vehicles Oil Jetty Area. The mean TSPM values at Oil Jetty were 489 µg/m³ .The mean PM_{10} values were 190 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 97 µg/m³).The average values of SO_2, NO_x and NH_3 were within the permissible limit, The mean concentration of SO_2, NO_x and NH3 were 4.01 µg/m³, 17.76 µg/m³ and 9.79 µg/m³ respectively.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Oil Jetty. The mean Benzene concentration was 1.15 µg/m³ .Well below the permissible limit of 5.0 µg/m³. , HC's were below the detectable limit and Carbon Monoxide concentration was 2.02 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 3: Kandla Colony – Estate Office (AL-3)

Table 3 : Results of Air Pollutant Concentration at Estate Office										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit		**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL3 – 1	01.11.21	205	114	80	2.20 2.64 3.08	2.64	22.87 30.49 13.34	22.23	13.79 16.85 18.38	16.34
AL3 – 2	09.11.21	302	134	90	3.08 2.64 3.52	3.08	13.97 11.43 16.51	13.97	9.70 7.40 5.36	7.49
AL3 – 3	12.11.21	422	215	92	3.52 4.84 3.08	3.81	13.34 19.69 24.77	19.27	8.93 7.40 4.60	6.98
AL3 – 4	17.11.21	610	270	108	5.28 2.64 1.32	3.08	10.80 10.16 6.99	9.32	13.02 10.47 7.15	10.21
AL3 – 5	19.11.21	459	269	100	5.28 3.96 2.64	3.96	26.04 33.66 16.51	25.41	8.93 9.96 8.68	9.19
AL3 – 6	24.11.21	736	363	102	5.71 2.64 6.15	4.84	19.69 14.61 24.14	19.48	10.47 9.70 6.64	8.93
AL3 – 7	26.11.21	483	180	98	5.28 3.96 2.20	3.81	20.96 15.24 16.51	17.57	11.49 10.98 10.47	10.98
AL3 – 8	29.11.21	677	189	105	2.20 4.84 2.64	3.22	15.88 14.61 19.69	16.73	12.25 8.93 5.87	9.02
Monthly Average		487	217	97		3.55		18.00		9.89
Standard Deviation		182	81	9		0.69		4.93		2.91

NS: Not Specified

Table 3B : Results of Air Pollutant Concentration at Kandla Port Colony					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL3 -1	1.11.21	1.07	BQL	2.07	577
AL3 -2	9.11.21	1.1	BQL	1.91	583
AL3 -3	12.11.21	1.19	BQL	1.8	510
AL3 -4	17.11.21	1.11	BQL	1.91	480
AL3 – 5	19.11.21	1	BQL	2.1	652
AL3 – 6	24.11.21	1.1	BQL	1.84	672
AL3 – 7	26.11.21	1.26	BQL	2.12	364
AL3 – 8	29.11.21	1.26	BQL	2.01	426
Monthly Average		**1.14**	**-**	**1.97**	**533**
Standard Deviation		**0.09**	**-**	**0.12**	**108**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS- Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Kandla Port Colony was attributed by vehicle emission produced from trucks and heavy duty vehicles that pass through the road outside Kandla Port Colony. The mean TSPM values at Oil Jetty were 487 µg/m³, The mean PM_{10} values were 217 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 97 µg/m³). The average values of SO_2, NO_x and NH3 were 3.55 µg/m³, 18.0 µg/m³ and 9.89 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Kandla Port Colony. The mean Benzene concentration was 1.14 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.97 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 4: Gopalpuri Hospital (AL-4)

Table 4 : Results of Air Pollutant Concentration at Gopalpuri Hospital										
Parameter	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period		**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit		**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL4 -1	01.11.21	145	81	36	3.52 2.20 2.64	2.78	8.26 15.88 14.61	12.91	9.19 10.47 7.15	8.93
AL4 -2	09.11.21	254	132	89	2.64 1.32 2.20	2.05	9.53 13.34 13.97	12.28	5.87 5.36 4.85	5.36
AL4 -3	12.11.21	309	136	92	2.20 3.52 2.64	2.78	10.16 8.26 11.43	9.95	3.83 5.87 5.36	5.02
AL4 -4	17.11.21	474	249	101	3.52 2.64 2.20	2.78	9.53 11.43 9.53	10.16	6.64 4.60 5.87	5.70
AL4 – 5	19.11.21	298	127	90	2.64 3.52 1.76	2.64	16.51 10.16 19.69	15.46	5.87 8.42 6.13	6.81
AL4 – 6	24.11.21	351	170	98	3.08 2.64 1.76	2.49	15.88 10.16 13.34	13.13	5.87 9.19 11.49	8.85
AL4 – 7	26.11.21	285	132	87	2.64 3.96 3.08	3.22	17.78 16.51 15.88	16.73	6.38 7.91 5.36	6.55
AL4 – 8	29.11.21	738	469	104	3.52 3.96 2.64	3.37	13.34 14.61 12.07	13.34	8.17 8.93 7.91	8.34
Monthly Average		357	187	87		2.77		12.99		6.95
Standard Deviation		180	124	21		0.41		2.33		1.58

NS: Not Specified

Table 4B : Results of Air Pollutant Concentration at Gopalpuri Hospital					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL4 -1	1.11.21	1.02	BQL	2.01	609
AL4 -2	9.11.21	1.15	BQL	2.04	509
AL4 -3	12.11.21	1.26	BQL	1.94	487
AL4 -4	17.11.21	1.09	BQL	1.73	450
AL4 – 5	19.11.21	1.08	BQL	1.88	544
AL4 – 6	24.11.21	1.2	BQL	2.13	580
AL4 – 7	26.11.21	1.18	BQL	1.91	559
AL4 – 8	29.11.21	1.14	BQL	2.2	505
Monthly Average		**1.14**	**-**	**1.98**	**530**
Standard Deviation		**0.08**	**-**	**0.15**	**52**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Gopalpuri Hospital was attributed by vehicle emission produced from light motor vehicles of the colony residents. The mean TSPM values at Oil Jetty were 357 µg/m³, The mean PM_{10} values were 187 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean= 87 µg/m³). The average values of SO_2, NO_x and NH_3 were 2.77 µg/m³, 12.99 µg/m³ and 6.95 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Gopalpuri Hospital. The mean Benzene concentration was 1.14 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.98 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 5: Coal Storage Area (AL-5)

Table 5 : Results of Air Pollutant Concentration at Coal Storage Area										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL5 – 1	01.11.21	306	154	89	2.20 3.08 4.40	3.22	20.96 21.60 18.42	20.33	8.93 7.40 13.02	9.79
AL5 – 2	09.11.21	590	288	106	9.67 4.84 3.96	6.15	19.69 23.50 15.88	19.69	15.83 17.61 15.57	16.34
AL5 – 3	12.11.21	680	351	104	10.55 7.03 9.67	9.08	22.87 26.04 31.12	26.68	8.68 6.64 8.17	7.83
AL5 – 4	17.11.21	712	355	108	2.20 1.76 3.52	2.49	19.69 20.96 22.23	20.96	13.53 9.19 7.91	10.21
AL5 – 5	19.11.21	696	380	110	5.28 6.15 3.96	5.13	20.96 19.69 26.68	22.44	10.72 9.96 13.02	11.23
AL5 – 6	24.11.21	622	352	101	3.52 3.96 5.71	4.40	14.61 18.42 19.69	17.57	15.83 15.06 13.02	14.64
AL5 – 7	26.11.21	578	218	106	3.52 4.84 3.52	3.96	16.51 20.96 18.42	18.63	10.98 9.19 7.91	9.36
AL5 – 8	29.11.21	596	241	108	5.28 2.64 2.20	3.37	22.23 27.31 29.22	26.25	10.98 13.02 14.30	12.76
Monthly Average		598	292	104		4.73		21.57		11.52
Standard Deviation		128	81	7		2.10		3.36		2.87

NS: Not Specified

Table 5B : Results of Air Pollutant Concentration at Coal Storage Area					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL5 – 1	1.11.21	1.1	BQL	1.97	593
AL5 – 2	9.11.21	1.28	BQL	1.56	582
AL5 – 3	12.11.21	1.07	BQL	2.1	453
AL5 – 4	17.11.21	1.02	BQL	1.98	494
AL5 – 5	19.11.21	1.17	BQL	2.07	544
AL5 – 6	24.11.21	1	BQL	1.91	571
AL5 – 7	26.11.21	1.23	BQL	1.78	636
AL5 – 8	29.11.21	1.20	BQL	2.07	511
Monthly Average		**1.13**	**-**	**1.93**	**548**
Standard Deviation		**0.10**	**-**	**0.18**	**59**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Coal Storage Area was comparatively highest among all the locations of Air Quality monitoring in Kandla Port. High values of TSPM, $PM_{10,}$ $PM_{2.5}$, SO_2, NO_X at this location was due to lifting of coal with grab and other coal handling processes near Berth no. 6 & 7. Moreover, the traffic was also heavy around this place for transport of coal thus emissions produced from heavy vehicles. The mean TSPM values at Coal storage were 598µg/m^3. The mean PM_{10} values were 292 µg/m^3, which is well above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 104 µg/m^3). The average values of SO_2, NO_x and NH_3 were 4.73 µg/m^3, 21.57 µg/m^3 and 11.52 µg/m^3 respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Coal Storage Area. The mean Benzene concentration was 1.13 µg/m^3, well below the permissible limit of 5.0 µg/m^3. HC's were below the detectable limit and Carbon Monoxide concentration was 1.93 mg/m^3, well below the permissible limit of 4.0 mg/m^3.

Location 6: Tuna Port (AL-6)

Table 6 : Results of Air Pollutant Concentration at Tuna Port										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL6 -1	01.11.21	214	97	61	3.52 2.64 1.76	2.64	20.96 12.07 11.43	14.82	14.04 12.51 9.70	12.08
AL6 – 2	09.11.21	314	149	102	1.76 2.64 1.32	1.90	10.16 11.43 10.16	10.59	6.38 6.64 8.42	7.15
AL6 – 3	12.11.21	425	208	104	4.84 5.28 2.64	4.25	16.51 20.96 15.24	17.57	6.64 4.85 8.17	6.55
AL6 – 4	17.11.21	504	280	110	2.20 1.76 3.08	2.34	5.08 7.62 8.89	7.20	6.13 8.42 6.64	7.06
AL6 – 5	19.11.21	432	242	106	2.64 2.20 1.76	2.20	22.87 13.34 18.42	18.21	13.02 11.74 10.47	11.74
AL6 – 6	24.11.21	315	149	96	5.28 1.76 3.96	3.66	30.49 22.23 27.95	26.89	9.96 15.57 12.76	12.76
AL6 – 7	26.11.21	326	140	98	2.20 3.08 3.52	2.93	13.34 15.24 16.51	15.03	9.19 8.93 10.47	9.53
AL6 – 8	29.11.21	569	298	104	2.20 2.64 3.96	2.93	15.88 13.34 18.42	15.88	10.72 8.93 11.23	10.30
Monthly Average		387	195	98		2.86		15.77		9.65
Standard Deviation		116	73	15		0.78		5.79		2.48

NS: Not Specified

Table 6B : Results of Air Pollutant Concentration at Tuna Port					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL6 -1	01.11.21	1.2	BQL	1.91	586
AL6 – 2	09.11.21	1.02	BQL	2.1	600
AL6 – 3	12.11.21	1.08	1.91	1.91	452
AL6 – 4	17.11.21	1.26	BQL	1.94	507
AL6 – 5	19.11.21	1.21	BQL	2.08	593
AL6 – 6	24.11.21	1.01	BQL	1.98	568
AL6 – 7	26.11.21	1.203	BQL	2.08	577
AL6 – 8	29.11.21	1.19	BQL	2.04	517
Monthly Average		**1.15**	**-**	**2.01**	**550**
Standard Deviation		**0.10**	**-**	**0.08**	**52**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS- Not Specified

The mean TSPM values at Tuna Port were 387 µg/m³, The mean PM_{10} values were 195 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 98 µg/m³). The average values of SO_2, NO_x and NH_3 were 2.86 µg/m³, 15.77 µg/m³ and 9.65 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Tuna Port. The mean Benzene concentration was 1.15 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 2.01 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 7: Signal Building (Vadinar) (AL-7)

Table 7 : Results of Air Pollutant Concentration at Signal Building

Parameters	Date	TSPM [µg/m3]	PM10 [µg/m3]	PM2.5 [µg/m3]	SO2 [µg/m3]		NOx [µg/m3]		NH3 [µg/m3]	
Sampling Period	-	24hr	24hr	24hr	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)	8 hr	24hr (Avg.)
NAAQMS limit	-	NS	100 µg/m3	60 µg/m3	-	80 µg/m3	-	80 µg/m3	-	400 µg/m3
AL7 -1	01.11.21	251	137	109	2.20 3.96 3.52	3.22	7.62 13.34 14.61	11.86	6.89 6.13 4.08	5.70
AL7 -2	09.11.21	215	115	84	5.71 6.15 7.03	6.30	26.04 14.61 11.43	17.36	4.60 10.47 5.87	6.98
AL7 -3	12.11.21	202	104	76	3.52 4.84 3.52	3.96	10.16 26.04 13.34	16.51	6.38 10.72 8.93	8.68
AL7 -4	17.11.21	200	103	84	2.64 5.28 3.96	3.96	19.69 13.34 10.16	14.40	7.91 4.60 5.87	6.13
AL7 -5	19.11.21	224	104	94	5.71 3.52 2.64	3.96	13.97 19.69 15.24	16.30	9.19 7.15 6.64	7.66
AL7 -6	24.11.21	238	118	77	4.40 2.64 6.15	4.40	10.16 6.99 14.61	10.59	5.87 4.60 7.40	5.96
AL7 -7	26.11.21	213	120	64	2.64 2.20 5.71	3.52	15.88 7.62 19.69	14.40	14.04 10.72 6.38	10.38
AL7 -8	29.11.21	207	115	84	5.71 2.64 1.32	3.22	10.16 15.24 14.61	13.34	8.17 7.91 6.89	7.66
Monthly Average		219	115	84		4		14		7
Standard Deviation		18	11	13		1		2		2

NS: Not Specified

Table 7B : Results of Air Pollutant Concentration at Signal Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL7 -1	01.11.21	1.03	BQL	1.75	569
AL7 – 2	09.11.21	1.16	BQL	1.85	629
AL7 – 3	15.11.2021	1.35	BQL	1.78	501
AL7 – 4	18.11.2021	1.09	BQL	2	449
AL7 – 5	19.11.2021	1	BQL	1.89	458
AL7 – 6	22.11.2021	1.22	BQL	1.87	510
AL7 – 7	25.11.2021	1.08	BQL	1.99	541
AL7 – 8	29.11.2021	1.18	BQL	1.88	565
Monthly Average		**1.14**	**-**	**1.88**	**528**
Standard Deviation		**0.11**	**-**	**0.09**	**60**

*NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS_ Not Specified

The mean TSPM values at Vadinar Port were 219 µg/m³. The mean PM_{10} values were 115 µg/m³, which is below the permissible limit. $PM_{2.5}$ values were also within the permissible limit (mean = 84 µg/m³). The average values of SO_2, NO_x and NH_3 were 4.0 µg/m³, 14.0 µg/m³ and 7.0µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Vadinar Port. The mean Benzene concentration was 1.14 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.88 mg/m³, well below the permissible limit of 4.0 mg/m³.

Location 8: Admin Building (Vadinar) (AL-8)

Table 8 : Results of Air Pollutant Concentration at Admin Building										
Parameters	**Date**	**TSPM [µg/m3]**	**PM10 [µg/m3]**	**PM2.5 [µg/m3]**	**SO2 [µg/m3]**		**NOx [µg/m3]**		**NH3 [µg/m3]**	
Sampling Period	**-**	**24hr**	**24hr**	**24hr**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**	**8 hr**	**24hr (Avg.)**
NAAQMS limit	**-**	**NS**	**100 µg/m3**	**60 µg/m3**	**-**	**80 µg/m3**	**-**	**80 µg/m3**	**-**	**400 µg/m3**
AL8 -1	01.11.21	204	83	73	4.84 2.64 2.20	3.22	20.96 19.69 15.24	18.63	6.38 5.87 5.62	5.96
AL8 -2	09.11.21	193	86	75	4.40 2.64 2.20	3.08	13.34 20.33 13.34	15.67	8.93 6.64 10.98	8.85
AL8 -3	12.11.21	241	126	107	2.64 3.08 1.76	2.49	15.88 22.87 9.53	16.09	4.85 5.62 7.40	5.96
AL8 -4	17.11.21	167	100	53	3.52 4.84 3.08	3.81	17.78 10.16 10.80	12.91	8.42 10.47 3.83	7.57
AL8 -5	19.11.21	183	151	72	2.20 1.76 3.52	2.49	10.16 9.53 12.07	10.59	5.36 8.17 6.13	6.55
AL8 -6	24.11.21	197	104	80	3.52 5.71 6.59	5.28	15.88 10.16 14.61	13.55	8.93 7.91 6.13	7.66
AL8 -5	26.11.21	226	111	88	3.52 1.76 4.84	3.37	10.16 13.34 10.80	11.43	11.74 5.87 8.93	8.85
AL8-6	29.11.21	226	104	106	2.64 3.52 2.20	2.78	10.16 20.96 8.26	13.13	9.19 5.87 7.15	7.40
Monthly Average		205	108	82		3		14		7
Standard Deviation		25	22	18		1		3		1

NS: Not Specified

Table 8B : Results of Air Pollutant Concentration at Admin Building					
Parameter	**Date**	**C_6H_6 [µg/m³]**	**HC***	**CO [mg/m³]**	**CO_2 [ppm]**
Sampling Period		**8 hr**	**Grab Sampling**	**Grab Sampling**	**Grab Sampling**
NAAQMS limit		**5.0 µg/m³**	**NS**	**4.0 mg/m³**	**NS**
AL8 -1	01.11.21	1.23	BDL	1.88	571
AL8-2	09.11.21	1.09	BDL	2.04	581
AL8 -3	15.11.2021	1.29	BDL	2.17	465
AL8-4	18.11.2021	1.05	BDL	1.82	452
AL8 -5	19.11.2021	1.01	BDL	1.92	482
AL8-6	22.11.2021	1.28	BDL	1.73	496
AL8-7	25.11.2021	1.15	BDL	1.85	524
AL8-8	29.11.2021	1.13	BDL	2.02	561
Monthly Average		**1.15**	**-**	**1.93**	**517**
Standard Deviation		**0.10**	**-**	**0.14**	**50**

* NMHC- Non- Methane Hydrocarbons
BQL- Below Quantification Limit (Quantification Limit – NMHC: 0.5 ppm)
NS-Not Specified

The overall values of TSPM, PM_{10}, $PM_{2.5}$, SO_2, NO_x and NH_3 at Admin Building Vadinar was comparatively low among all the locations of Air Quality monitoring in Kandla Port and Vadinar Port. The mean TSPM values at Vadinar Port were 205 µg/m³. The mean PM_{10} values were 108 µg/m³, which is above the permissible limit. $PM_{2.5}$ values were above the permissible limit (mean = 82.0 µg/m³). The average values of SO_2, NO_x and NH_3 were 3.0 µg/m³, 14.0 µg/m³ and 7.0 µg/m³ respectively and were all within the permissible limit.

The levels of Benzene, Hydrocarbons (HC) and CO were within the permissible limit at Admin Building, Vadinar Port. The mean Benzene concentration was 1.15 µg/m³, well below the permissible limit of 5.0 µg/m³. HC's were below the detectable limit and Carbon Monoxide concentration was 1.93 mg/m³, well below the permissible limit of 4.0 mg/m³.

1.4 Observations and Conclusion

During the monitoring period, the overall Ambient Air Quality of the port area was found to be well within the desired levels for various gaseous pollutants. However, Particulate matter as PM_{10} and $PM_{2.5}$ was found to exceed the limits at locations like Near Coal storage area, Marine Bhavan, Estate Office, Tuna Port and Oil Jetty area.

2. Drinking Water Quality Monitoring

Drinking Water Quality Monitoring was carried out at twenty stations at Kandla, Vadinar & Township Area of Deendayal Port.

2.1 Drinking Water Monitoring Methodology

Drinking water samples were collected from 20 locations as prescribed in the tender document. Samples for physico-chemical analysis were collected in 1 liter carboys and samples for microbiological parameters were collected in sterilized bottles. These samples were then analyzed in laboratory for various drinking water parameters at Kandla Lab/Surat.

The Sampling and Analysis was done as per standard methods - IS 10500:2012. The water samples were analyzed for various parameters, viz. Color , Odor, Turbidity , Conductivity , pH , Chlorides , TDS, Total Hardness, Iron , Sulphate , Salinity , DO, BOD, Na, K, Ca, Mg, F, NO_3, NO_2, Mn, Cr-6, Cu, Cd, As, Hg, Pb, Zn, Bacterial Count (cfu) .

2.2 Results

The Drinking Water Quality monitoring data for 20 stations are given in below from table No. 9 to Table No. 15

Table 9: Drinking Water Quality Monitoring Parameters for Nirman Building 1, P & C building & Main Gate (North) at Kandla

Sr. No.	Parameter	Unit	Nirman Building 1	P & C building	Main Gate North	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.3	7.4	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	990	1280	1310	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1860	2430	2540	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	491.09	461.02	516.15	250.0	1000.0
9	Ca as Ca	mg/l	64.13	68.14	60.12	75.0	200.0
10	Mg as Mg	mg/l	63.18	70.47	68.04	30.0	100.0
11	Total Hardness	mg/l	420	460	430	200.0	600.0
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.32	0.35	0.34	1.0	1.5
14	Sulphate as SO4	mg/l	286.8	289.2	283.2	200.0	400
15	Nitrite as NO2	mg/l	<0.1	<0.1	<0.1	NS*	NS*
16	Nitrate as NO3	mg/l	6.41	7.88	6.20	45.0	No Relaxation
17	Salinity	%	0.86	0.80	0.89	NS*	NS*
18	Sodium as Na	mg/l	202	225	277	NS*	NS*
19	Potassium as K	mg/l	5.08	3.26	5.26	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	0.003
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	0.001
26	Lead	mg/l	BQL	BQL	BQL	0.01	0.01
27	Zinc	mg/l	BQL	BQL	BQL	5.0	15.0
28	Bacterial Count	CFU/100 ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe-0.009 mg/l, Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 10: Drinking Water Quality Monitoring Parameters for Canteen, West Gate – I &Wharf Area at Kandla

Sr. No.	Parameter	Unit	Canteen	West Gate – I	Wharf Area	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.3	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1410	1350	1420	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2710	2560	2730	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride as Cl	mg/l	541.20	486.08	491.09	250.0	1000.0
9	Ca as Ca	mg/l	64.13	56.11	64.13	75.0	200.0
10	Mg as Mg	mg/l	68.04	68.04	72.90	30.0	100.0
11	Total Hardness	mg/l	440	420	460	200.0	600.0
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides as F	mg/l	0.41	0.29	0.34	1.0	1.5
14	Sulphate as SO4	mg/l	291.6	204.0	194.4	200.0	400
15	Nitrite as NO2	mg/l	<0.1	<0.1	<0.1	NS*	NS*
16	Nitrate as NO3	mg/l	8.10	12.25	8.87	45.0	No Relaxation
17	Salinity	%	0.83	0.93	0.98	NS*	NS*
18	Sodium as Na	mg/l	201	195	279	NS*	NS*
19	Potassium as K	mg/l	4.28	4.08	4.69	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	0.003
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	0.001
26	Lead	mg/l	BQL	BQL	BQL	0.01	0.01
27	Zinc	mg/l	BQL	BQL	BQL	5.0	15.0
28	Bacterial Count	CFU/100 ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 11: Drinking Water Quality Monitoring Parameters for Sewa sadan – 3, Workshop I &Custom Building at Kandla

Sr. No.	Parameter	Unit	Sewa Sadan – 3	Workshop	Custom Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.4	7.7	7.5	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1360	1325	1430	500	2000
3	Turbidity	NTU	1	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2530	2480	2680	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride	mg/l	656.46	611.36	516.15	250.0	1000.0
9	Ca as Ca	mg/l	56.11	60.12	64.13	75.0	200.0
10	Mg as Mg	mg/l	75.33	65.61	72.90	30.0	100.0
11	Total Hardness	mg/l	450	420	460	200.0	600.0
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides	mg/l	0.23	0.45	0.46	1.0	1.5
14	Sulphate	mg/l	198.0	290.4	230.4	200.0	400
15	Nitrite	mg/l	<0.1	<0.1	<0.1	NS*	NS*
16	Nitrate	mg/l	10.42	9.57	13.94	45.0	No Relaxation
17	Salinity	%	0.88	0.89	1.19	NS*	NS*
18	Sodium as Na	mg/l	303	248	327	NS*	NS*
19	Potassium as K	mg/l	4.30	5.61	8.26	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	0.003
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	0.001
26	Lead	mg/l	BQL	BQL	BQL	0.01	0.01
27	Zinc	mg/l	BQL	BQL	BQL	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 12: Drinking Water Quality Monitoring Parameters for Port Colony Kandla, Hospital Kandla & A.O. Building at Gandhidham

Sr. No.	Parameter	Unit	Port Colony Kandla	Hospital Kandla	A.O. Building	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.6	7.3	7.2	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1310	1410	1430	500	2000
3	Turbidity	NTU	0	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2540	2690	2740	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	<0.1	<0.1	<0.1	NS*	NS*
8	Chloride	mg/l	481.07	531.18	516.15	250.0	1000.0
9	Ca as Ca	mg/l	72.14	76.15	64.13	75.0	200.0
10	Mg as Mg	mg/l	55.89	58.32	68.04	30.0	100.0
11	Total Hardness	mg/l	410	430	440	200.0	600.0
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides	mg/l	0.48	0.85	0.52	1.0	1.5
14	Sulphate	mg/l	210.0	291.6	301.2	200.0	400
15	Nitrite	mg/l	<0.1	<0.1	<0.1	NS*	NS*
16	Nitrate	mg/l	10.28	13.24	9.79	45.0	No Relaxation
17	Salinity	%	1.10	0.93	0.87	NS*	NS*
18	Sodium as Na	mg/l	154	384	218	NS*	NS*
19	Potassium as K	mg/l	3.26	4.69	4.03	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	0.003
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	0.001
26	Lead	mg/l	BQL	BQL	BQL	0.01	0.01
27	Zinc	mg/l	BQL	BQL	BQL	5.0	15.0
28	Bacterial Count	CFU/100 ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 13: Drinking Water Quality Monitoring Parameters for School Gopalpuri, Guest House & E - Type Quarter at Gopalpuri, Gandhidham

Sr. No.	Parameter	Unit	School Gopalpuri	Guest House	E - Type Quarter	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.4	7.6	7.5	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1400	1720	1090	500	2000
3	Turbidity	NTU	1	0	1	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	2640	2730	2130	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride	mg/l	496.10	526.17	481.07	250.0	1000.0
9	Ca as Ca	mg/l	60.12	56.11	68.14	75.0	200.0
10	Mg as Mg	mg/l	80.19	77.76	65.61	30.0	100.0
11	Total Hardness	mg/l	480	460	440	200.0	600.0
12	Iron as Fe	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides	mg/l	0.60	0.81	0.63	1.0	1.5
14	Sulphate	mg/l	314.4	214.8	289.2	200.0	400
15	Nitrite	mg/l	<0.1	<0.1	<0.1	NS*	NS*
16	Nitrate	mg/l	10.91	12.39	10.00	45.0	No Relaxation
17	Salinity	%	0.96	0.93	0.90	NS*	NS*
18	Sodium as Na	mg/l	287	106	246	NS*	NS*
19	Potassium as K	mg/l	5.28	6.29	2.25	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	0.003
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	0.001
26	Lead	mg/l	BQL	BQL	BQL	0.01	0.01
27	Zinc	mg/l	BQL	BQL	BQL	5.0	15.0
28	Bacterial Count	CFU/100 ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 14: Drinking Water Quality Monitoring Parameters for F - Type Quarter, Hospital Gopalpuri & Tuna Port

Sr. No.	Parameter	Unit	F - Type Quarter	Hospital Gopalpuri	Tuna Port	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.6	7.3	7.42	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1020	1250	1150	500	2000
3	Turbidity	NTU	0	1	0	1.0	5.0
4	Odor	-	Odorless	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Unit	Colorless	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1950	2380	2000	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	BQL	NS*	NS*
8	Chloride	mg/l	611.36	576.28	520	250.0	1000.0
9	Ca as Ca	mg/l	64.13	60.12	76.15	75.0	200.0
10	Mg as Mg	mg/l	55.89	72.90	55.89	30.0	100.0
11	Total Hardness	mg/l	390	450	420	200.0	600.0
12	Iron as Fe+3	mg/l	BQL	BQL	BQL	0.3	No Relaxation
13	Fluorides	mg/l	0.86	0.57	0.75	1.0	1.5
14	Sulphate	mg/l	301.2	285.6	274.8	200.0	400
15	Nitrite	mg/l	<0.1	<0.1	<0.1	NS*	NS*
16	Nitrate	mg/l	10.91	10.07	9.93	45.0	No Relaxation
17	Salinity	%	0.95	0.87	1.10	NS*	NS*
18	Sodium as Na	mg/l	235	235	248	NS*	NS*
19	Potassium as K	mg/l	3.98	5.54	4.8	NS*	NS*
20	Manganese	mg/l	BQL	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	BQL	0.003	0.003
24	Arsenic	mg/l	BQL	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	BQL	0.001	0.001
26	Lead	mg/l	BQL	BQL	BQL	0.01	0.01
27	Zinc	mg/l	BQL	BQL	BQL	5.0	15.0
28	Bacterial Count	CFU/100 ml	Absent	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

Table 15: Drinking Water Quality Monitoring Parameters for Vadinar Jetty & Port Colony at Vadinar

Sr. No.	Parameter	Unit	Vadinar Jetty	Port Colony Vadinar	Acceptable Limits as per IS 10500 : 2012	Permissible Limits in the absence of Alternate Source as per IS 10500 : 2012
1	pH	pH Unit	7.5	7.3	6.5 to 8.5	6.5 to 8.5
2	Total Dissolved Solids	mg/l	1060	1120	500	2000
3	Turbidity	NTU	ND	ND	1.0	5.0
4	Odor	-	Odorless	Odorless	Agreeable	Agreeable
5	Color	Hazen Units	Colorless	Colorless	5.0	15.0
6	Conductivity	µs/cm	1960	2150	NS*	NS*
7	Biochemical Oxygen Demand	mg/l	BQL	BQL	NS*	NS*
8	Chloride	mg/l	486.08	521.16	250.0	1000.0
9	Ca as Ca	mg/l	68.14	60.12	75.0	200.0
10	Mg as Mg	mg/l	68.04	68.04	30.0	100.0
11	Total Hardness	mg/l	450	430	200.0	600.0
12	Iron as Fe+3	mg/l	BQL	BQL	0.3	No Relaxation
13	Fluorides	mg/l	0.86	0.69	1.0	1.5
14	Sulphate	mg/l	23.04	22.56	200.0	400
15	Nitrite	mg/l	<0.1	<0.1	NS*	NS*
16	Nitrate	mg/l	7.88	10.63	45.0	No Relaxation
17	Salinity	%	0.88	0.94	NS*	NS*
18	Sodium as Na	mg/l	52.8	40.2	NS*	NS*
19	Potassium as K	mg/l	3.3	2.1	NS*	NS*
20	Manganese	mg/l	BQL	BQL	0.1	0.3
21	Hexavalent Chromium	mg/l	BQL	BQL	NS*	NS*
22	Copper	mg/l	BQL	BQL	0.05	1.5
23	Cadmium	mg/l	BQL	BQL	0.003	0.003
24	Arsenic	mg/l	BQL	BQL	0.01	0.05
25	Mercury	mg/l	BQL	BQL	0.001	0.001
26	Lead	mg/l	BQL	BQL	0.01	0.01
27	Zinc	mg/l	BQL	BQL	5.0	15.0
28	Bacterial Count	CFU/100ml	Absent	Absent	Absent	Absent

*NS: Not Specified

BQL- Below Quantification Limit, (BOD-2.0 mg/l, Fe-0.009 mg/l,Mn- 0.01 mg/l, Cr^{+6}- 0.03 mg/l, Cu-0.004 mg/l, Cd-0.003 mg/l, As-0.003mg/l, Hg-0.001 mg/l, Pb-0.006mg/l, Zinc-0.021 mg/l).

2.3 Results & Discussion

The colour of all drinking water samples was < 5 Hazen unit and odour of the samples was also agreeable. All parameters are found to be within the specified limit of the Drinking water Standard.

pH

The limit of pH value for drinking water is specified as 6.5 to 8.5. pH value in the studied area varied from 7.1 to 7.7 pH unit. All the sampling points showed pH values within the prescribed limit by Indian Standards.

Total Dissolved Solids (TDS)

TDS values in the studied area varied between 900 -1800 mg/l. None of the sampling points showed higher TDS values than the prescribed limit by Indian standards.

Conductivity

Electrical Conductivity is the ability of a solution to transfer (conduct) electric current. Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The conductivity in the samples collected during the month of November ranged from 1800-3000 µs/cm. Electrical conductivity standards do not appear in BIS standards for drinking water.

BOD

BOD value in the studied area was found Below Quantification Limit (2.0 mg/l). Indian standards does not show any standard values for BOD in drinking water.

Chlorides

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. Chloride value in the studied area varied between 400-700 mg/l and is found to be within the Permissible limit of the Drinking Water Standard.

Calcium

Calcium value in the studied area varied between 50 - 80 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. If calcium is present beyond the maximum acceptable limit, it causes incrustation of pipes.

Magnesium

Magnesium value in the studied area varied between 50-85 mg/l. All the locations had Magnesium within the prescribed limits of 30-100 mg/L.

Total Hardness

Hardness value in the studied area varied between 350-480 mg/l and is found to be within the Permissible limit of the Drinking Water Standard. The prescribed limit by Indian Standards is 200-600 mg/L.

Iron

Iron value in the studied area was found Below Quantification Limit (0.009 mg/l) and hence well below the permissible limit as per Indian Standards is 0.3 mg/L. The excess amount of iron causes slight toxicity; gives stringent taste to water.

Fluoride

Fluoride value in the studied area varied between 0.1 – 1.0 mg/l and hence well below the permissible limit as per Indian Standards is 1.0-1.5 mg/L. Moderate amounts lead to dental effects, but long-term ingestion of large amounts can lead to potentially severe skeletal problems.

Sulphates

Sulphate value in the studied area varied between 20 – 350 mg/l. All the sampling points showed sulphate values within the prescribed limits by Indian Standards (200-400 mg/L). Sulphate content in drinking water exceeding the 400 mg/L imparts bitter taste.

Nitrites (NO_2) and Nitrates (NO_3)

Nitrite values in all the water samples were found Below Quantification Limit (0.1 mg/l). There are no specified standard values for Nitrites in Drinking water. The minimim Nitrate value in drinking water of KPT was 6.20 mg/l which is well within the permissible limit of the Drinking water Standard.

Salinity

Salinity in drinking water in the present samples collected ranged from 0.5 to 1.4 %. There are no prescribed Indian standards for salinity in Drinking water**.**

Sodium and Potassium Salts

Sodium values in the samples collected ranged from 40 - 400 mg/l and Potassium salts ranged from 2.0 to 8.5 mg/l. There are no prescribed limits of Sodium and Potassium in Indian standards for Drinking water**.**

Heavy Metals in Drinking Water

In the present study period drinking water samples were analyzed for Mn, Cr, Cu, Cd, As, Hg, Pb and Zn. All these heavy metals were well Below the Quantification limits prescribed by the Indian Standards.

Bacteriological Study

Analysis of the bacteriological parameter at all location shows that Bacteria is not present and hence Bacterial count is in line with the permissible limit of drinking water. This shows that all the drinking water samples were safe from any bacteriological contamination.

2.4 Conclusions

These results are compared with acceptable limits as prescribed in IS 10500:2012 – Drinking Water Specification. It is seen from the analysis data that during the study period the water was safe for human consumption at all drinking water monitoring stations.

3. Noise Level Monitoring

Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. Noise Monitoring was done at 13 stations at Kandla, Vadinar and Township area.

3.1 Method of Monitoring

Sampling was done at all stations for 24 hour period. Data was recorded using automated sound level meter. The intensity of sound was measured in sound pressure level (SPL) and common unit of measurement is decibel (dB).

3.2 Results

Table 16: Noise Monitoring data for ten locations of Deendayal Port and two locations of Vadinar Port

Sr. No.	Location	Day Time Average Noise Level (SPL) in dB(A)	Night Time Average Noise Level (SPL) in dB(A)
	Sampling Time	**6:00 am to 10:00 PM**	**10:00PM to 6:00 AM**
1	Marine Bhavan	73.9	53.4
2	Nirman Building 1	62.3	51.0
3	Tuna Port	57.2	50.9
4	Main Gate North	67.0	61.8
5	West Gate I	70.5	65.1

6	Canteen Area	64.5	51.0
7	Main Road	68.4	51.5
8	ATM Building	74.4	57.3
9	Wharf Area /Jetty Area	72.9	68.1
10	Port & Custom Office	67.8	41.8
	Vadinar Port		
11	Entrance Gate of Vadinar Port	66.4	53.2
12	Nr. Port Colony, Vadinar	60.7	54.1
13	Nr. Vadinar Jetty	72.4	66.5

3.3 **Conclusions-** Noise sources in port operations include cargo handling, vehicular traffic, and loading / unloading containers and ships. The Day Time Average Noise Level (SPL)in all 13 locations at Deendayal Port ranged from 57.2 dB(A) to 74.4 dB(A) and it was within the permissible limits of 75 dB(A) for the industrial area for the daytime. The Night Time Average Noise Level (SPL) in all 13 locations of Deendayal Port ranged from 41.8 dB to 68.4 dB(A) and it was within the permissible limits of 70 dB(A) for the industrial area for the night time.

4. Soil Monitoring

Sampling and analysis of soil samples were undertaken at six locations within the study area (Deendayal Port and Vadinar Port) as a part of EMP. The soil sampling locations are initially decided based on the locations as provided in the tender document of the Deendayal Port.

4.1 Methodology

The soil samples were collected in the month of November 2021. The samples collected from the all locations are homogeneous representative of each location. At random locations were identified at each location and soil was dug from 30 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples were filled in polythene bags, labeled in the field with number and site name and sent to laboratory for analysis.

4.2 Results

Table-17: Chemical Characteristics of Soil in the Study Area

Sr. No.	Parameter	Unit	Station Name					
			SL1	SL2	SL3	SL4	SL5	SL6
			Tuna Port	IFFCO Plant	Khori Creek	Nakti Creek	KPT Admin Site	KPT Colony
			Near main gate of Port	10 m away from main gate	Sand from creek at low tide		Vadinar	
1	Texture		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	pH	-	8.42	7.92	8.44	8.23	7.79	8.43
3	Electrical Conductivity	µs/cm	14,070.0	16,210.0	13,680.0	9,240.0	387.0	314.0
4	Moisture	%	18.17	9.01	21.39	21.08	3.46	3.95
5	Total Organic Carbon	%	0.20	0.49	0.20	0.72	0.85	0.43
6	Alkalinity	mg/kg	80.08	120.12	60.06	100.10	60.06	80.08
7	Total Nitrogen	%	BQL	BQL	BQL	BQL	BQL	BQL
8	Chloride	mg/kg	1,956.8	4,112.2	1,800.9	514.7	21.7	113.4
9	Sulphate	mg/kg	212.0	279.0	93.3	165.1	44.7	27.7
10	Phosphorus	mg/kg	2.20	1.89	1.41	2.15	BQL	1.74
11	Potassium	mg/kg	539.0	327.4	409.2	667.6	70.4	62.0
12	Sodium	mg/kg	5,752.0	4,061.6	3,954.0	1,477.0	72.8	65.9
13	Calcium	mg/kg	200.40	488.98	252.00	470.42	436.87	256.51
14	Copper as Cu	mg/kg	14.90	29.50	9.80	27.60	88.4	48.4
15	Lead as Pb	mg/kg	5.80	6.40	3.50	8.20	BQL	4.2
16	Nickel as Ni	mg/kg	35.30	16.60	23.50	37.70	33.8	27.3
17	Zinc as Zn	mg/kg	40.60	104.80	25.4	55.20	66.00	30.50
18	Cadmium as Cd	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (TN:0.001%, Cd: 1.0mg/kg).

4.3 Discussion

The data shows that value of pH ranges from 7.92 at IFFCO Plant to 8.44 at Khori Creek indicating that all soil samples are neutral to slight basic. Iffco Plant samples showed maximum conductivity of 16,210.0 µmhos/cm, while Tuna Port location showed minimum conductivity of 14,070.0 µmhos/cm. Conductivity at Vadinar Port was 387 and 314 µmhos/cm at Admin site and Vadinar Port colony respectively.

Total organic Carbon ranged from 0.2 % to 0.72 at Deendayal Port. At Vadinar Port, organic carbon content ranged from 0.85 % to 0.43 %.

The concentration of Phosphorus and Potassium in the soil samples varies from 1.41 to 2.15 mg/kg and 327.0 to 670.0 mg/kg respectively at Deendayal Port. The mean concentration of Phosphorous at Vadinar site was 1.74 mg/kg and mean concentration of Potassium at Vadinar site was 132 mg/kg.

These differences in NPK in soil at different locations are due to the dissimilar nature of soil at each of the locations. Samples SL3 & SL4 (Khori Creek & Nakti Creek) are of saline nature as they are coastal soil; where as other locations are inland locations and have different chemical properties.

Heavy Metals in the Soil

Traces of Copper, Lead, Nickel and Zinc were observed in the soil samples collected from all the four locations of Deendayal Port and two locations of Vadinar Port. Cadmium metal was below detection limit in the Soil.

4.4 Conclusion

The soils of Deendayal Port and Vadinar Port appears to be neutral to basic with varying levels of Chloride, Sulphate, NPK and Calcium. As the nature of soil at different locations are different with respect to its proximity to the sea, the samples showed high degree of variations in their chemical properties.

5. Sewage Treatment Plant Monitoring

This involves safe collection of waste water (spent/used water) from wash areas, bathroom, industrial units, etc., waste from toilets of various buildings and its conveyance to the treatment plant and final disposal in conformity with the requirement and guide lines of State Pollution Control Board and other statutory bodies.

5.1 Methodology for STP Monitoring

To monitor the working efficiency of Sewage Treatment Plant (STP), STP Inlet and Outlet Samples were collected once a week. Locations selected are namely Gopalpuri Township, Deendayal Port and Vadinar. Samples were collected in 1 lit. Carboys and were analyzed in laboratory for various parameters.

5.2 Results

Kandla STP

Table 18: Sewage Water Monitoring at Kandla STP (1st Week)

Date of Sampling	02.11.2021

Sr. No.	Parameters	Unit	Results	
			KPT STP I/L	KPT STP O/L
1	pH	pH unit	7.82	7.46
2	Total Suspended Solids	mg/l	206	116.1
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	393.0	152.0
5	BOD @ 27 °C	mg/l	110.0	53.0
6.	Fecal Coliform	MPN Index / 100 ml	-	>1600.0
Aeration Tank				
7.	MLSS	mg/l	35.0	
8.	MLVSS	%	6.0	

Table 19: Sewage Water Monitoring at Kandla STP (2nd Week)

Date of Sampling	11.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			KPT STP I/L	**KPT STP O/L**
1	pH	pH unit	7.6	7.2
2	Total Suspended Solids	mg/l	152.2	72.4
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	384	103.0
5	BOD @ 27 °C	mg/l	120.0	24.0
6.	Fecal Coliform	MPN Index / 100 ml	-	9.2
Aeration Tank				
7.	MLSS	mg/l	7.0	
8.	MLVSS	%	90.0	

Table 20: Sewage Water Monitoring at Kandla STP (3rd Week)

Date of Sampling	17.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			KPT STP I/L	**KPT STP O/L**
1	pH	pH unit	7.35	7.14
2	Total Suspended Solids	mg/l	204	144
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	162	71
5	BOD @ 27 °C	mg/l	60.0	20.0
6.	Fecal Coliform	MPN Index / 100 ml	-	24.0
Aeration Tank				
7.	MLSS	mg/l	12.0	
8.	MLVSS	%	93.0	

Table 21: Sewage Water Monitoring at Kandla STP (4th Week)

Date of Sampling	22.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			KPT STP I/L	**KPT STP O/L**
1	pH	pH unit	7.82	7.46
2	Total Suspended Solids	mg/l	306	116
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	242	103.0
5	BOD @ 27 °C	mg/l	86.0	26.0
6.	Fecal Coliform	MPN Index / 100 ml	-	170.0
Aeration Tank				
7.	MLSS	mg/l	9.0	
8	MLVSS	%	98.0	

Gopalpuri Colony STP

Table 22: Sewage Water Monitoring at Gopalpuri STP (1st Week)

Date of Sampling	02.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			Gopalpuri STP I/L	**Gopalpuri STP O/L**
1	pH	pH unit	7.50	7.20
2	Total Suspended Solids	mg/l	210	120
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	414.0	142.0
5	BOD @ 27 °C	mg/l	122.0	53.0
6.	Fecal Coliform	MPN Index / 100 ml	-	>1600.0
Aeration Tank				
7.	MLSS	mg/l	86.0	
8	MLVSS	%	97.0	

Table 23: Sewage Water Monitoring at Gopalpuri STP (2nd Week)

Date of Sampling	11.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			Gopalpuri STP I/L	**Gopalpuri STP O/L**
1	pH	pH unit	7.46	7.2
2	Total Suspended Solids	mg/l	379.2	118
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	454	163.00
5	BOD @ 27 °C	mg/l	148.0	56.0
6.	Fecal Coliform	MPN Index / 100 ml	-	21.0
Aeration Tank				
7.	MLSS	mg/l	94.0	
8	MLVSS	%	92.0	

Table 24: Sewage Water Monitoring at Gopalpuri STP (3rd Week)

Date of Sampling	17.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			Gopalpuri STP I/L	**Gopalpuri STP O/L**
1	pH	pH unit	7.35	7.14
2	Total Suspended Solids	mg/l	204	144
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	162	71
5	BOD @ 27 °C	mg/l	60.0	20.0
6.	Fecal Coliform	MPN Index / 100 ml	-	24.0
Aeration Tank				
7.	MLSS	mg/l	12.0	
8	MLVSS	%	93.0	

Table 25: Sewage Water Monitoring at Gopalpuri STP (4th Week)

Date of Sampling	22.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			Gopalpuri STP I/L	**Gopalpuri STP O/L**
1	pH	pH unit	7.82	7.46
2	Total Suspended Solids	mg/l	306	116
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	242	103.0
5	BOD @ 27 °C	mg/l	86.0	26.0
6.	Fecal Coliform	MPN Index / 100 ml	-	170.0
Aeration Tank				
7.	MLSS	mg/l	9.0	
8.	MLVSS	%	98.0	

Vadinar STP

Table 26: Sewage Water Monitoring at Vadinar STP (1st Week)

Date of Sampling	02.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			Vadinar STP I/L	**Vadinar O/L**
1	pH	pH unit	7.62	7.41
2	Total Suspended Solids	mg/l	121	69
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	89.0	72.0
5	BOD @ 27 °C	mg/l	34.0	15.0

Table 27: Sewage Water Monitoring at Vadinar STP (2nd Week)

Date of Sampling	11.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			Vadinar STP I/L	**Vadinar O/L**
1	pH	pH unit	7.5	7.2
2	Total Suspended Solids	mg/l	109	31
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	173.0	62.0
5	BOD @ 27 °C	mg/l	48.0	20.0

Table 28: Sewage Water Monitoring at Vadinar STP (3rd Week)

Date of Sampling	17.11.2021

Sr. No.	**Parameters**	**Unit**	**Results**	
			Vadinar STP I/L	**Vadinar O/L**
1	pH	pH unit	7.7	7.5
2	Total Suspended Solids	mg/l	105	38
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	150	62
5	BOD @ 27 °C	mg/l	48.0	18.0

Table 29: Sewage Water Monitoring at Vadinar STP (4th Week)

Date of Sampling	25.10.2021

Sr. No.	Parameters	Unit	Results	
			Vadinar STP I/L	Vadinar O/L
1	pH	pH unit	7.5	7.3
2	Total Suspended Solids	mg/l	117	69
3	Residual Chlorine	mg/l	-	<0.5
4	COD	mg/l	192	101
5	BOD @ 27 °C	mg/l	60.0	24.0

5.3 Conclusions:

The GPCB standards of BOD, TSS and Residual Chlorine for STP outlet are 20 mg/lit, 30 mg/lit & 0.5 mg/lit respectively. It is suggested to do treatment on regular basis to avoid flow of contaminated/polluted water into the sea.

Marine Water Monitoring

The Forty Second Amendment to the Constitution in 1976 underscored the importance of 'green thinking'. Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country. Further, Article 51A(g) states that the "fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

Policy Statement for Abatement of Pollution (1992) has suggested developing relevant legislation and regulation, fiscal incentives, voluntary agreements and educational programs and information campaigns. It emphasizes the need for integration by incorporating environmental considerations into decision making at all levels by adopting frameworks namely, pollution prevention at source, application of best practicable solution, ensure polluter pays for control of pollution, focus on heavily polluted areas and river stretches and involve public in decision-making. The National Conservation Strategy and Policy Statement on Environment and Development, (1992) aimed at

"integrating environmental concerns with developmental imperatives to meet the challenges by redirecting the thrust of our developmental process so that the basic needs of our people could be fulfilled by making judicious and sustainable use of natural resources." The priorities mentioned in this policy document include the sustainable use of land and water resources, prevention and control of pollution and preservation of biodiversity.

The National Water Policy, (2002) contains provisions for developing, conserving, sustainable utilizing and managing this important water resources and need to be governed by national perspectives.

Marine Environment

On national and state levels, we have several policies and regulation like Water (Prevention and Control of Pollution) Act, 1974, to regulate pollution discharges and restore water quality of our aquatic resources including the prescription of monitoring activities. One of the important provisions of the Water Act, 1974, is to maintain and restore the 'wholesomeness' of our aquatic resources. Water quality monitoring is one of the first steps required in the rational development and management of water resources. In the field of water quality management, there has been a steady evolution in procedures for designing system to obtain information on the changes of water quality. The monitoring comprises all activities to obtain 'information' with respect to the water system.

Sampling Stations

The monitoring of marine environment for the study of biological and ecological parameters was carried out on 19th& 20th November-2021 in harbor regions of KPT and on 19th November-2021 at Vadinar during spring tide period of New moon phase of Lunar Cycle. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 26th& 27th November 2021 in harbor regions of KPT. 26th November -2021 in Vadinar during Neap tide period first quarter of Lunar Cycle..

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and two stations in Nakti creek and one station in Khori creek. The same sampling schedule was repeated during consecutive spring tide and neap tide in same month. Plankton samples from sub surface layer was

collected both during high tide period and low tide period from 1 water quality monitoring stations near Vadinar jetty area during spring tide and neap tide in this month .Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

Sampling Locations

Offshore monitoring requirement	Number of locations
Offshore Installations	3 in Kandla creek 2 in Nakti creek 1 in Khori creek 1 near Vadinar Jetty 1 near 1st SBM
Total Number of locations	**8**

5.4 Marine Water Quality

Marine water quality of marine waters of Deendayal Port Harbor waters, Khori and Nakti Creeks and two locations of Vadinar are monitored for various physico-chemical parameters during spring and neap tide of each month.

The results of marine water quality and Marine sediments are as below;

Table 30: Marine Water Quality Monitoring Parameters for location near KPT colony

Sr. No.	Parameters	Unit	Kandla Creek Near KPT colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.21	7.26	7.45	7.26
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.6	31.9	32.0	31.5
5	Turbidity	NTU	36	31	33	32
6	Total Dissolved Solids	mg/l	41592	42007	41300.0	41443.0

Sr. No.	Parameters	Unit	Kandla Creek Near KPT colony (1)			
			23°0'58"N 70°13'22."E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
7	Total Suspended Solids	mg/l	655	870	754.2	571.1
8	Total Solids	mg/l	42247	42877	42054.2	42014.1
9	DO	mg/l	4	4.2	4.1	4.3
10	COD	mg/l	82.0	90.0	80.0	78.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.65	0.60	0.76	0.65
13	Phosphate	mg/l	0.35	0.24	0.16	0.18
14	Sulphate	mg/l	2772	2700	2184	2580
15	Nitrate	mg/l	2.89	2.46	2.45	3.44
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	561.12	480.96	480.96	521.04
18	Magnesium	mg/l	1725.3	1530.9	1676.7	1603.8
19	Sodium	mg/l	9038.0	8014.0	8629.0	9638.0
20	Potassium	mg/l	313.0	271.0	336.0	378.0
21	Iron	mg/l	1.42	1.30	1.32	1.10
22	Chromium	mg/l	0.12	0.11	0.13	0.12
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	0.05	0.06	0.06	0.05
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	0.07	0.09	0.06	0.08
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 31: Marine Water Quality Monitoring Parameters for location near passenger Jetty One at Kandla

Sr. No.	Parameters	Unit	Near passenger Jetty One (2)			
			23° 0'18 "N 70°13'31"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.12	7.31	7.30	7.20
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.0	31.6	32.2	31.4
5	Turbidity	NTU	35	28	38	42
6	Total Dissolved Solids	mg/l	39062	40035	40245.0	36627.0
7	Total Suspended Solids	mg/l	784	773	528.3	504
8	Total Solids	mg/l	39845	40808	40773.3	37131.0
9	DO	mg/l	4.3	3.9	4.2	4
10	COD	mg/l	88.0	86.0	92.0	90.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.56	0.53	0.76	0.69
13	Phosphate	mg/l	0.24	0.26	0.19	0.20
14	Sulphate	mg/l	2580	3132	2340	2700
15	Nitrate	mg/l	3.03	3.31	2.80	3.98
16	Nitrite	mg/l	BQL	BQL	BQL	BQL
17	Calcium	mg/l	601.20	681.36	561.12	601.2
18	Magnesium	mg/l	1555.2	1652.4	1676.7	1628.1
19	Sodium	mg/l	9530.0	9278.0	9116.0	9368.0
20	Potassium	mg/l	349.0	336.0	272.0	302.0
21	Iron	mg/l	1.88	1.70	1.48	1.55
22	Chromium	mg/l	0.12	0.11	0.11	0.14
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	0.04	0.05	0.06	0.04
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	0.10	0.09	0.09	0.10
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Nitrite: 0.05mg/lCu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 32: Marine Water Quality Monitoring Parameters for location Near Coal Berth

Sr. No.	Parameters	Unit	Near Coal Berth			
			22°59'12"N 70°13'40"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.30	7.46	7.30	7.36
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.0	31.8	32.7	31.0
5	Turbidity	NTU	34	29	36	40
6	Total Dissolved Solids	mg/l	43205	41674	43606.0	40029.0
7	Total Suspended Solids	mg/l	590	863	500.2	604.3
8	Total Solids	mg/l	43795	42537	44106.2	40633.3
9	DO	mg/l	4	5.1	4.5	4.4
10	COD	mg/l	90.0	86.0	88.0	79.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.69	0.75	0.56	0.64
13	Phosphate	mg/l	0.28	0.34	0.17	0.20
14	Sulphate	mg/l	3240	2016	2676	2148
15	Nitrate	mg/l	3.87	4.58	2.95	2.62
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	641.28	601.20	480.96	521.04
18	Magnesium	mg/l	1628.1	1749.6	1749.6	1749.6
19	Sodium	mg/l	9425.0	8408.0	9423.0	8709.0
20	Potassium	mg/l	339.0	299.0	306.0	230.0
21	Iron	mg/l	1.41	1.78	1.76	1.56
22	Chromium	mg/l	0.11	0.13	0.13	0.12
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	0.06	0.05	0.05	0.07
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	0.08	0.09	0.09	0.07
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l).

Table 33: Marine Water Quality Monitoring Parameters for location Khori creek at Kandla

Sr. No.	Parameters	Unit	KPT 4			
			Near 15/16 Berth			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.35	7.50	7.50	7.20
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.1	32.6	31.9	31.6
5	Turbidity	NTU	43	39	45	33
6	Total Dissolved Solids	mg/l	42399	39089	38986.0	39711.0
7	Total Suspended Solids	mg/l	743	577	681.8	530.3
8	Total Solids	mg/l	43142	39666	39667.8	40241.3
9	DO	mg/l	4.6	4.5	5.2	5.6
10	COD	mg/l	92.0	90.0	82.0	89.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.82	0.58	0.58	0.51
13	Phosphate	mg/l	0.28	0.25	0.22	0.20
14	Sulphate	mg/l	1620	3492	2388	2100
15	Nitrate	mg/l	1.97	3.03	2.71	2.06
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	561.12	641.28	561.12	440.88
18	Magnesium	mg/l	1579.5	1603.8	1603.8	1822.5
19	Sodium	mg/l	9423.0	9014.0	9526.0	9468.0
20	Potassium	mg/l	341.0	301.0	218.0	221.0
21	Iron	mg/l	1.62	1.33	1.74	1.21
22	Chromium	mg/l	0.16	0.12	0.14	0.16
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	0.04	0.05	0.06	0.04
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	0.08	0.06	0.09	0.08
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 34: Marine Water Quality Monitoring Parameters for location Nakti Creek near Tuna Port

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.30	7.20	7.30	7.40
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.6	31.2	31.2	31.1
5	Turbidity	NTU	36	42	36	31
6	Total Dissolved Solids	mg/l	40770	38329	38644.0	38955.0
7	Total Suspended Solids	mg/l	766	853	494.2	474
8	Total Solids	mg/l	41536	39182	39138.2	39429.0
9	DO	mg/l	4.1	4.7	4.6	4.8
10	COD	mg/l	98.0	96.0	96.0	98.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.53	0.89	0.75	0.64
13	Phosphate	mg/l	0.24	0.24	0.21	0.18
14	Sulphate	mg/l	3456	3732	2820	2424
15	Nitrate	mg/l	2.75	3.38	2.77	4.31
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	561.12	521.04	480.96	561.12
18	Magnesium	mg/l	1676.7	1725.3	1773.9	1676.7
19	Sodium	mg/l	9839.0	10125.0	10118.0	10168.0
20	Potassium	mg/l	399.0	402.0	387.0	390.0
21	Iron	mg/l	1.20	1.13	1.45	1.10
22	Chromium	mg/l	0.11	0.13	0.14	0.14
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	0.05	0.07	0.07	0.08

Sr. No.	Parameters	Unit	Nakti Creek Near Tuna Port			
			22°57'49."N 70° 7'0.67"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	0.07	0.09	0.10	0.09
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l).

Table 35: Marine Water Quality Monitoring Parameters for location Nakti Creek Near NH-8A at Kandla

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.52	Sampling not possible during Low Tide	7.52	Sampling not possible during Low Tide
2	Color	-	Colorless		Colorless	
3	Odor	-	Odorless		Odorless	
4	Salinity	ppt	31.8		32.2	
5	Turbidity	NTU	35		35	
6	Total Dissolved Solids	mg/l	41695		42152.0	
7	Total Suspended Solids	mg/l	684		452	
8	Total Solids	mg/l	42379		42604.0	
9	DO	mg/l	4.8		5.1	
10	COD	mg/l	100.0		94.0	
11	BOD	mg/l	BQL		BQL	
12	Silica	mg/l	0.96		0.53	
13	Phosphate	mg/l	0.23		0.17	
14	Sulphate	mg/l	3780		2376	
15	Nitrate	mg/l	3.24		3.61	
16	Nitrite	mg/l	<0.05		<0.05	
17	Calcium	mg/l	480.96		601.2	

Sr. No.	Parameters	Unit	Nakti Creek Near NH-8A			
			23° 02'01"N 70° 09'31"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
18	Magnesium	mg/l	1725.3		1628.1	
19	Sodium	mg/l	10308.0		10319.0	
20	Potassium	mg/l	409.0		364.0	
21	Iron	mg/l	1.20		1.35	
22	Chromium	mg/l	0.11		0.12	
23	Copper	mg/l	BQL		BQL	
24	Arsenic	mg/l	BQL		BQL	
25	Cadmium	mg/l	0.06		0.06	
26	Mercury	mg/l	BQL		BQL	
27	Lead	mg/l	0.08		0.11	
28	Zinc	mg/l	BQL		BQL	

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l).

Table 36: Marine Water Quality Monitoring Parameters for locations Nr. Vadinar Jetty

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.60	7.70	7.41	7.52
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	31.2	32.0	31.5	31.4
5	Turbidity	NTU	45	39	42	40
6	Total Dissolved Solids	mg/l	38510	42661	40025.0	40250.0
7	Total Suspended Solids	mg/l	585	523	548.9	505
8	Total Solids	mg/l	39095	43184	40573.9	40755.0
9	DO	mg/l	4.4	4.6	4.7	4.6

Sr. No.	Parameters	Unit	Nr.Vadinar Jetty			
			22°26'25.26"N 69°40'20.41"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
10	COD	mg/l	76.0	80.0	72.0	70.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.85	1.02	0.75	0.82
13	Phosphate	mg/l	0.22	0.25	0.18	0.17
14	Sulphate	mg/l	2580	2700	2592	2508
15	Nitrate	mg/l	2.75	3.59	3.67	3.39
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	601.20	521.04	641.28	480.96
18	Magnesium	mg/l	1603.8	1676.7	1652.4	1676.7
19	Sodium	mg/l	10968.0	10848.0	11126.0	10829.0
20	Potassium	mg/l	344.0	382.0	355.0	392.0
21	Iron	mg/l	1.06	1.70	1.12	1.42
22	Chromium	mg/l	0.12	0.13	0.14	0.13
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	0.05	0.04	0.08	0.07
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	0.10	0.08	0.10	0.09
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l, Zinc-0.1 mg/l).

Table 36 (a): Marine Water Quality Monitoring Parameters for locations Nr. Vadinar SPM

Sr. No.	Parameters	Unit	Nr.Vadinar SPM			
			22°30'56.15"N 69°42'12.07"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
1	pH	pH unit	7.40	7.60	7.45	7.26

Sr. No.	Parameters	Unit	Nr.Vadinar SPM			
			22°30'56.15"N 69°42'12.07"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
2	Color	-	Colorless	Colorless	Colorless	Colorless
3	Odor	-	Odorless	Odorless	Odorless	Odorless
4	Salinity	ppt	32.2	32.1	32.0	31.8
5	Turbidity	NTU	33.0	34.0	36.0	33.0
6	Total Dissolved Solids	mg/l	41700.0	41987	40610.0	40925
7	Total Suspended Solids	mg/l	635.0	480	513.0	548
8	Total Solids	mg/l	43340.0	43924	41384.0	42000
9	DO	mg/l	4.3	4.1	4.5	4.3
10	COD	mg/l	90.0	92.0	78.0	70.0
11	BOD	mg/l	BQL	BQL	BQL	BQL
12	Silica	mg/l	0.92	0.96	0.6	0.78
13	Phosphate	mg/l	0.24	0.25	0.2	0.16
14	Sulphate	mg/l	2628.0	2364	2316.0	2556
15	Nitrate	mg/l	3.10	3.38	3.34	3.68
16	Nitrite	mg/l	<0.05	<0.05	<0.05	<0.05
17	Calcium	mg/l	481.0	561.12	521.0	561.12
18	Magnesium	mg/l	1652.4	2065.5	1676.7	1701
19	Sodium	mg/l	10318	10829	10418	10786
20	Potassium	mg/l	354	355	377	354
21	Iron	mg/l	1.60	1.80	1.27	1.90
22	Chromium	mg/l	0.14	0.14	0.13	0.12
23	Copper	mg/l	BQL	BQL	BQL	BQL
24	Arsenic	mg/l	BQL	BQL	BQL	BQL
25	Cadmium	mg/l	0.05	0.04	0.08	0.08
26	Mercury	mg/l	BQL	BQL	BQL	BQL
27	Lead	mg/l	0.09	0.08	0.11	0.09

Sr. No.	Parameters	Unit	Nr.Vadinar SPM			
			22°30'56.15"N 69°42'12.07"E			
			Spring Tide		Neap Tide	
	Tide		High Tide	Low Tide	High Tide	Low Tide
28	Zinc	mg/l	BQL	BQL	BQL	BQL

BQL- Below Quantification Limit, (BOD-2.0 mg/l,Cu-0.1 mg/l, As-0.1mg/l, Hg-0.01 mg/l,Zinc-0.1 mg/l).

5.4.1 Marine Sediments

Sediment samples were collected with Van Veen Grab from the six locations in Kandla Port Waters and two locations in Vadinar Port. Samples were collected and preserved in silver foil in ice box to prevent the contamination/decaying of the samples.

5.5 Results

The Sediment Quality results are given in below from table no. 34 A & B.

Table 34A: Results of Analysis of Sediment of Kandla & Vadinar Port (Spring Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 3	KPT - 4	KPT - 5	Jetty	SPM
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.72	1.34	1.36	2.74	1.53	2.31	2.00
3	Organic Carbon	mg/kg	0.99	0.78	0.79	1.59	0.89	1.34	1.16
4	Inorganic Phosphate	mg/kg	112.0	121.0	116.0	124.0	128.0	122.0	133.0
5	Moisture	%	29.43	23.11	31.0	27.25	25.69	27.4	43.00
6	Aluminium	mg/kg	ND	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	11.2	10.5	12.3	11.4	10.5	13.2	13.00
8	Phosphate	mg/kg	2.57	2.73	9.48	6.12	11.84	5.96	6.68
9	Sulphate	mg/kg	283.0	257.0	411.0	182.0	338.0	209.0	494.7
10	Nitrite	mg/kg	0.12	0.11	0.12	0.12	0.11	0.1	0.11
11	Nitrate	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
12	Calcium	mg/kg	364.7	152.3	505.0	76.2	325.0	225.0	177.0
13	Magnesium	mg/kg	260.0	241.0	158.0	175.0	308.0	58.3	228.4

14	Sodium	mg/kg	1819.0	2881.0	876.0	1858.0	4022.0	3159.0	8637.0
15	Potassium	mg/kg	119.0	166.0	102.0	113.0	263.0	283.0	1036.7
16	Chromium	mg/kg	60	46.6	51.2	43.2	58	46.40	65.00
17	Nickel	mg/kg	32.1	33.7	24.9	28	32.5	28.00	45.60
18	Copper	mg/kg	39.9	14.6	33	16.8	31.8	26.80	21.00
19	Zinc	mg/kg	81.90	52.70	60.80	42.70	68.70	64.30	65.90
20	Cadmium	mg/kg	2.0	BQL	BQL	BQL	BQL	BQL	BQL
21	Lead	mg/kg	18.50	5.4	9.0	5.70	11.4	10.90	5.20
22	Mercury	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
23	Arsenic	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL

*ND - Not Detected, BQL: Below Quantification Limit (NO3:10.0mg/kg, Cd: 1.0mg/kg, Hg: 1.0mg/kg, As: 1.0mg/kg)

Table 34B: Results of Analysis of Sediment of Kandla & Vadinar Port (Neap Tide)

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 3	KPT - 4	KPT - 5	Jetty	SPM
1	Texture	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
2	Organic Matter	mg/kg	1.12	1.50	2.88	1.41	0.69	1.43	1.69
3	Organic Carbon	mg/kg	0.65	0.87	1.67	0.82	0.40	0.83	0.98
4	Inorganic Phosphate	mg/kg	118.0	126.0	120.0	130.0	128.0	112.0	130.0
5	Moisture	%	17.76	22.98	20.4	14.01	22.6	34.3	32.16
6	Aluminium	mg/kg	ND	ND	ND	ND	ND	ND	ND
7	Silica	mg/kg	12.0	11.3	10.5	11.3	9.8	11.4	12.60
8	Phosphate	mg/kg	17.14	2.91	7.83	0.49	2.54	15.65	2.20
9	Sulphate	mg/kg	255.0	427.0	290.0	440.0	390.0	564.0	595.0
10	Nitrite	mg/kg	0.1	0.11	0.1	0.11	0.12	0.1	0.11
11	Nitrate	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
12	Calcium	mg/kg	180.0	188.0	172.0	180.0	176.0	116.0	140.0
13	Magnesium	mg/kg	38.9	102.1	82.6	150.7	58.3	158.0	179.8

Sr. No.	Parameters	Unit	KPT - 1	KPT - 2	KPT - 3	KPT - 4	KPT - 5	Jetty	SPM
14	Sodium	mg/kg	325.0	853.6	743.8	656.1	414.0	1895.0	1810.0
15	Potassium	mg/kg	25.7	72.3	52.3	52.3	40.0	248.0	307.0
16	Chromium	mg/kg	25.7	38.6	28.6	27.3	31.3	51.90	56.20
17	Nickel	mg/kg	18.0	29.2	20.1	18.4	17.8	32.40	72.70
18	Copper	mg/kg	12.30	20.30	6.70	9.40	7.90	22.20	41.10
19	Zinc	mg/kg	24.90	57.40	32.80	27.90	25.50	46.40	1511.00
20	Cadmium	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
21	Lead	mg/kg	4.60	6.7	7.5	3.70	3.3	24.70	29.60
22	Mercury	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL
23	Arsenic	mg/kg	BQL	BQL	BQL	BQL	BQL	BQL	BQL

*ND - Not Detected, BQL: Below Quantification Limit (NO3:10.0mg/kg,Cd: 1.0mg/kg,Hg: 1.0mg/kg, As: 1.0mg/kg)

REPORT

ON

ECOLOGICAL MONITORING

OF MARINE ENVIRONMENT

IN

DPTHARBOURAREA, NEAR BY CREEKS

AND

VADINAR JETTY AND SPM

FOR

DEENDAYAL PORT TRUST

November, 2021

INTRODUCTION:

Sampling Stations:

The monitoring of marine environment for the study of biological and ecological Parameters was carried out on19thNovember, 2021 in harbour region of DPT at Kandla Creek, and on 20thNovember, 2021 in creeks near by the port during spring tide. The monitoring of marine environment for the study of biological and ecological parameters was repeated again on 26thNovember, 2021 in harbour region of DPT at Kandla Creek and on27thNovember 2021 in creeks near by the port during neap tidal condition.

Plankton samples from sub surface layer was collected both during high tide period and low tide period from 3 water quality monitoring stations of KPT harbour area and one stations in Nakti creek and one station in Khori creek. Sampling at second sampling station of Nakti creek was possible only during high tide period. The same sampling schedule was repeated during consecutive Neap tide and spring tide in same month.

Plankton samples from sub surface layer were collected during high tide period and low tide period from monitoring station near Vadinar jetty at Path Finder Creek during neap tide on 11/11/2021 and spring tide period on 26/11/2021 Collected water samples were processed for estimation of Chlorophyll- a, Pheophytin- a, qualitative &quantitative evaluation of phytoplankton, qualitative &quantitative evaluation zooplanktons (density and their population).

TABLE #1 SAMPLING LOCATIONS

monitoring requirement	**Number of locations**
Kandla creek	3 in Kandla creek
Nakti creek	2 in Nakti creek
Khori Creek	1 in Khori creek
Vadinar jetty	1 near Vadinar Jetty
SPM	1 near I stSPM
Total Number of locations	**8**

Sampling methodology adopted:

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.

50 litres of the water sample were collected from Sub surface by using bucket. From the collected water sample 1 litres of water sample were taken in an opaque plastic bottle for chlorophyll estimation, thereafter plankton samples were collected by using filtration assembly with nilyobolt cloth of 20µm mesh size.

Samples Processing for chlorophyll estimation:

Samples for the chlorophyll estimation were preserved in ice box on board in darkness to avoid degradation in opaque container covered with aluminium foil. Immediately after reaching the shore after sampling, 1 litre of collected water sample was filtered through GF/F filters (pore size 0.45 µm) by using vacuum filtration assembly. After vacuum filtration the glass micro fiber filter paper was grunted in tissue grinder, macerating of glass fiber filter paper along with the filtrate was done in 90% aqueous Acetone in the glass tissue grinder with glass grinding tube. Glass fiber filter paper will assist breaking the cell during grinding and chlorophyll content was extracted with 10 ml of 90% Acetone, under cold dark conditions along with saturated magnesium carbonate solution in glass screw cap tubes. After an extraction period of 24 hours, the samples were transferred to calibrated centrifuge tubes and adjusted the volume to original volume with 90% aqueous acetone solution to make up the evaporation loss. The extract was clarified by using centrifuge in closed tubes. The clarified extracts were then decanted in clean cuvette and optical density was observed at wavelength 664, 665 nm. By using corrected optical density, Chlorophyll-a value was calculated as given in (APHA, 1998).

PLANKTON:

The entire area open water in the sea is the pelagic realm. Pelagic organisms live in the open sea. In contrast to the pelagic realm, the benthic realm comprises organisms and zone of the bottom of the sea. Vertically the pelagic realm can be dividing into two zones based on light penetration; upper photic or euphotic zone and lower dark water mass, aphotic zone below the photic zone.

The term plankton is general term for organisms have such limited powers of locomotion that they are at the mercy of the prevailing water movement. Plankton is subdivided to phytoplankton and zooplankton. Phytoplankton is free floating organisms that are capable of photosynthesis and zooplankton is the various free floating animals.

Pelagic zone, represents the entire ocean water column from the surface to the deepest depths, is home to a diverse community of organisms. Differences in their locomotive ability categorize the organisms in the pelagic realm into two, ***plankton*** and ***nekton*** (Lalli and Parsons, 1997). ***Plankton*** consists of all organisms drifting in the water and is unable to swim against water currents, whereas ***Nekton*** includes organisms having strong locomotive power. Ecological studies on the plankton community, which form the base of the aquatic food chain, help in the better understanding of the dynamics and functioning of the marine ecosystem. The term 'Plankton' first coined by Victor Hensen (1887), Plankton, (Greek word: *planktos*meaning "passively drifting or wandering") is defined as drifting or free-floating organisms that inhabit the pelagic zone of water. Based on their mode of nutrition planktonic organisms are categorised into phytoplankton (organisms having an autotrophic mode of nutrition) and zooplankton (organisms having a heterotrophic mode of nutrition).

Phytoplankton in the marine environment:

Phytoplankton is 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).The phytoplankton those normally captured in the net from the Gulf of Kutch is normally dominated by these two major groups; diatoms and dinoflagellates. Phytoplankton also include numerous and diverse collection of extremely small, motile algae which are termed micro flagellates (naked flagellates) as well as and Cyanophytes (blue-green 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 in the marine environment:

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 (Beaugrand et al., 2004). Zooplankton grazing in the marine environment controls the primaryProduction and helps in determining the pelagic ecosystem (Banse, 1995). 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.

Based on the duration of planktonic life, zooplankton are categorised into Holoplankton (organisms which complete their entire lifecycle as plankton) and Meroplankton (organisms which are planktonic during the early part of their lives such as the larval stages of benthic and nektonic organisms). Tychoplankton are

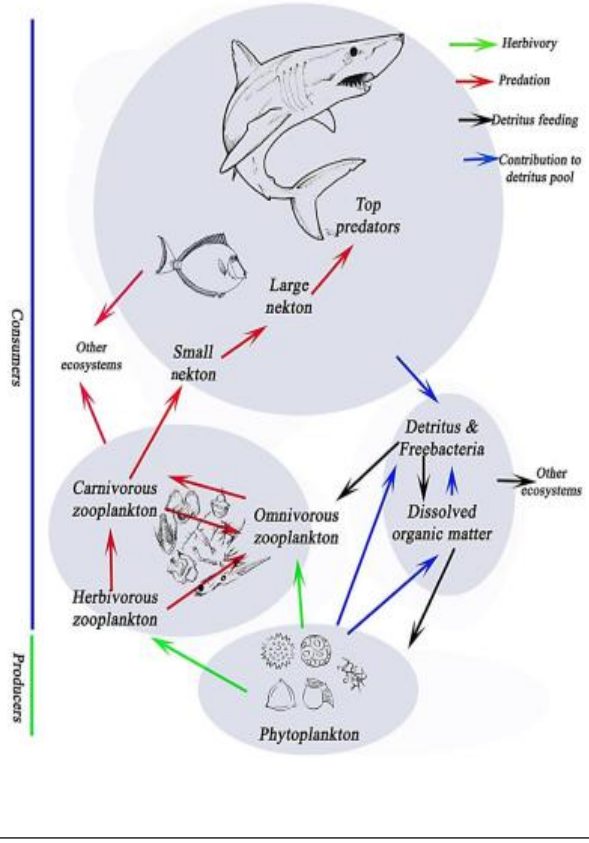
organisms which live a brief planktonic life, such as the benthic crustaceans (Cumaceans, mysids, isopods) which ascend to the water column at night for feeding and certain ectoparasitic copepods, they leave the host and spend their life as plankton during their breeding cycle.

Zooplankton can be subdivided into holoplankton, i.e., permanent members of the plankton (e.g., Calanoid copepods), and meroplankton, i.e., temporary members in the plankton e.g., larvae of fish, shrimp, and crab). The meroplankton group consists of larval and young stages of animals that will adopt a different lifestyle once they mature. In contrast to phytoplankton which consist of a relatively smaller variety of organisms, Zooplankton are extremely divers, consist of a host of larval and adult forms representing many animal phylum.

Among the zooplankton one group always dominate than others; members of sub class copepods (Phylum Athropoda) and Tintinids (Phylum Protozoa) among the net planktons. These small animals are of vital importance in marine ecosystem as one of the primary herbivores animals in the sea, and it is they provide vital link between primary producer (autotrophs) and numerous small and large marine consumers.

As their community structure and function are highly susceptible to changes in the environmental conditions regular monitoring of their distribution as well as their interactions with various physicochemical parameters is inevitable for the sustainable management of the ecosystem (Kusum et al., 2014). Of all the marine zooplankton groups, copepods mainly Calanoid copepods are the dominant groups in marine subtropical and tropical waters and exhibit considerable diversity in morphology and habitats they occupy (Madhupratap, 1991;)

It has been well established that potential of pelagic fishes viz. finfishes, crustaceans, molluscs and marine mammals either directly or indirectly depend on zooplankton. The herbivorous zooplankton is efficient grazers of the phytoplankton and is referred to as living machines transforming plant material into animal tissue. Hence they play an essential role as the intermediaries for nutrients/energy transfer between primary and tertiary trophic levels. Due to their large density, shorter lifespan, drifting nature, high group/species diversity and different tolerance to the stress, they used as the indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem (Ghajbhiye, 2002).



Simplified marine food web

Spatial distribution of Plankton:

A characteristic of plankton population is that they tend to occur in patches, which are varying spatially on a scale of few meters to far as few kilometres in distance. They also vary in time scale, season as well as vertically in the water column. It is this patchiness and its constant changes in time and spot, that has made it so difficult for plankton biologist to learn about the ecology of plankton. The biological factors that causes this patchiness is due to the ability of zooplankton to migrate vertically and graze out the phytoplankton at a rapid rate that can create patchiness. Similarly the active swimming ability by certain zooplankton organisms can cause to aggregate in dense group.

At its most extreme, because the water in which plankton is suspended is constantly moving, each sample taken by the plankton biologists remain a different volume of water, so each sample is unique and replicate does not exist.

Plankton may also exhibit vertical patchiness. Physical factors contribute to this type of patchiness include light intensity, nutrients and density gradients in the water column.

Phytoplankton in particular tends to be unequally distributed vertically, which leads to the existence of different concentration of a chlorophyll value between photic zone and below the photic zone.

Methodology adopted for Plankton sampling:

Mixed plankton sample were obtained from the sub surface layer at each sampling locations by towing the net horizontally with the weight .After the tow of about 15-30minutes, plankton net was pulled up and washed down to the tail and collected the plankton adhered to plankton net in the collection bucket at the bottom by springing outer and inner surface of the net with sea water, while the net was hanging with the mouth upward. For quantitative evaluation 50 L water samples were collected from subsurface layer and filtered through 20µm mesh size net by using bucket and filtration assembly.

Preservation and storage:

Both filtered plankton and those collected from the plankton net were preserved with 5% buffered formalin and stored in 1L plastic container for further processing in the laboratory.

Sample concentration:

The collected plankton samples were concentrated by using centrifuge and made up to 50 ml with 5% formalin -Glycerine mixture.

Taxonomic evaluation:

Before processing, the sample was mixed carefully and a subsample was taken with a calibrated Stempel-pipette. 1 ml of the concentrated plankton samples were transferred on a glass slide with automatic pipette. The plankton sample on the glass slides were stained by using Lugol's iodine and added glycerine to avoid drying while observation. The plankton samples were identified by using Labex triangular Research microscope with photographic attachment. Microphotographs of the plankton samples were taken for record as well as for confirming the identification. The bigger sized zooplankton was observed through dissecting stereomicroscope with magnification of 20-30 x. Plankton organisms in the whole slide were identified to the lowest axon possible. A thorough literature search was conducted for the identification of the different groups of zooplankton that were encountered

Cell counts by drop count method:

The common glass slide mounted with a 1ml of concentrated phytoplankton/zooplankton sample in glycerol and covered with cover slip 22x 60mm was placed under the compound microscope provided with a mechanical

stage. The plankton was then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton in each microscopic field was thus counted. When first microscopic field row was finished the next consecutive row was adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted. From this total number in 1ml of the concentrated plankton, total number of plankton in the original volume of sample filtered was calculated as units/L.

BENTHIC ORGANISMS:

Benthos is those organisms that are associated with the sea bed or benthic habitats. Epi- benthic organisms live attached to a hard substratum or rooted to a shallow depth below the surface. In fauna organisms live below the sediment–water interface. Interstitial organisms live and move in pore water among sedimentary grains.

Because the benthic organisms are often collected and separated on sieves, a classification based on the overall size is used. Macro benthos include organisms whose shortest dimension is greater than or equal to 0.5 mm. Meio benthos are smaller than 0.5mm but larger than 42µ in size.

The terms such as macro fauna and Meio fauna generally have little relevance with taxonomic classification. The terms Meio fauna and macro fauna depend on the size. Meio fauna were considered as good bioassay of community health and rather sensitive indicators of environmental changes

SAMPLING METHODOLOGY ADOPTED FOR SUB TIDAL REGION:

Van veen sampler (0.09m^2) was used for sampling bottom sediments. Two sets of sediments were sampled from each location, one for macro fauna and other for Meio fauna. The macro fauna in the sediments were sieved on board to separate out the organisms. The fixation of Meio fauna is normally done by bulk fixation of the sediment sample. The bulk fixation is done by using 10% formalin (Buffered with borate). The organisms were preserved with seawater as diluting agent.

Sample sieving:

Sediments samples were sieved to extract the organisms. Sieving was performed carefully as possible to avoid any damage to the animals. The large portion of the sediment was split in to smaller portions and mixed with sea water in a bucket. The cohesive lumps were broken down by continuous stirring. The disaggregated sediments were then passed through the sieves.

Sample staining:

Sorting of the Meio fauna from the sieve is difficult task especially in the preserved material, because organisms are not easily detectable. To facilitate the animal detection the entire sample retained on the sieve after sieving operation were stained by immersing the sieve in a flat bottom tub with 1% Rose Bangal stain; a protein stain. A staining period of 10-30 minutes is sufficient for sample detection.

DIVERSITY INDICES:

On the whole, diversity indices provide more information about community composition than simply species richness (number of species present); they also, take the relative abundances of different species into account. Based on this fact, diversity indices therefore depend not only on species richness but on the evenness, or equitability, with which individuals are distributed among the different species (Magurram, A. E. (1988)

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.

The basic idea of diversity 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 (Carol H.R. *etal*. 1998). Biodiversity is commonly expressed through indices based on species richness and species abundances (Whittaker 1972, Lande 1996, Purvis and Hector 2000). 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.

A diversity Index is a single statistic that incorporates in formation on richness and evenness. The diversity measures that incorporate the two concepts may be termed heterogeneity measures (Magurran, 2004).

Any study intended to interpret causes and effect of adverse impact on Biodiversity of communities require suitable measures to evaluate specie richness and Diversity. The former is number of species in community, while latter is a function of relative frequency of different species. Species richness is the iconic measure of biological diversity (Magurran, 2004). Several indices have been created to measure the diversity of species; however, the most widely used

in the last decades are the Shannon (1948) and Simpson (1949) (Buzas and Hayek 1996; Gorelick 2006), with the components of diversity: richness (*S)* and evenness (*J)*

Simpson's diversity index

Simpson's index (**D**) is a measure of diversity, which takes into account both species richness, and evenness of abundance among the species present.. The Simson index is one of the meaningful and robust biodiversity measures available.(Magurran ,2004).

The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i = the total number of organisms of each individual species

N = the total number of organisms of all species

The value of D ranges from 0 to 1. With this index, 0 represents infinite diversity and, 1, no diversity. When D increases diversity decreases. Simpson's index is therefore usually expressed as 1-D or 1/D. (Magurran, 2004)

Low species diversity suggests:

relatively few successful species in the habitat

the environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment

food webs which are relatively simple

change in the environment would probably have quite serious effects

High species diversity suggests:

a greater number of successful species and a more stable ecosystem

more ecological niches are available and the environment is less likely to be hostile complex food webs

environmental change is less likely to be damaging to the ecosystem as a whole

Species richness indices

The species richness ***(S)*** is simply the number of species present in an ecosystem. Species richness Indices of species richness are widely used to quantify or monitor the effects of anthropogenic disturbance. A decline in species richness may be concomitant with severe or chronic human-induced perturbation (Fair Fair weather 1990,) Species richness measures have traditionally been the mainstay in assessing the effects of environmental degradation on the biodiversity of natural assemblages of organisms (Clarke &Warwick, 2001)

Species richness is the iconic measure of biological diversity (Magurran, 2004). The species richness ***(S)*** is simply the number of species present in an ecosystem. This index makes no use of relative abundances. The term species richness was coined by McIntosh (1967) and oldest and most intuitive measure of biological diversity (Magurran, 2004).

Margalef's diversity index is a species richness index. Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, were derived.

The value of a diversity index increases both when the number of types increases and when evenness increases. For a given number of types, the value of diversity index is maximised when all types are equally abundant (Rosenzweig, M. L. (1995).

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 (Odum 1971 and Reish 1984). Shannon-Wiener's index **(H**) reproduces community parameters to a single numberby using an equation.

Shannon and Weiner index represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxa. It varies from 0 for communities with only single taxa to high values for community with many taxa each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range of polluted and unpolluted ecosystems, Wilham and Dorris (1968) concluded that the values of the index greater than 3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln\left(\frac{n_j}{N}\right)$$

RESULTS:

CHLOROPHYLL-a:

Water Samples for the chlorophyll estimation were collected from sub surface layer during high tide and low tide period of the tidal cycle for each sampling locations and analysed for Chlorophyll -a and after acidification for Pheophytin –a. Chlorophyll- a value was used as algal biomass indicator (APHA,1998) Algal biomass was estimated by converting Chlorophyll value.

In the sub surface water chlorophyll-a was varying from 0.559 -0.868 mg/m^3.in harbour region of DPT in Kandla Creek during sampling done in spring tide period of November, 2021. In the nearby creeks chlorophyll-a was varying from 0.246 -0.954 mg/m^3.Pheophytin –a level was below detectable limit- the all the sampling stations during springtide

In the sub surface water chlorophyll-a was varying from 0.535 -0.921mg/m^3.in harbour region of DPT in Kandla Creek during sampling done in neap tide period of November , 2021 . In the nearby creeks chlorophyll-a was varying from 0.425 –1.923 mg/m^3.·Pheophytin –a level was below detectable limit- the all the sampling stations except KPT-4 Khori-I during low tide and high tide and KPT-5 Nakti-I during High tide period.

In the sub surface water chlorophyll-a was varying from 0.393 -0.338 mg/m^3.in harbour region of DPT OOT in path finder Creek during sampling done in spring tide period ofNovember, 2021. In the sub surface water chlorophyll-a was varying from 1.356 -0.500 mg/m^3.in harbour region of DPT OOT in path finder Creek during sampling done in Neap Tide period of November, 2021

In the sub surface water chlorophyll-a was varying from 0.424 -0.290 mg/m^3.in SPM region of DPT OOT in path finder Creek during sampling done in spring tide period of November, 2021. In the sub surface water chlorophyll-a was varying from 0.703 -0.409 mg/m^3.in SPM region of DPT OOT in path finder Creek during sampling done in Neap Tide period of November, 2021

TABLE #2 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA IN KANDLA CREEK ,NEAR BY CREEKS AND DPT OOT JETTY IN PATH FINDER CREEK AND SPM NEAR VADINAR DURING SPRING TIDE IN NOVEMBER,2021

Sr. No.	Station	Tide	Chlorophyll-a (mg/m^3)	Pheophytin-a (mg/m^3)	Algal Biomass (Chlorophyll method) mg/m^3
DPT HARBOUR AREAKANDLA CREEK					
1	KPT1	High tide	0.748	BDL	50.15
		Low tide	0.559	BDL	37.45
2	KPT 2	High tide	0.677	BDL	45.36
		Low tide	0.764	BDL	51.19
3	KPT 3	High tide	0.835	BDL	55.94
		Low tide	0.868	BDL	58.16
CREEKS					
4	KPT-4 Khori-I	High tide	0.661	BDL	44.29
		Low tide	0.720	BDL	48.24
5	KPT-5 Nakti-I	High tide	0.848	BDL	56.82
		Low tide	0.954	BDL	63.92
6	KPT-5 Nakti-II	High tide	0.246	BDL	16.48
PATHFINDER CREEK VADINAR					
7	VADINAR-I jetty	Low tide	0.393	BDL	26.33
8		High tide	0.338	BDL	22.65
9	SPM	High tide	0.424	BDL	28.41
10	SPM	Low tide	0.290	BDL	19.43

BDL: Below Detectable Limit.

TABLE #3 VARIATIONS IN CHLOROPHYLL –a PHEOPHYTIN- a AND ALGAL BIOMASS FROM SAMPLING STATIONS IN DPT HARBOUR AREA , NEAR BY CREEKS AND DPT OOT JETTY IN PATH FINDER CREEK AND SPM NEAR VADINARDURING NEAP TIDE IN NOVEMBER,2021

Sr. No.	Station	Tide	Chlorophyll-a (mg/m³)	Pheophytin-a (mg/m³)	Algal Biomass (Chlorophyll method) mg/m³
DPTHARBOUR AREAKANDLA CREEK					
1	KPT1	High tide	0.748	BDL	50.12
		Low tide	0.535	BDL	35.85
2	KPT 2	High tide	0.713	BDL	47.77
		Low tide	0.713	BDL	47.77
3	KPT 3	High tide	0.882	BDL	59.09
		Low tide	0.921	BDL	61.71
CREEKS					
4	KPT-4 Khori-I	High tide	1.669	0.484	111.82
		Low tide	1.178	0.380	78.93
5	KPT-5 Nakti-I	High tide	1.923	0.570	128.84
		Low tide	0.882	BDL	59.09
6	KPT-5 Nakti-II	High tide	0.425	BDL	28.47
PATHFINDER CREEK VADINAR					
7	VADINAR-I jetty	Low tide	1.356	0.415	90.85
8		High tide	0.500	BDL	33.50
9	SPM	High tide	0.703	BDL	47.10
10	SPM	Low tide	0.409	BDL	27.40

BDL: Below Detectable Limit.

PHYTOPLANKTON POPULATION:

For the evaluation of the Phytoplankton population in DPT harbour area and within the immediate surroundings of the port, sampling was conducted from 5 sampling locations (3 in harbour area and two in Nakti creek) during high tide period and low tide period of spring tide and neap tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by; Diatoms blue green algae and dinoflagellatesduring spring tide period.Diatoms were represented by 16genera. Blue green were represented by 2 genera and dinoflagellates were represented by two generaduring the sampling conducted in spring tide in November,2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area

and nearby creeks was varying from 43-198 units/ L during high tide period and133-220 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the harbour and nearby creeks was represented by Diatoms, Blue green algae and Dinoflagellates duringNeap tide period. Diatoms were represented by 20genera Blue green algae were represented 1genera and Dinoflagellates with two genera during the sampling conducted in Neap tide in November, 2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area and nearby creeks was varying from83-327 units/ L during high tide period and 108 -252 units/ L during low tide of Neap Tide.

For the evaluation of the Phytoplankton population in DPT OOT jetty area in Path Finder creek sampling was conducted from one sampling locations ; jetty area during high tide period and low tide of spring tide. For the evaluation of the Phytoplankton population in DPTOOT jetty area in Path Finder creek in Vadinar sampling was conducted from 2 sampling locations ; jetty area and one near SPM during high tide period and low tide of Neap tide.

The phytoplankton community of the sub surface water in the path finder creeks was represented by only Diatoms spring tide period. Diatoms were represented by 11 genera during the sampling conducted in spring tide in November, 2021. Phytoplankton of the sampling stations at sub surface layer in the harbour area was varying from 162 units/ L during high tide period and 178 units/ L during low tide of Spring Tide. Phytoplankton of the sampling stations at sub surface layer in the SPM area was varying from 154 units/ L during high tide period and 130 units/ L during low tide of Spring Tide.

The phytoplankton community of the sub surface water in the path finder creeks was represented by Diatoms,and Dinoflagellatesduring Neap tide period.Diatoms were represented by 15 generaand dinoflagellates by two genera during the sampling conducted in Neap tide in November, 2021. Phytoplankton of the sampling stations at sub surface path finder creek nearOOT Jetty was varying from 227 units/ L during high tide period and 182 -744 units/ L during low tide of Neap Tide. Phytoplankton of the sampling stations at sub surface path finder creek near SPM area was varying from 158 units/ L during high tide period and 158 units/ L during low tide of Neap Tide.

Species Richness Indices and Diversity Indices:

Margalef’s diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla creek and nearby creeks sampling stations was varying from 1.595-3.091 with an average of 2.396during the sampling conducted in High tide period of spring tide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla creek region and nearby creeks was varying from2.236 -2.863 with an average of 2.554 during the consecutive low tide period.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations in Kandla creek and nearby creeks was varying from 2.339-2.984 with an average of 2.696 during the sampling conducted in High tide period of Neaptide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the Kandla creek region and nearby creeks was varying from2.450-2.713 with an average of 2.624 during consecutive low tide.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was 1.769 at OOT jetty area and 1.588 at SPM area during the sampling conducted in High tide period of spring tide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the path finder creeknear OOT jetty was 1.737 and 1.644 at SPM during the consecutive low tide period.

Margalef's diversity index (Species Richness) S of phytoplankton communities in the stations was 2.561 at OOT jetty area and 2.370 at SPM area during the sampling conducted in High tide period of Neap tide. While Margalef's diversity index (Species Richness) S of phytoplankton communities in the path finder creek near OOT jetty was 2.114 and SPM area was 2.195 during the consecutive low tide period.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.727-0.907 (H'(log10)) between selected sampling stations with an average value of 0.805 during high tide period of spring tide at Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.787 -0.895 (H'(log10))

between selected sampling stations with an average value of 0.853 during consecutive low tide at Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.695 -0.931 (H'(log10)) between selected sampling stations with an average value of 0.823 during high tide period of neap tide at Kandla creek and nearby creeks. Shannon-Wiener's Index (H) of phytoplankton communities in the sampling stations was in the range of 0.759-0.867 (H'(log10)) between selected sampling stations with an average value of 0.810 during consecutive low tide at Kandla creek and nearby creeks.

Shannon-Wiener's Index (H) of phytoplankton communities in the stations was 0.798 atOOT jetty area and 0.7551 at SPM area during the sampling conducted in High tide period of spring tide. While Shannon-Wiener's Index (H) of phytoplankton communities in the path finder creek near OOT jetty was 0.715 and 0.771 at SPM during the consecutive low tide period.

Shannon-Wiener's Index (H) of phytoplankton communities in the stations was 0.787 at OOT jetty area and 0.7330 at SPM area during the sampling conducted in High tide period of Neap tide. While Shannon-Wiener's Index (H) of phytoplankton communities in the path finder creek near OOT jetty was 0.729 and at SPM area was 0.712 during the consecutive low tide period.

Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of phytoplankton of Kandla Harbour region and nearby creeks is less but with abundant population of few, with relatively few ecological niches and only very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran,2004).

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in the Kandla Harbour region and nearby creeks, which was varying from 0.742- 0.830 between selected sampling stations with an average of 0.788 during high tide period of spring tide. Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks, which was varying from 0.786- 0.832

between selected sampling stations with an average of 0.809during consecutive low tide .

Simpson diversity index (1-D) of phytoplankton communities was below 0.9 at all sampling stations in Kandla Harbour region and nearby creeks, during high tide period and low tide period during neap tide also, which was varying from 0.664-0.841 with an average value of 0.774 between selected sampling stations during high tide period and varying from 0.732-0.824 with an average value of 0.771 between selected sampling stations during consecutive low tide period Low species diversity suggests a relatively few successful species in this habitat.

Simpson diversity index (1-D) of phytoplankton communities in the stations was 0.813 atOOT jetty area and 0.779 at SPM area during the sampling conducted in High tide period of spring tide at Path finder creek . While Simpson diversity index (1-D) of phytoplankton communities in the path finder creek near OOT jetty was 0.753 and 0.794 at SPM during the consecutive low tide period in the path finder creek.

