**APSEZL/EnvCell/2019-20/018** **Date:** 20.05.2019

To

**Additional Principal Chief Conservator of Forests (C),**
Ministry of Environment, Forest and Climate Change,
Regional Office (WZ), E-5, Kendriya
Paryavaran Bhawan, Arera Colony,
Link Road No. – 3, Bhopal – 462 016.
E-mail: rowz.bpl-mef@nic.in

**Sub** : Half yearly Compliance report for Environment and CRZ Clearance for "Water Front Development Project at Mundra, Dist. Kutch, Gujarat.

**Ref** : i) Environment and CRZ clearance granted to M/s Adani Ports & SEZ Limited vide letter dated 12th January, 2009 and 19th January, 2009 bearing MoEF letter No. 10-47/2008-IA.III.
ii) Environment and CRZ clearance Extension order granted to Water Front Development Project at Mundra in Kutchh District (Gujarat) vide letter dated 7th October, 2015 bearing MoEF letter No. 10-47/2008- IA.III.
iii) Ministry's Order dated 18.09.2015

**Dear Sir,**

Please refer to the above cited reference for the said subject matter. In connection to the same, it is to state that copy of the compliance report for the Environmental and CRZ Clearance for the period of October – 2018 to March – 2019 has been submitted through mail communication and acknowledge of the same is attached here for your records.

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

**Avinash Rai**
**Chief Executive Officer**
**Mundra & Tuna Port**

**Encl: As above**
**Copy to:**

1) The Director (IA Division), Ministry of Environment, Forests & Climate Change, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi-110003
2) Zonal Officer, Regional Office, CPCB – Western Region, Parivesh Bhawan, Opp. VMC Ward Office No. 10, Subhanpura, Vadodara – 390 023
3) Member Secretary, GPCB – Head Office, Paryavaran Bhavan, Sector 10 A, Gandhi Nagar – 382 010
4) Deputy Secretary, Forests & Environment Department, Block – 14, 8th floor, Sachivalaya, Gandhi Nagar – 382 010
5) Regional Officer, Regional Office GPCB (Kutch-East), Gandhidham, 370201

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

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adani

# Environmental Clearance Compliance Report

## Waterfront Development Project, Mundra, Dist. Kutch, Gujarat

## Adani Ports and SEZ Limited

For the period of
October-2018 to March-2019

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| | | |
|---|---|---|
| adani | Adani Ports and Special Economic Zone Limited, Mundra. | From : Oct'18<br>To : Mar'19 |
| Status of the conditions stipulated in Environment and CRZ Clearance | | |

# Compliance Report of Environmental and CRZ Clearance

| adani | Adani Ports and Special Economic Zone Limited, Mundra. | From : Oct'18<br>To : Mar'19 |
|---|---|---|

**Status of the conditions stipulated in Environment and CRZ Clearance**

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

| Description (Type of Facility or Berth) | Approved Berths or Length as per Environmental & CRZ Clearance | So far Developed and In Operation |
|---|---|---|
| | Nos. of Berths or Length | Nos. of Berths |
| Multipurpose | 4<br>(550 m + 2 Berths) | 4 |
| Container | 16<br>(2680 m + 2000 m) | 7<br>(2110 m) |
| Ro-Ro | 2 | - |
| Coal | 6 | 4 |
| Dry-Bulk Cargo | 5 | - |
| Liquid/POL | 9* | - |
| LNG | 2 | Progressive towards commissioning (being developed by GSPC LNG Limited as per NOC given by APSEZ) |
| Light & Heavy Engineering | 2 | - |
| Port Craft | 1<br>(330 m) | - |
| Shipyard | 2 | - |

* Liquefied Petroleum Gas (LPG) Terminal is being developed under Waterfront Development Project of Adani Ports and SEZ Limited and LPG will be handled at existing Multipurpose Terminal APSEZ. LPG terminal is being developed by M/s. Mundra LPG Terminal Pvt. Ltd., which is 100% subsidiary of APSEZ.

In addition to above berths or facilities, following components were also approved.

1. Dredging Quantity: 210 $Mm^3$. Overall dredging to the tune of 123 $Mm^3$ is completed till date
2. Back-up area, back-up facilities like railway line, rail slidings, rail truck loading, open paved areas, associated buildings, utilities, amenities, etc. and connectivity to rail and road corridor for each port were approved and majority of them are constructed and in operation. Remaining facilities will be developed based on future requirements.
3. Seawater intake channel and outfall channel for power plants, desalination plants (47 MLD is operational out of 300 MLD) and other industrial requirements approved and is already in operation.

**Half yearly Compliance report for Environment and CRZ Clearance for the project "Water Front Development Project (WFDP) at Mundra, Dist. Kachchh, Gujarat of M/s. Adani Ports and SEZ Limited"**