Simpson diversity index (1-D) of phytoplankton communities in the stations was 0.765 at OOT jetty area and 0.737 at SPM area during the sampling conducted in High tide period of Neap tide at Path finder Creek. While Simpson diversity index (1-D) of phytoplankton communities in the path finder creek near OOT jetty was 0.738 and at SPM area was 0.708 during the consecutive low tide period.

Low species diversity suggests a relatively few successful species in this habitat. The environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment. Any change in the environment would probably have quite serious effects.

Table # 4PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND ,NEAR BY CREEKS DURING SPRING TIDE IN NOVEMBER,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	177	17/20	85	3.091	0.9004	0.8193
	2	152	16/20	80	2.986	0.9067	0.8305
	3	192	11/20	55	1.902	0.7268	0.7421
	4	167	13/20	65	2.345	0.7525	0.7454
	5	198	14/20	70	2.458	0.7886	0.7683
	6	43	7/20	35	1.595	0.7583	0.825
LOW TIDE	1	133	15/20	75	2.863	0.8948	0.8214
	2	153	15/20	75	2.783	0.893	0.832
	3	190	14/20	70	2.478	0.8679	0.8106
	4	137	12/20	60	2.236	0.8213	0.7966
	5	220	14/20	70	2.41	0.7872	0.786

Table # 5 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND ,NEAR BY CREEKS DURING NEAP TIDE IN NOVEMBER,2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	131	15/24	62.5	2.872	0.9308	0.8406
	2	120	13/24	54.16	2.507	0.8561	0.8136
	3	213	17/24	70.83	2.984	0.8315	0.7733
	4	259	14/24	58.33	2.339	0.7394	0.7223
	5	327	17/24	70.83	2.763	0.6955	0.6641
	6	83	13/24	54.16	2.716	0.8861	0.8316
LOW TIDE	1	108	13/24	54.16	2.563	0.791	0.7606
	2	134	13/24	54.16	2.45	0.8677	0.8239
	3	177	15/24	62.5	2.705	0.7892	0.7325
	4	252	16/24	66.66	2.713	0.7591	0.7444
	5	182	15/24	62.5	2.69	0.8458	0.7939

Table # 6 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND , NEAR BY CREEKS DURING SPRING TIDE IN NOVEMBER, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	41-197	16/20	80
			BLUE GREEN	0-4	2/20	10
			DINOFLAGELLATES	0-3	2/20	10
			TOTAL PHYTO PLANKTON	**43-198**	**20**	-
LOW TIDE	Sub surface	5	DIATOMS	129-216	16/20	80
			BLUE GREEN	0-4	2/20	10
			DINOFLAGELLATES	0-2	2/20	10
			TOTAL PHYTO PLANKTON	**133-220**	**20**	-

Table # 7 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND , NEAR BY CREEKS DURING NEAP TIDE IN NOVEMBER,2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	DIATOMS	81-326	21/24	87.6
			BLUE GREEN	0-2	1/24	4.16
			DINOFLAGELLATES	0-2	2/24	8.33
			TOTAL PHYTO PLANKTON	**83-327**	**24**	
LOW TIDE	Sub surface	5	DIATOMS	108-251	21/24	87.6
			BLUE GREEN	0-2	1/24	4.16
			DINOFLAGELLATES	0-1	2/24	8.33
			TOTAL PHYTO PLANKTON	**108-252**	**24**	

Table # 8 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOTAT PATH FINDER CREEK , VADINAR &NEAR BY SPM, DURING SPRING TIDE IN NOVEMBER, 2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	jetty	162	10/11	90.90	1.769	0.7989	0.8132
	SPM	178	10/11	90.90	1.737	0.7149	0.7536
LOW TIDE	jetty	154	9/11	81.82	1.588	0.7441	0.7796
	SPM	130	9/11	81.82	1.644	0.7712	0.7937

Table # 9 PHYTOPLANKTON VARIATIONS IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOTAT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING NEAP TIDE IN NOVEMBER, 2021

Tide	Sampling Station	Abundance In units/L	No of Species observed /total species	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	227	15/17	88.24	2.581	0.7875	0.7647
	SPM	182	12/17	70.59	2.114	0.7288	0.7383
LOW TIDE	Jetty	158	13/17	76.47	2.37	0.733	0.7374
	SPM	150	12/17	70.59	2.195	0.7123	0.7087

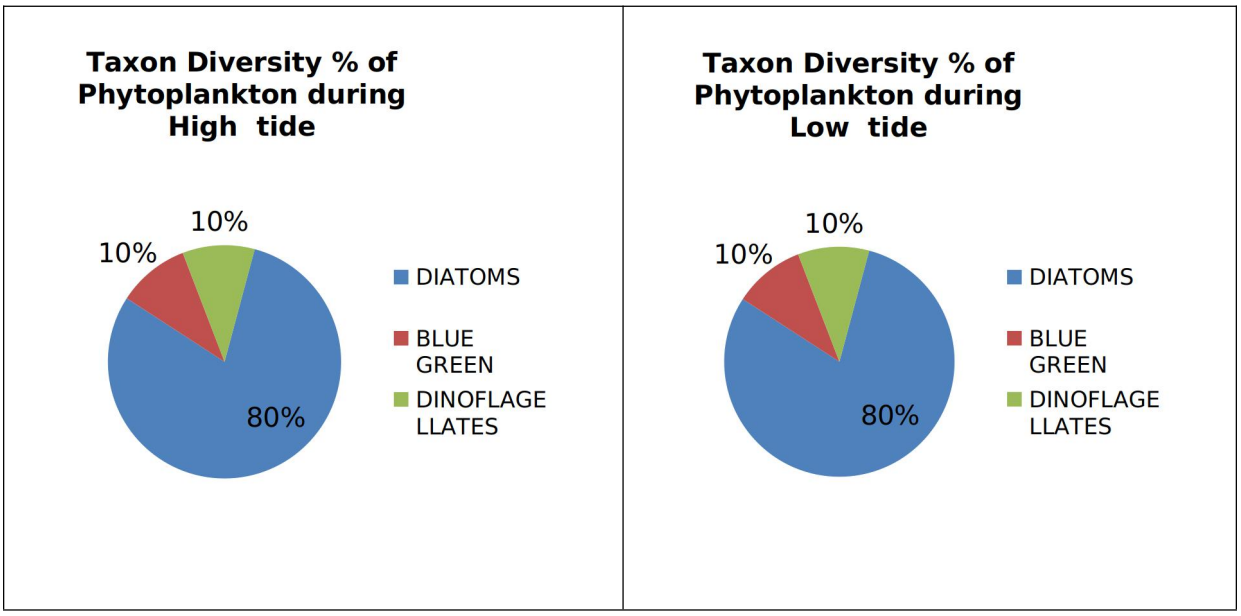
Table # 10 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT DPTOOT AT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING SPRING TIDE IN NOVEMBER, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	1	DIATOMS	162-178	11/11	100
			TOTAL PHYTO PLANKTON	162-178	**11**	
LOW TIDE	Sub surface	1	DIATOMS	130-154	11/11	100
			TOTAL PHYTO PLANKTON	130-154	**11**	

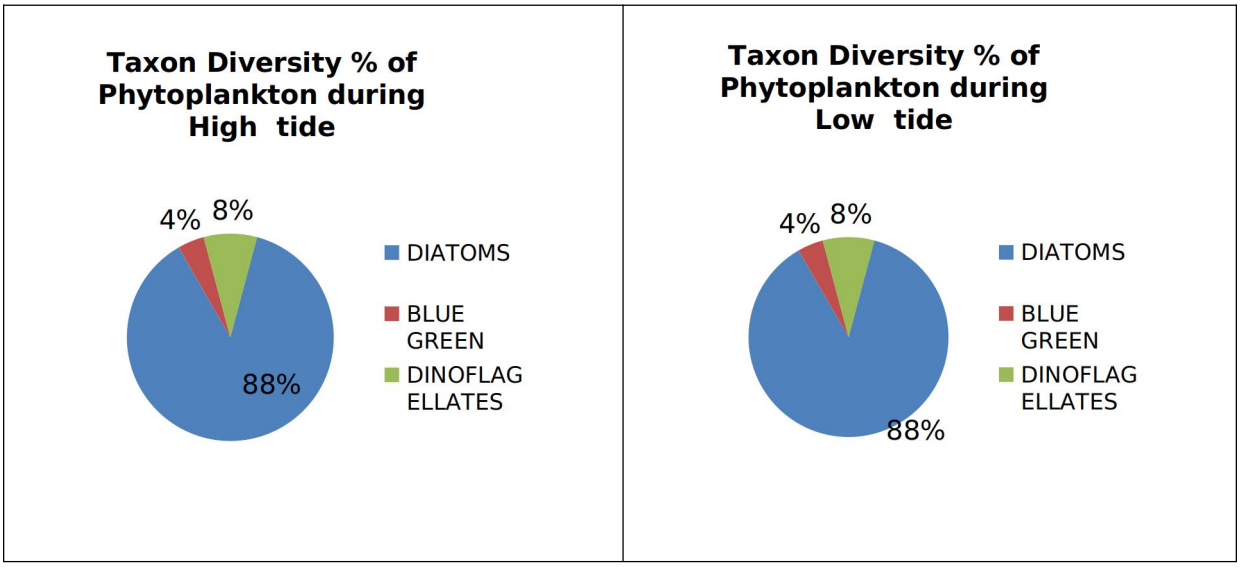
Table # 11 ABUNDANCE OF PHYTOPLANKTON SUBSURFACE SAMPLING STATIONS IN DPT DPTOOT AT PATH FINDER CREEK , VADINAR & NEAR BY SPM, DURING NEAP TIDE IN NOVEMBER, 2021

Tide	Surface	No of Sampling location	Group of phytoplankton	Phytoplankton Group range Units/L	Genera or species /total Phyto plankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	DIATOMS	182-226	15/17	88.24
			DINOFLAGELLATES	0-1	2/17	11.76
			TOTAL PHYTO PLANKTON	**182-227**	**17**	
LOW TIDE	Sub surface	2	DIATOMS	148-157	15/17	88.24
			DINOFLAGELLATES	0-1	2/17	11.76
			TOTAL PHYTO PLANKTON	148-158	**17**	

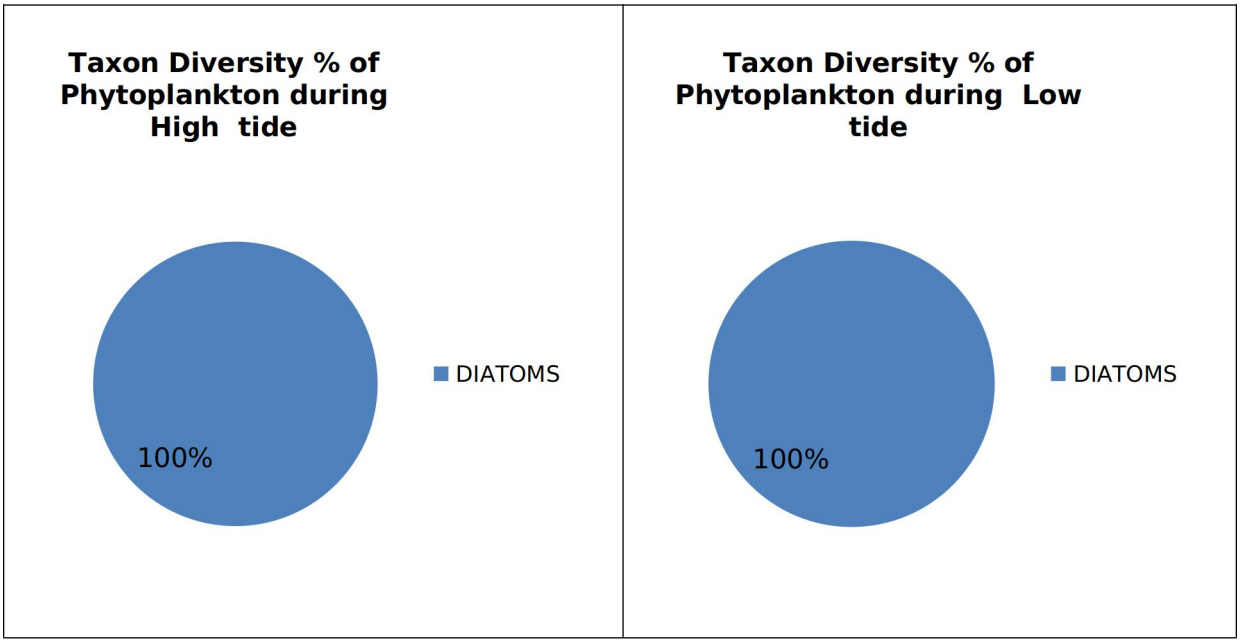
Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide in Kandala creek and nearby creeks



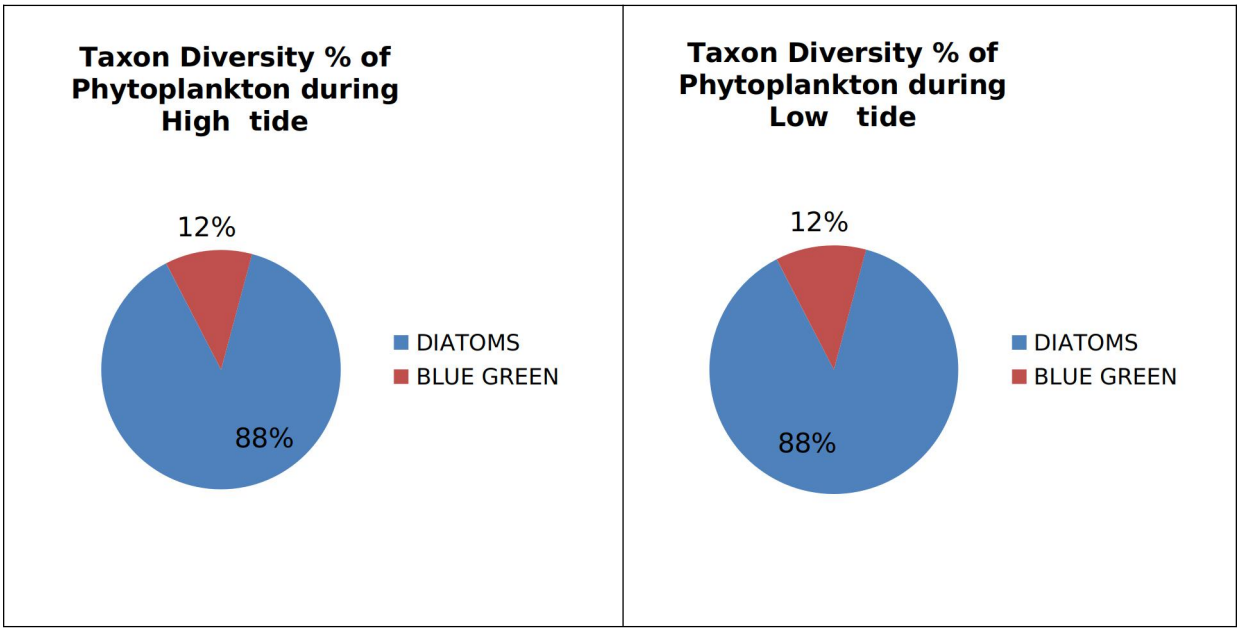
Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide in Kandala creek and nearby creeks



Taxon Diversity % of Phytoplankton during High tide and Low tide period during spring tide in Path Finder Creek, Vadinar



Taxon Diversity % of Phytoplankton during High tide and Low tide period during Neap tide in Path Finder Creek, Vadinar



ZOOPLANKTON POPULATION:

For the evaluation of the Zooplankton population in DPT harbour area and within the immediate surroundings of the port sampling was conducted from 6 sampling locations (3 in harbour area and two in Nakti creek and one in Khoricreek) during high tide period and low tide period of spring tide and Neap tide in November,2021. The Zooplankton community of the sub surface water in

the harbour and nearby creeks during spring tide was represented by mainly 4 groups, and 5 larval forms; Tintinids, Copepods,Rotifers, Urochordatesand larval forms represented from the group of Crustacea, Molluscansand Polychaetes. The Zooplankton community of the sub surface water in the harbour and nearby creeks during neap tide was represented by mainly Six groups, Tintinids, Copepods, Arrow worms, Mysids, Urochordata, Ciliates and unidentified Cnidarian member and larval forms of Crustacea Molluscans and Echinodermata Larvae Polychaete Larvae..,

Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 25-106x10^3 N/ m^3 during high tide and 58-85x10^3 N/ m^3during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT harbour area and nearby creek was varying from 40-143 x10^3 N/ m^3 during high tide and83-129x10^3 N/ m^3during low tide of Neap Tide period.

For the evaluation of the Zoo plankton population in DPT OOT jetty area in Path Finder creek and SPM in Vadinar selected 2 sampling locations (1 in jetty area and one near SPM) Duringspring tide sampling plankton sample were collected only at Jetty area during consecutive high tide period and low tide period. During Neap tide sampling Plankton samples were collected from jetty area and SPM during consecutive high tide period and low tide period.
The Zooplankton community of the sub surface water in the path finder creek creeks during spring tide was represented by mainly Titinids , Copepods and larval forms of Crusracens, Molluscs and Polychaetes .The Zooplankton community of the sub surface water in the path Finder creeks at Jetty region and SPM during neap tide was represented by mainly three groups, Tintinids, Copepods , Urochordates and , five Larval forms were represented from the major group of Crustaceans , Molluscans , and Polychaetes,.

Zooplankton of the sampling stations at sub surface layer in the DPT OOTjetty area of path finder creek was 87 x103 N/ m^3 during high tide and 117 x103 N/ m^3 during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT SPM area of path finder creek was 85 x10^3 N/ m^3 during high tide and 109 x10^3 N/ m^3 during low tide of Spring Tide period. Zooplankton of the sampling stations at sub surface layer in the DPT OOT jetty area in path finder creekwas recorded 54x10^3 N/ m^3during high tide and 86x10^3 N/ m^3 during consecutive low tide period of Neap . Zooplankton of the sampling

stations at sub surface layer in the DPT SPM area in path finder creek was recorded 72 x10^3 N/ m^3during high tide and 92 x10^3 N/ m^3 during consecutive low tide period of Neap Tide .

Species Richness Indices and Diversity Indices:

Margalef's diversity index (Species Richness)S

At the organismal level, the most widely used biodiversity measures are those based on the number of species present, perhaps adjusted for the number of individuals sampled, Here Margalef's Species richness index (d), or indices that describe the evenness of the distribution of the numbers of individuals among species, are derived.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the stations Kandla creek region and nearby creeks was varying from 1.733-2.796 with an average of 2.196 during the sampling conducted in High tide period. Margalef's diversity index (Species Richness) S of Zooplankton communities varying from.1.871-2.217 with an average of 2.026 during the sampling conducted in low tide period during Spring tide.

Margalef's diversity index (Species Richness) S of Zooplankton communities in the Kandla creek region and nearby creeks sampling stations was varying from2.771-3.983with an average of 3.445 during the sampling conducted in high tide and varying from2.635- 3.054 with an average of 3.049 during the sampling conducted in low tide during Neap tide period

Margalef's diversity index (Species Richness) S of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted inconsecutive High tide period and low tide of spring tide was recorded as 1.769 and 1. 588 respectively..

Margalef's diversity index (Species Richness) S of Zooplankton communities near SPmat Path finder creek was varying from 2.256-2.572 during the sampling conducted in High tide period of Neap tide. While Margalef's diversity index (Species Richness) S of Zooplankton communities in the two stations at Path finder creek was varying from2.020- 1.769 during the consecutive low tide period.

Shannon-Wiener's index:

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.725-0.945 (H'(log10)) between selected sampling stations with an average value of 0.811 (H'(log10)) during high tide period of spring tide. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour

region and nearby creeks was in the range of 0.703-0.884 (H'(log10)) between selected sampling stations with an average value of 0.780 (H'(log10)) during consecutive low tide period.

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.782-1.119 (H'(log10)) between selected sampling stations with an average value of 1.000 (H'(log10)) during high tide period of Neap tide. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling stations in Kandla Harbour region and nearby creeks was in the range of 0.855-1.059 (H'(log10)) between selected sampling stations with an average value of 0.950(H'(log10)) during consecutive low tide period.

Shannon-Wiener's Index (H) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.799 and 0.7441 respectively.. Shannon-Wiener's Index (H) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of Neap tide was recorded as 0.742 and 0.709 respectively

Shannon-Wiener's Index (H) of Zooplankton communities in the two stations at Path finder creek was varying from 0.715-0.798 during the sampling conducted in High tide period of Spring tide. While Shannon-Wiener's Index (H)of Zooplankton communities in the two stations at Path finder creek was varying from -0.771-0.7441during the consecutive low tide period.

Shannon-Wiener's Index (H) of Zooplankton communities in the two stations at Path finder creek was varying from 0.743-0.849 during the sampling conducted in High tide period of Neap tide. While Shannon-Wiener's Index (H) of Zooplankton communities in the two stations at Path finder creek was varying from -0.641 - 0.709 during the consecutive low tide period.

Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. The Shannon-Wiener's index increases as both the richness and the evenness of the community increase. This result indicates that diversity of Zooplankton of Kandla Harbour region and nearby creeks stations is slightly high with very minimum diverse population but very few opportunist organisms are really well adapted to this environment and thrive better than other species.

Simpson's diversity index:

Simpson's index (D) is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. The Simson index is one of the meaningful and robust biodiversity measures available. (Magurran, 2004).

Simpson diversity index (1-D) of Zooplankton communities was below 0.9 most of sampling stations in the Kandla Harbour region and nearby creeksduring high tide and low tide of spring tide period, which was varying from 0.751-0.910between selected sampling stations with an average of 0.804 during high tide period and was varying from 0.722- 0.854 with an average value of 0.780 between selected sampling stations during low tide

Simpson diversity index (1-D) of Zooplankton communities was blow 0.9 at all sampling stationsin the Kandla Harbour region and nearby creeks except few during high tide and low tide period, which was varying from 0.766 - 0.912 between selected sampling stations with an average of 0.863 during high tide period and was varying from 0.795- 0.896with an average value of 0.843 between selected sampling stations during consecutive low tide

This low species diversity suggests a relatively few of successful species in this habitat during November, 2021 sampling.

Simpson diversity index (1-D) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.813and 0.779 respectively. Simpson diversity index (1-D) of Zooplankton communities in the sampling station near SPM at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.753 and 0.779 respectively.

Simpson diversity index (1-D) of Zooplankton communities in the sampling station near jetty at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of Neap tide was recorded as 0.778 - 0.729 respectively. Simpson diversity index (1-D) of Zooplankton communities in the sampling station near SPM at Path Finder Creek, Vadinar during the sampling conducted in consecutive High tide period and low tide of spring tide was recorded as 0.817 and 0.697 respectively.

Table # 12 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREA AT KANDLA CREEK AND NEAR BY CREEKS DURING SPRING TIDE IN NOVEMBER,2021

Tide	Sampling Station	Abundance In $Nx10^3/m^3$	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	75	10/16	62.5	2.085	0.7569	0.751
	2	82	11/16	68.75	2.269	0.8385	0.8154
	3	66	10/16	62.5	2.148	0.8294	0.8224
	4	106	11/16	68.75	2.144	0.7752	0.7641
	5	101	9/16	56.25	1.733	0.7251	0.7651
	6	25	10/16	62.5	2.796	0.9451	0.91
LOW TIDE	1	69	9/16	56.25	1.889	0.8145	0.809
	2	58	10/16	62.5	2.217	0.8838	0.8542
	3	72	9/16	56.25	1.871	0.7031	0.7218
	4	69	10/16	62.5	2.126	0.7896	0.7899
	5	85	10/16	62.5	2.026	0.7112	0.7272

Table # 13 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT HARBOUR AREAAT KANDLA CREEK AND NEAR BY CREEKS DURING NEAP TIDE IN NOVEMBER,

Tide	Sampling Station	Abundance In No $x10^3/m^3$	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	1	118	20/28	71.42	3.983	1.119	0.9122
	2	102	17/28	60.71	3.459	0.9987	0.875
	3	108	19/28	67.86	3.844	1.085	0.8974
	4	143	18/28	64.29	3.425	1.118	0.9087
	5	101	16/28	57.14	3.25	0.9028	0.8212
	6	40	11/28	39.29	2.711	0.7823	0.7667
LOW TIDE	1	83	13/28	46.43	2.716	0.8552	0.7949
	2	128	18/28	64.29	3.504	1.059	0.8958
	3	129	18/28	64.29	3.498	1.055	0.8815
	4	89	14/28	50	2.896	0.8648	0.7975
	5	95	13/28	46.43	2.635	0.9189	0.8434

2021

Table # 14 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREAATKANDLA CREEK AND ,NEAR BY CREEKS DURING SPRING TIDE IN NOVEMBER,2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton x10^3 Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	3-13	3/16	18.75
			Copepods	11-40	6/16	37.5
			Rotifers	0-2	1/16	6.25
			Urochordata	1-4	1/16	6.25
			Larval forms	5-52	5/16	31.25
			TOTAL ZOOPLANKTON N/ M^3	**25-106**	**16**	
LOW TIDE	Sub surface	5	Tintinids	5-9	3/16	18.75
			Copepods	20-27	6/16	37.5
			Rotifers	0	1/16	6.25
			Urochordata	0-4	1/16	6.25
			Larval forms	30-53	5/16	31.25
			TOTAL ZOOPLANKTON N/M^3	**58-85**	**16**	

Table # 15 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT HARBOUR AREA IN KANDLA CREEK AND , NEAR BY CREEKS DURING NEAP TIDE IN NOVEMBER, 2021

Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton x10^3 Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	6	Tintinids	7-36	5/28	17.86
			Copepods	11-49	8/28	28.58
			Mysids	0-1	2/28	7.14
			Arrow worms	0-2	1/28	3.57
			Urochordata	0-2	1/28	3.57
			Ciliates	0-4	1/28	3.57
			Medusa	0-4	1/28	3.57
			Larval forms	20-58	7/28	25
			Foraminiferans	0-4	2/28	7.14
			TOTAL ZOOPLANKTON N/M^3	**40-143**	**28**	
LOW TIDE	Sub surface	5	Tintinids	10-32	5/28	17.86
			Copepods	17-54	8/28	28.58
			Mysids	0-2	2/28	7.14
			Arrow worms	0-1	1/28	3.57
			Urochordata	0-2	1/28	3.57
			Ciliates	0-1	1/28	3.57
			Medusa	0-1	1/28	3.57
			Larval forms	50-62	7/28	25

			Foraminiferans	**0-3**	2/28	7.14
			Total Zooplankton N/M3		**28**	

Table # 16 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURING SPRING TIDE IN NOVEMBER,2021

Tide	Sampling Station	Abundance In $x10^3$N / m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	87	11/13	84.62	2.239	0.6821	0.6864
	SPM	85	12/13	92.31	2.476	0.7967	0.788
LOW TIDE	Jetty	117	10/13	76.92	1.89	0.7264	0.7265
	SPM	109	10/13	76.92	1.918	0.6599	0.6624

Table # 17 ZOOPLANKTON VARIATION IN ABUNDANCE AND DIVERSITY IN SUB SURFACE SAMPLING STATIONS IN DPT OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURING NEAP TIDE IN NOVEMBER,2021

Tide	Sampling Station	Abundance In Nx10^3/ m^3	No of Species/groups observed /total species/group	% of diversity	Margalef's diversity index (Species Richness S)	Shannon Weiner index H (log_{10})	Diversity Index (Simpson's Index) 1-D
HIGH TIDE	Jetty	227	15/17	88.23	2.581	0.7875	0.7647
	SPM	182	12/17	70.59	2.114	0.7288	0.7383
LOW TIDE	Jetty	158	13/17	76.47	2.37	0.733	0.7374
	SPM	150	12/17	70.59	2.195	0.7123	0.7087

Table # 18 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT OOT AREAAT PATH FINDER CREEK AND NEAR BY SPM DURING SPRING TIDE IN NOVEMBER,2021

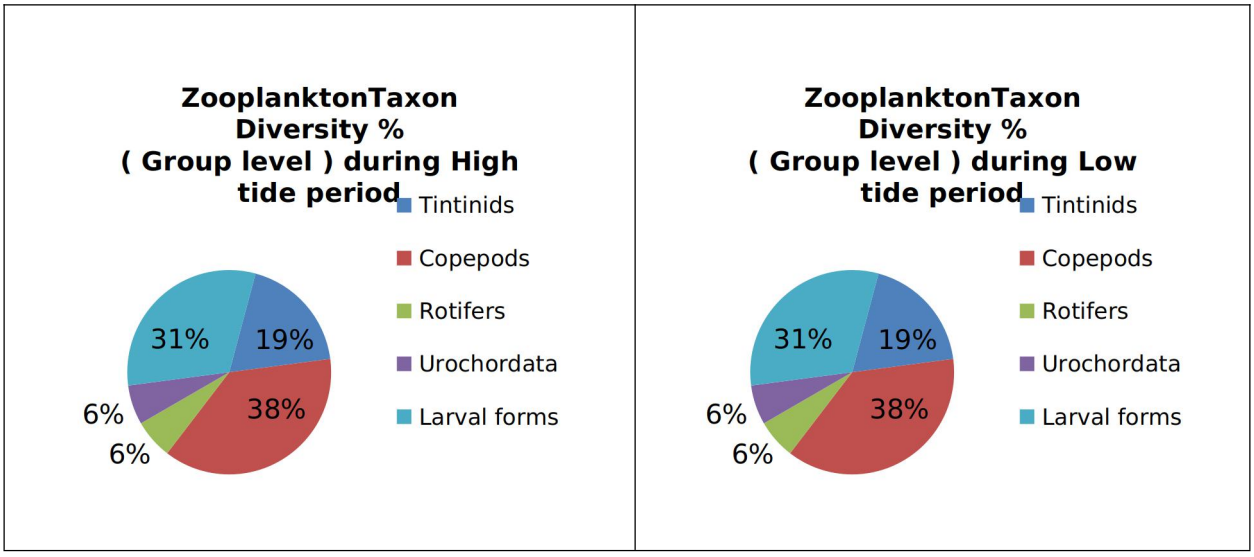
Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	Tintinids	6-7	3/13	23.08
			Copepods	30-39	6/13	46.15
			Larval forms	39-51	4/13	30.77
			TOTAL ZOOPLANKTON NO/L	**85-87**	**13**	
LOW TIDE	Sub surface	2	Tintinids	15-16	3/13	23.08
			Copepods	30-35	6/13	46.15
			Larval forms	67-73	4/13	30.77

			TOTAL ZOOPLANKTON NO/M3	**109-117**	**13**	

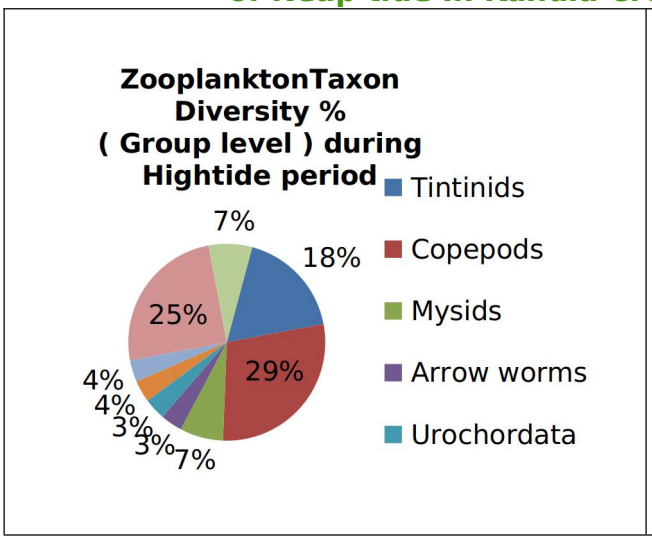
Table # 19 ABUNDANCE OF ZOOPLANKTON IN SUBSURFACE SAMPLING STATIONS IN DPT OOT AREA AT PATH FINDER CREEK AND NEAR BY SPM DURING NEAP TIDE IN NOVEMBER, 2021

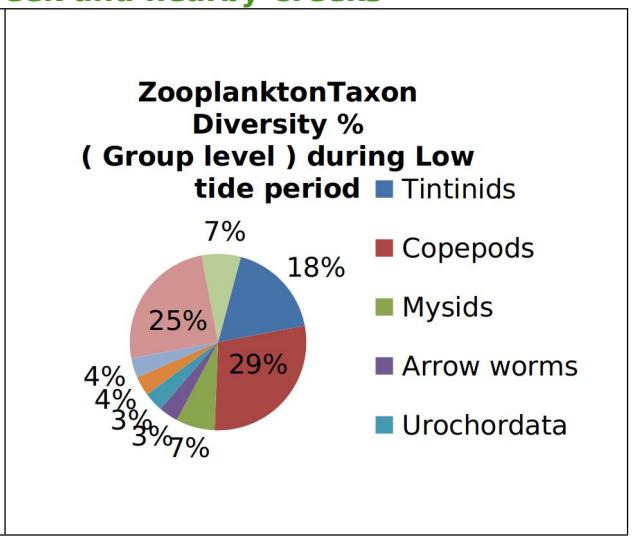
Tide	Surface	No of Sampling locations	Group of Zooplankton	Abundance of Zooplankton $x10^3$ Group Range	Genera or species /total Zooplankton	Taxon Diversity % (Group level)
HIGH TIDE	Sub surface	2	Tintinids	6-9	4/17	23.53
			Copepods	25-31	7/17	41.18
			Urochordata	0-1	1/17	5.88
			Larval forms	23-41	5/17	29.41
			TOTAL ZOOPLANKTON	**48-63**	**17**	
LOW TIDE	Sub surface	2	Tintinids	9-10	4/16	25
			Copepods	43-47	7/16	43.75
			Urochordata	0	0	0
			Larval forms	43-47	5/16	31.25
			TOTAL ZOOPLANKTON NO/M3	**77-83**	**16**	

Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide In Kandla Creek and near by Creeks

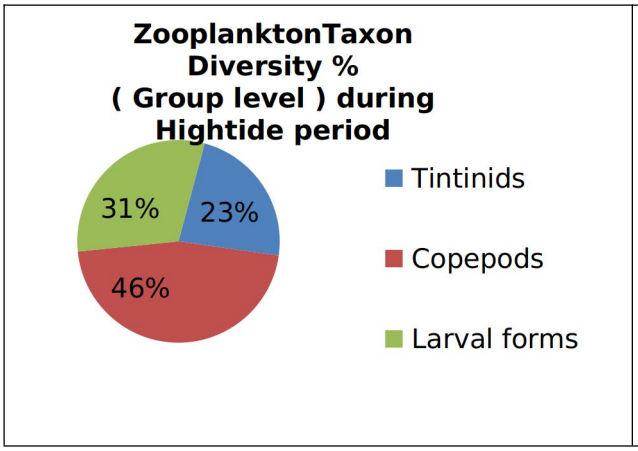


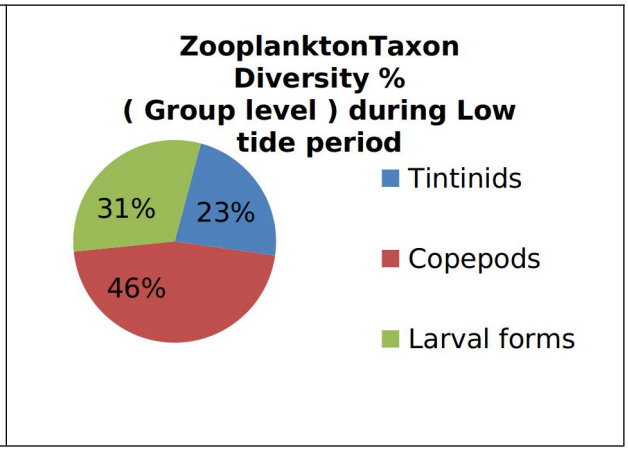
Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide In Kandla Creek and nearby Creeks



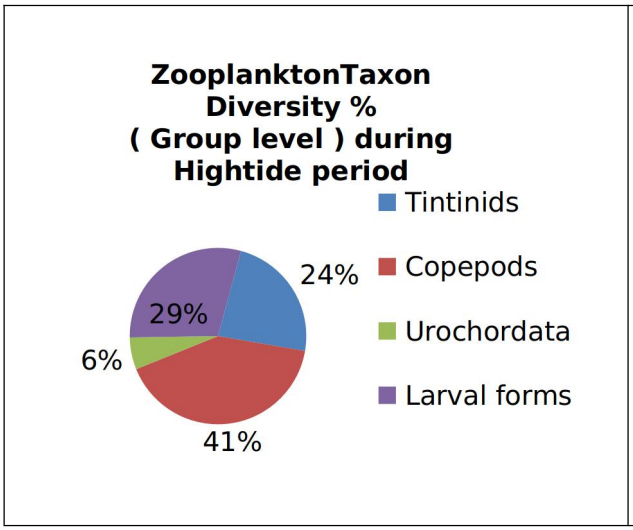


Taxon Diversity % of Zooplankton during High tide and Low tide period of Spring tide In Path Finder Creek and near Jetty





Taxon Diversity % of Zooplankton during High tide and Low tide period of Neap tide In Path Finder Creek near jetty and nearby SPM



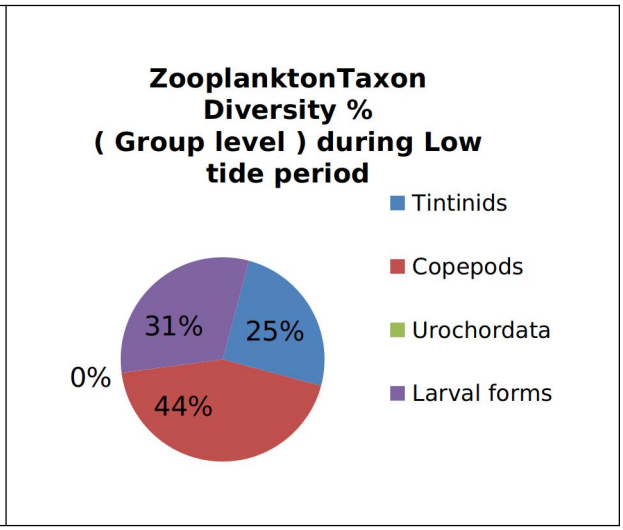


TABLE # 20SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKS DURINGSPRING TIDE OF NOVEMBER 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Rare
					Arthrospira sp.	B2	Rare
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D2	Abundant
			Triceratiales	Triceratiaceae	*Odontella*sp	D3	Occasional
					*Triceratium*sp.	D4	Occasional
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Dominant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D6	Rare
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D7	Occasional
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D8	Occasional
			Leptocylindrales	Leptocylindraceae	*Leptocylindrussp*	D9	Occasional
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D10	Frequent
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D11	Occasional
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D12	Frequent
					Thalassionema sp.	D13	Rare
			Fragilariales	Fragilariaceae	*Fragilaria*sp	D14	Frequent
					*Synedra*sp	D15	Rare
			Tabellariales	Tabellariaceae	*Tabellaria*sp	D16	Rare
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Peridiniales	Protoperidiniaceae	*Protoperidinium sp.*	DF1	Rare
			Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF2	Rare

TABLE # 21 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKS DURING AND NEAP TIDE OF NOVEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
BLUE GREEN ALGAE	Cyanophyta	Cyanophyceae	Nostocales	Oscillatoriaceae	*Oscillatoria* sp.	B1	Rare
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Occasional
					*Thalassiosira*sp	D2	Occasional
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D3	Frequent
			Triceratiales	Triceratiaceae	*Odontella*sp	D4	Rare
					*Triceratium*sp.	D5	Occasional
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D6	Dominant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D7	Rare
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D8	Occasional
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D9	Rare
			Leptocylindrales	Leptocylindraceae	*Leptocylindrus*sp	D10	Rare
			Lithodesmiales	Lithodesmiaceae	*Ditylum*sp	D11	Frequent
		Bacillariophyceae	Bacillariales	Bacillariaceae	*Bacillaria*sp.	D12	Occasional
					*Nitzschia*sp	D13	Rare
			Naviculales	Naviculaceae	*Navicula*sp	D14	Rare
				Pleurosigmataceae	*Pleurosigma*sp	D15	Rare
			Surirellales	Entomoneidaceae	*Entomoneis*sp	D16	Rare
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D17	Abundant
					Thalassionema sp.	D18	Occasional
			Fragilariales	Fragilariaceae	*Fragilaria*sp	D19	Frequent
					*Synedra*sp	D20	Rare
			Tabellariales	Tabellariaceae	*Tabellaria*sp	D21	Rare
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Gonyaulacales	Ceratiaceae	*Ceratiumfurca*	DF1	Rare
					Ceratiumtripos	DF2	Rare

TABLE # 22 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING SPRING TIDE OF NOVEMBER 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D1	Dominant
			Triceratiales	Triceratiaceae	*Triceratium*sp.	D2	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D3	Abundant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D4	Rare
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D5	Occasional
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D6	Frequent
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D7	Occasional
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D8	Rare
			Bacillariales	Bacillariaceae	*Bacillaria*sp.	D9	Rare
					*Pseudo-Nitzschia*sp	D10	Occasional
		Fragilariophyceae	Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D11	Frequent

TABLE # 23 SYSTEMATIC ACCOUNT OF PHYTOPLANKTON IN THE SAMPLING LOCATIONS IN OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING AND NEAP TIDE OF NOVEMBER, 2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	Relative Abundance
DIATOMS	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Thalassiosiraceae	*Planktoniella*sp	D1	Occasional
					*Thalassiosira*sp	D2	Rare
			Coscinodiscales	Coscinodiscaceae	*Coscinodiscus sp.*	D3	Dominant
			Triceratiales	Triceratiaceae	*Triceratium*sp	D4	Rare
			Biddulphiales	Biddulphiaceae	*Biddulphia*sp	D5	Abundant
			Hemiaulales	Bellerocheaceae	*Bellerochea*sp	D6	Occasional
			Rhizosoleniales	Rhizosoleniaceae	*Rhizosolenia sp.*	D7	Occasional
			Chaetocerotales	Chaetocerotaceae	*Chaetoceros*sp	D8	Rare
			Lithodesmiales	Lithodesmiaceae	*Ditylumsp*	D9	Frequent
		Bacillariophyceae	Naviculales	Pleurosigmataceae	*Pleurosigma*sp	D10	Rare
			Bacillariales	Bacillariaceae	*Bacillaria*sp.	D11	Occasional
					*Nitzschia*sp	D12	Rare
					*Pseudo-Nitzschia*sp	D13	Frequent
		Fragilariophyceae	Fragilariales	Fragilariaceae	*Synedra sp.*	D14	Rare
			Thalassionematales	Thalassionemataceae	*Thalassiothrix sp.*	D15	Occasional
DINO FLAGELLATES	Dinoflagellata / Dinozoa	Dinophyceae	Gonyaulacales	Ceratiaceae	*Ceratiumfusus*	DF1	Rare
					Ceratiumfurca	DF2	Rare

TABLE #24 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKSDURING SPRING TIDE OF NOVEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Rare
				Codonellidae	*Tintinnopsis radix*	T2	Rare
					Tintinnopsisfailakkaensis	T3	Occasional
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Frequent
				Clausocalanidae	*Clausocalanus sp.*	C2	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C3	Abundant
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C4	Rare
				Euterpinidae	*Euterpina sp.*	C5	Occasional
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C6	Rare
ROTIFERS	ROTIFERA	Rotifera Subclass: Eurotatoria	Superorder: Monogononta Order:Ploimida	Brachionidae	*Brachionusplicatilis*	R1	Rare
UROCHORDATA	CHORDATA SUB PHYLUM UROCHORDATA	Appendicularia		Oikopleuridae	*Oikopleura sp.*	U1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L2	Occasional

MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L3	Rare
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L4	Occasional
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L5	Rare

TABLE # 25 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING OF DPT HARBOUR AREA AT KANDLA CREEK AND NEARBY CREEKSDURING NEAP TIDE OF NOVEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Frequent
				Codonellidae	*Tintinnopsisgracilis*	T2	Occasional
					Tintinnopsis radix	T3	Frequent
					Tintinnopsisfailakkaensis	T4	Occasional
				Tintinnidae	*Amphorides sp.*	T5	Rare
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Occasional
				Eucalanidae	*Pareucalanus sp.*	C2	Rare
				Clausocalanidae	*Clausocalanus sp.*	C3	Rare
				Centropagidae	*Centropages sp.*	C4	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C5	Abundant
			Harpacticoida	Ectinosomatidae	*Microsetella*sp.	C6	Frequent
				Euterpinidae	*Euterpina sp.*	C7	Occasional
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C8	Rare
ARROW WORMS	CHAETOGNATHA	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta sp.*	A1	Rare

MYSIDS	ATHROPODA CRUSTACEA	Malacostraca	Mysida, Decapoda	Solenoceridae	*Solenocerasp.*	M1	Rare
				Luciferidae	*Lucifer sp.*	M2	Rare
UROCHORDATA	CHORDATA SUB PHYLUM UROCHORDATA	Appendicularia		Oikopleuridae	*Oikopleura sp.*	U1	Rare
CILIATES	CILIOPHORA	Oligohymenophorea	Sessilida	Zoothamniidae	*Zoothamniumsp.*	CI1	Rare
MEDUSA	PHYLUM CNIDARIA	Hydrozoa			Unidentified medusa	ME 1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L2	Frequent
GROUP	**PHYLUM**	**CLASS**	**ORDER**	**FAMILY**	**GENUS/SPECIES**	**#**	**RELATIVE ABUNDANCE**
BARNACLE LARVAE	ATHROPODA CRUSTACEA	Maxillopoda Thecostraca			Cirripede larvae	L3	Occasional
CYPHONAUTES LARVAE	BRYOZOA				Cyphonautes larvae	L4	Occasional
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L5	Rare
ECHINODERMATA LARVAE	ECHINODERMATA				Ophipluutes larvae/ Echinoplutes larvae	L6	Rare
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L7	Occasional
FORAMINIFERA	FORAMINIFERA	Globothalamea	Rotaliida	Globigerinidae	*Globigerina* sp.	F1	Rare
				Rotalliidae	*Rotalia* sp.	F2	Rare

TABLE # 26 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING SPRING TIDE OF NOVEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Occasional
				Codonellidae	*Tintinnopsisgracilis*	T2	Rare
					Tintinnopsis radix	T3	Occasional
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Frequent
				Clausocalanidae	*Clausocalanus sp.*	C2	Rare
			Cyclopoida	Oithonidae	*Oithona sp.*	C3	Abundant
			Harpacticoida	Euterpinidae	*Euterpina sp.*	C4	Rare
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C5	Rare
				Corycaeidae	*Corycaeus sp.*	C6	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L2	Occasional
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L3	Occasional
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L4	Occasional

TABLE # 27 SYSTEMATIC ACCOUNT OF ZOOPLANKTON FROM THE SAMPLING LOCATIONS OF DPT OOT AREA AT PATH FINDER CREEK AND NEARBY SPM AT VADINAR DURING NEAP TIDE OF NOVEMBER,2021

GROUP	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	#	RELATIVE ABUNDANCE
TINTINIDS	PROTOZOA CILIOPHORA	Spirotrichea	Tintinnida	Tintinnidiidae	*Leprotintinnussp.*	T1	Occasional
				Codonellidae	*Tintinnopsisgracilis*	T2	Rare
					Tintinnopsis radix	T3	Occasional
				Codonellopsidae	*Codonellopsis* sp.	T4	Rare
COPEPODS	ATHROPODA	Crustacea Subclass: Copepoda	Calanoida	Paracalanidae	*Acrocalanus* sp.	C1	Abundant
				Eucalanidae	*Subeucalanus sp.*	C2	Rare
				Clausocalanidae	*Clausocalanus sp.*	C3	Occasional
			Cyclopoida	Oithonidae	*Oithona sp.*	C4	Frequent
			Harpacticoida	Euterpinidae	*Euterpina sp.*	C5	Rare
			Poicilostomatatoida	Oncaeidae	*Oncaea sp.*	C6	Rare
				Corycaeidae	*Corycaeus sp.*	C7	Rare
UROCHORDATA	CHORDATA SUB PHYLUM UROCHORDATA	Appendicularia		Oikopleuridae	*Oikopleura sp.*	U1	Rare
CRUSTACEAN LARVAE	ARTHROPODA (CRUSTACEA)	Copepoda			Nauplius larvae of Copepods	L1	Dominant
BRACHYURA LARVAE	ARTHROPODA (CRUSTACEA)	Malacostraca Decapoda			Brachyuran Zoea larvae	L2	Rare
MOLLUSCAN LARVAE	MOLLUSCA	Gastropoda Streptoneura			Opisthobranchia larvae	L3	Rare
POLYCHAETE LARVAE	ANNELIDA	Polychaeta			Trochophore larvae	L4	Occasional
BIVALVE LARVAE	MOLLUSCA	Pelecypoda			Veliger larvae of Bivalves	L5	Rare

BENTHIC ORGANISMS:

Few Benthic organismswere observed in the collected sediments by using the Van-veen grabs during the sampling conducted during spring tide period andNeap tide period from DPT harbour region and nearby creek.The meiobenthic organisms during spring tide were represented by Polychaetes,and Nematodes. The polychaetes were representedby *Scyphoproctus sp*. *Notomastus*sp,*Dasybranchus.* The meiobenthic organisms in the collected samples were varying from 50-180N/M ^{2}during spring tide and 60-130 N/M

Table # 28BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPT HARBOUR AREA CREEKS DURING SPRING TIDE IN NOVEMBER ,2021

Benthic fauna	ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS REPRESENTATION BY GROUP						
	DPT HARBOUR			CREEKS			
POLYCHAETES	KPT-1	KPT-2	KPT-3	KPT-4	KPT-5	KPT-6	
Family : Capitellidae *c*	0	40	0	20	20	NS	
Family : Capitellidae *Notomastus* sp.	40	60	40	80	30	NS	
Total Polychates N/M^2	40	100	40	120	50		
Un identified Nematode worms	10	20	40	60	20	NS	
TOTAL Benthic Fauna NUMBER/ M^2	50	120	80	180	70	-	

NS : No sample

Table # 29 BENTHIC FAUNA IN THE SAMPLING LOCATIONS IN DPT HARBOUR AREA CREEKS DURING NEAP TIDE IN NOVEMBER ,2021

Benthic fauna	ABUNDANCE IN NO/M ^{2} DIFFERENT SAMPLING STATIONS REPRESENTATION BY GROUP						
	DPT HARBOUR			CREEKS			
POLYCHAETES	KPT-1	KPT-2	KPT-3	KPT-4	KPT-5	KPT-6	
Family : Capitellidae *Dasybranchus sp.*	10	20	10	10	20	NS	
Family : Capitellidae *Notomastus* sp.	50	60	20	40	20	NS	
Family : Glyceridae Glycera	10	20	10	0	0	NS	

Total Polychates N/M²	70	100	40	50	40		
Un identified Nematode worms	20	30	30	30	20	NS	
TOTAL Benthic Fauna NUMBER/ M²	90	130	70	80	60	-	

NS : No sample

Meteorological Data

Automatic Weather station have been installed in Seva Sadan -3 at the Deendayal Port which records the data on Temperature (°C), Humidity (%),Wind (mph), Dew Point (°C), Wind Direction (°), Pressure, Solar radiation, heat Index and UVI.

Temperature

The mean day time temperature for Deendayal Port was 30.3 °C. The day-time maximum temperature was 38.6 °C. The mean night time temperature was 26.5 °C. The minimum mean night time temperature recorded was 30.6 °C.

Air Pressure

The mean absolute air pressure for the month of November was 1009.9 hpa, whereas the mean relative pressure was 1009.3 hpa. The maximum absolute air pressure recorded for the month of November was 1016.5 hpa.

Heat Index

The mean day-time heat index for the month of November was 33.8 ^{o}C. The maximum heat index recorded was 55^{o}C.

Solar Radiation

The mean Solar Radiation in November was 252.2 w/m^2. The maximum solar radiation recorded in the month of November was 746.6 w/m^2.

Humidity

The mean day-time humidity was 60.0 % for the month of November and mean night time humidity was 72.4%. Maximum humidity recorded during day-time was 94.0 % and maximum humidity recorded during night-time was 93.0%.

Wind Velocity and Wind Direction

The mean wind velocity for the entire month of November was 4.6 km/hour. Maximum wind velocity recorded was 29.2 Km/hr . The wind direction was mostly S to N.

Conclusive Summary and Remedial measures Suggested

The AAQ monitoring at six locations of Deendayal Port indicates that the mean PM_{10} values at four locations viz. Coal storage area, Marine Bhavan and Oil Jetty area were found above the permissible standards (100 µg/m^3)and$PM_{2.5}$was above permissible limits at Coal storage location(Limit 60 µg/m^3).

Drinking water at all the twenty locations was found potable and was within permissible limits of BIS standards (IS 10500).

Noise quality was also within the set permissible standards of an Industrial Area. The noise level observed during day time was >75 dB (A) and at night time was >70 dB (A) during the entire monitoring period.

The sewage treated water of Deendayal Port Colony (Gopalpuri) was in line with the standards set by the Gujarat Pollution Control Board.

Reasons for higher Values of PM_{10}

Large amount of coal is handled at Berth No. 6, 7, 8 and 9. The unloading of coal directly in the truck, using grabs cause coal to spread in air as well as coal dust to fall on ground. This settled coal dust again mixes with the air while trucks travel through it.

Also, the coal laden trucks are not always covered with tarpaulin sheets and these results in spillage of coal from trucks/dumpers during its transit from vessel to yard or storage site. This also increased PM values around marine Bhavan & Coal storage area.

Remedial Measures

The values of PM_{10} during the month of November, 2021 were observed beyond the permissible limit at four locations mentioned above. Given below are the remedial measures suggest to minimize the Air pollution at Deendayal Port.

Guidelines for Coal Handling by GPCB should be strictly followed. (http://gpcb.gov.in/pdf/coal-handling-guidelines.pdf)

Except for the higher values of PM_{10} at Coal storage site, Oil Jetty, Tuna Port and Marine Bhavan locations, the monitoring results for the present month suggest that the overall Environment Quality of Deendayal Port is satisfactory.

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Annexure -VIII

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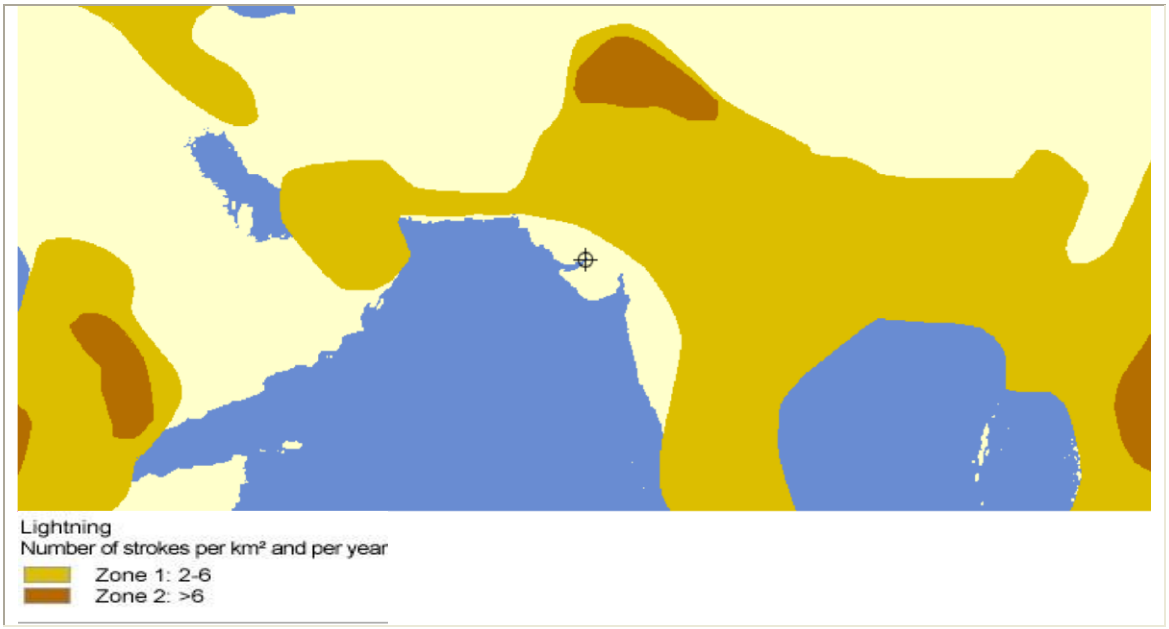
As per Munich Re World Map for Natural hazards, Gandhidham region is in Zone – I which means on an average there are 2 - 6 lightning strikes per km area per year which signifies moderate risk exposure. [2]

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 Diaster 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 TRUSTfor 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 TRUSTwas 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 & Pillot 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.

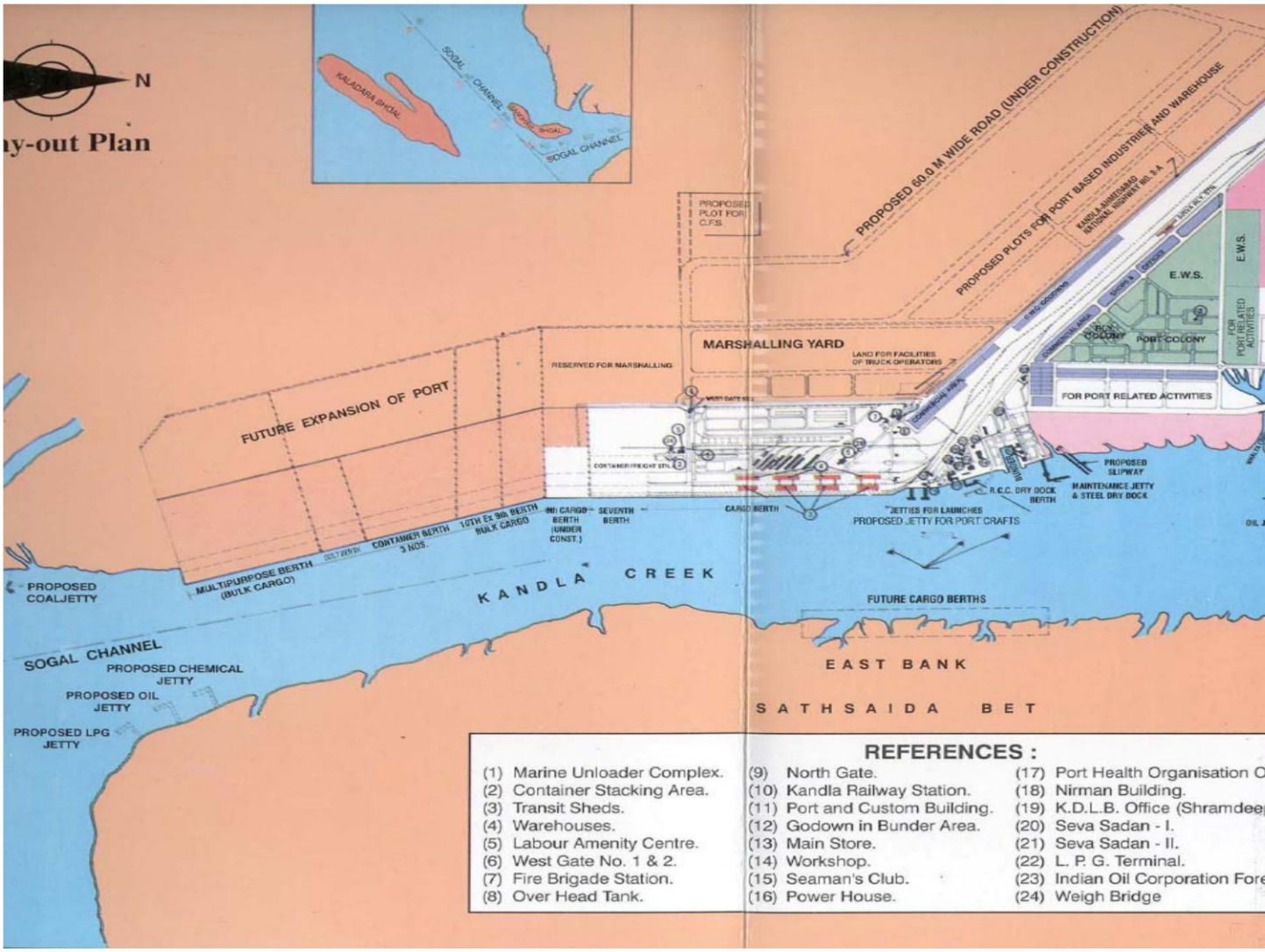
3.5 Port Location

- 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



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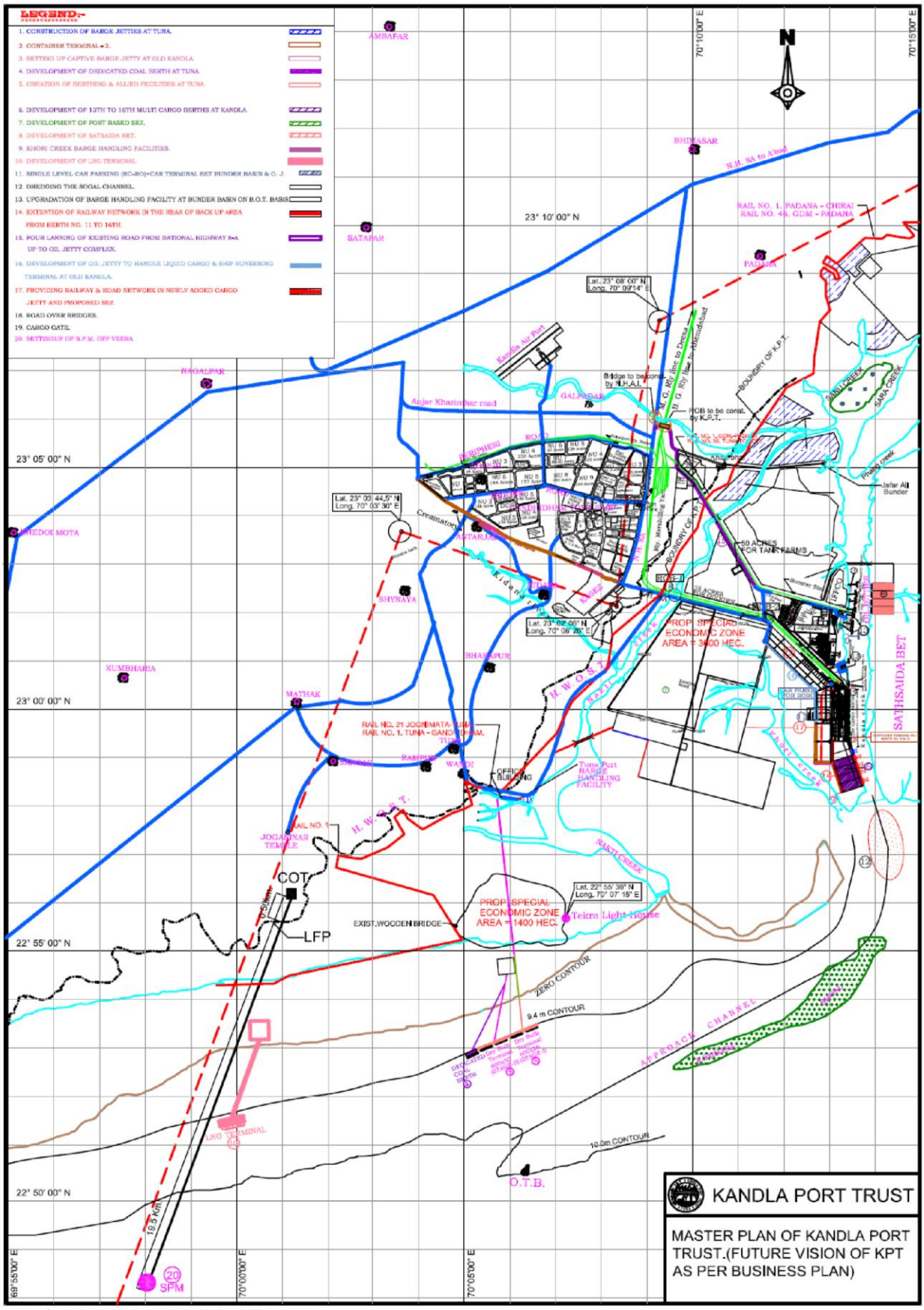
3.6 Future Vision of KPT as per Business Plan


LEGEND:-
1. CONSTRUCTION OF BARGE JETTIES AT TUNA.
2. CONTAINER TERMINAL - 2.
3. SETTING UP CAPTIVE BARGE JETTY AT OLD KANDLA.
4. DEVELOPMENT OF DEDICATED COAL BERTH AT TUNA.
5. CREATION OF BERTHING & ALLIED FECILITIES AT TUNA.
6. DEVELOPMENT OF 13TH TO 16TH MULTI CARGO BERTHS AT KANDLA.
7. DEVELOPMENT OF PORT BASED SEZ.
8. DEVELOPMENT OF SATSAIDA BET.
9. KHORI CREEK BARGE HANDLING FACILITIES.
10. DEVELOPMENT OF LNG TERMINAL.
11. SINGLE LEVEL CAR PARKING (RO-RO)+CAR TERMINAL BET BUNDER BASIN & O. J.
12. DREDGING THE SOGAL CHANNEL.
13. UPGRADATION OF BARGE HANDLING FACILITY AT BUNDER BASIN ON B.O.T. BASIS
14. EXTENTION OF RAILWAY NETWORK IN THE REAR OF BACK UP AREA FROM BERTH NO. 11 TO 16TH.
15. POUR LANNING OF EXISTING ROAD FROM NATIONAL HIGHWAY 8-A UP TO OIL JETTY COMPLEX.
16. DEVELOPMENT OF OIL JETTY TO HANDLE LIQUID CARGO & SHIP BUNKERING TERMINAL AT OLD KANDLA.
17. PROVIDING RAILWAY & ROAD NETWORK IN NEWLY ADDED CARGO JETTY AND PROPOSED SEZ.
18. ROAD OVER BRIDGES.
19. CARGO GATE.
20. SETTINGUP OF S.P.M. OFF VEERA
AMBAPAR
BHIMASAR
N.H. 8A to Ahmd
SATAPAR
PADANA
RAIL NO. 1, PADANA - CHIRAI
RAIL NO. 46, GDM - PADANA
Lat. 23° 08' 00" N
Long. 70° 09'14" E
Kandla Air Port
Bridge to be const. by N.H.A.I.
B.G. RLY. line to Deesa
B.G. RLY. line to Ahmedabad
BOUNDRY OF K.P.T.
ROB to be const. by K.P.T.
NAGALPAR
Anjar Khambhar road
GALANDAR
SAMTI CREEK
SAPA CREEK
23° 05' 00" N
Phitty creek
Jafar Ali Bunder
Lat. 23° 03' 44.5" N
Long. 70° 03' 30" E
Creamatory
MEDOI MOTA
SHIVNAYA
50 ACRES FOR TANK FARMS
PROP. SPECIAL ECONOMIC ZONE AREA = 3000 HEC.
Lat. 23° 02' 05" N
Long. 70° 08' 20" E
KUMBHARIA
BHANAPUR
23° 00' 00" N
MATHAK
SATSAIDA BET
RAIL NO. 21 JOGINIMATA - TUNA
RAIL NO. 1, TUNA - GANDHIDHAM, TUNA
RAMPAR
WAROI
OFFICE BUILDING
Tuna Port BARGE HANDLING FACILITY
JOGANINAR TEMPLE
RAIL NO. 1
COT
LFP
EXIST.WOODEN BRIDGE
PROP. SPECIAL ECONOMIC ZONE AREA = 1400 HEC.
Lat. 22° 55' 39" N
Long. 70° 07' 15" E
Tekra Light House
22° 55' 00" N
ZERO CONTOUR
9.4 m CONTOUR
APPROACH CHANNEL
LNG TERMINAL
10.0m CONTOUR
O.T.B.
22° 50' 00" N
16.5 Km
SPM
KANDLA PORT TRUST
MASTER PLAN OF KANDLA PORT TRUST.(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 Alchol)
- 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 Hexonol
- Cyclo Hexanone
- Cumene
- Di Octylphthalate
- Ethanol – IPA (Mix)
- Ethanol
- Ethyl Hexonol
- 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 Prophyl 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
- Potosh
- 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 Handlling 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

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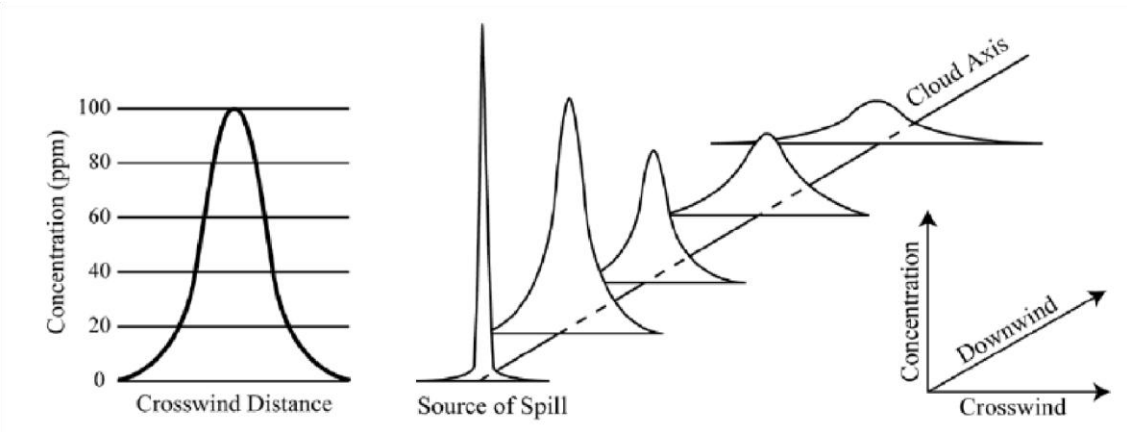
use ALOHA's default LOCs, the red zone represents the worst hazard.

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.

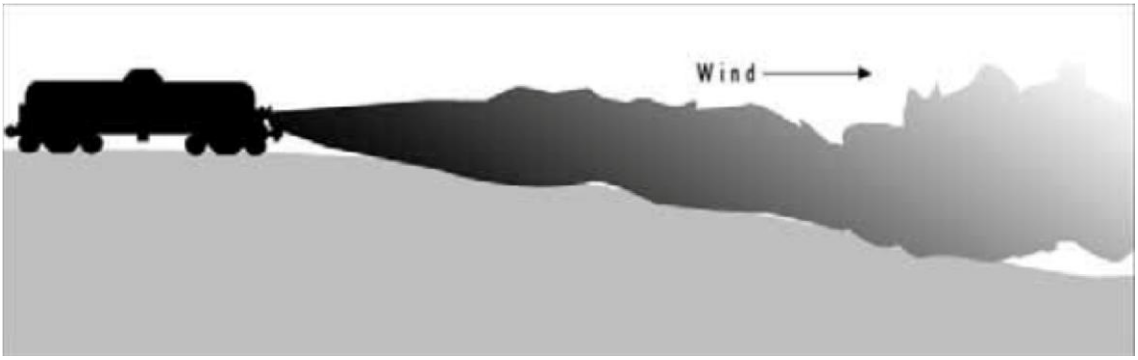
Gaussian distribution (left) & Gaussian Spread (right)



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 chemicals 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:

- Red: 10 kW/m^2 (potentially lethal within 60 sec);
- Orange: 5 kW/m^2 (second-degree burns within 60 sec); and
- Yellow: 2 kW/m^2 (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 Intensity (kW/m^2)	Time for Severe Pain (S)	Time for 2nd 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:

- Red: 8.0 psi (destruction of buildings);
- Orange: 3.5 psi (serious injury likely); and
- 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 etal. 1988, and Lees 2001).

Explosion Overpressure Damage Estimates

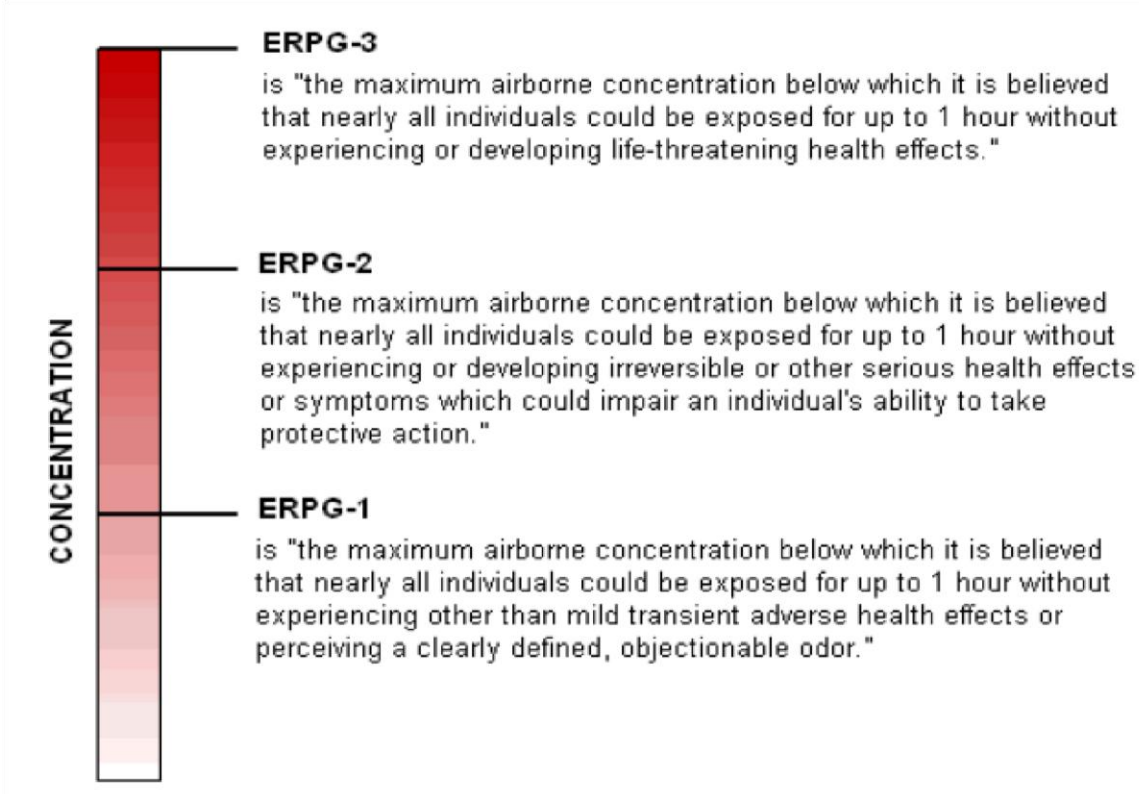
Overpressure* (psig)	Expected Damage
0.04	Loud noise (143 dB); sonic boom glass failure.
0.15	Typical pressure for glass failure.
0.40	Limited minor structural damage.
0.50-1.0	Windows usually shattered; some window frame damage.
0.70	Minor damage to house structures.
1.0	Partial demolition of houses; 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.

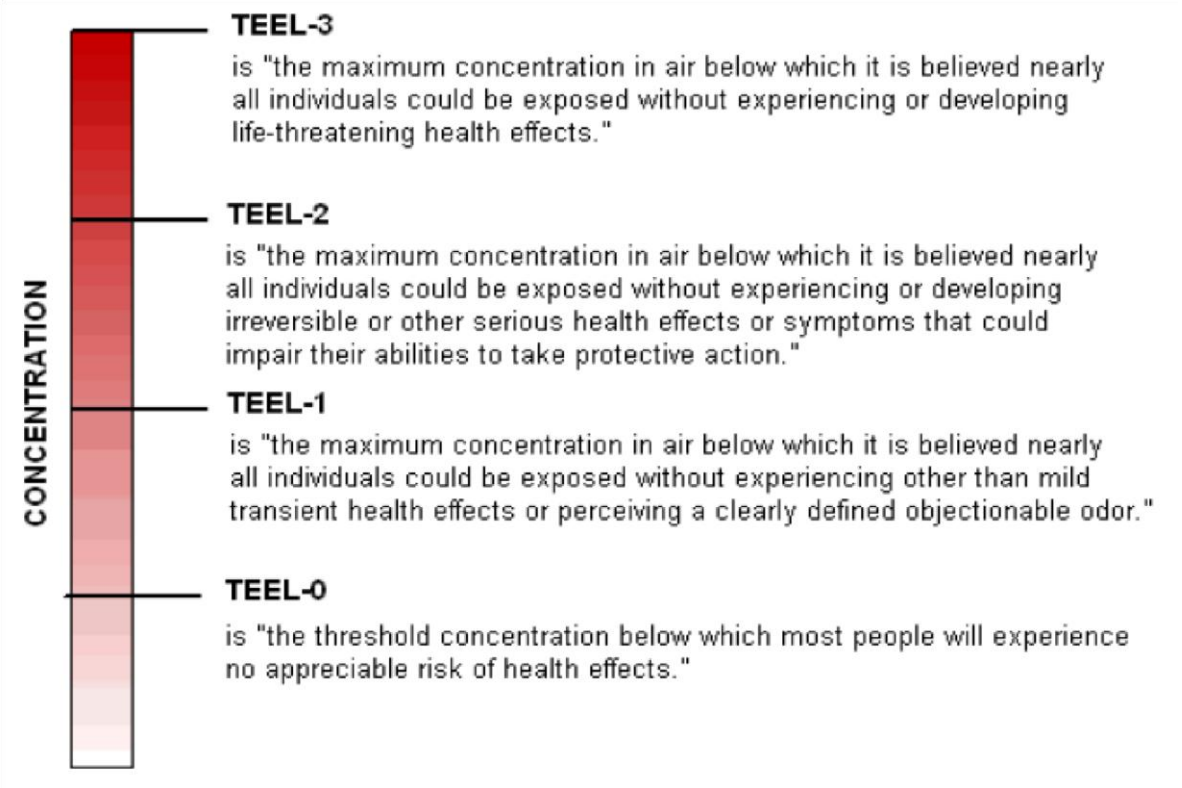
The guidelines are focused on one period of time: 1 hour. Exposure in the field may be longer or shorter. However, the ERPG committee strongly advises against trying to extrapolate ERPG values to longer periods of time.

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

- Emergency equipment should be placed more than 60 meters away from the unloading hoses / source of leak to prevent damage to them due to over pressures.
- All fire fighting operation should be carried out from a 57 meter distance from the unloading hose, unless fire suits and close proximity suits are used by the fire fighting personnel.
- Whatever is the emergency (fire) at the berth, the sprinklers / water curtain at the berth edge should be activated. • All persons not directly connected with the operation should be moved beyond 88 meters from the fire / leak
- There should be no source of ignition in the chemical jetty (1 to 6) areas.
- The complete chemical jetty complex is a flame proof zone at all times.

4.7.2 Jetty No – 1 Instantaneous Release / Ev TOLUENE

Chemical	Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
	ERPG - 3 1000 ppm	ERPG – 2 300 ppm	ERPG – 1 50 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	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
Jetty 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

Chemical		Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
		TEEL – 3 20 ppm	TEEL – 2 12 ppm	TEEL – 1 8 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 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	ERPG - 2 150 ppm	ERPG -1 50 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 Two	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 Three	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 5700 ppm	TEEL - 2 3200 ppm	TEEL - 1 200 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 Three	**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	-----	------	-----

	ACETONE (Burning Puddle)	-----	------	-----	-----	------	-----	-----	------	20	24	32

- 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.

4.7.8 METHANOL

Chemical	Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance		
	ERPG - 3 5000 ppm	ERPG - 2 1000 ppm	ERPG- 1 200 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 Three	**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	TEEL-2 10000 ppm	TEEL -1 1500 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 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)											

- 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 form 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 5000 ppm	ERPG - 2 1000 ppm	ERPG - 1 200 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 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	-----	------	-----

	VCM (Burning Puddle)	-----	------	-----	-----	------	-----	-----	------	< 10	< 10	< 10

- VCM is highly toxic, hence all persons handling the emergency involving VCM should wear full respiratory protection (BA sets) and handle the emergency from a distance of more than 48 meters.
- Nearby shanty should be put on the alert for evacuation in case emergency evacuation is needed.
- All persons handling the emergency should be sent to the Kandla Port hospital for VCM poisoning check up.

4.7.11 Jetty No – 5 Instantaneous Release / Ev AMMONIA

Chemical	Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
	AEGL - 3 1100 ppm	AEGL - 2 160 ppm	AEGL - 1 30 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 Five	**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

Chemical		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

- 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	TEEL - 2 610 ppm	TEEL - 1 610 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 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.

4.7.14 Jetty No – 6 Instantaneous Release / Evaporation Puddle / Burning Puddle for SKO

Chemical	Dispersion Distances			LEL Distances		Overpressure Distances			Pool Fire Heat Radiation Distance For		
	TEEL – 3 1250 ppm	TEEL – 2 1000 ppm	TEEL - 1 600 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 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.

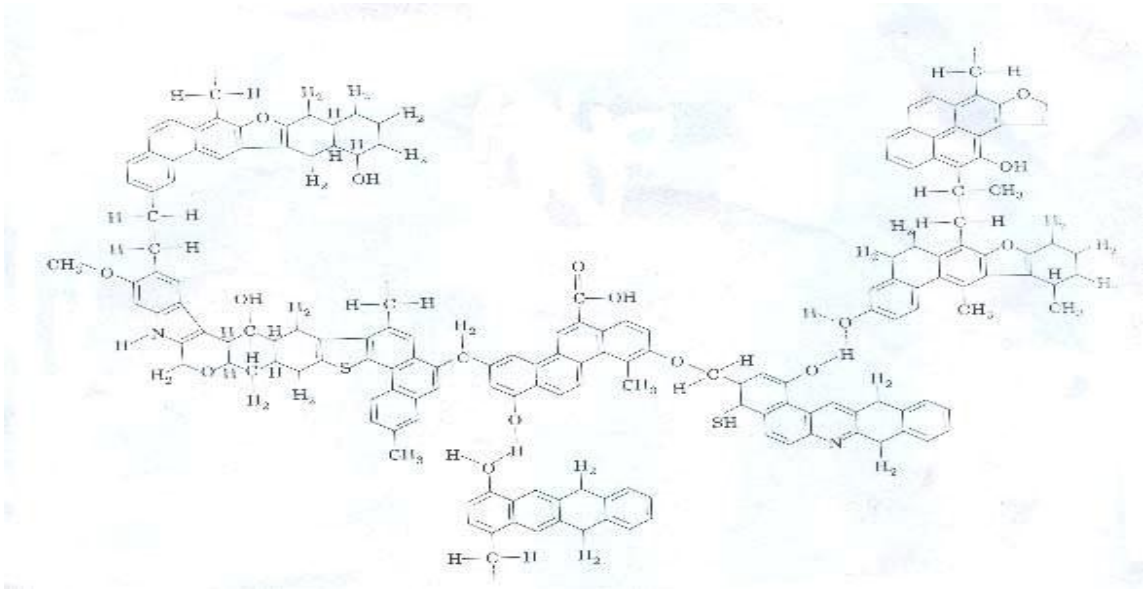
4.8 Coal Storage at Open Yard

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 of 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 of 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

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

- Storing coal with low sulphur content is helpful. Sulphur compounds in coal liberate considerable heat as they oxidize.

- Air circulating within a coal pile should be restricted as it contributes to heating; compacting helps seal air out.

- 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.

- 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 if 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 O_2 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	=	5.6×10^{-8} KW/m^{2}K^4

$FQ\ 4\Pi K$ 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 Tf = 900DegC = 1173K

Ambient surrounding temperature Ta= 27DegC to 35DegC = 300K – 308K

$Q = \sigma A \varepsilon (T f^4 - T_a^4)$

σ = 5.68 x 10 -8 kW/m2K4

$T f^4 = (1173)^4$ K

T_a^4 = $(300)^4$ K

For active coal burning area = $10m^2$

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

Q = 950 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 = 1.7m

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 m

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

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

For active coal burning area – 100 m^2

Q = 5.6 x 10-8 x 0.9 x 100 ($1173^4 - 300^4$)

= 9500 kW/m2

For Heat radiation 4 kW/m2 impact distance D

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

For Heat radiation 12.5 KW/m2 impact distance D

D = $\sqrt{(9500\times0.15)/(4\times3.14\times12.5)}$ = 3.012 m

For Heat radiations 37.5 KW/m2 impact distance D

D = $\sqrt{(9500\times0.15)/(4\times3.14\times37.5)}$ = 1.74 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

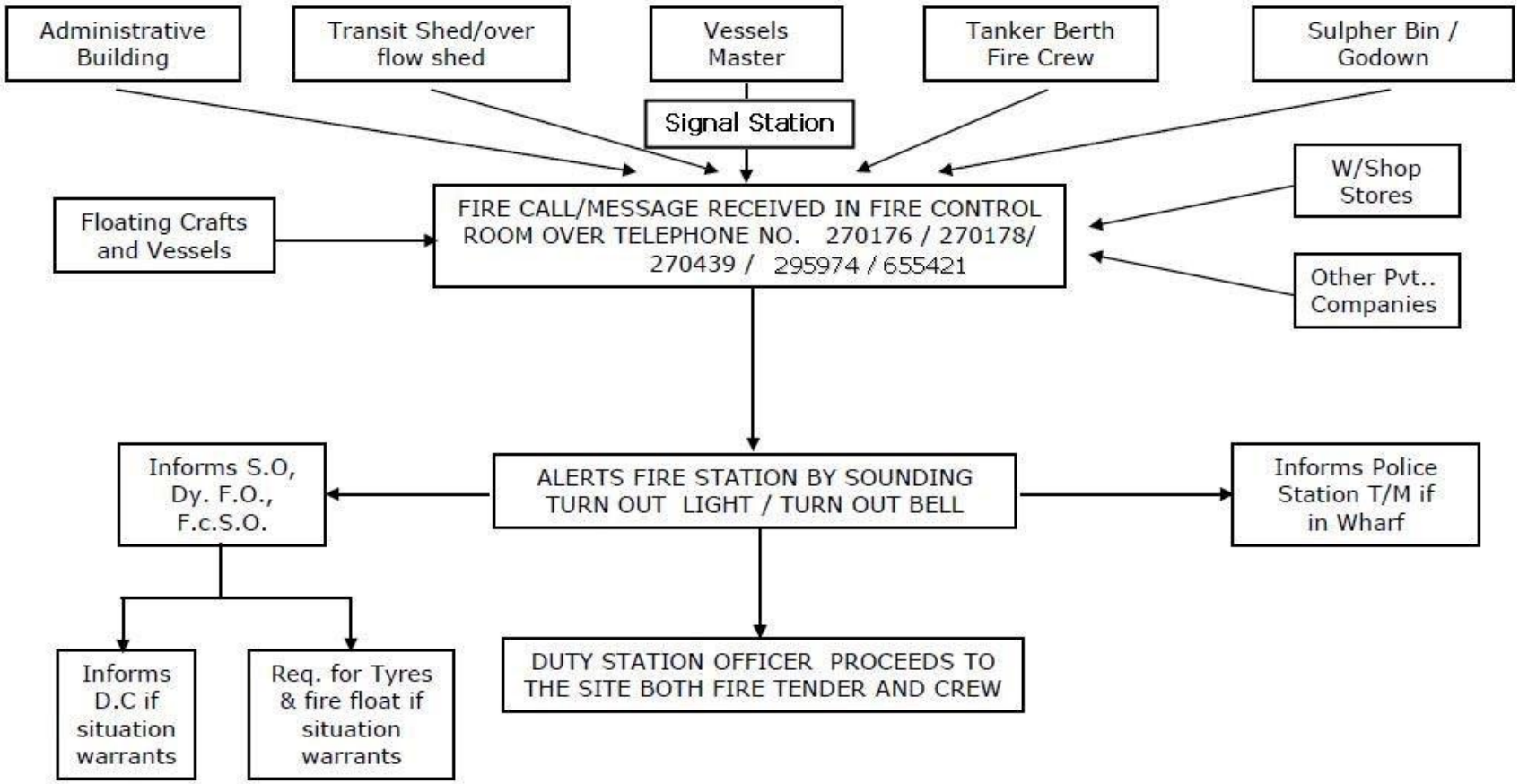
37.5 kW/m^2	0.5 m	1.74 m

Assuming that 100m^2 surface area of the coal stack is smouldering no person should approach the stock within 6 m distance.

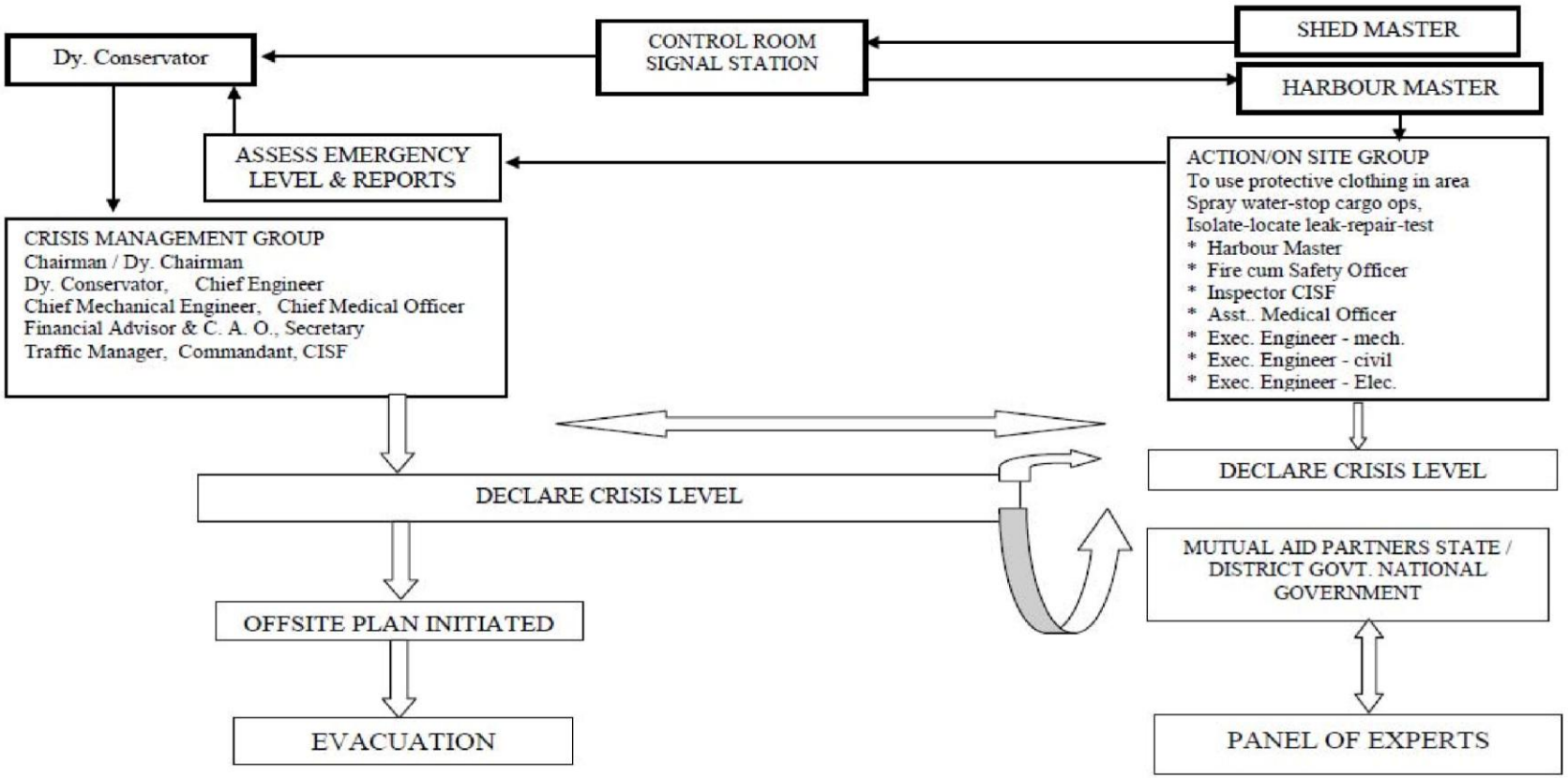
All fire fighting should be done from more than 5.3 m away from the affected coal stack unless the fire fighter is fully clothed with fire protective clothing and respiratory protection

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) Informs 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/cm^2 & 300 liters at 40kg/cm^2).

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/cm^2 & 300 liters at 3.5kg/cm^2).

Foam Tank Capacity: 1000 liters.

Fire Monitor Discharge capacity 2750 lpm at 7kg/cm^2 with effective throw/Jet of minimum 45 meters.

Additional CO_2 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/cm^2 & 300 liters at 3.5kg/cm^2).

Foam Tank Capacity: 1000 liters.

Fire Monitor Discharge capacity 2750 lpm at 7kg/cm^2 with effective throw /Jet of minimum 45 meters.

Additional CO_2 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/cm^2.

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 800m^3/hr capacity, two jockey pumps of 25m^3/hr capacity, two foam pumps each of 22m^3/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 500m^3/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 270m^3/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 820m^3/hour each.
- 1 – HP Jockey pump electrical 80m^3/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
- CO_2 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 2kw/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 TRUSTcarried 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 pressur e		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/m^2. 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 m^2 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 PHenol

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 m^2. 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

Comments:

1. A toxic ammonia cloud of IDLH concentration (500 ppm would disperse upto 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 me ters	
		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 mete rs	
	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/m2	37.5 kW/m2
1.	Naphtha	Dyke fire	3	205	71	31
2.	Naphtha	Tank Roof	3	188	65	29

		Fire				

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

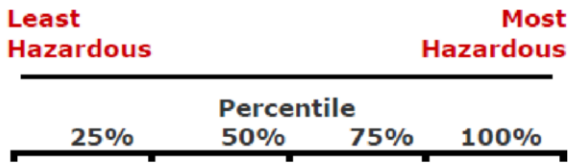
6 TOXIC HAZARD RANKING FOR HAZARDOUS CHEMICALS HANDLED AT PORT PREMISES

6.1 Hazard Ranking

6.1.1 Propane

CHEMICAL PROFILES|**Hazard Rankings**

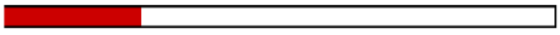
Chemical: PROPANE
CAS Number: 74-98-6



Human Health Rankings
Toxicity and exposure potential
Worker Exposure Hazard Score (IRCH)

Ecological Health Rankings
Toxicity and persistence
Environmental Hazard Value Score (IRCH)

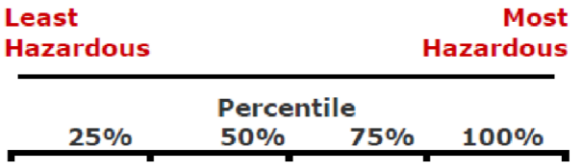
Integrated Environmental Rankings
Combined human and ecological scores
Total Hazard Value Score (IRCH)



6.1.2 Butane

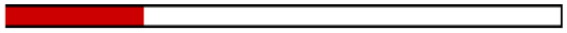
CHEMICAL PROFILES|**Hazard Rankings**

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)

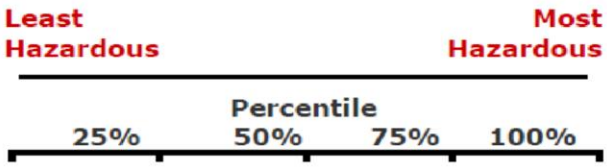


Integrated Environmental Rankings
Combined human and ecological scores
Total Hazard Value Score (IRCH)

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

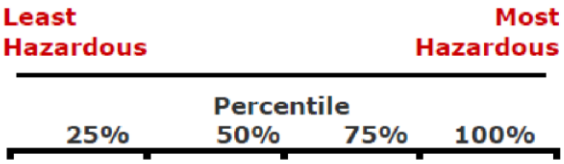
Combined human and ecological scores

- 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
- 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)

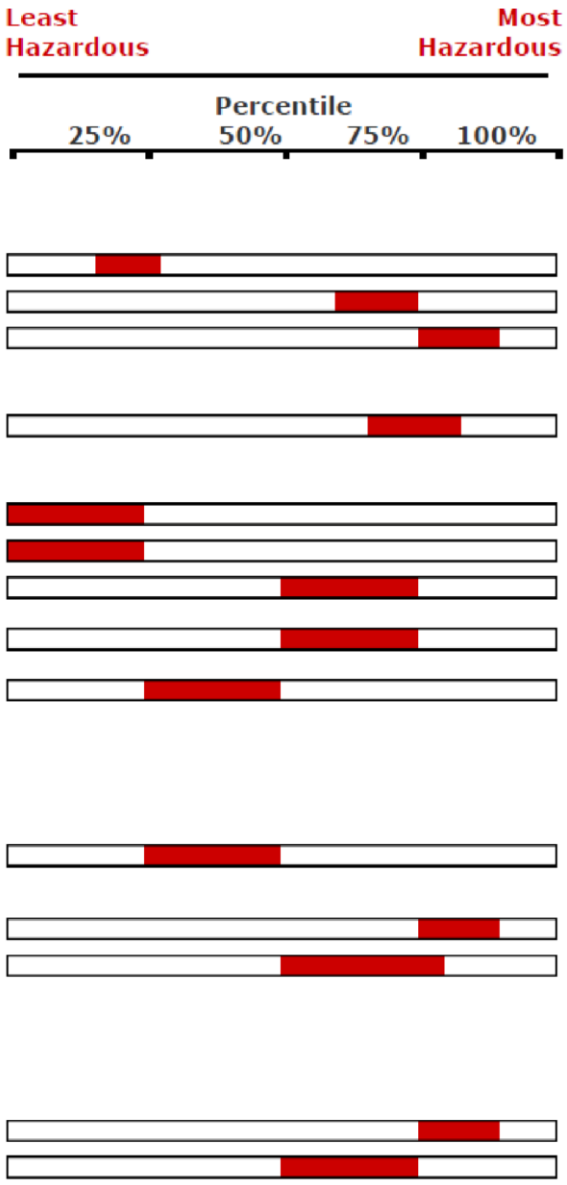
Integrated Environmental Rankings

Combined human and ecological scores
- Total Hazard Value Score (IRCH)
- Total Hazard Value Score (UTN)

6.1.5 Aniline

CHEMICAL PROFILES|Hazard Rankings

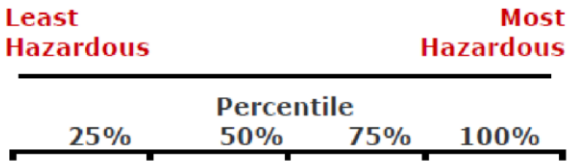
Chemical: ANILINE
CAS Number: 62-53-3



6.1.6 Benzene

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)

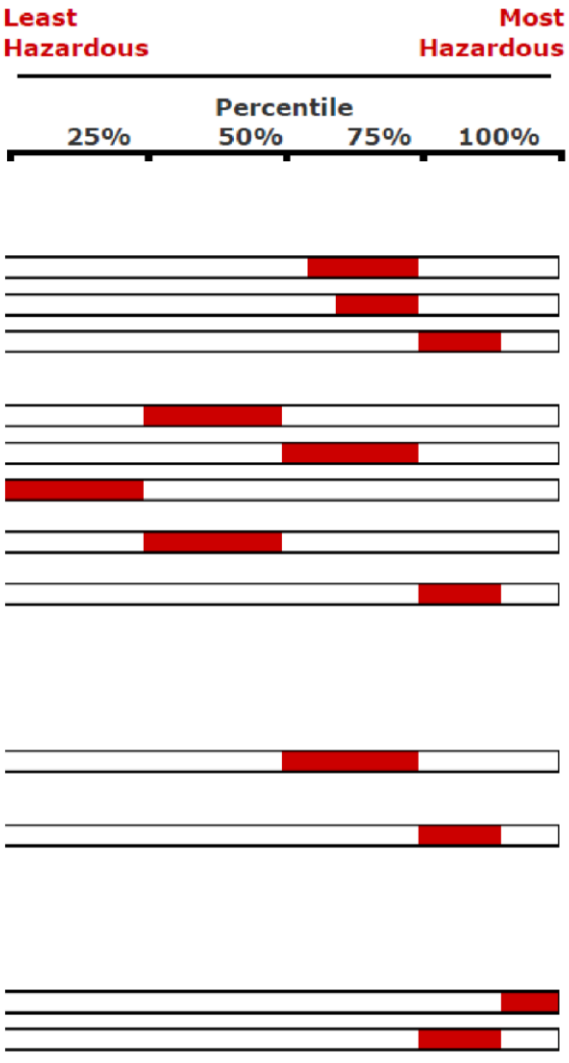
Integrated Environmental Rankings

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**

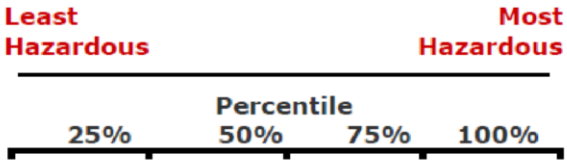
Chemical: 1,3-BUTADIENE
CAS Number: 106-99-0



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)

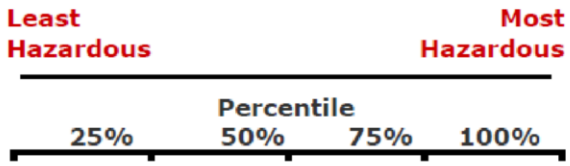
Integrated Environmental Rankings

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
- 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)

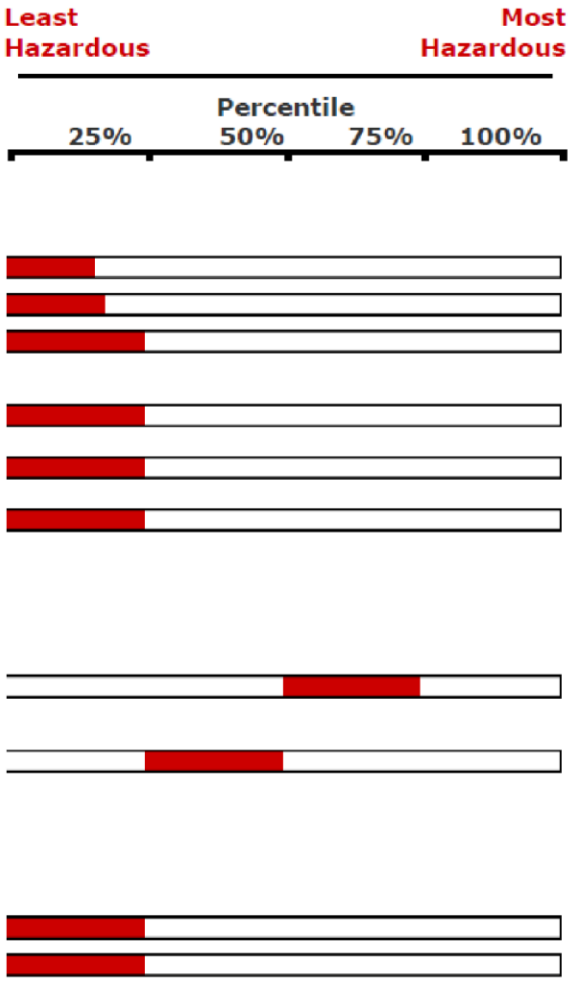
Integrated Environmental Rankings

Combined human and ecological scores
- Total Hazard Value Score (IRCH)
- Total Hazard Value Score (UTN)

6.1.10 Propylene

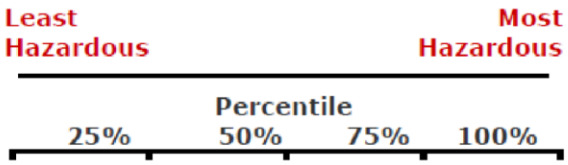
CHEMICAL PROFILES|**Hazard Rankings**

Chemical: PROPYLENE
CAS Number: 115-07-1



6.1.11 Vinyl Chloride

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)

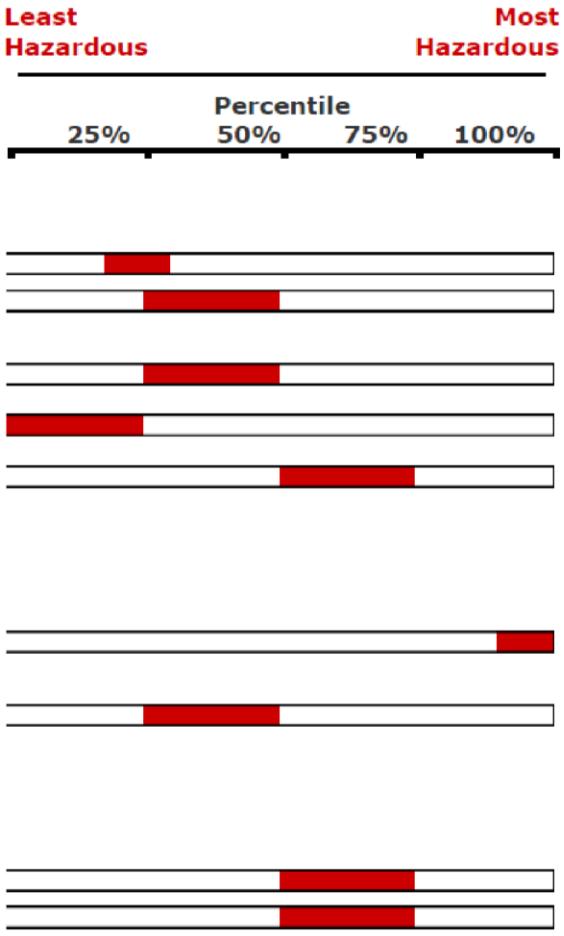
Integrated Environmental Rankings

Combined human and ecological scores
- Total Hazard Value Score (IRCH)
- Total Hazard Value Score (UTN)

6.1.12 Ammonia

CHEMICAL PROFILES|**Hazard Rankings**

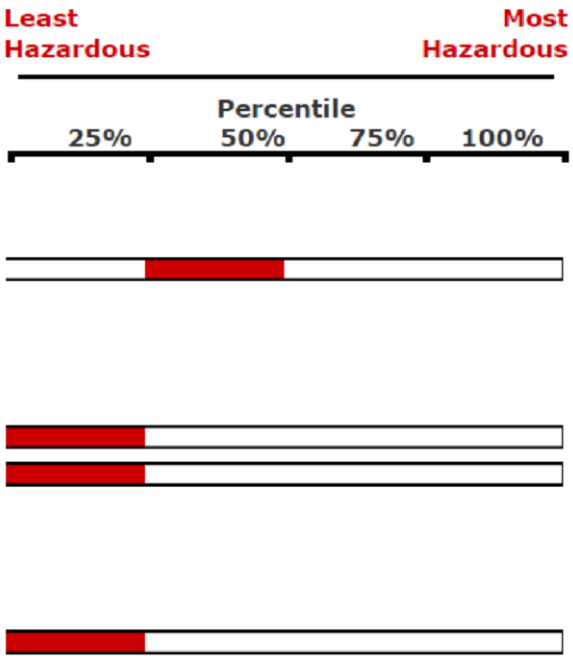
Chemical: AMMONIA
CAS Number: 7664-41-7



6.1.13 Ethanol

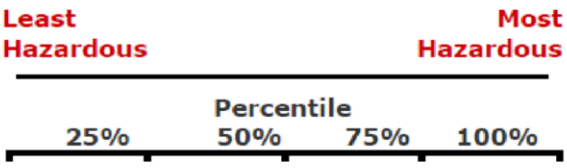
CHEMICAL PROFILES|**Hazard Rankings**

Chemical: ETHANOL
CAS Number: 64-17-5



6.1.14 Phenol

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)

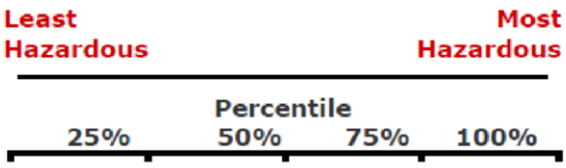
Integrated Environmental Rankings

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

- 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)

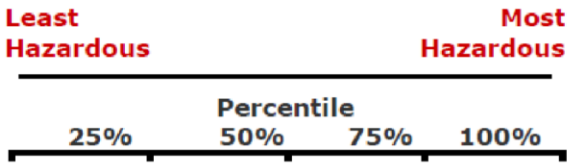
Integrated Environmental Rankings

Combined human and ecological scores

- Total Hazard Value Score (IRCH)
- Total Hazard Value Score (UTN)

6.1.16 Vinyl Acetate

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)

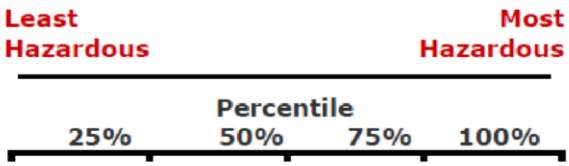
Integrated Environmental Rankings

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)

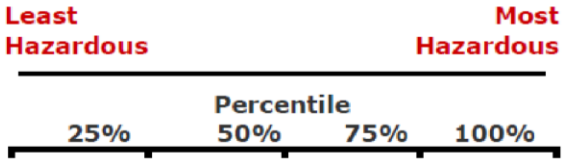
Ecological Health Rankings
Toxicity and persistence
Environmental Hazard Value Score (IRCH)

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)

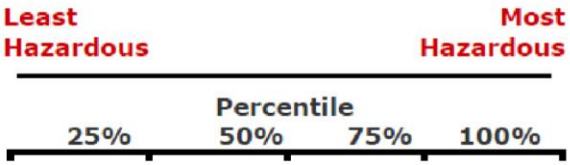
Ecological Health Rankings
Toxicity and persistence
Environmental Hazard Value Score (IRCH)

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

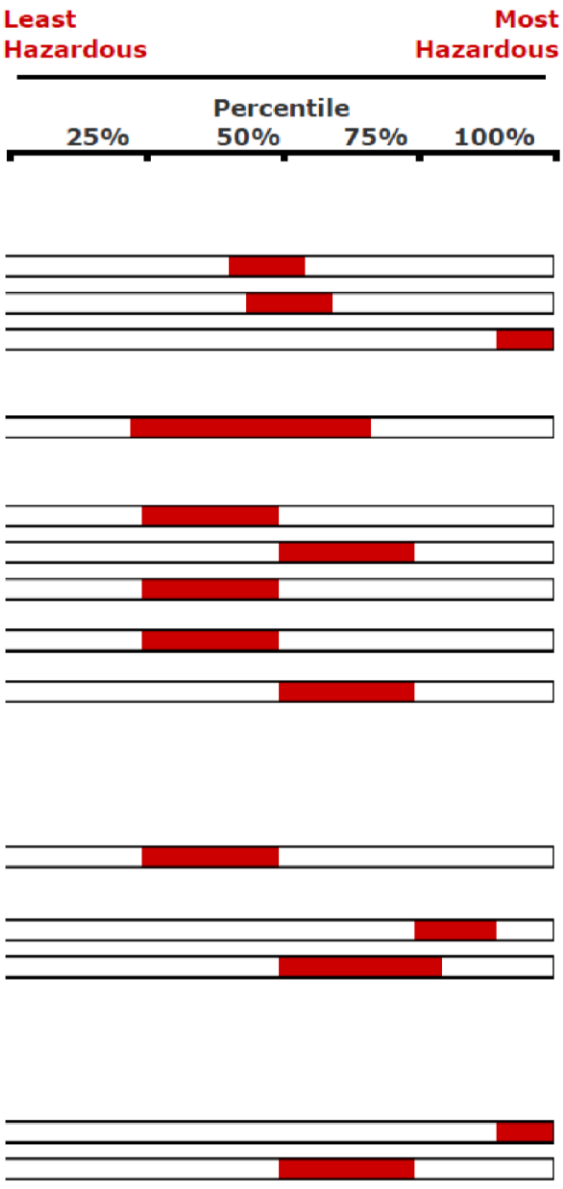


Ecological Health Rankings
Toxicity and persistence
Ecological Risk Screening Score (WMPT)

6.1.20 Ethyl Di Chloride (EDC)

CHEMICAL PROFILES|**Hazard Rankings**

Chemical: 1,2-DICHLOROETHANE
CAS Number: 107-06-2



Reference: http://www.scorecard.org/chemical-profiles/hazard-indicators

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

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 appraised 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	
Aerodrame Officer, Kandla		238370	223247
Indian Navy, Jamnagar		550263 to 5	550825
Airforce, Jamnagar		550245 to 7	550247

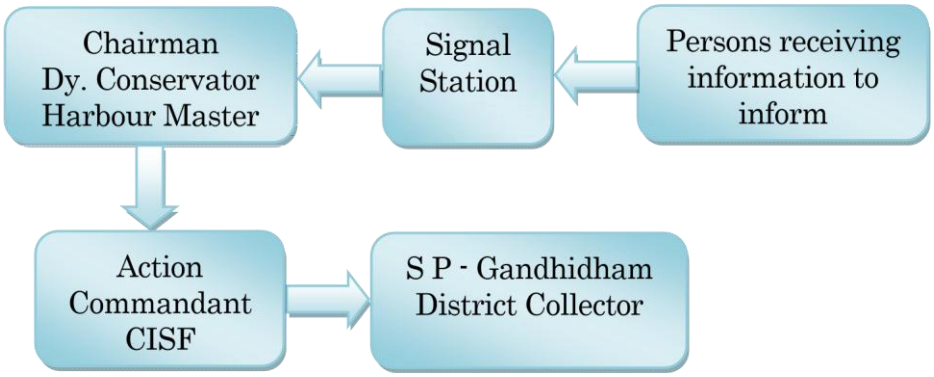
S. No	Designation	Present incumbent	Contact Telephone Numbers

			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.

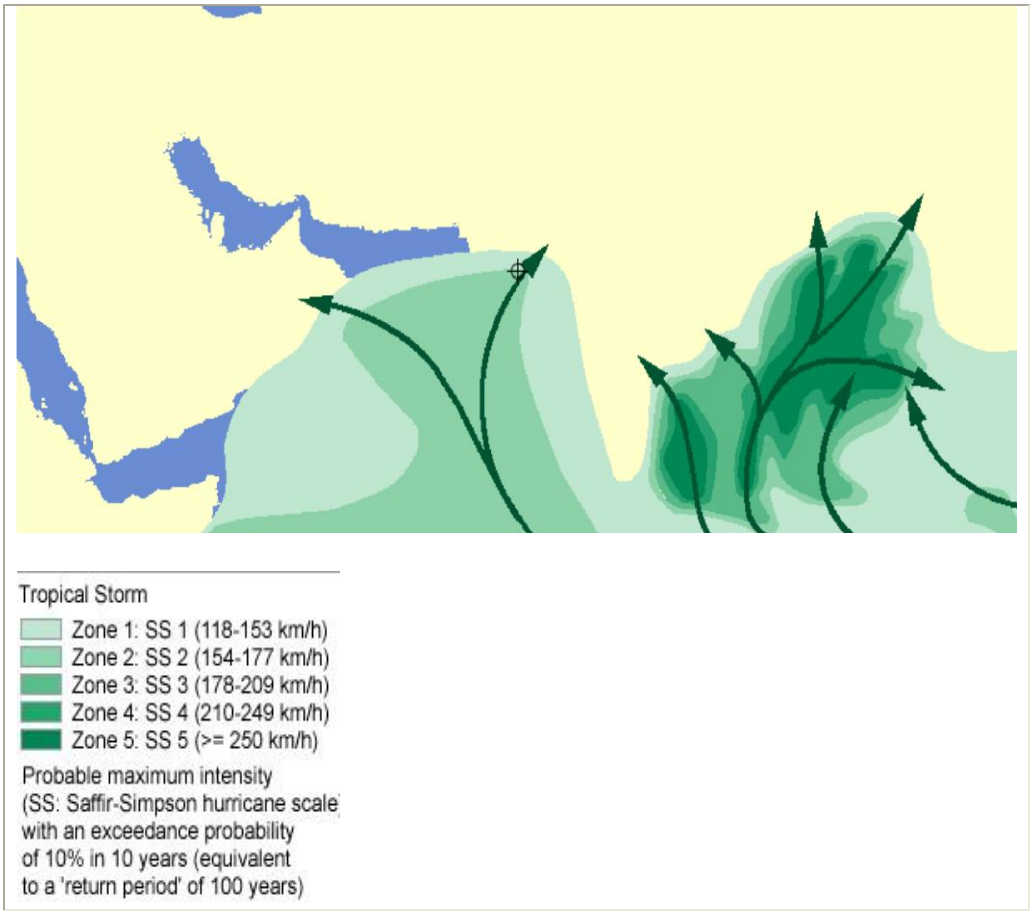
9 9 SEVERE WEATHER SITUATION

9.1 Act of God Perils (Cyclones Tsunami

9.1.1 Storms / Cyclone

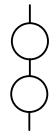
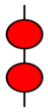
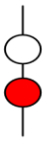
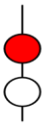
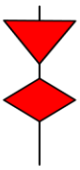
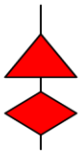
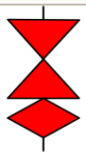
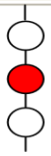
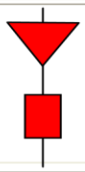
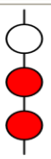
Even though Kandla is within the cyclone area of storms originating in the Arabian Sea and those that enter across the Indian Peninsula from the Bay of Bengal, cyclones are not as severe or frequent as in the Bay of Bengal. Historically, there has been major cyclone in the region in the year 1998.

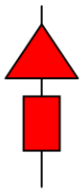
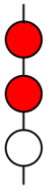
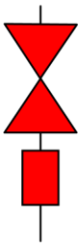
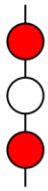
Hence the exposure to this peril is High.

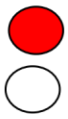


9.1.1.1

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 communicat ion	Failure of Communication with Meteorological head quarters has broken down and the local officer considers that there is danger of bad weather.



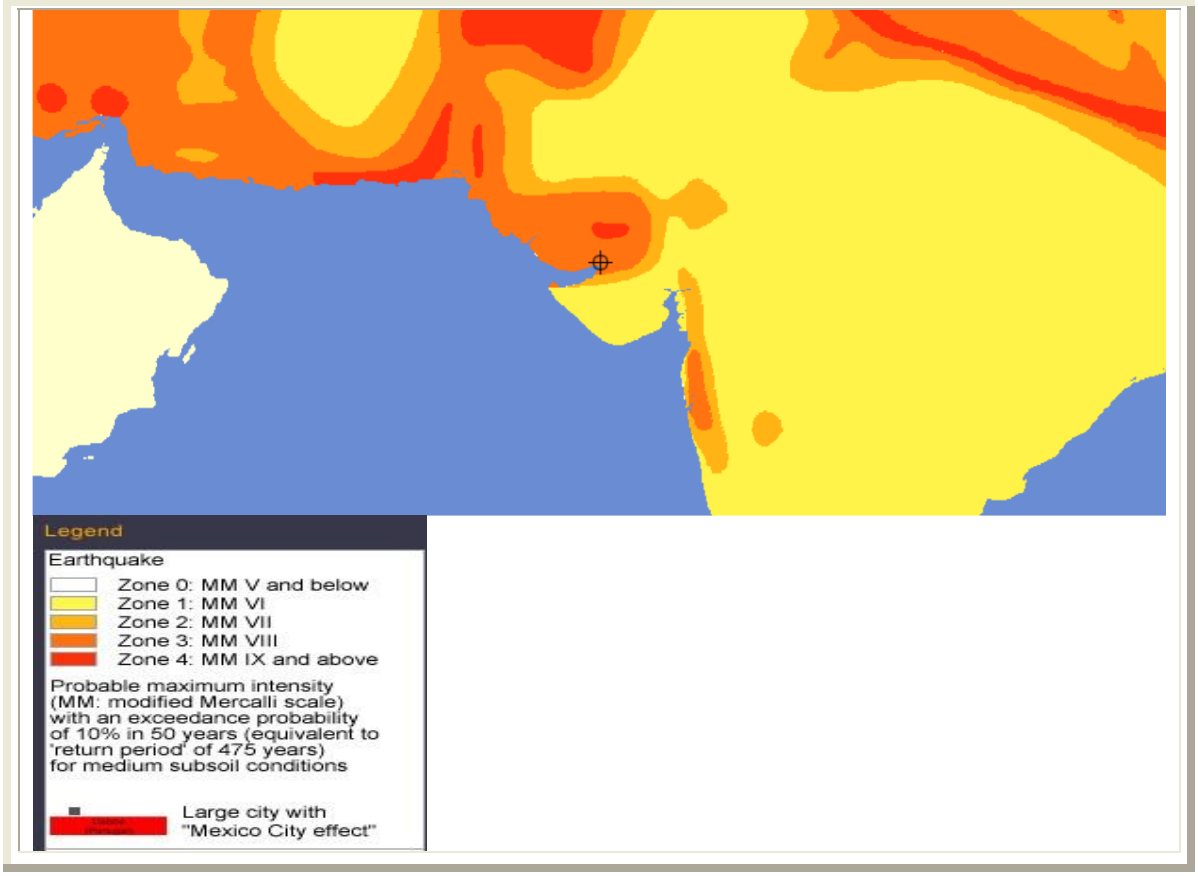
Red Light,

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.

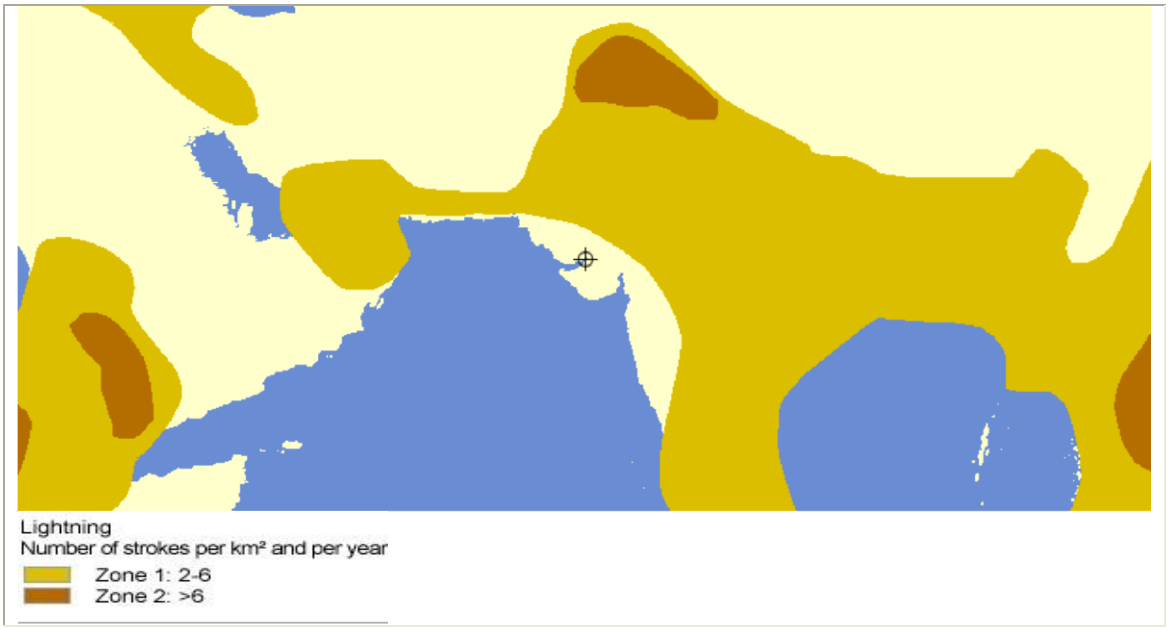
Thus taking the dynamic seismic scenario in to consideration risk exposure can be considered as High.



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]

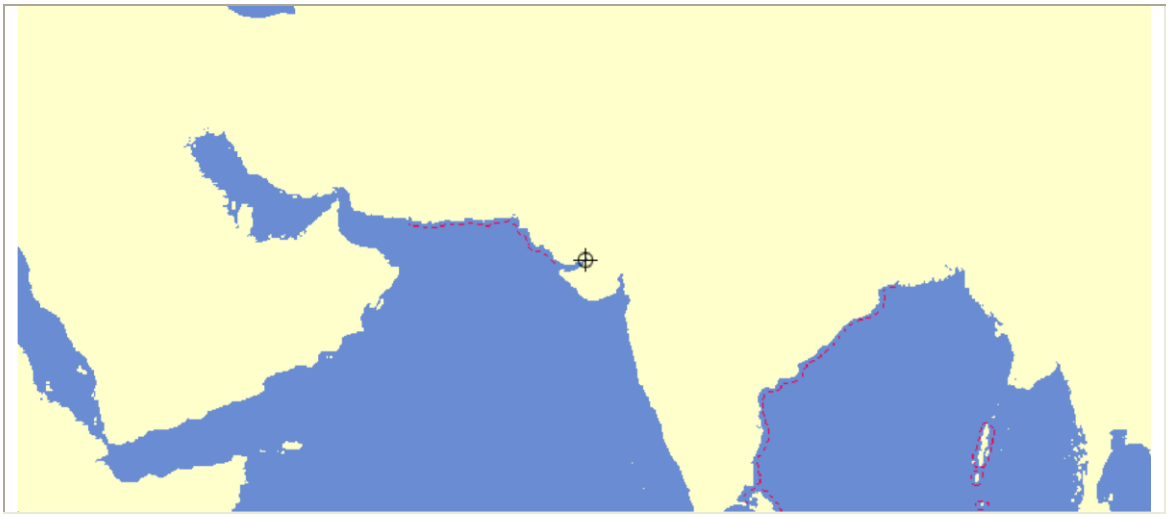
Thus risk exposure can be considered as moderate.



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 atSignal 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 roaster 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	Messanger	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	

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 VIPs

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 Ghandidham,	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, B Gandhidham		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. Brahmbhatt, 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.

9.13.1 Leave for Class 1 Class II Officers

All Class-I & Class-II Officers, the Technical Staff, the essential staff and other persons assigned with specific functions under this plan who wants 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 TRUSTon 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 TRUSTin early 1950s and were allotted to some persons who were engaged in Port related activities in those days.

DEENDAYAL PORT TRUSThas 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 NDDB 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 been 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. Bhuveneshwari 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	220212/238112 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. Dayalbha Chaturani, Mb:9825064245	221048 256713 220586 256706 Fax: 222930	-
27	Shri Rashmin A.Pandya DBZ-N-21/A, Gandhidham	Mr. Jagdis 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 Chaganla Punamchand, DBZ-N-197, Gandhidham	Mr. Chaganlal	220545	-

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	Indian Oil Corporation Ltd., Main Terminal, GIM Foreshore Terminal, Kandla KBPL LPG Import Plant	Mr. AK. Khanna Sr. Term. Manager Mr. KS Rao, Sr.TM Mr. PS Negi Plant Manager	233274 (O) 229002 (R) 270394 (O) 270628 (O) 270477 (O) 233359 ® 270978 (O) 236944	9427216637 9426416108 9426725342
8	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
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

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 Carrier Handling & Transport	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 Compex, 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			

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. Chakraborthy	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 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 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 TRUSTand (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, 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, 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, Ist 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 Laxman 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

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-SafetyOfficer 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)

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-SafetyOfficer, 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. CO_2 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 PrincipalOfficer, 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-SafetyOfficer 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 sleek 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 sleek and under his guidance all available port crafts can spray chemical dispersant. They can go up & down and try to stop/minimize the oil sleek 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 he 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 fro-eventual disposal ashore. If the oil sleek 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.

STRENGTHNING 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/Biol Ogical/RADIO ACTIVVE 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/Su pply	Chief Mechanical Engineer and Executive Engineer (Electrical) through Gujarat Electricity Board Authority.	

An Oil Installation	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,

10 PRESS MANAGEMENT

A Cell shall be created and headed by TP&PRO. The following staff member shall remain in the Press Cell.

(1) Dy. Secretary. (P) (2) PRA (3) Sr. Clerk (BDC) (4) Photographer

The Press Room shall come into operation immediately in the chamber of BDC. The Press Cell shall issue Daily Bulletin at 2:00pm and 07:00pm every day. The photographer should collect photos and develop every day, which will depict the situation as well as the work done by the Officers. P.R.A will accompany the photographer and bring the photos to the Cell every evening. He shall also bring daily Paper cuttings of reports. All Media people, Press, Journalists, etc. shall be attended to by the Dy. Secretary (P).

BDC Section will hire videographers and keep them standby for videography. They will accompany Chairman and Dy. Chairman also. One videographer will be placed at Kandla and another at Gandhidham. Similarly, BDC section will also ensure to keep one additional photographer at Kandla for taking photographs and these people should be hired as soon as Signal No. 5 is hoisted.

Secretary will be the overall In-charge of Liaison work with the Central / State Government officials / IMD, Ahmadabad / Pune Laboratory / Delhi Laboratory in which he can take the help of Dy. Secretary (P), Assistant Secretary (P) and report the matter to Chairman / Dy. Chairman immediately. They shall remain present in all the meetings relating to the Action Plan and report the proceedings of the Meeting to the Chairman/Dy. Chairman. They shall also communicate the action to be taken to the concerned Head of Departments. List of IMD Telephone is given below:

10.1 Important Telephone Numbers of Indian Meteorological Department Ahmedabad

Director Incharge,
Meteorological Centre,
RS/RW building
Airport colony
Ahmedabad, - 382745

Phone - Weather enquiry : (i) Interactive voice response system : 1800 180 1717

(ii) Duty Officer (AMO) : 22861413

Director I/C : 22865165

Meteorologist : 22865012 , Fax : 22865449

E-Mail : (i) Dr. Jayanta Sarkar:- j.sarkar@imd.gov.in

(ii) Mrs. Manorama Mohanty:- m.mohanty@imd.gov.in

Websites - www.imd.gov.in http://www.imdahm.gov.in/index.html

11 DEPARTMENT WISE ACTION PLAN

11.1 General Administration Department

The overall in charge for setting up control room at Gandhidham will be the Secretary. He shall ensure setting up the control room at AO Building within two hours of warning and the matter reported to the Chairman/Dy. Chairman. Two telephones should be kept in the control room, one for receiving and the other for outward calls. Tel. No. 238055 will be used for incoming calls and 239055 for outgoing calls.

Labour Officer (Mr. Pradhan), and the Head Masters of BVM School shall reach and open the schools/community hall etc, and keep them ready for accommodating the shifted people.

The OSD (Estate), Land Section and, Asstt. Estate Manager should ring up major salt leaseholders and advising them to evacuate their labourers and report the action to the Chairman within two hours. Action taken should be confirmed in writing thereafter, Dy. Secretary (G) will guide them and will do the overall supervision of this job.

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

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 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

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. Suryawanshi 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 THROGH 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

,

Mr. Sunil Kumar	Flotilla Supdt.	270280	226121		7874627756

2. Signal Station270549/270194/9825227246 Fax 270624

3. Fire Station270176/270178/270439/550421/271244/271377

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 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.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	

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

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

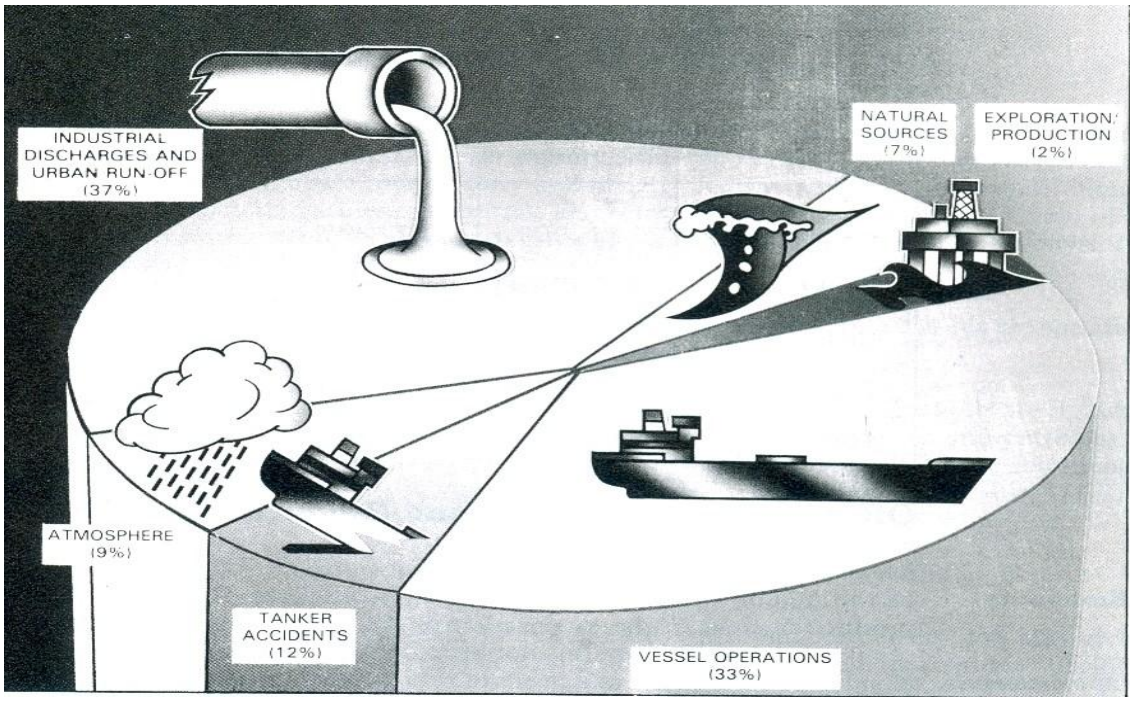
Periodical Meetings will be conducted with the Executive Engineer's/ DSOs/Staff Member to assess the progress made during the day and to instruct further course of action in the matter.

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 worlds 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, 00,000 tones 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 tones 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 tones given in the table below. In fact, a few large accidents give rise to the majority of the oil spilt 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%)

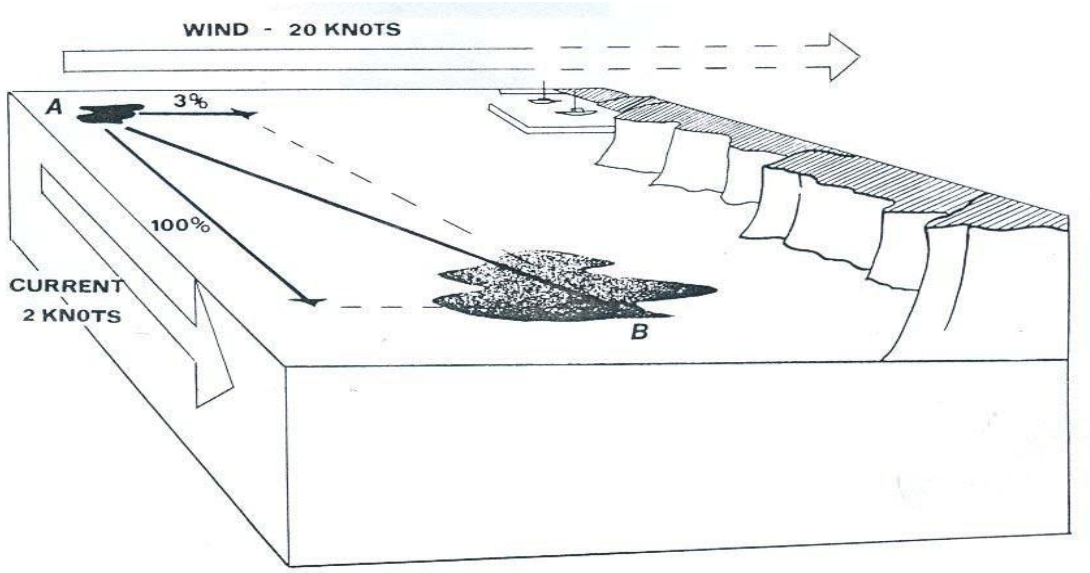
12.2 Forecasting Slick Movement

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.

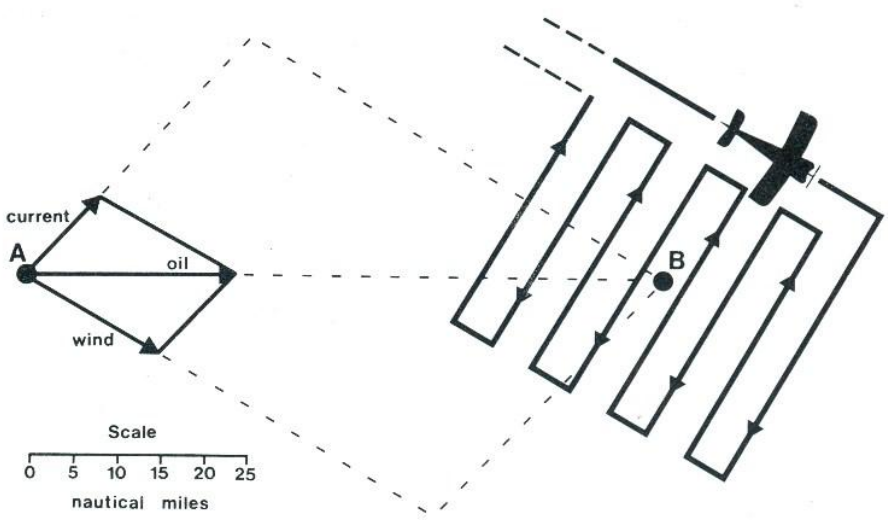
12.3 Aerial Surveillance at Sea

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

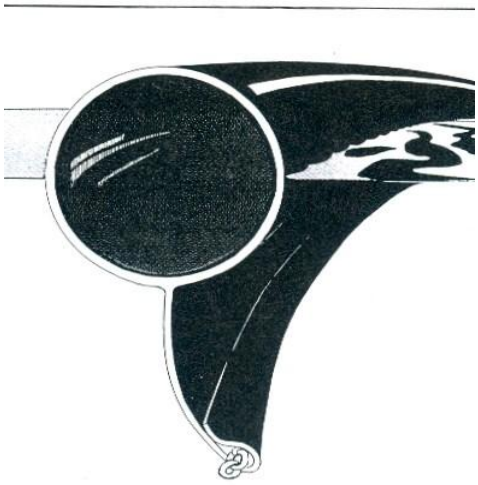
Designs vary considerably but all normally incorporate the following features:

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:

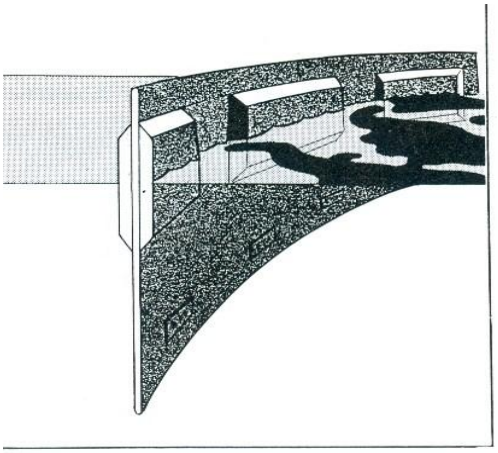
12.7.1 Curtain Booms

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.



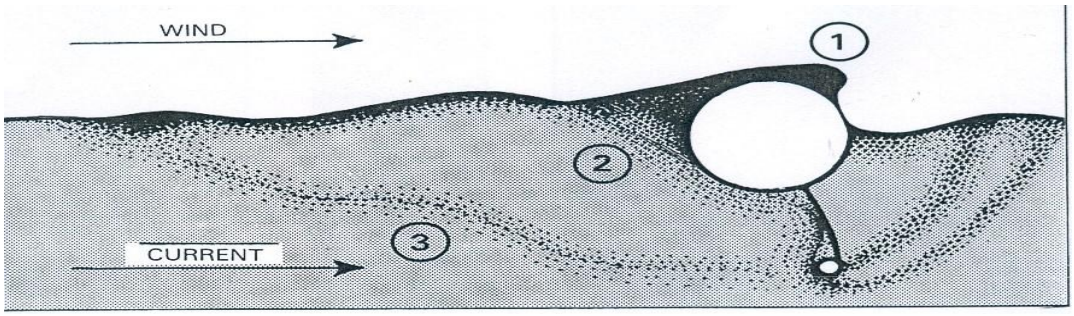
12.7.2.1 Common features

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 inexpert 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

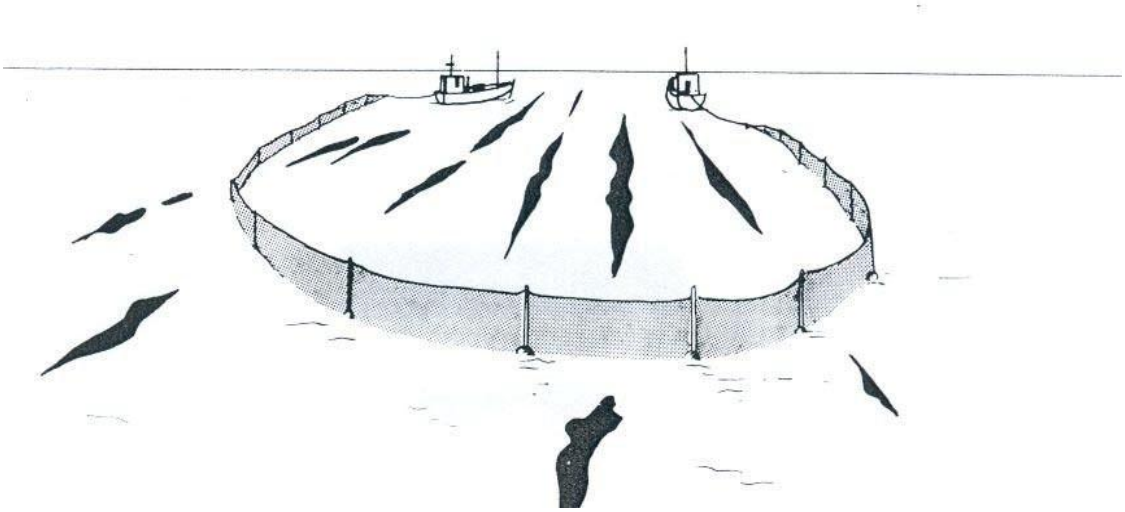
The use of nets to recover solid tar balls is an obvious application and the extension of their use to contain viscous oils theoretically presents a number of advantages over the use of conventional booms. In particular, the open structure should offer less resistance to water movement so that light 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

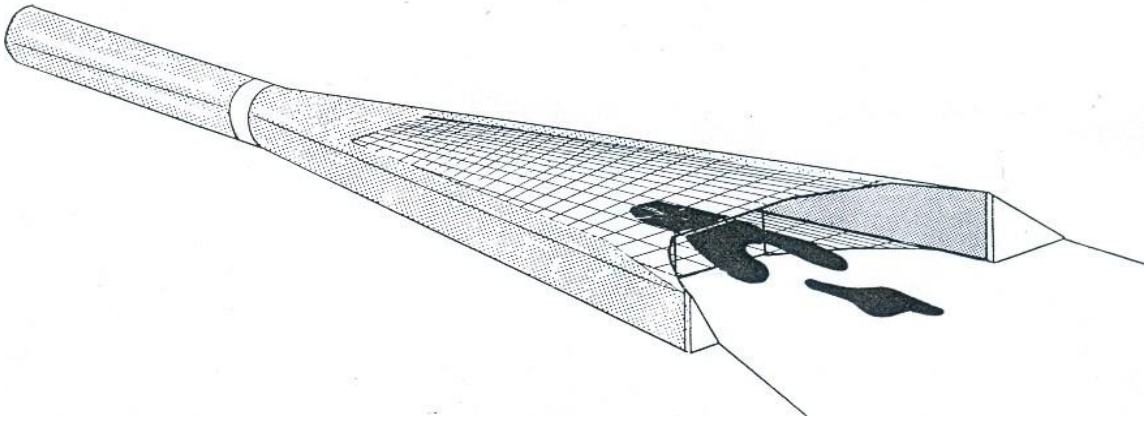
Two basic designs of net have so far been developed which draw on experience from the fishing industry a long double net based on the purse seine method of fishing which can be used to corral or collect floating oil or which can be moored to protect sensitive areas; and a trawl net with a detachable '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.

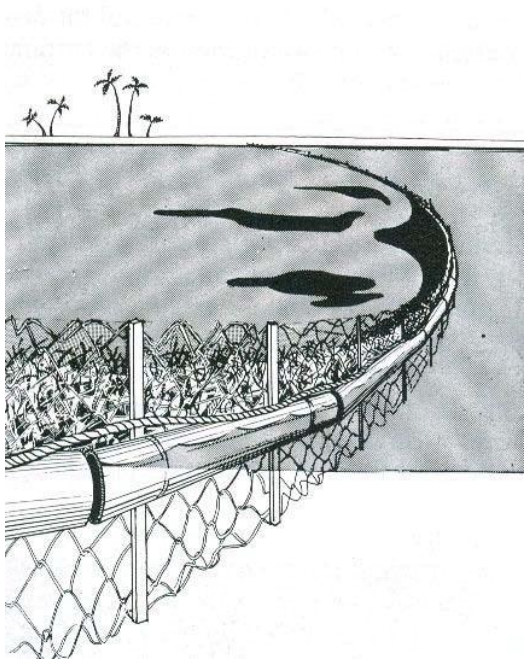


Oil trawl for collecting floating solid oil into a detachable cod-end.

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.



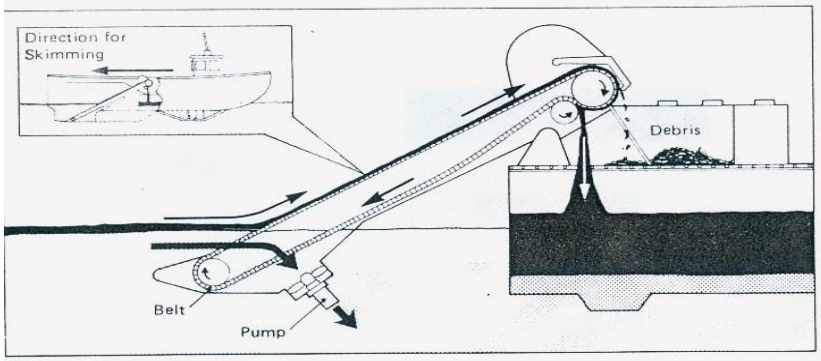
Fixed oil barrier constructed with straw bales and wire netting nailed to wooden stakes.

12.9.1.1 Recovery

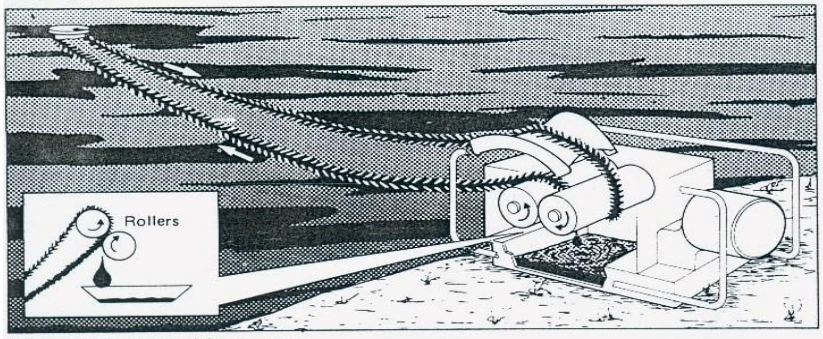
The rapid recovery of contained oil is vital to prevent its escape and the contamination of other areas. Recovery can be achieved using skimmers, pumps, sorbents, manual techniques and non-specialized mechanical equipment, such as vacuum trucks.

12.10 Skimmers

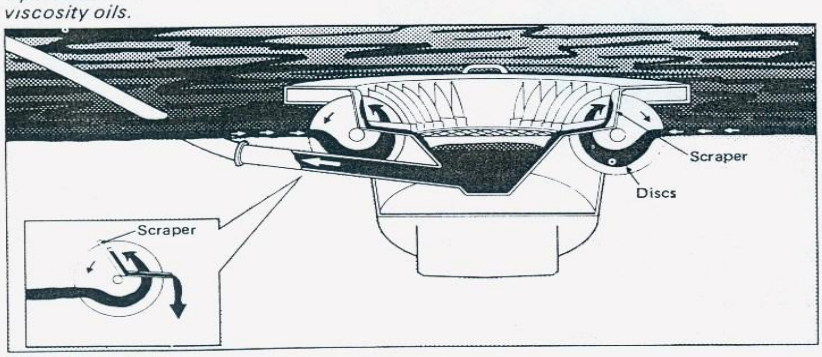
ADHESION DEVICES



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. Conversely, 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.

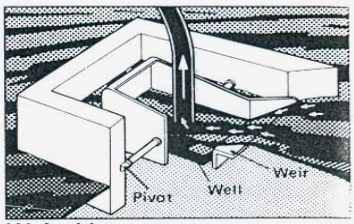


Oleophilic rope skimmers
A central tension core rope, through which is interwoven oleophilic strands forming a long continuous mop. The floating mop is pulled by powered rollers around a return pulley. The rollers squeeze the oil into a storage tank. Operational limit – sea state 3. Sensitive to increasing viscosity. Preference medium viscosity oils.

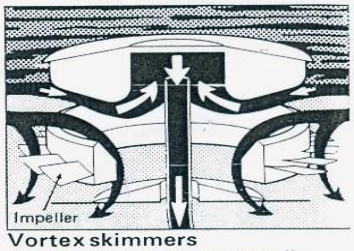


Disc skimmers
Discs rotate through the oil/water interface. Oil adheres to the disc surface, is removed by scraper to a central collection point and is pumped to storage. Operational limit – sea state 2. Sensitive to emulsified oils, waves, debris. Preference – medium viscosity oils.

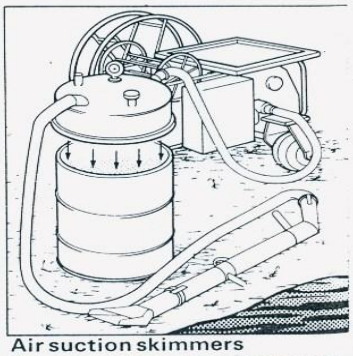
SUCTION DEVICES



Weir skimmers
Oil flows over a self-levelling 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.



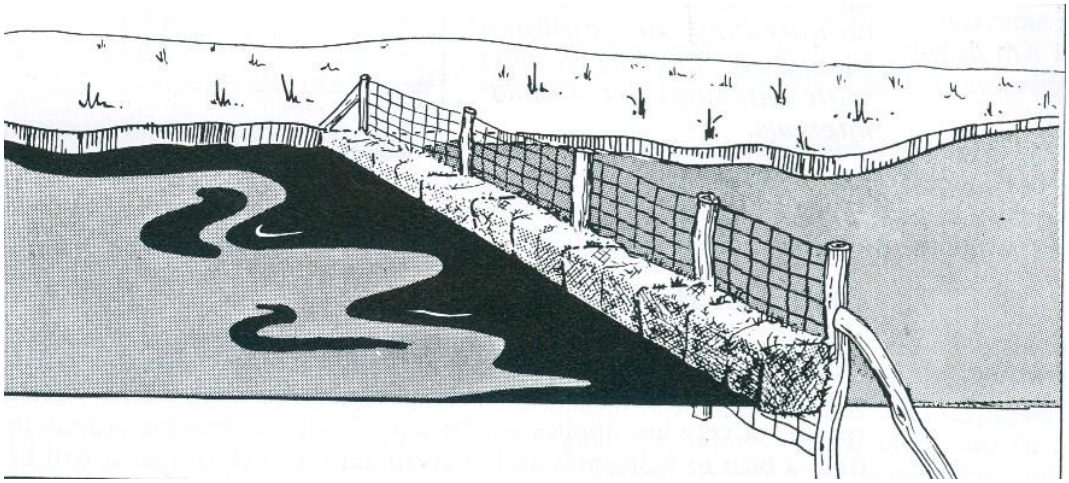
Vortex skimmers
A vortex induced by an impeller causes the oil to concentrate at the centre of the vortex due to centrifugal effects. The collected oil is pumped from the top and the free water released from the bottom. Operational limit – sea state 2 and 0.5 kt water movement. Sensitive to debris. Preference – 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 INDUSTIRAL 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, Old Kandla, Kutch	Mr.S.Ramakrishnan Terminal Manager	270987 (O) 257249 ®	9879572107

7	Indian Oil Corporation Ltd.,	Mr. AK. Khanna Sr. Term. Manager	233274 (O) 229002 (R)	9427216637
	Main Terminal, GIM	Mr. KS Rao, Sr.TM	270394 (O)	9426416108

	Foreshore Terminal, Kandla KBPL LPG Import Plant	Mr. PS Negi Plant Manager	270628 (O) 270477 (O) 233359 ® 270978 (O) 236944 ®	9426725342

8	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
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 TRUSTas 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 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 continues 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 an 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.

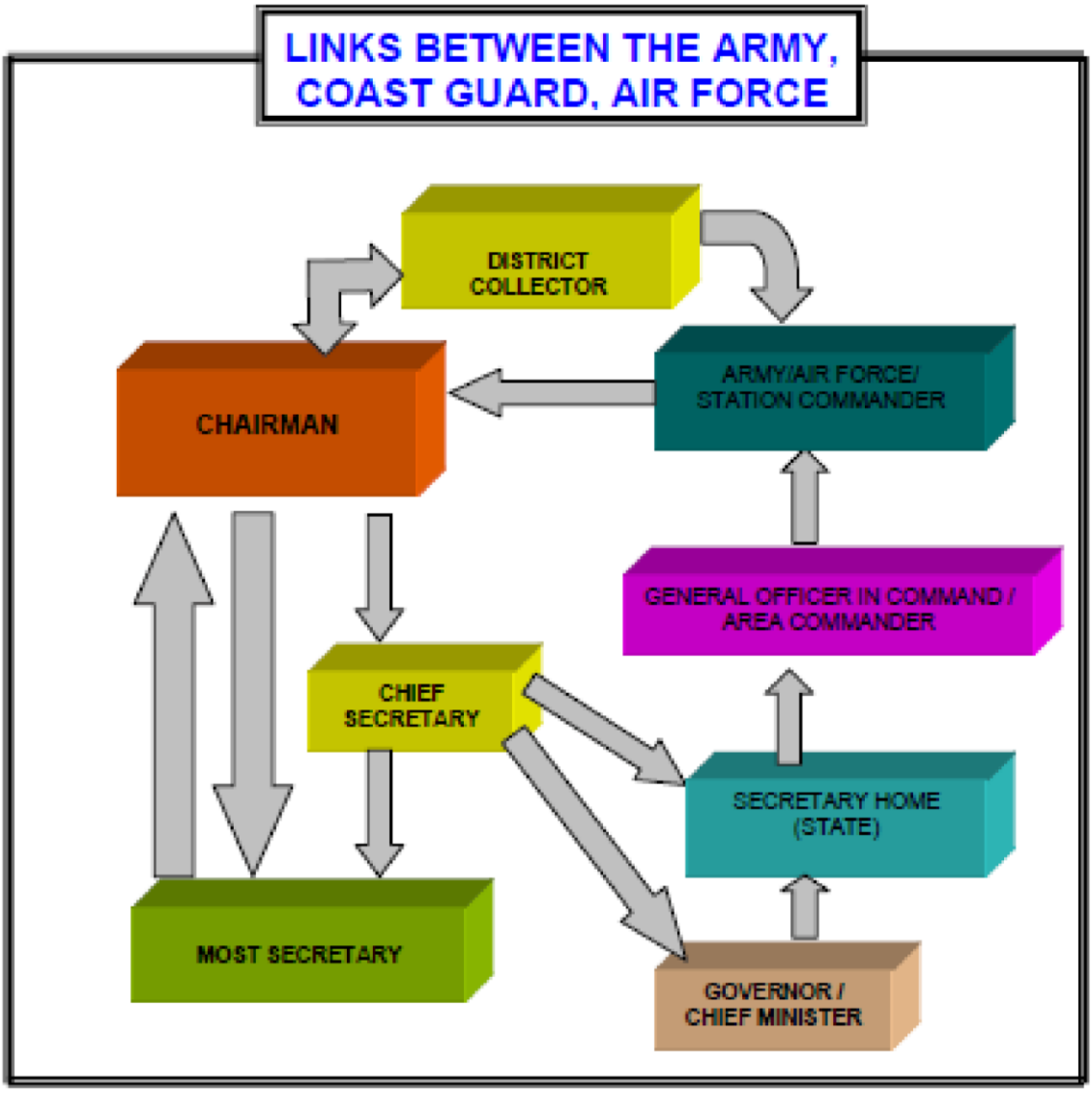
The Chairman / Deputy Chairman would be the coordinating officials for liaisoning with the Station Commander (army, navy as well as air force) after consulting the District Administration.

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

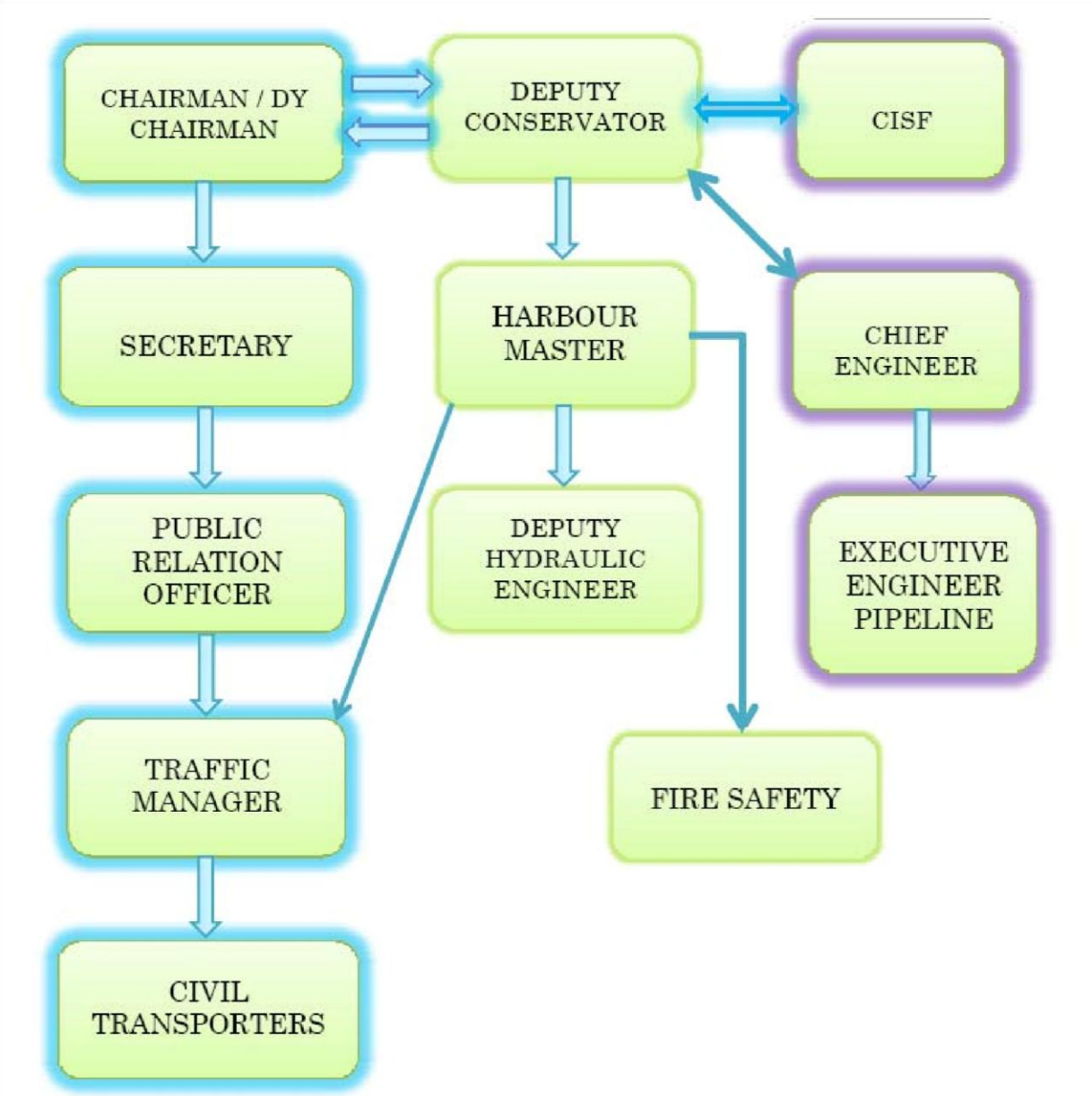
③ Administrative function

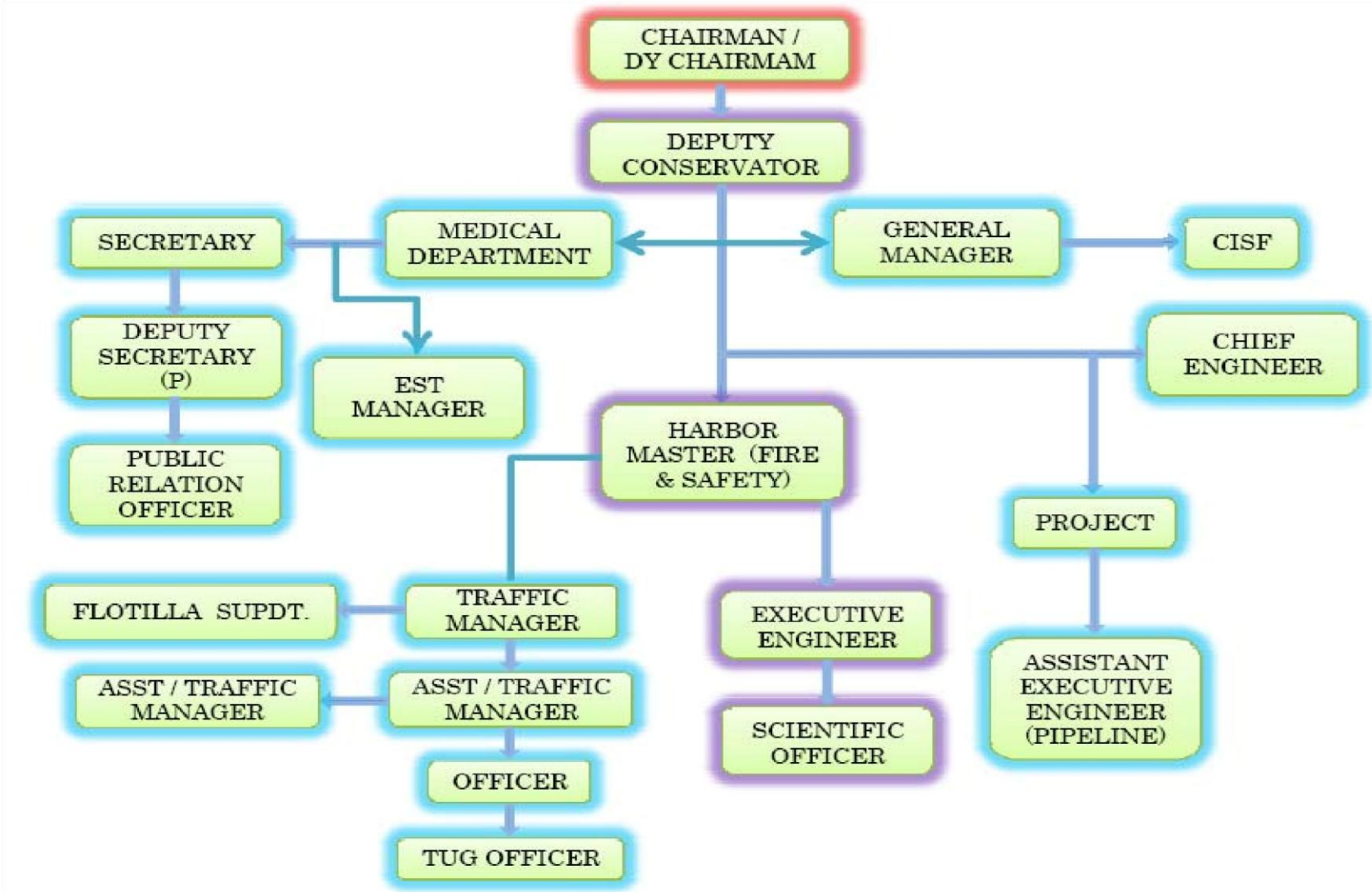
EMERGENCY NOTIFICATION SHEET	
1.	Plant / Location Name _____ Unit _____ Address of Plant / Site _____
2.	Date _____ Time of Call _____
3.	Caller's Name _____ Caller's Position _____ Caller's Telephone Number _____
4.	Time (or Anticipated Time) of Accident / Emission _____ Projected Duration of Accident / Emission _____

5.	Type of Accident / Emission _____
6.	Emergency Alert Level (EAL) : Check One ALERT [ ] SITE EMERGENCY [ ] GENERAL EMERGENCY [ ]
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


CHAIRMAN / DY CHAIRMAN
DEPUTY CONSERVATOR
CISF
SECRETARY
HARBOUR MASTER
CHIEF ENGINEER
PUBLIC RELATION OFFICER
DEPUTY HYDRAULIC ENGINEER
EXECUTIVE ENGINEER PIPELINE
TRAFFIC MANAGER
FIRE SAFETY
CIVIL TRANSPORTERS


CHAIRMAN / DY CHAIRMAM
DEPUTY CONSERVATOR
SECRETARY
MEDICAL DEPARTMENT
GENERAL MANAGER
CISF
DEPUTY SECRETARY (P)
EST MANAGER
CHIEF ENGINEER
PUBLIC RELATION OFFICER
HARBOR MASTER (FIRE & SAFETY)
PROJECT
FLOTILLA SUPDT.
TRAFFIC MANAGER
EXECUTIVE ENGINEER
ASSISTANT EXECUTIVE ENGINEER (PIPELINE)
ASST / TRAFFIC MANAGER
ASST / TRAFFIC MANAGER
SCIENTIFIC OFFICER
OFFICER
TUG OFFICER

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 Crek 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 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

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 recee 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 CAPABILITES 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 TRUSTOFF SHORE OIL TERMINAL – VADINAR PORT

19.1 Vadinar Port Information

Vadinar Port is an important port in DEENDAYAL PORT TRUSTGroup 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 TRUSThas 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 Signalman 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 OkhaPorbundar 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 Sing Hospital)	2553515	2553676
15	Indian Air Force, Jamnaga 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&Admn 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.hawai.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. a 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.Supdt.		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,	2550320
		Nr. Old Railway station, Jamnagar	
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 availibility

Name of Driver (Motor) & their Residence Telephone No : To be arranged by XEN (M&E) as per availibility

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.

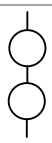
19.16.7 Important Telephone Nos of IMD http://www.imdahm.gov.in/index.html

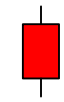
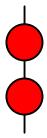
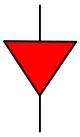
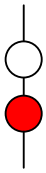
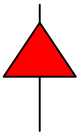
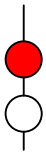
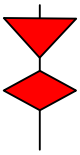
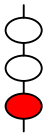
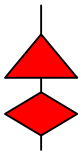
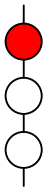
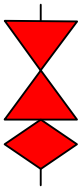
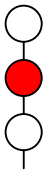
19.16.8 List of Vehicle Hire / Transport Travel Contractors at Jamnagar

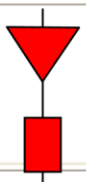
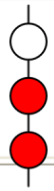
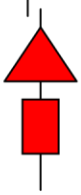
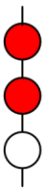
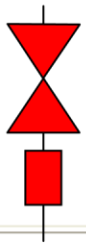
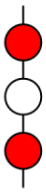
Sr.No	Name and address of Transport / traveler	Telephone
1	Pavan Travels, Pancheshwar tower, Jamnagar	2552002
2	Patel Travels, Pancheshwar tower. Jamnagar	2552419 /

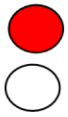
		2660243
3	Ashwamegh Travels, Jamnagar	2670613
4	Sheenath Travels, Jamnagar	2663315 / 2662215
5	Royal Travels, Opp. Town Hall, Jamnagar	2553333 / 2553636
6	Pruthvi Travels, Sikka Patia, SIKKA (Jamnagar.)	244466
7	Shree Divya Travels, Jamnagar	2677601
8	Payal Travels, Jamnagar	2551514 / 2551415
9	Gujarat 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 o 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 Disconnector 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	5.2	> 0.84	Black	Persistent,	Arabian Light,
	Oil			oils	Viscous, Emulsion. Fresh oil amenable to dispersants	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 Pot 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 scarpers 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 792m^3/hr at 15 kg/cm^2).
b. Engine driven – 1 No (Discharge capacity 822m3/hr (standby).
c. Jockey Pump (Discharge capacity 33m^3/hr at 10.5 kg/cm^2).

19.18.3 Fire water Pump for Hydrant System – 4 Nos

a. Main Motor Driven Pump – 1 No (Discharge capacity 792m^3/hr at 15 kg/cm^2).
b. Engine driven – 1 No (Discharge capacity 822m^3/hr (standby).
c. Jockey Pump (Discharge capacity 33m^3/hr at 10.5 kg/cm^2).

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/cm^2
The flow rate of hydrant is 1800 lpm at 7.5 kg/cm^2

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/cm^2.

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 m^3/hr at 16kg/cm^2

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 – $37 m^3/hr$

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 m^3/hr at $16 kg/cm^2$

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% CO_2 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 West – 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. H_2S 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 -Viramgam, Viramgam - Koyali, Viramgam-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 220 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 oilwhich 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:

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)	02838288201 to 288207, 02838220033		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 2550101 2675091 101	2550340

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 2712413	2560252 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 Fighitng 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 pumpa) 385 KL/Hr @ 91mb) 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**	

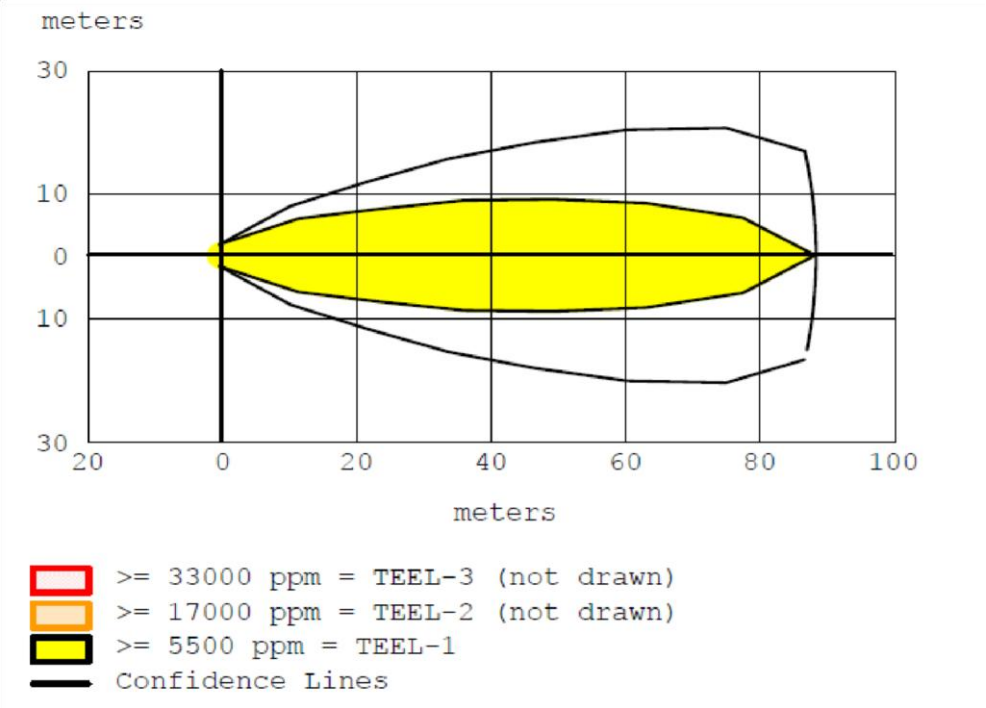
	CO_2 Type	33 Nos.
	2.0 Kg	13 Nos.
	3.2Kg	Nil
	4.5 Kg.	15 Nos.
	6.8 Kg.	05 Nos.
	DCP Type	27 Nos.
	5 Kg	01 No
	10 Kg	20 Nos.
	75 Kg	06 Nos.
5	**Fixed Fire Fighitng Facilities**	
	Fire Water Mains (size) and date of Pressure Testing	8" Dia tested on July'10
	Fire water pond/tank (no. and capacity)	2 nos 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

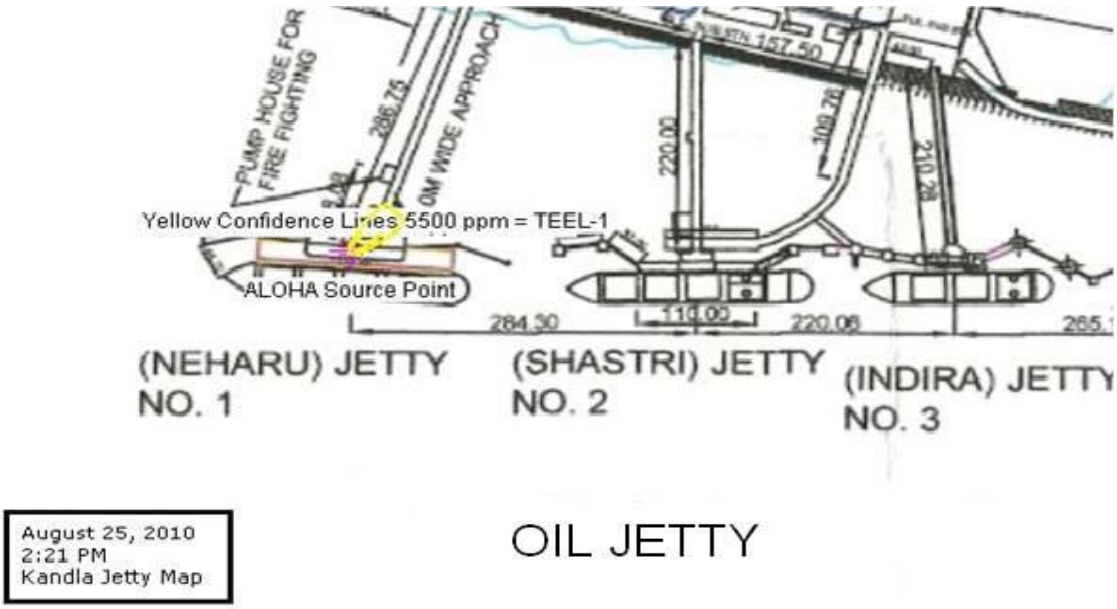
20.1 Graphs & Contours of various MCLS worked out at Jetty (Refer Chapter 4.7)

20.1.1 Jetty One – LPG

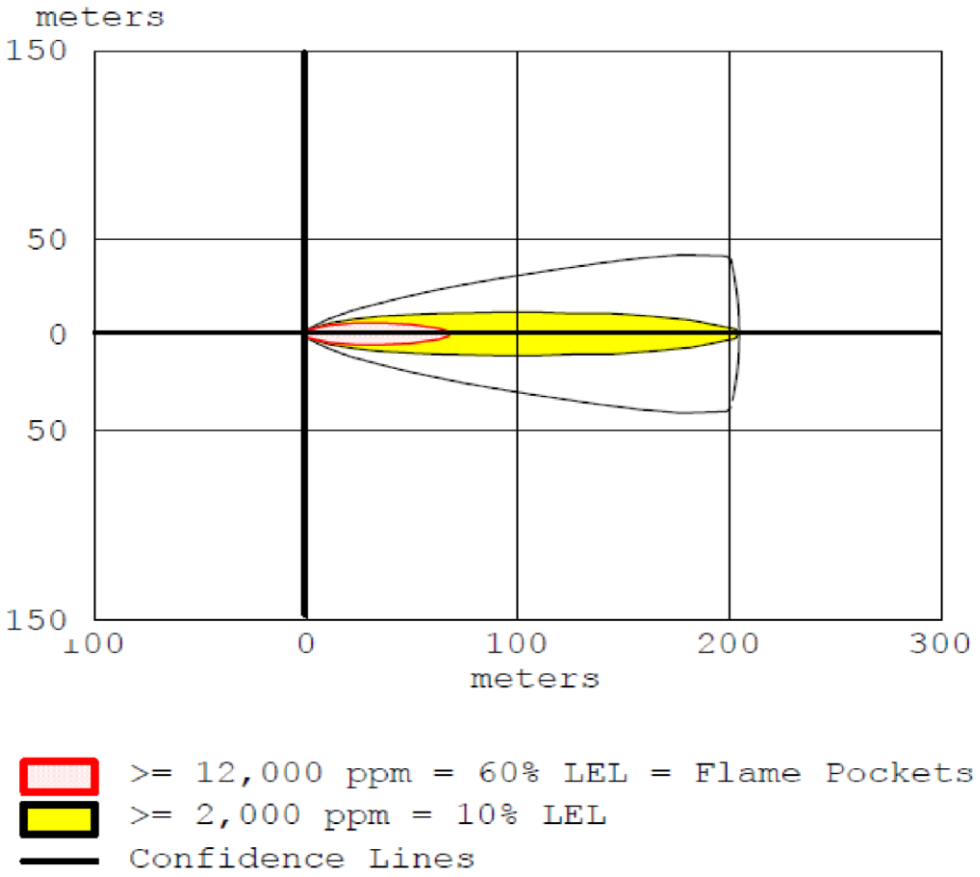
20.1.1.1 Instantaneous Release – Toxic Threat Zone (Graph)



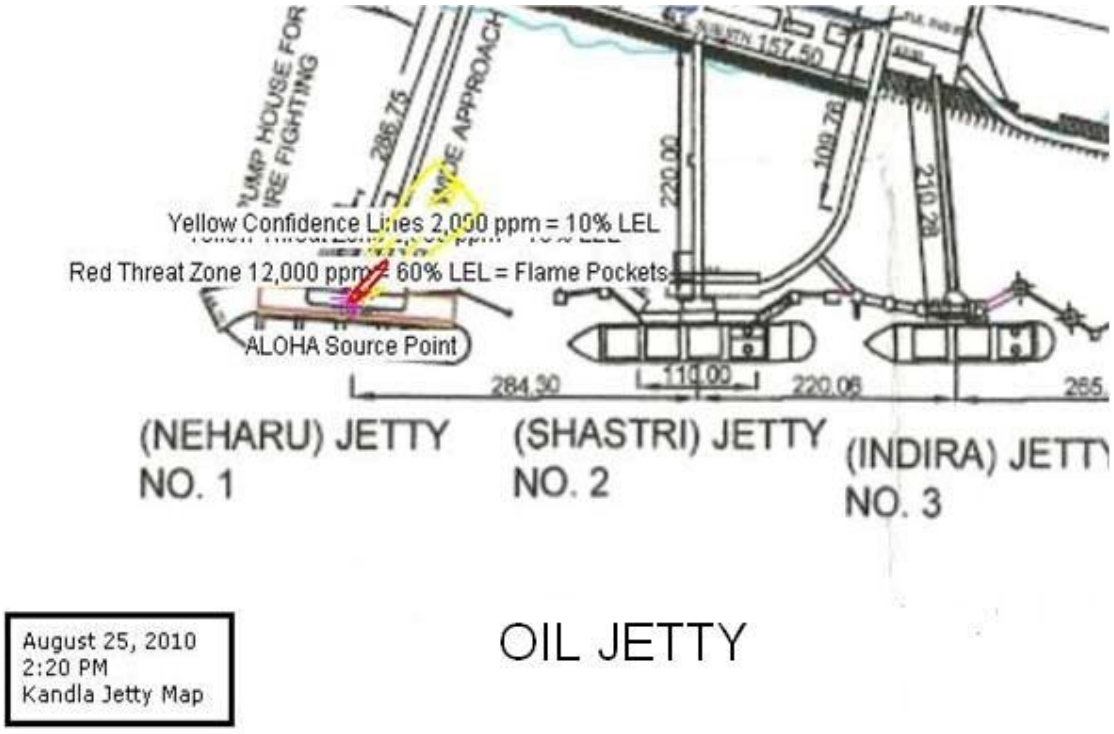
20.1.1.2 Instantaneous Release – Toxic Threat Zone (Contour)



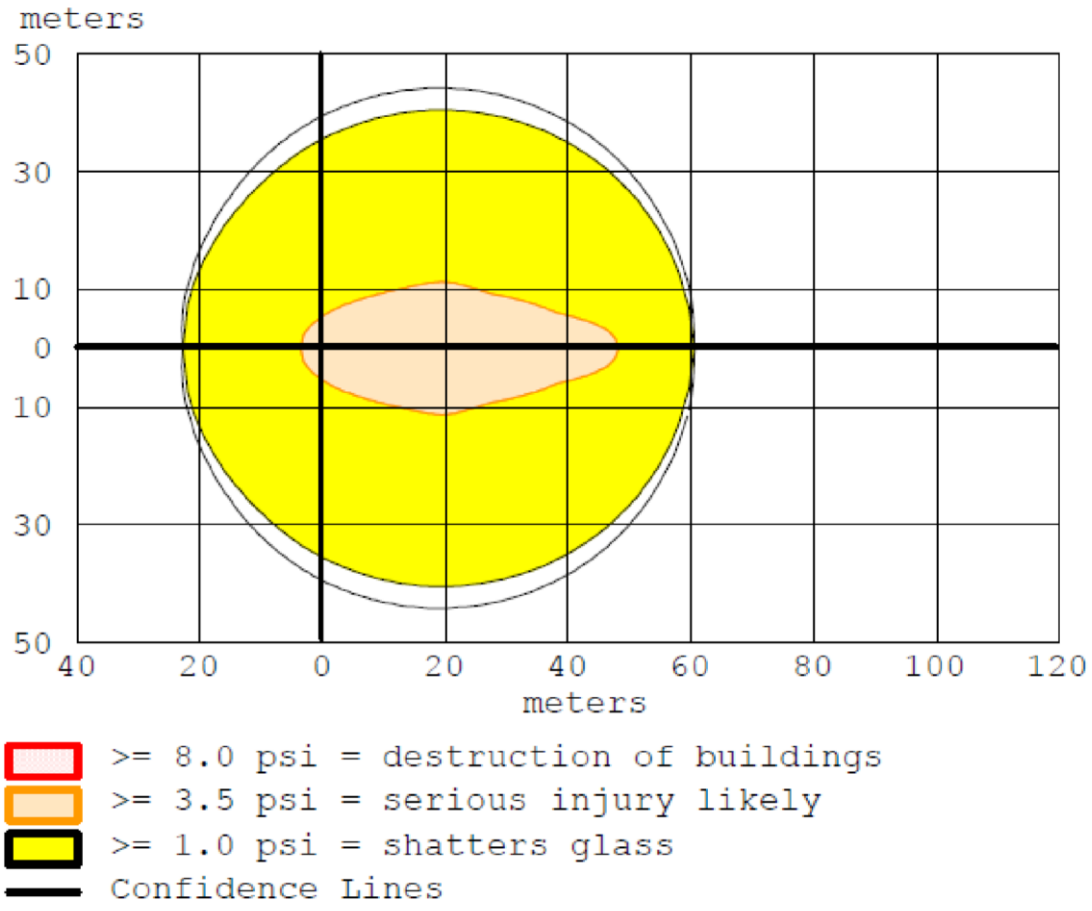
20.1.1.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



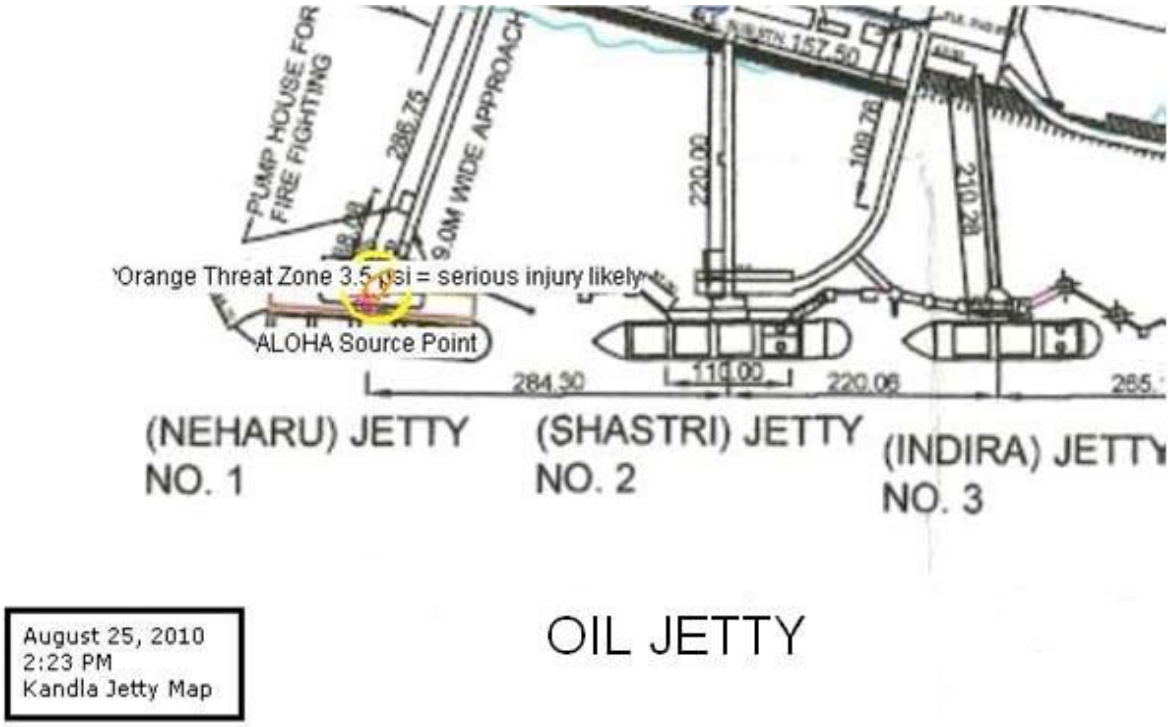
20.1.1.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



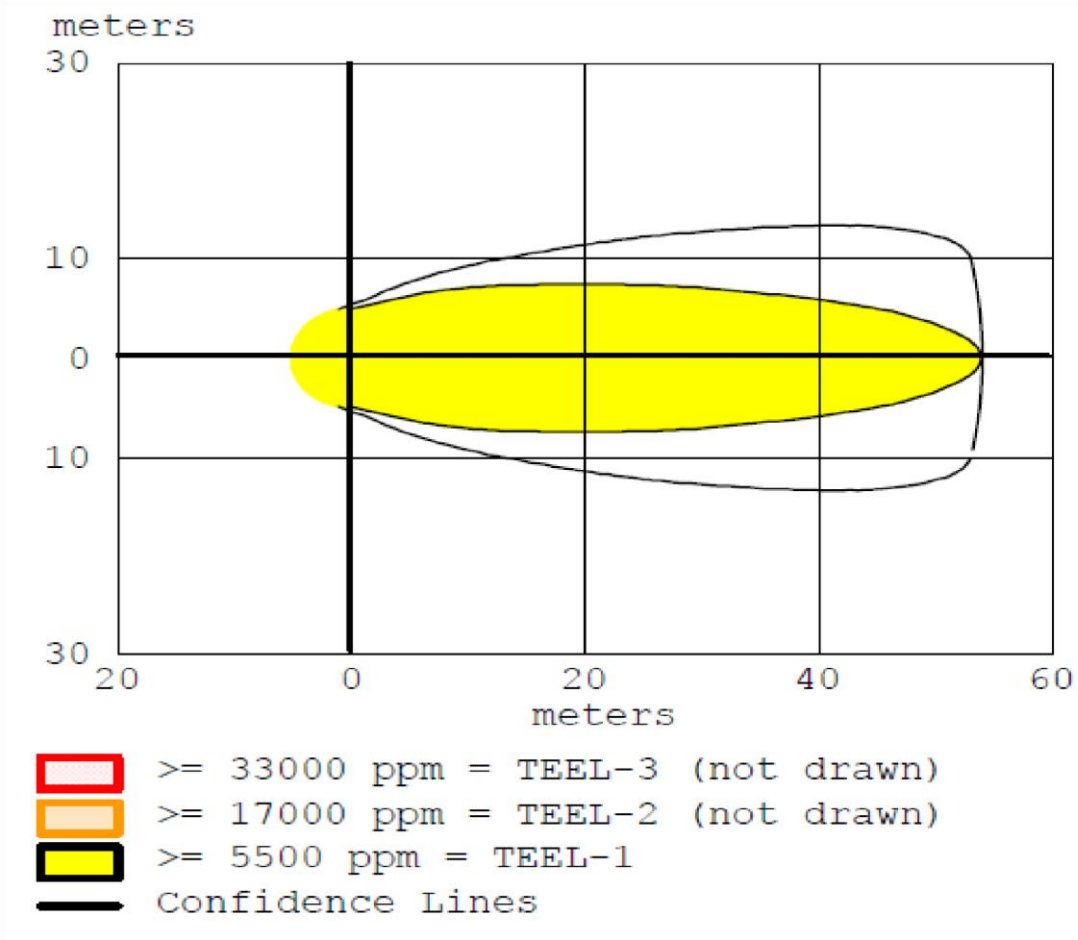
20.1.1.5 Instantaneous Release – Overpressure (Graph)



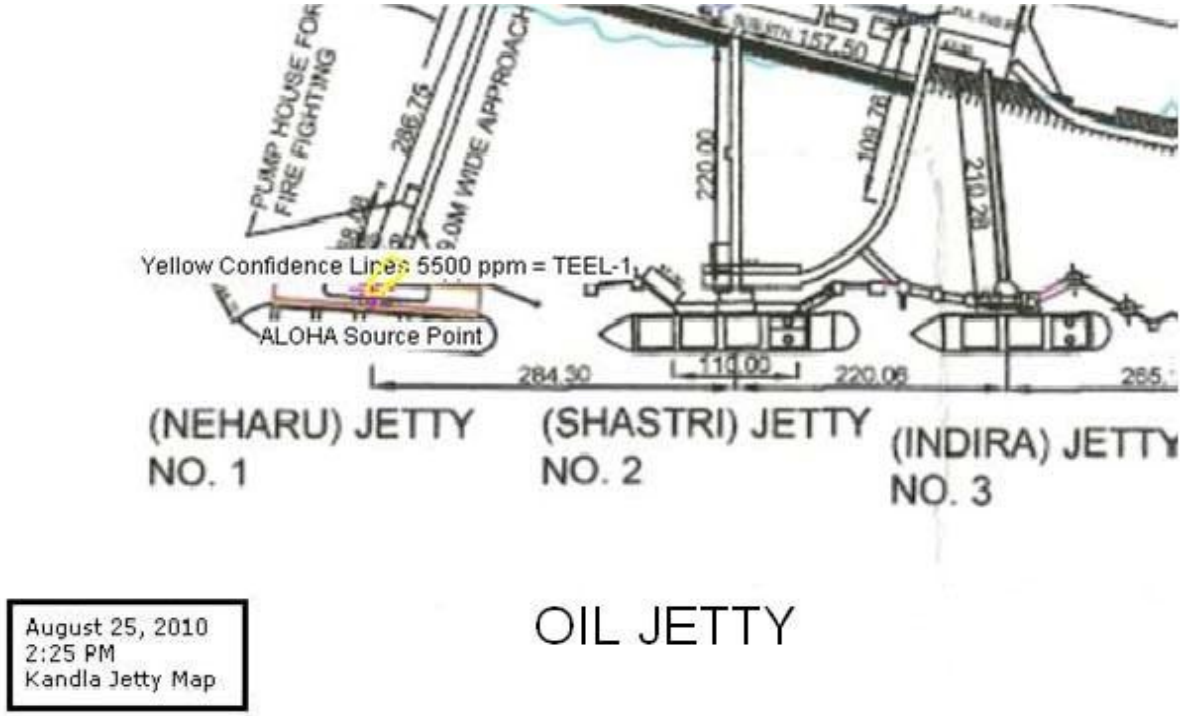
20.1.1.6 Instantaneous Release – Overpressure (Contour)



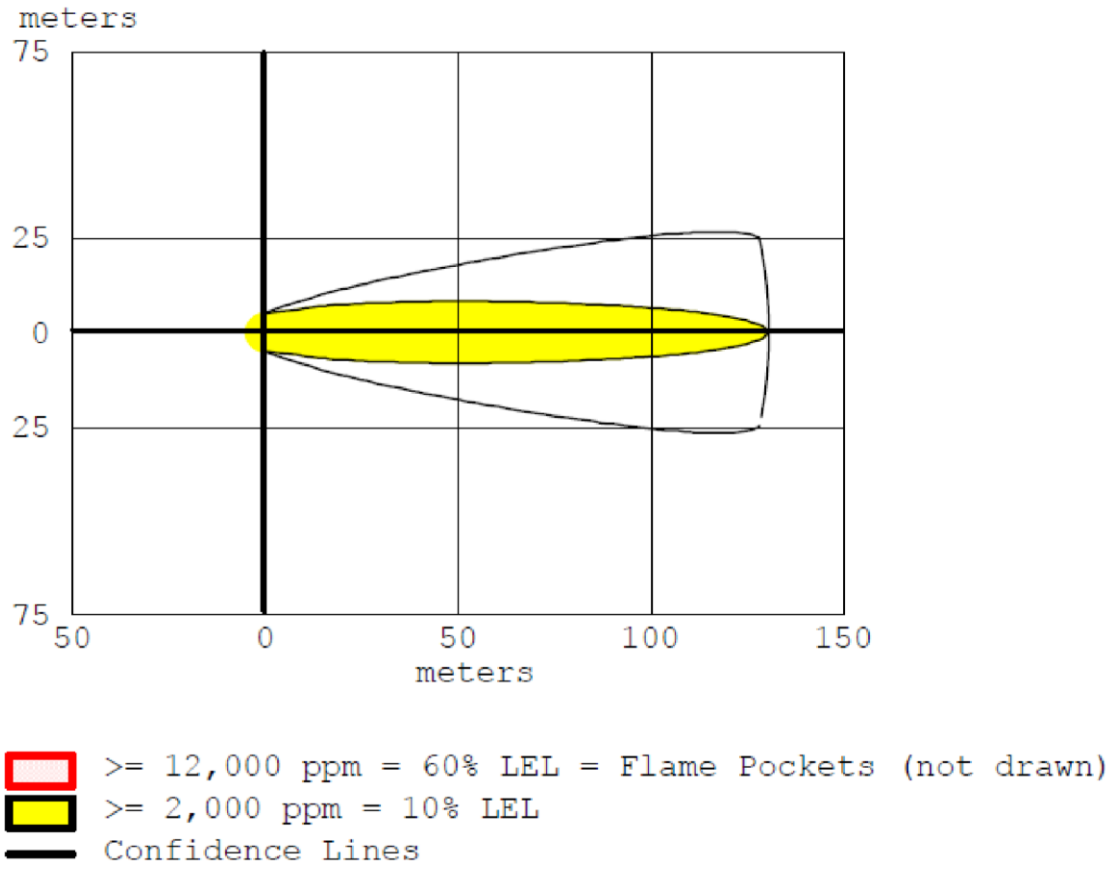
20.1.1.7 Evaporating Puddle – Toxic Threat Zone (Graph)