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| **Specific Conditions** | | |
| i | No existing mangroves shall be destroyed during construction / operation of the Project. | Complied.<br><br>Project is being developed as per permissions granted.<br><br>Conservation of mangroves:<br>• In and around APSEZ, approx. 1800 ha. mangrove area was identified by NIO in an EIA report prepared in the year 1998.<br>• Out of this 1800 ha area, 1254 ha area was further demarcated as potential mangrove conservation by NIO in the year 2008 (as part of the EIA report of WFDP).<br>• It may be noted that the entire area of 1254 ha is not covered with mangroves.<br>• Entire area is being conserved and there is no disturbance to the mangroves in this area. Measures such as restricted entry and regular surveillance have resulted in overall growth of mangroves within this area.<br>• As per MoEF&CC directive, APSEZ entrusted NCSCM to demarcate mangroves in and around APSEZ area. As per their study, presently, mangrove cover in and around APSEZ is over 2340 ha. The analysis of the comparison between 2011 and 2016-17 has shown an overall growth of 246 ha.<br>• NCSCM final report on comprehensive and integrated plan for preservation and conservation of mangroves and associated creeks in and around has been submitted to the concerned authorities i.e. MoEF&CC, New Delhi and GCZMA, Gandhinagar vide our letter dated 04.06.2018 and details of the same were submitted along with last EC compliance report of period Apr'18 to Sep'18. |
| ii | There shall be no filling up of the creek and reclamation of the creeks. | Complied.<br><br>Conservation of creeks:<br>• The prominent creek system (main creeks and small branches of creeks) in and around APSEZ are: (1) Kotdi (2) Baradimata (3) Navinal (4) Bocha (5) Mundra (Oldest port |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | | (Juna Bandar) leading to Bhukhi river).<br>• All above creek mouths are open allowing free flow of water in to the creeks and surrounding areas and there is no filling or reclamation of any creek area.<br>• This aspect is also confirmed from the recent study of NCSCM, which highlights the bathymetry data of the entire coast around APSEZ.<br>• From the bathymetry data it can be concluded that there are sufficient depths at the creek mouths and all creek mouths are open allowing flushing of water.<br>• APSEZ has so far constructed 19 culverts having total length of approx. 1100 m with total cost of INR 20 Crores. Three RCC Bridges have also been constructed over Kotdi creek with total length of 230 m and cost of INR 10 Crores. Photographs showing the same were submitted along with half yearly compliance report for the period Apr'17 to Sep'17. |
| iii | The Project proponent shall comply with all the Orders/directions of the Honorable High Court of Gujarat and Supreme Court in the matter. | Complied.<br><br>There are two ongoing matters pending (one pending at High Court and other pending at Supreme Court). Updated status of litigation is attached as **Annexure – 1**. |
| iv | Adequate safety measures for the offshore structure and ship navigation shall be taken in view of the High Current in the area. | Complied.<br><br>The hydrodynamic study for the waterfront area has been carried out by HR Wallingford, a maritime design expert. As per the recommendations in their report, the following safety measures are implemented.<br>1. The alignment of the berth has been kept in line with the current flow in order to reduce the effect of current on vessels moored alongside.<br>2. The breasting dolphins have been designed in such a configuration so as to provide appropriate lead to the vessels mooring ropes.<br>3. The berth being in line with the current flow will facilitate Pilotage operation and provide better maneuverability of vessels.<br>4. The strength of the berth structure has been calculated to absorb the energy transferred to fenders while berthing of tanker vessels at the terminal.<br>5. Navigational buoys and lead lights marking the channel and clearing distance off the breakwater are installed. |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | | 6. The strength of the fenders at the berth and the SWL of the bollards / winches are sufficient to absorb the forces of vessels alongside keeping in mind the monsoon weather conditions.<br>7. Sufficient depths are maintained at all times to ensure 10% UKC at the time of berthing / un-berthing.<br>8. The capstans / winches / bollards are of adequate strength with respect to the vessels being handled.<br>9. The berth has been designed at an appropriate distance from the existing berths at MMPT-1 in order to safely allow berthing / un-berthing of vessels at MMPT-1 with vessels berthed at the South Port tanker terminal.<br>10. Berths have been planned close to the breakwater as there is a reduced strength of current along the coastline. |
| v | The shore line changes in the area shall be monitored periodically and the report submitted every 6 months to Regional Office Bhopal. | Complied.<br><br>Shore line change aspect has been studied in detail as part of following two studies;<br>• Bathymetry & Topography study, preparation of plan for protection of creeks/ mangrove area including buffer zone, mapping of co-ordinates, running length, HTL, CRZ boundary.<br>• A Regional Impact Assessment study to identify impacts of all the existing as well as proposed project activities in Mundra region.<br><br>As per the outcome of these studies, no erosion is observed on the coast of the project area. As part of the Regional Impact Assessment study, the possible changes in shoreline that may occur due to the proposed developments in 10 km area on either side of the waterfront development project have been predicted. It has been inferred from the modelling study that the shift in the shoreline will be less than 0.5 m/year, which reconfirms that the APSEZ facility would pose insignificant impact on the Mundra shoreline. Accretion is observed at South port and at West port due to approved reclamation activities.<br><br>Based on the study outcome, it is recommended to map the coastal morphology (shoreline change) at least once in three years. The said recommendation will be implemented |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | | and the next shoreline change assessment will be carried out during 2020-21.<br><br>Please refer **Annexure – B** (Compliance of MoEF&CC Order dated 18th Sep, 2015) for further details regarding the mentioned studies. |
| vi | The recommendations of the risk assessment shall be implemented; any change in the design of the project shall come before the committee for seeking necessary approval. | Complied.<br>Risk Assessment was carried out at the time of preparation of the EIA report for the Liquid Berths and LNG terminal. However, it may be noted that liquid berths are not yet developed. Hence recommendations of Risk Assessment will be implemented once the liquid berths & pipelines are developed by APSEZ.<br><br>The LNG terminal is being constructed by GSPC LNG Ltd. and a separate Environment and CRZ clearance is obtained by them. Please refer general condition no ix below for details regarding the same.<br><br>LPG is proposed to be handled from the existing multipurpose terminal and storage tanks are being constructed in the back up area. A detailed risk assessment study as per MoEF&CC letter no. F. No. 10-47/2008-IA-III dated 31st May, 2016 is carried out by iFluids Engineering for handling as well as storage activities. Recommendations of the risk assessment have been implemented as part of the construction activity and details of the same are attached as **Annexure – 2**. Reports of the same were submitted to MoEF & CC along with half yearly compliance report for the period Apr'17 to Sep'17.<br><br>There are no other activities which attract requirement of Risk Assessment. |
| vii | Mangrove plantation of 200 ha to be done in consultation with GEER / GEC of Forest Department, a detailed plan shall be submitted within six months from the date of receipt of this letter. | Complied.<br><br>APSEZ has consulted Gujarat Institute of Desert Ecology (GUIDE) as they are one of the authorized agencies of Dept. of Forest & Env., Govt. of Gujarat for carrying out mangrove afforestation. GUIDE has completed mangrove plantation in an area of 200 ha at Jakhau, Gujarat during the year 2012-13. Copy of the mangrove plantation completion certificate was submitted along with last EC compliance report for the period Apr'18 to Sep'18. Total expenditure for the said work |

<table>
<tr><th>Sr. No.</th><th>Condition as per clearance letter</th><th>Compliance Status as on 31-03-2019</th></tr>
<tr><td></td><td></td><td>was INR 40 lakh.<br><br>It may be noted that to enhance the marine biodiversity, till date APSEZ has carried out mangrove afforestation in more than 2850 ha. area across the coast of Gujarat. Total expenditure for the same till date is INR 832 lakh. Please refer Annexure – 3 for green belt development and mangrove afforestation efforts done by APSEZ.</td></tr>
<tr><td>viii</td><td>It shall be ensured that during construction and post construction of the proposed jetty the movement of fishermen vessel of the local communities are not interfered with.</td><td>Complied.<br><br>During project proposal, APSEZ proposed to provide four (4) dedicated accesses at Juna Bandar, Luni, Bavdi Bandar and Zarpara for the fishermen to approach the sea for fishing activity. However, during construction as well as operation, through fishermen consultative process, so far APSEZ has provided seven (7) access roads instead of four (4). Total length of all the approach roads is approx. 23 Kms and expenditure involved is Rs. 637 Lacs. There is no hindrance to the movement of fisherman boats.<br><br>Further, APSEZ is actively working with local community (including fishermen community) around the project area and provides required support for their livelihood and other concerns through the CSR arm – Adani Foundation. Following activities have been carried out during the period FY 2018-19.<br><br>
<table>
<tr><th>Area</th><th>Activity</th></tr>
<tr><td>Sustainable Livelihood – Fisher folk</td><td>• Average 123 KL of water was supplied to 1086 households from different settlements on a daily basis under Machhimar Shudhh Jal Yojana.<br>• Adani Foundation constructed four Balwadis for kids between the age group of 2.5 years to 5 years at different settlements under Vidya Deep Yojana.<br>• Participatory scholarship support for fisherman children studying in SMJ high school Luni and to above 12th standards Students. 80 percentage support given by Adani foundation and 20 percentage support by parents!<br>• RTG Crane Operator: 03 Fisherman Youth<br>• Dori Work & Mud Work Training: 65 Women<br>• Mangrove Plantation, moss cleaning, etc.: 6261 Man-days.<br>• In addition to this, employment worth of 35787 man-days has been provided till date. The</td></tr>
</table>
</td></tr>
</table>

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | | Foundation has also supported Pagadiya fishermen as painting labours by providing them with employment and job in various fields.<br>• Total average **560 fishermen** were benefitted by Mobile Dispensary during last half year. Adani Foundation has extended financial assistance to more than **114 financially challenged patients** from the Fisher Folk Community in case of medical urgency during this year.<br>• The project for the senior citizens is popularly known as Vadil Swasthya Yojana and till date **350 senior citizens** from fisher folk community are enrolled in the scheme.<br>**Fisherman Amenities work**<br>391 Students : Education Support<br>134 Stunners : Adani Vidya Mandir<br>16 Fisherman : Alternate livelihood<br>78 Fisherwomen : Linkages for schemes<br>1312 Fisherman : Community Engagement<br>1086 Fisherman : Potable water provision<br>6261 Mandays : Mangroves Plantation<br>231 Fisherman : Capacity Building<br><br>Please refer **Annexure – 4** for full details of CSR activities carried out by Adani Foundation in the Mundra region. Budget for CSR Activity for the FY 2018-19 is to the tune of INR 1697 lakh. Out of which, Approx. INR 1624 lakh are spent during the year 2018-19. |
| ix | Relocation of the fishermen community if any shall be done strictly in accordance with the norms prescribed by the State Government. | Not Applicable<br><br>The project was conceptualized in such a way that there are no fishermen settlements in the project proposal. Hence there is no relocation of fishermen communities required. |
| x | Marine ecology monitoring shall be done regularly during construction of breakwater and dredging /disposal operation. | Complied.<br><br>Constructions as well as dredging operations are ongoing activities. Marine monitoring is being carried out once in a month by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratory Pvt. Ltd. Summary of the same for duration from Oct'18 to Mar'19 is mentioned below.<br><br>**Total Sampling Locations & frequency: 09 Nos. (Frequency: Once a month)**<br><br>**Parameter** \| **Unit** \| **Surface** \| **Bottom** |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|

| | | Max | Min | Max | Min |
|---|---|---|---|---|---|
| pH | -- | 8.37 | 8.07 | 8.24 | 8.03 |
| TSS | mg/L | 382 | 182 | 364 | 218 |
| BOD (3 Days @ 27 °C) | mg/L | 12.8 | 3.0 | 5.0 | 2.0 |
| DO | mg/L | 6.8 | 6.0 | 6.8 | 5.6 |
| Salinity | ppt | 35.7 | 33.9 | 36.0 | 3.0 |
| TDS | mg/L | 36734 | 34327 | 37434 | 34218 |

Please refer **Annexure – 5** for detailed analysis reports and accreditation certificate. Approx. INR 20.36 Lakh is spent for all environmental monitoring activities during the FY 2018-19. Marine monitoring for west port area has been carried out by M/s. Adani Power Limited. Monitoring reports are also enclosed as **Annexure – 5**.

Summary of ecological parameters is given below:
**Plankton Diversity:** A total of five stations were distributed throughout the sampling effort. Samples were collected during September 2017. A maximum 24 genera of Amphidinium, Amphora, Bacteriastrum, Cerataulina, Ceratium, Chaetoceros, Coscinodiscus, Cylindrotheca, Ditylum, Fragilaria, Gunardia, Hemialus, Lauderia, Melosira, Navicula, Odontella, Pleurosigma, Pseudonitzschia, Rhizosolenia, Scrippsiella, Skeletonema, Surirella, Thalassionema and Thalassiosira identified from station 3 during the period of investigation and a minimum 18 genera of phytoplankton Cerataulina, Chaetoceros, Coscinodiscus, Cylindrotheca, Ditylum, Dinophysis, Fragilaria, Leptocylindrus, Melosira, Meuneria, Navicula, Odontella, Pleurosigma, Protoperidinium, Rhizosolenia, Skeletonema, Thalassionema and Thalassiosira identified from station 2 & 4. The phytoplankton abundance in the study region was ranged from 10000 to 41952 cells L-1. Highest phytoplankton abundance was observed at the ST-3 Surface water. However, lowest phytoplankton abundance was observed at the ST-5 Surface water. The maximum number of groups (24) found at ST-3.