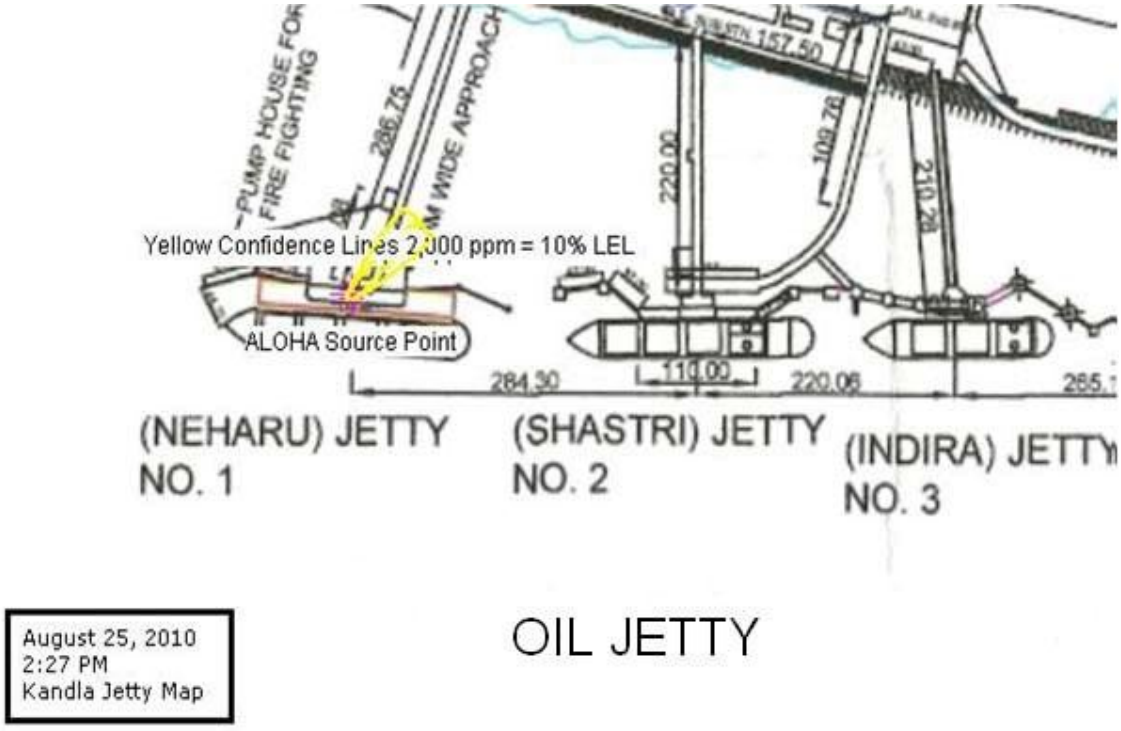
20.1.1.8 Evaporating Puddle – Toxic Threat Zone (Contour)



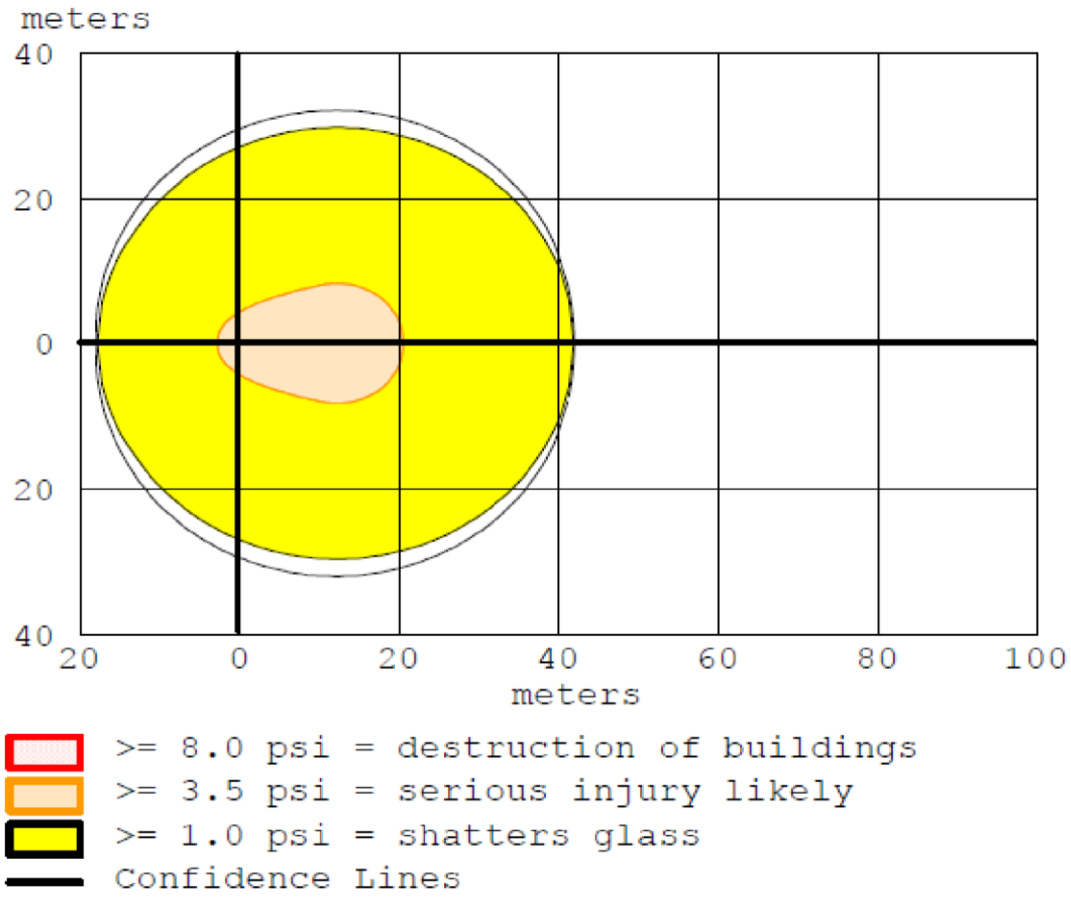
20.1.1.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



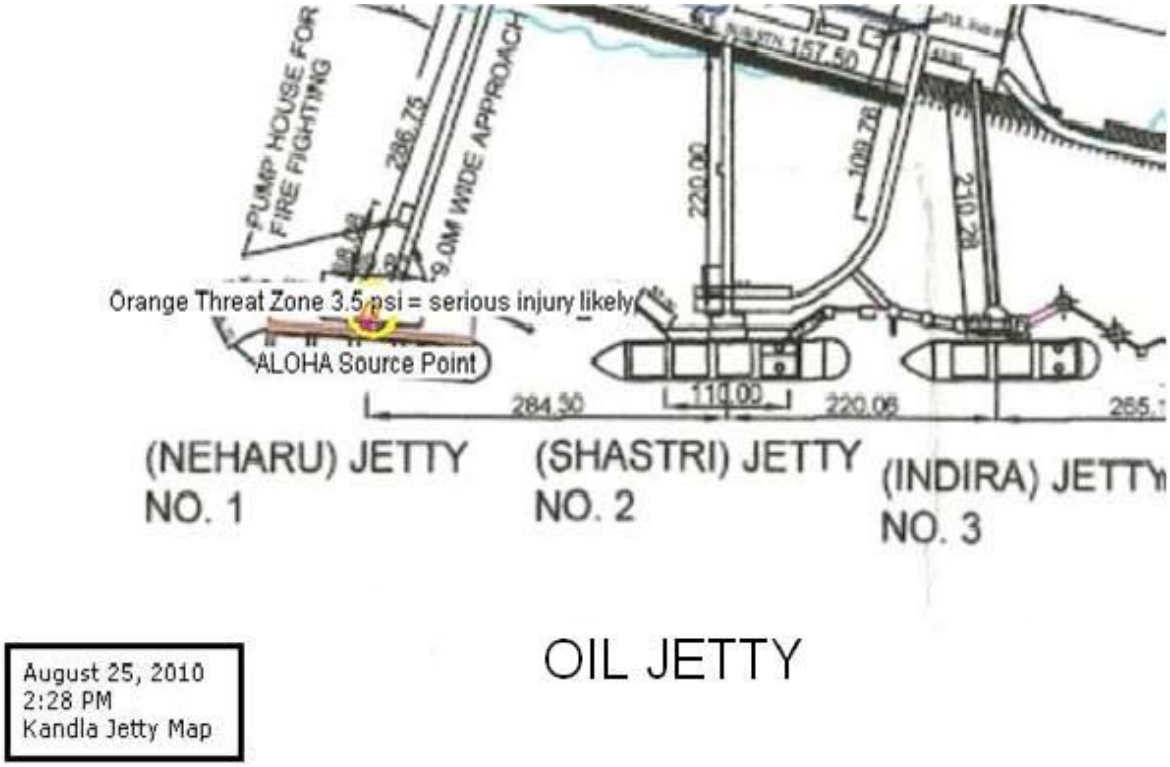
20.1.1.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



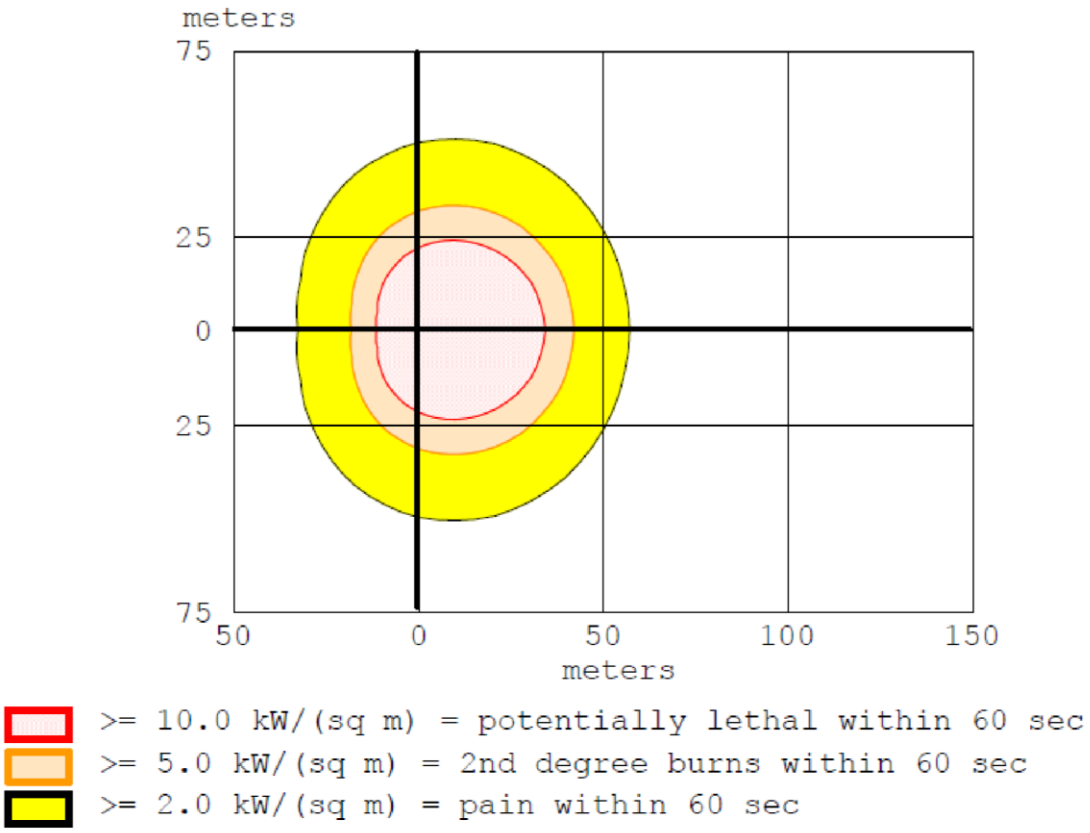
20.1.1.11 Evaporating Puddle – Overpressure (Graph)



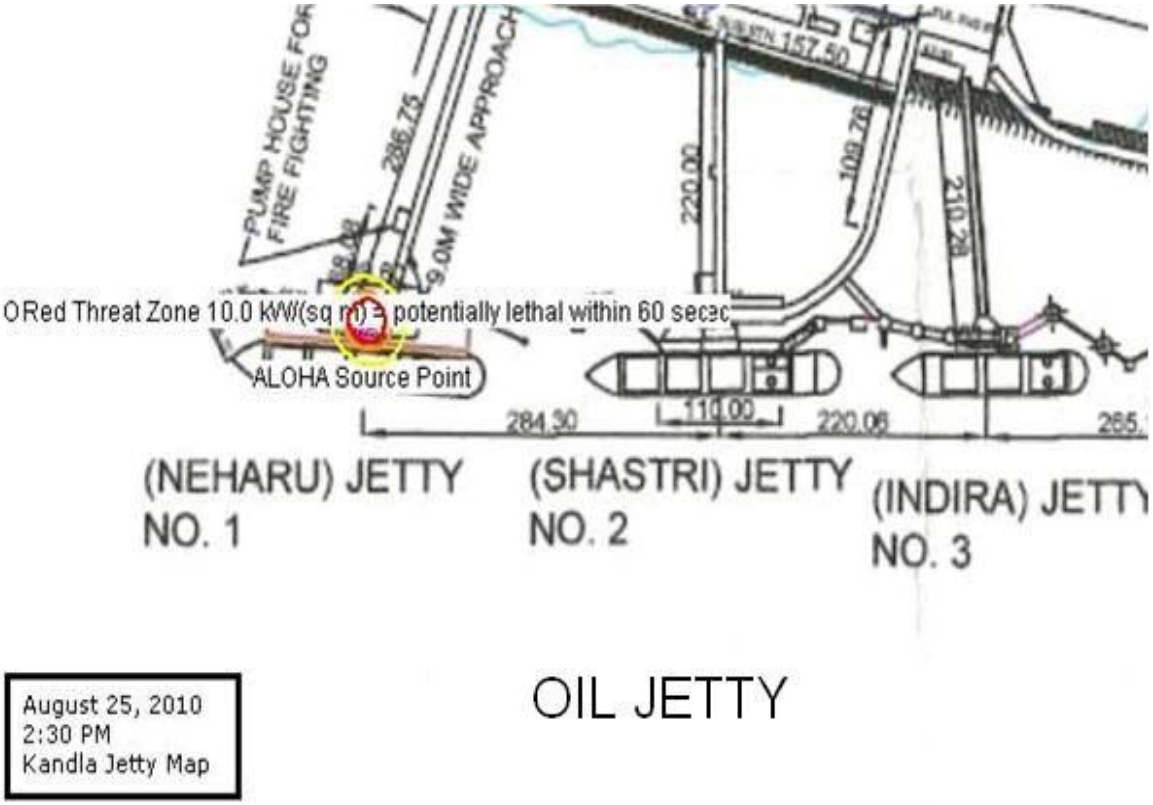
20.1.1.12 Evaporating Puddle – Overpressure (Contour)



20.1.1.13 Burning Puddle – Thermal Radiation (Graph)

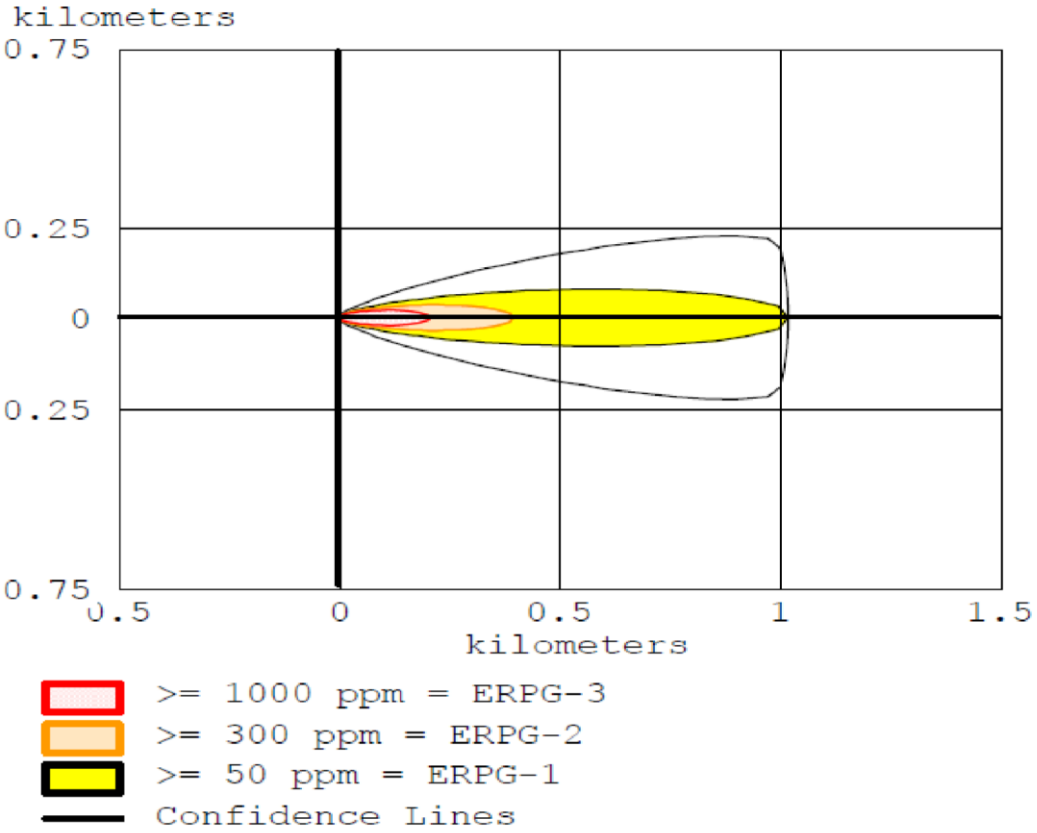


20.1.1.14 Burning Puddle – Thermal Radiation (Contour)

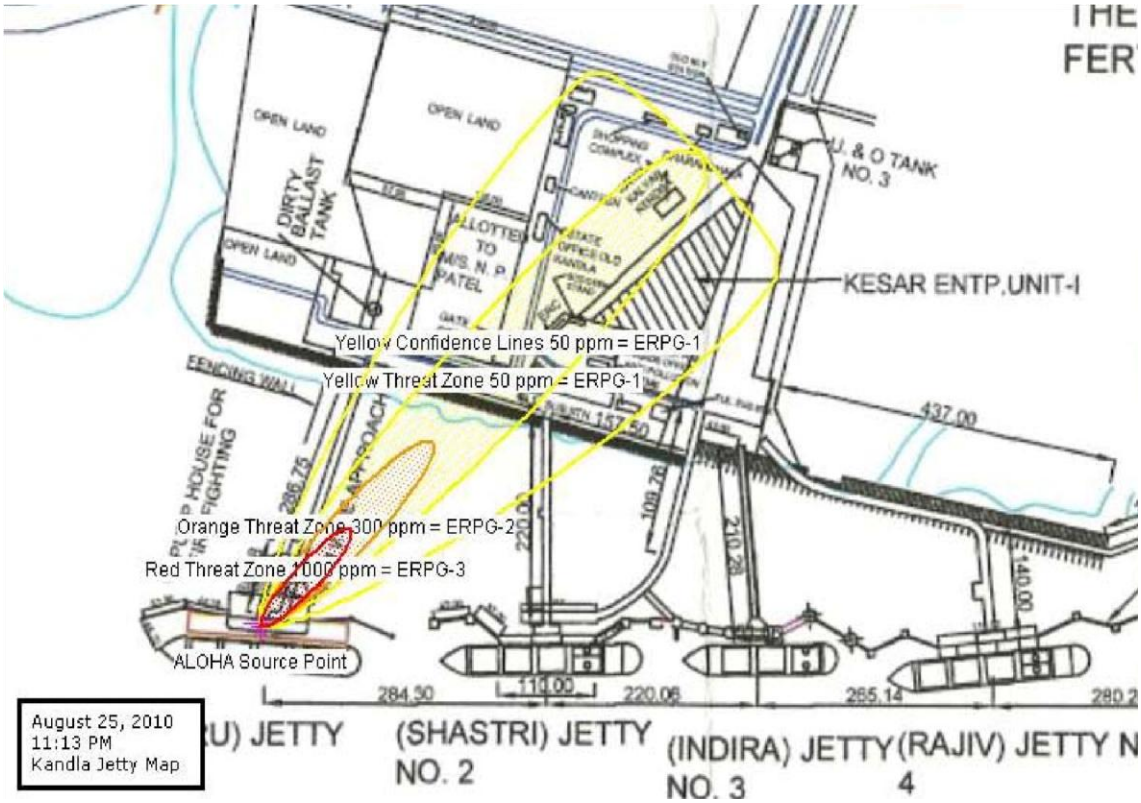


20.1.2 Jetty One – Toluene

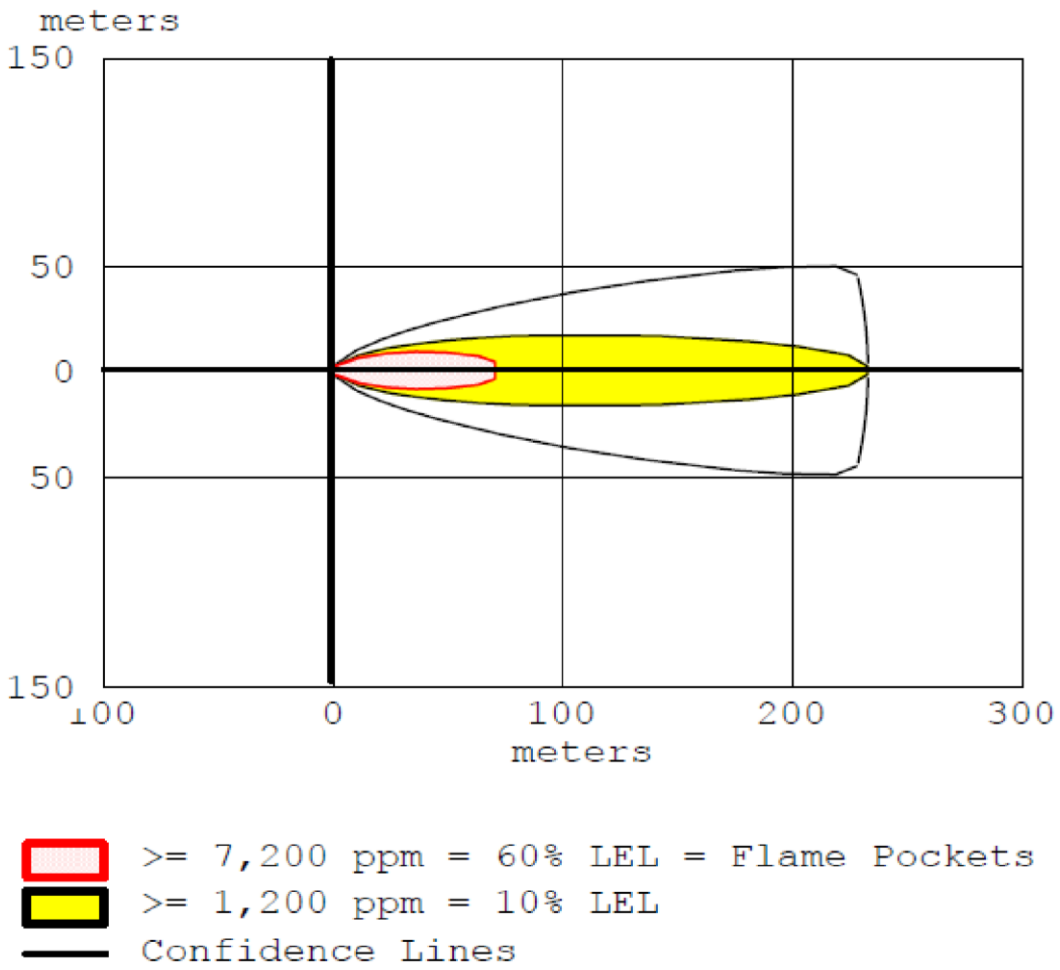
20.1.2.1 Instantaneous Release – Toxic Threat Zone (Graph)



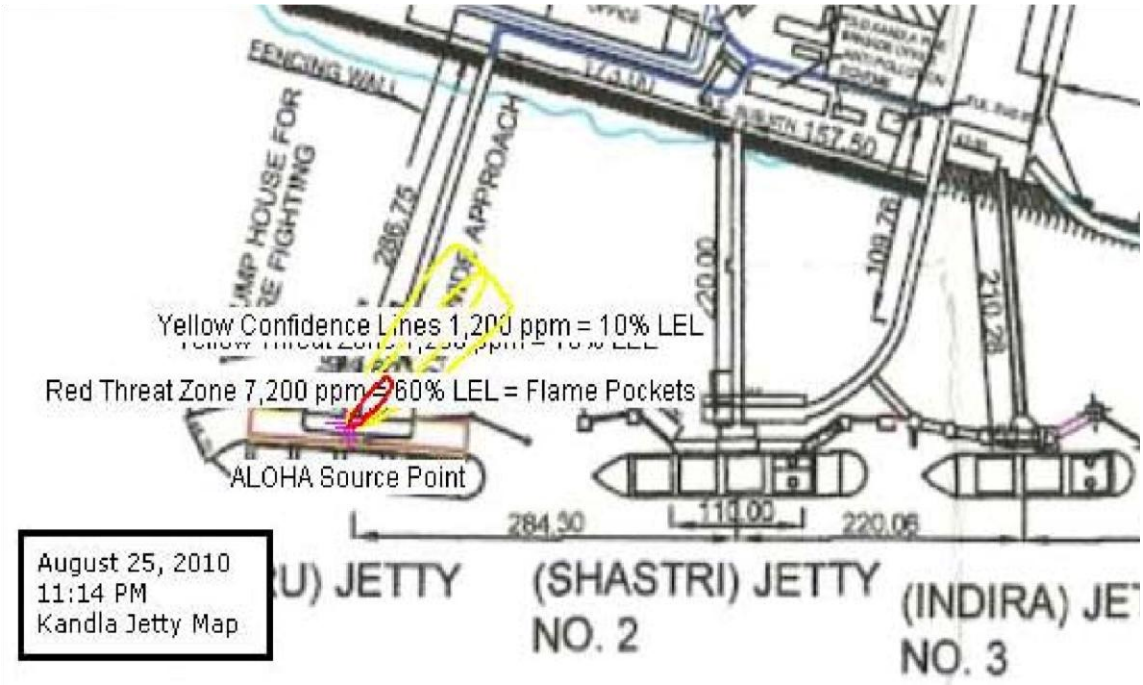
20.1.2.2 Instantaneous Release – Toxic Threat Zone (Contour)



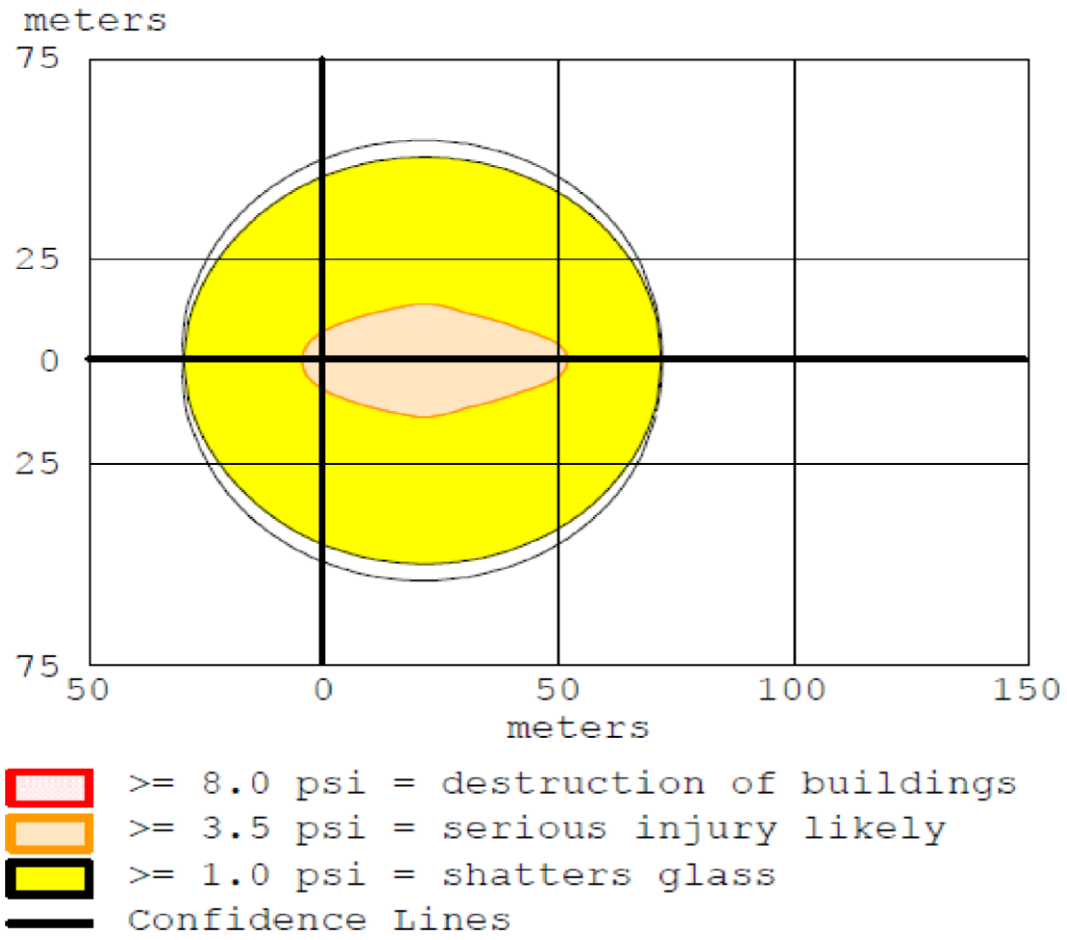
20.1.2.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



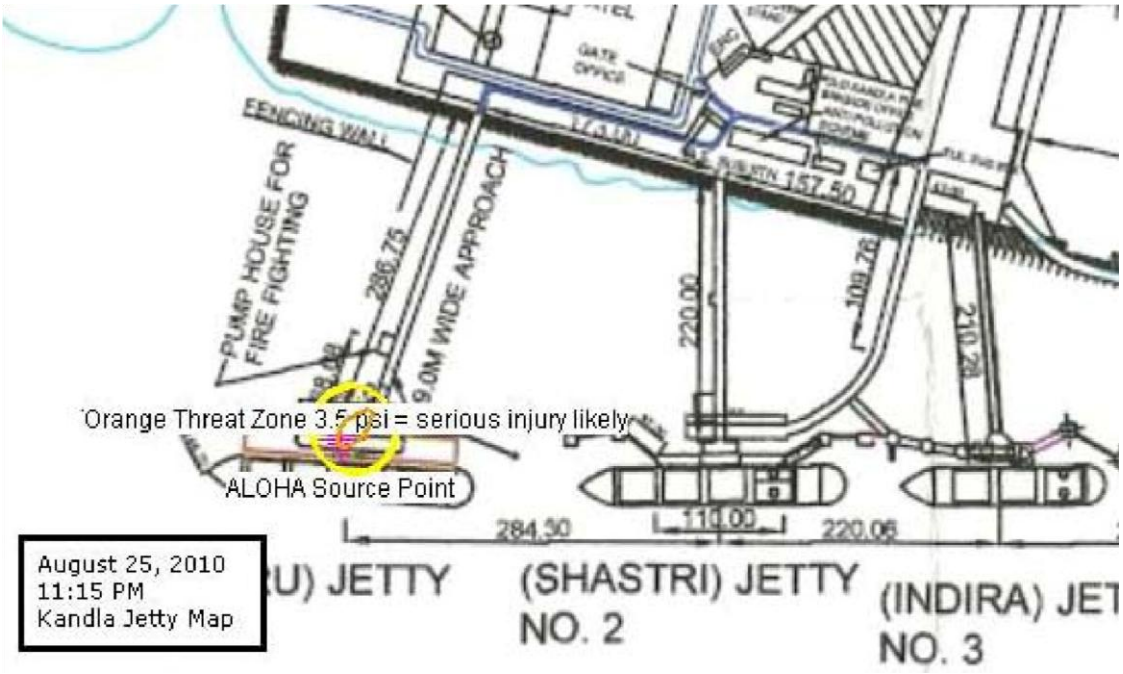
20.1.2.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



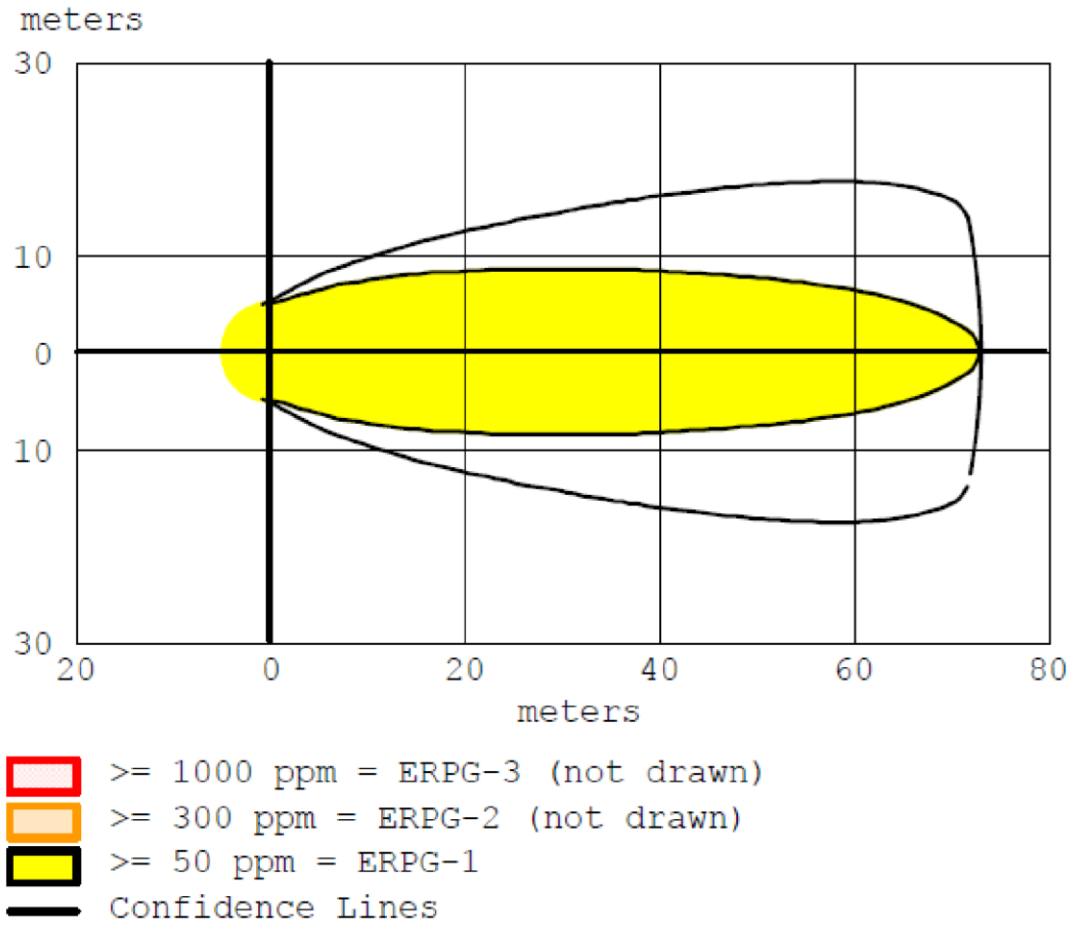
20.1.2.5 Instantaneous Release – Overpressure (Graph)



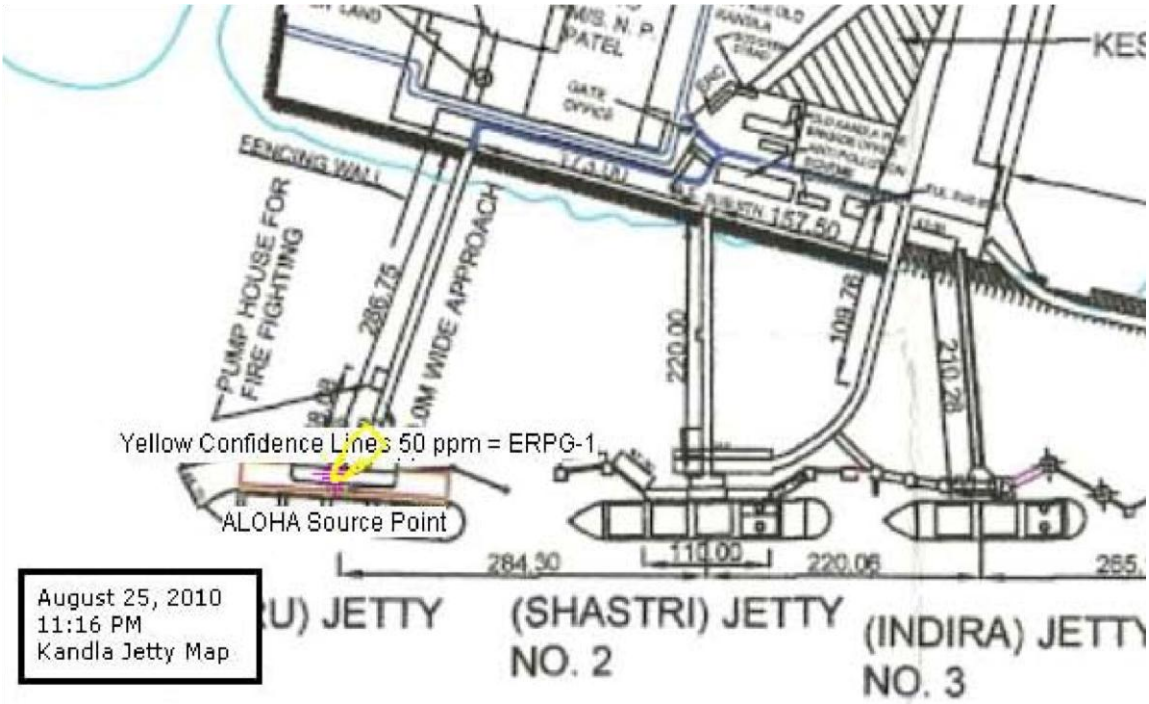
20.1.2.6 Instantaneous Release – Overpressure (Contour)



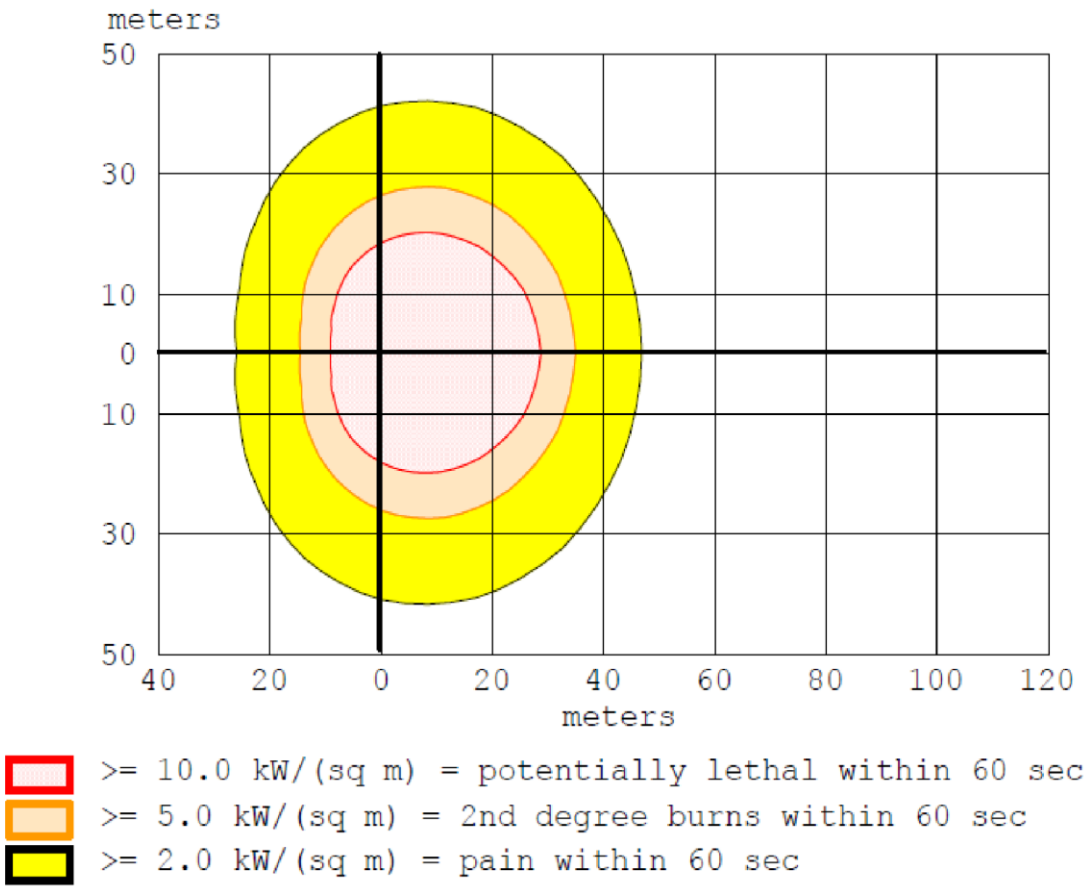
20.1.2.7 Evaporating Puddle – Toxic Threat Zone (Graph)



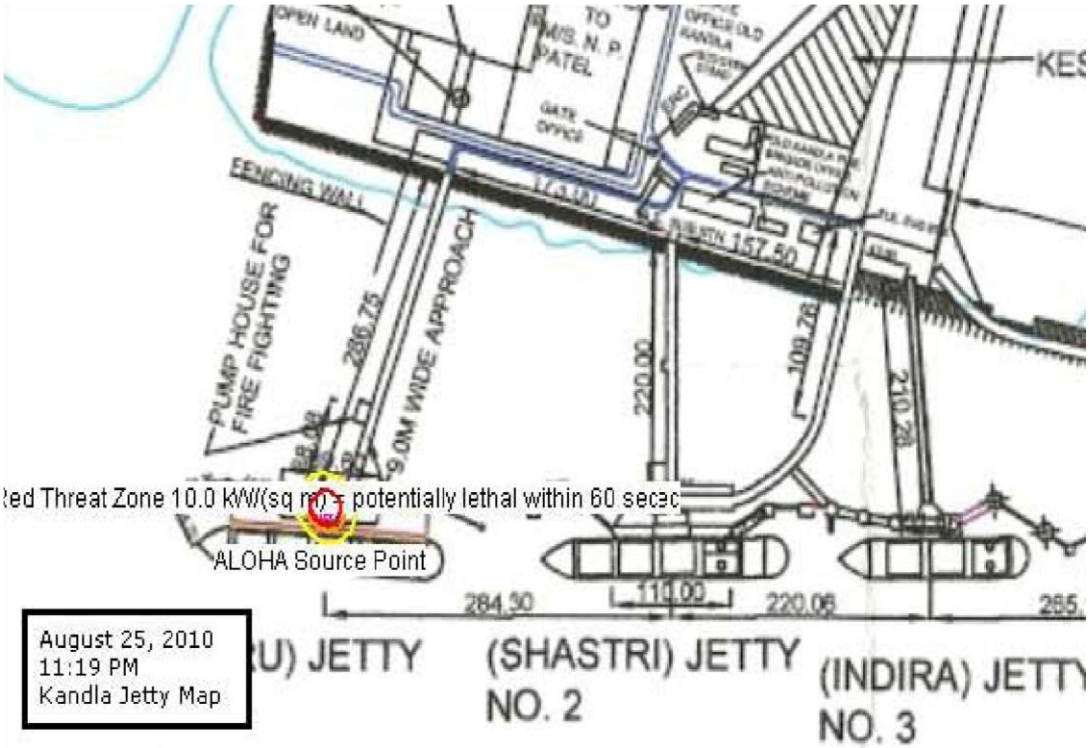
20.1.2.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.2.9 Burning Puddle – Thermal Radiation (Graph)

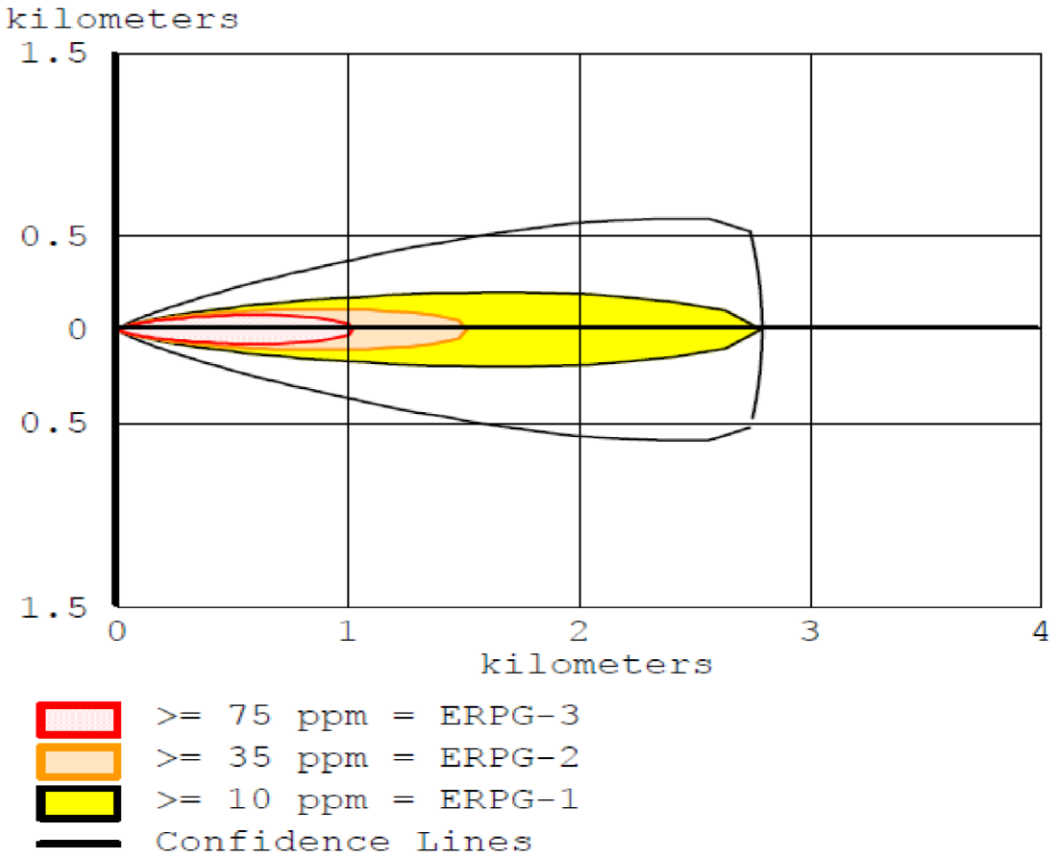


20.1.2.10 Burning Puddle – Thermal Radiation (Contour)

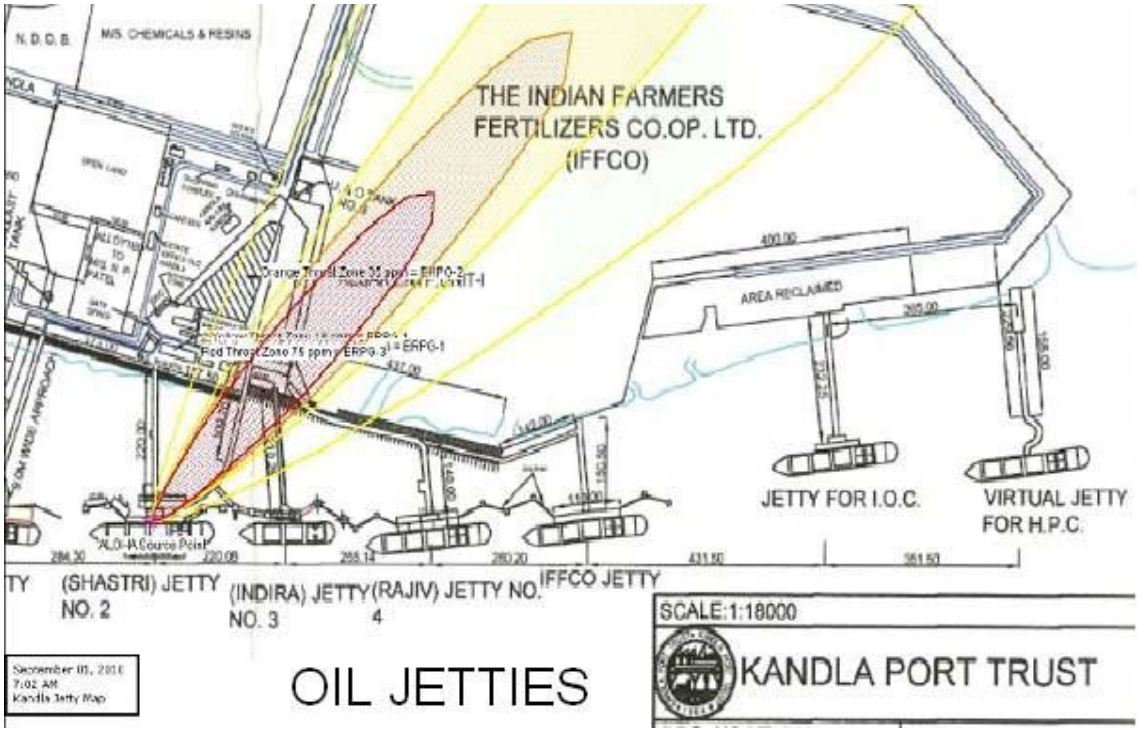


20.1.3 Jetty Two – Acrylonitrile

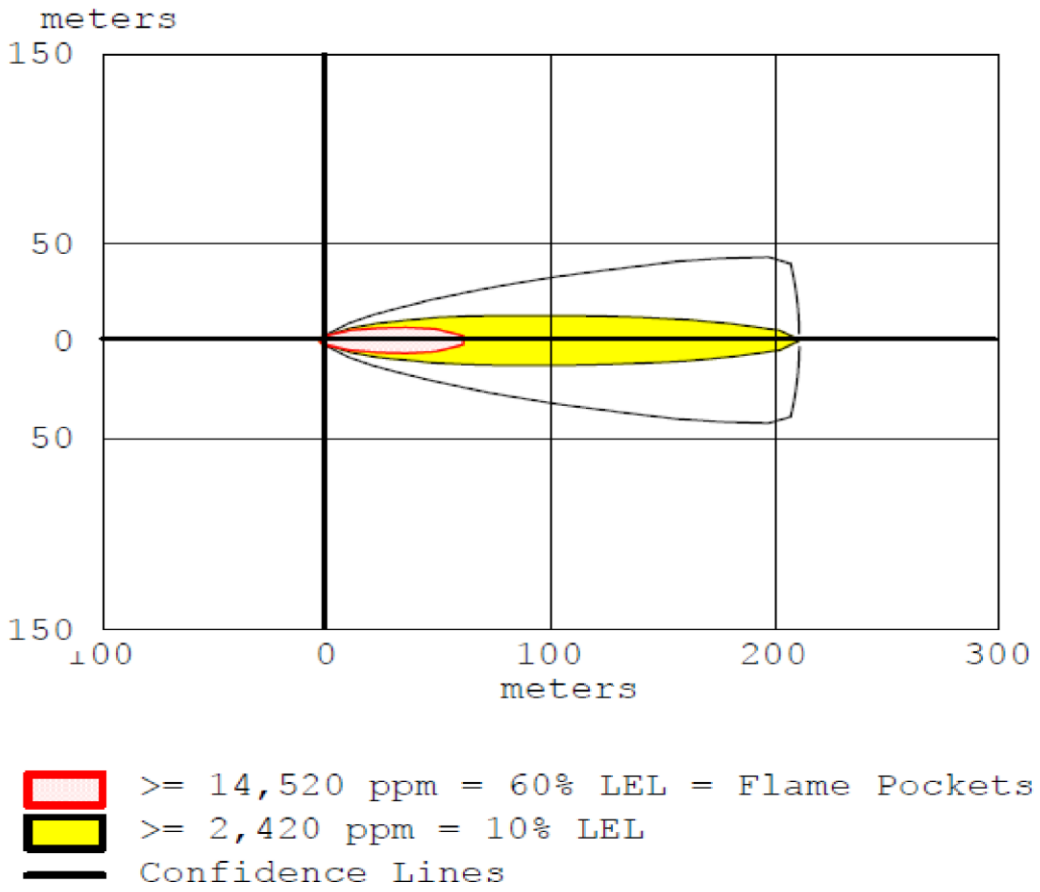
20.1.3.1 Instantaneous Release – Toxic Threat Zone (Graph)



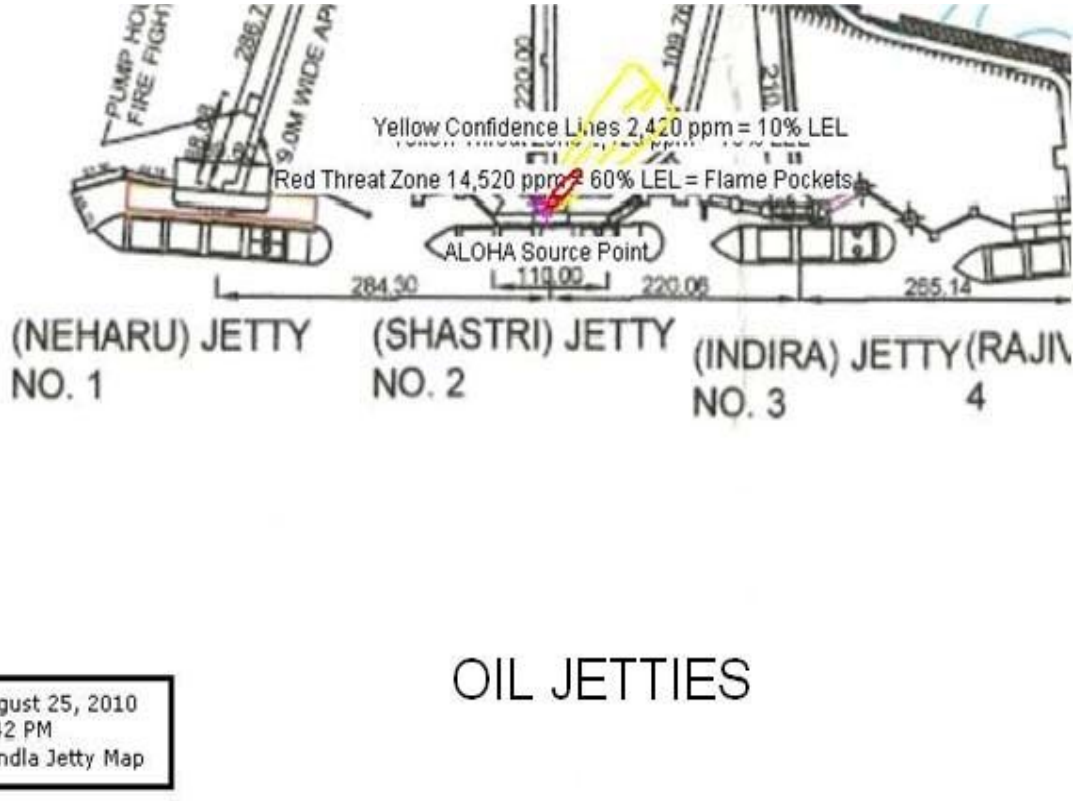
20.1.3.2 Instantaneous Release – Toxic Threat Zone (Contour)



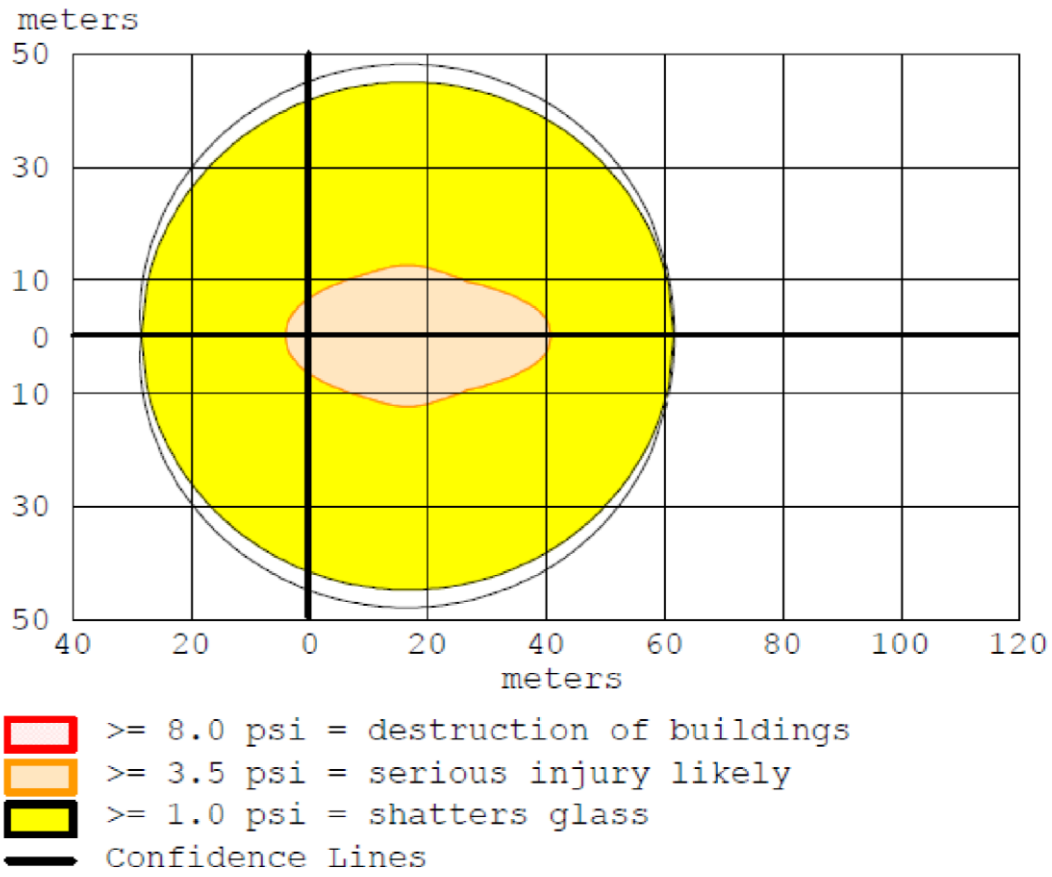
20.1.3.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



20.1.3.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



20.1.3.5 Instantaneous Release – Overpressure (Graph)

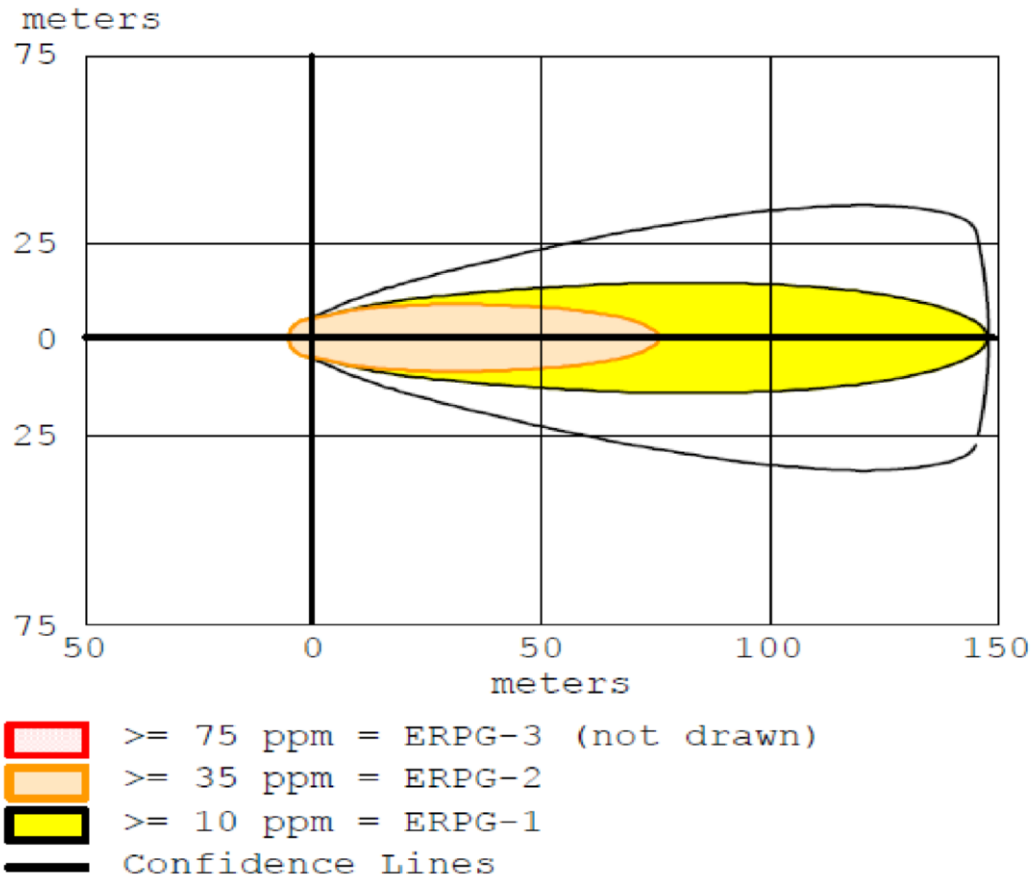


20.1.3.6 Instantaneous Release – Overpressure (Contour)

OIL JETTIES

August 25, 2010
2:43 PM
Kandla Jetty Map

20.1.3.7 Evaporating Puddle – Toxic Threat Zone (Graph)

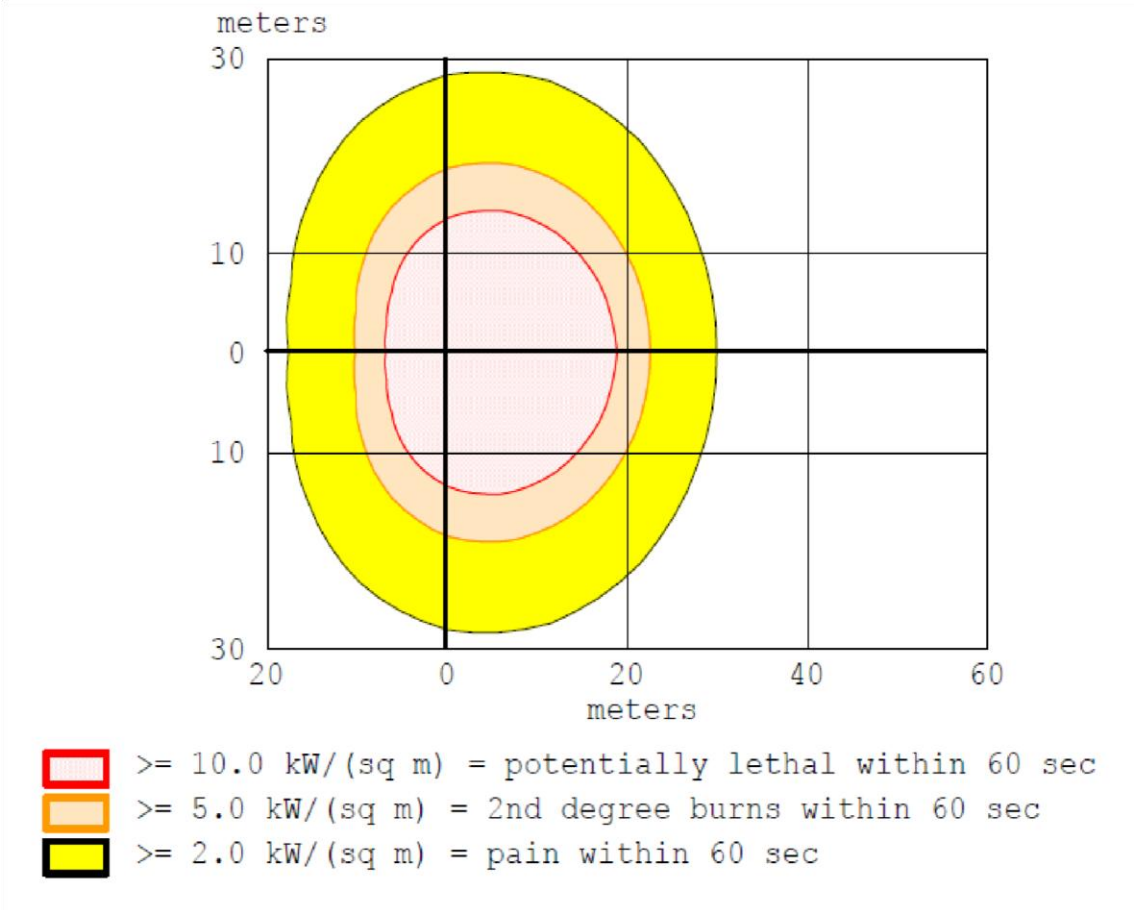


20.1.3.8 Evaporating Puddle – Toxic Threat Zone (Contour)

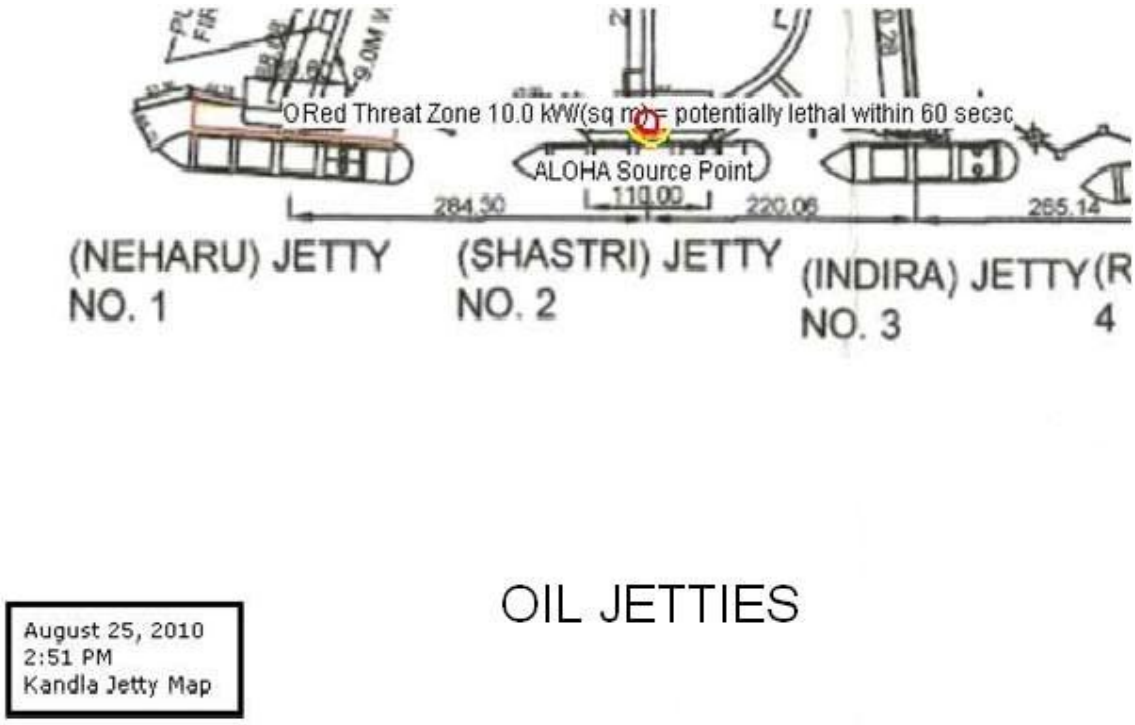
August 25, 2010
2:47 PM
Kandla Jetty Map

OIL JETTIES

20.1.3.9 Burning Puddle – Thermal Radiation (Graph)

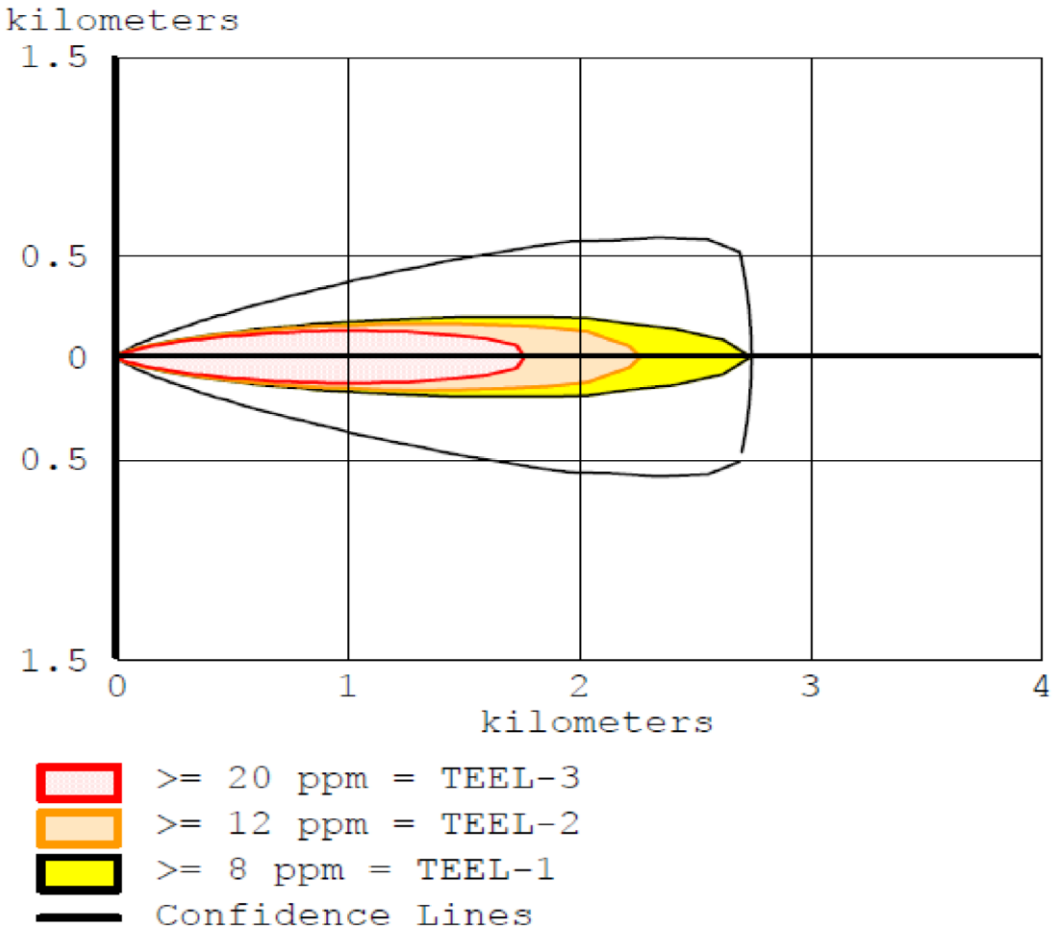


20.1.3.10 Burning Puddle – Thermal Radiation (Contour)

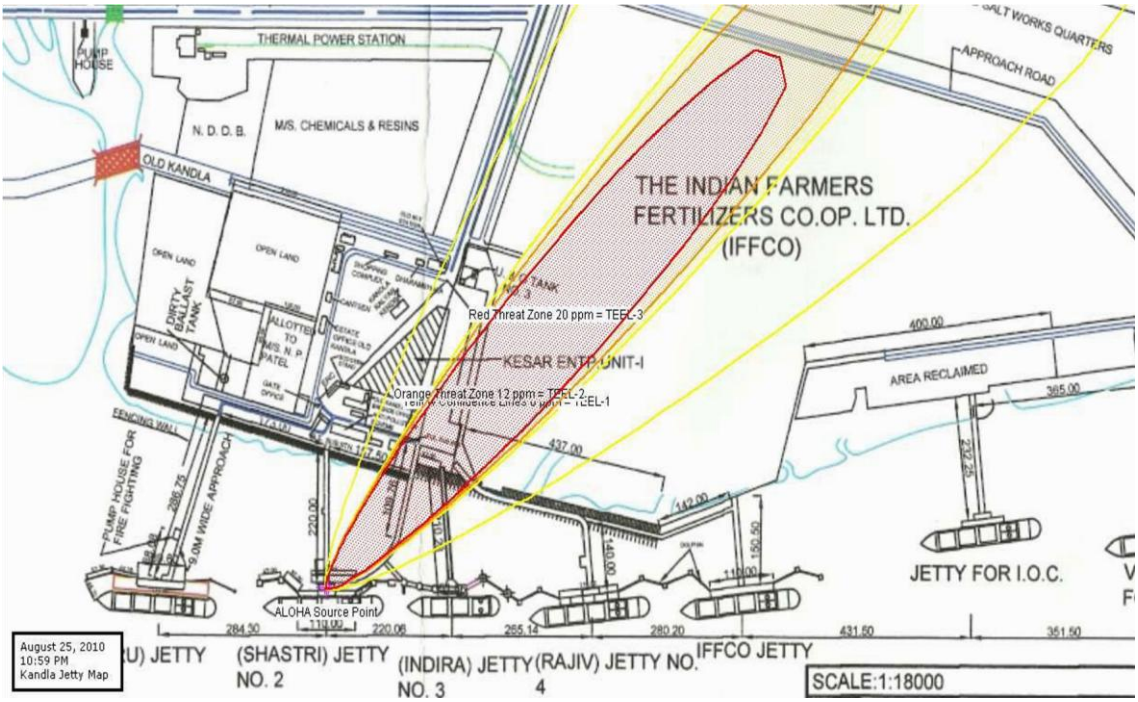


20.1.4 Jetty Two – Aniline

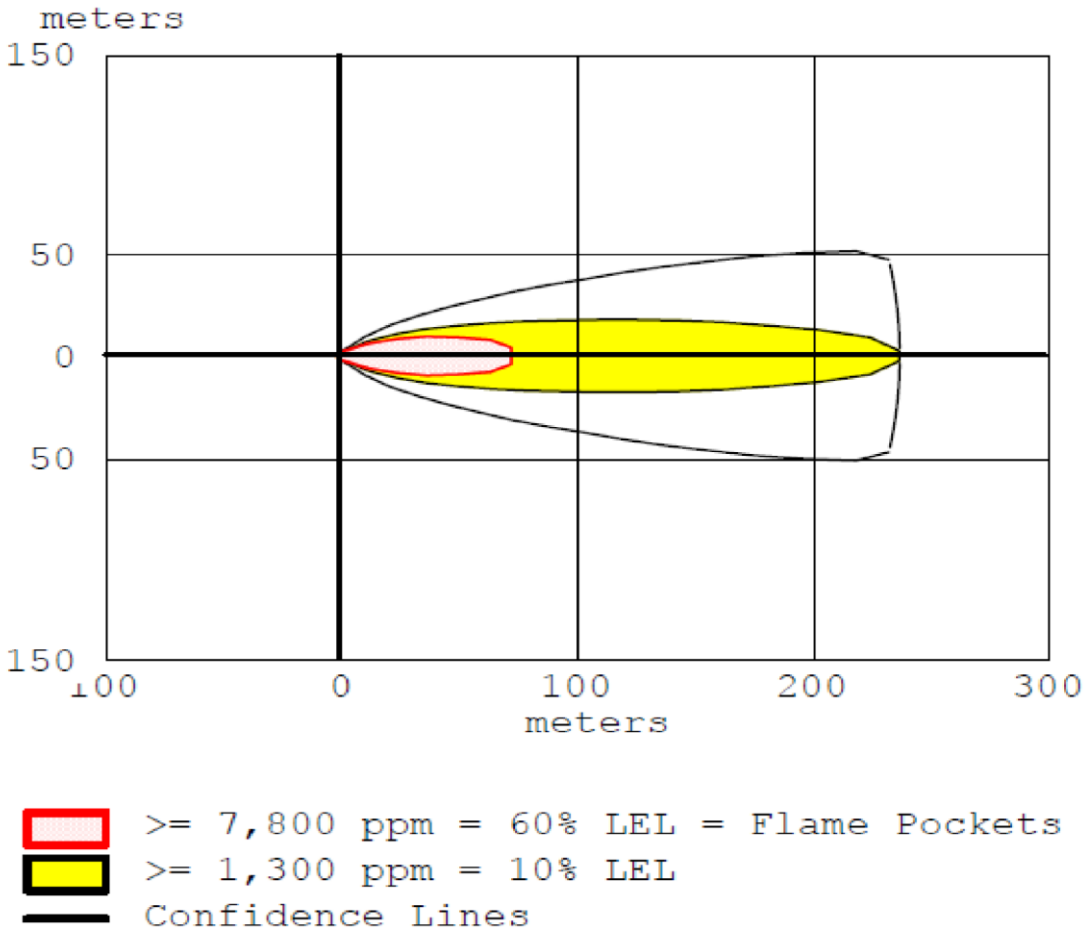
20.1.4.1 Instantaneous Release – Toxic Threat Zone (Graph)



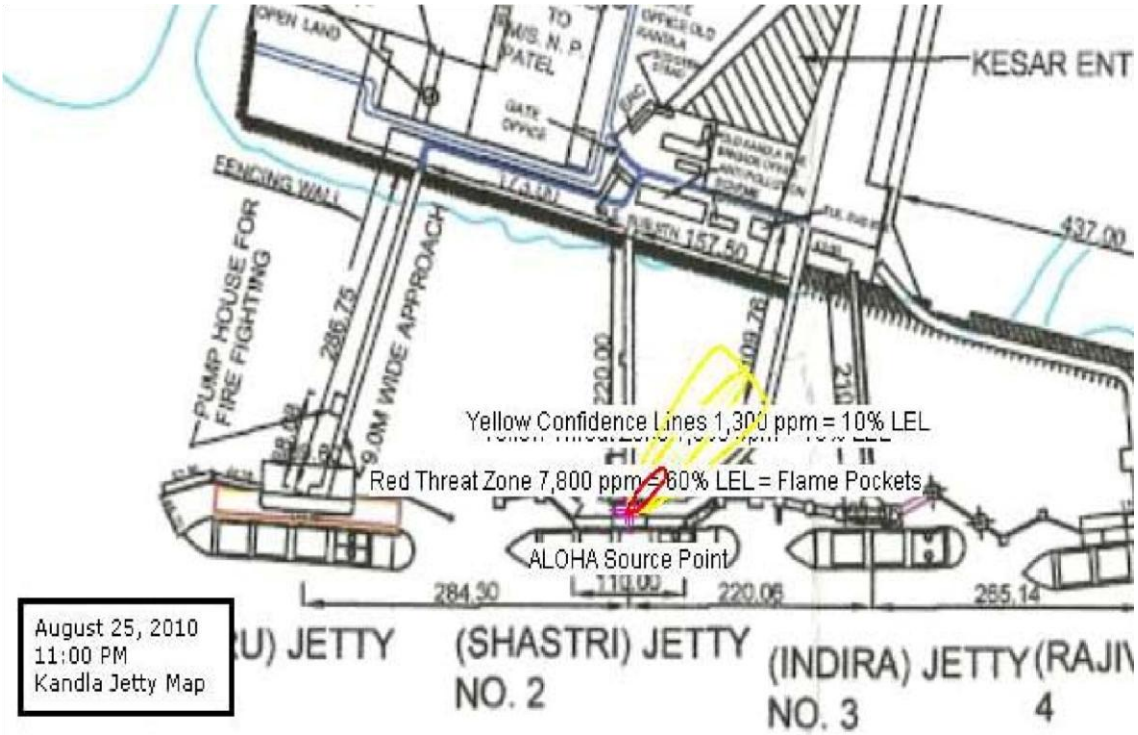
20.1.4.2 Instantaneous Release – Toxic Threat Zone (Contour)



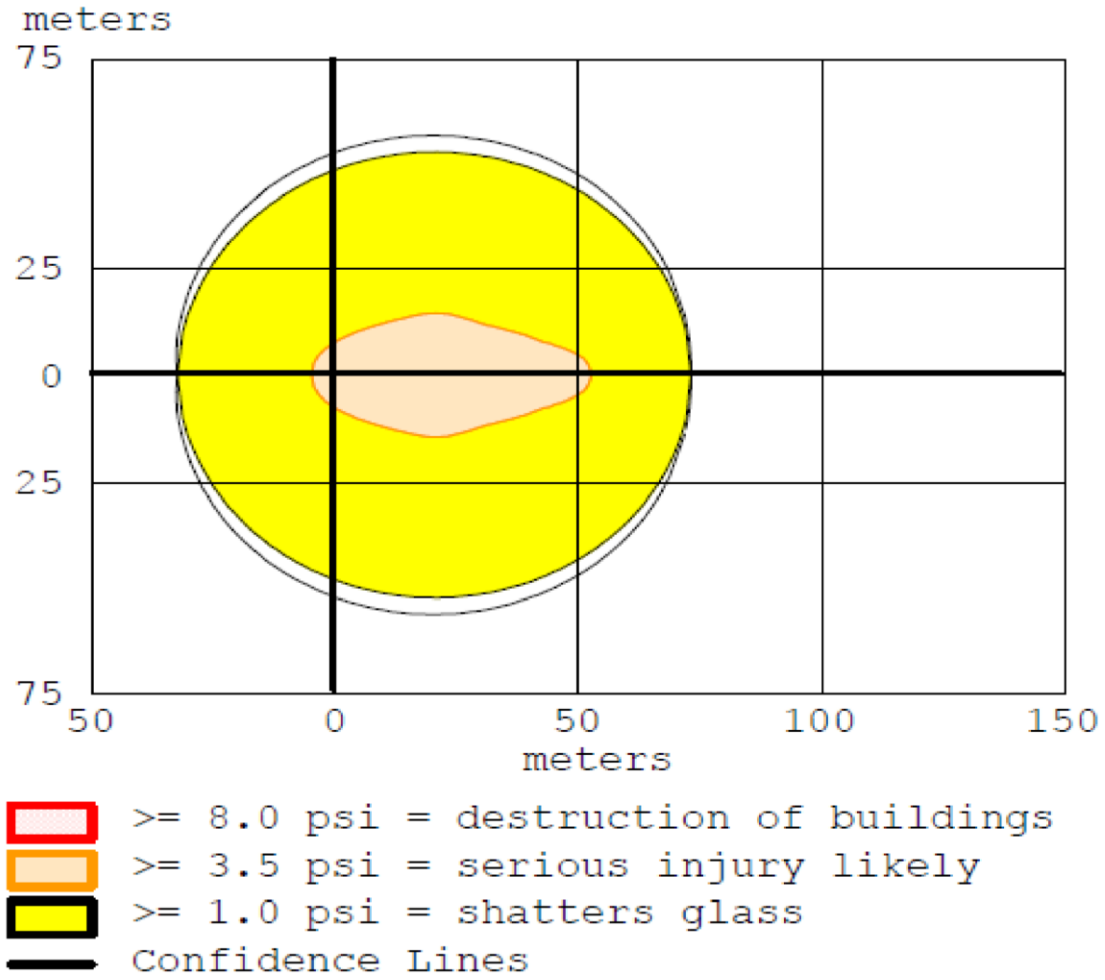
20.1.4.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



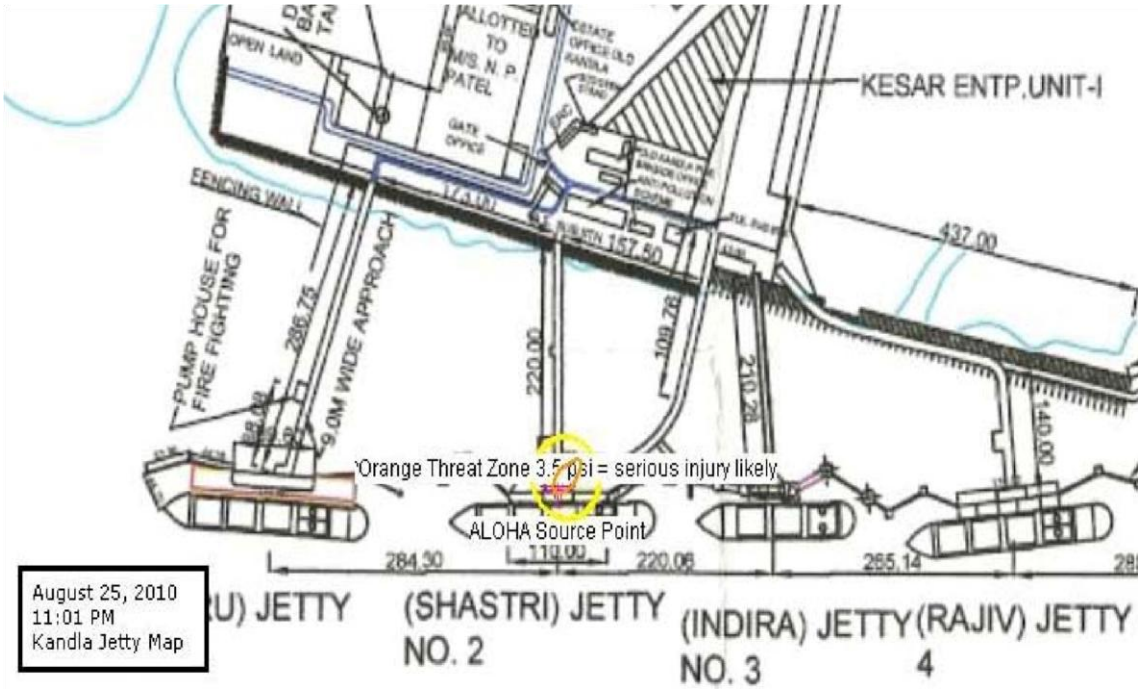
20.1.4.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



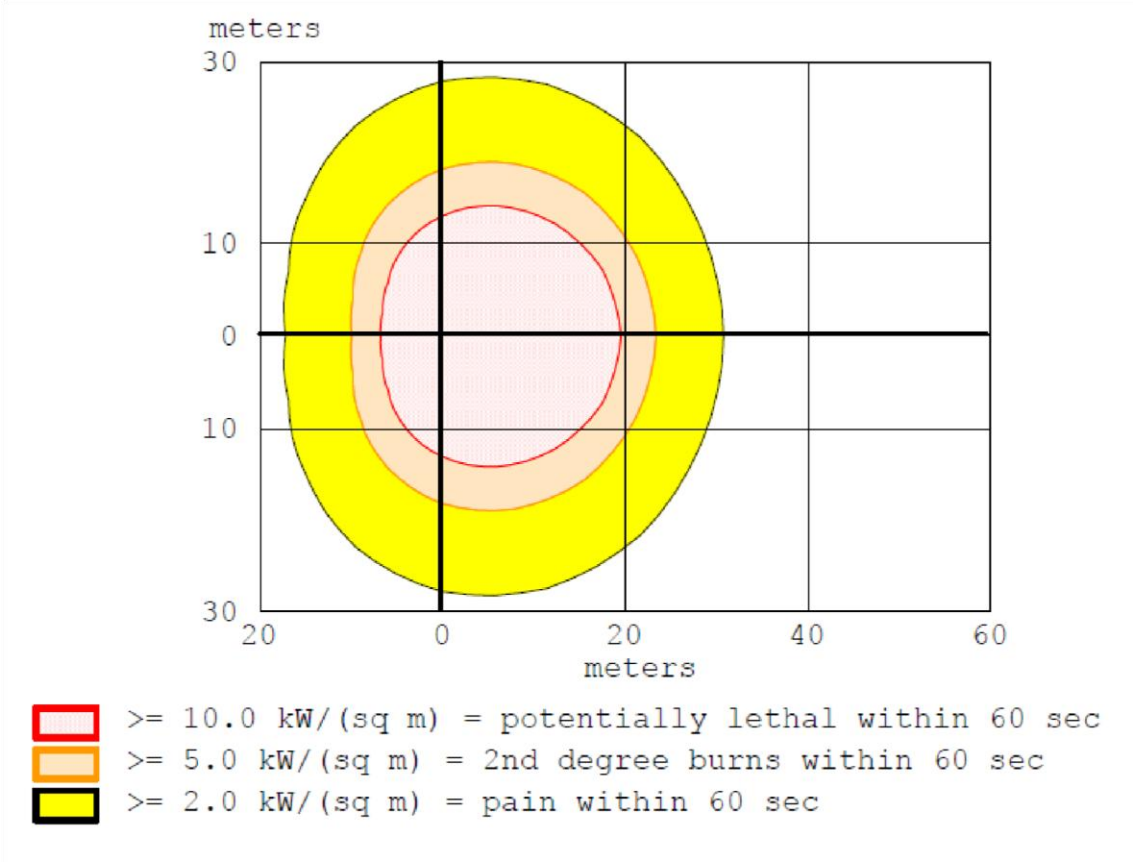
20.1.4.5 Instantaneous Release – Overpressure (Graph)



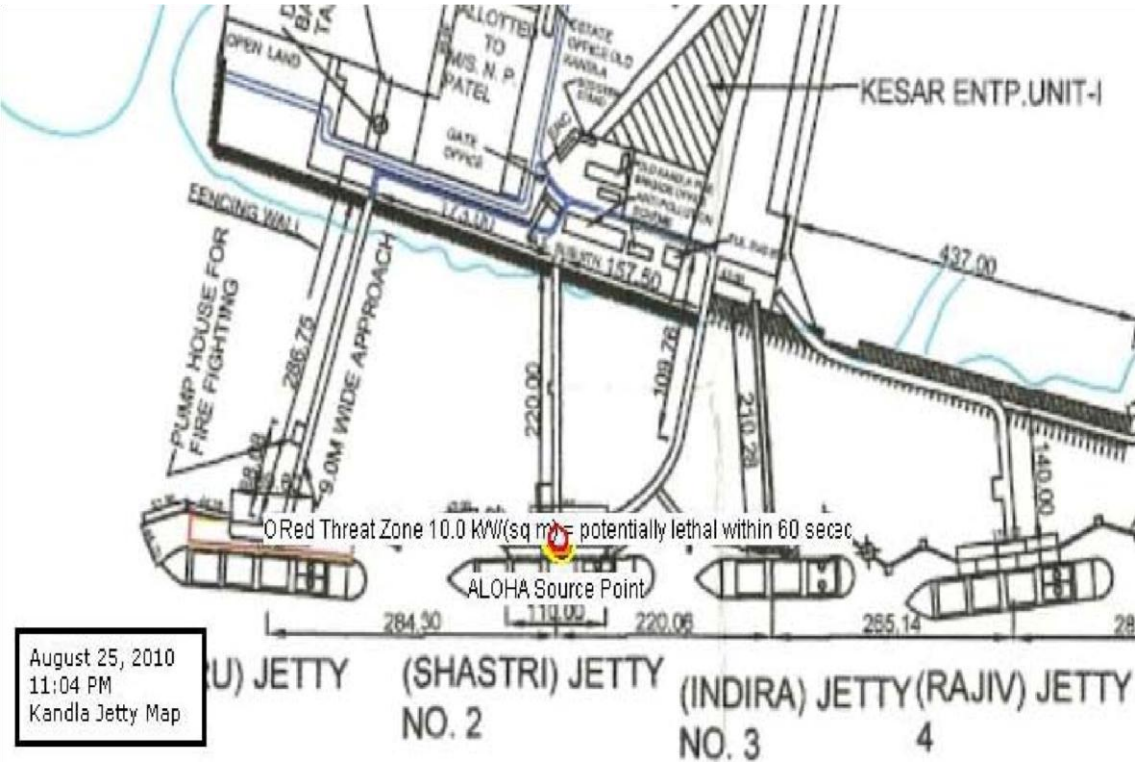
20.1.4.6 Instantaneous Release – Overpressure (Contour)



20.1.4.7 Burning Puddle – Thermal Radiation (Graph)

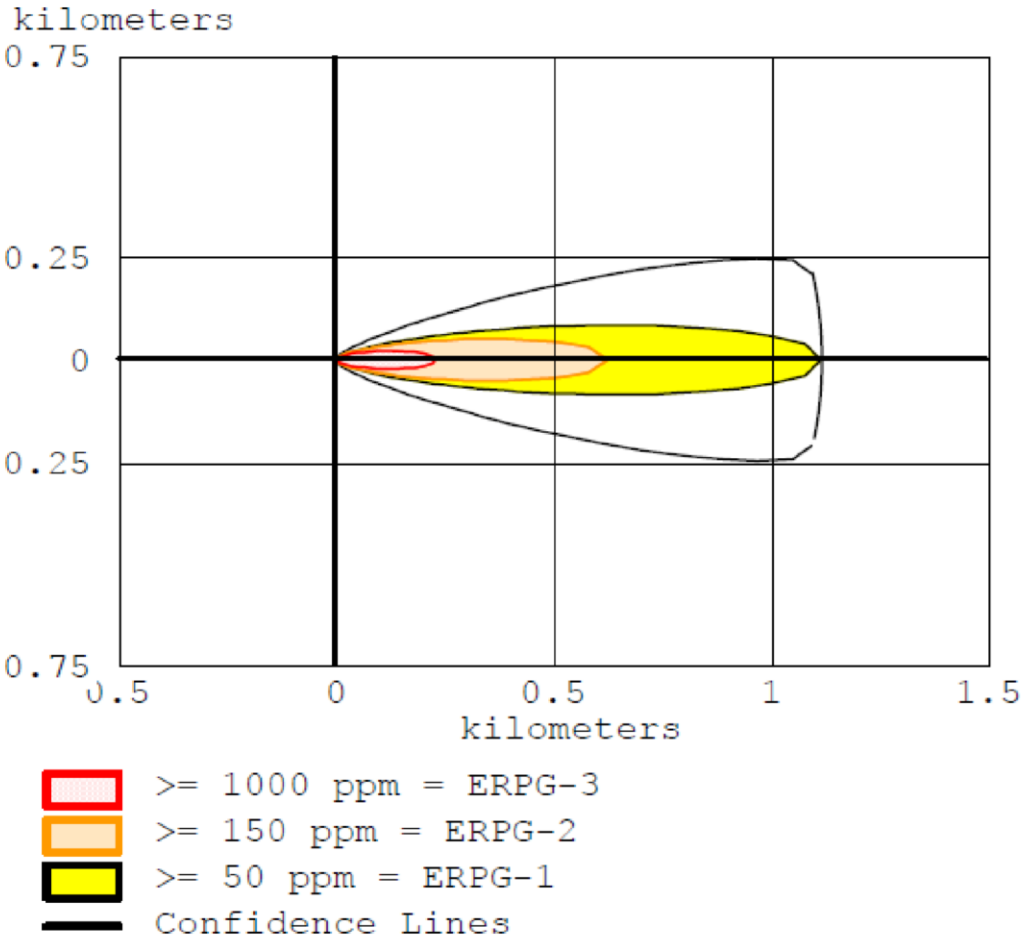


20.1.4.8 Burning Puddle – Thermal Radiation (Contour)

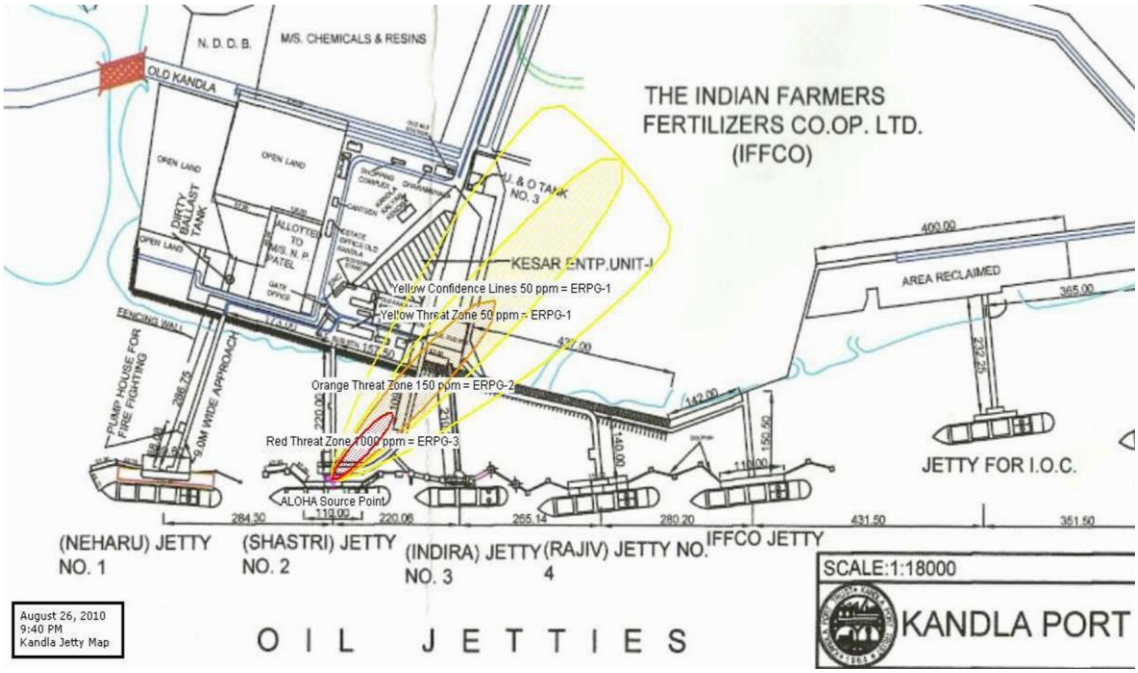


20.1.5 Jetty Two – Benzene

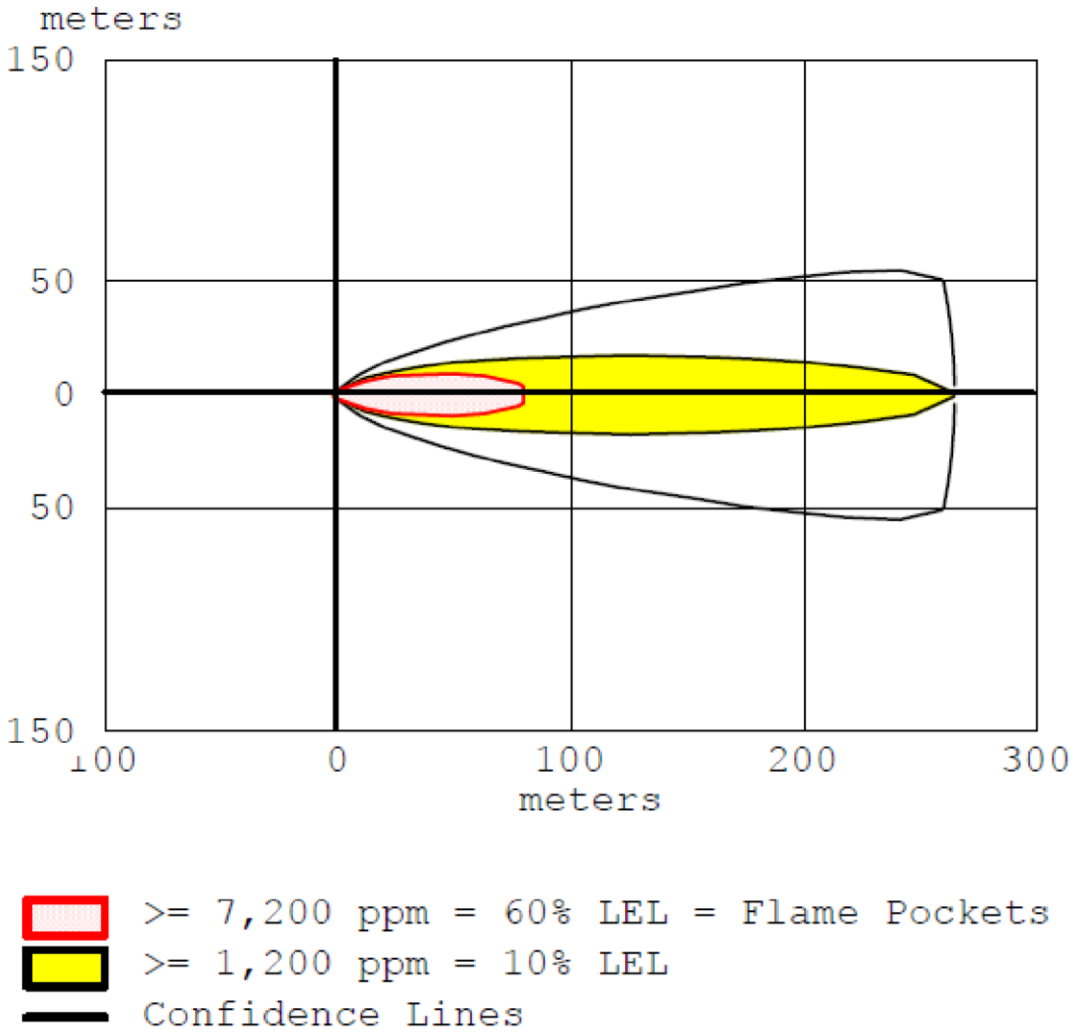
20.1.5.1 Instantaneous Release – Toxic Threat Zone (Graph)