**Benthic Diversity:** Benthic invertebrates in the present study area were distributed on the surface of bed forms i.e. sandy and Silty clay in nature. The abundance and diversity, species composition of benthic invertebrates were

<table>
<tr><th>Sr. No.</th><th>Condition as per clearance letter</th><th>Compliance Status as on 31-03-2019</th></tr>
<tr><td></td><td></td><td>recorded which is the indicators of changing environmental conditions. A total 5 sub tidal stations and 3 intertidal transect were distributed throughout the sampling effort. Samples were collected during December 2017. Sub tidal: A maximum 4 group of Bivalvia, Polychaeta, Amphipoda, and Sipuncula identified from station 1 & 5 during the period of investigation and a minimum 2 Polychaeta and Amphipoda Benthic fauna recorded from station 2. In the sub tidal region macro benthos abundance was higher at ST-1 (575 no. m-2), whereas lowest abundance was recorded at ST-2 (100 no. m-2). Benthic group count was ranged from 2 to 4, with maximum groups at ST-1&5. High biomass was recorded at ST-5 (8.63mg. m-2) as compared to other stations.</td></tr>
<tr><td>xi</td><td>Regular Monitoring of air quality shall be done in the settlement areas around the Project site and appropriate safeguard measures shall be taken.</td><td>Complied.<br><br>Ambient Air Quality and Noise monitoring are being carried out by NABL accredited and MoEF&CC authorized agency namely M/s. Pollucon Laboratory Pvt. Ltd. Summary of the same for duration from Oct'18 to Mar'19 is mentioned below.<br><br>Air sampling locations & frequency: 10 nos. (twice a week) & Noise sampling locations & frequency: 7 nos. (once in a month)
<table>
<tr><th>Parameter</th><th>Unit</th><th>Max</th><th>Min</th><th>Perm. Limit$</th></tr>
<tr><td>$PM_{10}$</td><td>µg/m$^3$</td><td>99.6</td><td>47.3</td><td>100</td></tr>
<tr><td>$PM_{2.5}$</td><td>µg/m$^3$</td><td>59.2</td><td>19.0</td><td>60</td></tr>
<tr><td>$SO_2$</td><td>µg/m$^3$</td><td>29.4</td><td>6.3</td><td>80</td></tr>
<tr><td>$NO_2$</td><td>µg/m$^3$</td><td>46.6</td><td>13.6</td><td>80</td></tr>
<tr><th>Noise</th><th>Unit</th><th>Max</th><th>Min</th><th>Perm. Limit</th></tr>
<tr><td>Day Time</td><td>dB(A)</td><td>74.1</td><td>55.1</td><td>75</td></tr>
<tr><td>Night Time</td><td>dB(A)</td><td>72.3</td><td>56.4</td><td>70</td></tr>
</table>
$ as per NAAQ standards, 2009<br>Values recorded confirms to the stipulated standards.<br><br>Please refer Annexure – 5 for detailed analysis reports Approx. INR 20.36 Lakh is spent for all environmental monitoring activities during the FY 2018-19. Ambient air quality monitoring in surrounding villages is being carried</td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Condition as per clearance letter</th><th>Compliance Status as on 31-03-2019</th></tr>
<tr><td></td><td></td><td>out by M/s. Adani Power Limited, Mundra and monitoring reports of the same are also enclosed in Annexure – 4.<br><br>Following safeguard measures are taken for abatement of dust emissions.<br>• Regular sprinkling on road and other open area<br>• Regular cleaning of roads<br>• Dry fog Dust Suppression System (DSS) in hopper, transfer towers and conveyor belts<br>• Use of water mist canon<br>• Closed type conveyor belts<br>• Regular sprinkling on coal heaps<br>• Covering other types of dry bulk cargo heaps<br>• Installation of wind breaking wall<br>• Development of greenbelt along the periphery of the storage yards/back up area<br>• Mechanized handling system for coal and other dry bulk cargo<br>• Wagon loading and truck loading through closed silo</td></tr>
<tr><td>xii</td><td>Sewage arising in the Port area shall be disposed off after adequate treatment to conform to the standards stipulated by Gujarat State Pollution Control Board and shall be utilized / recycled for Gardening, Plantation and Irrigation.</td><td>Complied.<br><br>Entire quantity of sewage generated is being treated in designated ETP / STP and treated sewage is used for Horticulture purposes.<br><br>
<table>
<tr><th>Location</th><th>Capacity</th><th>Quantity of Treated water (Avg. Oct'18 to Mar'19)</th><th>Type of ETP / STP</th></tr>
<tr><td>LT</td><td>265 KLD</td><td>99 KLD</td><td>Activated Sludge</td></tr>
<tr><td>West port</td><td>55 KLD</td><td>20 KLD</td><td>FAB</td></tr>
</table>
<br>Third party analysis of the treated water is being carried out once in a month at Liquid Terminal (LT) & twice in a month at West Port by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratory Pvt. Ltd. Summary of the same for duration from Oct'18 to Mar'19 is mentioned below.<br><br>
<table>
<tr><th>Parameter</th><th>Unit</th><th>Max</th><th>Min</th><th>Perm. Limit$</th></tr>
<tr><td colspan="5">Industrial Effluent / Sewage</td></tr>
<tr><td>pH</td><td>--</td><td>8.4</td><td>7.1</td><td>6.5 to 8.5</td></tr>
</table>
</td></tr>
</table>

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | | <table><tr><td>TSS</td><td>mg/L</td><td>72</td><td>25</td><td>100</td></tr><tr><td>TDS</td><td>mg/L</td><td>1921</td><td>1024</td><td>2100</td></tr><tr><td>COD</td><td>mg/L</td><td>94</td><td>68</td><td>100</td></tr><tr><td>BOD (3 Days @27°C)</td><td>mg/L</td><td>26</td><td>18</td><td>30</td></tr><tr><td>Ammonical Nitrogen</td><td>mg/L</td><td>7.2</td><td>2.7</td><td>50</td></tr><tr><td colspan="5">Domestic Sewage</td></tr><tr><td>pH</td><td>--</td><td>9.05</td><td>6.85</td><td>6.5 – 8.5</td></tr><tr><td>TSS</td><td>mg/L</td><td>27</td><td>10</td><td>100</td></tr><tr><td>BOD (3 Days @27 °C)</td><td>mg/L</td><td>19</td><td>6</td><td>30</td></tr><tr><td>Residual Chlorine</td><td>ppm</td><td>1.0</td><td>0.2</td><td>Min 0.5</td></tr><tr><td>Fecal Coliform</td><td>Nos.</td><td>920</td><td>210</td><td><1000</td></tr></table> $ as per CC&A granted by GPCB<br>Values recorded confirms to the stipulated standards.<br><br>Please refer **Annexure – 5** for detailed analysis reports. Approx. INR 20.36 Lakh is spent for all environmental monitoring activities during the FY 2018-19. |
| xiii | Adequate Plantation shall be carried out along the roads of the Port premises and a green belt shall be developed. | Complied.<br><br>APSEZ has developed its own "Dept. of Horticulture" which is taking measures/ steps for terrestrial greening as well as mangrove plantation.<br><br>The species such as *Ficus Infectoria, Ficus religiosa, Terminalia arjuna, Cocos nucifera, Washingtonia fillifera, Casurina spp., Azadirachta Indica, Eucalyptus spp., Jatropha curacus, Ficus bengalensis, Subabool spp., Casia fistula, Date Palm* and *Delonix regia* are grown within APSEZ area.<br><br>Within the port areas approx. 180 hectare of greenbelt having 4,26,366 trees with the density of 2369 trees per hectare is developed till date. So, far more than 450 ha. area is developed as greenbelt with plantation of more than 8.3 Lacs trees within the entire APSEZ area.<br><br>Please refer **Annexure – 3** for further details regarding greenbelt development, mangrove afforestation and updated green belt development plan. Total expenditures of the horticulture dept. during the FY 2018-19 are INR 580 lakh. |
| xiv | There shall be no withdrawal of Ground Water in CRZ area for this Project. | Complied.<br><br>APSEZ does not draw any ground water for the water requirement. Present source of water for various project |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | | activities is desalination plant of APSEZ and/or Narmada water through Gujarat Water Infrastructure Limited. Average water consumption for entire APSEZ area is 4.2 MLD during the compliance period Oct'18 to Mar'19. |
| xv | Specific arrangements for rain water harvesting shall be made in the Project design and the rain water so harvested shall be optimally utilized. Details in this regard shall be furnished to this Ministry's Regional Office at Bhopal within 3 months. | Complied.<br><br>Groundwater recharge cannot be done at the project site since the entire project is in the intertidal / sub tidal areas. Rain water within project area is managed through storm water drainage.<br><br>During current year approx. 24 KL of rain water from storm water collected and utilized on land for gardening / plantation purpose. We have also connected roof top rain water duct of operational building (Tug Berth Building within MPT) with u/g water tank for utilization of collected rain water for gardening / horticulture purpose. Photograph showing the same is attached as **Annexure – 6**.<br><br>However, APSEZ has carried out rainwater harvesting activities in the nearby villages for benefit of the locals. Following measures are taken for the same during the year 2011 – 13 and the same have benefited to the local farmers.<br>1. Pond deepening activities at villages<br>2. 18 check dams were constructed under the 'Sardar Patel Sahbhagi Jalsanchay Yojna'<br>Total cost of these efforts was approx. INR 320 lakh.<br><br>Under Sujlam Suflam project Adani Foundation has successfully completed pond deepening work in Mundra & Abdasa Taluka in record time. 26 pond deepening in Mundra and 7 pond deepening in Abdasa accomplished with all parameters calculated. In Mundra taluka 51723 cum excavation work has been done which increase storage capacity of 51 ML. In Naliya taluka 14550 cum excavation work has been done which increase storage capacity of 15 ML. Total 66 ML storage capacity will be increased.<br><br>**<u>Participatory Ground Water Management:</u>**<br>Adani foundation has started participatory ground water management project. The objective of the project was to reduce the salinity ingress in and around the coastal regions of Mundra, Kutchh and mitigate the ill-effects of |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | | this manmade problem to improve the livelihoods of the rural people. The Project will help to get water table high, also it will help in agricultural activities.<br><br>As a part of pre monsoon activities with ACT (Arid Communities and Technologies – NGO) under this program, we have carried out following work. But, due to negligible rainfall we are not able to find out outcome of this project.<br>i. Borana – Artificial bore well recharge (work completed)<br>ii. Mangara – Artificial bore well recharge (work completed)<br>iii. Dhrub – Pond deepening work (work completed)<br>iv. Mota Kapaya – abended bore well recharge (work completed)<br><br>Please refer **Annexure – 4** for full details of CSR activities carried out by Adani Foundation in the Mundra region. Budget for CSR Activity for the FY 2018-19 is to the tune of INR 1697 lakh. Out of which, Approx. INR 1624 lakh are spent during the year 2018-19. |
| xvi | Land Reclamation shall be carried out only to the extent that it is essential for this Project. | Complied.<br><br>Out of approved reclamation area of 1138 ha for west port, 695 ha area is reclaimed and out of approved reclamation area of 700 ha for south port, 665 ha area is reclaimed. Details of the same were submitted along with last compliance report submission for the period Apr'17 to Sep'17 and there is no further change. |
| xvii | No Product other than those permissible in the Coastal Regulation Zone Notification, 1991 shall be stored in the Coastal Regulation Zone area. | Complied.<br><br>No products other than those permissible in the CRZ Notification 1991 are stored in the CRZ area. |
| **General Conditions** | | |
| i | Construction of Proposed structures, if any in the Coastal Regulation Zone area shall be undertaken meticulously confirming to the existing Central/local | Complied.<br><br>All construction activities are carried out confirming to the existing rules and regulation and as per the CRZ notification. |