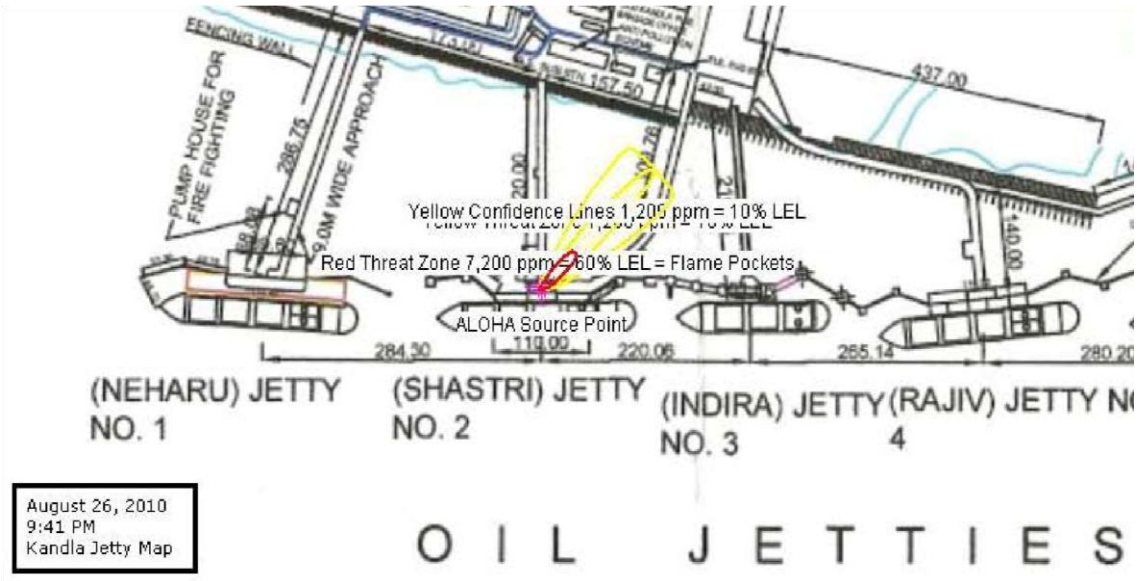
20.1.5.2 Instantaneous Release – Toxic Threat Zone (Contour)



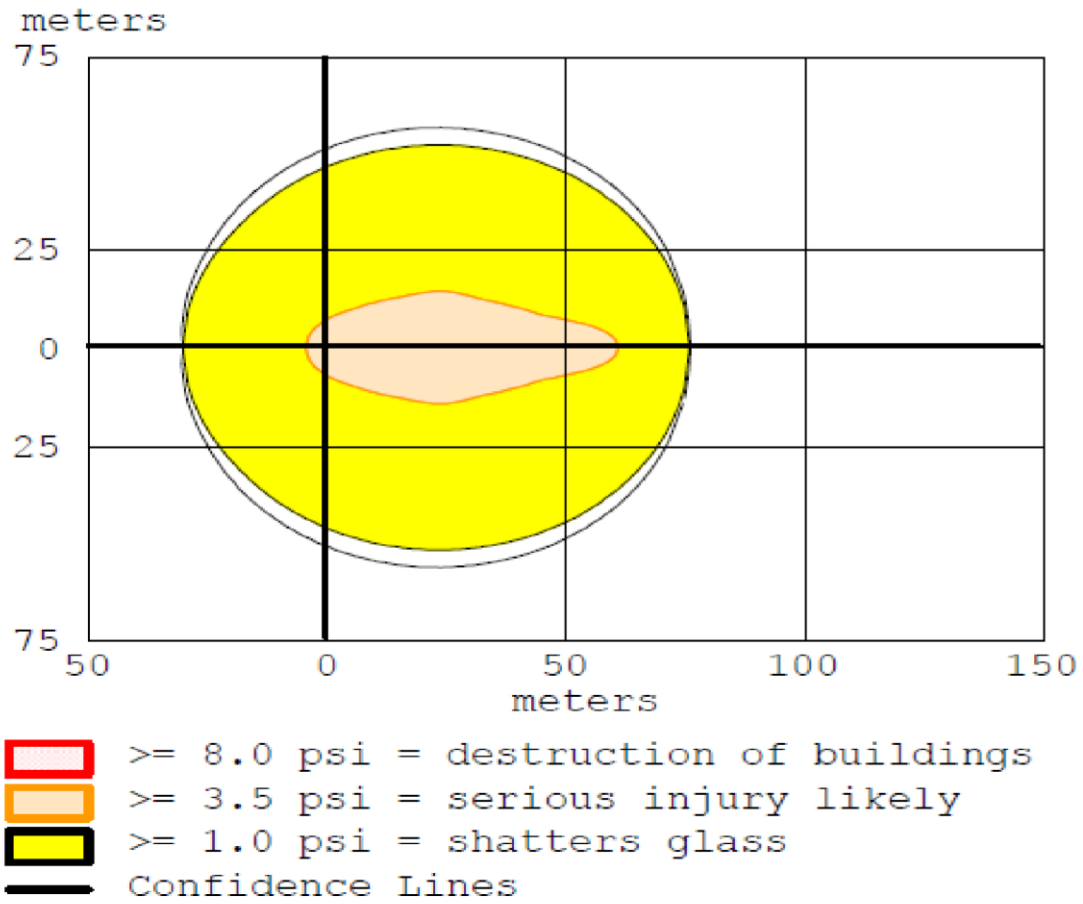
20.1.5.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



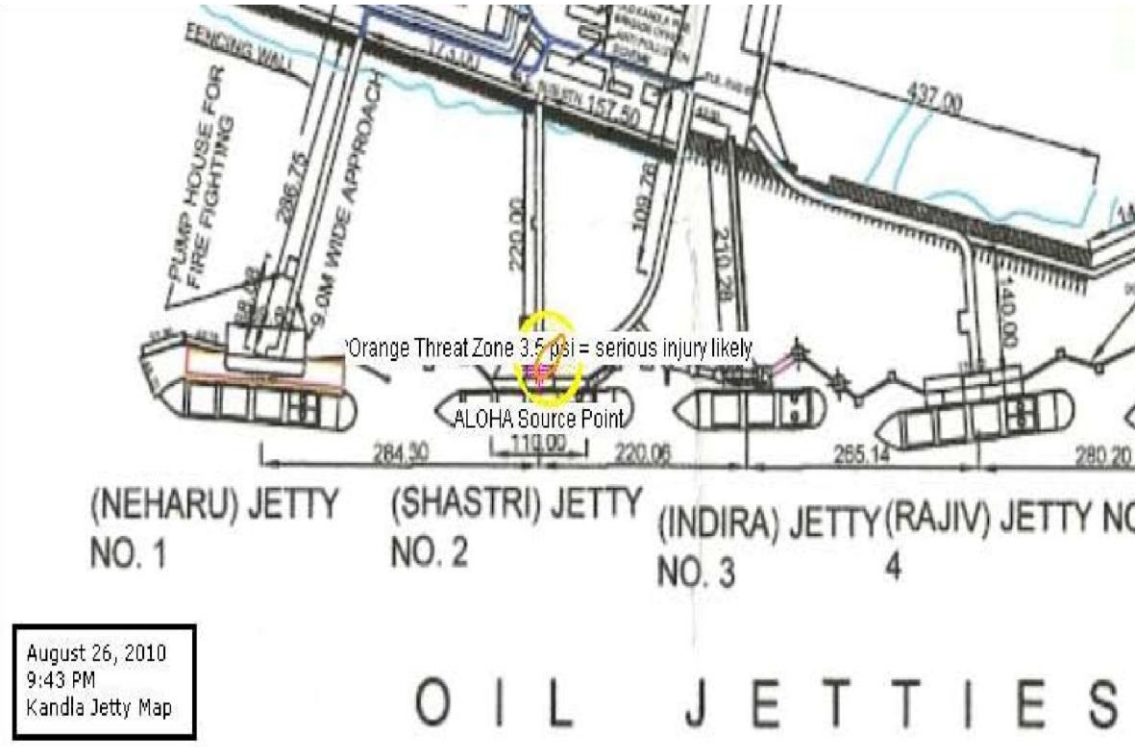
20.1.5.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



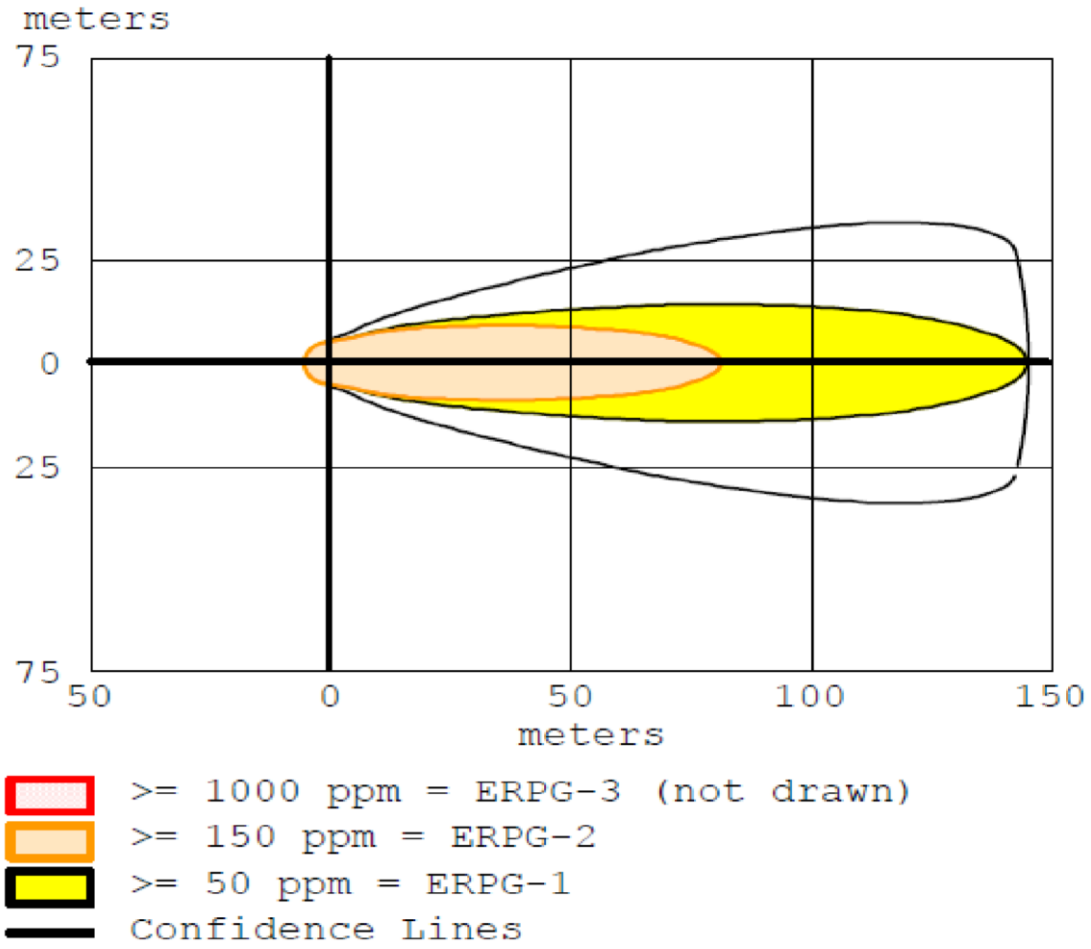
20.1.5.5 Instantaneous Release – Overpressure (Graph)



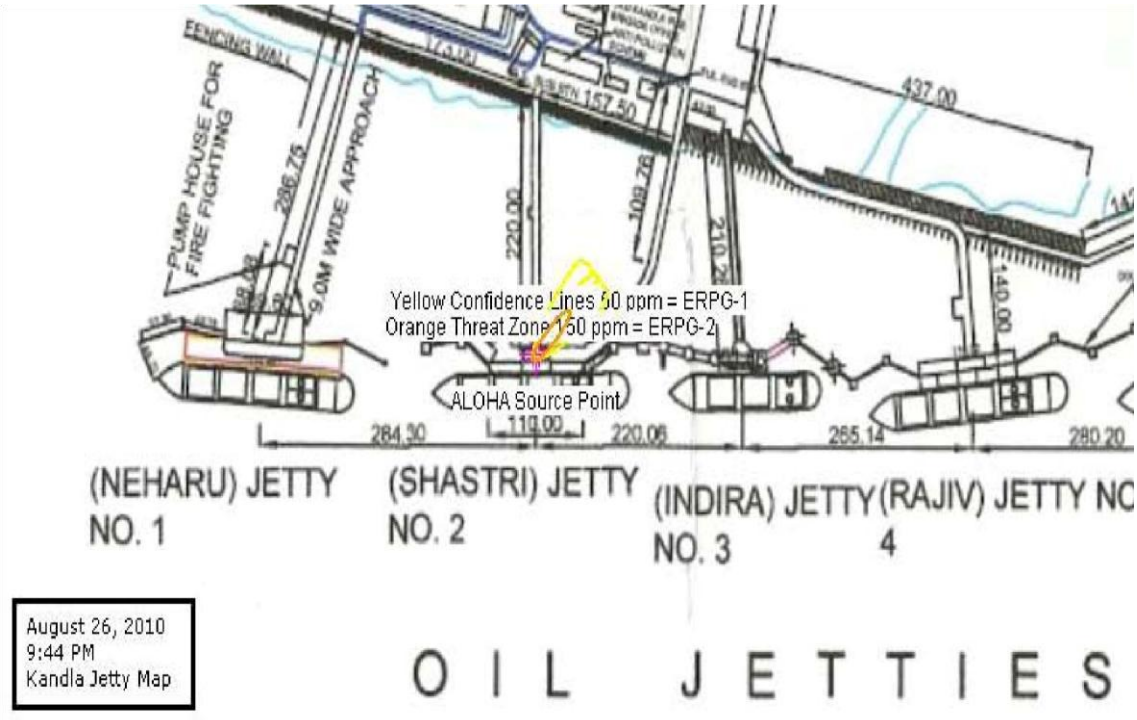
20.1.5.6 Instantaneous Release – Overpressure (Contour)



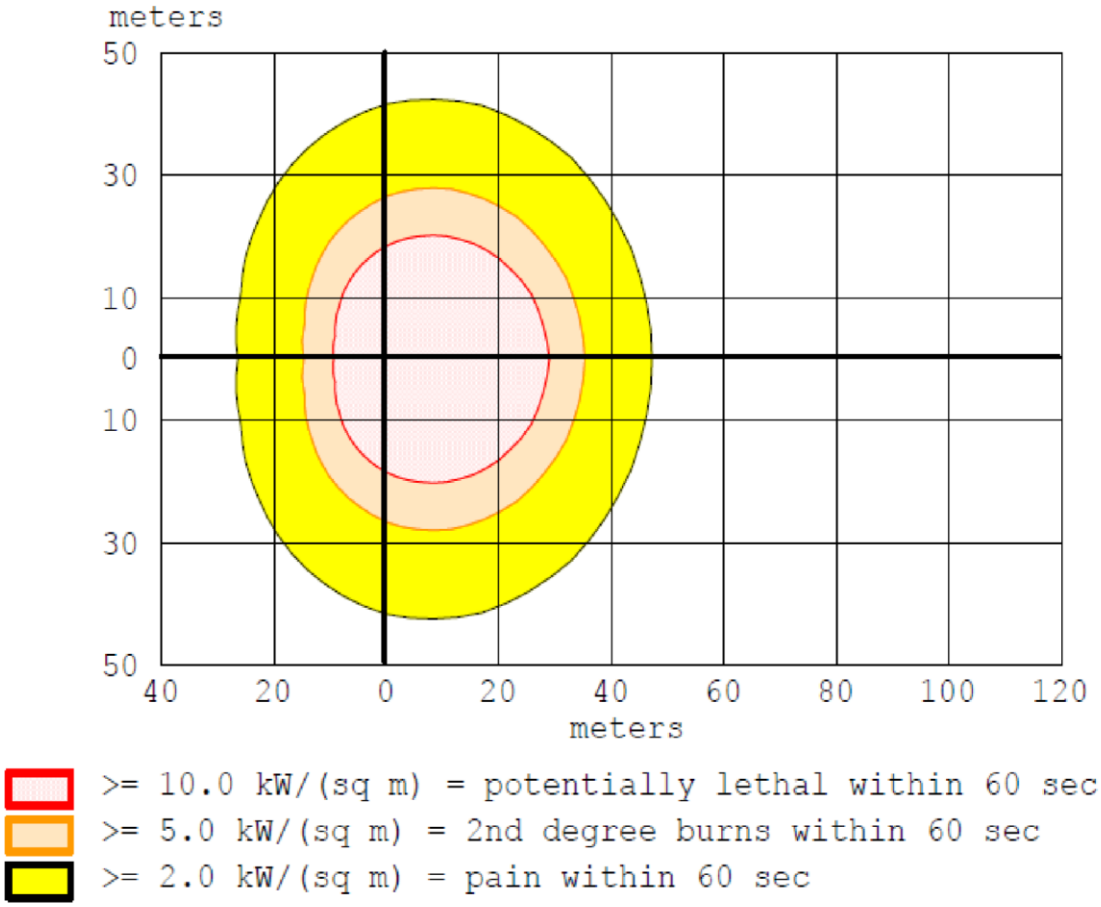
20.1.5.7 Evaporating Puddle – Toxic Threat Zone (Graph)



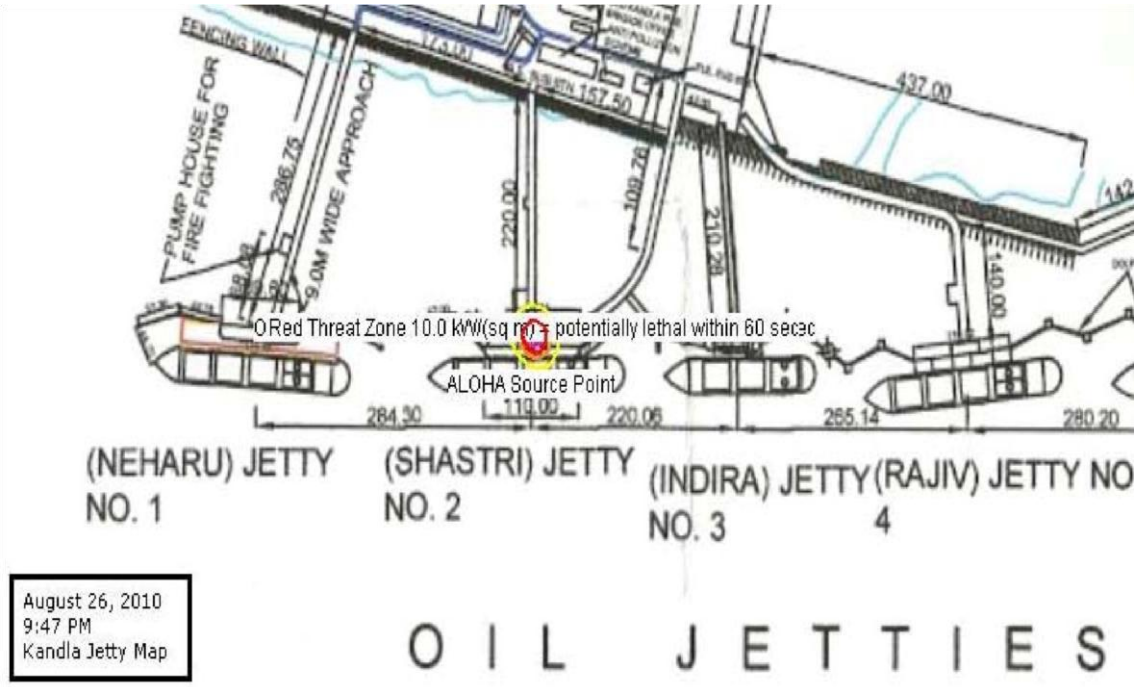
20.1.5.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.5.9 Burning Puddle – Thermal Radiation (Graph)

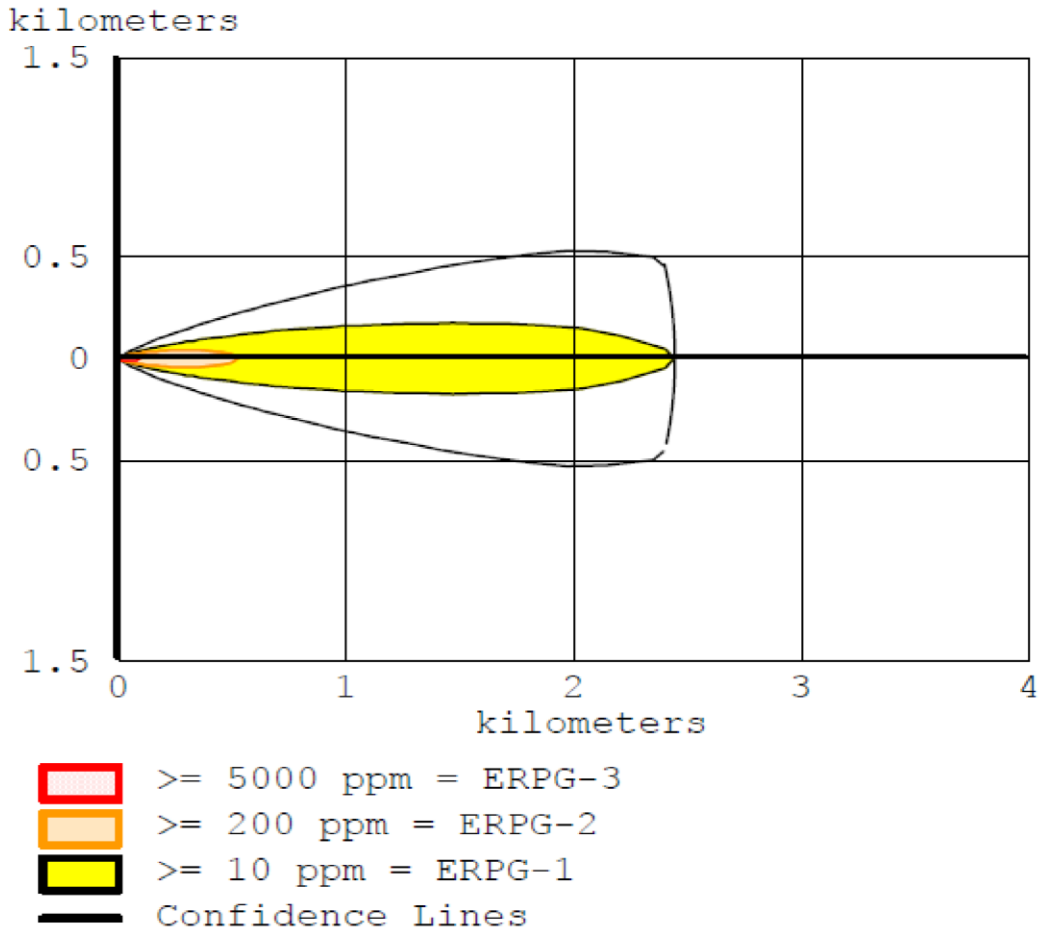


20.1.5.10 Burning Puddle – Thermal Radiation (Contour)

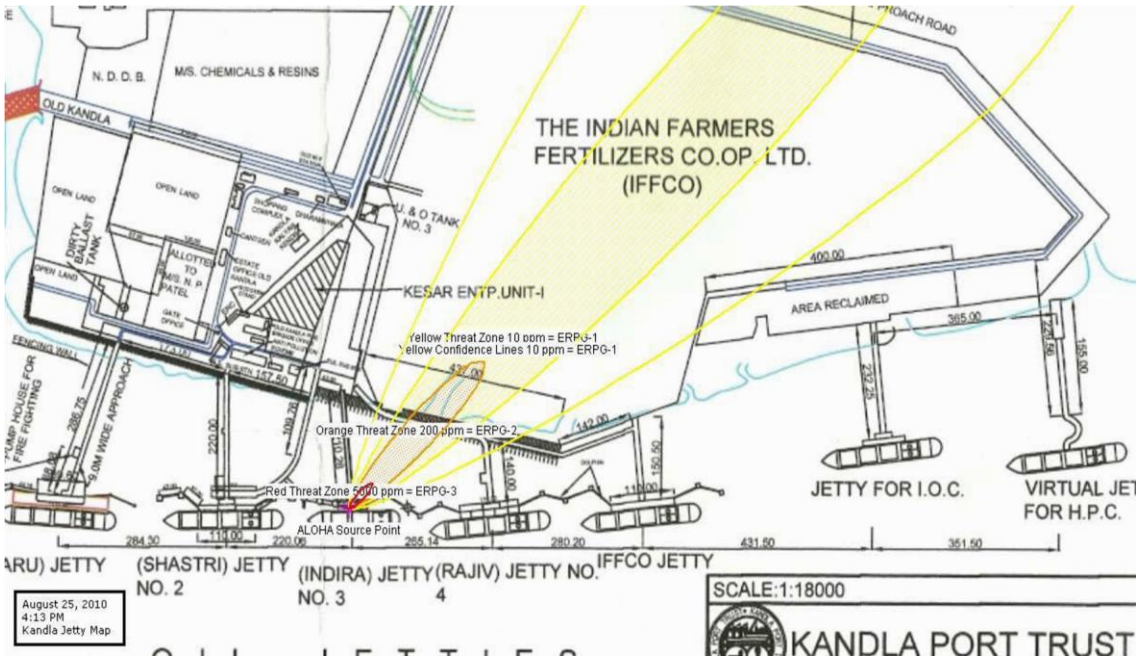


20.1.6 Jetty Three – 1:3, Butadiene

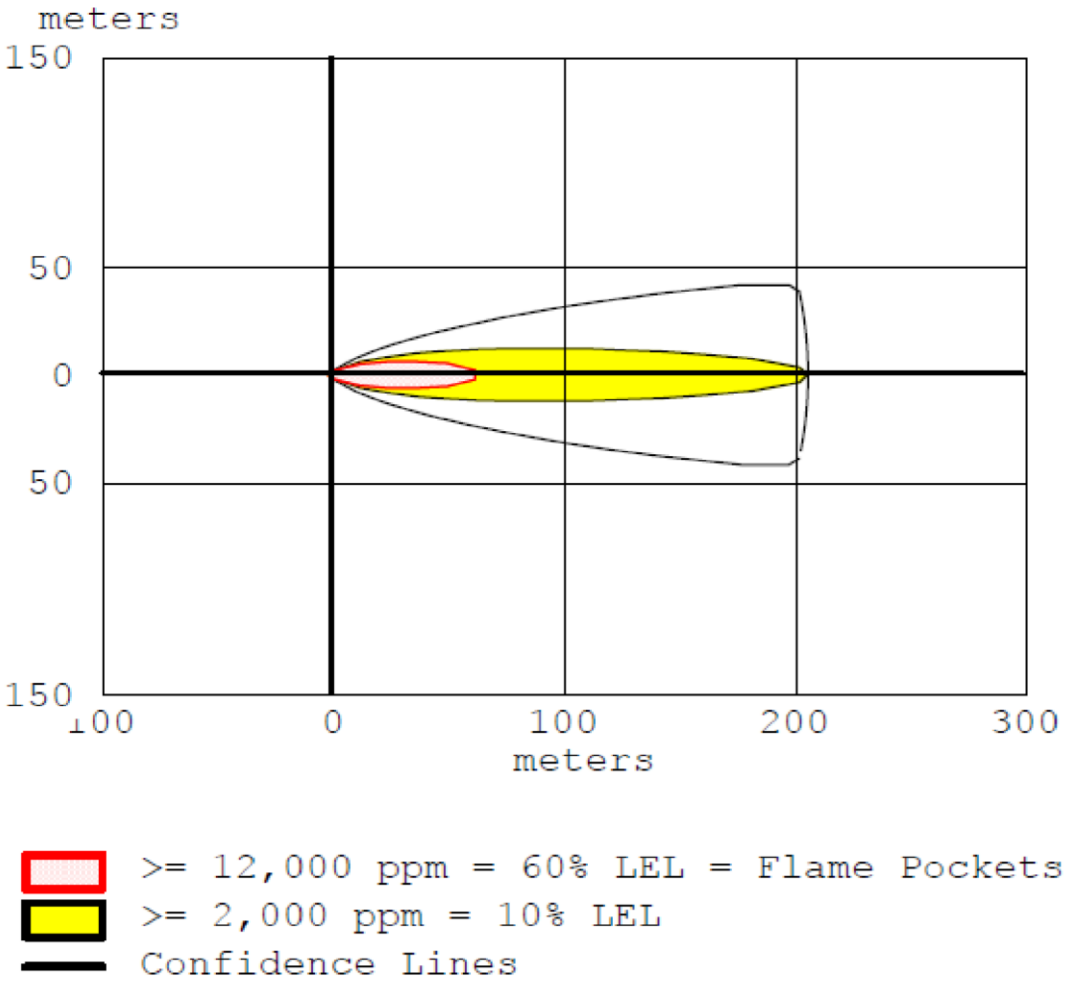
20.1.6.1 Instantaneous Release – Toxic Threat Zone (Graph)



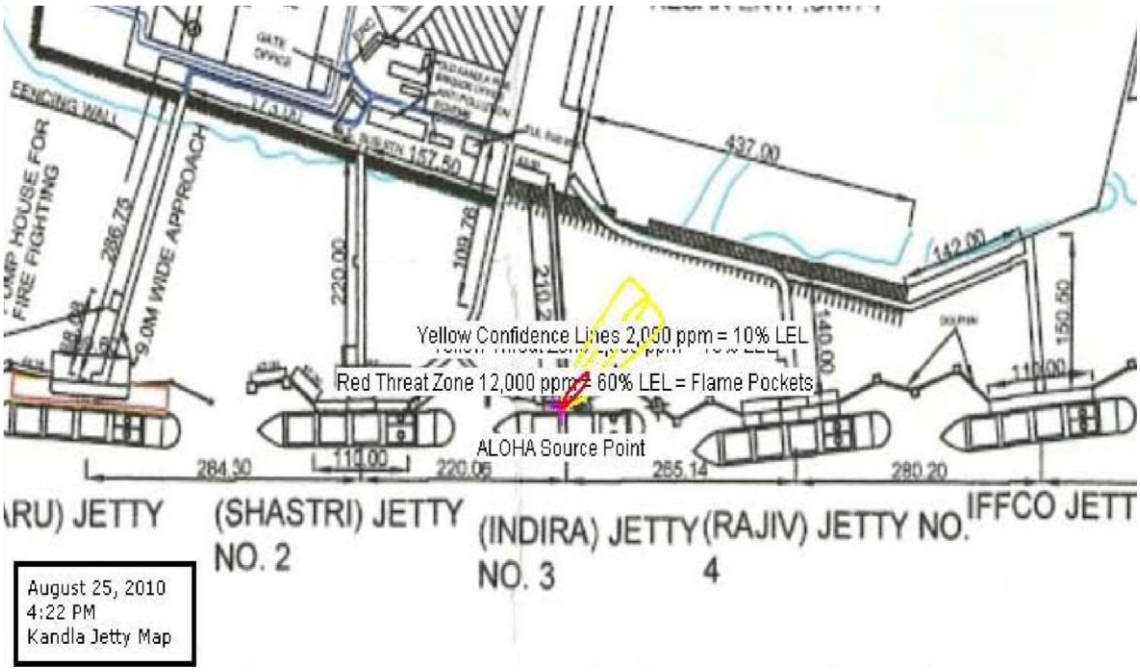
20.1.6.2 Instantaneous Release – Toxic Threat Zone (Contour)



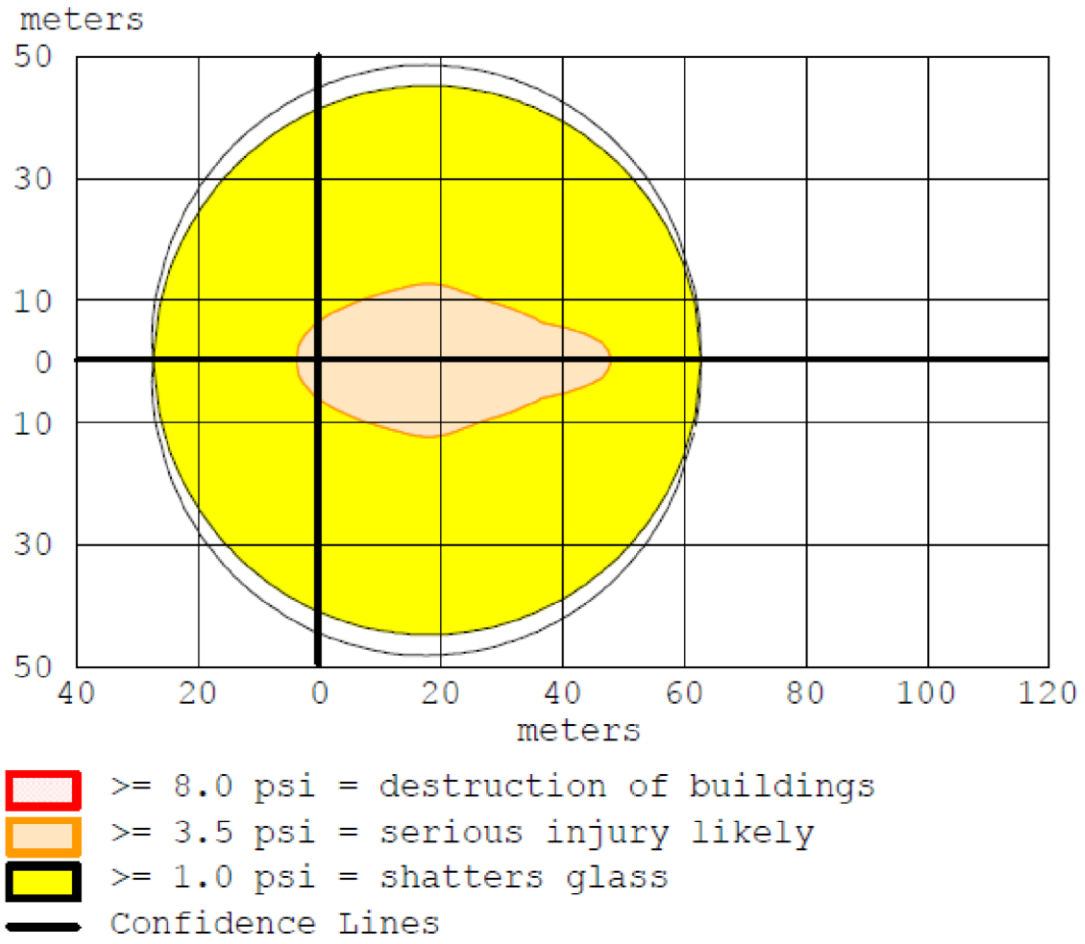
20.1.6.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



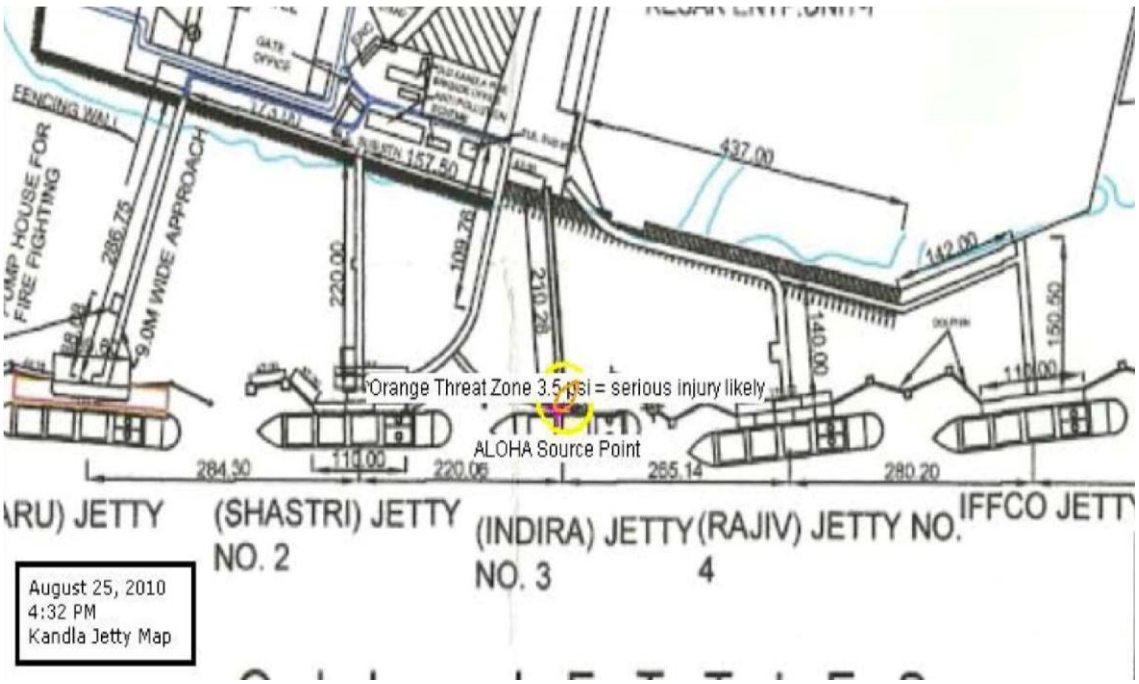
20.1.6.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



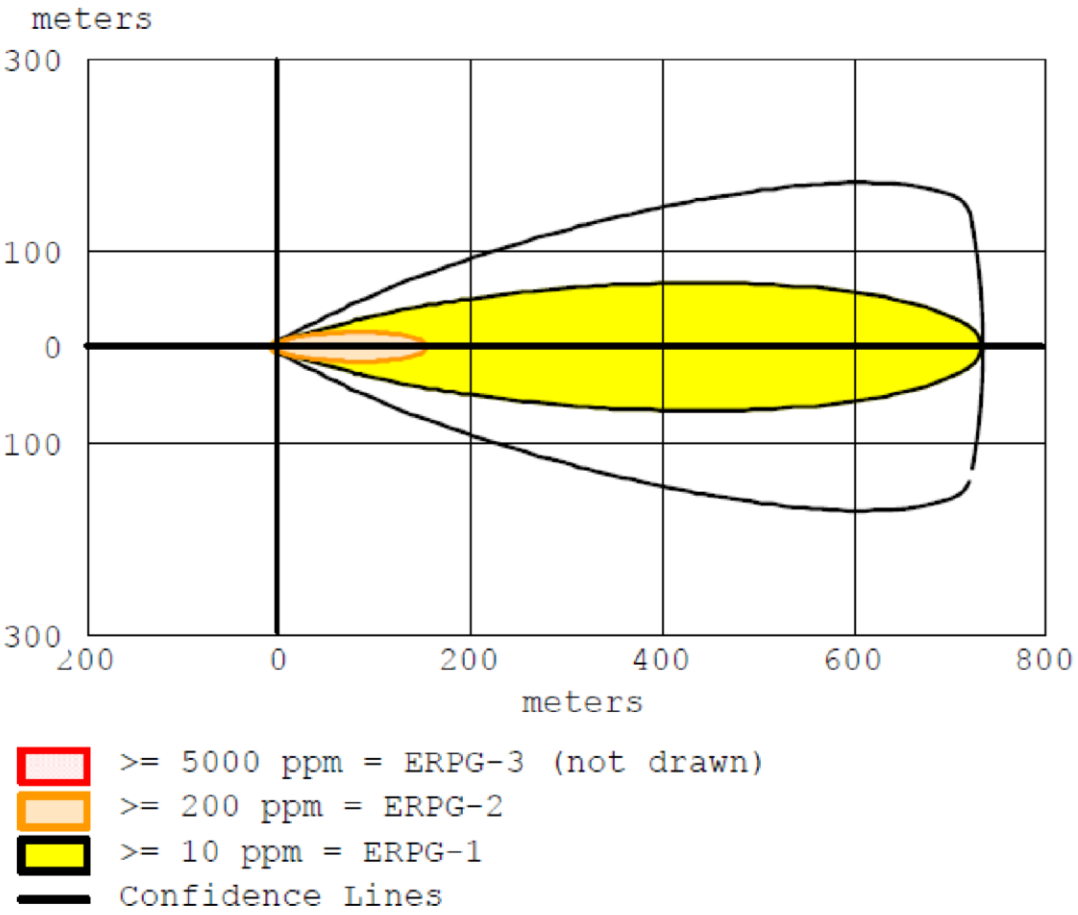
20.1.6.5 Instantaneous Release – Overpressure (Graph)



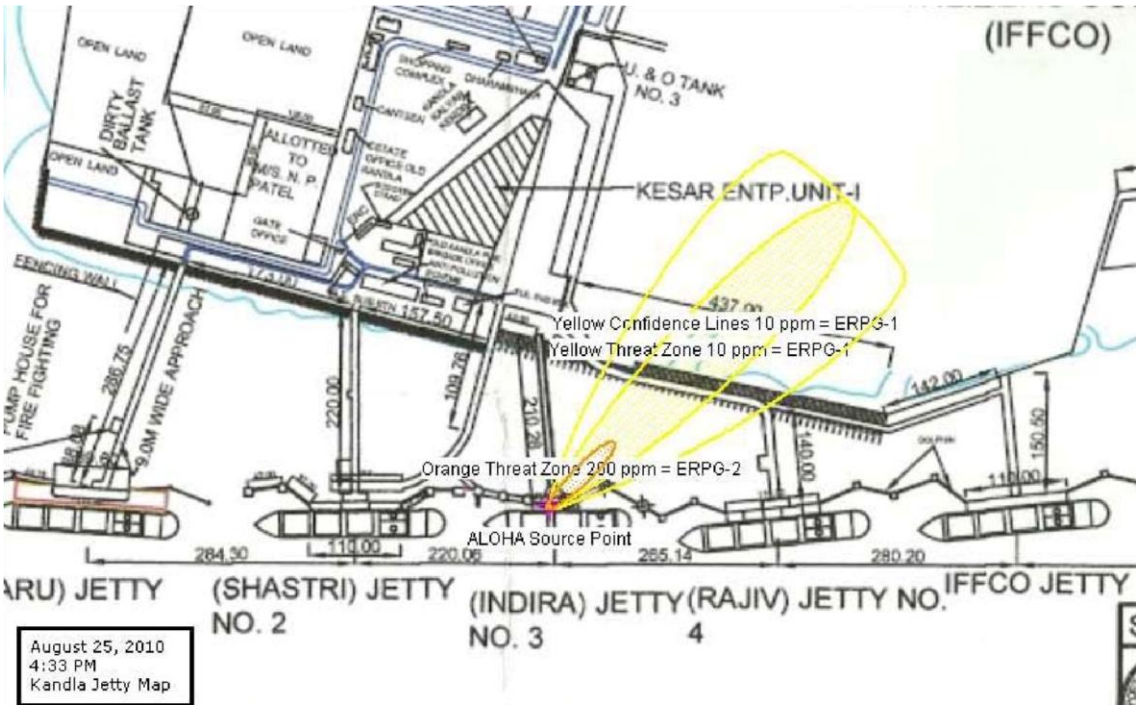
20.1.6.6 Instantaneous Release – Overpressure (Contour)



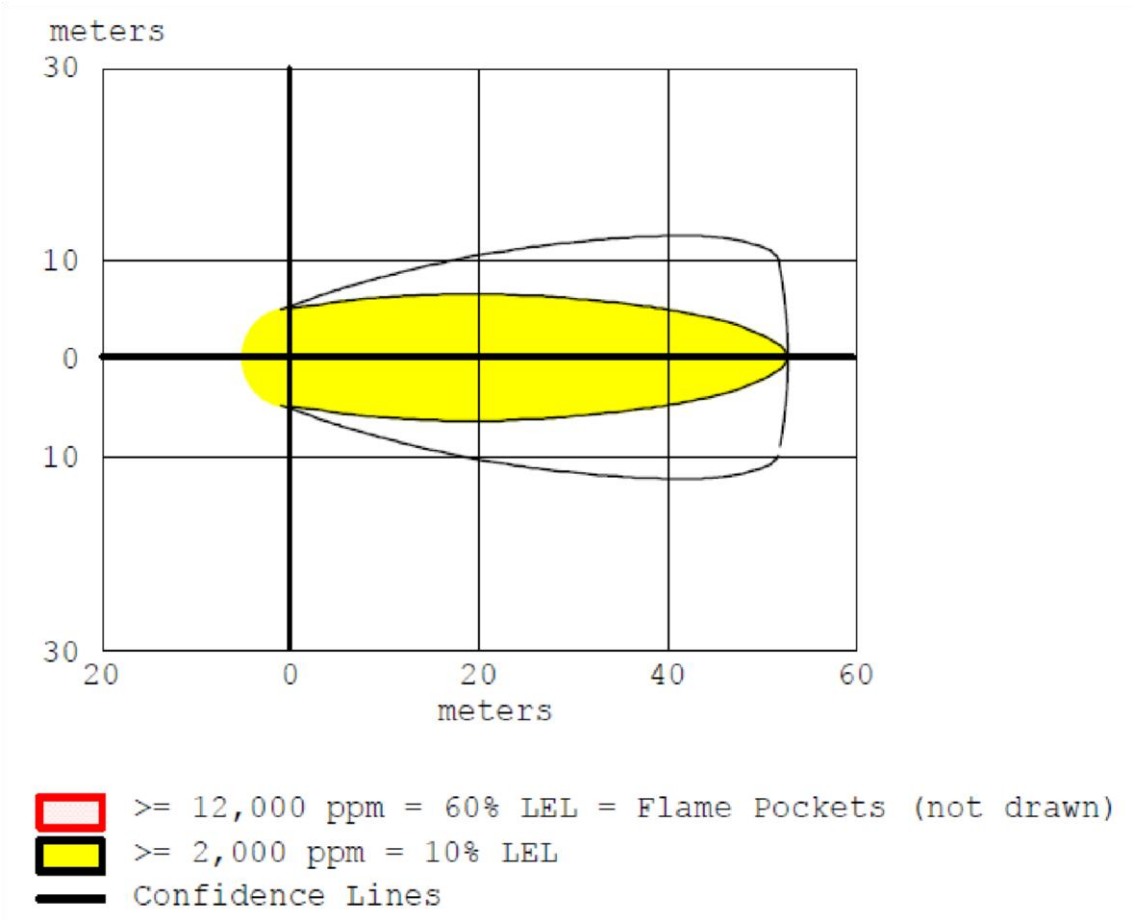
20.1.6.7 Evaporating Puddle – Toxic Threat Zone (Graph)



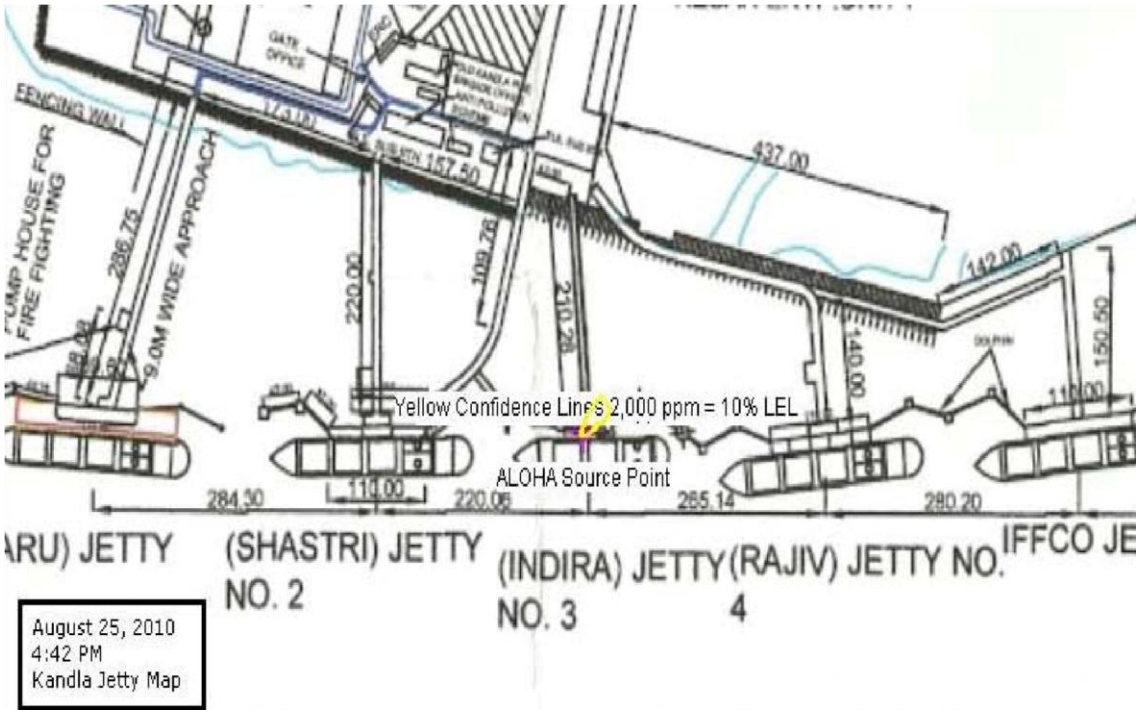
20.1.6.8 Evaporating Puddle – Toxic Threat Zone (Contour)



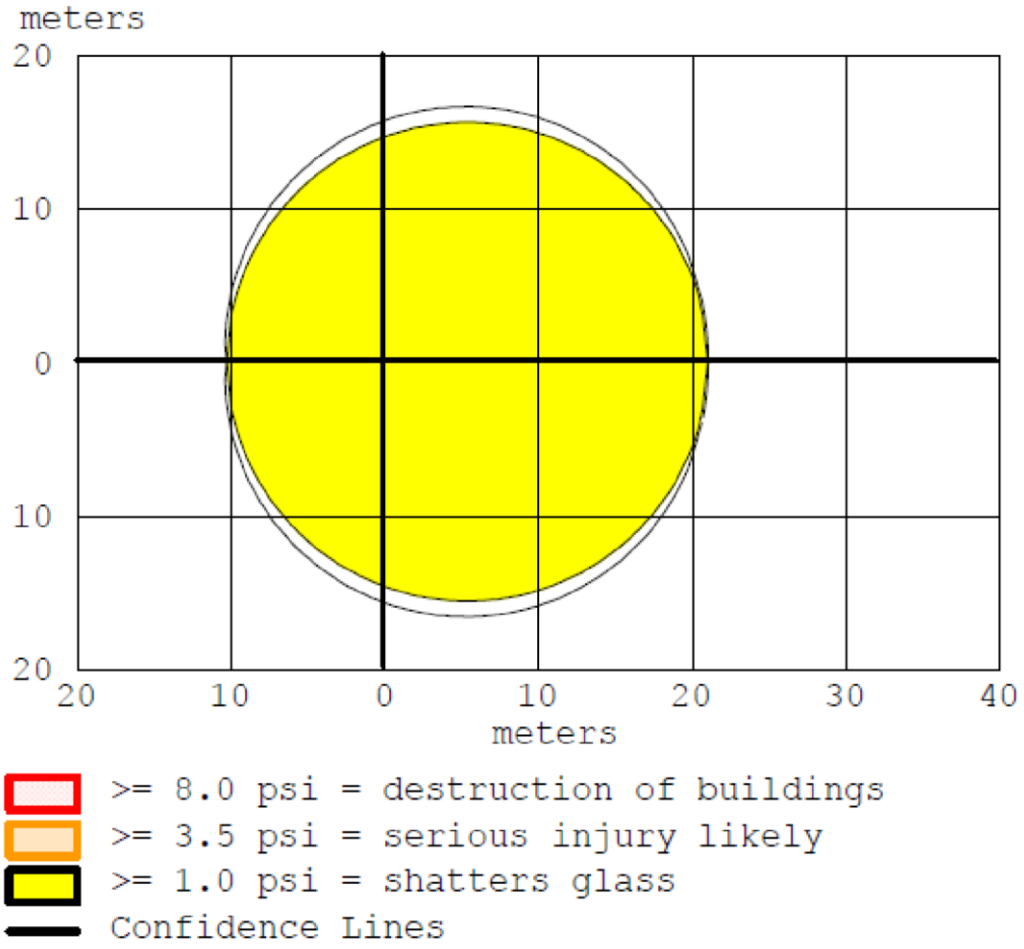
20.1.6.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



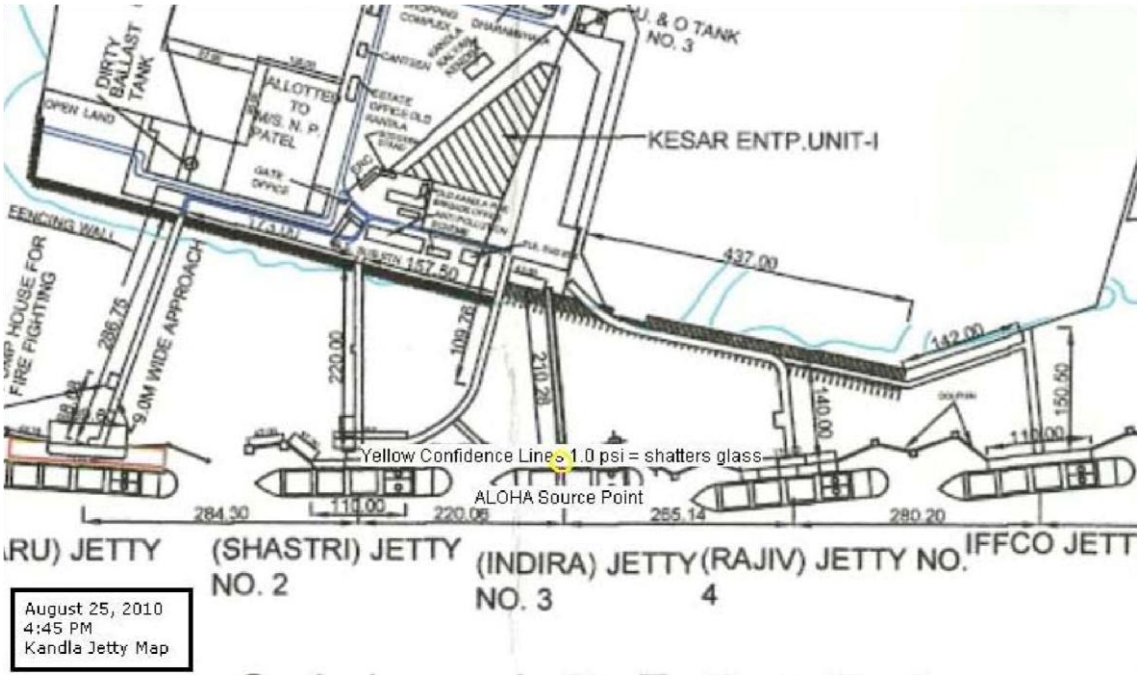
20.1.6.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



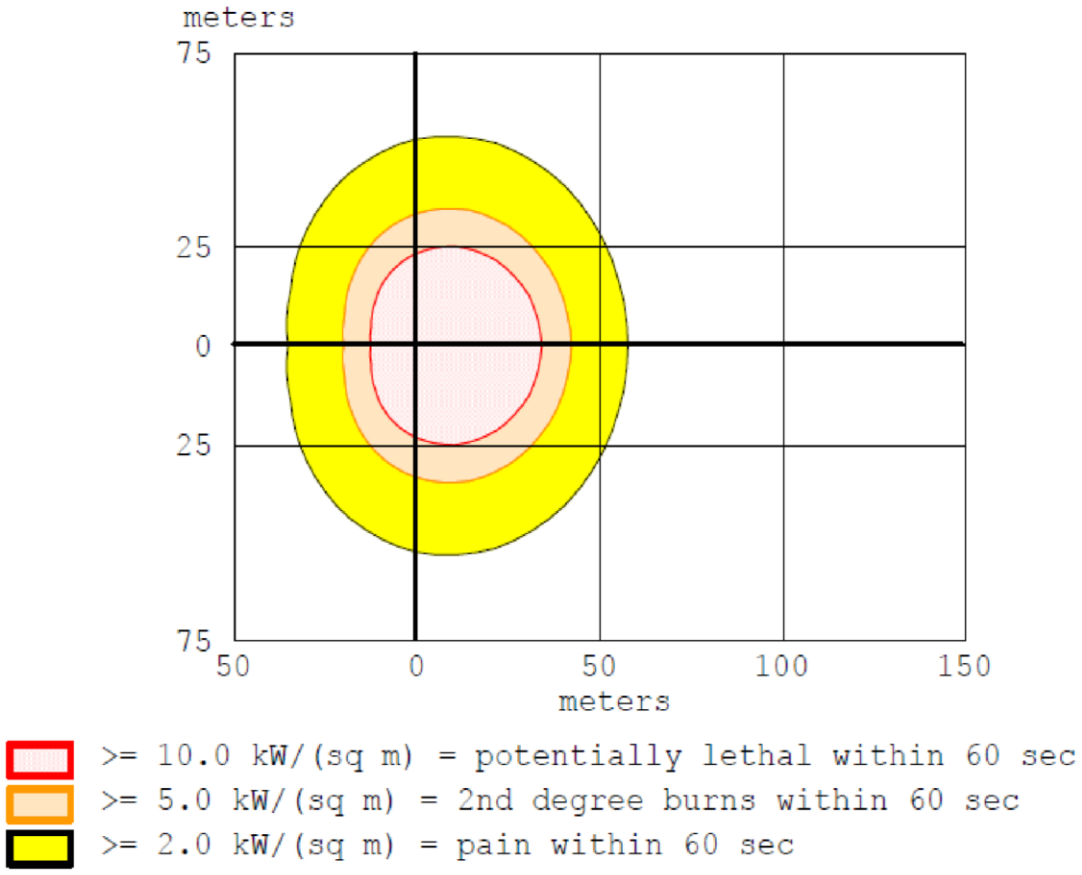
20.1.6.11 Evaporating Puddle – Overpressure (Graph)



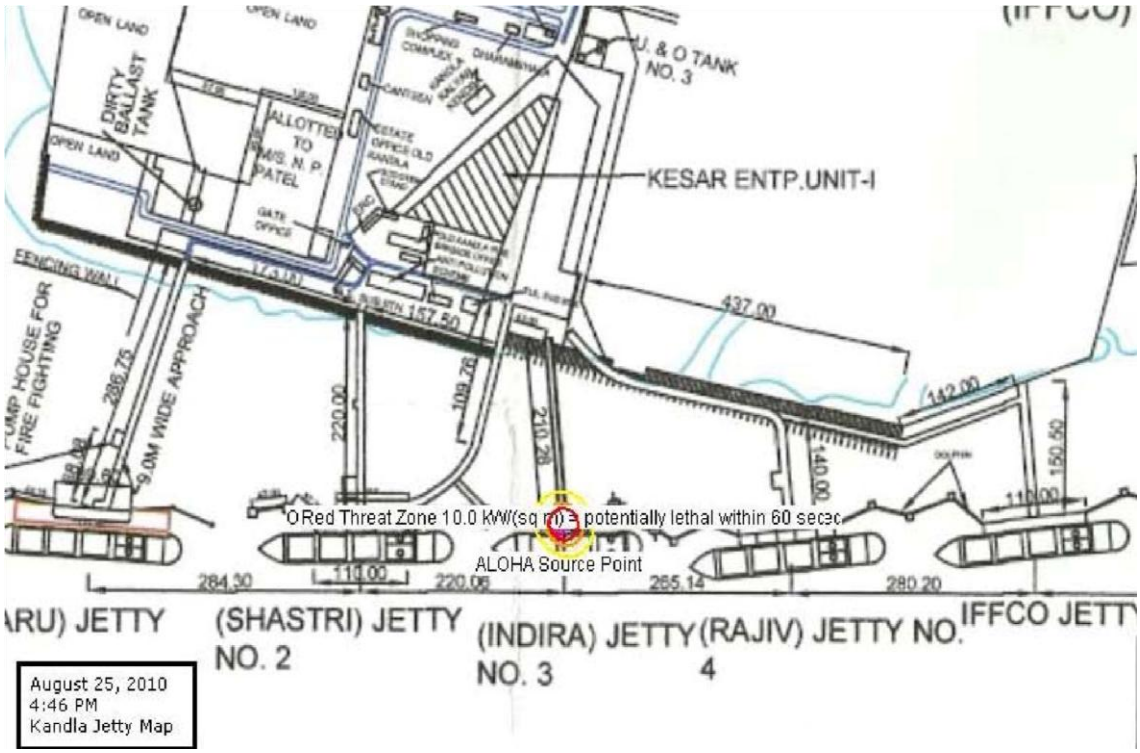
20.1.6.12 Evaporating Puddle – Overpressure (Contour)



20.1.6.13 Burning Puddle – Thermal Radiation (Graph)

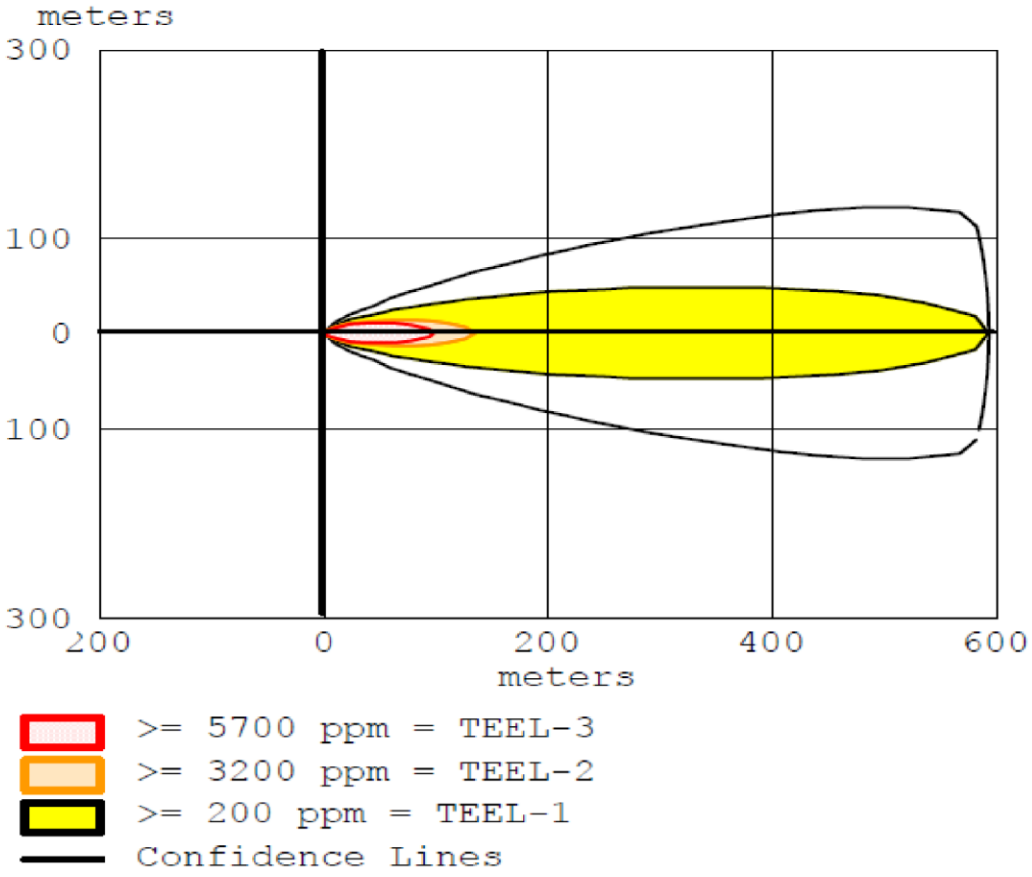


20.1.6.14 Burning Puddle – Thermal Radiation (Contour)

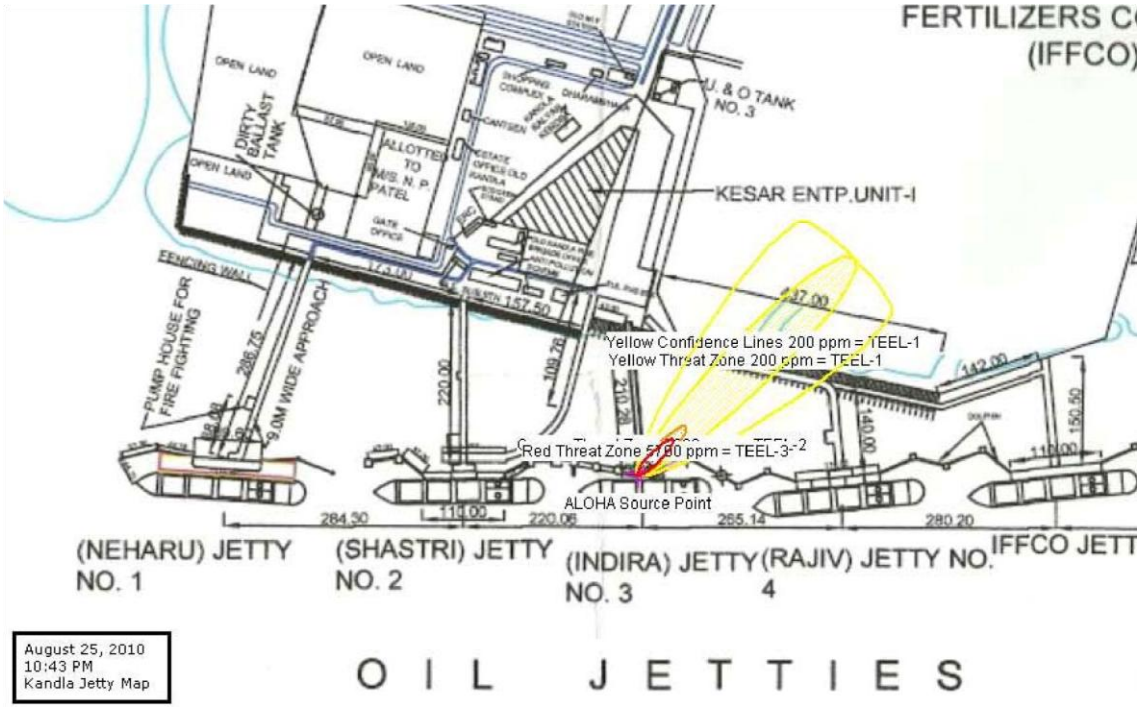


20.1.7 Jetty Three – Acetone

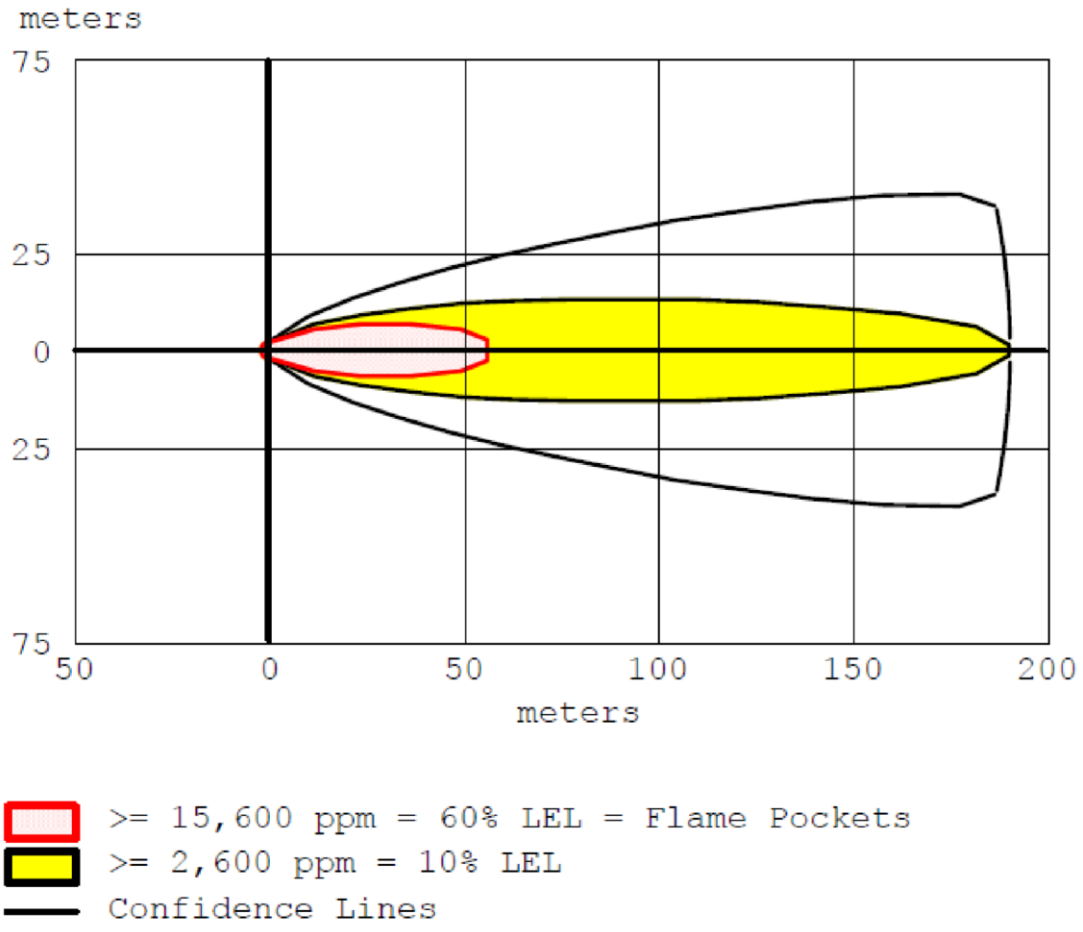
20.1.7.1 Instantaneous Release – Toxic Threat Zone (Graph)



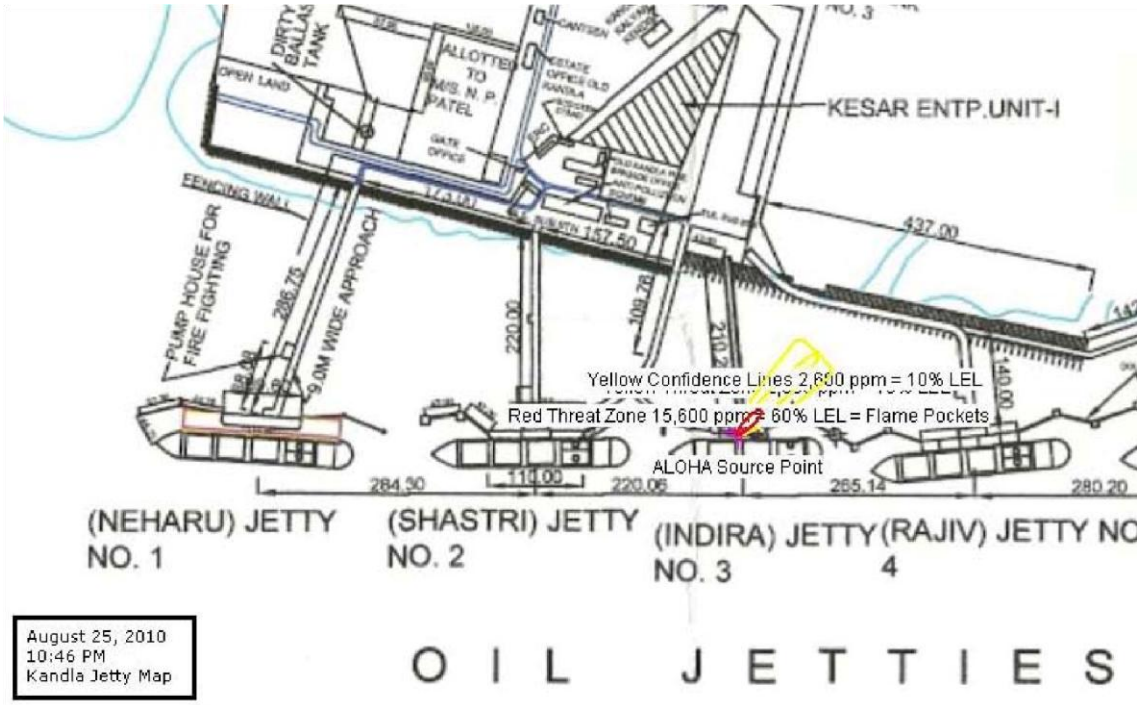
20.1.7.2 Instantaneous Release – Toxic Threat Zone (Contour)



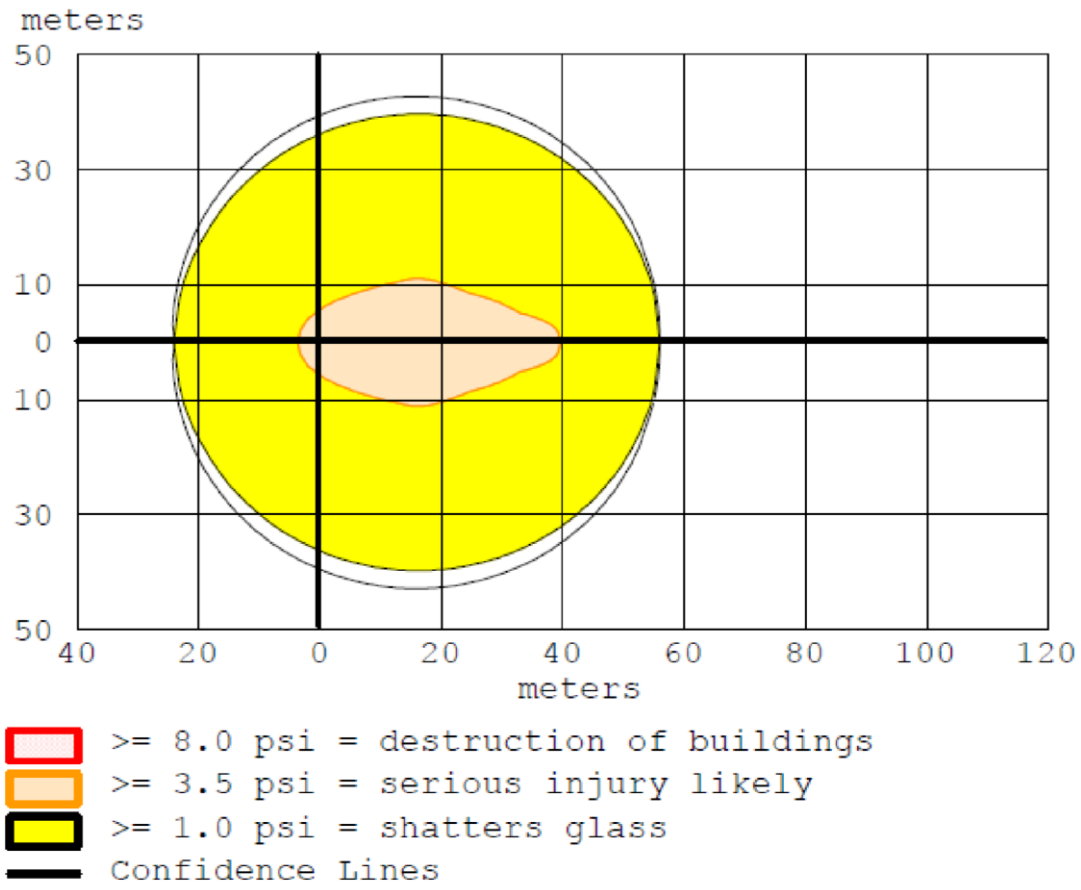
20.1.7.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



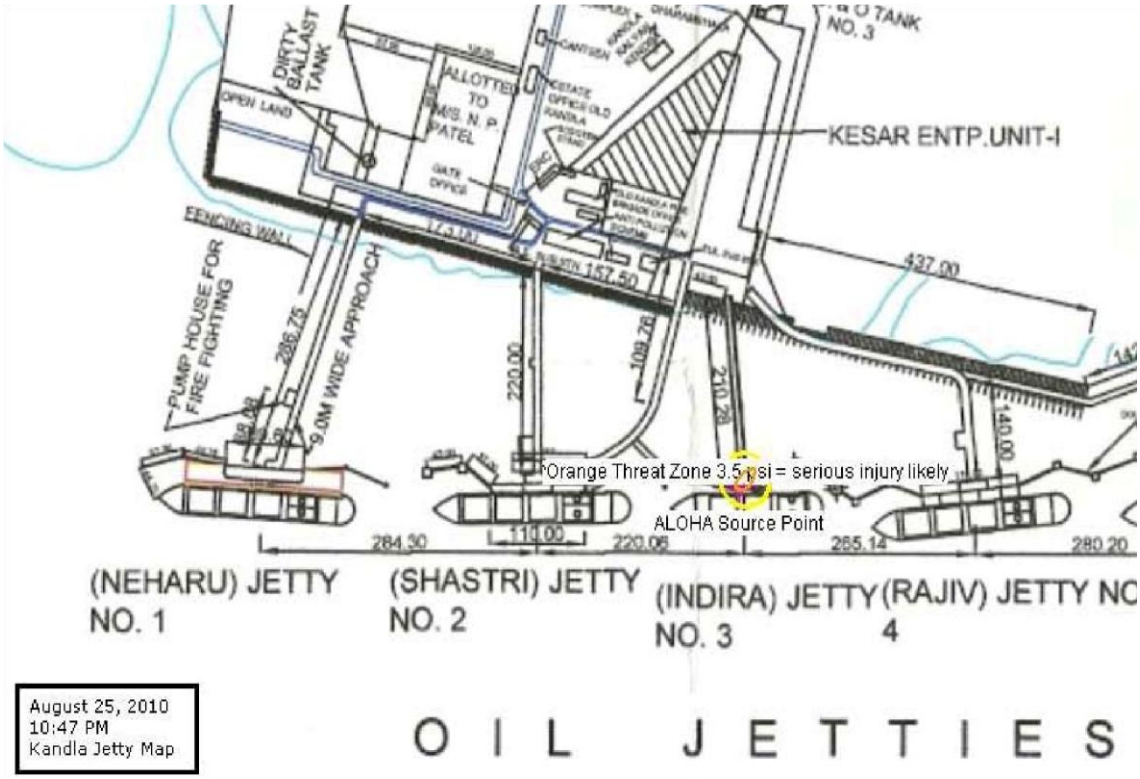
20.1.7.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



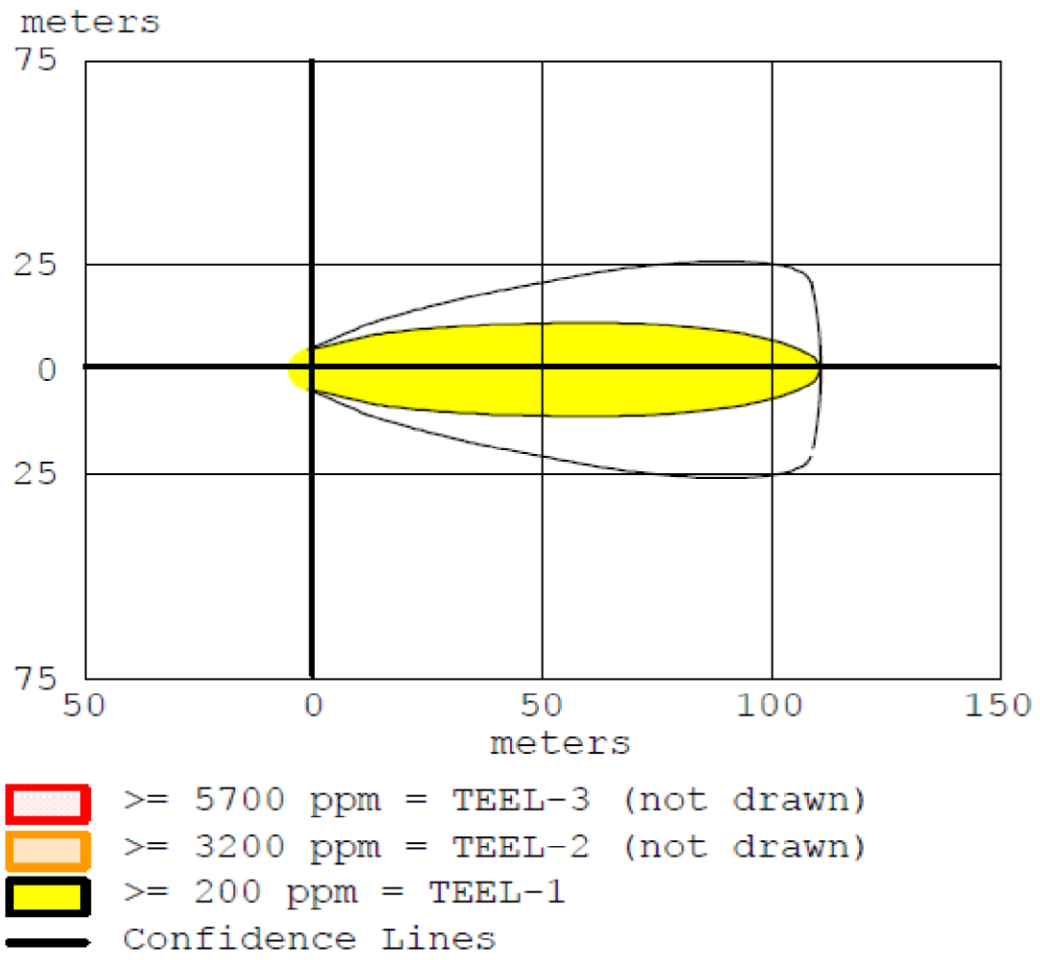
20.1.7.5 Instantaneous Release – Overpressure (Graph)



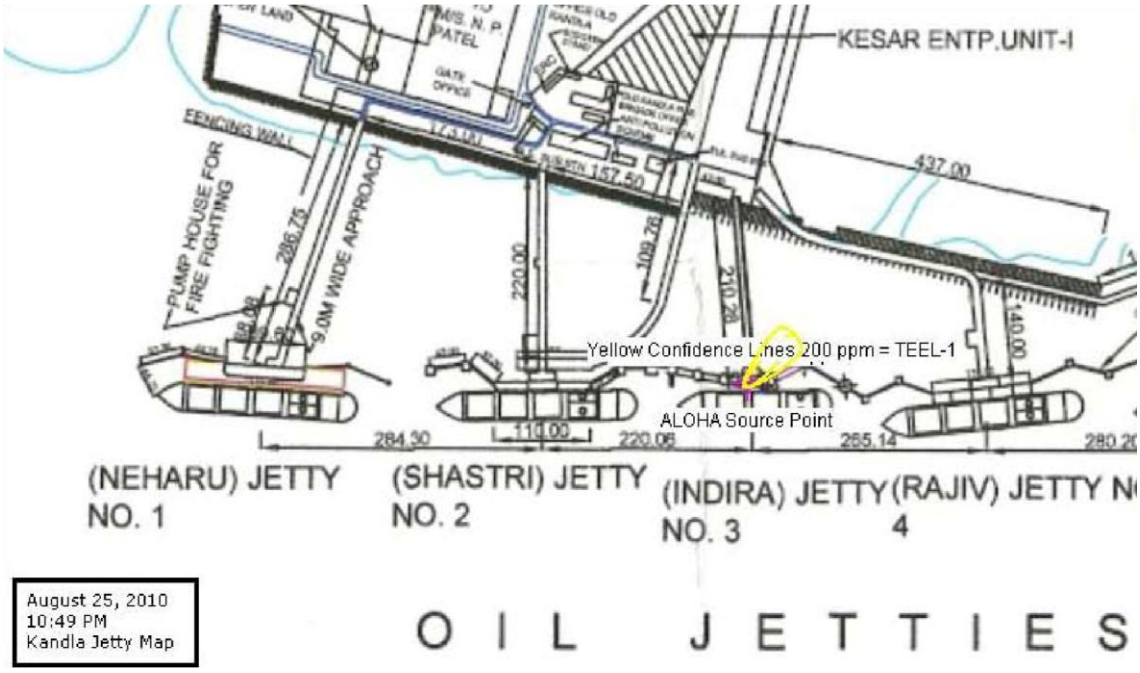
20.1.7.6 Instantaneous Release – Overpressure (Contour)



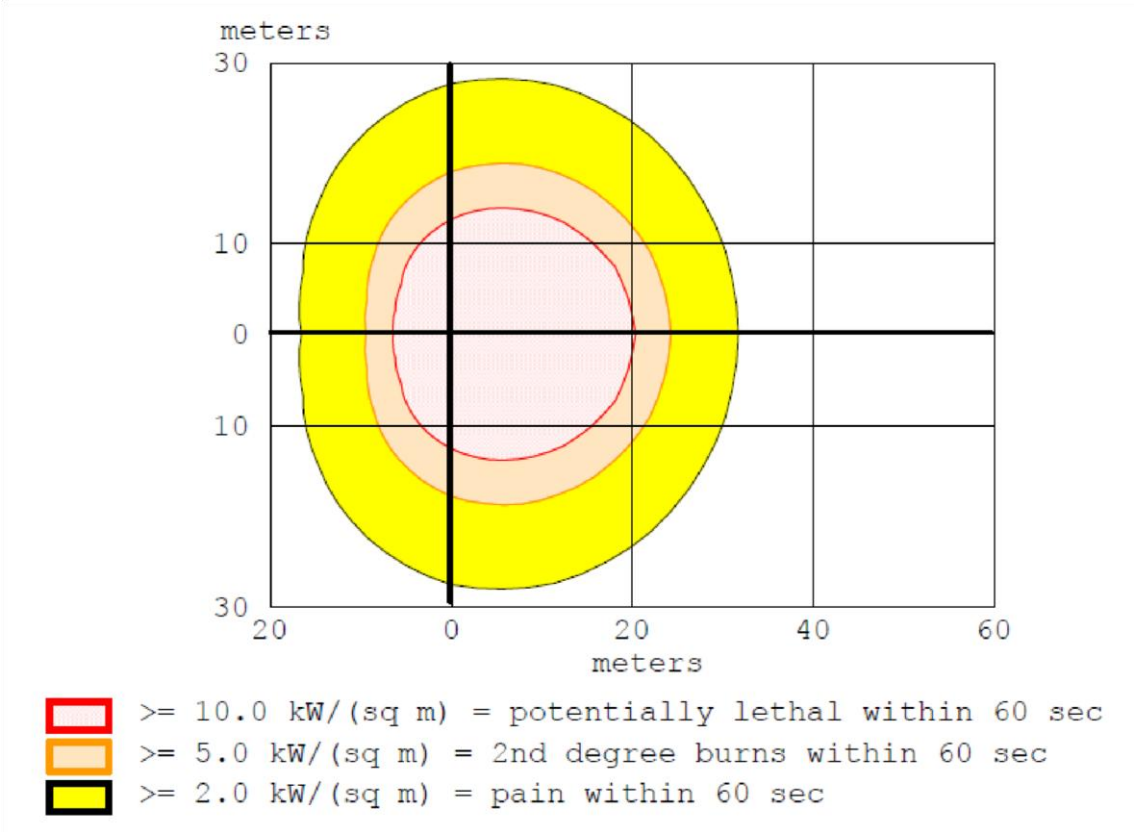
20.1.7.7 Evaporating Puddle – Toxic Threat Zone (Graph)



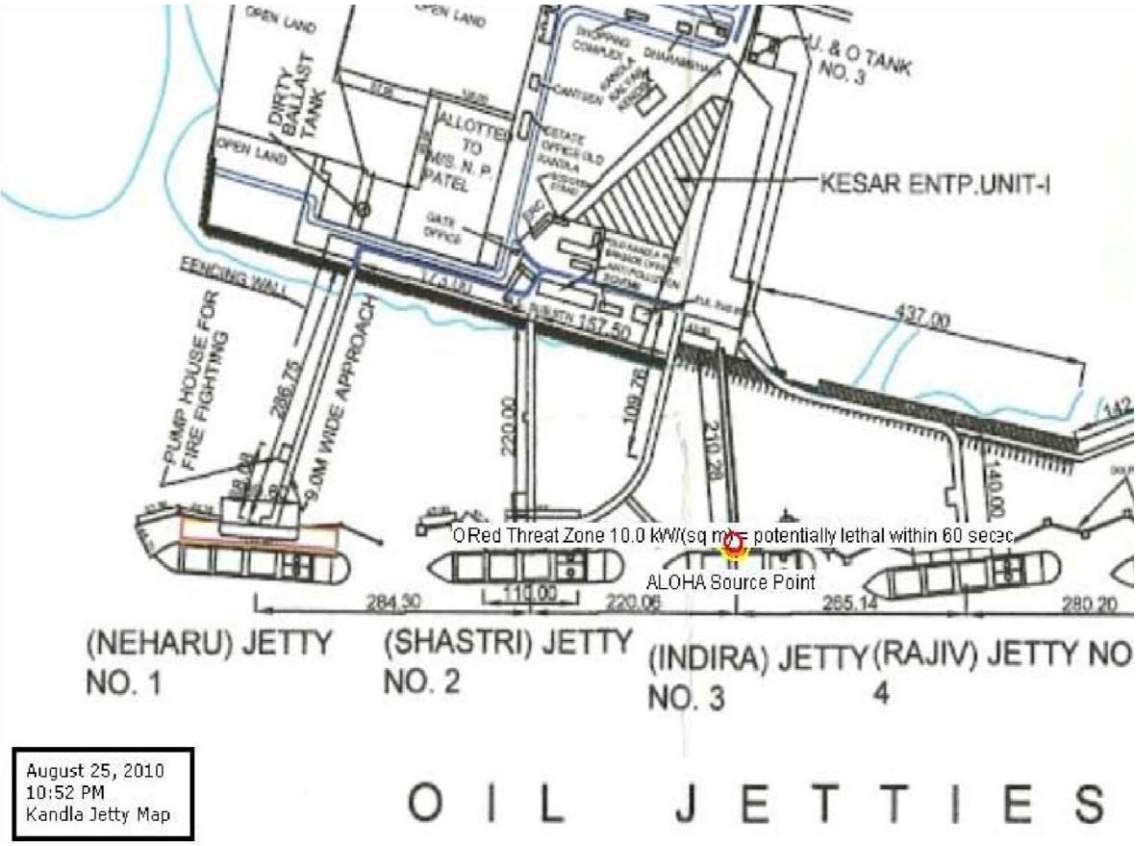
20.1.7.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.7.9 Burning Puddle – Thermal Radiation (Graph)