<table>
<tr><th>Sr. No.</th><th>Condition as per clearance letter</th><th>Compliance Status as on 31-03-2019</th></tr>
<tr><td></td><td>rules and regulations including Coastal Regulation Zone Notification 1991 and its amendments. All the construction designs/ drawings relating to the proposed construction activities must have approvals of the concerned State Government Departments/ Agencies.</td><td>Further, the requisite permissions from Gujarat Maritime Board (GMB), for carrying out construction activities are taken from time to time. Details of the same are mentioned below:<br><br>• Permission for starting construction work for South port vide letter no GMB/N/PVT/711/870 dated 26.02.2009<br>• Permission for starting construction work for West port vide letter no GMB/N/PVT/711/871 dated 26.02.2009<br><br>The copies of these letters were submitted as part of the compliance report submission for the period Apr'16 to Sep'16.<br><br>The project has been developed as per Consent to Establish (CtE) and Consent to Operate (CtO) granted by SPCB. The present in-force CtO are mentioned below.<br><br>
<table>
<tr><th>Permission</th><th>Project</th><th>Ref. No. / Order No.</th><th>Valid till</th></tr>
<tr><td>CtO – Renewal</td><td>Mundra Port Terminal</td><td>AWH-83561</td><td>20.11.2021</td></tr>
<tr><td>CtO – Renewal</td><td>West Port – WFDP</td><td>AWH-79241</td><td>23.06.2021</td></tr>
<tr><td>CtO - Amendment</td><td>Mundra Port Terminal</td><td>WH-88317</td><td>20.11.2021</td></tr>
<tr><td>CtE – Fresh</td><td>LPG Terminal</td><td>CTE – 88079</td><td>04.07.2022</td></tr>
<tr><td>CtO – Amendment</td><td>West Port – WFDP</td><td>AWH-91678</td><td>01.02.2022</td></tr>
<tr><td>CtE – Amendment</td><td>LPG Terminal</td><td>PC/CCA-KUTCH-1437/GPCB ID: 53331/468197</td><td>04.07.2022</td></tr>
<tr><td>CtO - Amendment</td><td>Mundra Port Terminal</td><td>GPCB/CCA-Kutch -39(5)/ ID-17739/473575</td><td>20.11.2021</td></tr>
<tr><td>CtE – Amendment</td><td>LPG Terminal</td><td>PC/CCA-KUTCH-1437/PCB ID-53331/473995</td><td>03.10.2025</td></tr>
<tr><td>CtO - Amendment</td><td>Mundra Port Terminal</td><td>H-98086</td><td>20.11.2021</td></tr>
</table>
<br>Copy of updated / amendment in CtO and CtE are attached as Annexure – 7.</td></tr>
<tr><td>ii</td><td>Adequate provision for infrastructure facilities such as water supply, fuel,</td><td>Not applicable<br><br>Most of the construction labours reside in the nearby</td></tr>
</table>

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | sanitation etc. shall be ensured for construction workers during the construction phase of the project so as to avoid felling of trees/mangroves and pollution of water and the surroundings. | villages where all basic facilities are easily available. There are no housing requirements for labours inside the project area. |
| iii | The project authorities must make necessary arrangements for disposal of solid wastes and for the treatment of effluents by providing a proper wastewater treatment plant outside the CRZ area. The quality of treated effluents, solid waste, and noise level etc. must conform to the standards laid down by the competent authorities including the Central/ State Pollution Control Board and the Union Ministry of Environment and Forests under the Environment (Protection) Act, 1986, whichever are more stringent. | Complied.<br><br>Monitoring of environmental attributes viz. Air, Water, Noise, Soil, etc. is being carried out on regular basis by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratory Pvt. Ltd. Approx. INR 20.36 Lakh is spent for all environmental monitoring activities during the FY 2018-19.<br><br>Please refer Specific Conditions no. x, xi & xii for further details regarding environmental monitoring.<br><br>**Liquid Effluent & Sewage** – It is being treated at decentralized treatment plants and treated water confirming the stipulated norms is being utilized for horticulture purposes within APSEZ. Please refer specific condition no xii above for details regarding the same.<br><br>**Waste Management** – APSEZ has adopted 5R concept for environmentally sound management of different types of solid & liquid wastes. Please refer below details about management of each type of waste.<br><br>**Municipal Solid Waste**: A well-established system for segregation of dry & wet waste is in place. All wet waste (Organic waste) is being segregated & utilized for compost manufacturing and/or biogas generation for cooking purpose. The compost is further used by in house horticulture team for greenbelt development. Whereas dry recyclable waste is being sorted in various categories. Presently manual sorting is being done for sorting of different types of solid waste. Segregated recyclable materials such as Paper, Plastic, Cardboard, PET Bottles, Glass etc. are then sent to respective recycling units, whereas remaining non-recyclable waste is bailed and sent |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|

to cement plant (M/s. Sanghi Industries Ltd., Kutch and/or M/s. Ambuja Cement Ltd., Kodinar) for Co-processing as RDF (Refused Derived Fuel).

**Hazardous Waste:**

- E – Waste & Used Batteries are being sold to GPCB registered recyclers namely M/s. e-Processing House.
- Solid Hazardous Waste is being disposed through co-processing through common facility i.e. M/s. Saurshtra Enviro Projects Pvt. Ltd., Bhachau and/or cement industries of Sanghi Industries Ltd., Kutch and/or Ambuja Cement Ltd., Kodinar. Used/Waste Oil is being sold to GPCB authorized recyclers / re-processors namely M/s. Western India Petrochem Industry, Bhavnagar.
- Downgrade chemicals generated from cleaning of storage tanks / pipelines are being sold to authorized solvent recovery facilities namely M/s. Acquire Chemicals, Ankleshwar however during the compliance period, there was no disposal of downgrade chemicals.
- Slop Oil received from vessels is treated to separate water and oil particles in Oil Water Separator system. Separated oil from the same is being sold to authorized recycler / reprocessor namely M/s. Western India Petrochem Industry, Bhavnagar and water is sent to ETP for further treatment. However during the compliance period, there was no disposal of Slope Oil.

Details of permissions / agreements of hazardous waste authorized vendors were submitted along with last EC Compliance Report for the period Apr'18 to Sep'18.

The following table summarizes the waste management practice (for Oct'18 to Mar'19) for different types of wastes at APSEZ:

| Waste | Quantity in MT | Disposal method |
|---|---|---|
| **Hazardous Waste** | | |
| Pig Waste | 5.87 | Co-processing at cement industries |
| Tank Bottom Sludge | 21.59 | |
| Oily Cotton waste | 66.22 | |
| ETP Sludge | 5.21 | |

<table>
<tr><th>Sr. No.</th><th>Condition as per clearance letter</th><th>Compliance Status as on 31-03-2019</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Used / Spent Oil</td><td>92.03</td><td rowspan="2">Sell to registered recycler</td></tr>
<tr><td>Discarded Containers</td><td>8.72</td></tr>
<tr><td colspan="3">Municipal Solid Waste</td></tr>
<tr><td>Recyclables</td><td>92.26</td><td>After recovery sent for recycling</td></tr>
<tr><td>Refuse Derived Fuel</td><td>178.24</td><td>Co-processing at Cement Industries</td></tr>
<tr><td>Wet Waste (food waste+ Organic waste)</td><td>188.44 MT (Manure) & 1938 Cum (Biogas)</td><td>Converted to Manure for Horticulture use / Biogas for cooking purpose</td></tr>
</table>
</td></tr>
<tr><td>iv</td><td>The Proponent shall obtain the requisite consents for discharge of effluents and emissions under the Water (Prevention and Control of pollution) Act, 1974 and the Air (Prevention and Control of pollution) Act, 1981 from the Gujarat Pollution Control Board before commissioning of the Project and copy of each of these shall be sent to this Ministry.</td><td>Complied.<br><br>All construction activities are carried out confirming to the existing rules and regulation and as per the CRZ notification.<br><br>Please refer General condition no. i for permission granted from state pollution control board regarding the same.</td></tr>
<tr><td>v</td><td>The sand dunes, corals, and mangroves, if any, on the site shall not be disturbed in any way.</td><td>Complied<br><br>There are no sand dunes and corals at the project site. 1254 ha area identified as potential mangrove conservation is being conserved and there is no disturbance to the mangroves in this area. Please refer specific condition no i above for details regarding the same.</td></tr>
<tr><td>vi</td><td>A copy of the clearance letter will be marked to the concerned Panchayat / Local NGO, if any from whom any suggestions /representations has been received while processing the proposal.</td><td>Complied.<br><br>Copy of the clearance letter was marked to the concerned panchayats. A typical proof of the same submitted to Mundra village Panchayat on 21.03.2009 was submitted as a part of compliance report submission for the period Apr'16 to Sep'16.</td></tr>
</table>

<table>
<tr><th>Sr. No.</th><th>Condition as per clearance letter</th><th>Compliance Status as on 31-03-2019</th></tr>
<tr><td>vii</td><td>The funds earmarked for environment protection measures shall be maintained in a separate account and there shall be no diversion of these funds for any other purpose. A year wise expenditure on environmental safeguards shall be reported to this Ministry's Regional Office at Bhopal and the State Pollution Control Board.</td><td>Complied.<br><br>Separate budget for the Environment protection measures is earmarked every year. All environment and horticulture activities are considered at corporate level and budget allocation is done accordingly. All the expenses are recorded in advanced accounting system of the organization.<br><br>Budget for environmental management measures (including horticulture) for the FY 2018-19 is to the tune of INR 1069 lakh. Out of which, Approx. INR 1008 lakh are spent during the FY 2018-19. Detailed breakup of the expenditures for the past 3 years is attached as Annexure – 8.<br><br>Details regarding the past six compliance report submissions are mentioned below:<br><br>
<table>
<tr><th>Sr. no.</th><th>Compliance period</th><th>Date of submission</th></tr>
<tr><td>1</td><td>Oct'15 to Mar"16</td><td>30.05.2016</td></tr>
<tr><td>2</td><td>Apr'16 to Sep'16</td><td>01.12.2016</td></tr>
<tr><td>3</td><td>Oct'16 to Mar'17</td><td>30.05.2017</td></tr>
<tr><td>4</td><td>Apr'17 to Sep'17</td><td>01.12.2017</td></tr>
<tr><td>5</td><td>Oct'17 to Mar'18</td><td>29.05.2018</td></tr>
<tr><td>6</td><td>Apr'18 to Sep'18</td><td>30.11.2018</td></tr>
</table>
</td></tr>
<tr><td>viii</td><td>Full support shall be extended to the Officers of this Ministry's Regional Office at Bhopal and the Officers of the Central and State Pollution Control Boards by the Project Proponents during their inspection for monitoring purposes, by furnishing full details and action plans including the action taken reports in respect of mitigative measures and other environmental Protection activities.</td><td>Complied<br><br>APSEZ is always extending full support to the regulatory authorities during their visit to the project site. All necessary documents are submitted as per the request of the visiting authorities.</td></tr>
</table>

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| ix | In case of deviation or alteration in the Project including the implementing agency, a fresh reference shall be made to this Ministry for modification in the clearance conditions or imposition of new ones for ensuring environmental protection. | Complied.<br><br>LNG terminal was initially approved under the Waterfront Development Project. However the same is now being developed by GSPC LNG Ltd. for which, separate EC and CRZ clearance has already been obtained from MoEF&CC by them. Copy of the same was submitted along with compliance report submission for the period Oct'16 to Mar'17.<br><br>LPG terminal was initially approved under the Waterfront Development Project of Adani Ports and SEZ Limited and the same is being developed by M/s. Mundra LPG Terminal Pvt. Ltd., which is 100% subsidiary of APSEZ. |
| x | The Ministry reserves the right to revoke this clearance, if any of the conditions stipulated are not complied with to the satisfaction of this Ministry. | Point noted and agreed. |
| xi | This Ministry or any other competent authority may stipulate any other additional conditions subsequently, if deemed necessary, for environmental protection which shall be complied with. | Complied<br><br>As part of the directions given by MoEF&CC vide order dated 18th Sep, 2015, following studies were proposed.<br><br>• Bathymetry & Topography study, preparation of plan for protection of creeks/ mangrove area including buffer zone, mapping of co-ordinates, running length, HTL, CRZ boundary.<br>• A Regional Impact Assessment study to identify impacts of all the existing as well as proposed project activities in Mundra region.<br><br>Please refer **Annexure – B** for further details regarding the mentioned studies. |
| xii | The project proponent shall advertise at least in two local newspapers widely circulated in the region around the Project, | Complied.<br><br>The original copy of the EC and CRZ clearance was obtained on 10.03.2009 and advertisement (containing informing that the EC and CRZ clearance is accorded to the |