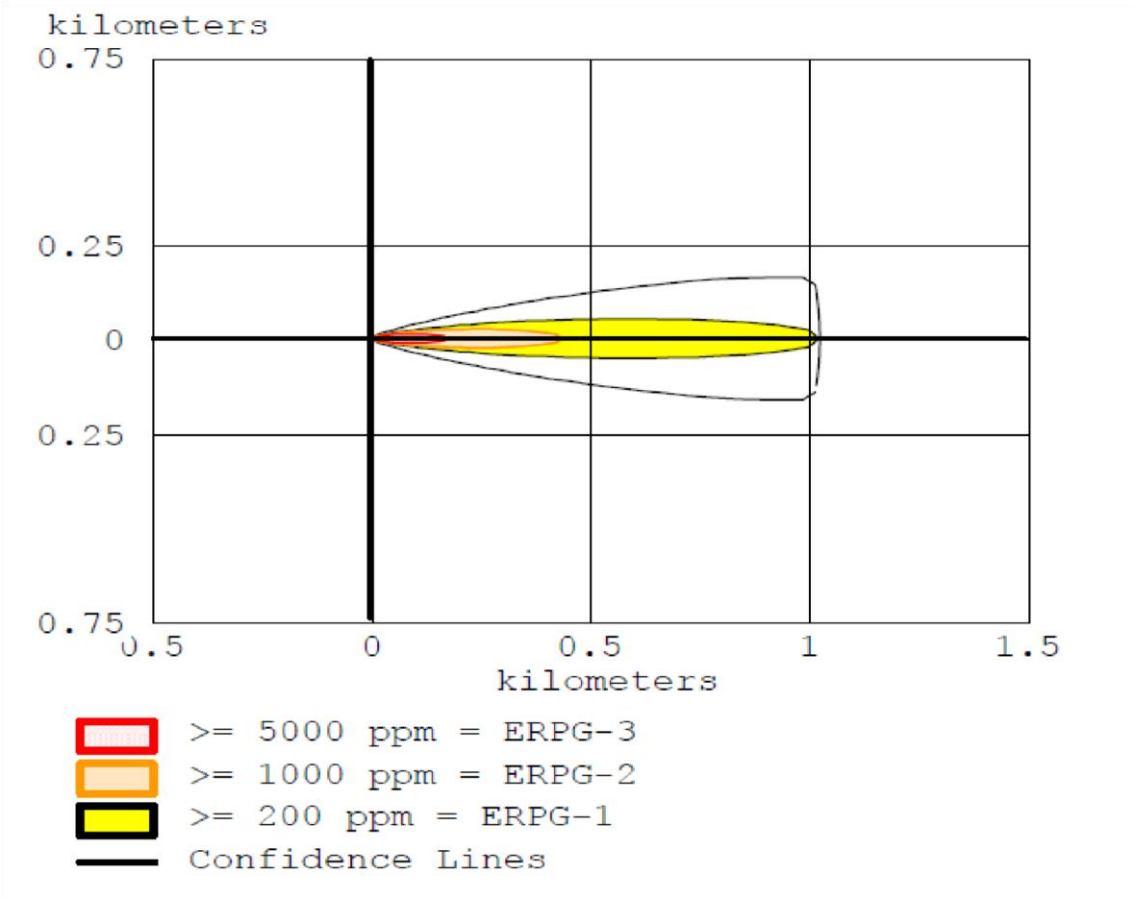


20.1.7.10 Burning Puddle – Thermal Radiation (Contour)

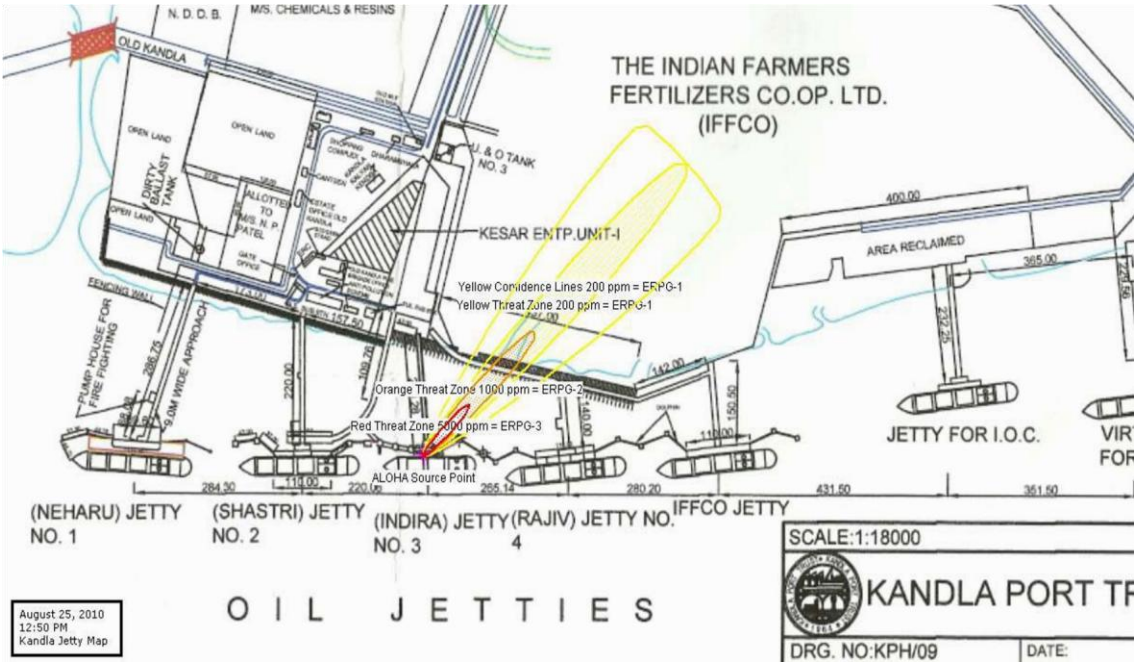


20.1.8 Jetty Three – Methanol

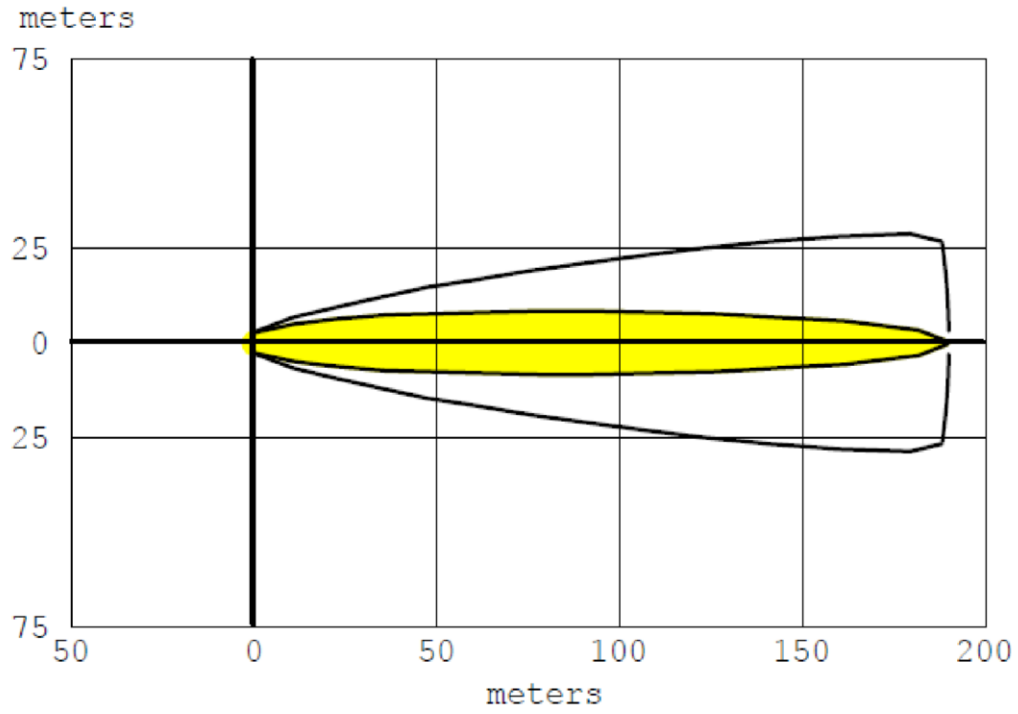
20.1.8.1 Instantaneous Release – Toxic Threat Zone (Graph)



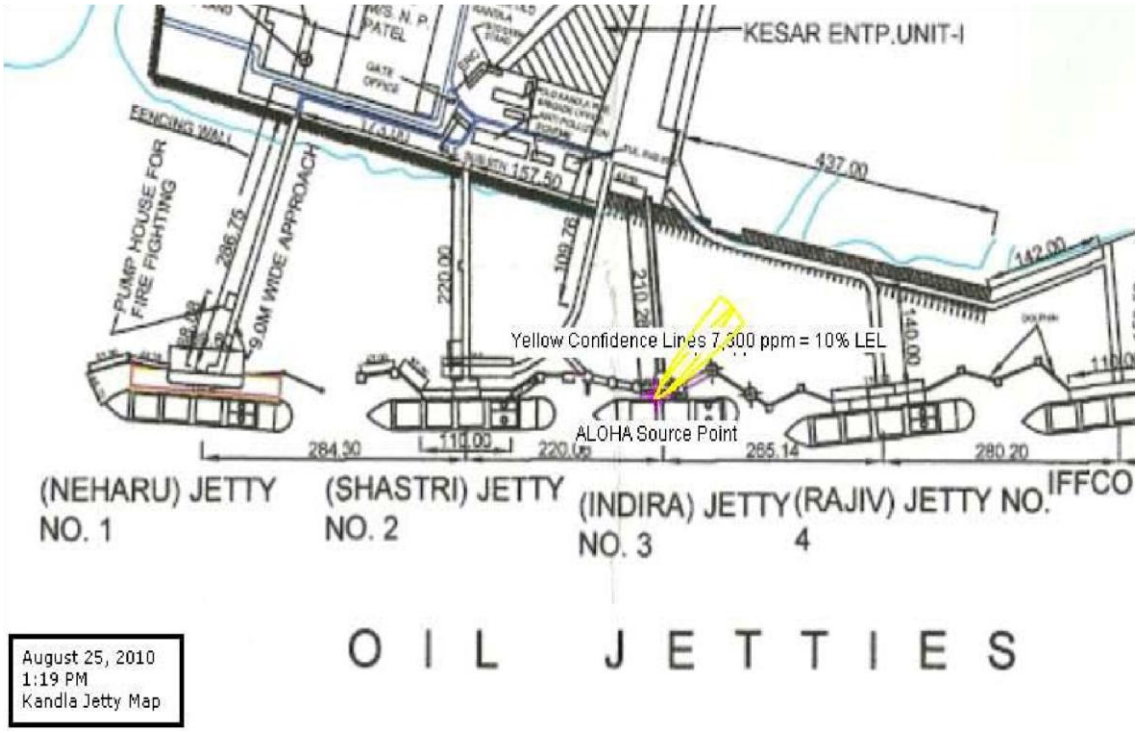
20.1.8.2 Instantaneous Release – Toxic Threat Zone (Contour)



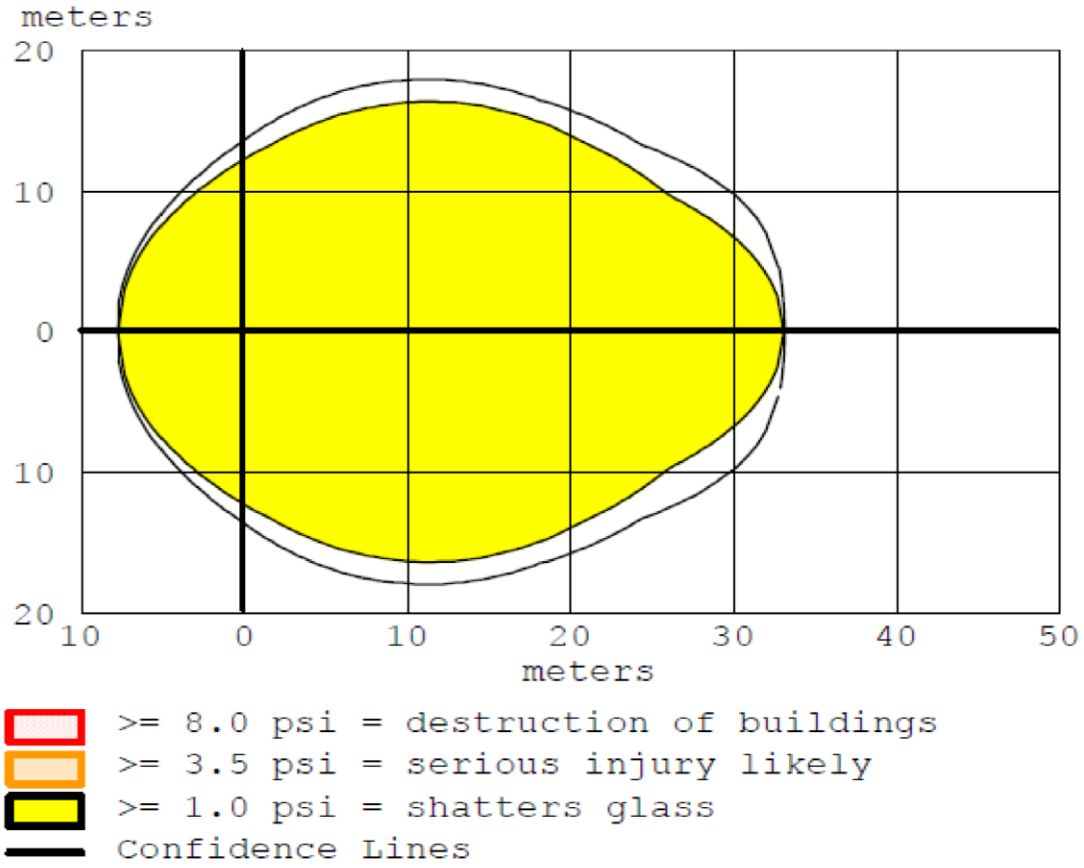
20.1.8.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



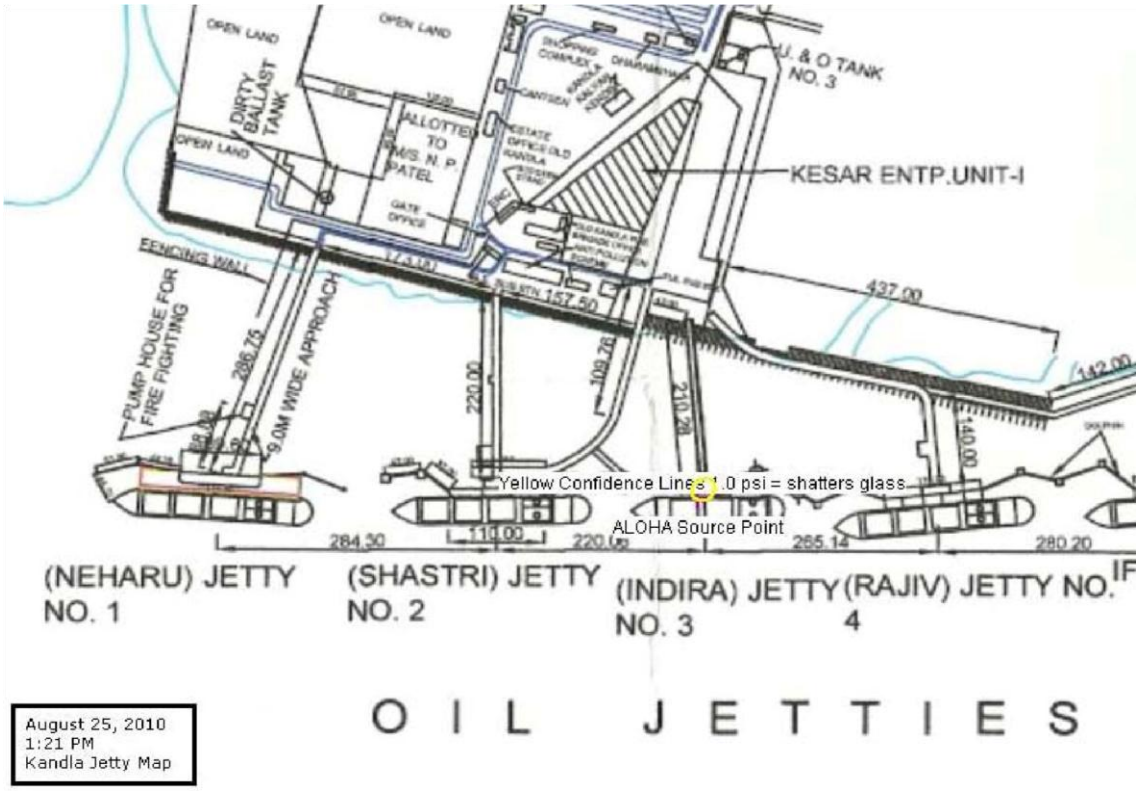
20.1.8.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



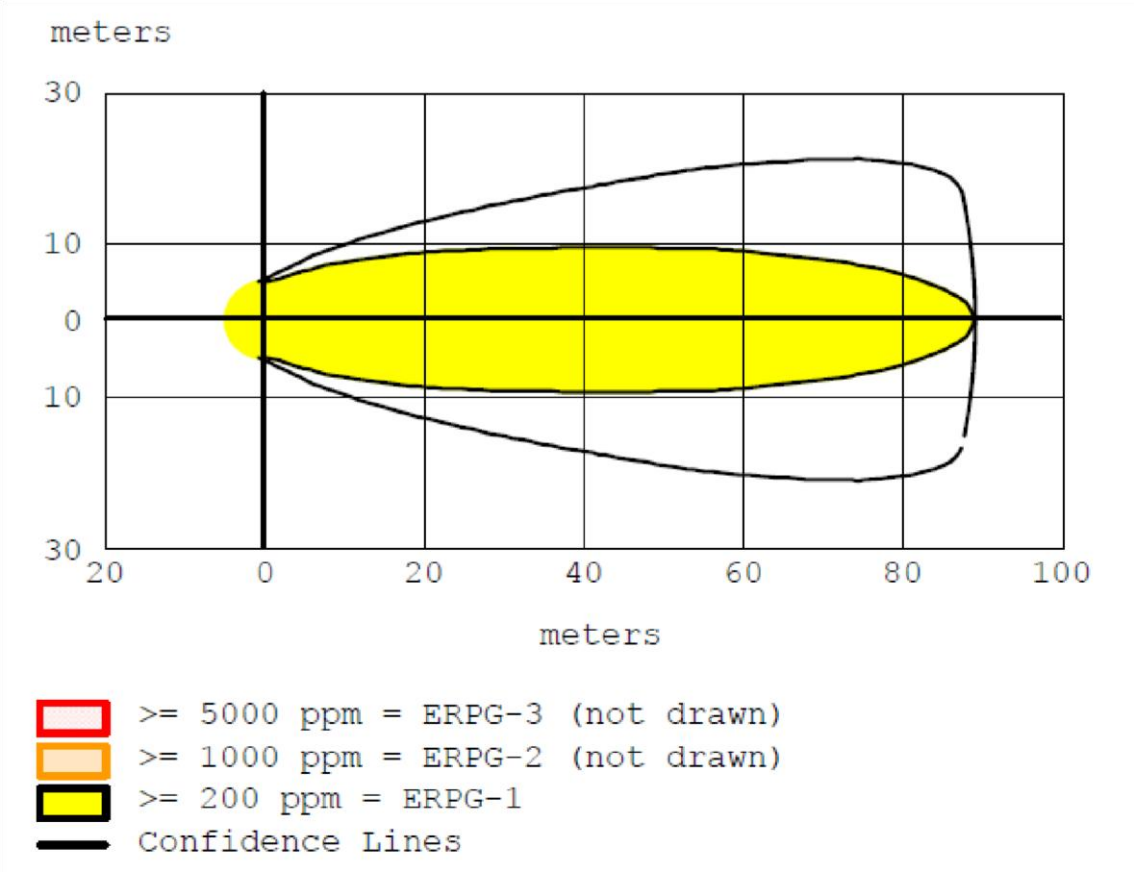
20.1.8.5 Instantaneous Release – Overpressure (Graph)



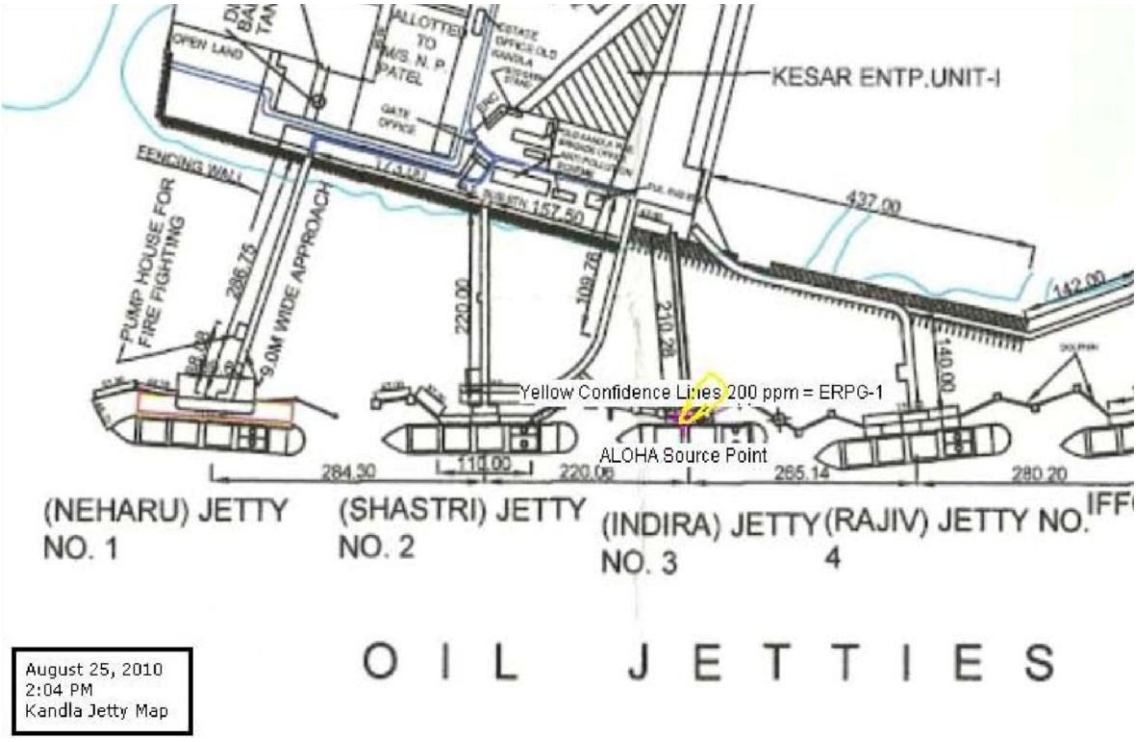
20.1.8.6 Instantaneous Release – Overpressure (Contour)



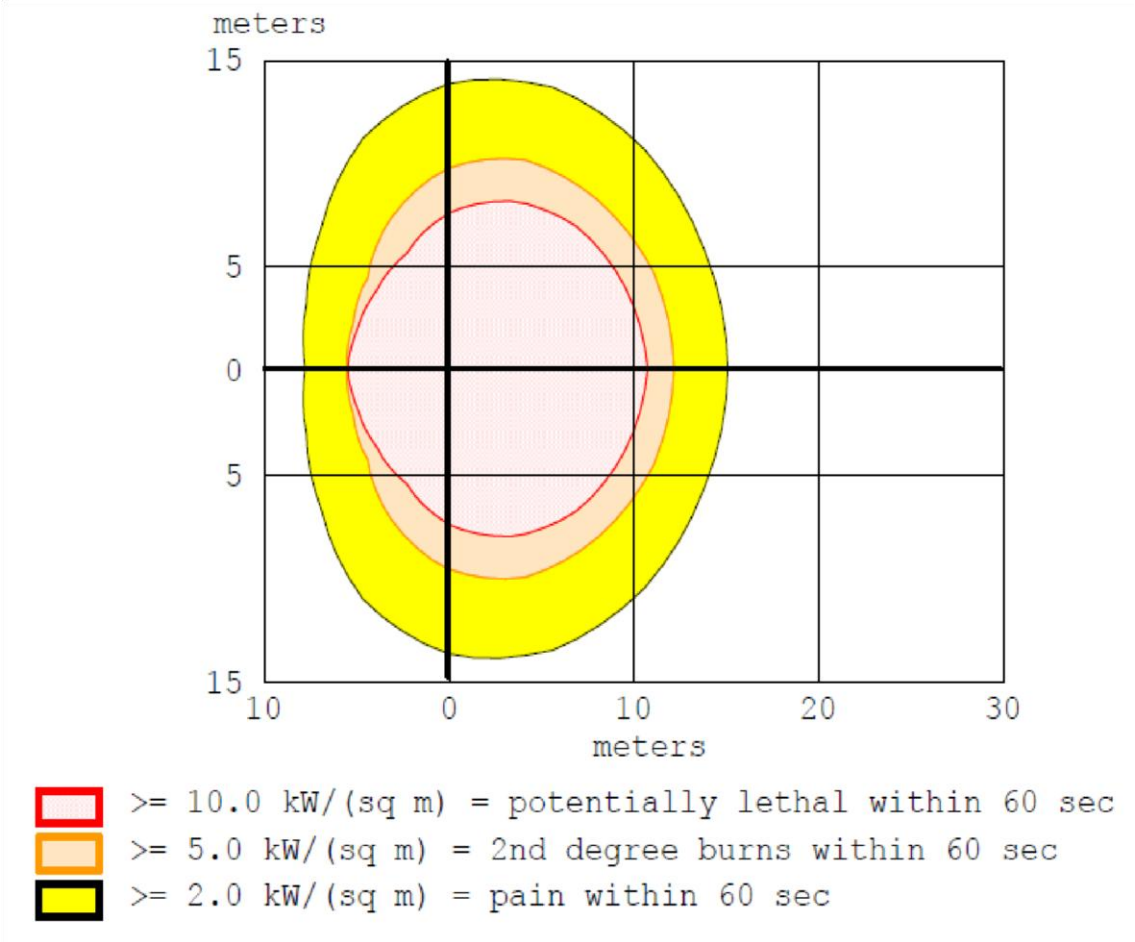
20.1.8.7 Evaporating Puddle – Toxic Threat Zone (Graph)



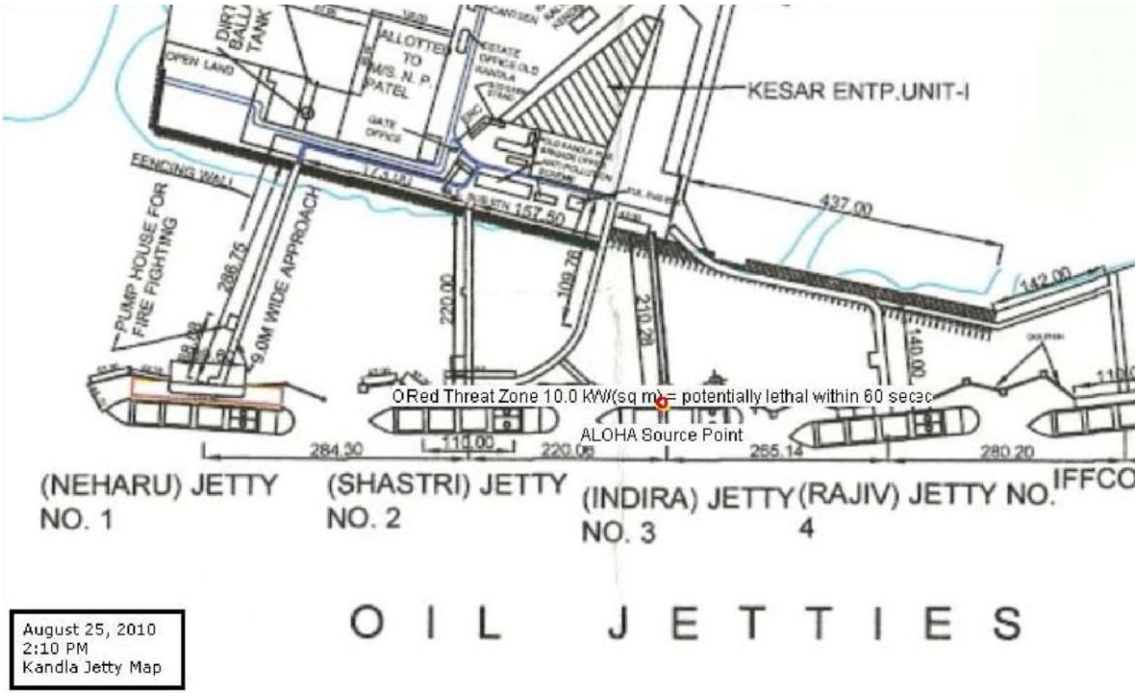
20.1.8.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.8.9 Burning Puddle – Thermal Radiation (Graph)

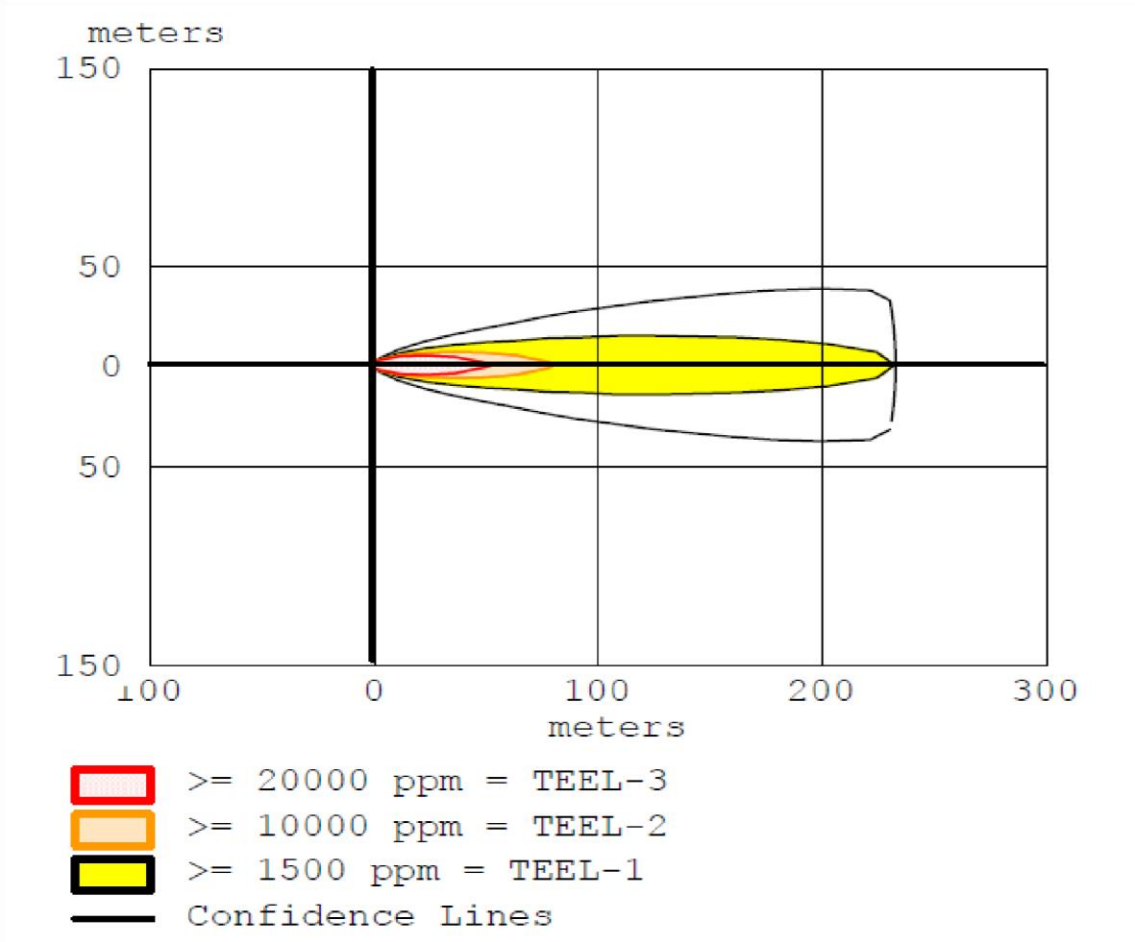


20.1.8.10 Burning Puddle – Thermal Radiation (Contour)

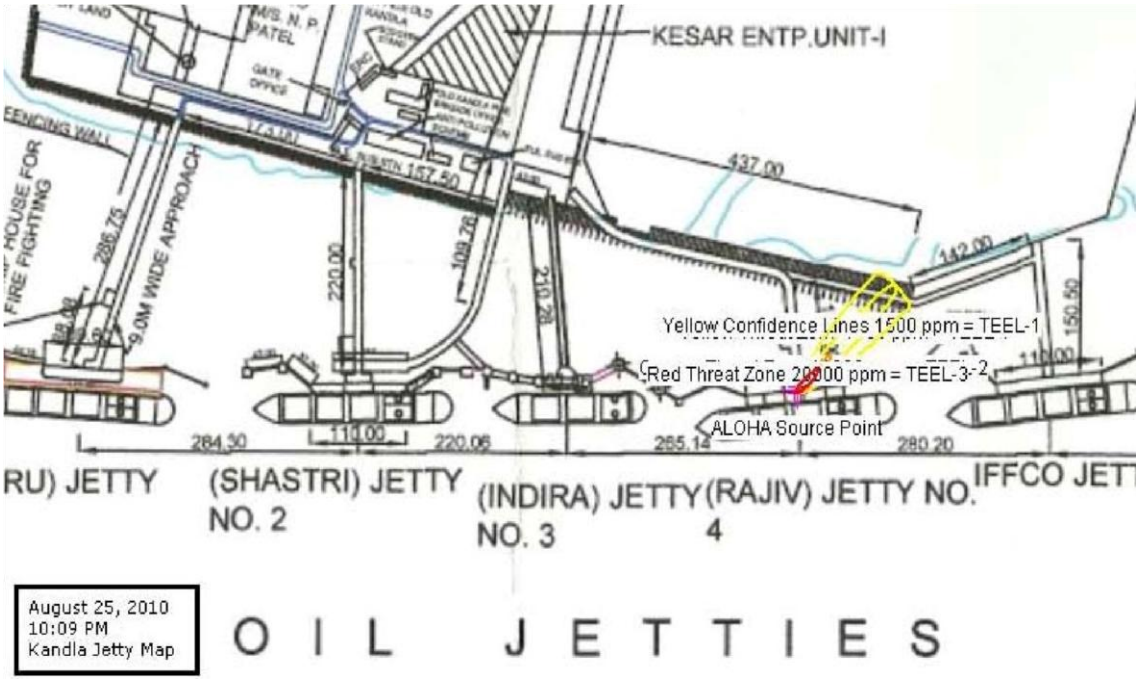


20.1.9 Jetty Four – Propylene

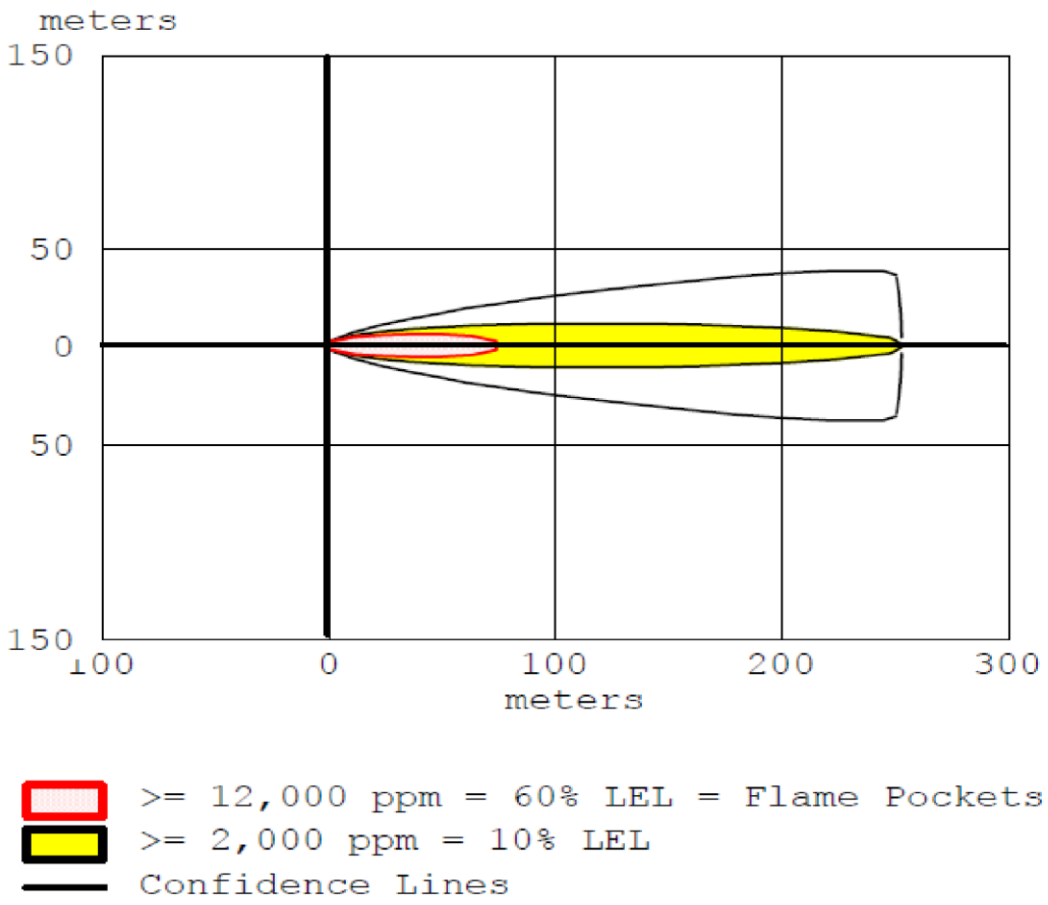
20.1.9.1 Instantaneous Release – Toxic Threat Zone (Graph)



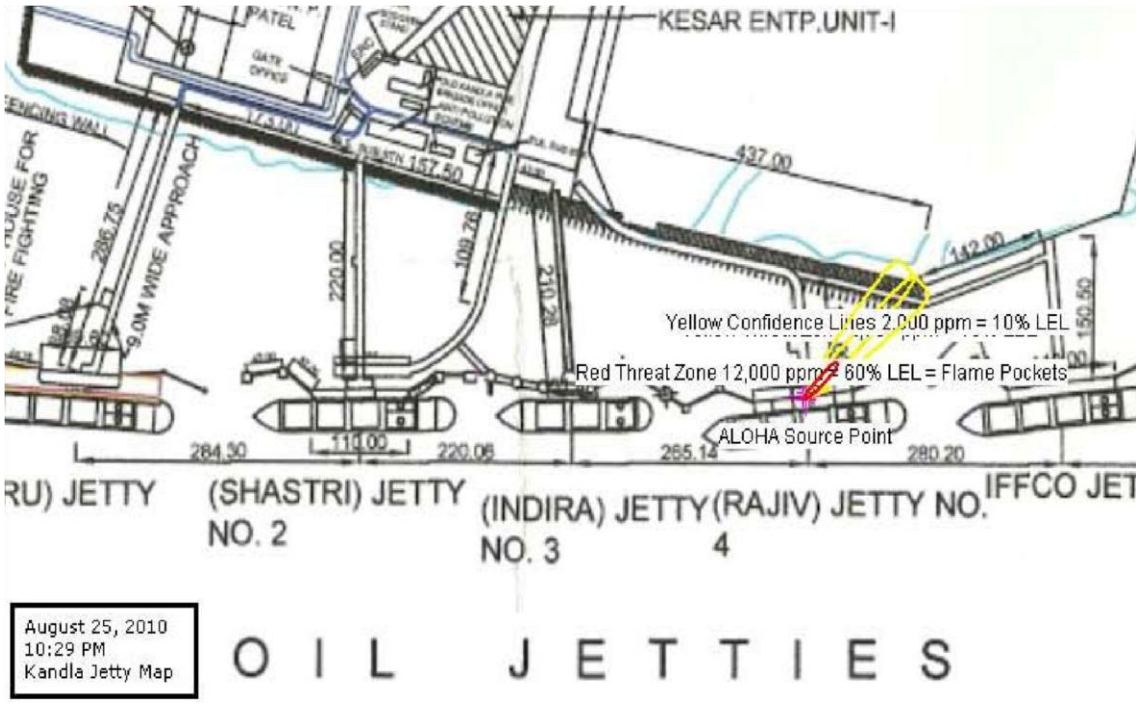
20.1.9.2 Instantaneous Release – Toxic Threat Zone (Contour)



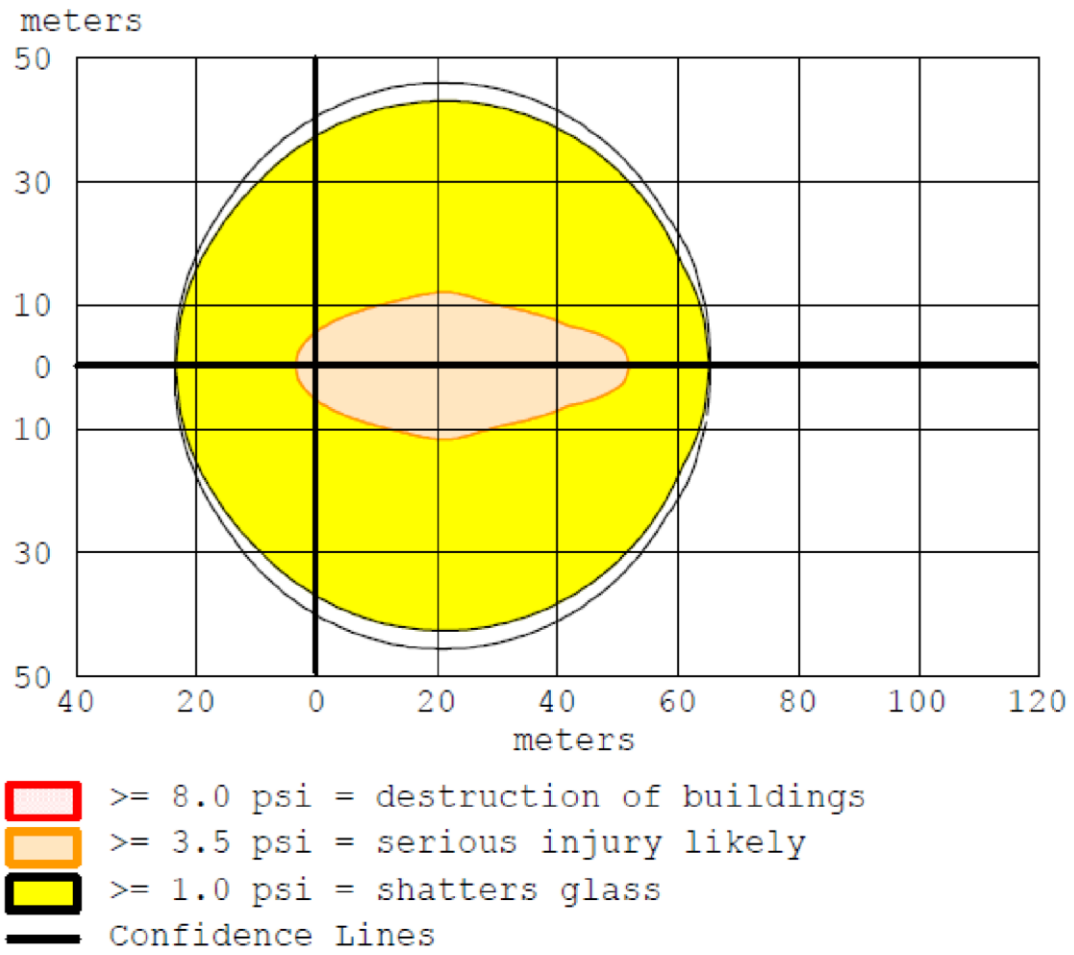
20.1.9.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



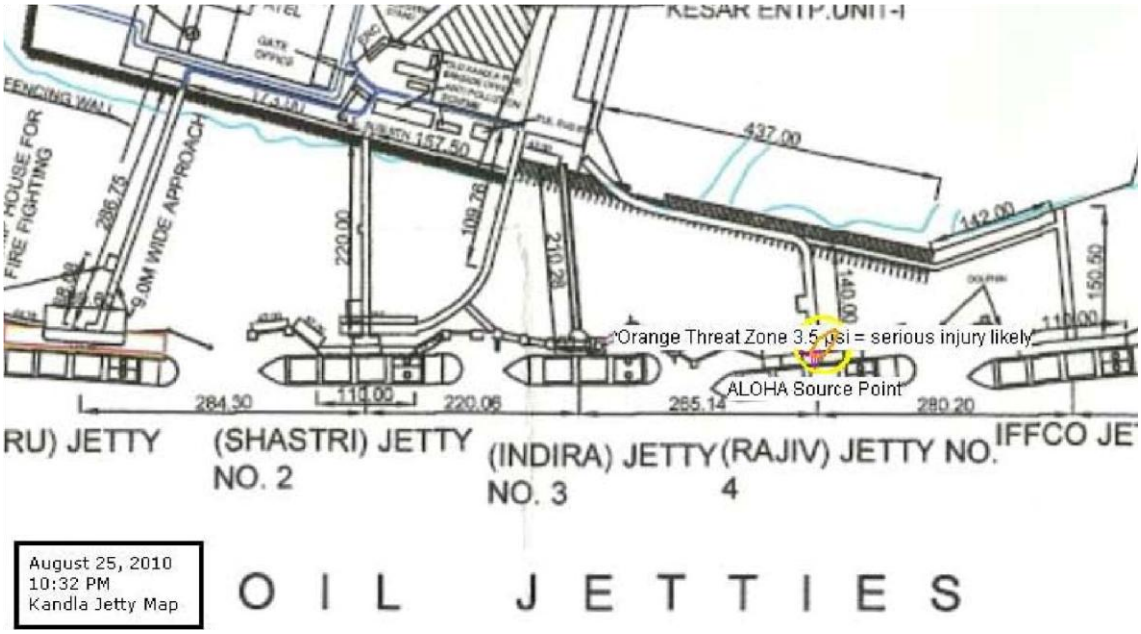
20.1.9.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



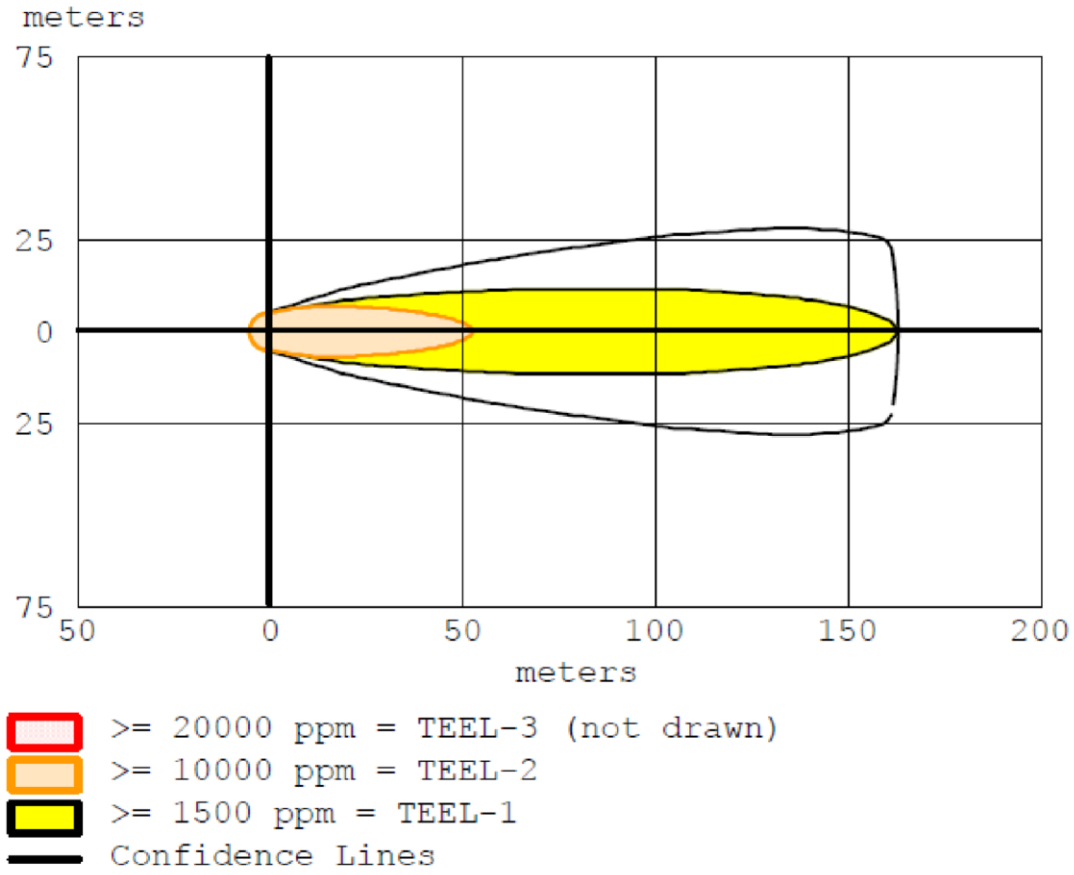
20.1.9.5 Instantaneous Release – Overpressure (Graph)



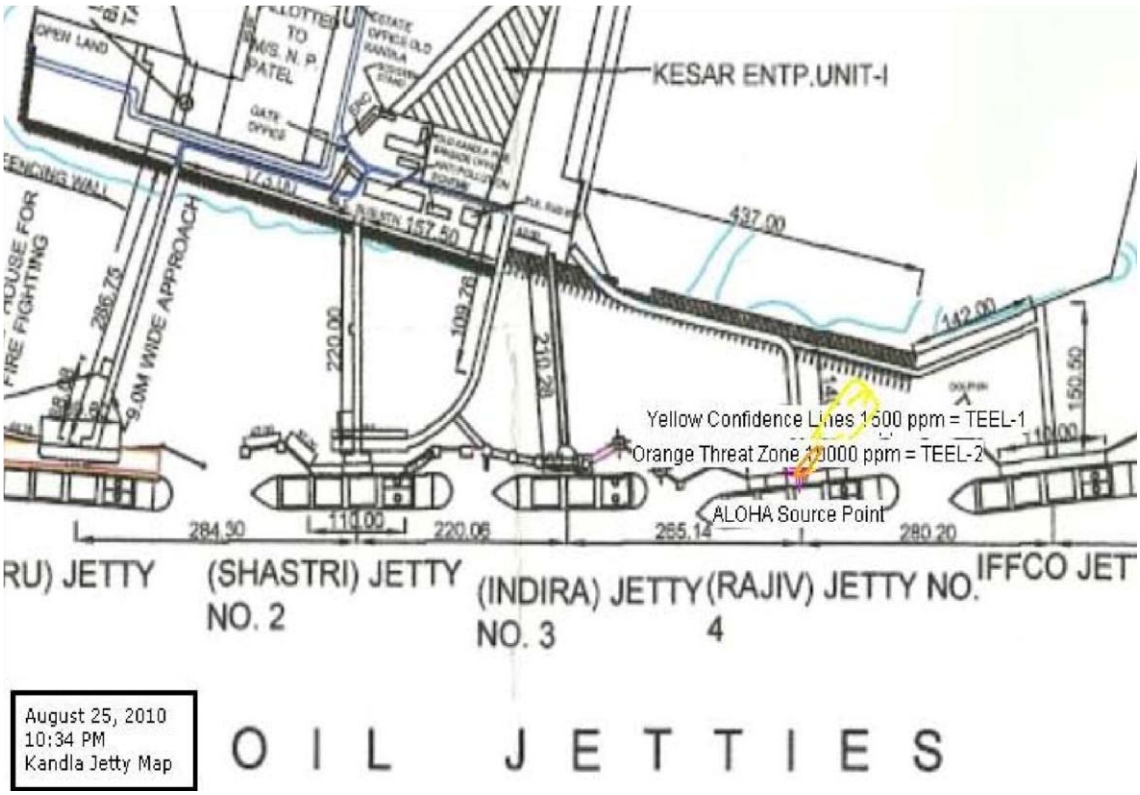
20.1.9.6 Instantaneous Release – Overpressure (Contour)



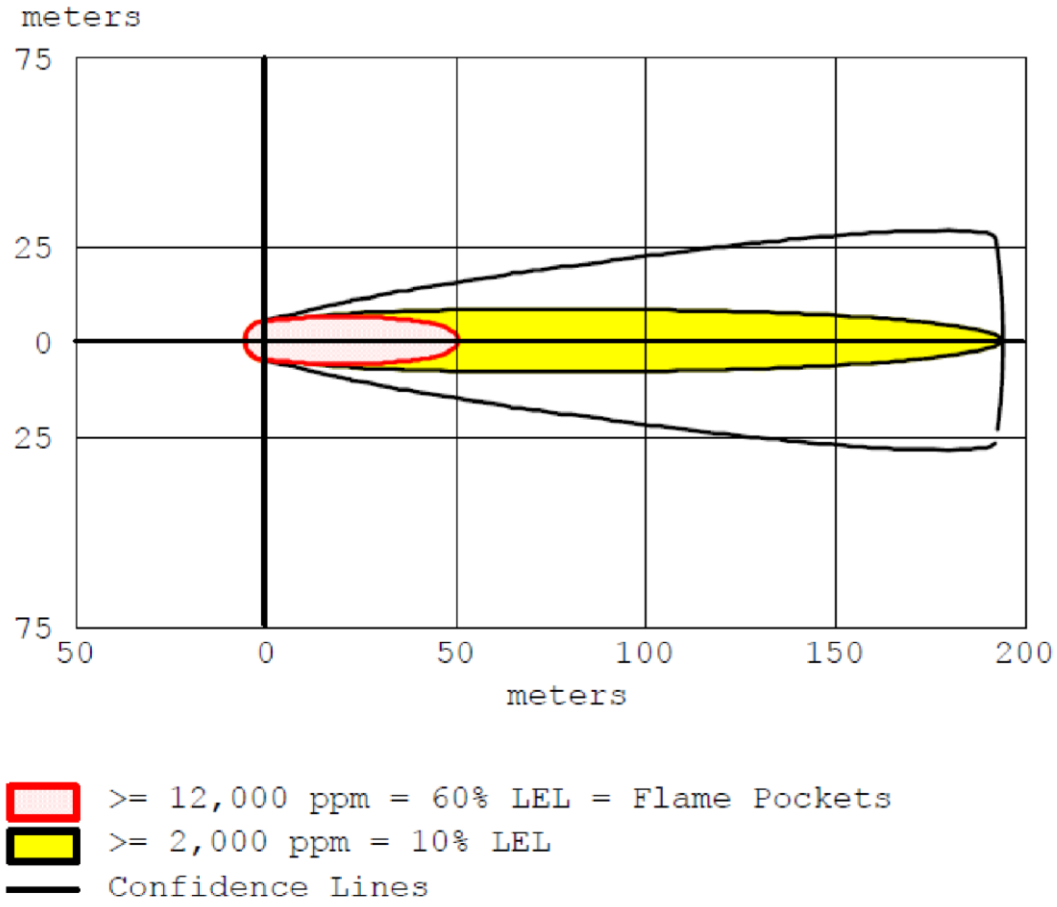
20.1.9.7 Evaporating Puddle – Toxic Threat Zone (Graph)



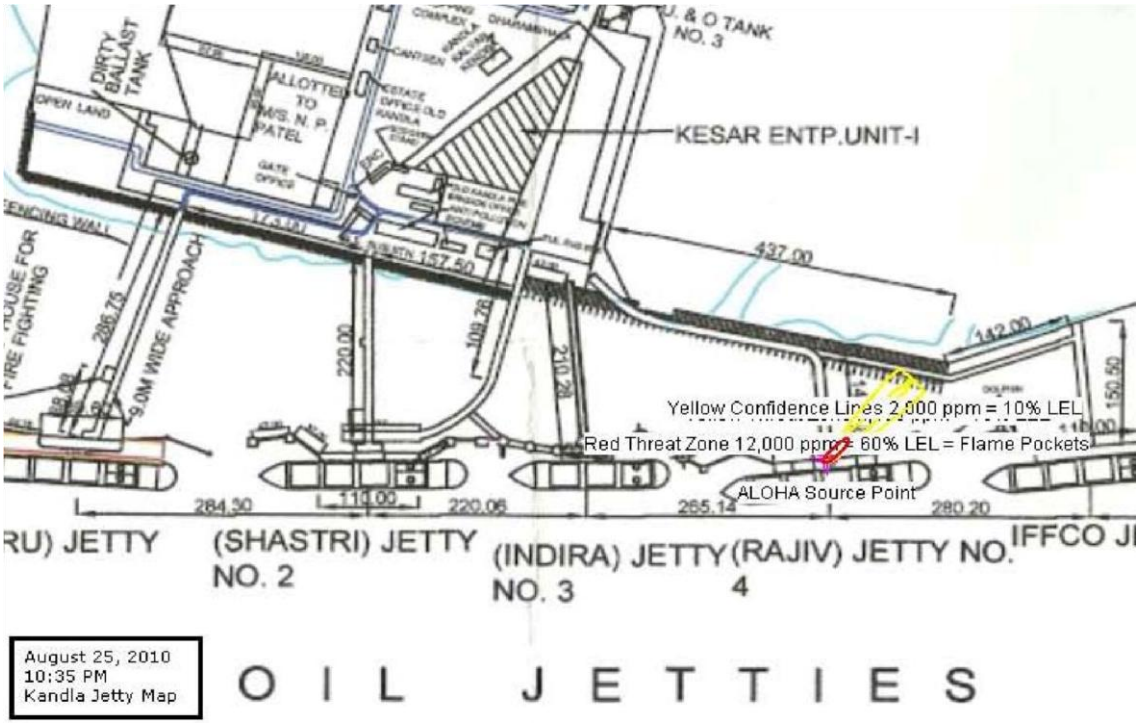
20.1.9.8 Evaporating Puddle – Toxic Threat Zone (Contour)



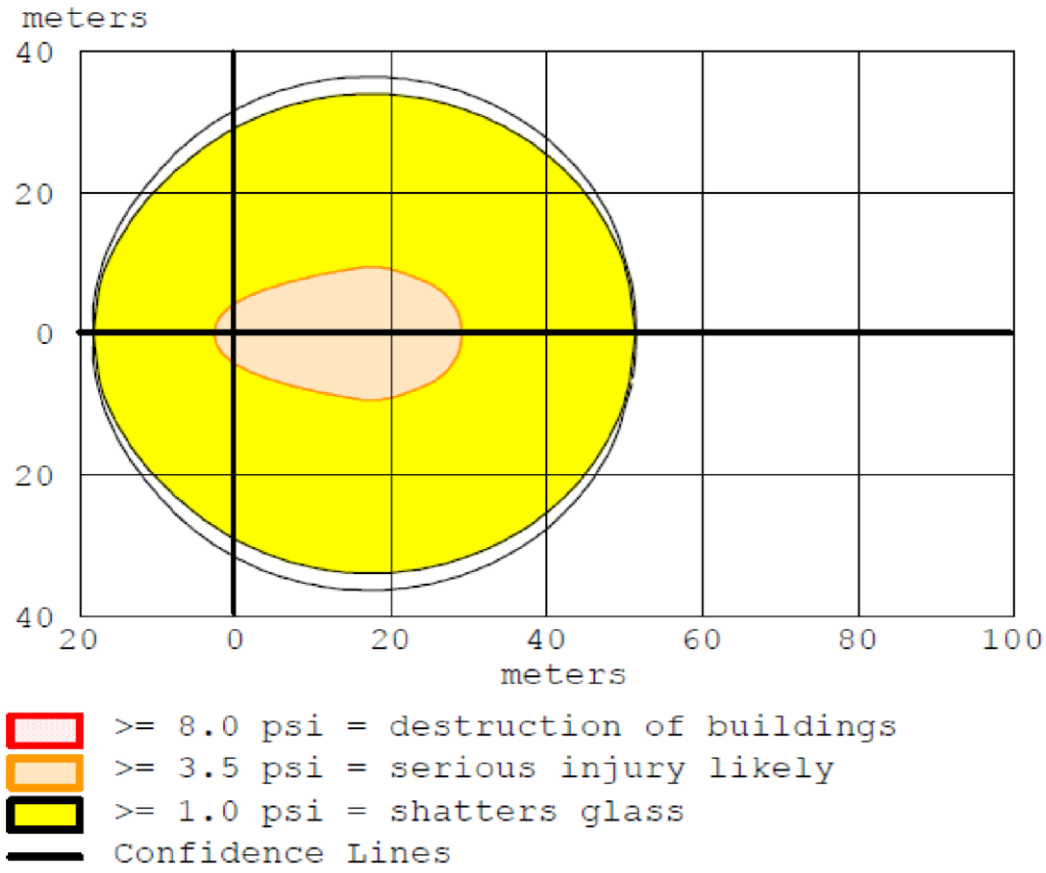
20.1.9.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



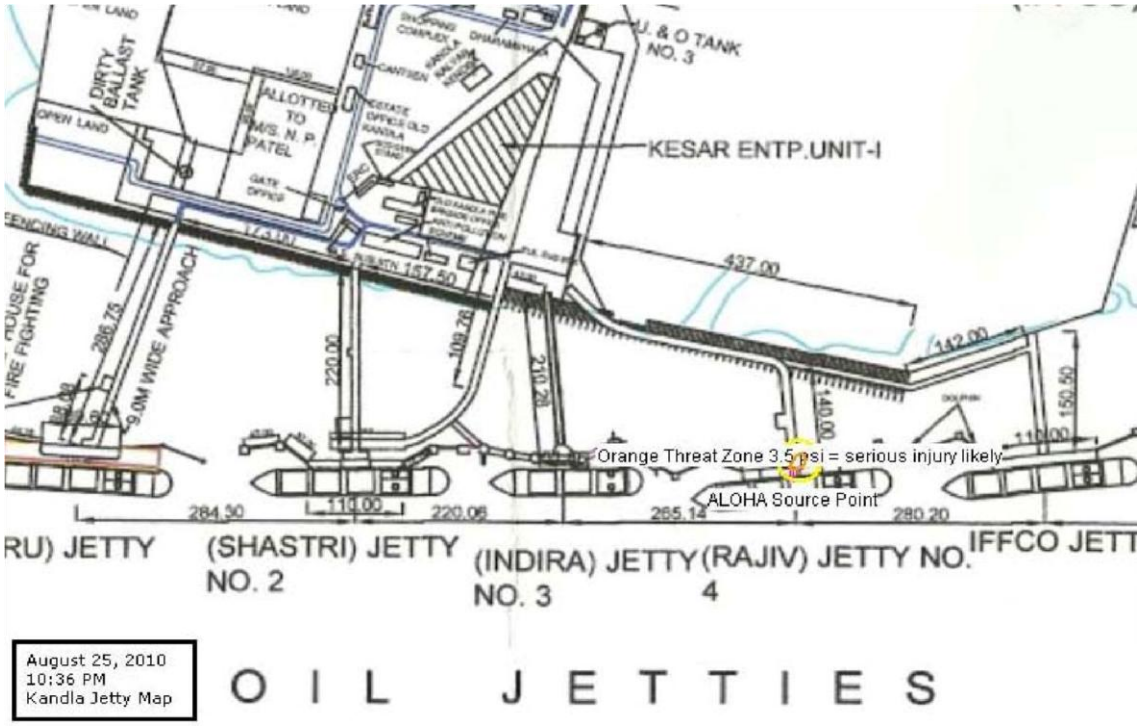
20.1.9.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



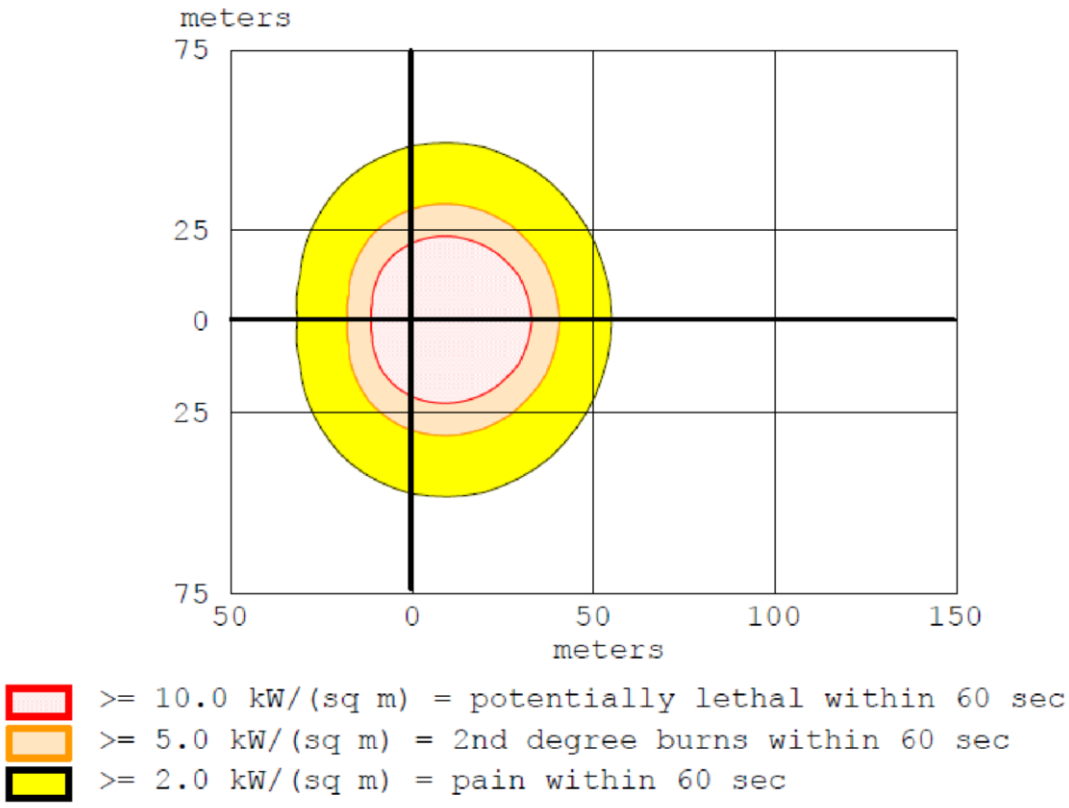
20.1.9.11 Evaporating Puddle – Overpressure (Graph)



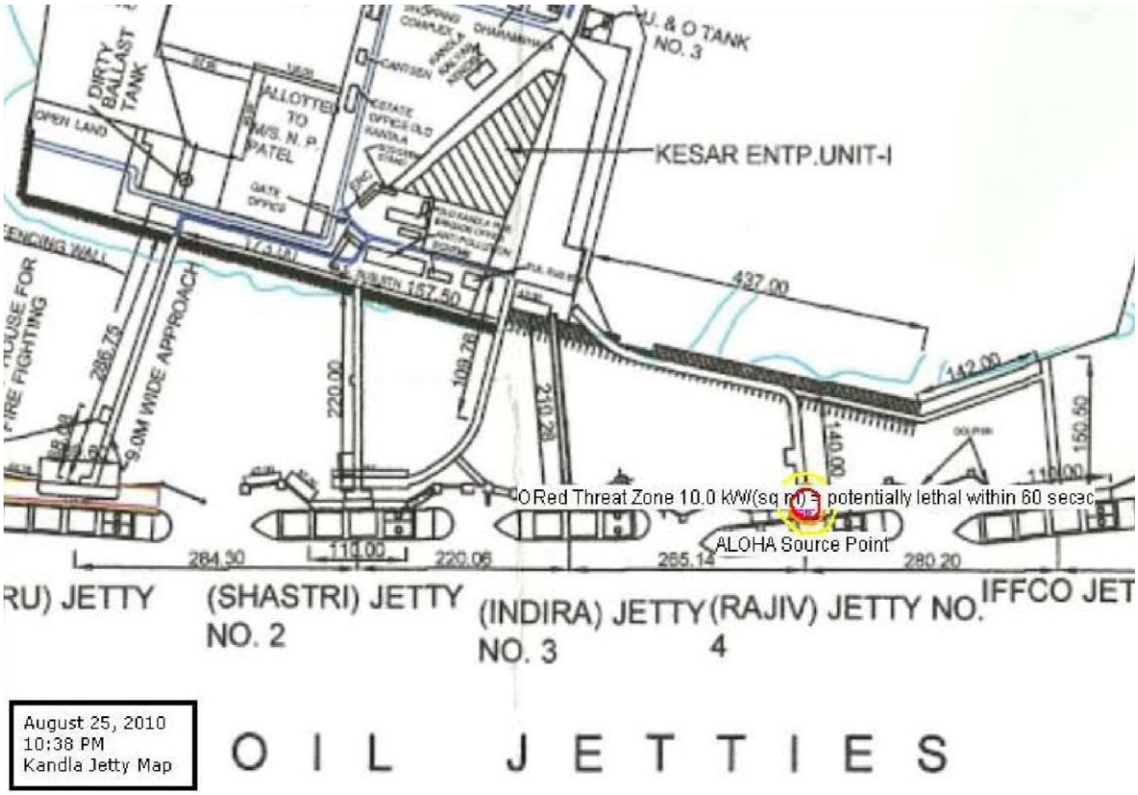
20.1.9.12 Evaporating Puddle – Overpressure (Contour)



20.1.9.13 Burning Puddle – Thermal Radiation (Graph)

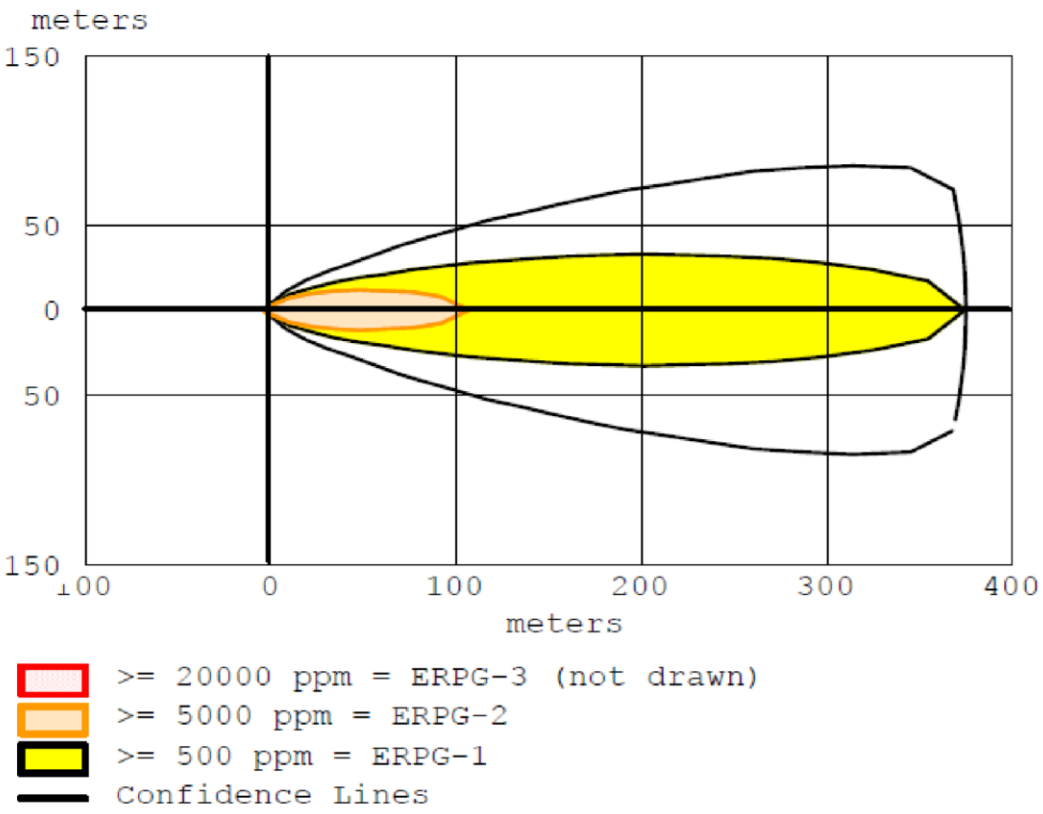


20.1.9.14 Burning Puddle – Thermal Radiation (Contour)

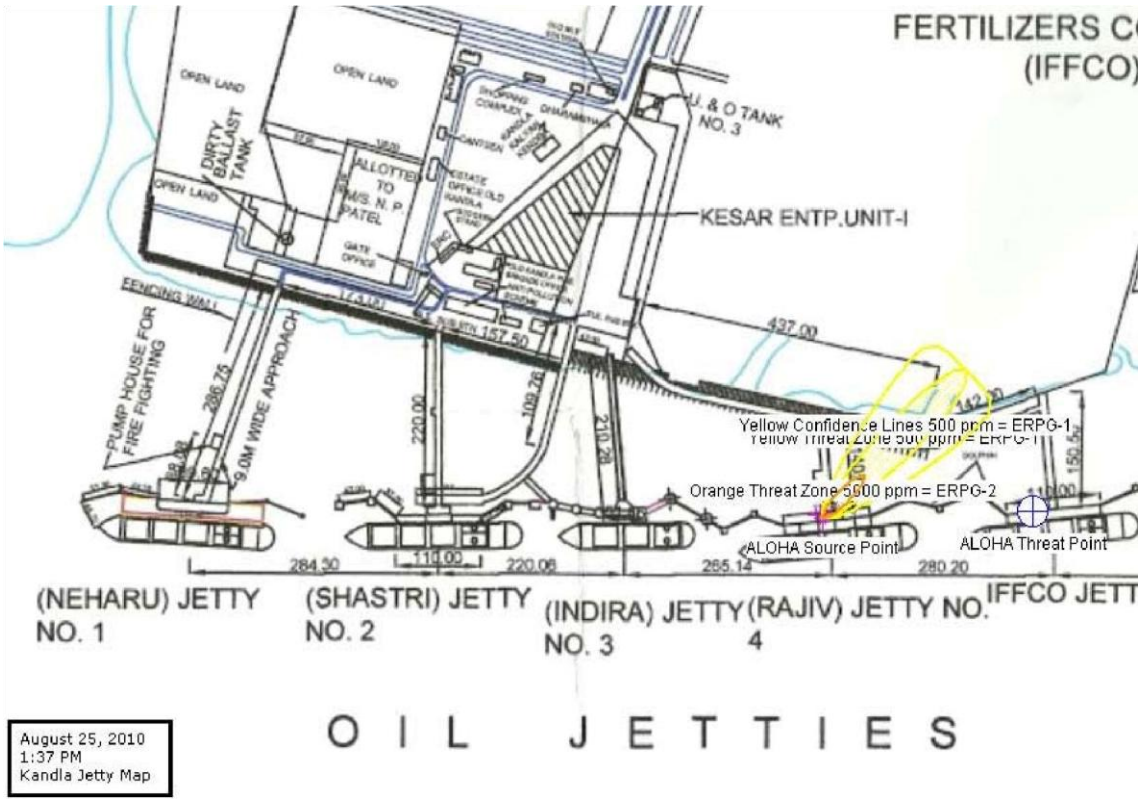


20.1.10 Jetty Four – Vinyl Chloride

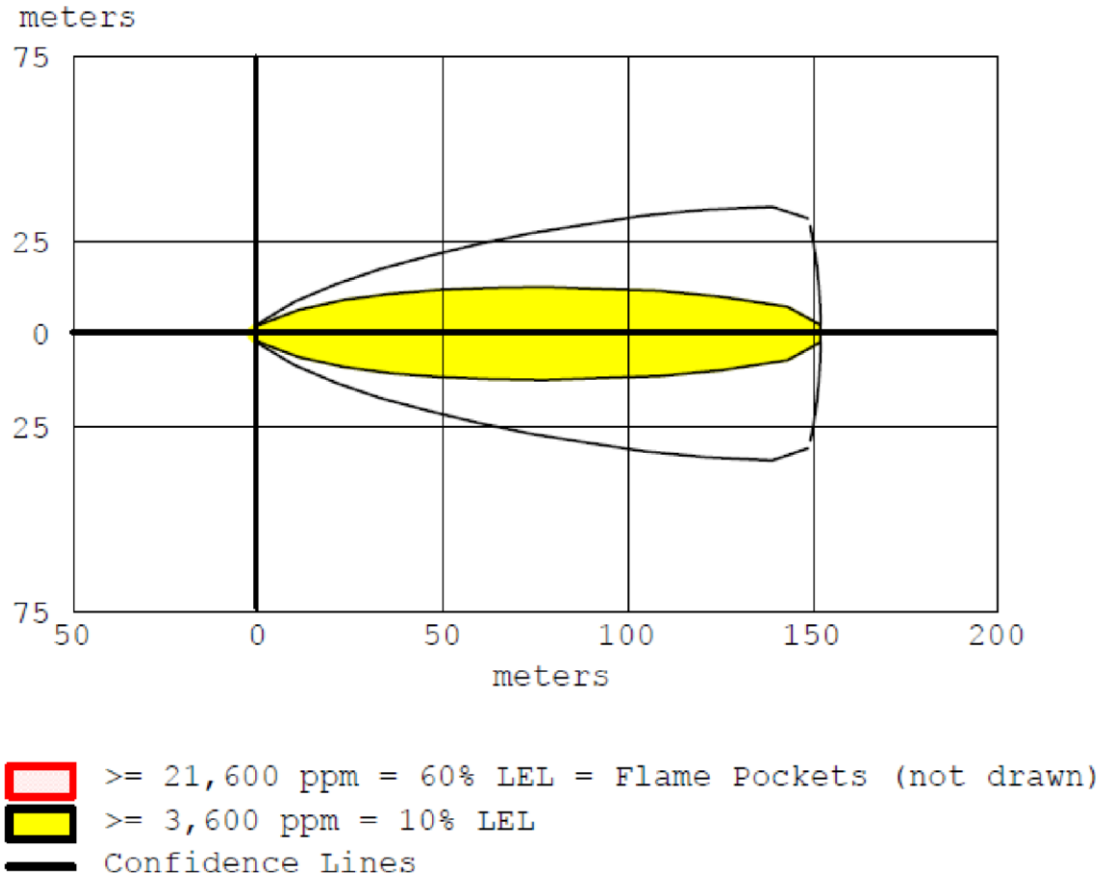
20.1.10.1 Instantaneous Release – Toxic Threat Zone (Graph)



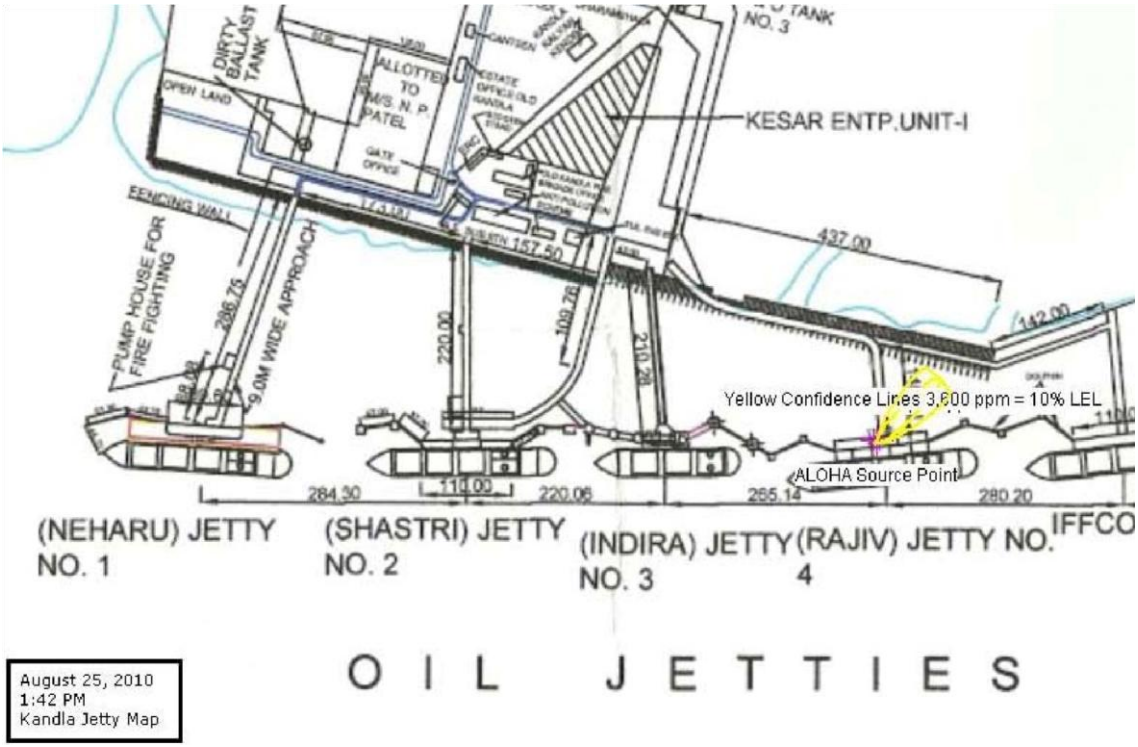
20.1.10.2 Instantaneous Release – Toxic Threat Zone (Contour)



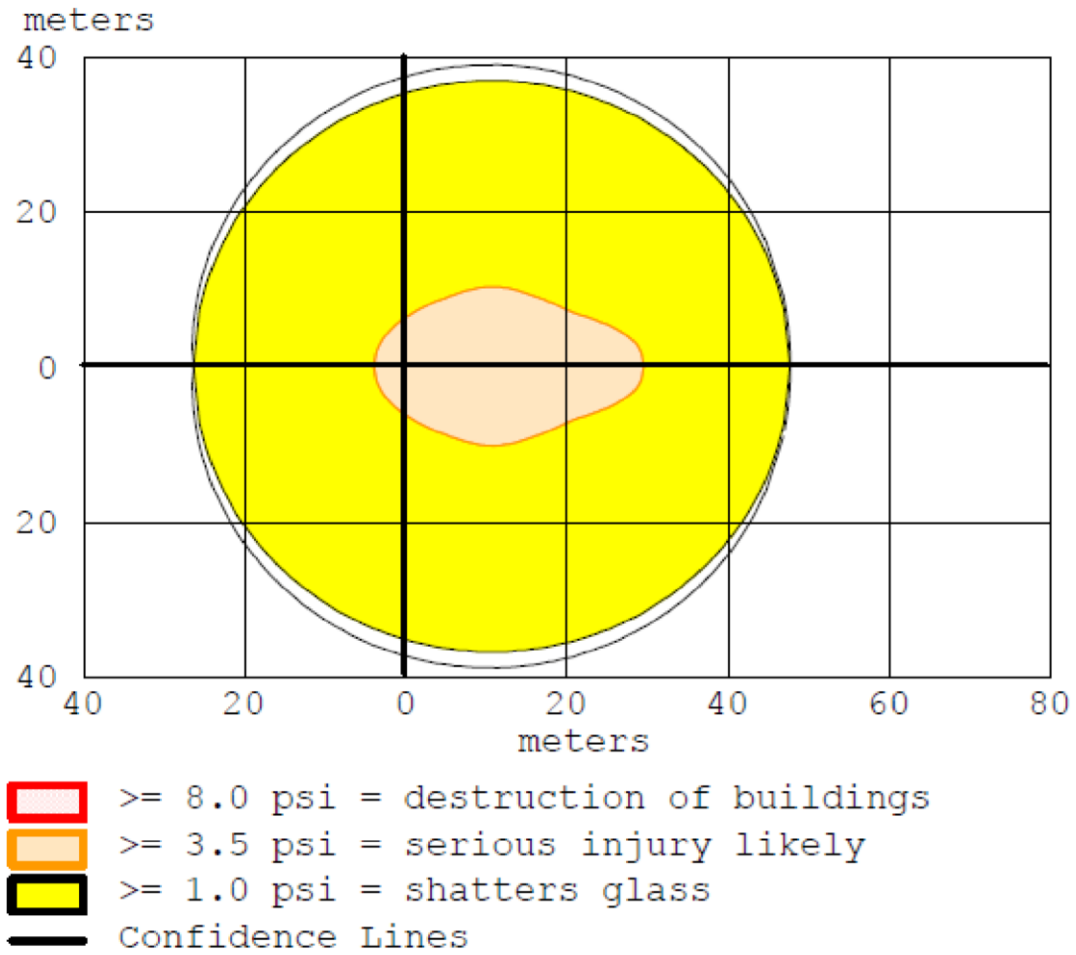
20.1.10.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



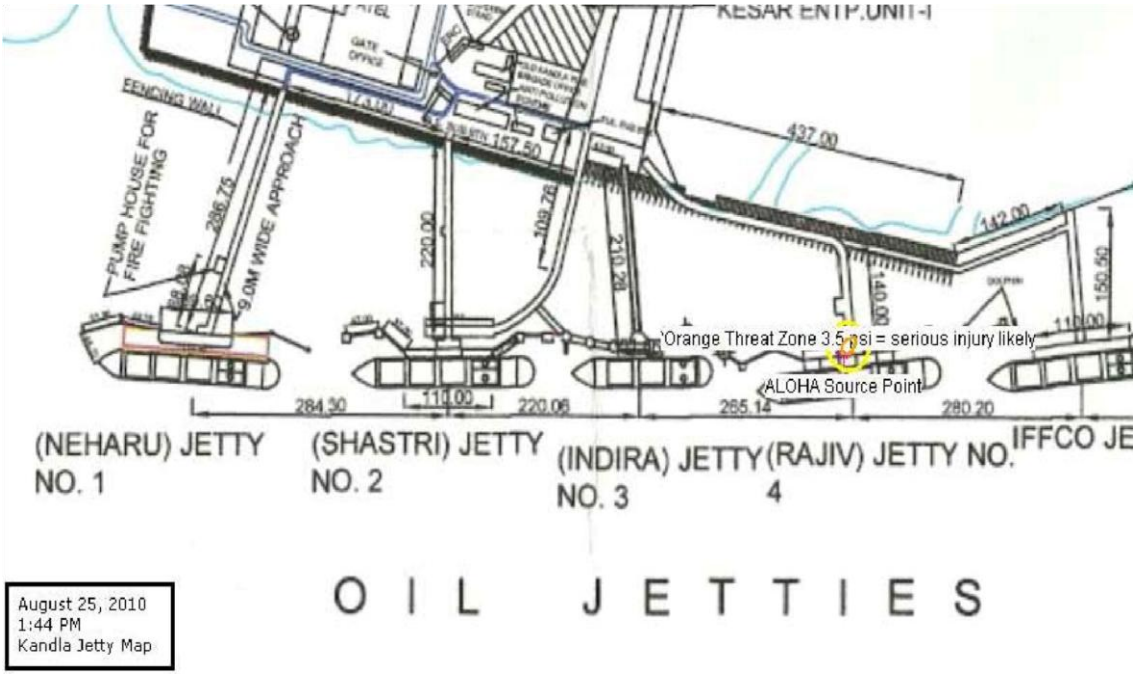
20.1.10.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



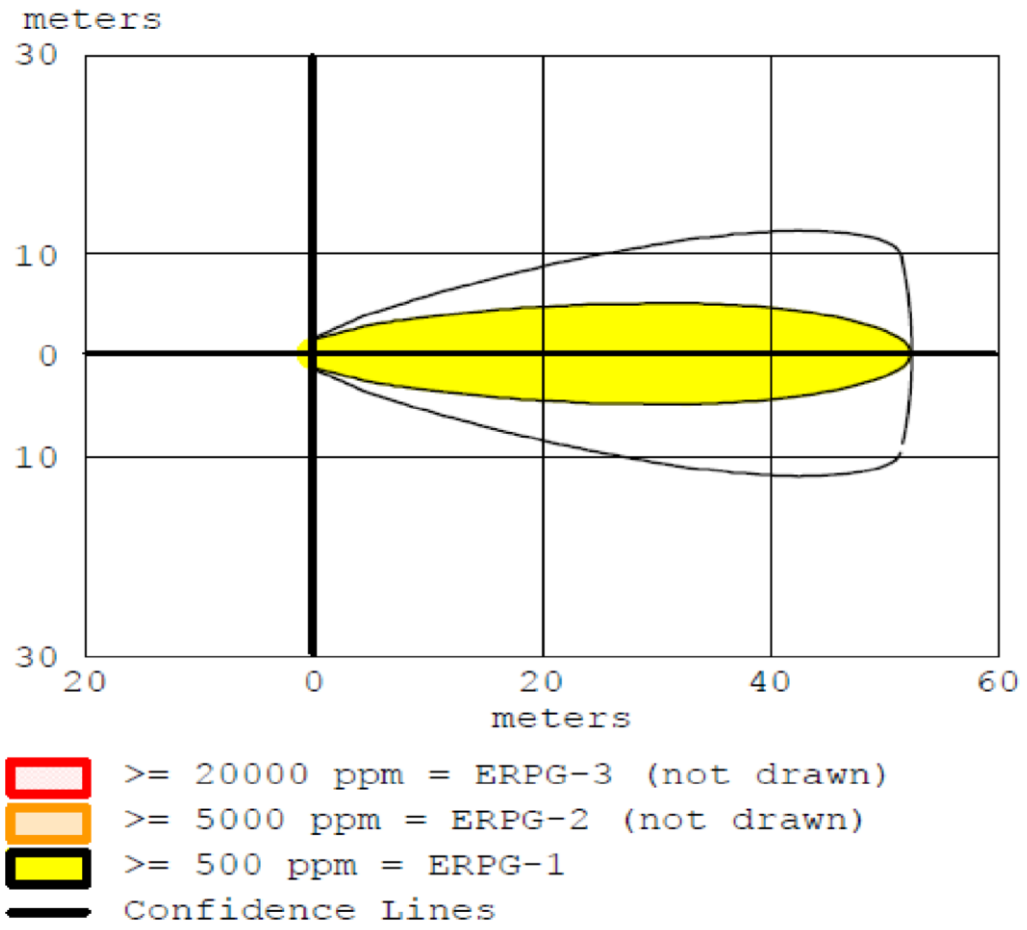
20.1.10.5 Instantaneous Release – Overpressure (Graph)



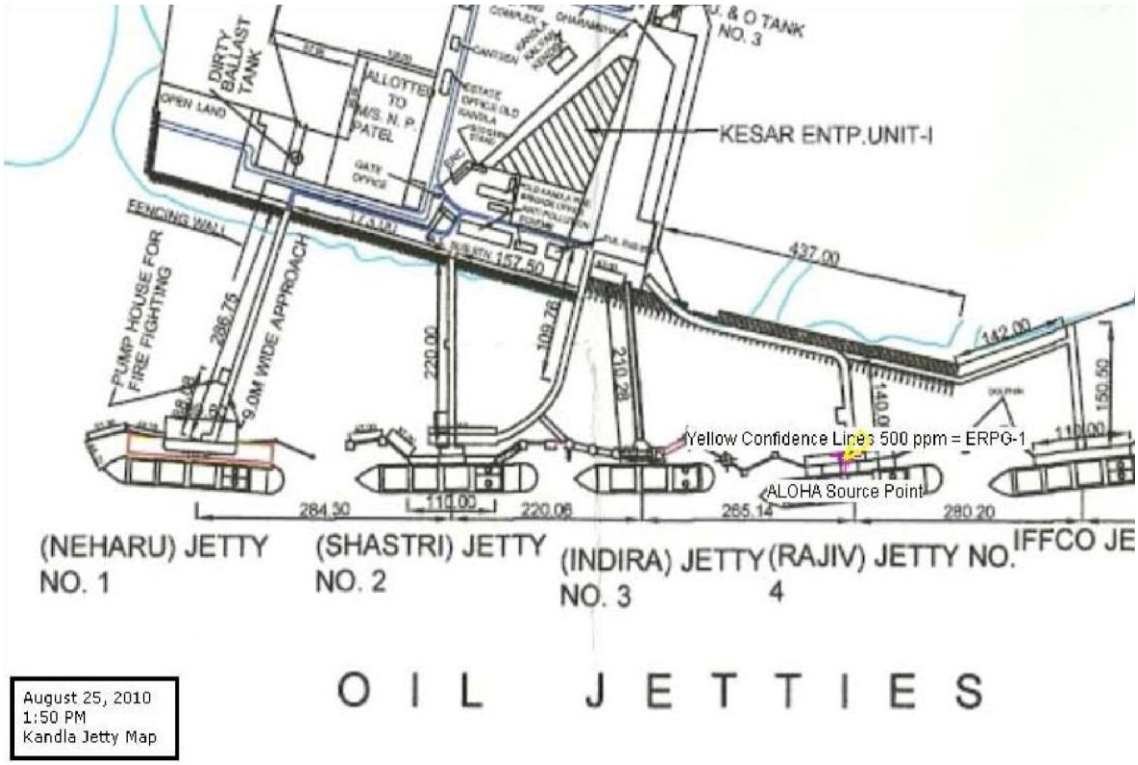
20.1.10.6 Instantaneous Release – Overpressure (Contour)



20.1.10.7 Evaporating Puddle – Toxic Threat Zone (Graph)

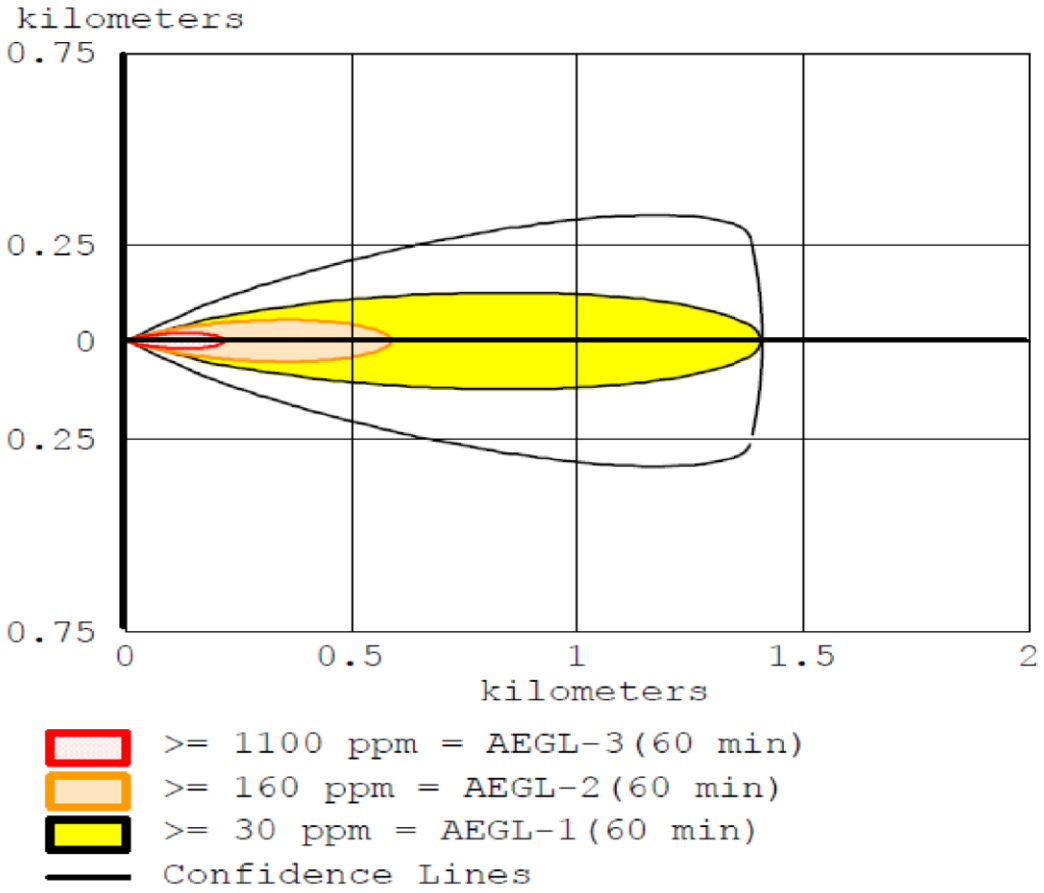


20.1.10.8 Evaporating Puddle – Toxic Threat Zone (Contour)

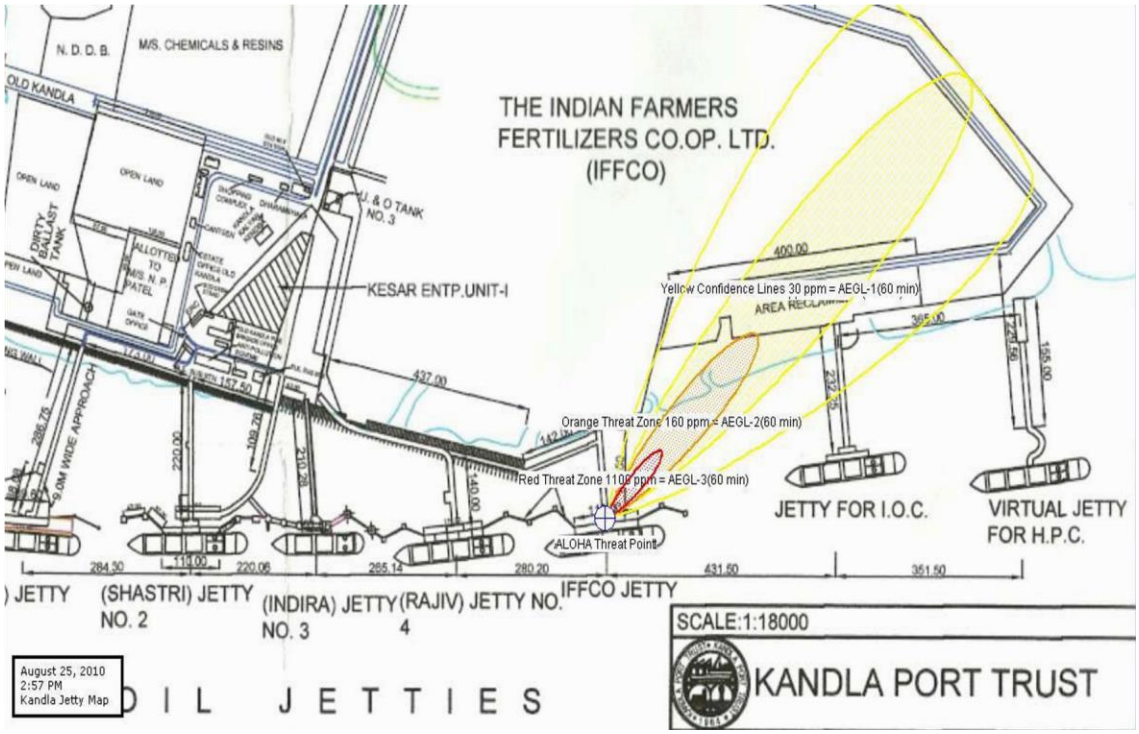


20.1.11 Jetty Five – Ammonia

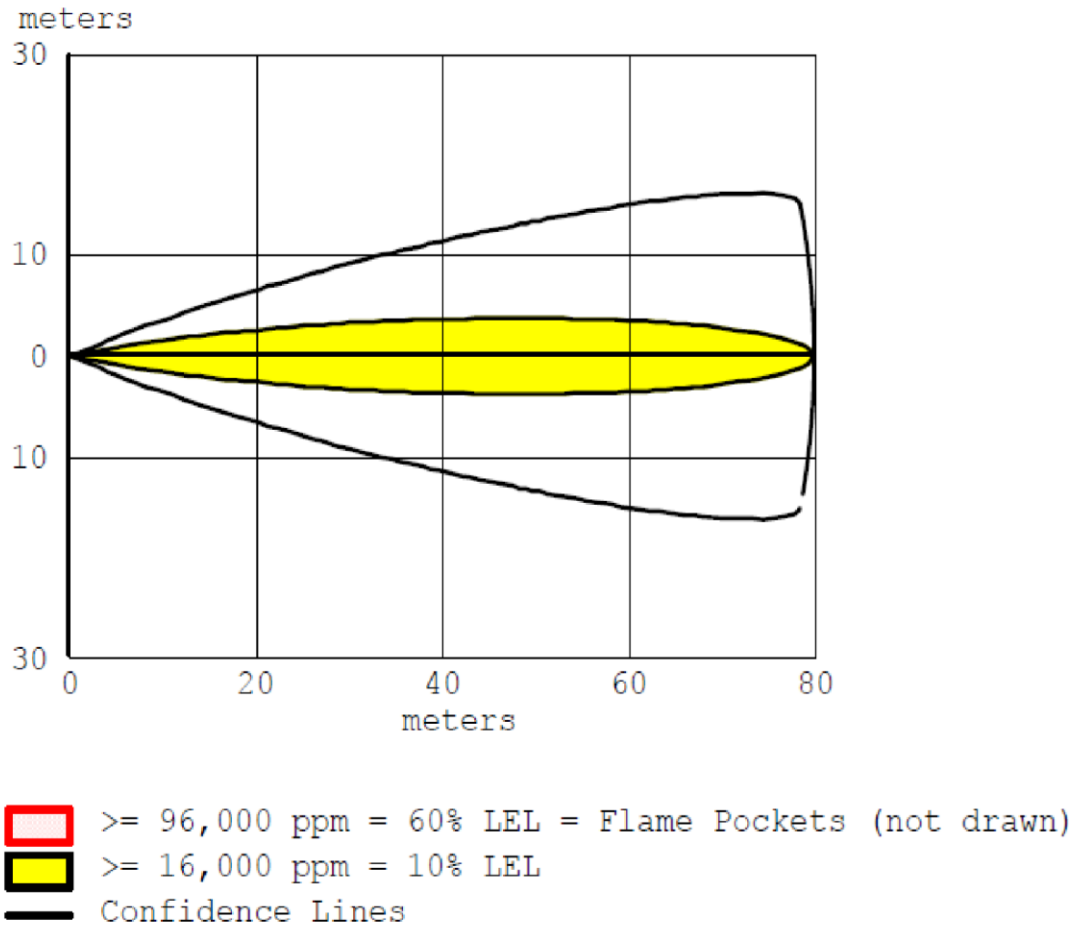
20.1.11.1 Instantaneous Release – Toxic Threat Zone (Graph)



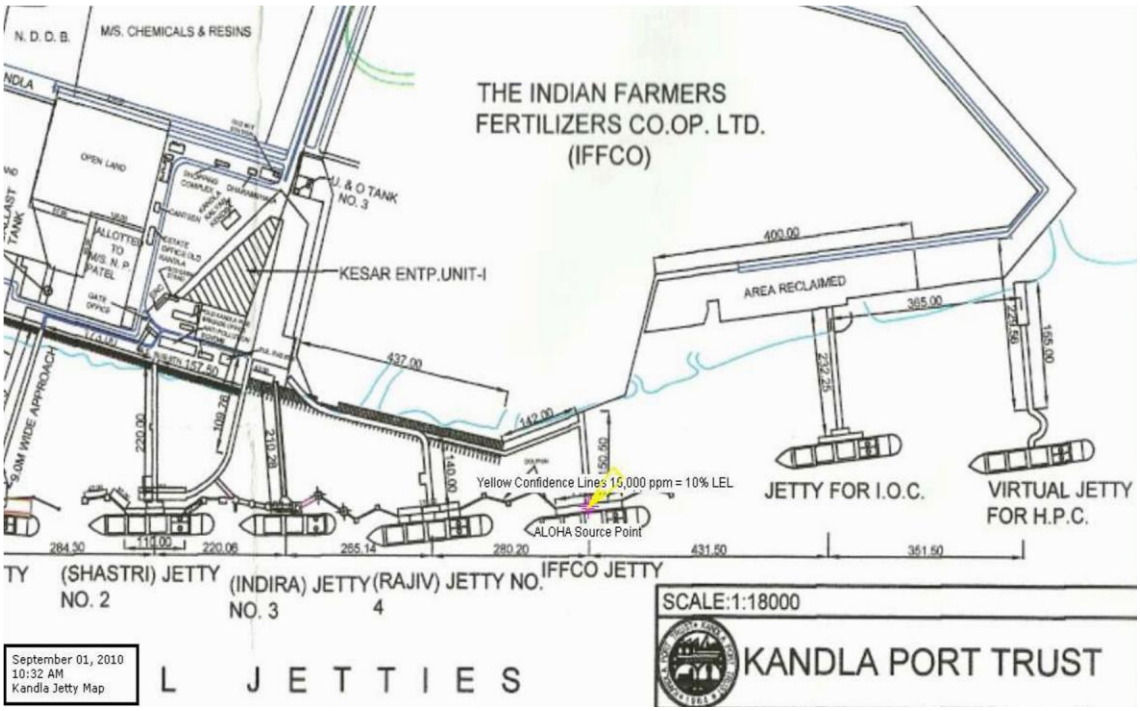
20.1.11.2 Instantaneous Release – Toxic Threat Zone (Contour)



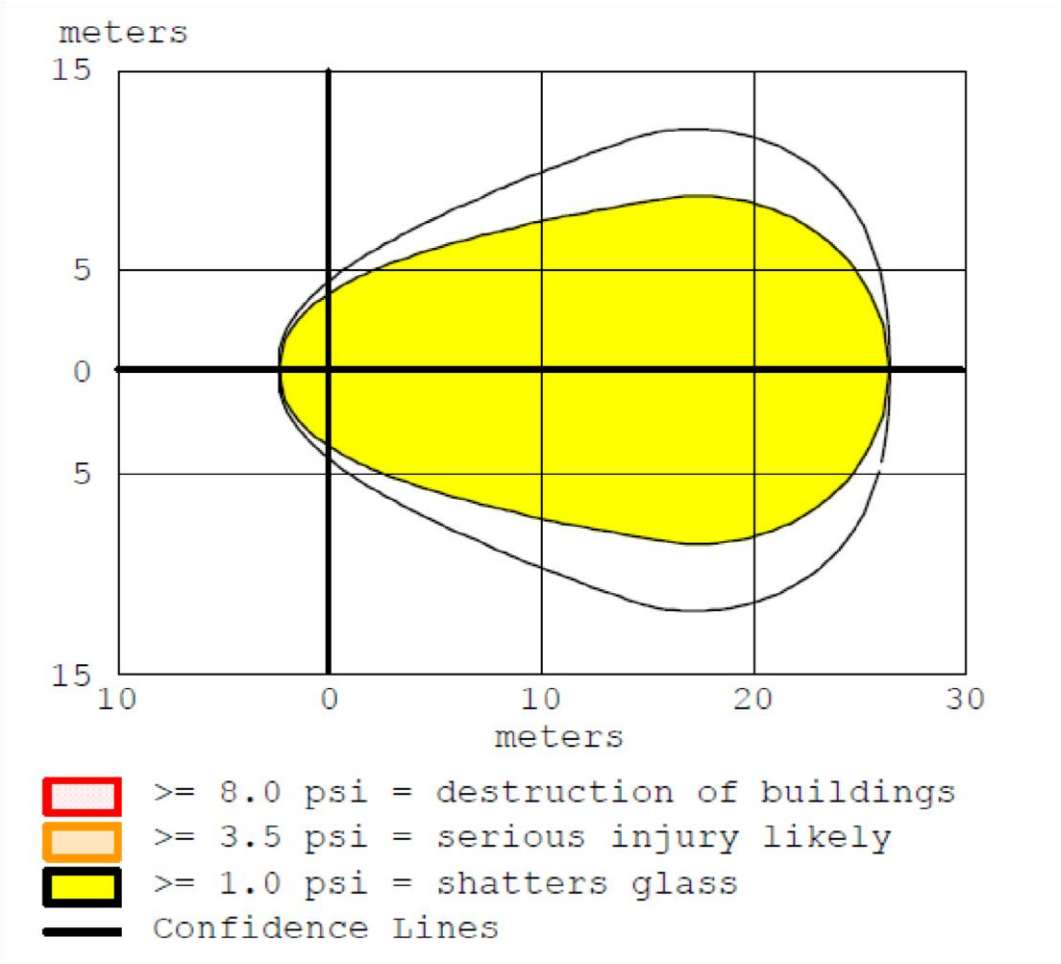
20.1.11.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



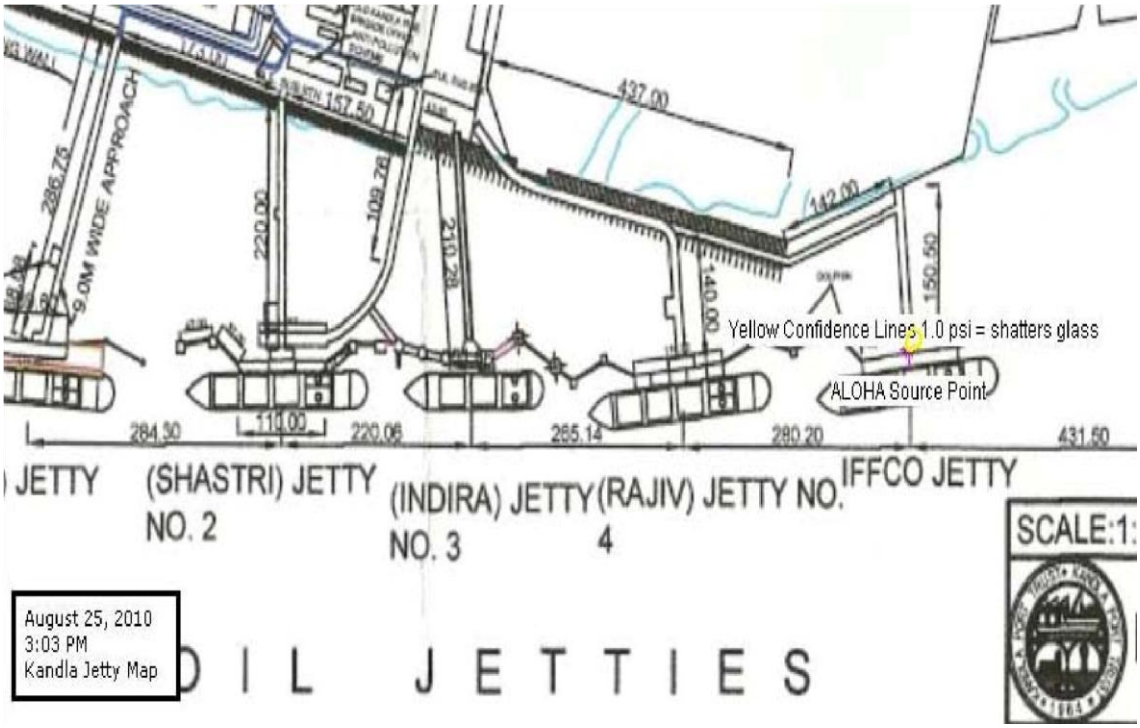
20.1.11.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



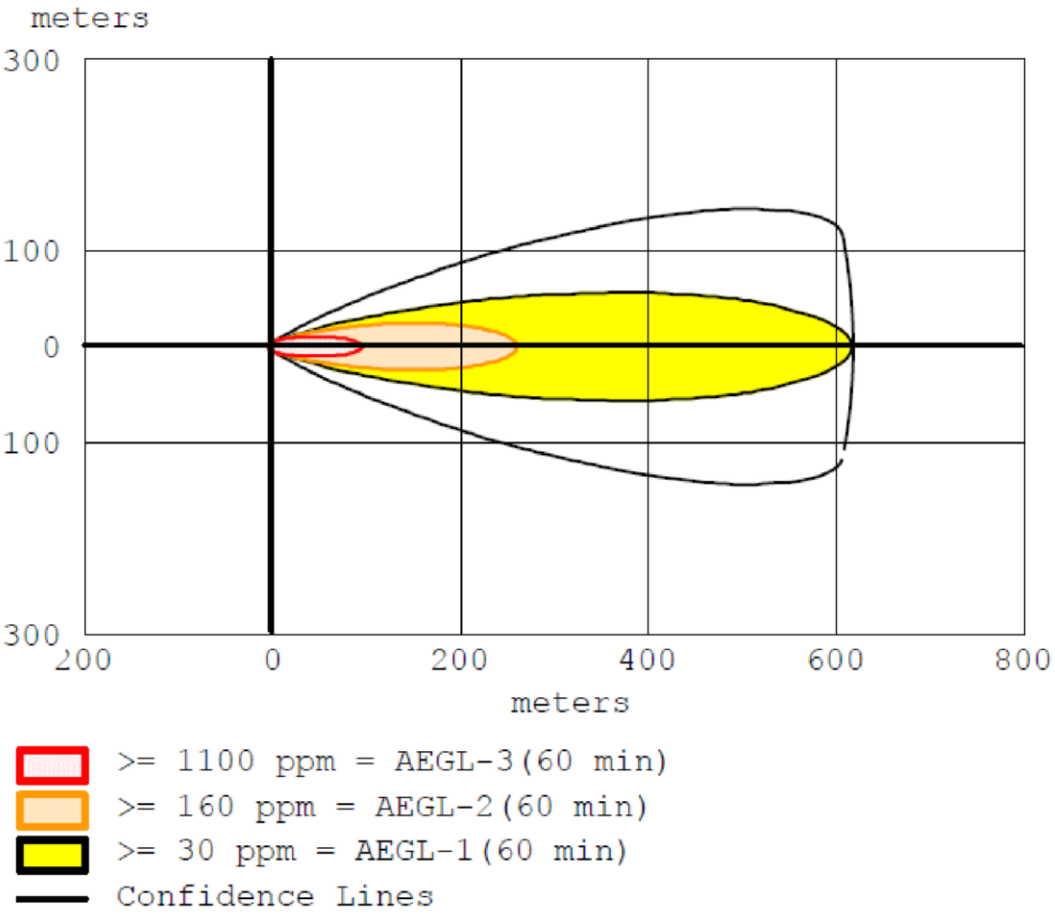
20.1.11.5 Instantaneous Release – Overpressure (Graph)



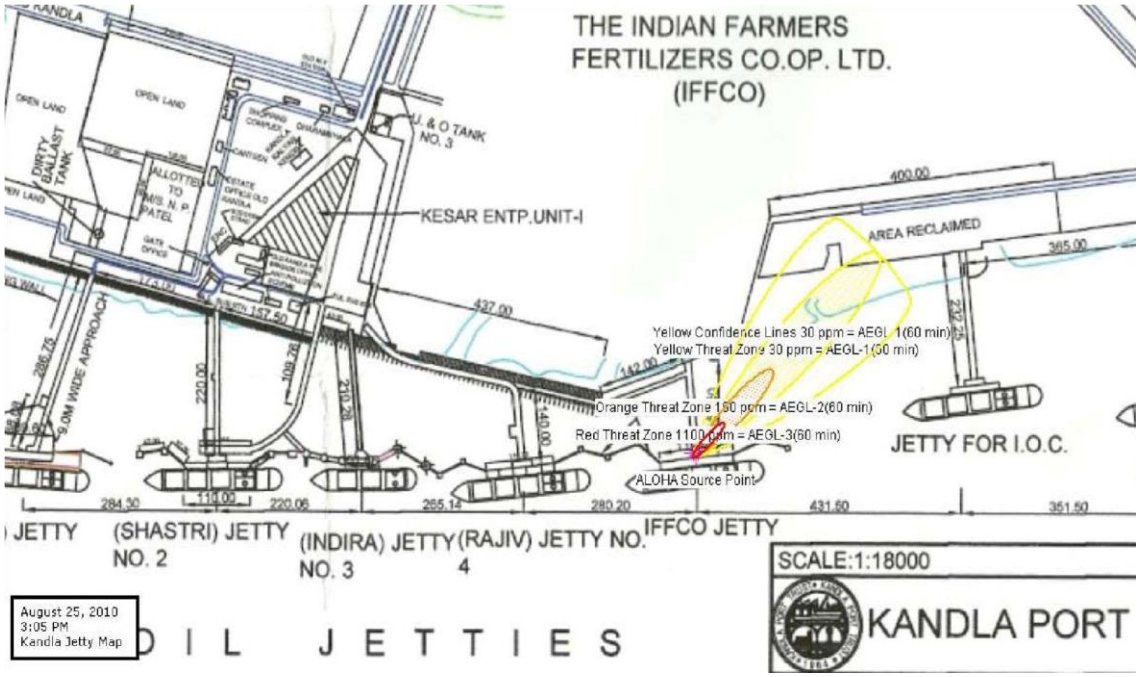
20.1.11.6 Instantaneous Release – Overpressure (Contour)



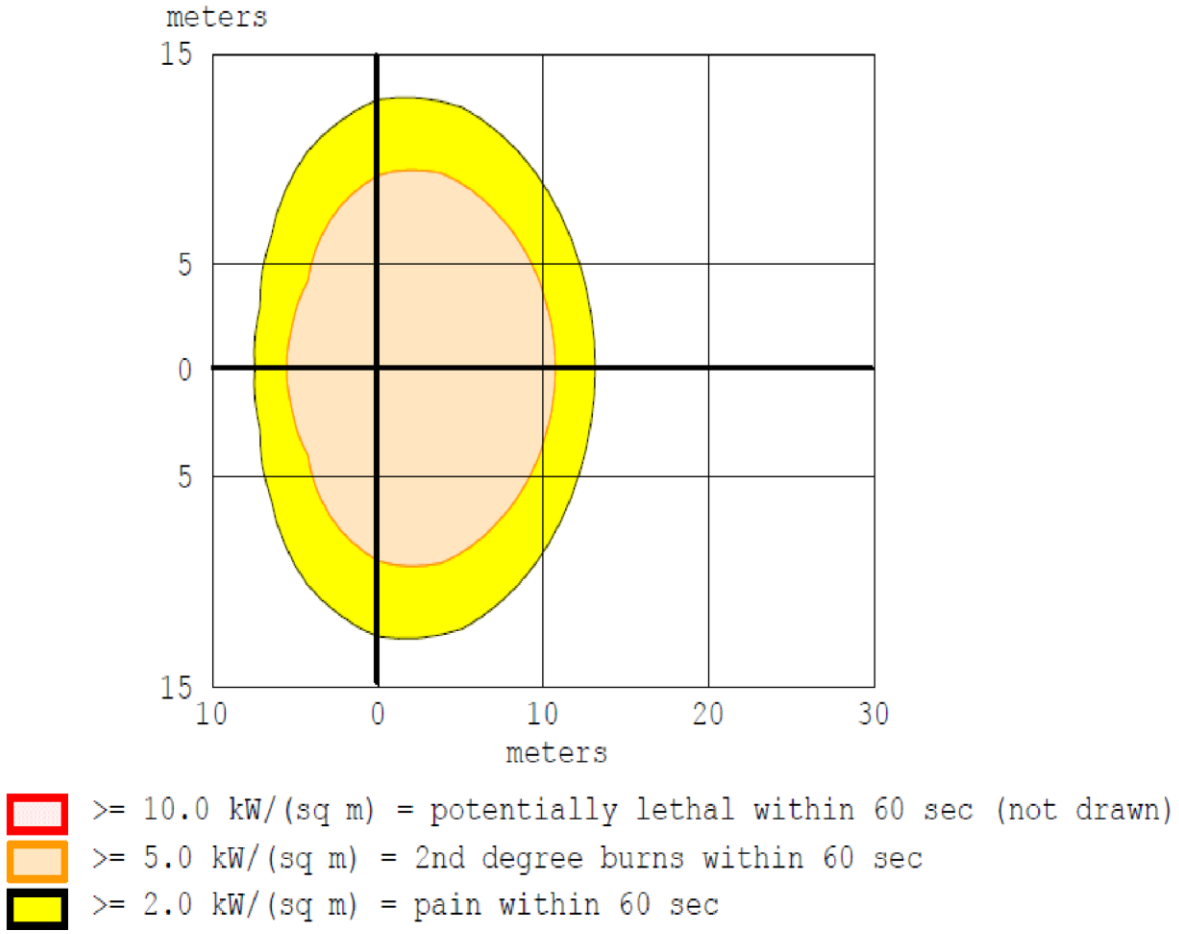
20.1.11.7 Evaporating Puddle – Toxic Threat Zone (Graph)



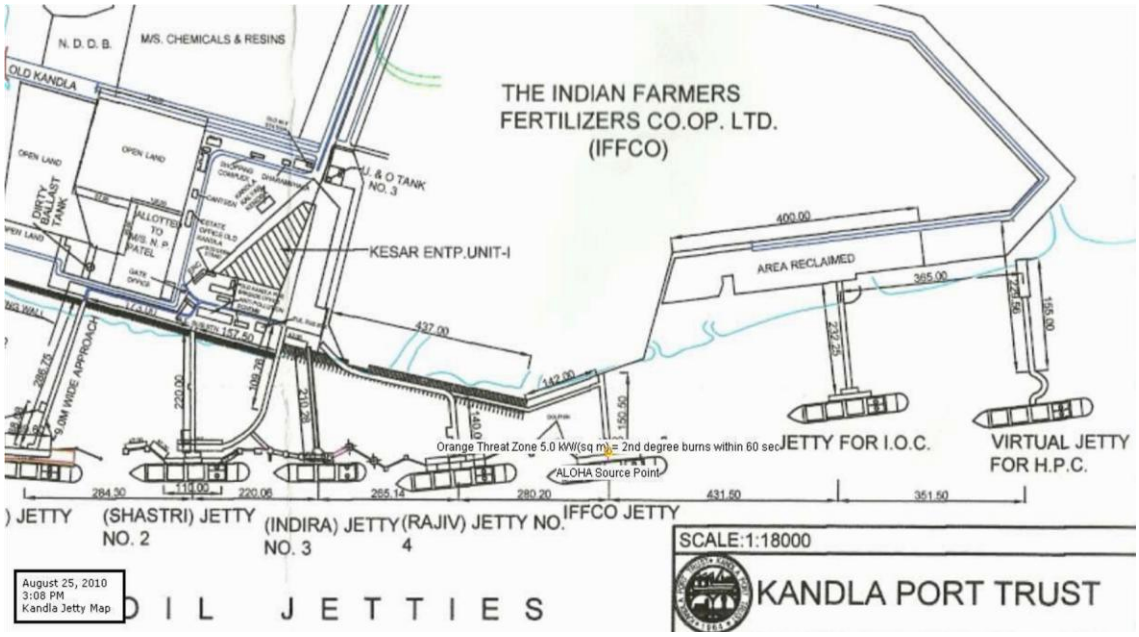
20.1.11.8 Evaporating Puddle – Toxic Threat Zone (Contour)



20.1.11.9 Burning Puddle – Thermal Radiation (Graph)

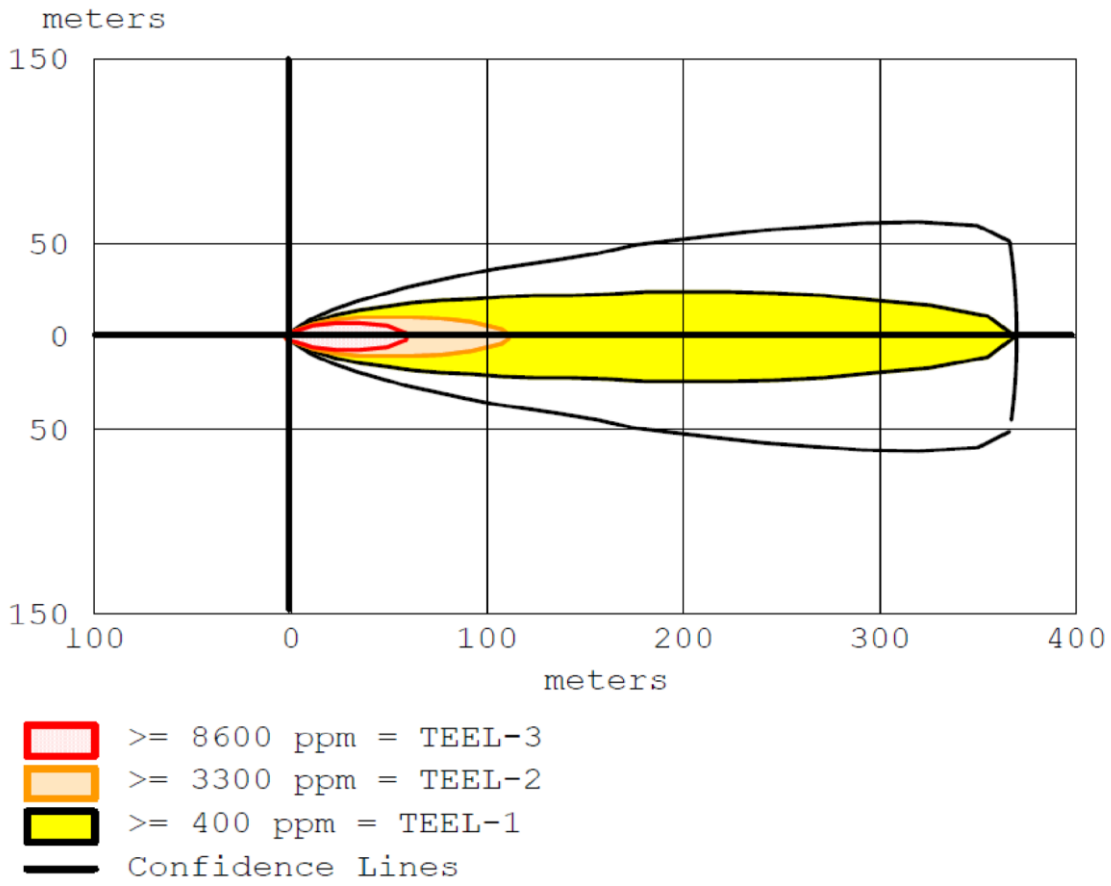


20.1.11.10 Burning Puddle – Thermal Radiation (Contour)

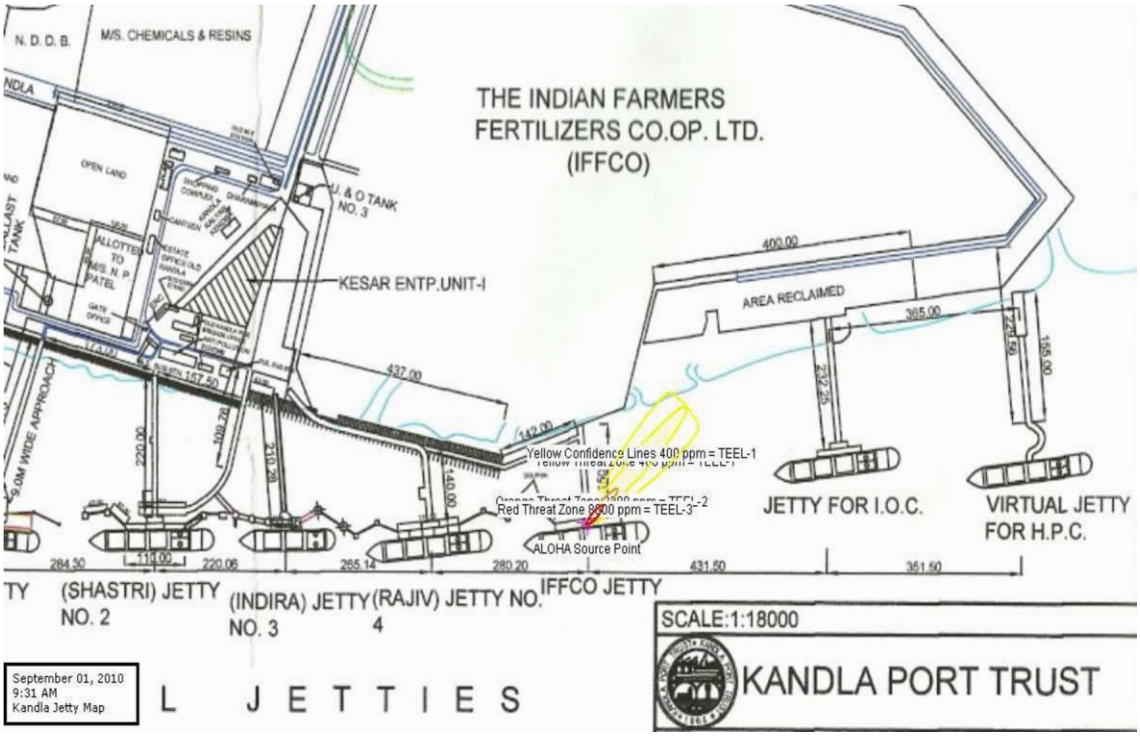


20.1.12 Jetty Five – HSD

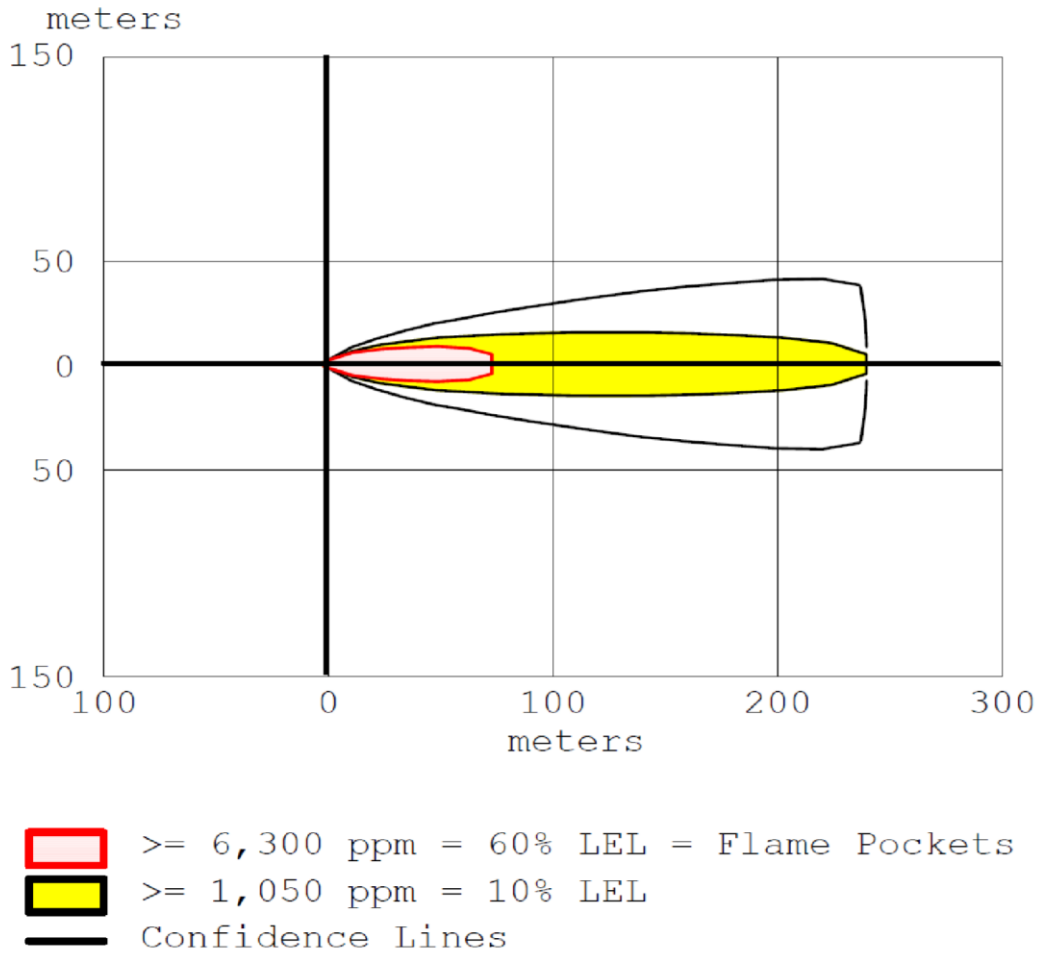
20.1.12.1 Instantaneous Release – Toxic Threat Zone (Graph)



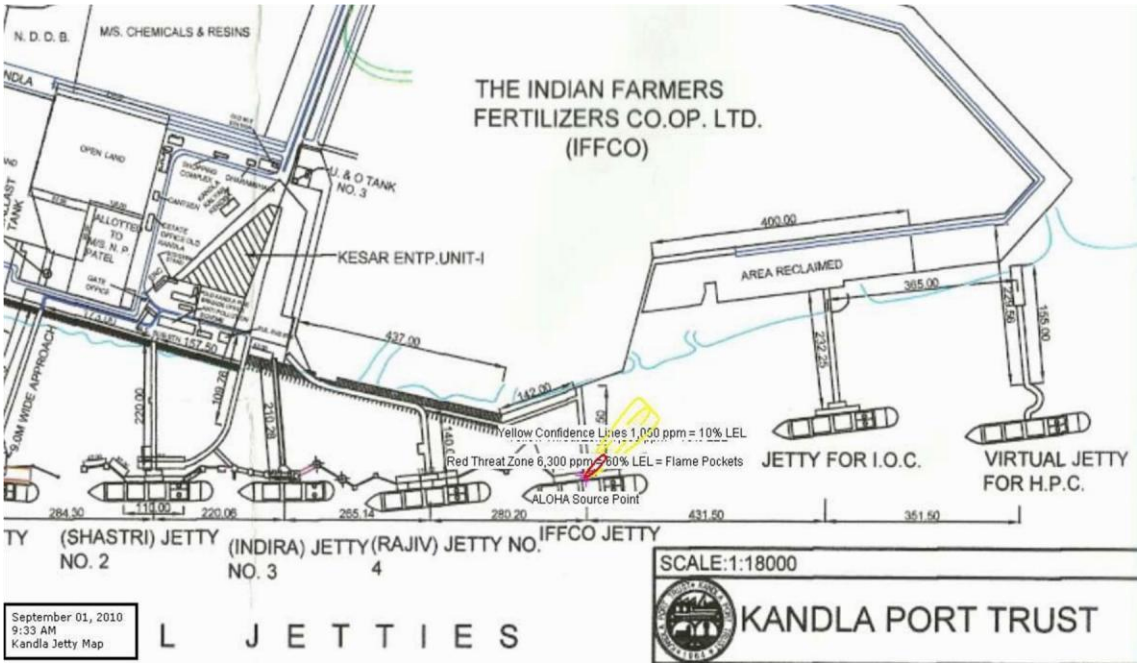
20.1.12.2 Instantaneous Release – Toxic Threat Zone (Contour)



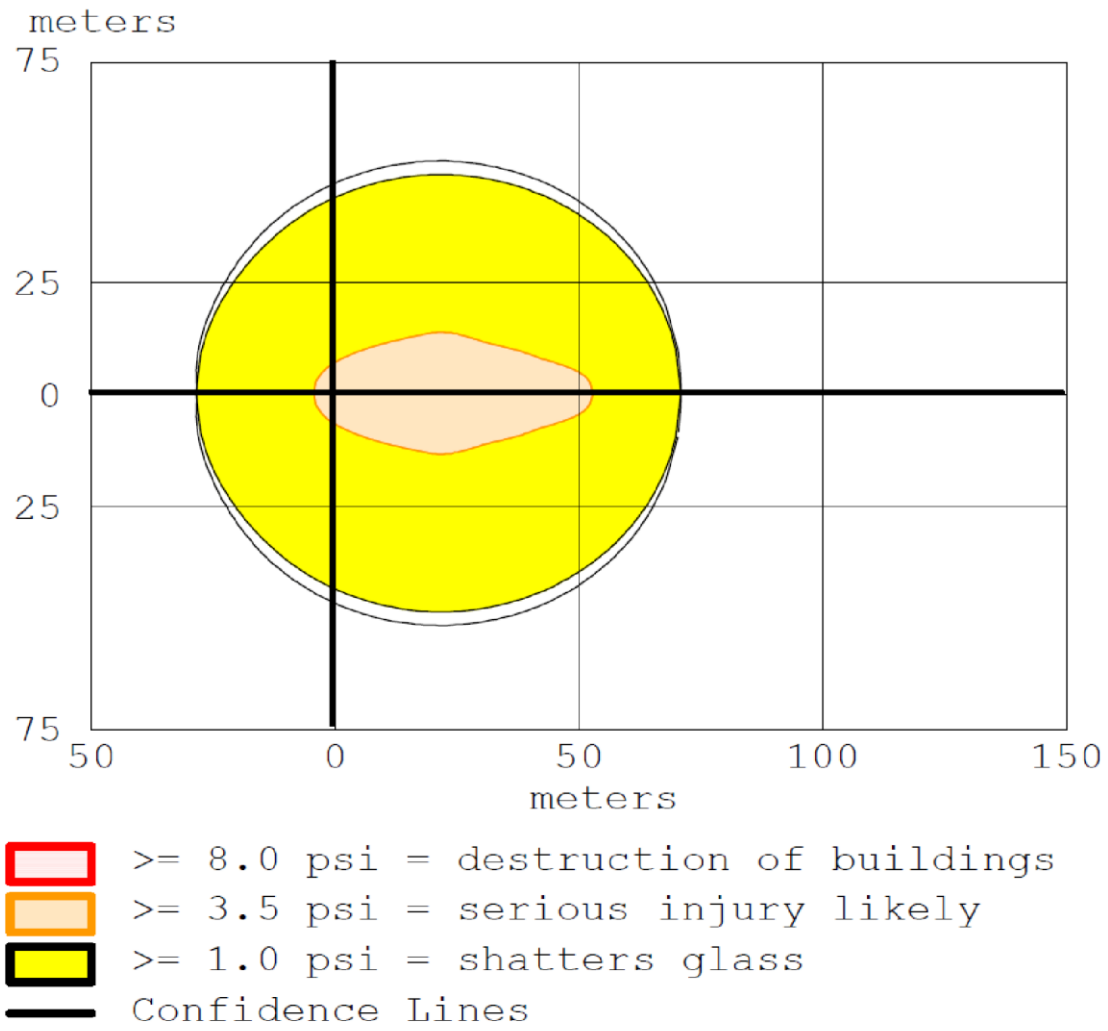
20.1.12.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



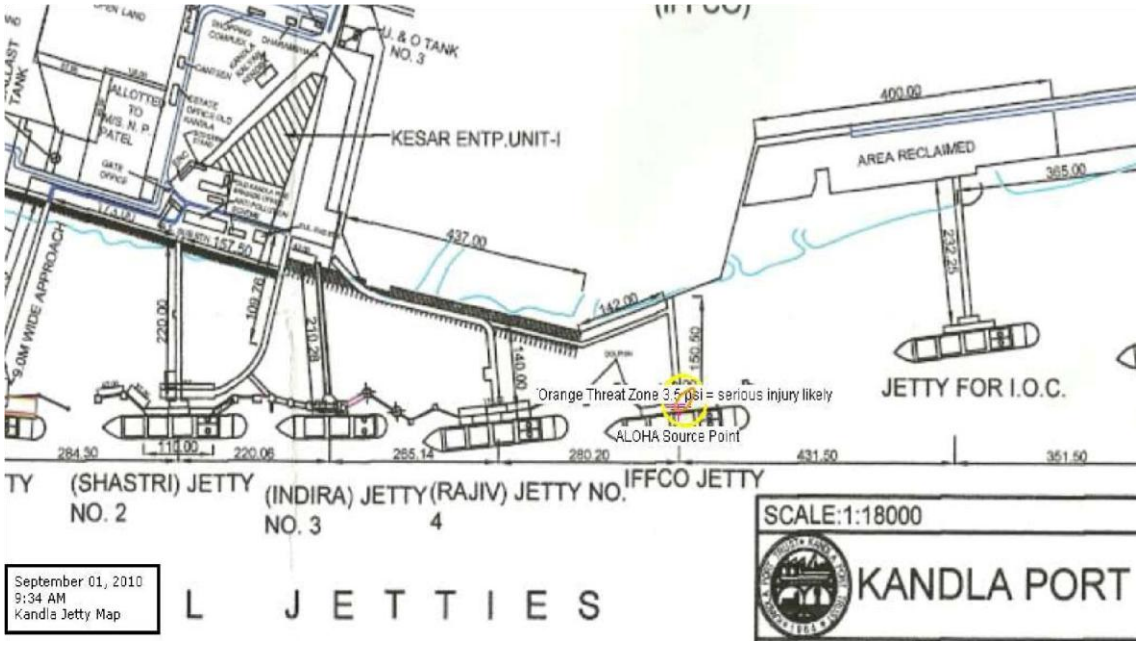
20.1.12.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



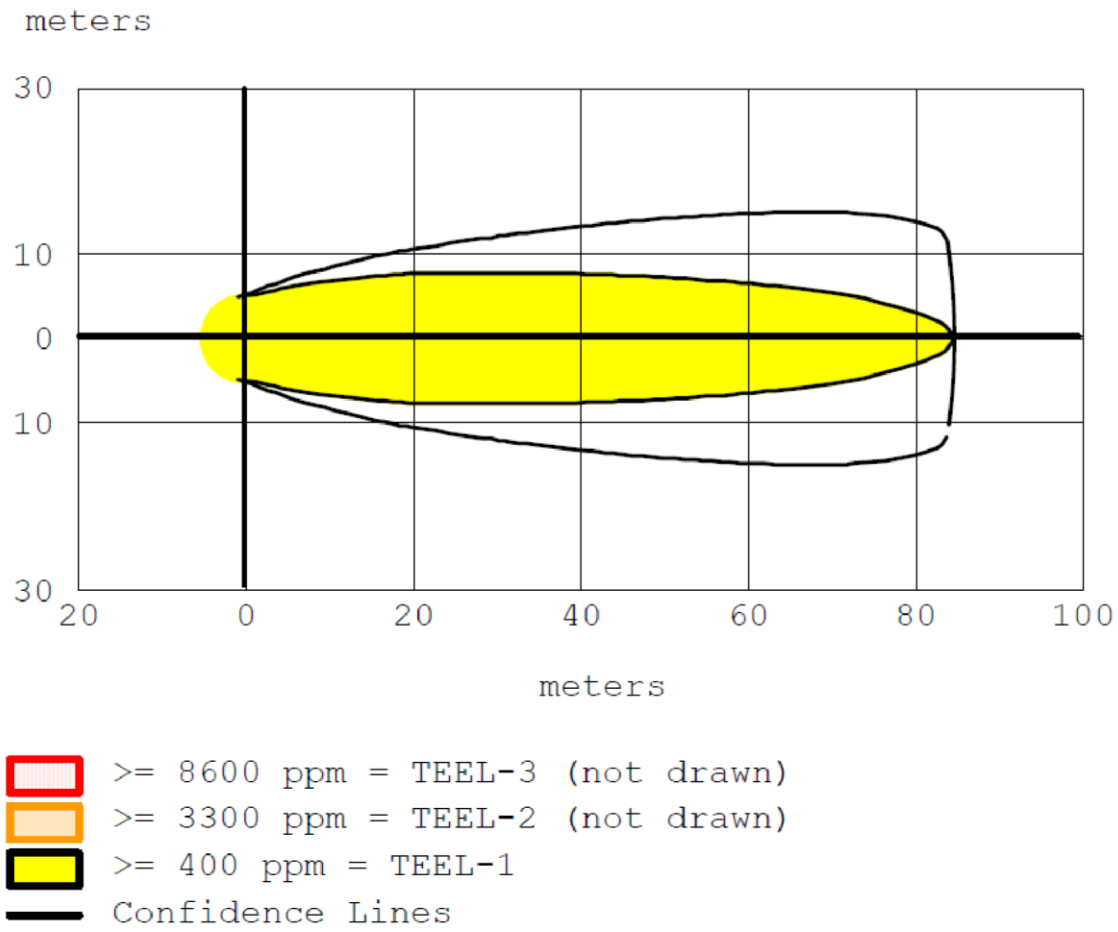
20.1.12.5 Instantaneous Release – Overpressure (Graph)



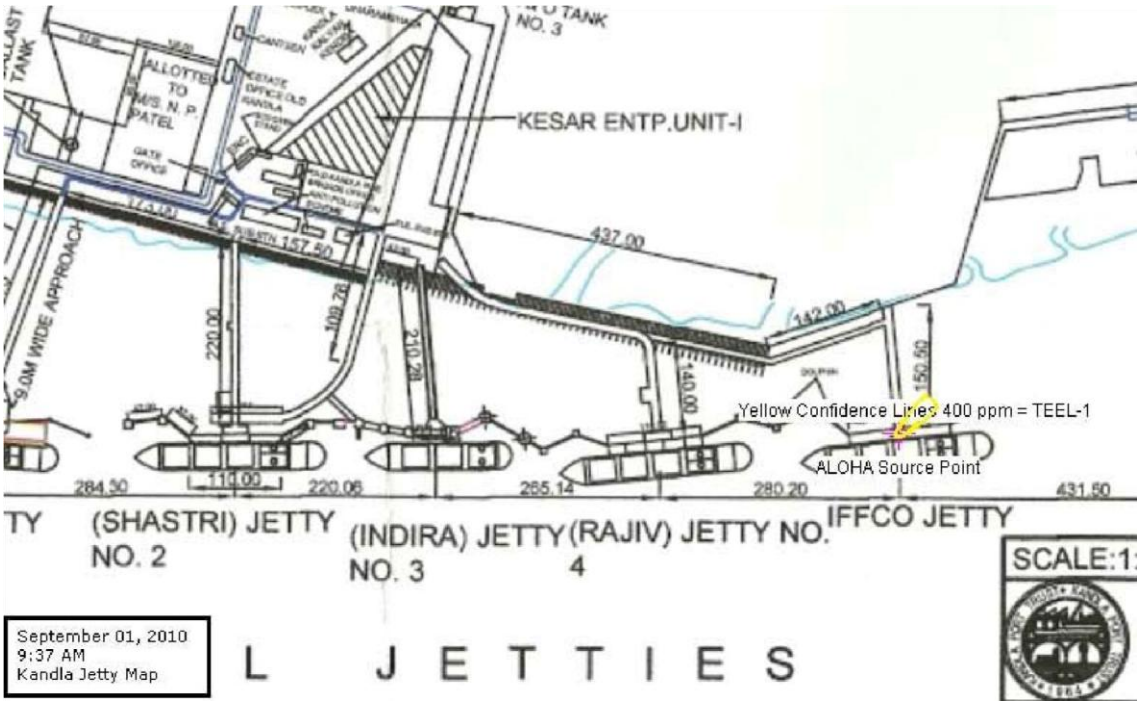
20.1.12.6 Instantaneous Release – Overpressure (Contour)



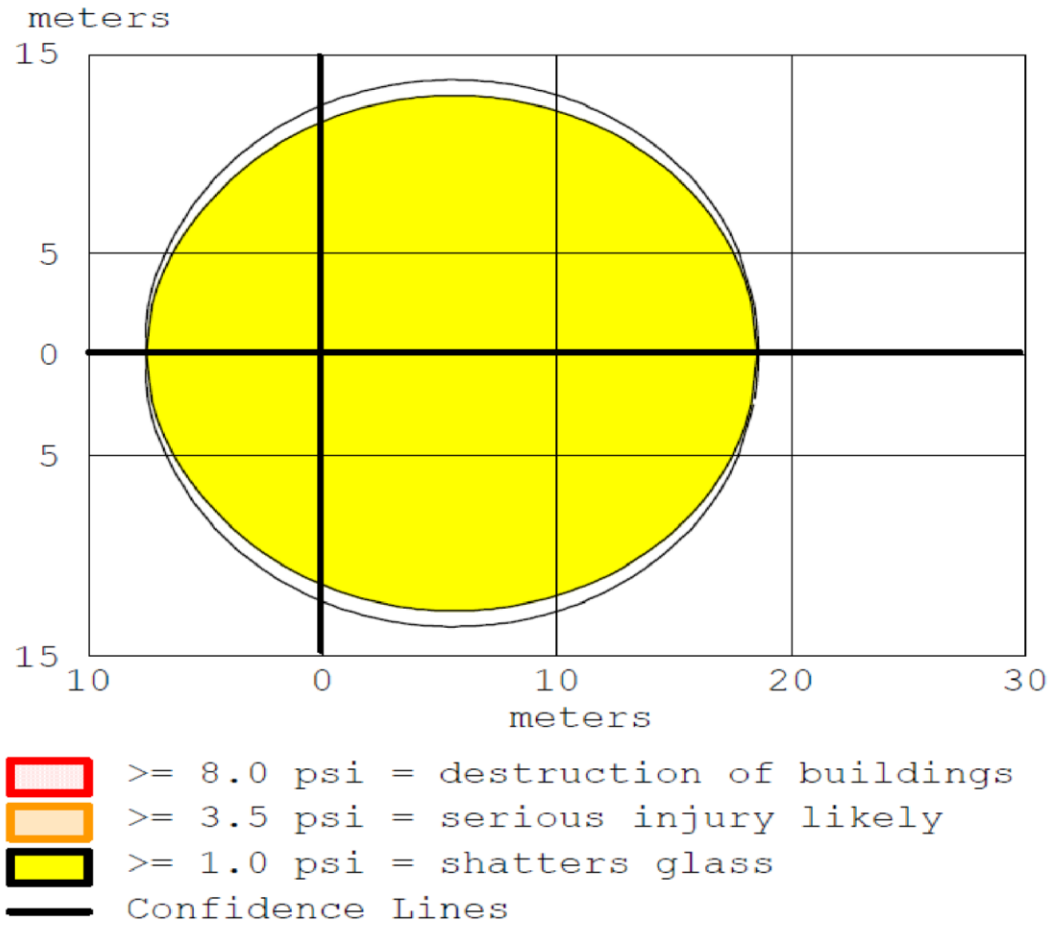
20.1.12.7 Evaporating Puddle – Toxic Threat Zone (Graph)



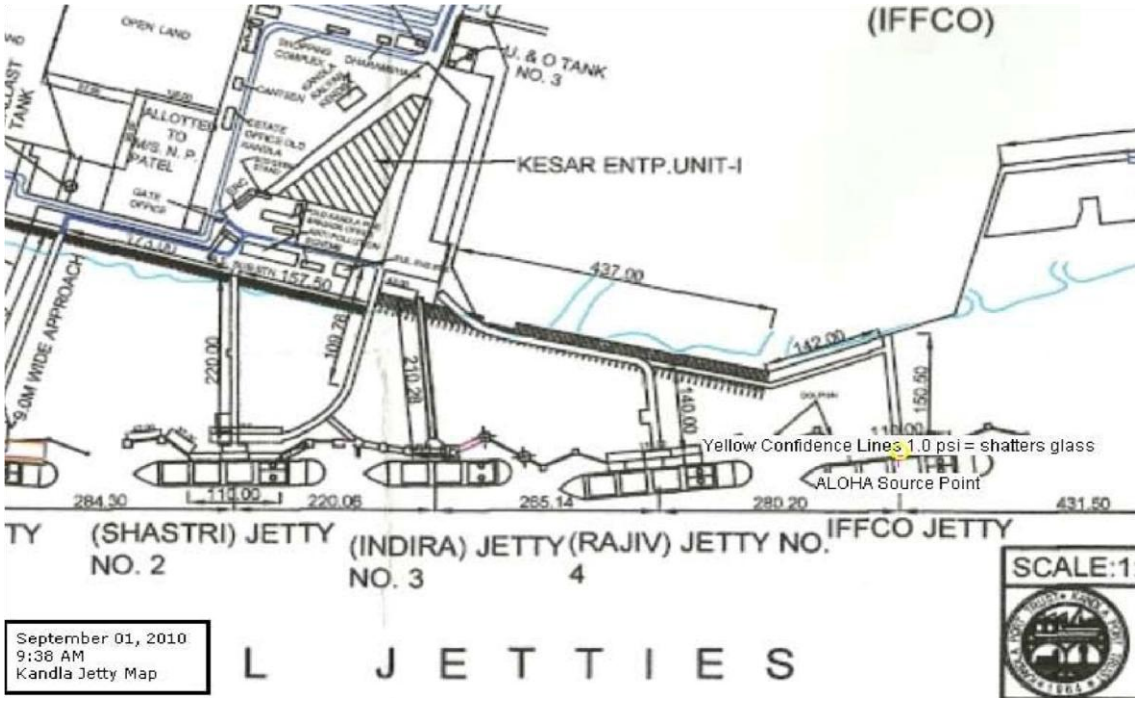
20.1.12.8 Evaporating Puddle – Toxic Threat Zone (Contour)



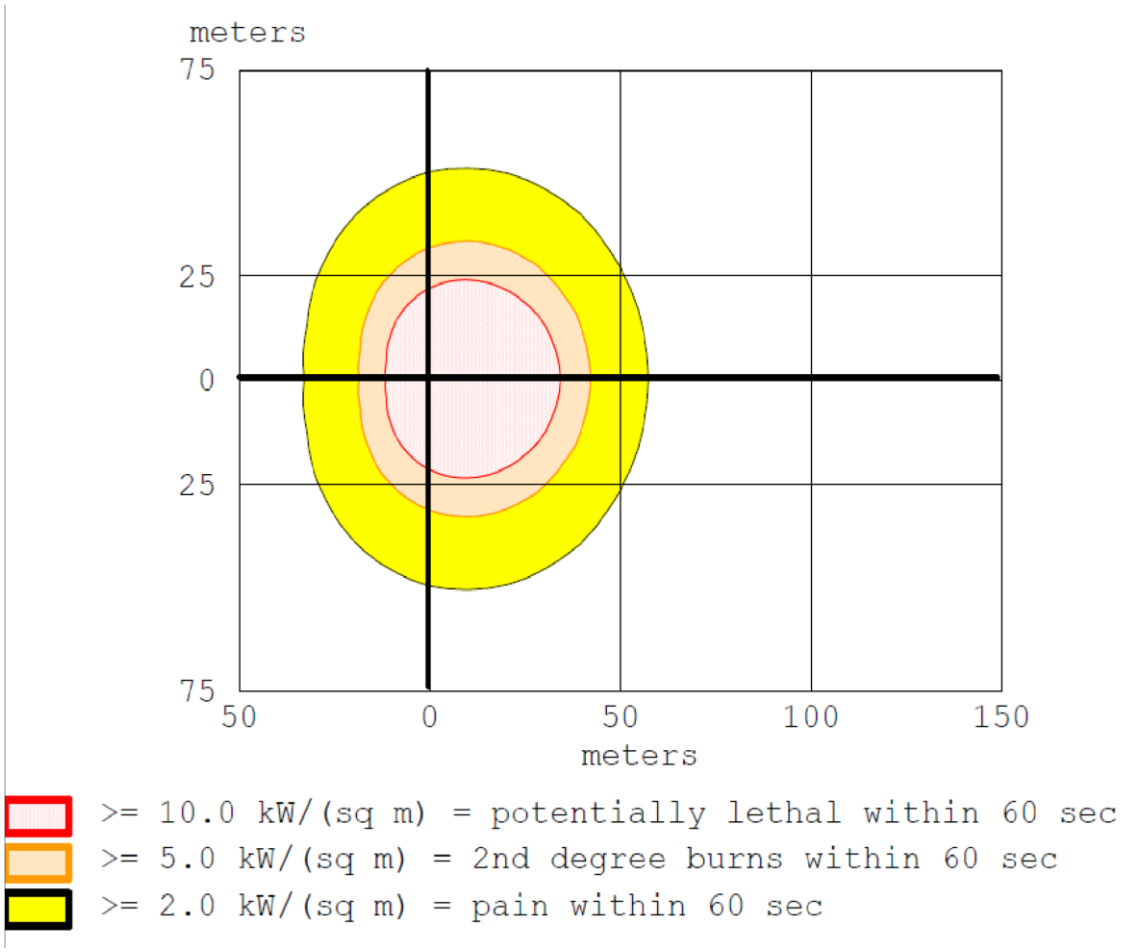
20.1.12.9 Evaporating Puddle – Overpressure (Graph)



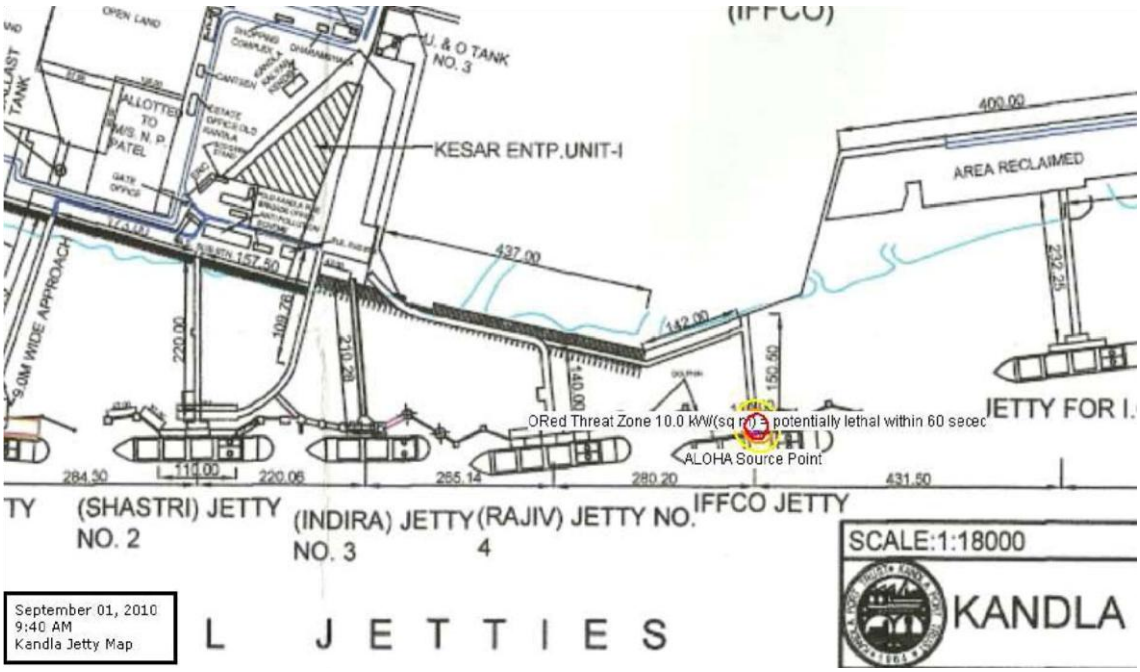
20.1.12.10 Evaporating Puddle – Overpressure (Contour)



20.1.12.11 Burning Puddle – Thermal Radiation (Graph)

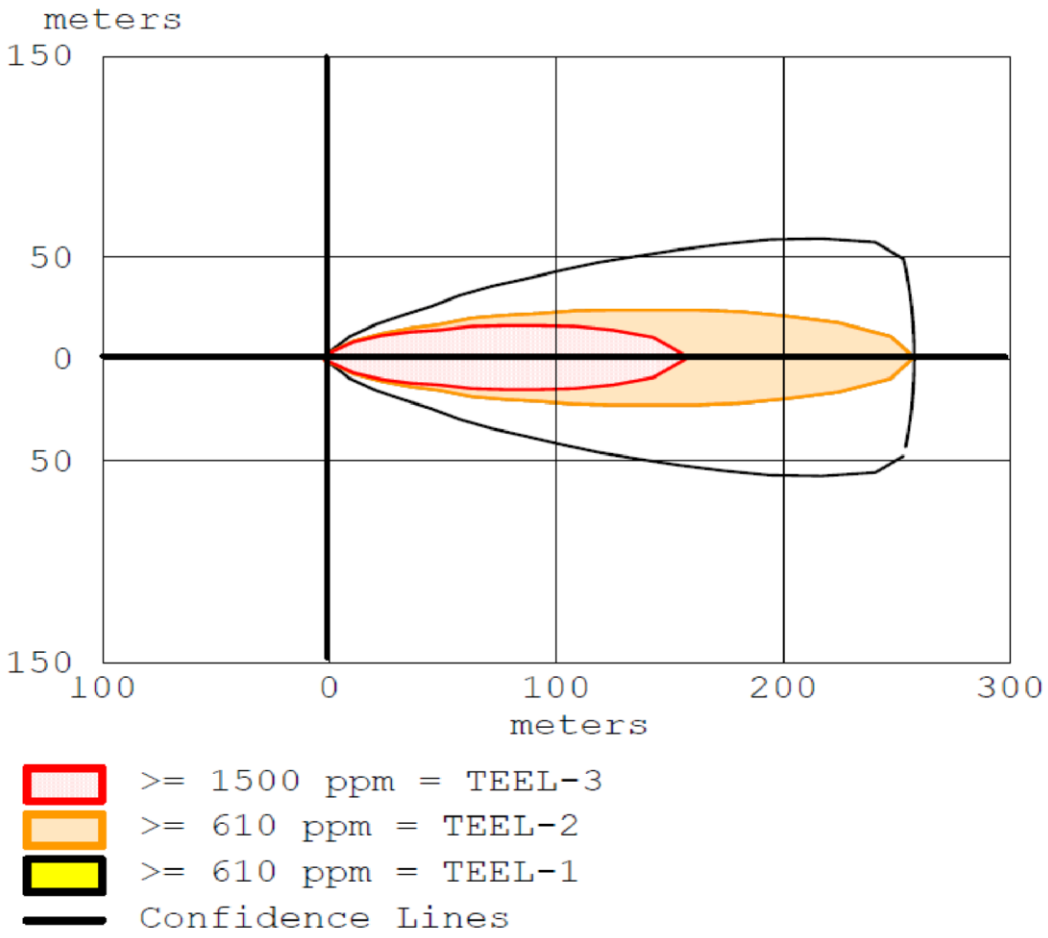


20.1.12.12 Burning Puddle – Thermal Radiation (Contour)

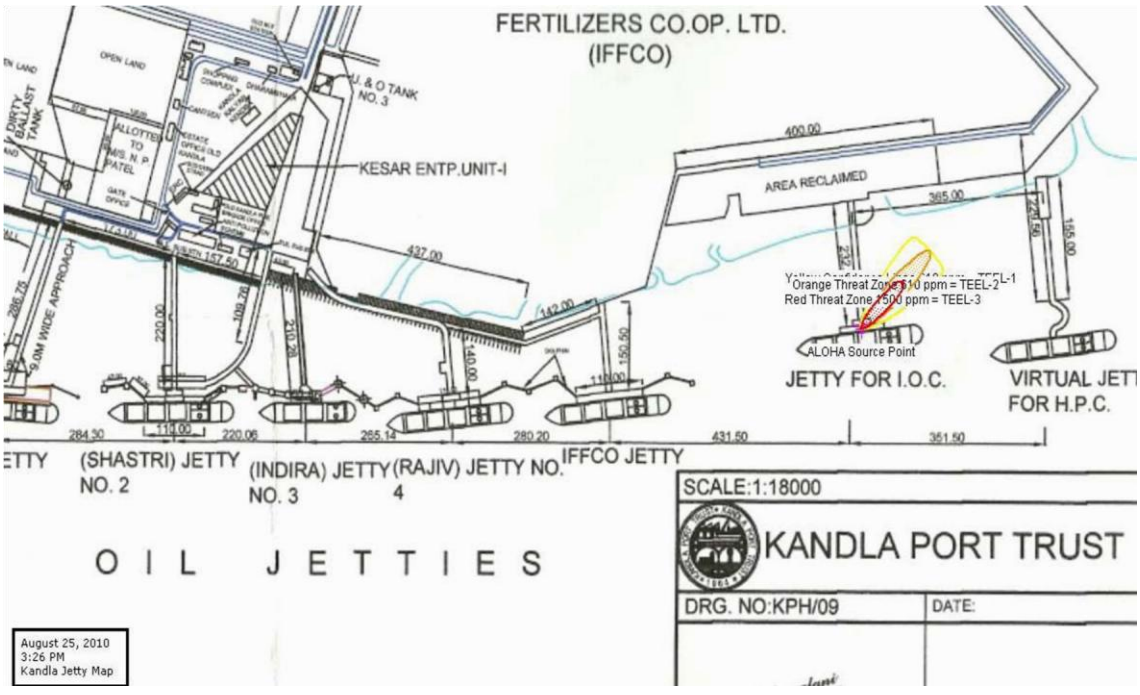


20.1.13 Jetty Six – Motor Spirit

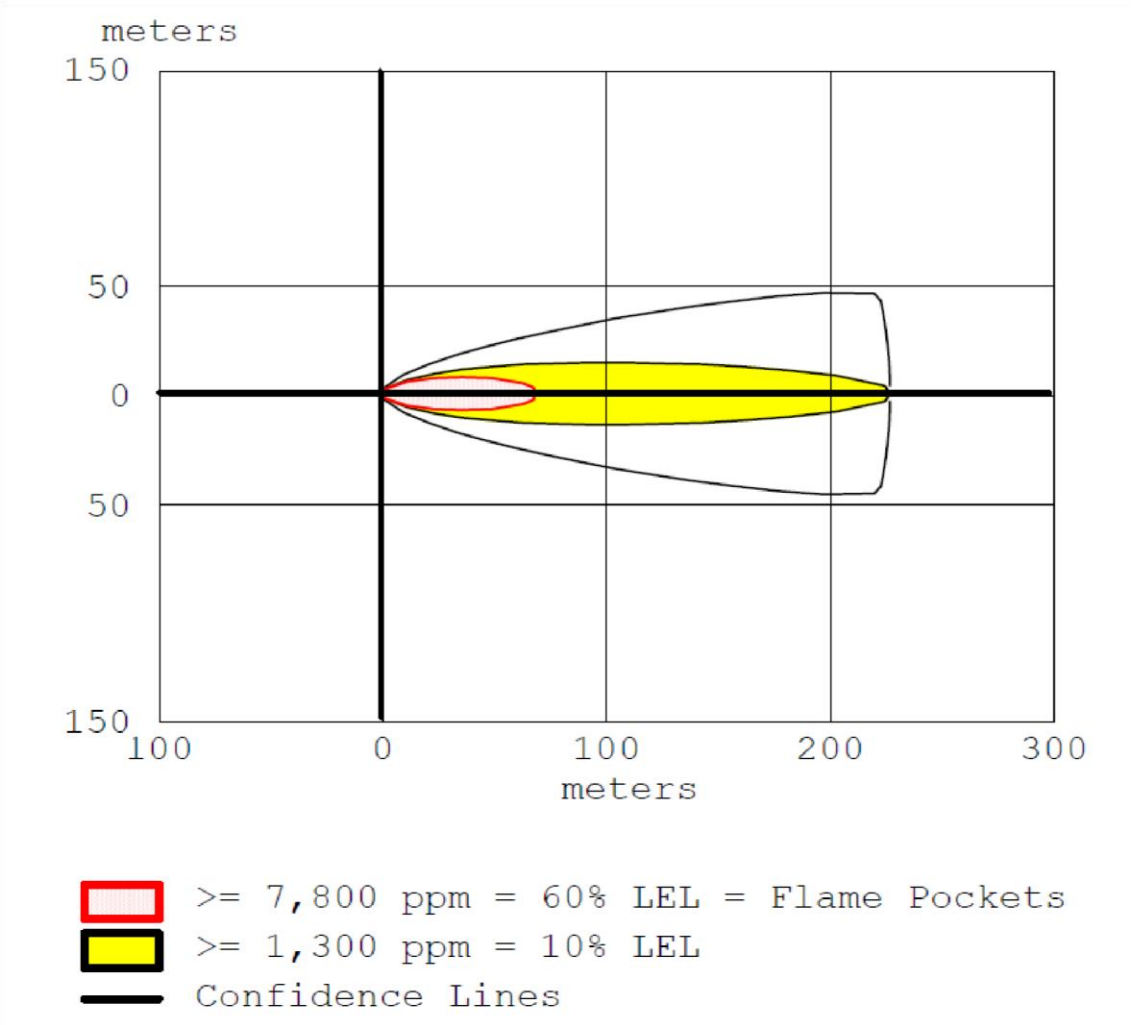
20.1.13.1 Instantaneous Release – Toxic Threat Zone (Graph)



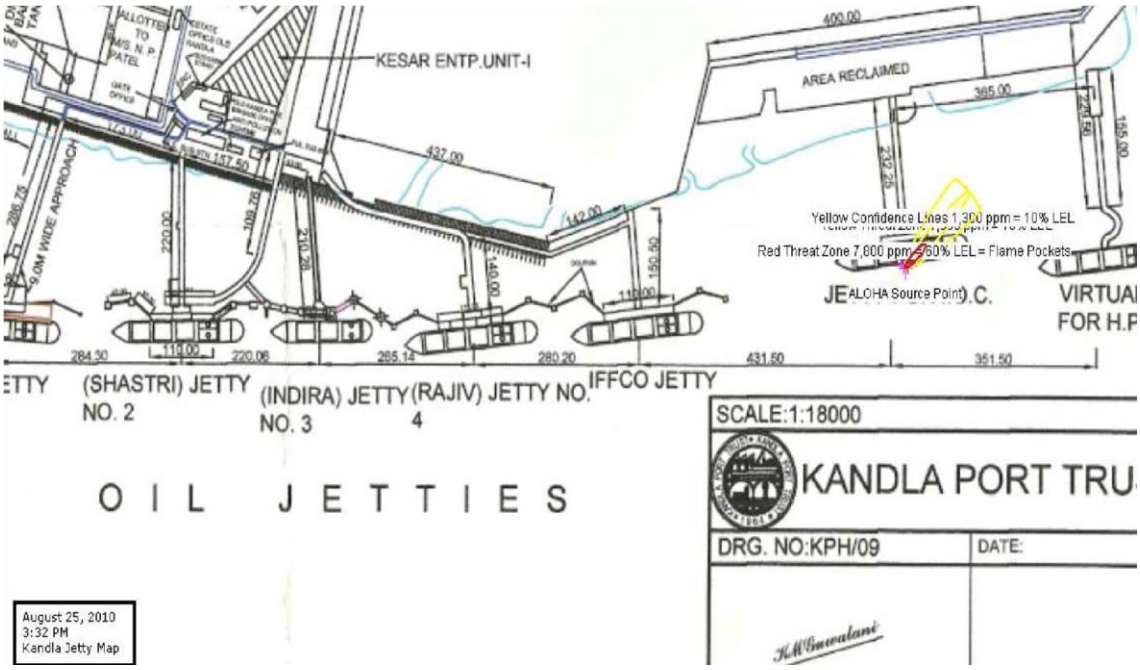
20.1.13.2 Instantaneous Release – Toxic Threat Zone (Contour)



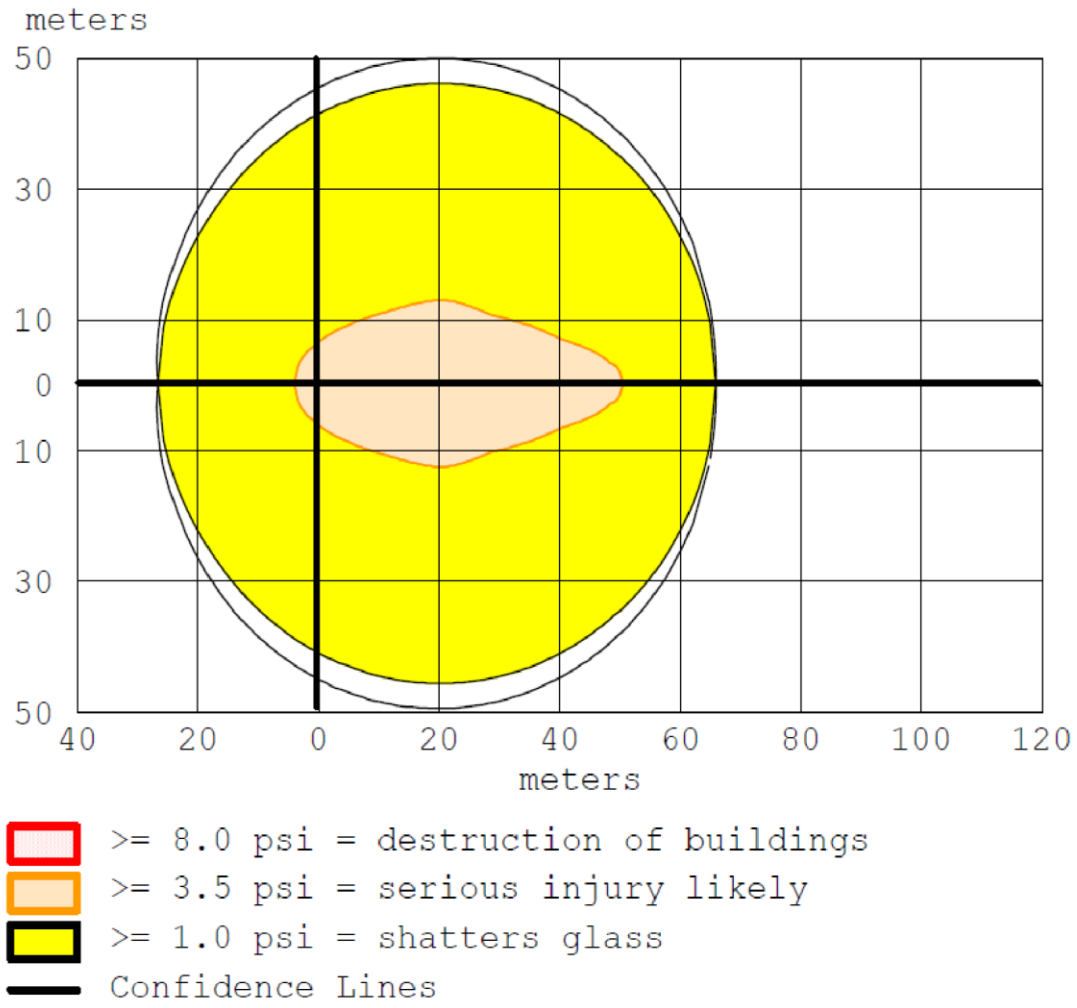
20.1.13.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



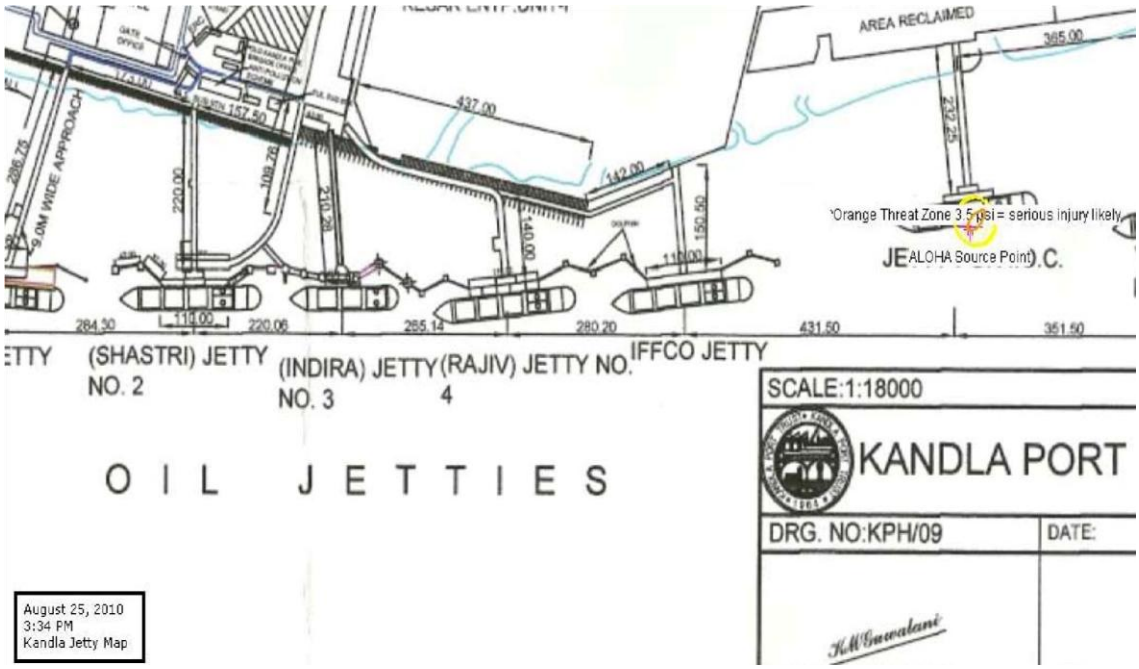
20.1.13.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



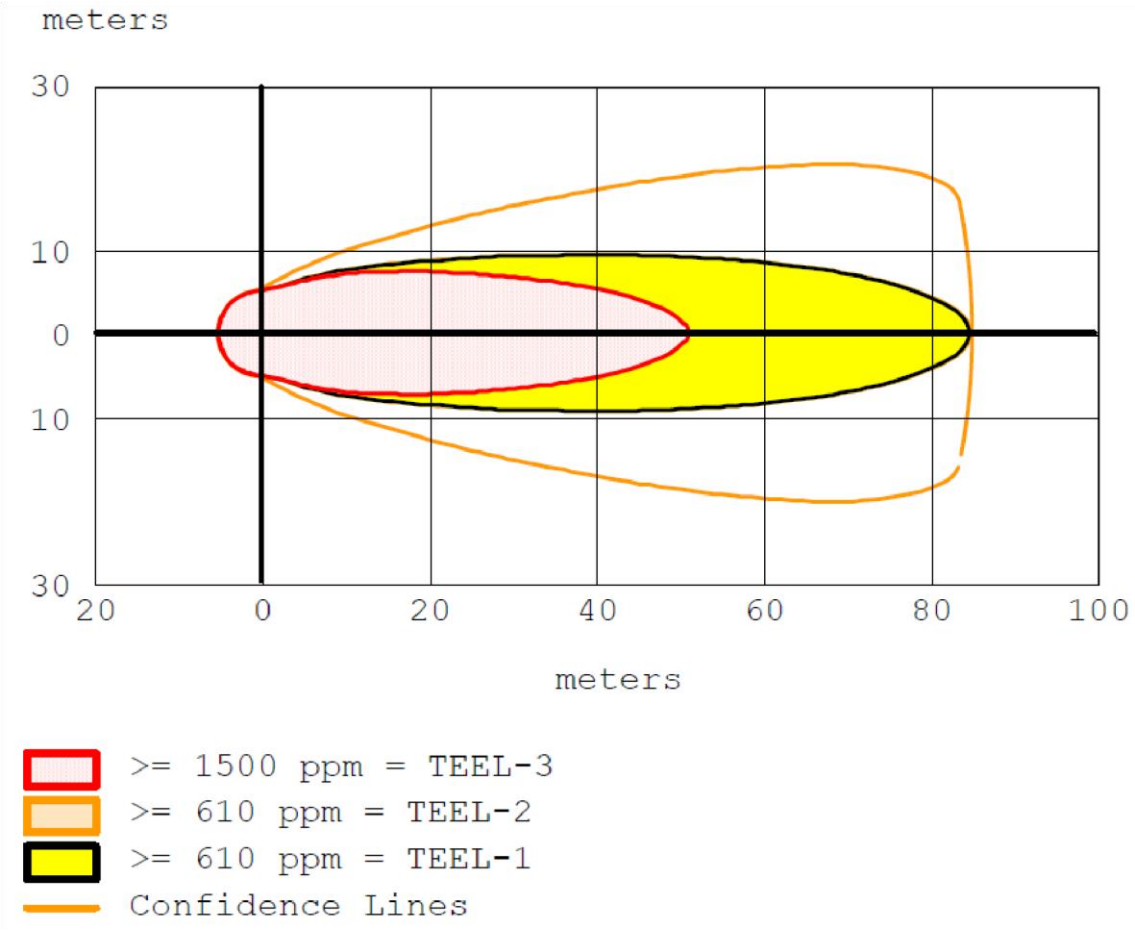
20.1.13.5 Instantaneous Release – Overpressure (Graph)



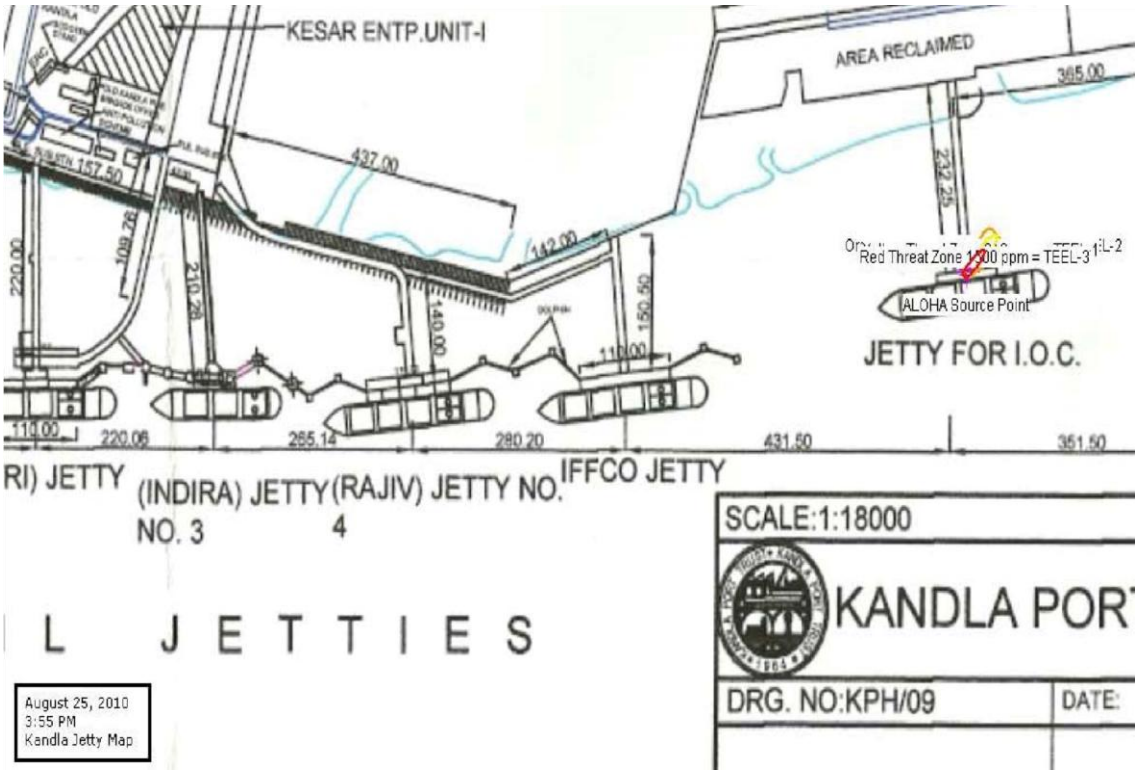
20.1.13.6 Instantaneous Release – Overpressure (Contour)



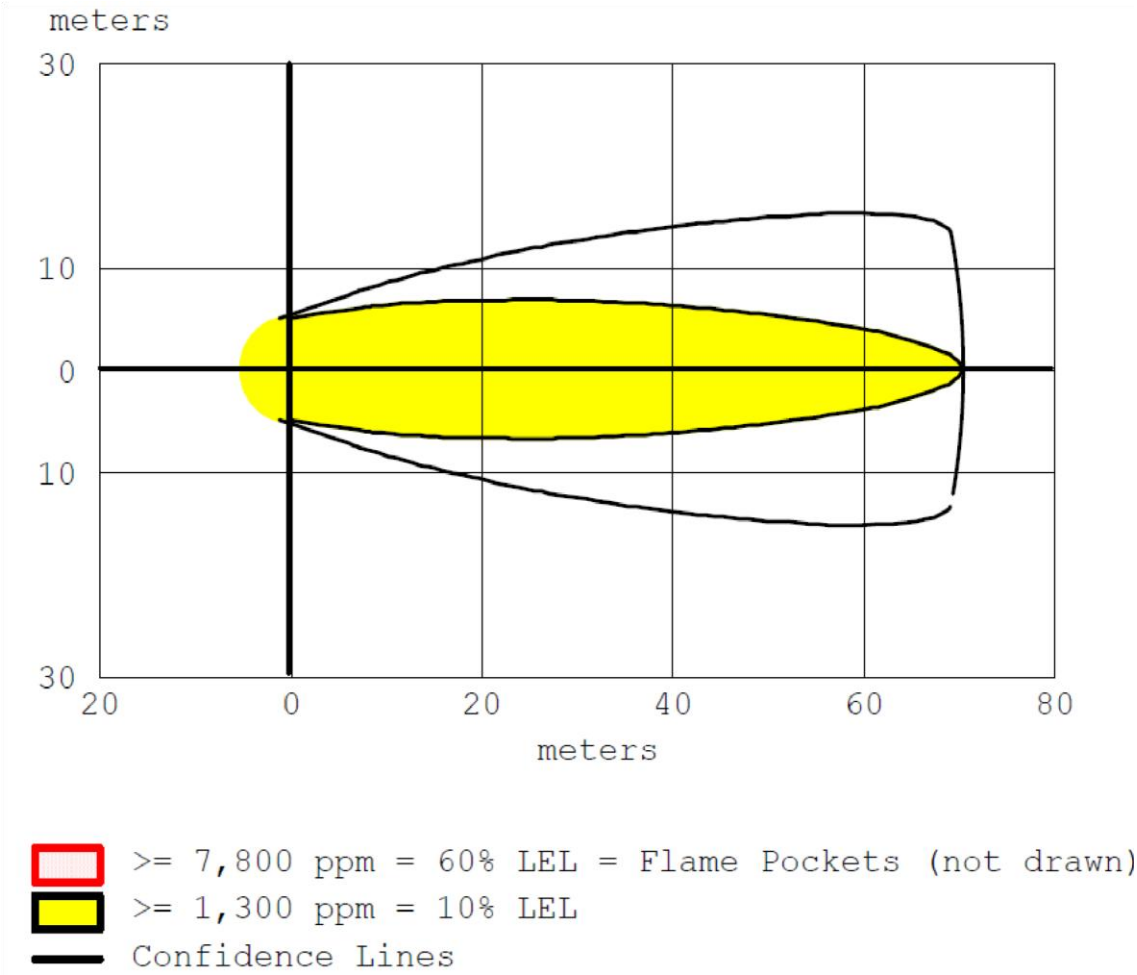
20.1.13.7 Evaporating Puddle – Toxic Threat Zone (Graph)



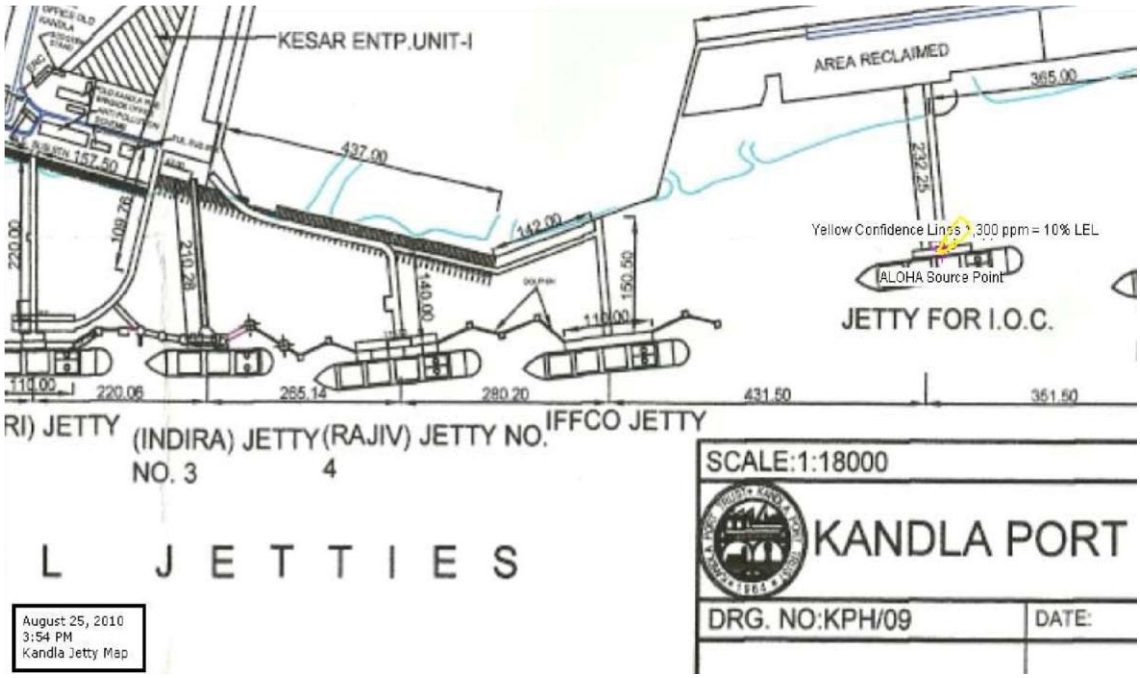
20.1.13.8 Evaporating Puddle – Toxic Threat Zone (Contour)



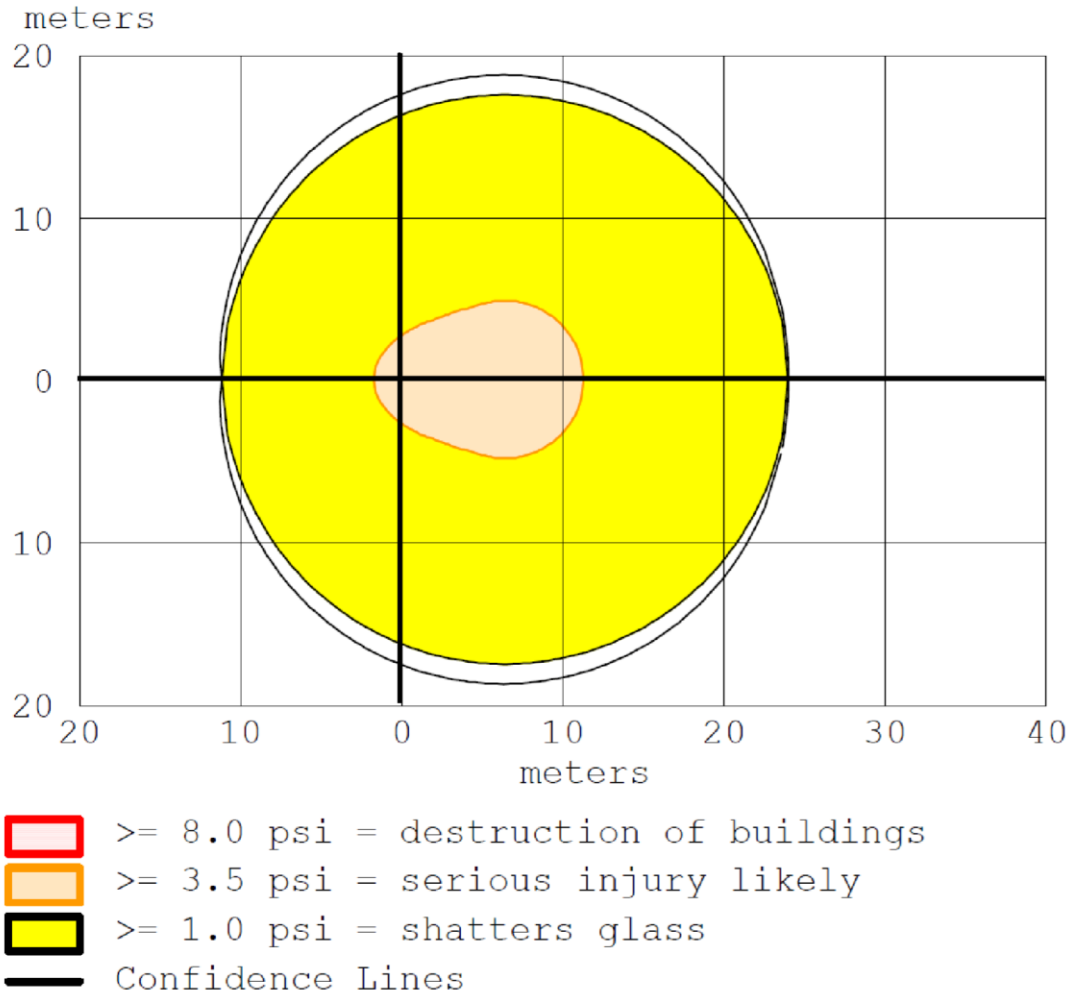
20.1.13.9 Evaporating Puddle – Flammable Area of Vapor Cloud (Graph)



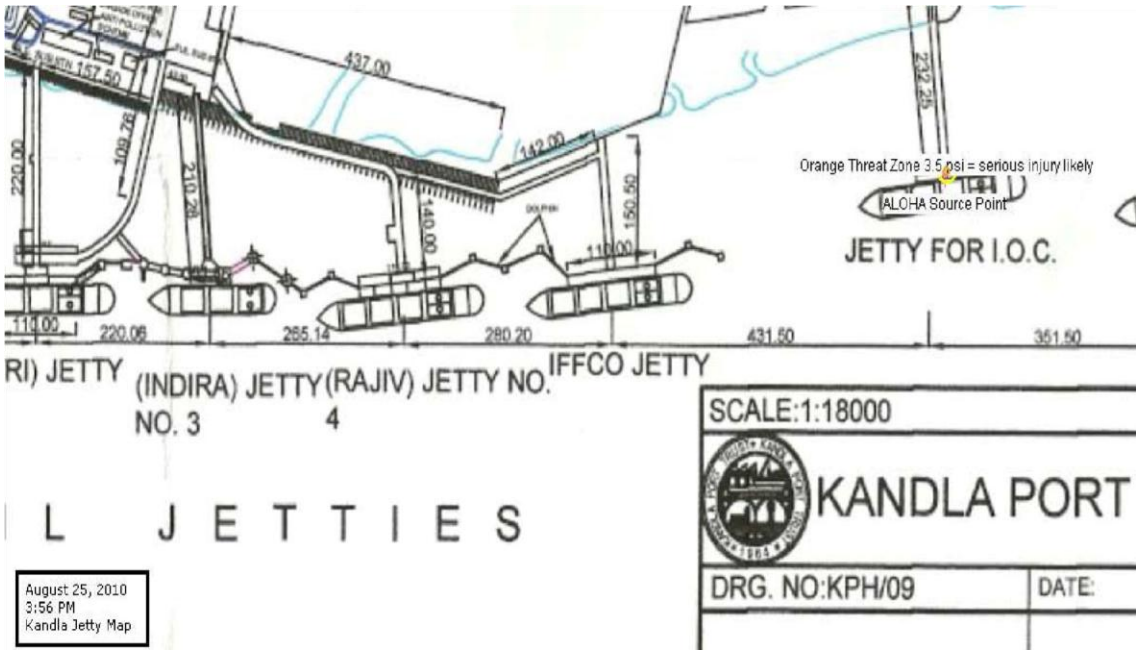
20.1.13.10 Evaporating Puddle – Flammable Area of Vapor Cloud (Contour)



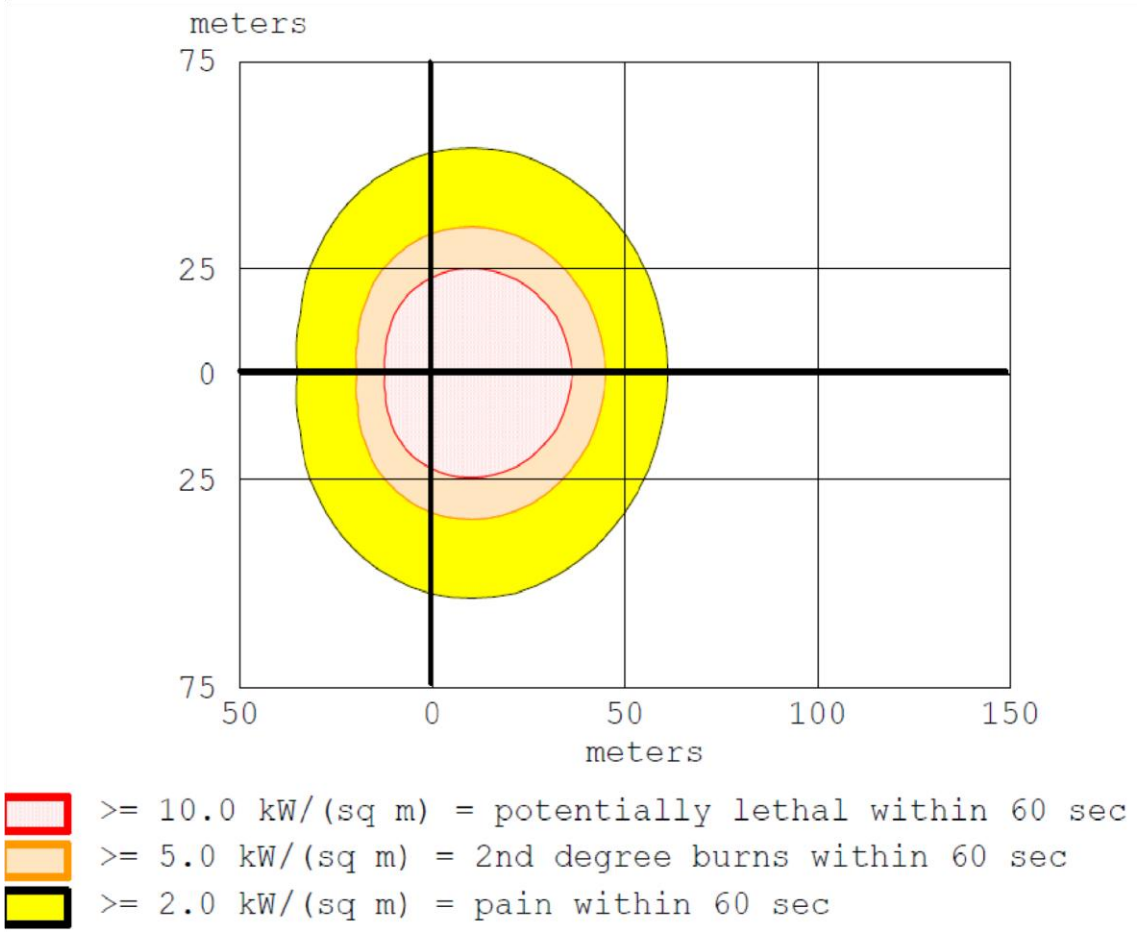
20.1.13.11 Evaporating Puddle – Overpressure (Graph)



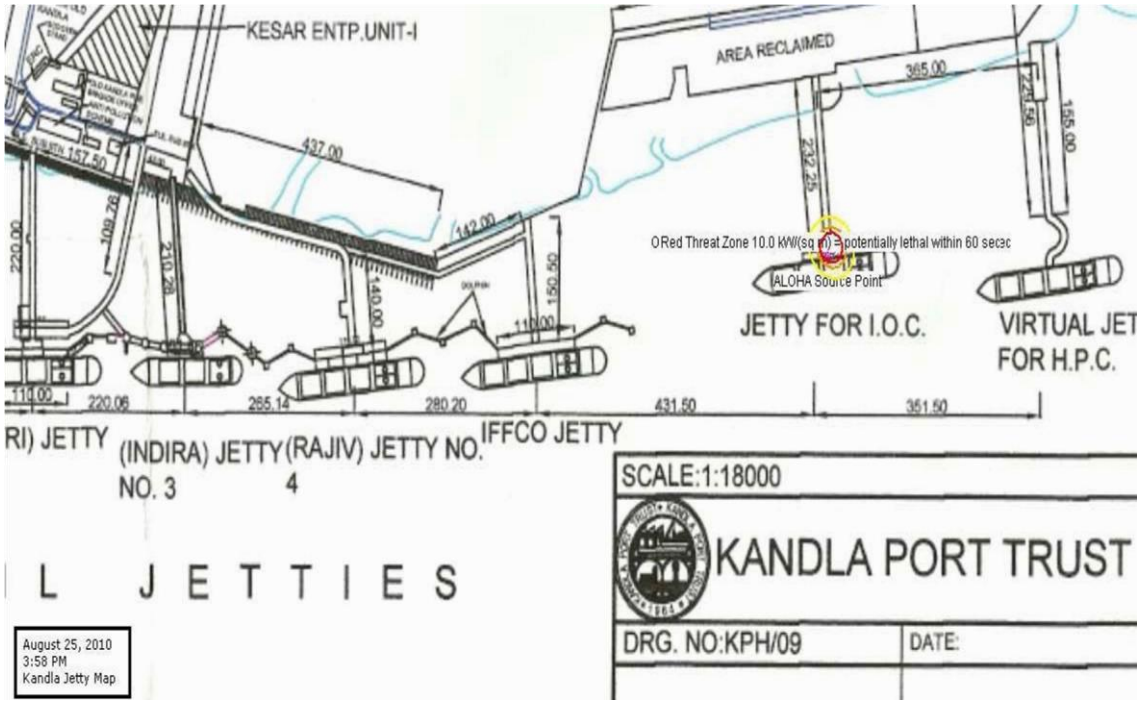
20.1.13.12 Evaporating Puddle – Overpressure (Contour)



20.1.13.13 Burning Puddle – Thermal Radiation (Graph)

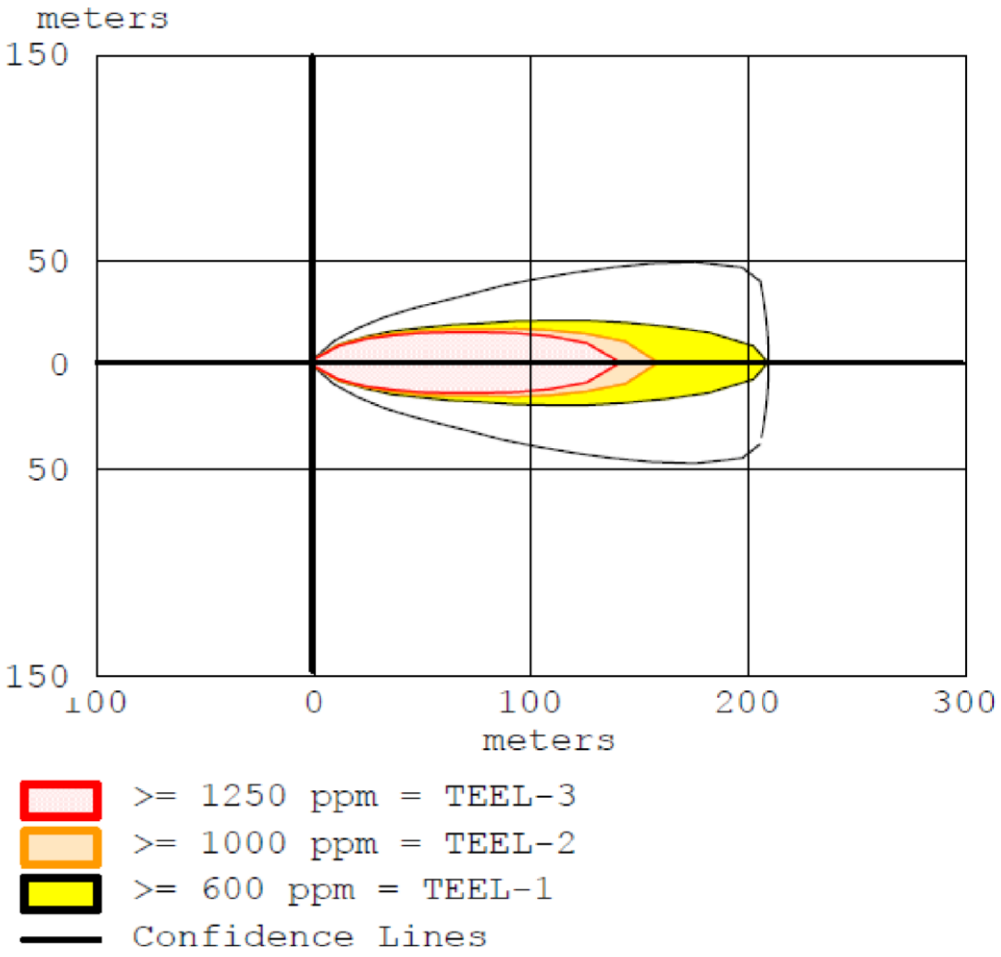


20.1.13.14 Burning Puddle – Thermal Radiation (Contour)

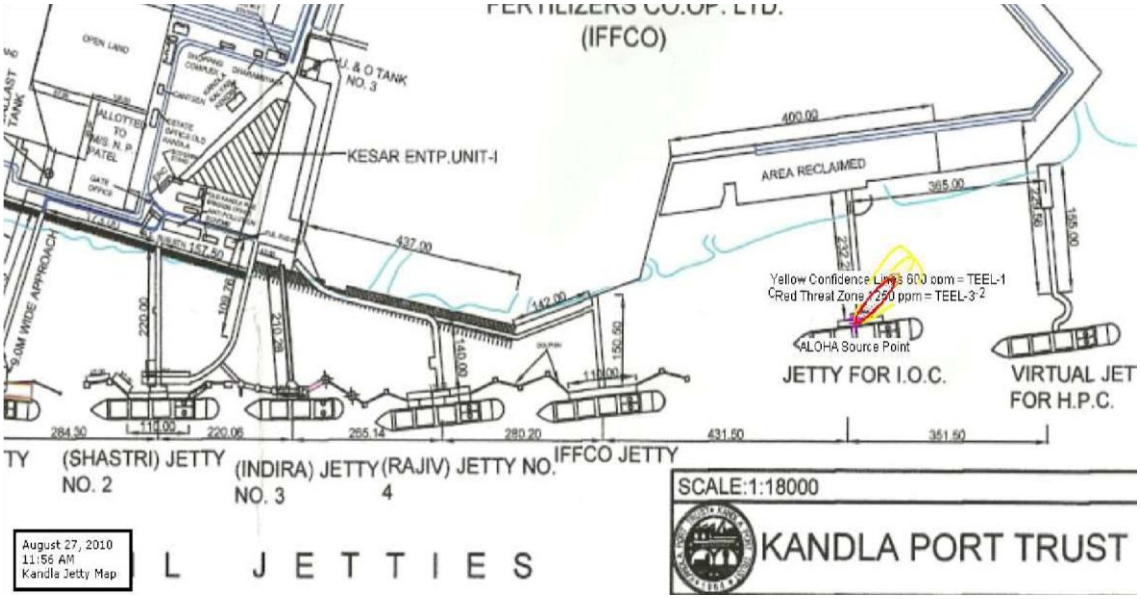


20.1.14 Jetty Six – Motor Spirit

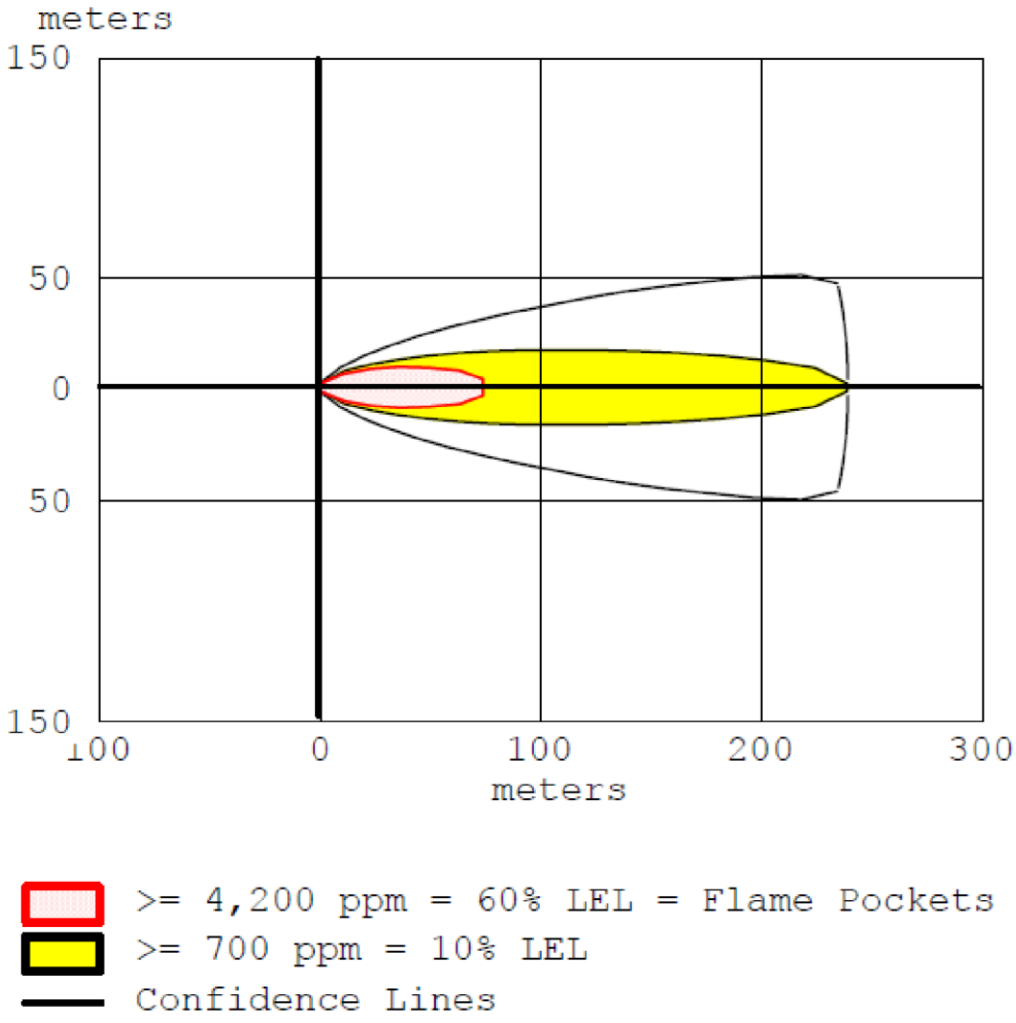
20.1.14.1 Instantaneous Release – Toxic Threat Zone (Graph)



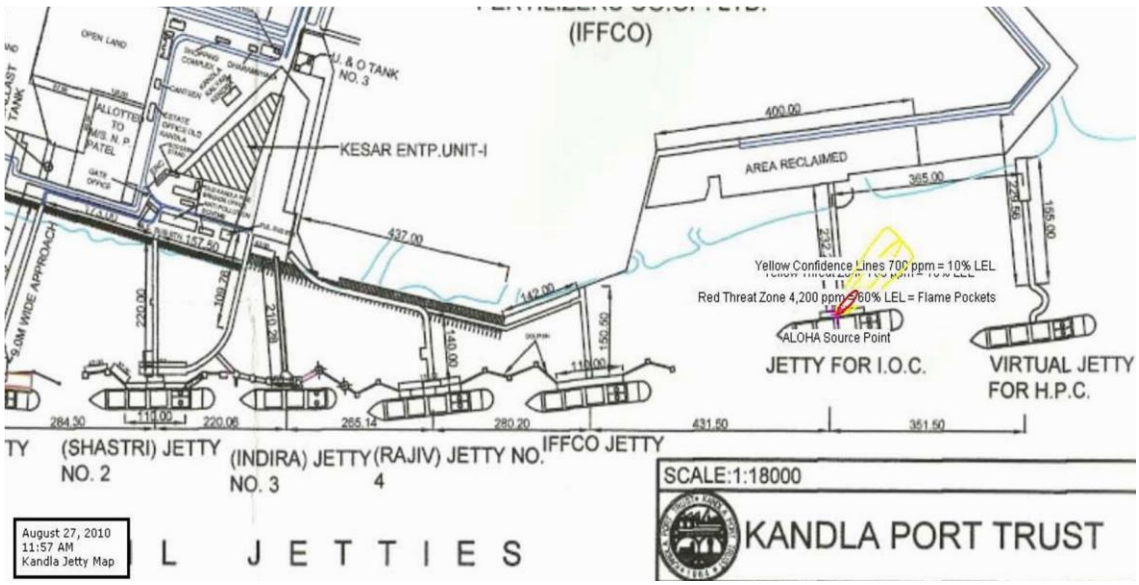
20.1.14.2 Instantaneous Release – Toxic Threat Zone (Contour)



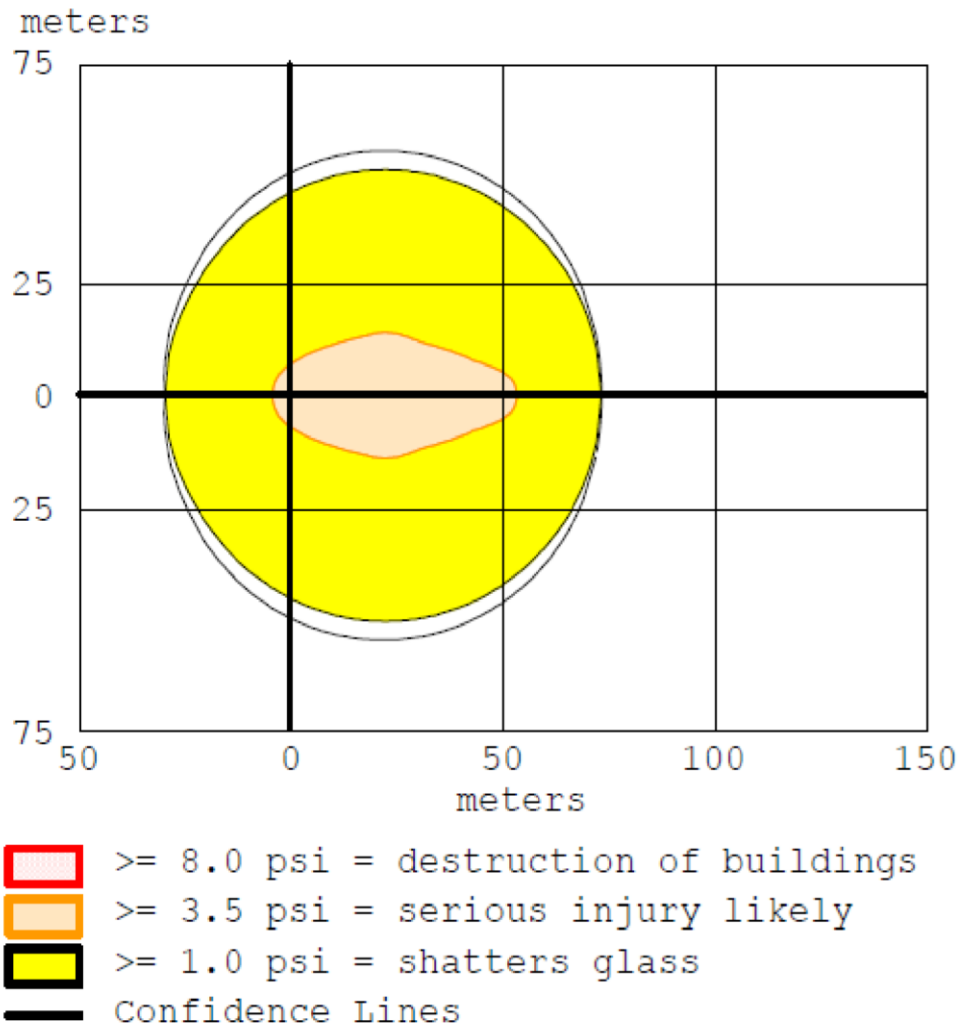
20.1.14.3 Instantaneous Release – Flammable Area of Vapor Cloud (Graph)



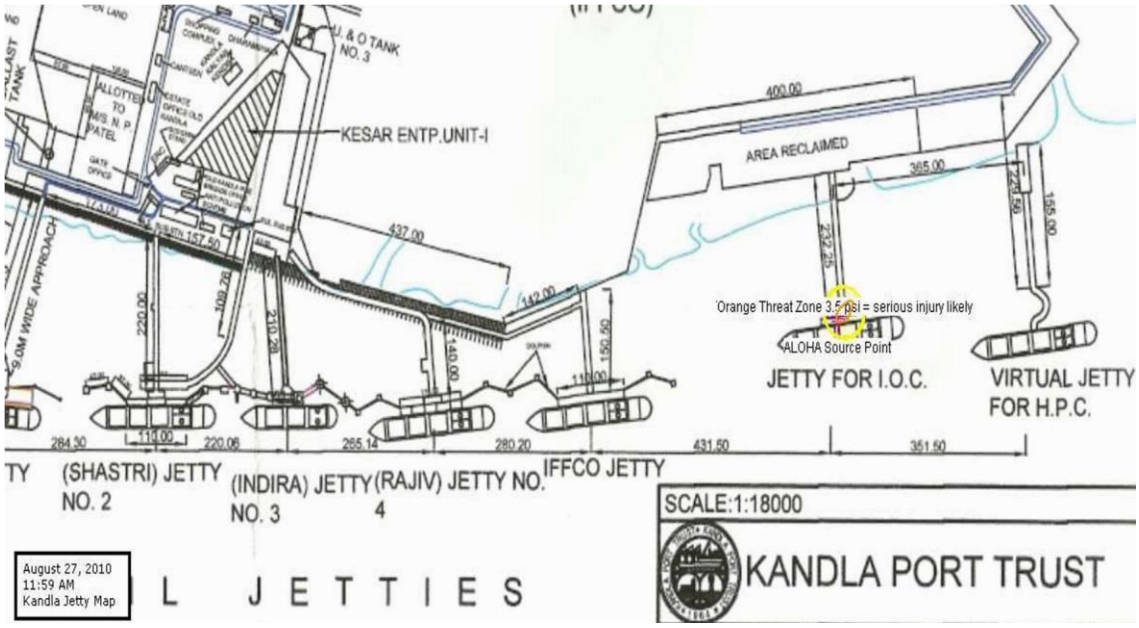
20.1.14.4 Instantaneous Release – Flammable Area of Vapor Cloud (Contour)



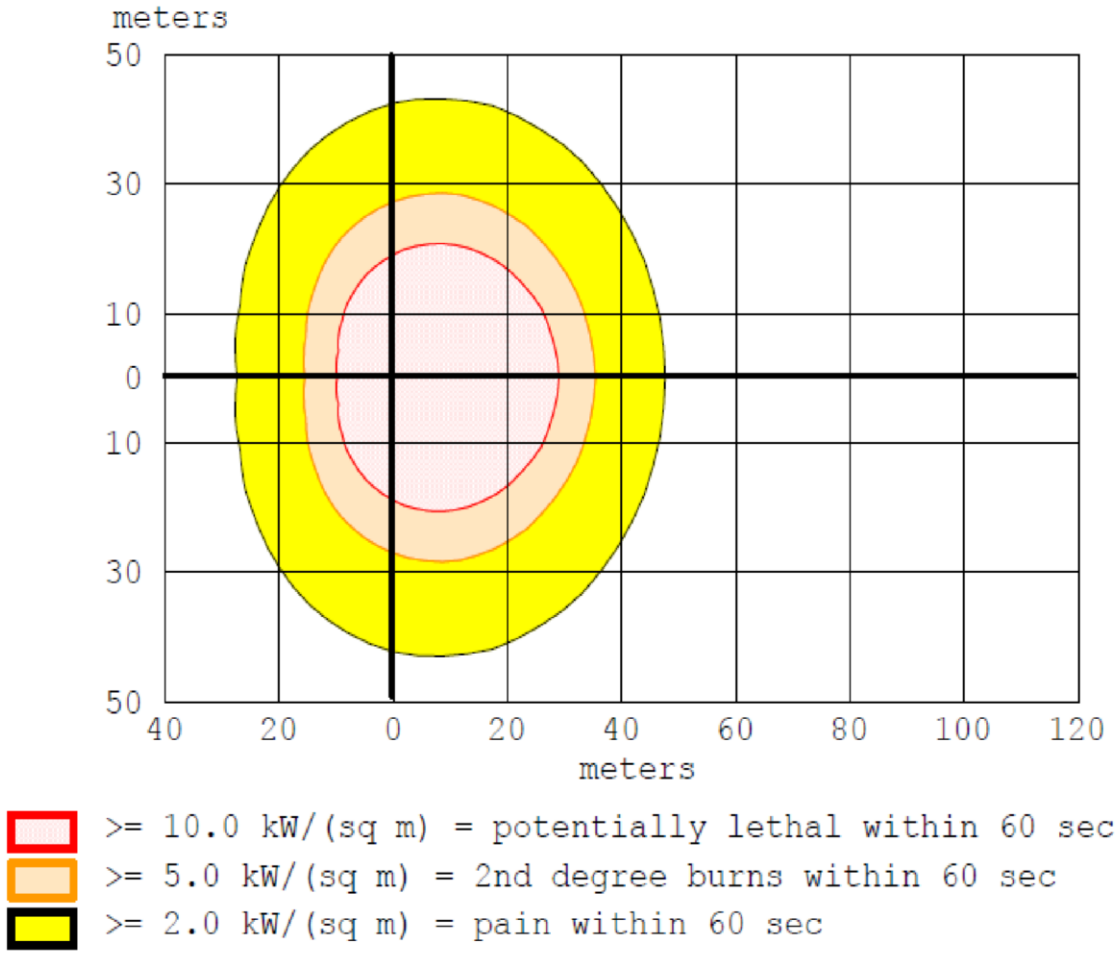
20.1.14.5 Instantaneous Release – Overpressure (Graph)



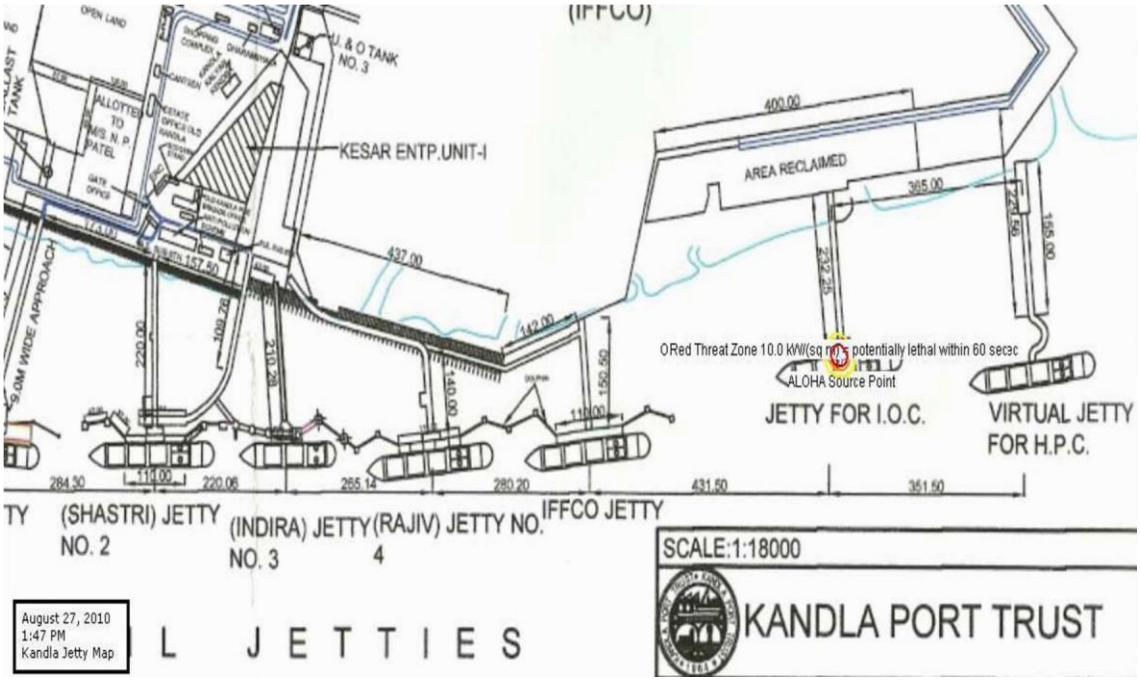
20.1.14.6 Instantaneous Release – Overpressure (Contour)



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

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,	3238363	7451465	-
	Gandhinagar			
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,	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 Medcine				
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

1	General Hospital, Bhuj Civil Surgeon, Bhuj	222850	250554
2	Referal 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 of Vehicle.
(A) Vehicle Hire Contractors					
2	M/s Rohit Enterprise /RISHABH ENTERPRISE	Mr. Rohit Shah 228550/237538 237547 (O) 234140 (R) Mob.9825225121			
3	M/s Jai Somnath Travels (GIM)	Mr. Mishra Mob.9825386739			
(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	

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 Samiti Trust, 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. Supdt (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 compounde r residi ng in hospital	First Come first Serve
11	Divine Life Society, Adi r	261802	Hospital Premises	Round the clock	
12	Atmaram Severam Charitable Trust	237759 Mob 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	Trinity Shipping & Allied Services Pvt
Tel. 220213, 221253	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.BS. 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
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

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

ANNEXURE – II

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. Shaktisinh Gohil,	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	Telephone Numbers		
		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 Sankarbhai 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 <u>Mangubhai C. Patel</u>** 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

<u>OFFICIALS</u>

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	
Aerodrame 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		

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

ANNEXURE – XI

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 Electonics, "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. Bhuveneshwari 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, 4th 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	2nd 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	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. Swaminarayan	1st Floor, H-6, Op. Tejas Society,	079-	231981,	

	Vijay Trade Carriar	Ghatlodia, Ahmedabad	231983	231982	

Annexure – XV

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	L**iberty 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

1	General Hospital, Bhuj Civil Surgeon, Bhuj	222850	250554
2	Referal 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	Availability 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 compounder 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			

ANNEXURE-XX

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 Bapu'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, 2nd 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	

Annexure-XXII

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

ANNEXURE-XXIII

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

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

ANNEXURE-XXIV

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. Chakraborthy	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.BS. 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
Metealfe Hodgkinsons Pvt Limited Tel. 220940, 221740, 233707, 221845 Fax. 231629	U. . Marine (India) surveyors

	Tel. 220070 Fax. 233228

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. Nidhiresh 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	

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.

Annexure -IX

Annexure C

CSR Activities at Deendayal Port Trust

Details of CSR

Sr. No	Year	Board Resolution For Budget Provision	Board Approved Budget Provision	Board Resolution for approval of the CSR activities	Board Approved Amount For CSR Activities	Actual Exp. Upto Nov'20 (Rs. In Lakhs)	Net balance (Rs. In Lakhs)	Remarks
1	2	3	4	5	6	7	6-7	
1	2011-2012	369 of 28.03.2012	3.00 Cr					
2	2012-2013	17 of 31.05.2012	4.00 Cr					
				61 of 30.08.2012	564.00 Lakh	564.00	Nil	Works completed
3	2013 -2014	99 of 30.09.2013	6.43 Cr					
4	2014-2015	322 of 21.11.2014	1.07 Cr	20 of 16.04.2015	236.22 Lakh	188.18	8.04	Works in progress
5	2015-2016	151 of 12.02.2016	1.50 Cr	48 of 12.08.2016	28.00 Lakh	5.00	23.00	Works in progress
6	2016-2017	138 of 06.01.2017	2.60 Cr	52 of 2.8.2017	140.30 Lakh	146.00	-5.70	Works completed
7	2017-2018	41 of 2.08.2017	7.02 Cr	15 of 04.05.2018	155.10 Lakh	115.37	39.73	Works in progress
8	2018-19	51 of 07.08.2019	6.70 Cr	111 of 4.12.2018	154.90 Lakh	50.50	104.40	Works in progress
					1278.52 Lakh	**1069.05**	**209.47**	
9	2019-20	58 of 10.10.2019	5.49 Cr	92 of 06.12.2019	1838.57 Lakh	Nil		MoS approval is awaited
		Total	**37.81 Cr**		**3117.09 Lakh**			
						Spent in PM Fund for COVID-19=800 Lakhs		

Year-wise details of CSR works undertaken by DPT during 2012 – 13 to 2019 – 20 are given in **Tables 7.3a, 7.3b, 7.3c, 7.3d, 7.3e, 7.3f** and **7.3g**.

Table 7.3a: CSR Works Undertaken by DPT during 2011-12 and 2012 – 13

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	Repair of road from Dr. Baba Saheb Ambedkar Circle to NH 8A (via Ganesh Nagar)	518
2	Repair of road from S.T. Bus Stand to Sunderpuri Cross Road via Collector Road	
3	Repair of road from NH 8A Railway Crossing to Maninagar (along railway track)	
4	Repair of road from Khanna Market Road (Collector Road) to Green Palace Hotel	
5	Construction of internal roads at "Shri Ram" Harijan Co-operative Housing Society (near Kidana)	
6	Construction of cremation ground and graveyard with other facilities at Vadinar	19.44
7	Providing cement concrete internal roads in Village Vadinar Stage - I	16.16
8	Approach road provided for developing tourism at Village Veera near Harsidhi Mata Temple	4.65
9	Water tank along with R.O. provided near developing tourism area	0.30
10	Creating facilities of flooring and steps surrounding lake to stop soil erosion and attract tourists at Village Veera.	4.80
	TOTAL	563.35

Table 7.3b: CSR Works Undertaken by DPT during 2014-15

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	Construction of community hall – cum – school at Maheshwari Nagar, Gandhidham	51.90
2	Renovation of "Muktidham" (cremation ground) at Kandla	10.65
3	Sunderpuri – 1 Valmiki Community Hall	5.00
4	Sunderpuri – 2 Valmiki Community Hall	5.00
5	Ganeshnagar Community Hall	10.00
6	Jagjivan Maheshwari Community Hall	10.00
7	Various works of road at Sapnanagar	99.19
8	Construction of compound wall in the dam of Jogninar Village	14.48
	TOTAL	206.22

Table 7.3c: CSR Works Undertaken by DPT during 2015-16

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	Construction of Bus Stand at Vadinar Village	10.00
2	Providing drainage system at Vadinar Village	6.00
3	Providing and laying of water supply lines in Vadinar Village	6.00
4	Road from Gandhidham Post Office to Merchantile Marine Department Office along with toilet facilities	60.00
5	Construction of toilets for girls / women at Khari Rohar, Village	3.00
6	Construction of toilets for girls at Mathak Primary School, Mathak, Village	3.00
	TOTAL	**88.00**

Table 7.3d: CSR Works Approved by DPT Board for 2016-17

Sl. No.	Name of Work	Cost (Rs. In lakhs)
1	RCC community hall at Harsidhi Mata Temple, Village Veera, Anjar Taluka	19.00
2	Fabricated Community Hall at Sanghad Village, Anjar Taluka	21.00
3	CSR Works for Shri Maheshwari Meghvad Samaj, Gandhidham at graveyard behind Redison Hotel	8.00
4	CSR Works for Shri Dhanraj Matiyadev Mukti Dham, Sector 14, Rotary Nagar, Gandhidham	30.50
5	CSR Works for Nirvasit Harijan Co-operative Housing Society, Gandhidham Health Cum Education Centre	41.00
6	CSR Works for Shri Rotary Nagar Primary School, Gandhidham	2.80
7	CSR Works at NU-4, NU-10(B) Sapnanagar & Saktinagar, Golden Jubilee Park at Gandhidham	18.00
	TOTAL	**140.30**

Table 7.3e: CSR Works Approved for 2017-18

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
1	CSR Works at Shri Ganesh Nagar High School, Gandhidham	Principal, Shri Ganesh Nagar Govt High School, Gandhidham	38.30 Lakhs
2	CSR Works for MOLANA AZAD Primary School, Kandla	Shri M L Bellani, Trustee, DPT, Shri Kandla Port Education Society, New Kandla	7.00 Lakhs
3	Grant financial contribution for facility of Army Cantonment for 50 nos. air coolers at Kutch Border Area	Shri Vinod L Chavda, MP	15 Lakhs
4	40% of the estimated cost of providing drainage lines at Tuna and Vandi villages under Swachh Bharat Abhiyan.	Shri Sarpanch, Tuna Village & Vandi village & Shri M L Bellani, Trustee, DPT	**Rs. 39.80 Lakhs** *Approx. estimated Cost Rs.99.50 Lakhs, of which 40% to be contributed by DPT.*
5	CSR works for S.H.N. Academy English School (managed by Indian Inst. Of Sindhology – Bharati Sindhu Vidyapeeth), Adipur	Director, S.H.N Academy English School	**40 Lakhs**
6	Construction of internal roads at Bhaktinagar Society, Kidana	Smt Maltiben Maheshwari, MLA	**15 Lakh**
		TOTAL	**155.10**

Table 7.3f: CSR Works Approved for 2018-19

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
1	CSR work to Donate 100 Nos of Computers to Daughters of Martyred Soldiers in the country under the "BETI BACHAO BETI PADHAO" program by Atharva Foundation, Mumbai	Chairman, Atharva Foundation, Mumbai	**24.00**
2	CSR work to Donate ONE (40 Seater) School Bus for Deaf Children Students for the Institute of Mata Lachmi Rotary Society, Adipur	Mata Lachmi Rotary Society, Adipur	**18.00**
3	CSR work to Providing One R.O Plant with Cooler at PanchyatPrathmikSala, Gadpadar Village for the ANARDE Foundation, Kandla&Gandhidham Center.	Dist. Rural Development Officer, Annarde Foundation-Kandla & Gandhidham	**1.50**
4	CSR work for Providing Drainage Line at MeghparBorichi village, AnjarTaluka	Shri Vasanbhai Ahir, MLA, Gujarat Govt	**25.00**
5	CSR work for Construction of Health Centre at Kidana Village	Shri Vinod L Chavda, MP	**13.00**
6	CSR work to provide 4 Nos. of Big Dust Bin for MithiRoharJuth Gram Panchayat.	Shri Sarapanch, Mithi RoharJuth Gram Panchayat	**3.40**

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
7	CSR work for Renovation & construction of shed at CharanSamaj, Gandhidham –Adipur.	Shri Vinod L Chavda, MP	**10.00**
8	CSR Work for Renovation/Repairing of Ceiling of School Building at A. P Vidhyalay, Kandla.	Smt Maltiben K. Maheshwary, MP, Gandhidham.	**10.00**
9	CSR work for Construction of Over Head Tank & Providing 10 Nos of Computers (for students) of NavjivanViklangSevashray, Bhachau, Kutch	Shri Jitendra Joshi, Founder Secretary, Shri Navjivan Viklang Sevashray, Bhachau, Kutch	**9.50**
10	CSR work to Provide Books & Tuition fees for Educational facilities to weaker section children of ValmikiSamaj, Kutch.	Shri Manohar Jala, Chairman of "National Commission of Safai Karamcharis"	**2.00**
11	CSR work to provide Water Purifier & Cooler for the ST. Joseph's Hospital, Gandhidham	Smt. Maltiben K Mahewari, MLA ,Gandhidham	**1.50**
12	CSR work for Construction of Second Floor (Phase – I) for Training Centre of "GarbhSanskran Kendra" "Samarth Bharat Abhiyan" of Kutch Kalyan Sangh, Gandhidham	Shri Vinod L Chavda, MP, Kutch	**37.00**
		TOTAL	**154.90**

Table 7.3g: CSR works approved for the year 2019-20 (approval from Ministry of Shipping still awaited)

Sl. No.	Name of Work	Proposal Received from / / Name of Organization / N.G.O	Cost (Rs. In lakhs)
1	CSR activities for Providing Drainage line at Nani Nagalpar village.	Sarpanch of Village:-Nani Nagalpar, Taluk: Anjar.	**3.00**
2	CSR activities for Development of ANGANWADI Building at School no- 12 at Ward no 3 & 6 at Anjar.	Shri Vasanbhai Ahir, MLA	**7.00**
3	CSR activities for Improving the facilities of Garden at Sapna Nagar(NU-4)& (NU-10 B),Gandhidham.	Shri K P Maheshwari, Resident Sapnanagar, Gandhidham	**18.00**
4	CSR activities for Providing of Plastic Shredding Machine to Mirror Charitable Trust, Gandhidham.	Mirror Charitable Trust ,Gandhidham	**4.75**
5	CSR activities for development of School premises of Shri Guru Nanak Edu. Society, Gim.	Shri Guru Nanak Education Society, Gandhidham.	**30.00**
6	CSR activities for the improvement of the facilities at St. Joseph Hospital & Shantisadan at Gandhidham	St. Joseph Hospital Trust, Gandhidham	**20.00**
7	CSR activities for the improvement of the facilities at SVP (SardarValabhbhai Patel) Multipurpose Hall at Gandhidham	Request from MarwadiYuva Munch & UNION Gandhidham	**500.00**
8	Consideration of Expenditure for running of St Ann's High School at Vadinar of last 5 years 2014 to 2019 under CSR.	Proposal from COM, OOT Vadinar, DPT	**825.00**
9	CSR activities for development of school premises of Shri Adipur Group Kanya Sala no-1 at Adipur	Principal, Shri Adipur Group KanyaSala, Adipur	**6.50**
10	CSR activities for development of school premises of Shri Jagjivan Nagar Panchyat Prathmiksala, Gandhidham.	Principal, Shri Jagjivan Nagar Panchyat Prathmiksala, Gandhidham.	**16.50**
11	CSR activities for development of school premises of Ganeshnagar Government high school, Gandhidham.	Shri Vinod L Chavda, MP, Kutch	**9.00**
12	CSR activities for improving greenery, increase carbon sequestration and beat Pollution at Kandla, DPT reg.	Work awarded to Forest Department , Bhuj	**352.32**
13	CSR activities for providing infrastructures facilities at "Bhiratna Sarmas Kanya Chhatralaya" under the Trust of Samaj Nav- Nirman at Mirjapur highway, Ta Bhuj.	SamajNav- Nirman at Mirjapur highway, Ta Bhuj.	**46.50**
		TOTAL	**1838.57**

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
1	CSR activities for the development of gardening at Sector -5 , Gim	Shri Sarvodaya Co-Operative Housing Society Ltd	**Appx Cost – Rs 25.00 Lakhs** **Cost for** – Comp wall, Benches, Plantation, walkway, other facilities (Land is reserved for Garden development only since from 50 years)
2	CSR activities for providing various facilities in SHRI GANESHNAGAR GOVT HIGHSCHOOL, GANDHIDHAM	Principal of School	**Appx cost –Rs 20.00 Lakhs** (Two times CSR works carried out at school by DPT)
3	CSR activities for the VadhiyarVankarSamajvaadi, NaviSunderpuriGim	SmtMaltiben K Maheswari, MLA	**Appx Cost Rs 6.00 Lakhs** Cost for Const. of Comp Wall
4	CSR activities for Construction work of Cabin at Oslo Area- Gim	SmtMaltiben& Shri VinadChavda	Cost not mentioned.
5	CSR activities & Land requirement forAkhil Kutch SamastaMeghvanshiGurjarmeghwal Charitable Trust ,Gim.	Shri Akhil Kutch SamastaMeghvanshiGurjarmeghwal Charitable Trust. Shri Dharmendra R Gohil	Cost Not mentioned. (demand of Land for development of SAMAJ VADI in Gandhidham)
6	CSR Activities for providing Water supply pipe line, Play ground and sports equipment, electric facilities, drinking water facilities for poor people & Fishermen at VANDI Village.	Shri R RKhambhra, PRO , Collector Office, Bhuj.	**Appx Cost Rs 51.00 Lakhs** (Last year also applied by village Sarpanch) & Recommended by Shri VASANBHAI AHIR, MLA, Shri V L Chavda, MP)
7	CSR activities for the Tuna village,	Sarpanch, Tuna village	**Appx Cost Rs. 25 Lakhs** **Cost for :-**

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
	Ta -Gim		2 No Fab shed 20'x20'x1250= 10 Lakh 2 Nos of Agnawadi =10 Lakh Fab shed for school=5 Lakh
8	CSR activities for the Global Vision India Foundation, Gim	Global vision India Foundation, G'dham	Requirement of Land –OR- Old building at Gandhidham for foundation of welfare activities.
9	CSR activities for the UNITED ORPHANAGE FOR THE DISABLED, TAMIL NADU	UNITED ORPHANAGE FOR THE DISABLED, TAMIL NADU	**Cost Rs 25,000.00** (Winter sweaters for children)
10	CSR activities for the Garden Development on already bounded area with Compound wall near Plot no 448 Sector-1/A, Gandhidham.	Residents, near Plot no 448, Sector-1/A, Gim.	**AppxCost Rs 20.00 Lakhs** (Requirement to provide benches, drinking water facility, plantation, lightings & walkways in side bounded area)
11	CSR activities for donation of Land for the Shri SUNDARPUI Govt Primary School, Gim	SmtMalti ben Maheshwari, MLA	(request for Land Requirement)
12	CSR activities for Extension of Adarsh Primary School building, Adipur	GandhidhamMatri Mandal, English Medium School, Adipur	**Appx Cost Rs. 40.00 Lakhs** (Construction for 4 Rooms extension) (Trust registered under Societies Registration Act XXI -1860, Reg No F-42 dtd 23.9.1965. Land belong to Trust)
13	CSR Activities for providing HD projector for KANYA MAHA VIDYALAYA, Adipur	Principal, KANYA MAHA VIDYALAYA, Adipur	**Cost Rs 1.50 Lakhs** (School Managed by G'dhamMaitry Mandal, Adipur)

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
14	CSR activities for DONATION various Medical Equipment for the Hospital of Gandhidham Jain SevaSamiti, Adipur	Gandhidham Jain SevaSamiti, Adipur	**Cost for** :- 1) Fresenius Haemodialysis Machine Rs 38.00 Lakh 2) Maltislice Helical CT Scanner- Rs 52.00 Lakhs 3) Others Rs 54.00 Lakhs (**Total Appx Cost Rs 144 Lakhs**)
15	CSR activities for SHRI VIDI JUTH GRAM PANCHAYAT, Vidi, Anjar	Sarpanch, Vidi Gram	**Appx Cost Rs 30.00 Lakhs** Cost for- Drainage , Garbage vehicle, and Cattle shed (Already applied earlier at Sr-5/12)
16	CSR activities for SOS CHILDRESN'S VILLAGES INDIA, Madhapar, Bhuj	Director, SOS Children's Village of India-Bhuj	**Appx Cost Rs 31.00 Lakhs** (request for Financial support towards parentless and abandoned Children Education support located at Bhuj) & support to women working in SOS.
17	Gujarat Biodiversity Board, Gandhinagar invites to involved National & Global endeavour of conservation of biodiversity by creating financial partnership with GBB under CSR programme of expenditure to be incurred 187 Lakh.	GUJARAT BIODIVERSITY BOAD, GANDHINAGAR	**Requirement-** Financial Support from DPT for **AppxRs 1.88 Cr.** (Cost for various meetings, collection of primary data from villagers , processing of documentation, printing , TA DA of Technical support &Miscexp for 150 Peoples Biodiversity Register (PBR).

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
18	CSR activities for providing furniture & Home appliances for ROJAVANAM TRUST at Madurai.	Shri Arul Kannan, Director	**Appx Cost Rs 30 Lakhs** (seeking help to provide facilities to Aged & Homeless people living in Trust and Purchasing of New Ambulance)
19	CSR activities for providing Dialysis Machine for treatment of Kidney patients at "ST JOSEPH'S HOSPITAL TRUST" at Gandhidham.	Sr. Franciline, Administrator of Hospital.	**Appx Cost Rs 31.36 Lakhs** (Cost of 5 Nos of Dialysis Machines for treatment of kidney patients)
20	CSR activities for providing facilities in Girls Hostel of Gasturba Gandhi BalikaVidhyalay, Gandhidham.	Shri Vinod L Chavda, MP	**Appx cost Rs 30 Lakhs.** (Cost of Comp Wall, Entrance gate, Girls toilets etc)
21	CSR works for providing Oxygen Generator Plant and 45 KV Silent Generator for COVID HOSPITAL at Swami LilashahKutia, Adipur.	Secretary, BHARAT VIKAS PARISHAD, Gandhidham	**Appx Cost Rs 80.00 Lakhs** (Facilities for 100 Beds of COVID patient which it to be extend upto 240 Beds)
22	CSR works for providing Two Numbers of Oxygen Concentrator and others medical equipment for the Trust ,Antarjal, Gim.	President SHRI SARV JEEV KALYAN TRUST, ANTARJAL, Gandhidham	**Appx Cost Rs21.50 Lakhs** (Facilities to be provided for the treatment of CORONA PATIENTS at their trust.)
23	CSR works for providing Fabricated Shed , Construction of Compound Wall and Land levelling for the Cattle of **GauSevaSamiti-Tappar** at Gram-Tappar, Ta Anjar.	Shri Vinod Chavda, MP &Presedent , GauSevaSamiti, village Tappar, Ta-Anjar	**Appx Cost Rs84 Lakhs** (Facilities to be provided for Cattle shelters at Village.) (Land belongs to Gram-panchayat)
24	CSR works for Construction of Auditorium Hall at RSETI (Rural Self Employment Training Institute) at	Shri Vinod Chavda, MP & Director of RSETI, Bhuj	**Cost not mentioned.** (Facilities to be provided

List of CSR applications received from various NGOs , Organizations , Village Sharpanchs etc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
	Bhujodi-Bhuj.		for the people needs Self-employment activities.)
25	CSR works for Providing of Furniture for the School "SHRI GALPADAR PANCHAYAT PRATHMIC KUMAR GROUP SALA " atGalpadar Village Ta Gim.	Principal, SHRI GALPADAR PANCHAYAT PRATHMIC KUMAR GROUP SALA " atGalpadar Village Ta Gim.	**Cost not mentioned.** (Facilities to be provided for the Students of Workers & poor village people who study in the school.)
26	Construction of Shed, hall and Gate for the DADA Bhagwandas Charitable Trust, Adipur. (Sr no -4)	Shri Vinod Chavda, MP & DADA BHAGWANDAS CharitableTrust, Gandhidham	As per CSR Guideline- ➢ Promoting gender equality and empowering women ➢ Eradicating extreme hunger and poverty (Considered shed and hall) Fab Shelter Shed - 30'x100' x 1250=37.00 Lakh & RCC Hall – 20'x100'x1500=30.00 Lakh (**Appx Cost Rs67.00 Lakhs**) Land authority belongs to Trust given by GDA and NOC given by SRC.Doc submitted.
27	CSR work for reconstruction of the Internal Roads of the Sector-9B-C and Sector-10 area in Gandhidham.	President, Shri TejaKangad, The Gandhidham Chamber of Commerce and Industry, Gandhidham.	Cost not mentioned.

List of CSR applications received from various NGOs , Organizations , Village Sharpanchsetc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
	CSR Applications kept pending in last year Agenda:-		
27	CSR Activities for providing Water supply pipe line, Play ground and sports equipment, electric facilities, drinking water facilities for poor people & Fishermen at VANDI Village. (Sr no-3)	Sarpanch ,Village-VANDI , Ta- Anjar (Recommd. By Shri VASANBHAI AHIR, MLA, Shri V L Chavda, MP)	As per CSR Guideline- ➢ Env Sustainability ➢ Eradicating extreme hunger and poverty (to be Consider for health Center ,Drainage line, Water sump etc activities) **(Appx Cost - 51.00 Lakhs)** (Land authorization of Gram Panchayat)
28	Construction of Shed, hall and Gate for the DADA Bhagwandas Charitable Trust, Adipur. (Sr no -4)	DADA BHAGWANDAS CharitableTrust, Gandhidham (Recommd. By Shri V L Chavda, MP)	As per CSR Guideline- ➢ Promoting gender equality and empowering women ➢ Eradicating extreme hunger and poverty (Considered shed and hall) Fab Shed - 30'x100' x 1250=37.00 Lakh & RCC Hall – 20'x100'x1500=30.00 Lakh (**Appx Cost Rs 67.00 Lakhs**) Land authority belongs to Trust given by GDA and NOC given by SRC. Doc submitted.
29	10 Nos of Computers required for ShirMaheswarinagar Panchayat Girls Primary School, Gandhidham& Boys Group School, Gandhidham. (Sr no-8)	Maheswarinagar Panchayat Primary Kanya Sala, Gandhidham (Contact no 9913903686)	**AppxRs 5.00 Lakhs** As per CSR Guideline- ➢ Promotion of Education (to be consider for 20 Computers)

List of CSR applications received from various NGOs , Organizations , Village Sharpanchsetc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
			Visited the site. Land belongs to MahewariMeghwadSamaj given by SRC for school purpose, doc are awaited.
30	Construction of Shed and Roof at JeparMatiyadev, shamsanbhumi at Kidana village &Maheswari Community Hall at JuniSundarpuri ,Gandhidham. (Sr no-10)	Shri VINOD CHAVDA, MP	**AppxRs 15.00 Lakhs** (Land authorization not mentioned)
31	Drainage, road, Dust bins, & shed for Cattle shelters at VIDI Village, Ta –Anjar. (Sr no- 12)	Village- VIDI, Ta: Anjar	**AppxRs 30.00 Lakhs** As per CSR Guideline- ➢ Env Sustainability ➢ Eradicating extreme hunger and poverty (Consider for Garbage vehicle & Drainage Cost)
32	Education, Women empowerment and Primary health care services at Kutch area. (Sr no-13)	Light of Life Trust, **Mumbai.**	Cost not mentioned.
33	Request for Help Divyang persons to employment by providing machineries. (Sr no-14)	Kutch DivyangSangthan, Gandhidham.	Cost not mentioned
34	Construction of 2nd Floor of Shri MaheswariMeghwadSamaj, Gandhidham. (Sr no-20)	Shri MaheswariMeghwadSamaj, Gandhidham	**AppxRs. 15.00 Lakhs** (Visited the site and Land ownership documents awaited) (Name plate of DPT fixed at the Asset)

List of CSR applications received from various NGOs , Organizations , Village Sharpanchsetc for the FY 2021-22 .

Sr.No	Name of Scheme	Proposal Received from / Name of Organization / N.G.O	Brief Details
35	Installation of Mini Science Center at Anjar and Gandhidham. (Sr no-21)	STEM Learning Pvt Ltd, Mumbai.	Cost not mentioned.
36	CSR work for Shri Rampar Gram Panchayat. ➢ Wall Plastering for Cattles -7 Lakhs ➢ Shed for Cattel's-15 Lakhs (Sr no-25)	Shri Sarpanch, Rampar Village.	**AppxRs 22.00 Lakhs** (Land authorization of Gram Panchayat and under taking submitted by applicant)
37	CSR activities for the 45,000 Patients over the period of 3 years by "SMILE FOUNDATION", Mumbai. 1. Concept for Nutrition covering 3 years 2. Concept for Mobile Health Unit reaching beneficiaries for 3 years 3. Concept for Vocational Training with NGO (Sr no-29)	Proposal from "SMILE FOUNDATION " Mumbai.	Appx Cost- **Rs 539 Lakhs** for 3 years
38	Development of Park in Public utility plot in between Block "C" & "D" of Sapna Nagar (NU-4) , Gandhidham (Sr no -31)	Shri RAVI MAHESHWARI, DPT	Land belongs to DPT earmarked for recreational purpose. (Total Cost –Rs**88.75 Lakhs**)
39	CSR works for NariJanshsktiVikas Foundation at Gandhidham near Shakti Nagar. (Sr no-33)	NariJanshsktiVikas Foundation, Ahmedabad	➢ Promoting gender equality and empowering women ➢ Env Sustainability ➢ Under promotion of education (Consider for Computers with printers, Sewing machine & RO plant**Cost Rs 48 Lakhs**)

Annexure -X

Annexure B

કચ્છમિત્ર
(http://epaper.kutchmitradaily.com/)

કચ્છમિત્ર

દીનદયાલ પોર્ટ ટ્રસ્ટ

ભારત સરકારના પર્યાવરણ, વન અને ક્લાઈમેટ ચેન્જ મંત્રાલય દ્વારા દીનદયાલ પોર્ટ ટ્રસ્ટની પરિયોજના 'ડેવલોપમેન્ટ ઓફ 3 રિમેઇનિંગ ઈન્ટીગ્રેટેડ ફેસિલિટીઝ (સ્ટેજ-2) વિથિન ધ એક્ઝિસ્ટિંગ દીનદયાલ પોર્ટ ટ્રસ્ટ (અગાઉ-કંડલા પોર્ટ ટ્રસ્ટ) ઓફ ગાંધીધામ, કચ્છ, ગુજરાત'ને (૧) સેક્ટિંગ અપ ઓફ ઓઈલ જેટી નં. ૭ (૨) સેક્ટિંગ અપ ઓફ બાર્જ જેટી એટ જાકરિયાડી, (૩) સેક્ટિંગ અપ ઓફ બાર્જ પોર્ટ એટ બીરા (૪) એડમિનિસ્ટ્રેટિવ ઓફિસ બિલ્ડિંગ એટ તુણા ટેકરા (૫) રોડ કનેક્ટિંગ ઝોન બીરા બાર્જ જેટી ટુ તુણા ગેટ. માટે પર્યાવરણ અને સી.આર.ઝેડ.ની મંજૂરી આપવામાં આવેલ છે. આ મંજૂરી સંદર્ભના પત્રોની નકલો રાજ્ય પોલ્યુશન કંટ્રોલ બોર્ડ પાસેથી મળી શકશે. તેમજ ભારત સરકારના પર્યાવરણ, વન અને ક્લાઈમેટ ચેન્જ મંત્રાલયની વેબસાઈટ http://www.envfor.nic.in પર જોઈ શકાશે.

મુખ્ય ઈજનેર
દીનદયાલ પોર્ટ ટ્રસ્ટ

દીનદયાલ પોર્ટ ટ્રસ્ટ

ભારત સરકારના પર્યાવરણ, વન અને ક્લાઈમેટ ચેન્જ મંત્રાલય દ્વારા દીનદયાલ પોર્ટ ટ્રસ્ટની પરિયોજના 'ડેવલોપમેન્ટ ઓફ 3 રિમેઇનિંગ ઈન્ટીગ્રેટેડ ફેસિલિટીઝ (સ્ટેજ-1) વિથિન ધ એક્ઝિસ્ટિંગ કંડલા પોર્ટ ટ્રસ્ટ ઓફ ગાંધીધામ, કચ્છ, ગુજરાત'ને પર્યાવરણ અને સી.આર.ઝેડ.ની મંજૂરી આપવામાં આવેલ છે. આ મંજૂરી સંદર્ભના પત્રોની નકલો રાજ્ય પોલ્યુશન કંટ્રોલ બોર્ડ પાસેથી મેળવી શકશે. તેમજ ભારત સરકારના પર્યાવરણ, વન અને ક્લાઈમેટ ચેન્જ મંત્રાલયની વેબસાઈટ http://www.envfor.nic.in પર જોઈ શકાશે.

મુખ્ય ઈજનેર
દીનદયાલ પોર્ટ ટ્રસ્ટ

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Page 1

કચ્છમિત્ર

દુબઈમાં નિવૃત્ત પોલીસકર્મીએ દાદાગીરી-ધાકધમકી કરતાં ગુનો

આદિપુરના લોહાણા પરિવારને પોલીસ રક્ષણ આપવા માંગ

નાગરિક સંરક્ષણના બે વોર્ડનનું સન્માન

દુધઈમાં નિવૃત્ત પોલીસકર્મીએ દાદાગીરી-ધાકધમકી કરતાં ગુનો

ગાંધીધામ, તા. ૨૨ : અંજાર તાલુકા દુધઈ પોલીસ મથકમાં જુગારના ગંભીર ગુનામાં પોલીસ કર્મીને નશાયુક્ત હાલતમાં કારખાનેદારને પોલીસ મથકે બેસાડવા ! ...

ગાંધીધામમાં રહેણાક મકાનમાંથી ૩૩ હજારનો શરાબ પકડાયો

ગાંધીધામ, તા. ૨૨ : ગાંધીધામ પોલીસ મથકની વિવિધ ટીમોએ જુદા જુદા સ્થળોએ દરોડા પાડી કુલ રૂા. ૩૩,૩૮૦ ...

વોર્ડ ૧૨-બીમાંથી પોલીસે બે આરોપી પકડ્યા ઝડપ્યા

નારાયણ સરોવર અભયારણ્યમાં ભ્રષ્ટાચાર આચરાતો હોવાનો આક્ષેપ

નારાયણ સરોવર (તા. લખપત) તા. ૨૨ : ભારતીય સંસ્કૃતિના સિંહાસન અભયારણ્ય ખાતે કથાકિથતરાના અભયારણ્ય ખાતે ગ્રા-પ્રાણિસંગ્રહાલય દ્વારા ...

નાગરિક સંરક્ષણના બે વોર્ડનને સન્માન પત્ર તથા રોકડ ઈનામ આપતા ડીસી, સાથે ઓફિસ સ્ટાફ

નાગરિક સંરક્ષણના બે વોર્ડનનું સન્માન

ભુજ, તા. ૨૨ : કચ્છ એ આપત્તિપ્રવણ અને ભૂકંપની આપત્તિઓની વારંવાર સામનો કરવો પડે છે. કચ્છના નાગરિકોમાં નિષ્ણાત ભૂકંપ અને આપત્તિકાળ જીવન ...

પાંચ અઠવાડિયાની તાલીમ પાસ કરી ચૂકેલા ભુજના યુવાનોને પ્રમાણપત્ર અર્પણ

ભુજમાં જુગારના બે દરોડામાં નવ મહિલા અને એક પુરુષ, એક ત્યંઢળ ઝડપાયાં

ભુજ, તા. ૨૨ : ભુજમાં કેમ્પ વિસ્તારમાં રૂા.ની, પોર્ટ ખાતે ગણેશનગર વિસ્તારમાં જુગાર રમી રહેલા બાર મહિલા અને બે પુરુષ એવી કુલ ૧૭ વ્યક્તિ ...

પાંત્રીસ હજારથી વધુ માલમતા કબ્જે કરીને જુના દાખલ કરાયા

આદિપુરના લોહાણા પરિવારને પોલીસ રક્ષણ આપવા માંગ

ગાંધીધામ, તા. ૨૨ : આદિપુર ભુવનના સભ્યના પરિવારને પોલીસ રક્ષણ આપવા માટે ગાંધીધામ પ્રેસકોન્ફરન્સ યોજવામાં આવી હતી. પોલીસકર્મીના ...

ગાંધીધામ જૈનકુલ રત્નોદ્વારા ક્ષોહાણા સમાજ દ્વારા પોલીસવડાને રજૂઆત

ભરણપોષણ ન ચૂકવનારા ખીરસરા વિંઝાણના ઇસમને ૨૦૦ દિનની કેદ

નલિયા (તા. અબડાસા), તા. ૨૨ : ભરણપોષણના કેસમાં મોટા રકમ નહીં ચુકવતા નલિયા કોર્ટ ભરણપોષણ (મિ.) ...

નલિયાની અદાલતે ચકચાર ૨૬૫ કિલો આખો ઝુકાવ્યો

કેમ્પમાં ગામે જુની અદાવતમાં ધુમ્મસમાં બે મહિલા ઘાયલ

ભુજ, તા. ૨૨ : તાલુકાના કંપમાં ગામે જુની અદાવત રાખી ધારિયા, પાઈપ અને પથ્થર વડે મારામારી થતાં બે મહિલા ઘાયલ થયાની ફરિયાદ ...

આદિપુરમાં પતિ-પત્ની ઉપર કરાયેલો હુમલો

ગાંધીધામ, તા. ૨૨ : આદિપુરમાં પતિ-પત્ની ઉપર કરાયેલા હુમલાની ફરિયાદ નોંધાઈ છે. આદિપુરના પ્રકાશનગર વિસ્તારમાં રહેતા ...

ખોટ્યો છે.

ટ્રક ટ્રેલર (૫) નંગ

સેમી લોબેડ

ટાટા લેલાન્ડ ૩૫૧૮

¥૦ ફૂટ ૬૦૫૫ એકસલ

૨૦૧૪ થી ૨૦૧૬ મોડલ

ટાટા લેલાન્ડ ૬ વ્હીલ

૧૬ મેક્સિસ, ૨૦૧૪ થી ૨૦૧૬

ભાવીન શેઠે સાથે વાટાઘાટ કરો.

M. 9898908818

ટીનદયાલ પોર્ટ ટ્રસ્ટ

ટીનદયાલ પોર્ટ ટ્રસ્ટ

ભૂકંપરિર સિનેપ્લેક્સ-ભુજ

આ મનોરંજન ભુરતું રાખ્યું નોંધી લેજો

રૂા. ૧૦૦ (એક ટિકટ)

દિવસ	સમય	દિવસ	સમય
ભુજ	10.30 AM	ભુજ મેગા પ્રાણાદા સ્ક્રીનમાં	10.15 AM
ભુજ	12.45 PM	ભુજ મેગા પ્રાણાદા સ્ક્રીનમાં	12.35 PM
ભુજ	03.00 PM	ભુજ મેગા પ્રાણાદા સ્ક્રીનમાં	03.40 PM
ભુજ	05.20 PM	ભુજ મેગા પ્રાણાદા સ્ક્રીનમાં	06.40 PM
અંજાર	07.35 PM	ભુજ મેગા પ્રાણાદા સ્ક્રીનમાં	09.40 PM
ભુજ	10.00 PM		

બોક્સ ઓફિસ પુરીયા સવારે ૧૦થી ૧૦ બોક્સ ઓફિસ ૩૫ ચાલુ છે. : M. 99057 48561 • PAYTM ઓનલાઈન ટિકિટ પુરીયા બે-ટીકિટ પર ચાલુ છે.

Gehlot govt has no control over crime, says Union Minister

PRESS TRUST OF INDIA
JAIPUR, FEBRUARY 21

UNION MINISTER Arjun Ram Meghwal on Friday said the Ashok Gehlot-led Congress government is unable to rein in crime in Rajasthan and held it responsible for the Nagaur incident where two Dalit men were beaten up and tortured for allegedly stealing money.

Meghwal, along with party legislators Madan Diwalar and Mohan Ram, reached Nagaur on Friday and met the victims. He also visited the spot where the incident took place on Sunday.

"The chief minister is holding the portfolio of home minister but there is no control over crime and the government is responsible for the incident," Meghwal, the minister of state for heavy industries and public enterprises, said.

"There was also a failure on part of the police because they could not get to know about the incident when it happened," he added.

The Dalit men were beaten up, stripped and tortured by staffers of a motorcycle service agency in Karanu village after accusing them of committing theft.

A woman pays tribute to 'Bhasha Shahids' (language martyrs) at their memorial on the occasion of International Mother Language Day, in Kolkata on Friday. *PTI*

3 OGWS ARRESTED IN JAMMU AND KASHMIR'S SHOPIAN DISTRICT

Srinagar: Security forces on Friday arrested three overground workers of militants in Jammu and Kashmir's Shopian district, officials said. Three overground workers (OGWs) of militants were arrested from the Heff area of Shopian in the morning, they said. The arrested people have been identified as Shahid Ahmad Bhat, Zahoor Ahmad Padder and Bilal Ahmad Tell, the officials said. **PTI**

Arman Financial Services Limited

502-503, Sakar-III, Opp. Old High Court, Off. Ashram Road, Ahmedabad-380014. Gujarat Notice is hereby given that the Certificate (s) for the under mentioned Equity Shares of the Company have been lost/ misplaced and the holder (s) / purchaser (s) of the said Equity Shares have applied to the company to issue duplicate share certificate (s).
Any Person who has a claim in respect of the said shares should lodge the same with the company at Its Registered Office within 21 days from this date else the company will proceed to issue duplicate certificate (s) to the aforesaid applicants without any further intimation.

Folio No.	Name of Share Holder	No. Of Shares	Distinctive No.	Certificate No.
B00108	Balvant Patel	100	2091101 to 2091200	20938

Date : 21-02-2020
Place : Ahmedabad
Balvant Patel

SALUTE THE SOLDIER

CAPT SAHILL SHARMA,VrC
(26 Feb 1971- 22 Feb 1995)
25 years ago on this day you laid down your life in the service of our motherland, fighting the enemy in the world's highest battlefield, Siachen. You are fondly remembered and deeply missed by every member of 'YUDHE NIPUNAM' family. You are and always will be our leading light – CO and all ranks 237 Medium Regiment.

CENTRAL UNIVERSITY OF HARYANA
Mahendergarh - 123031 (Haryana)

POSTPONEMENT NOTICE OF 6TH CONVOCATION

Due to certain unavoidable circumstances, the 6th Convocation of the University scheduled to be held on 27th February, 2020 will now be held on Friday, 28th February, 2020.
All Concerned are advised to attend the Convocation accordingly.

Registrar

भारतीय विमानपत्तन प्राधिकरण AIRPORTS AUTHORITY OF INDIA

NOTICE INVITING GLOBAL E-TENDER

(1. Tender ID for Group B1 Airports: 2020_AAI_43717_1)
(2. Tender ID for Group B2 Airports: 2020_AAI_43719_1)
(3. Tender ID for Group B3 Airports: 2020_AAI_43720_1)

Airports Authority of India (AAI) invites Global E-tenders for **"Granting Concession for Ground Handling Services at Group B1, B2 and B3 Airports"** through CPP E-Tendering Portal. Last date and time of submission of respective bids is **"07th April 2020" up to 1800 hrs.** For detailed information log on to CPP e-Procurement Portal **: https://etenders.gov.in/eprocure/app** or AAI website**: www.aai.aero**. Further clarification/corrigendum if any will be notified through CPP e-Procurement portal. **N-110/2019-20**

DEENDAYAL PORT TRUST
(Erstwhile: Kandla Port Trust)
NIT No. 01/C.E. 2020

The Ministry of Environment, Forests & Climate Change, Government of India has accorded Environmental and CRZ Clearance for the Deendayal Port Trust Project "Development of 3 Remaining Integrated Facilities (stage I) within the existing Kandla Port Trust at Gandhidham, Kutch, Gujarat" and copies of the clearance letters are available with the State Pollution Control Board and may also be seen on the Website of the Ministry of Environment, Forests & Climate Change at **http://www.envfor.nic.in**.

Sd/-
Chief Engineer
Deendayal Port Trust
Delivering Maritime Excellence

WESTERN RAILWAY - RAJKOT DIVISION

PROPOSAL FOR LIVE CURRENT COLLECTION OF OVER HEAD LINE

Tender Notice No. DRM/RJT/E-Tender/TRD/2019-2020/04 (EL) Dt. 19-02-2020. Tender No. **DRM/RJT/EL/TRD/2019-2020/04 (i) Name of Work:** Rajkot Division: Proposal for live current collection of over head line over to Rajkot Division. **(ii) Approx. Cost:** ₹ 10,36,800/- **(iii) EMD:** ₹ 20,700/- **(iv)** Date and time for on line apply: on **20-03-2020** up to 15:00 Hours. **Address of the Office:** Divisional Railway Manager (Electrical/TRD), Western Railway, Kothi Compound, Rajkot-360 001. Web site: **www.ireps.gov.in** 195

Follow us on: twitter.com/WesternRly

GREATER CHENNAI CORPORATION
Solid Waste Management Department

S.W.M.C.No.A7/0670/2020

NOTICE INVITING TENDER

E-Tenders are invited for the following work in Single stage two cover system as detailed below.

The Superintending Engineer (SWM), Greater Chennai Corporation (GCC), invites on-line tender for "Selection of Concessionaire to process the Wet Waste handed over by the Greater Chennai Corporation and convert into Bio-CNG (100MT Capacity per day) at Madhavaram plant-II in Zone III in DFBOT Model under PPP mode" are available online on **www.tntenders.gov.in** from **06.03.2020** onwards.

Date and time of Pre Bid Meeting	18th March, 2020 at 11.00 A.M.
Last Date and Time of Submission of Bid	08th April, 2020 at 03.00 P.M.
Bid Opening Date and Time	09th April, 2020 at 04.00 P.M.
Cost of Tender Documents and EMD	Cost of tender document: Rs.20,000/- + 12% GST. EMD: Rs.9.75 Lakhs

DIPR/1016/Tender/2020
Superintending Engineer / SWM

NATIONAL INSTITUTE OF WIND ENERGY
(Formerly known as Centre for Wind Energy Technology)
An autonomous R&D Institution under the Ministry of New and Renewable Energy (MNRE), Government of India
Velachery - Tambaram Main Road, Pallikaranai, Chennai - 600 100.
URL : http://niwe.res.in

National Institute of Wind Energy (NIWE) is the technical arm of Ministry of New and Renewable Energy, Govt. of India in the field of Wind Energy. NIWE plays a proactive role in the development of Wind Energy especially in Wind Resources Assessment, Testing/Type Certification of Wind Turbine Generators, Research & Development and Information & Training Services.

Applications are invited for one post of **Additional Director (Finance & Administration) on Deputation basis** in Level **12 of 7th CPC – [Rs.78800-209200]**

For detailed advertisement and application please refer our website: **http://niwe.res.in**

Last date for submission of application is 21 days from the date of publication in the Employment News

Deputy Director General (F&A)

UTTAR PRADESH METRO RAIL CORPORATION LIMITED
(Formerly known as Lucknow Metro Rail Corporation Limited)
Administrative Building,VipinKhand, Gomti Nagar, Lucknow-226010

Ref: LKE-MCRC-1 & UPMRCTR-01 **Date: 21 February, 2020**

NOTICE INVITING TENDER

1. Uttar Pradesh Metro Rail Corporation Ltd. invites open bids through competitive bidding for the following Tender package
   (A) "LKE-MCRC-1: - "Maintenance cum rate Contract for Electrical & Mechanical (E&M) works at 17 elevated stations & Transport Nagar Depot of U P Metro at Lucknow."
   (B) "UPMRCTR-01: "Outsourcing of manpower for O&M work for preventive and corrective maintenance of 25 KV OHE and power supply installations (ASSs & RSSs) (excluding SCADA) of Uttar Pradesh Metro Rail Corporation Ltd."
2. Bid documents can be purchased between **10:00 Hours** to **17:30 Hours (IST)** on any working day with effective from **21.02.2020** to **12.03.2020** from the office of Uttar Pradesh Metro Rail Corporation Limited, Lucknow.
3. For further details, please visit UPMRCLwebsite **www.upmetrorail.com**.

Kumar Keshav, Managing Director

IRCON INTERNATIONAL LTD.
(A Govt. Of India Undertaking) Ministry of Railways
Website : www.ircon.org **CIN** - U45203DL1976GOI008171

e-Tender notice

e-tender number:- IRCON/3018/DFCCIL-CTP-12/ e-Tender/Infra work/SS1BII/08-309 Dated 21.02.2020. Tender in Two Stage bid System are Invited from bidders meeting qualifying requirement for the work "Construction of Civil works up to formation Double line railway involving Formation in Embankments/ Cuttings, Blanketing, minor bridges, Retaining walls, Drains, Ground Improvement works, Relocation of existing roads etc. from Ch. 112+ 000 (IR 79,300) to Ch. 125+000 (IR 92,300) in connection with construction of Western Dedicated Freight Corridor, Phase II (Vaitarana – Sachin Section) for sub packages SS1 B II in Maharashtra State".Estimated Cost (Including all taxes & GST): ₹ 37,84,51,100.00. **Last date and Time of Bid Submission:** 06.03.2020 up to 15:00 HoursFor Further details, Visit website at https:// www. etenders. gov.in/eprocure/app. Corrigendum if any would be hosted only on the web site.

For any clarification Contact the office of Undersigned on following address: Chief General Manager, IRCON INTERNATIONAL LIMITED, Plot no. 1/7/2, Vaishnav Nagri, Nr. Ayappa Temple, Atul- Parnera Road, Parnera, Distt. Valsad, Gujarat, 396001, Email: ircon.3018@ircon.org

MANAGED BY VIDYAMANDIR TRUST, SURAT
SMT.TANUBEN & DR.MANUBHAI TRIVEDI COLLEGE OF INFORMATION SCIENCE
Wadia Women's College Campus, Athwalines, Surat-395001
Ph.No.0261-2460995 E-mail: info@vidyamandirsoc.org
Website : tmtbcasurat.org
AFFILIATED TO VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

APPLICATIONS ARE INVITED FOR THE POSTS AS GIVEN BELOW

Sr. No.	Name of the Post	No. of the Post	Subject & Faculty
1.	Principal(12th Attempt)	01	B.C.A.
2.	Assistant Professor	01	B.C.A.

Qualifications, pay scale and service conditions are as per norms of U.G.C. Regulations 2018 and Veer Narmad South Gujarat University, Surat. Interested candidates should apply with their detailed Curriculum Vitae along with photographs, attested certificates, mark sheets, testimonials within 10 days from the date of publication of this employment notice by Reg.Post/Speed Post only in favour of Honarary Secretary, Vidyamandir Society, Surat.

Note : Candidates who do not possess NET/SLET/Ph.D. may also apply as Teaching Assistant as per norms of V.N.S.G.U. They will be considered for interview in absence of eligible candidates for remaining vacant position of Assistant Professor.

Place: Surat **Hon.Secretary**
Date : 22/02/2020 **Vidyamandir Society, Surat**

उत्तर-पूर्वी अंतरिक्ष उपयोग केंद्र / North Eastern Space Applications Centre
भारत सरकार / Government of India, अंतरिक्ष विभाग / Department of Space
उमियम / Umiam - 793103, मेघालय / Meghalaya, Tel: 0364 2570140. Fax: 0364 2570043

विज्ञापन सं./Advt. No. NESAC/RMT-TEMP/02/2019 **दिनांक/Date: 20.02.2020**

एनईसैक उमियम, में विभिन्न परियोजनाओं के तहत विशुद्ध रूप से अस्थायी आधार पर निम्नलिखित पदों को भरने के लिए पात्र उम्मीदवारों से आवेदन आमंत्रित कर रहे हैं/Applications are invited from eligible candidates for filling up the following positions on project basis, at NESAC, Umiam:

क्रम सं./ Sl No	पद का नाम / Name of Post	पद की सं./ No. of Post	मासिक पारिश्रमिक/ Monthly Remuneration
01	इलैक्ट्रॉनिक्स और इलेक्ट्रिकल इंजीनियरिंग, मौसम विज्ञान, भूविज्ञान, भूगोल, भू-भौतिकी, वनस्पति विज्ञान, कंप्यूटर विज्ञान, सूचना प्रौद्योगिकी, सुदूर संवेदन और जीआईएस, भूसूचना, कृषि, भौतिकी, पर्यावरण विज्ञान, भू-विज्ञान, सिविल इंजीनियरिंग, जल-संसाधन, जल-विज्ञान, वाटरशेड प्रबंधन आदि के क्षेत्र में शोध वैज्ञानिक। Research Scientist in the discipline of Electronics & Electrical Engineering, Meteorology, Geology, Geography, Geophysics, Botany, Computer Science, Information Technology, Remote Sensing & GIS, Geoinformatics, Agriculture, Physics, Environmental Science, Atmospheric Science, Earth Science, Civil Engineering, Water Resources, Hydrology, Watershed Management, etc.	14	पे मैट्रिक्स का स्तर 10 (₹ 56100-177500) प्लस एचआरए और स्वयं के लिए चिकित्सा लाभ/ Level 10 of the Pay Matrix (₹ 56100-177500) plus HRA & Medical Benefit for self
02	वानिकी, पारिस्थितिकीय, पर्यावरण विज्ञान, पारिस्थितिकीय और पर्यावरण विज्ञान, वन विज्ञान, स्थानिक सूचना, वायुमंडलीय भौतिकी, इलैक्ट्रॉनिक्स और संचार, भुविज्ञान, प्राणी विज्ञान, वन्यजीव विज्ञान, भूगोल, आरएस और जीआईएस, भू-विज्ञान, कृषि, भौतिकी, वायुमंडलीय विज्ञान, अंतरिक्ष विज्ञान, भौतिक विज्ञान, पृथ्वी विज्ञान आदि के क्षेत्र में जुनियर रिसर्च फैलो(जेआरएफ). Junior Research Fellow (JRF) in the discipline of Forestry, Botany, Life Science, Ecology, Environmental Science, Ecology & Environmental Science, Forest Science, Spatial Information, Atmospheric Physics, Electronics & Communication, Geology, Zoology, Wildlife Science, Geography, RS & GIS, Geoinformatics, Agriculture, Physics, Atmospheric Science, Space Science, Physical Science, Earth Science, etc.	07	₹ 31,000/- प्लस एचआरए और स्वयं के लिए चिकित्सा लाभ/ ₹ 31,000/- plus HRA & Medical Benefit for self

विस्तृत विज्ञापन के लिए कृपया एनईसैक वेबसाइट www.nesac.gov.in. जाएँ, शुद्धिपत्र / परिशिष्ट, यदि कोई होगा, तो केवल वेबसाइट में प्रकाशित किया जाएगा। आवेदन करने की अंतिम तिथि - १८, मार्च २०२० है। / The last date to apply for the post is March 18, 2020.For detailed advertisement, kindly visit NESAC Website: www.nesac.gov.in. Corrigendum/addendum, if any, will be published only in the NESAC website.

हस्ता / Sd/-
निदेशक, एनईसैक/Director, NESAC

PUBLIC NOTICE

This notice is given hereby to all concerned that the following shops in Agrasen Point situated on land bearing R. S. no. 151 of Umra, Tal.: City, Dist. Surat and comprised in T. P. Scheme no. 4, F. P. No. 97 are of the ownership of following owners :

1. Shop no. L/15 and L/16 are of the ownership of Avinash Shyamsunder Poddar.
2. Shop no. L/17 and L/18 are of the ownership of Anchal Avinash Poddar.

The following original documents in respect of the above properties have been misplaced.

1. Original sale deed bearing reg. no. 2495, dated 31.3.2003 and its original reg. fee receipt.
2. Original sale deed bearing reg. no. 2496, dated 31.3.2003 and its original reg. fee receipt.
3. Original sale deed bearing reg. no. 2497, dated 31.3.2003 and its original reg. fee receipt.
4. Original sale deed bearing reg. no. 2498, dated 31.3.2003 and its original reg. fee receipt.
5. Original reg. fee receipt of sale deed bearing reg. no. 635, dated 18.1.2005 (old no. 13144, dated 30.12.2004).
6. Original reg. fee receipt of sale deed bearing reg. no. 636, dated 18.1.2005 (old no. 13143, dated 30.12.2004).
7. Original reg. fee receipt of sale deed bearing reg. no. 637, dated 18.1.2005 (old no. 13142, dated 30.12.2004).
8. Original reg. fee receipt of sale deed bearing reg. no. 824, dated 20.1.2005 (old no. 13145, dated 30.12.2004).

If the aforesaid original documents are in the custody, security, possession by way of mortgage, encumbrance, etc. of any person, bank, financial institution, etc. the said custody, security, etc. may please be intimated in writing with proof thereof to the undersigned within 7 days of the publication of this notice, failing which, it shall be presumed that the aforesaid original documents are not in possession, security, encumbrance, etc. of any person, bank, financial institution and further procedure for mortgage of the aforesaid property by my client bank shall be completed and no objection, claim, etc. shall be entertained on the expiry of the aforesaid period of 7 days.

Manish J. Gandhi
Advocate
B-504-505, Tirupati Plaza,
Nanpura, Surat

Avinash Shyamsunder Poddar
Anchal Avinash Poddar

SARDAR SAROVAR NARMADA NIGAM LIMITED
(A wholly owned Government of Gujarat Undertaking)

Tender Notice No. & Name of the work	1) Est. Cost (Rs. in lacs) 2) Tender Fee (in Rs) 3) EMD (Rs. in lacs) 4) Class 5) Time Limit	(a) Pre bid Meeting (b) Last date for online downloading/submission of tender documents (c) Date for physical submission of tender documents. (d) Online verification of tender documents. (e) Opening of Technical bid (f) Opening of Price bid
1.	2	3.
Works under the Chief Engineer (SBC), SSNNL, Rajkot		
Tender Notice No- 04 of 2019-20 ID No-.399266 Constructing remaining Canal Earthwork, Lining, Structures & Service Road remaining minors, gaps, missing link for the Distributory LD-1, LD-2, LSD-2, LD-4, LD-5 & LD-8 & Its Minors work for the command area under Limbdi Branch Canal. (Package-I)	(1) 1554.37 (2) 21240/- (3) 15.55 (4) "AA" Class (5) 09 Months	(a) 25/02/2020 @ 12.00 Hrs (b) 11/03/2020 up to 18.00 hrs. (c) 12/03/2020 to 18-03-2020 up to 18.00 hrs. (d) 13/03/2020 at 11.00 hrs onwards. (if possible) (e) 13/03/2020 at 12.00 hrs onwards (if possible) (f) 16/03/2020 at 12.00 hrs. (if possible)
Tender Notice No- 04 of 2019-20 ID No.399267 Constructing remaining Canal Earthwork, Lining, Structures & Service Road for remaining minors,gaps,missing link for the Distributaries LD-9,LSD-9,LD-10,11,LD-12 and LSD-12 work of the command area under Limbdi Branch Canal. (Package-II).	(1) 1925.45 (2) 21240/- (3) 19.26 (4) "AA" Class (5) 09 Months	
Tender Notice No- 05 of 2019-20 ID No.399268 Constructing canal Earthwork,Lining, Structures & service Road for remaining minors,gaps ,missing link, for the Distributaries LD -13,LD-14,LD-15,LD-16,LD-17,LSD-17,LD-18 & LD-19 workof the command area Under Command Area of Limbdi Branch Canal (Package-III)	(1) 2128.19 (2) 21240/- (3) 21.29 (4) "AA" Class (5) 09 Months	
Tender Notice No- 06 of 2019-20 ID No.399269 Constructing Remaining Canal Earthwork, Structure, Lining for remaining minors,gaps,missing link for the Distributaries TD-1 & TD-2 work of the Command Area under of Limbdi Branch Canal.(Package-IV)	(1) 902.74 (2) 14160/- (3) 9.03 (4) "AA" Class (5) 09 Months	

Note : The details regarding contact place for physical submission and opening of tender, please visit website www.ssnnl.nprocure.com (INF/2364/19-20)

रजिस्ट्री सं. डी. एल.-33004/99 REGD. NO. D.L.-33004/99

भारत का राजपत्र
The Gazette of India

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सं. 465] नई दिल्ली, शनिवार, फरवरी 1, 2020 / माघ 12, 1941
No. 465] NEW DELHI, SATURDAY, FEBRUARY 1, 2020/MAGHA 12, 1941

MINISTRY OF ROAD TRANSPORT AND HIGHWAYS

NOTIFICATION

New Delhi, the 30th January, 2020

S.O. 499 (E).—Whereas by the notification of the Government of India in the Ministry of Road Transport and Highways, S.O. number 3512 (E) dated 26th September 2019, published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (ii) issued under sub-section (1) of section 3A of the National Highway Act, 1956 (48 of 1956) (hereinafter referred to as the said Act), the Central Government declared its intension to acquire the land specified in the Schedule annexed to the said notification for building (widening/four-laning, etc.), maintenance, management and operation of NH51 on the stretch of land from Km. 112.330 to Km. 166.610 (Deputy Collector Office, Rajula) in the district of AMRELI in the State of GUJARAT;

And whereas the substance of the said notification has been published in "Divya Bhaskar" and "The Indian Express" both dated 14.10.2019; under sub-section (3) of section 3A of the said Act;

And whereas objections have been received and the same have been considered and disallowed by the Competent Authority;

And whereas, in pursuance of sub-section (1) of section 3D of the said Act, the competent authority has submitted its report to the Central Government;

Now, therefore, upon receipt of the said report of the competent authority and in exercise of the powers conferred by the sub-section (1) of section 3D of the said Act, the Central Government hereby declares that the land specified in the said Schedule should be acquired for the aforesaid purpose;

And further, in pursuance of sub-section (2) of section 3D of the said Act, the Central Government hereby declares that on publication of this notification in the Official Gazette, the land specified in the said Schedule shall vest absolutely in the Central Government, free from all encumbrances.

A Public Notice under section 3G(3) of the National Highway Act - 1956 (48 of 1956) for inviting claims of compensation from all the interested persons.

Details of compensation from all the interested persons.

Sr. No.	Name of District	Name of Taluka	Name of Village	Date of Hearing	Time of Hearing	Venue of Hearing
1	Amreli	Jafrabad	Kagvadar Lothpur	25-02-2020	11:00 AM	Deputy Collector's Office, Rajula, Dist. Amreli

All interested Persons are hereby further informed by this Public Notice that, any submission with documentary proof made to the undersigned the Competent Authority and Deputy Collector, Rajula, Dist. Amreli on the date as shown aforesaid table, a statement containing, the details of his/her interest in or right over the acquired land, or any part thereof, referred to in the SCHEDULE of this public notice as co-proprietor, sub-proprietor mortgagee, tenant, or otherwise and of the nature of such interest, will be considered for apportionment and distribution of compensation for the aforesaid acquired land.

SCHEDULE

Brief description of the land to be acquired, with or without structures, falling within the NH51 in the stretch of land from Km. 112.330 to Km. 166.610 NH51 (Deputy Collector Office, Rajula) in the district of AMRELI in the State of GUJARAT.

State: GUJARAT District: AMRELI

Sr. No.	Survey Number	Type of Land	Nature of Land	Area in Hectare	Name of the Land Owner / Intrested Person Part Survey No.
1	2	3	4	5	6
Taluk: Jafrabad, Viilage: Kagvadar					
1	102/P1/P3	Private	Agriculture	0.0034	Varu Umeshbhai Madhubhai, Varu Vandaben Umeshbhai, Varu Komalben Umeshbhai, Varu Prithviraj bhai Umeshbhai, Varu Devendrabhai Umeshbhai Son of Umeshbhai 102 / P1 / P3
Viilage: Lothpur					
2	330 / 3	Private	Agriculture	0.0713	Nakum Balubhai Khodabhai, Nakum Govidbhai Khodabhai, Nakum Pithabhai Khodabhai 330 / 3
3	343	Private	Agriculture	0.0405	Rajyaguru Pushpaben Labhshankarbhai, Rajyaguru janakbhai Labhshankarbhai, Rajyaguru Nitinkumar Labhshankarbhai, Rajyaguru Ilaben Labhshankarbhai, Rajyaguru Kailashben Labhshankarbhai 343
4	346	Private	Agriculture	0.0677	Boricha Pithubhai Bhimabhai 346
5	347 / 3	Private	Agriculture	0.0038	Boricha Ashokbhai Bhimbhai 347 / 3
			TOTAL	0.1867	

[F. No. NHAI/11011/Gujarat/Rajkot /LA/3D2]
RAJESH GUPTA, Dy. Secy.

Rajkot Nagarik Sahakari Bank Ltd.

R.O. & H.O.: 'Arvindbhai Maniar Nagarik Sevalay', 150' Ring Road, Nr. Raiya Circle, Rajkot. Ph. 2555555

Symbolic Possession Notice (For Immovable Property)

The undersigned being the authorized officer of Rajkot Nagarik Sahakari Bank Ltd., H.O. Rajkot under the Securitization and Reconstruction of Financial Assets and Enforcement of Security interest Act, 2002 Section 13(2) and in exercise of powers conferred under the Security Interest (Enforcement) Rules, 2002 Issued a demand notice to the below mentioned borrower and Guarantor advising them to repay their bank dues mentioned in the notice with due interest thereon within 60 days from the date of notice and as they have failed to repay the amount, notice is hereby given to them and the public in general that the undersigned has taken **Symbolic possession** of the property described herein below in exercise of powers conferred on him under section 13(4) of SARFAESI ACT-2002, read with **rule 8(1)** of the Security Interest (Enforcement) Rules, 2002 for recovery of the secured debts. Following borrower and Guarantor in particular and the public in general is hereby cautioned not to deal with the property and any dealings with the property will be subject to the charge of Rajkot Nagarik Sahakari Bank Ltd., Rajkot for an amount mentioned below and interest thereon due from **01/02/2020**.

Sr. No.	Branch Name & Account No.	Borrower / Guarantor / Director / Partner name & If Bank issue Public notice in News Paper then date & News Paper Details	As per 13(2) Notice Outstanding Amount & Notice date	Date of Symbolic Possession	Outstanding Amount as on Dt. 31/01/2020	Mortgage Property Description
1	**Ahmedabad** 048051700000072 (SEC/3055)	**BORROWER(S) : Bhardan Subhroto Debobroto GUARANTOR(S) : Bardhana Debobrato Jagneshvar**	**Rs.10,68,914=00** (As on 30/11/2017) Notice Date: 07/12/2017	17/02/2020	**Rs. 12,90,800=00**	(1) Immovable Property situated in Ahmedabad Dist.Sub Dist. Ahmedabad-9 (Bopal) Dashkroi Tal Moje Gam Bopal Seem Paiki Block No.368 Final Plot No.10&11 Land Paiki Flat Constructed by "Sharadhdha(Bopal)Co.Op. Housing Soc.Ltd."Known As "Parikrama Flats"(Reg Gha No:17239 Dt :27-03-1996)Paiki Flat No.C/13 on 3rd Floor App. 105-00 Sq. Yard (App.87-69 Sq.Meter) alongwith Construction thereon acquired Vide Regd. Sale deed No.4390 Dated: 25/07/2012 in the Name of Shri Bardhana Debobrato (Tapan) Jagneshvar. (2) All Stocks of goods, machinery furniture & fixtures, computer etc. of the firm / company.

Dt. 21/02/2020, Rajkot. **Authorized Officer, Rajkot Nagarik Sahakari Bank Ltd., H.O., Recovery Department, Rajkot.**

Annexure -II

Monitoring the Implementation of Environmental Safeguards
Ministry of Environment, Forest & Climate Change
Regional Office (WZ) Bhopal
Monitoring Report

DATA SHEET

1.	Project type: River - valley/ Mining / Industry / Thermal / Nuclear / Other (specify)		:	Infrastructure & miscellaneous projects + CRZ
2.	Name of the project		:	Development of 3 Remaining Integrated Facilities (stage I) within the existing Deendayal Port Trust (Erstwhile: Kandla Port Trust) at Gandhidham, Kutch, Gujarat.
3.	Clearance letter (s) / OM No. and Date		:	Environment and CRZ clearance accorded by the MoEF&CC, GoI vide file no. 10-9/2017-IA-III dated 18/2/2020.
4.	Location		:	
	a.	District (S)	:	Kachchh
	b.	State (s)	:	Gujarat
	c.	Latitude/ Longitude	:	$23^0$01' N, $70^0$13' E
5.	Address for correspondence			
	a.	Address of Concerned Project Chief Engineer (with pin code & Telephone / telex / fax numbers	:	Chief Engineer, Deendayal Port Trust, A. O. Building, Gandhidham- 370 201. P. O. Box no. 50. Phone: 02836 233192 02836 220050
	b.	Address of Project: Engineer/Manager (with pin code/ Fax numbers)	:	Same as above
6.	Salient features			
	a.	of the project	:	**1.** Development of Container Terminal at Tuna off-Tekra on BOT Basis: (Jetty: T-shape 1100m X 54m, Capacity: 2.19 Million TEUs/Annum, Capital Dredging: 13,56,000 M^3, Maintenance Dredging 271200 M^3/year , Land Area req.: 84 ha, Break water: Length of 1400 m, with 20 m of height, Estimated Cost: 3097 cr.). **2.** Construction of Port Craft Jetty &

				Shifting of SNA Section. (Dredging: 27357.00 m3, Estimated Cost: 23.17 cr.). **3.** Providing Railway Line from NH 8A to Tuna Port.(Length – 11 km, Estimated cost: 94 cr.).
	b.	of the environmental management plans	:	The salient feature of the EMP is enclosed here with as **Annexure 1.**
7.		Production details during compliance period and (or) during the previous financial year		Project at Sr.No.1 – container terminal at Tuna tekra – No construction activity started. Under appraisal/approval stage. Project at Sr. no 2 – For Parking of port Crafts. Project at Sr.no. 3 – Railway Line from NH 8 A to tuna.
8.	Breakup of the project area		:	~95 Ha
	a.	submergence area forest & non-forest	:	NIL
	b.	Others	:	NIL
9.	Breakup of the project affected Population with enumeration of Those losing houses / dwelling units Only agricultural land only, both Dwelling units & agricultural Land &landless labourers/artisan		:	NIL
	a.	SC, ST/Adivasis	:	NIL
	b.	Others (Please indicate whether these Figures are based on any scientific And systematic survey carried out Or only provisional figures, it a Survey is carried out give details And years of survey)	:	NIL
10.	Financial details		:	
	a.	Project cost as originally planned and subsequent revised estimates and the year of price reference :		
	1.	Estimated Cost of the Project	:	Total Rs. 3214.17 Crore 1. Development of Container Terminal at Tuna off-Tekra on BOT Basis (Estimated Cost: 3097 cr.). 2. Construction of Port Craft

				Jetty & Shifting of SNA Section (Estimated Cost: 23.17 cr.). 3. Providing Railway Line from NH 8A to Tuna Port. (Estimated cost: 94 cr.).
	b.	Allocation made for environ-mental management plans with item wise and year wise Break-up.	:	The allocation made under the scheme of "Environmental Services & Clearance thereof other related Expenditure" during BE 2021-2022 is Rs. 266 Lakhs.
	c.	Benefit cost ratio / Internal rate of Return and the year of assessment	:	1. Development of Container Terminal at Tuna off-Tekra on BOT Basis. (Project IRR 14.77 %, Economic IRR 15.97%). 2. Providing Railway Line from NH 8A to Tuna Port. (Project IRR 14.4% and EIRR 15.47 %). The project of Construction of Port Craft jetty & shifting of SNA Section is essential looking towards safety aspect & smooth operation of entire Port (essential urgent requirement).
	d.	Whether (c) includes theCost of environmental management as shown in the above.	:	Yes
	e.	Actual expenditure incurred on the project so far	:	The projects viz.Construction of Port Craft jetty & shifting of SNA Section (Actual Cost: Rs. 22 crores) and Railway line NH 8 A to Tuna (Rs. 94 crores deposited by DPT to Indian Railways), have already been completed. The project of container terminal no activity started yet. Under appraisal/approval stage.

	f.	Actual expenditure incurred on the environmental management plans so far	:	The expenditure made under the scheme of "Environmental Services & Clearance thereof other related Expenditure" is Rs. 6,33,93,214.70 /- till November, 2021.
11.	Forest land requirement		:	
	a.	The status of approval for diversion of forest land for non-forestry use	:	NIL
	b.	The status of clearing felling	:	NIL
	c.	The status of compensatory afforestation, it any	:	NIL
	d.	Comments on the viability & sustainability of compensatory afforestation program in the light of actual field experience so far	:	NIL
12.	The status of clear felling in Non-forest areas (such as submergence area of reservoir, approach roads), it any with quantitative information		:	NIL
13.	Status of construction		:	
	a.	Date of commencement (Actual and/or planned)	:	1. Development of Container Terminal at Tuna off-Tekra on BOT Basis – No construction activity started yet. Activity likely to be started by June, 2022 (Tentative). 2. Construction of Port Craft Jetty & Shifting of SNA Section – Work Completed. 3. Providing Railway Line from NH 8A to Tuna Port. – Work completed.
	b.	Date of completion (Actual and/or planned)	:	1. Development of Container Terminal at Tuna off-Tekra on BOT Basis – No construction activity started yet. Planned completion June, 2025 (tentative). 2. Construction of Port Craft Jetty & Shifting of SNA Section – Work Completed. 3. Providing Railway Line from

				NH 8A to Tuna Port. – Work completed.
14.	Reasons for the delay if the Project is yet to start		:	The projects viz.Construction of Port Craft jetty & shifting of SNA Section and Railway line NH 8 A to Tuna, have already been completed. The project of container terminal no activity started yet. Under appraisal /approval stage at the MoPSW, GoI.
15	Details of site visit : a) The dates on which the project was monitored by the MoEF&CC, Regional Office on previous occasions (if applicable). b) Date of site visit for this monitoring report.			----- ------
16	Details of correspondence with project authorities for obtaining action plans/information on status of compliance to safeguards other than the routine letters for logistic support for site visit. (The first monitoring report may contain the details of all the letters issued so far but the later reports may cover only the letters issued subsequently)		:	---------