| Sr. No. | Condition as per clearance letter | Compliance Status as on 31-03-2019 |
|---|---|---|
| | one of which shall be in the vernacular language of the locality concerned informing that the Project has been accorded Environmental Clearance and copies of clearance letters are available with the State Pollution Control Board and may also be seen at the website of the Ministry of Environment & Forest at http://www.envfornic.in. The advertisement shall be made within 7 days from the date of issue of the clearance letter and a copy of the same shall be forwarded to the Regional Office of this Ministry at Bhopal. | proposed project and a copy of clearance letter is available with the SPCB and may also be seen at the website of MoEF&CC) was given in The Indian Express newspaper dated 18.03.2009. Copy of the same was submitted along with compliance report submission for the period Apr'16 to Sep'16. |
| xiii | The Project proponent shall inform the Regional Office at Bhopal 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. | Complied.<br><br>APSEZ had informed the Regional Office of MoEF&CC at Bhopal as well as MoEF&CC, New Delhi regarding the date of financial closure and the date of start of land development work vide letter sent in August, 2009. |
| xiv | Any appeal against this environmental clearance shall lie with the National Environment Appellate Authority, if preferred, within period of 30 days as prescribed under section 11 of the National Environment Appellate Act, 1997. | Point noted and agreed.<br><br>This EC and CRZ clearance was challenged in National Environment Appellate Authority. In this matter, Order has also been passed in favour of APSEZ. Copy of the same was submitted along with compliance report submission for the period Oct'16 to Mar'17. |

# ANNEXURE – A

## CRZ Recommendation Compliance Report of WFDP

**Compliance Status of CRZ Recommendation given by GCZMA for the Waterfront Development Project**

| Sr. No. | Specific Conditions | Compliance Status as on 31-03-2019 |
|---|---|---|
| **Specific Conditions** | | |
| 1 | The provisions of the CRZ notification of 1991 and subsequent amendments issued from time to time shall be strictly adhered to by the MPSEZL. No activity in contradiction to the provisions of the CRZ Notification shall be carried out by the MPSEZL. | Complied.<br><br>All construction and operation activities are being carried out in line with the CRZ recommendation and permissions granted. |
| 2 | All necessary permissions from different Government Departments/ agencies shall be obtained by the MPSEZL before commencing any activities. | Complied.<br><br>Necessary permissions from competent authority have been obtained before commencing any the activities.<br><br>Please refer condition no. i & iv of General Conditions of the EC & CRZ Clearance above. |
| 3 | All major creeks shall be protected and no reclamation shall be done in these creeks and entire development along the creek shall be done after carrying out detailed engineering with an objective of environmental protection including protection of all major creeks to ensure adequate free flow of water and drainage of rain water during rainy seasons. | Complied.<br><br>All major creeks within the APSEZ area are protected.<br><br>Please refer specific condition no iii of the EC and CRZ clearance for details regarding this point. |
| 4 | The project proponent shall conserve the 1254 ha. of area as committed and proposed in their master plan and shall carry out plantation of various mangrove species in the said area. | Complied.<br><br>Mangrove conservation area of 1254 Ha is conserved as proposed in the master plan.<br><br>Please refer specific condition no i of the EC and CRZ clearance for details regarding this point. |
| 5 | Massive mangroves plantation activity in at least 300 ha. area shall be carried out within a time frame of 5 years as committed by the project proponent. This would | Complied.<br><br>Mangrove plantation is already completed during the year 2012-13. Please refer specific condition no. vii of the EC and CRZ clearance for further details. |

| Sr. No. | Specific Conditions | Compliance Status as on 31-03-2019 |
|---|---|---|
| | be in addition to the earlier commitment for 1200 ha. of mangroves plantation. | |
| 6 | No effluent or sewage shall be discharged in to the CRZ area and it shall be treated to conform to the norms prescribed by the Gujarat Pollution Control Board and would be discharged to the point suggested by the NIO in consultation with the GPCB. | Complied.<br><br>No effluent or sewage is discharged in to the CRZ area.<br><br>Please refer specific condition no xii of the EC and CRZ clearance for details regarding this point. |
| 7 | All the recommendations and suggestions given by NIO in their Environment Impact Assessment report for conservation / protection and betterment of environment shall be implemented strictly by MPSEZL. | Complied.<br><br>Compliance report of environmental management plan and mitigation measures proposed as part of the EIA report is attached as **Annexure – 9.** |
| 8 | The construction and operational activities as well as dredging and reclamation activities shall be carried out in such a way that there is no negative impact on mangroves and other coastal /marine habitat except the proposed approx. 63 ha of area for which the compensation (300 ha.) is proposed. | Complied.<br><br>All construction and operation activities as well as dredging and reclamation activities are being carried out as per the approvals.<br><br>1254 ha area identified as mangrove conservation area is being conserved by APSEZ.<br><br>Please refer specific condition no i of the EC and CRZ clearance for details regarding this point. |
| 9 | The construction activities and dredging shall be carried out under the supervision/monitoring of the NIO or any such institute of repute. | Complied.<br><br>Construction activities are carried out as per EIA study carried out by NIO with all mitigative measures as suggested. Requisite permissions are taken from competent authorities such as GMB and GPCB. Site visits are being carried out by govt. officers from time to time to ensure compliance of the conditions stipulated in respective permissions. No capital dredging activities are carried out during the Oct'18 to Mar'19 period.<br><br>Please refer condition no. i, iv & viii of General Conditions of the EC & CRZ Clearance above. |

| Sr. No. | Specific Conditions | Compliance Status as on 31-03-2019 |
|---|---|---|
| 10 | The dredge material generated during capital dredging shall be used only for reclamation and that to be generated during maintenance dredging shall be disposed of at the place identified by NIO/CWPRS/WAPCOS through appropriate modeling and it shall be ensured that it does not create any negative impacts. | Complied.<br><br>Entire quantity of dredged material is used for reclamation activities only; no disposal is carried out in the sea. No capital dredging activities are carried out during the Oct'18 to Mar'19 period. |
| 11 | Necessary measures including the shore protection activities shall be undertaken to ensure that there are no erosion in surrounding area due to the proposed activities. | Complied.<br><br>All dredging and reclamation activities are carried out as per EC and CRZ Clearance and no erosion is observed.<br><br>For further details regarding the shoreline change study for the Mundra region, please refer specific condition no v of the EC and CRZ clearance. |
| 12 | The alignment of the jetties/berths and other structures shall be done after conducting the detailed modeling to ensure that there are no erosion and accretion in the region due to proposed activities. | Complied.<br><br>Detailed hydrodynamic modeling was carried out by NIO during preparation of the EIA report. All construction activities are being carried out as per the outcome/recommendations of the modeling report.<br><br>However, a detailed shoreline change assessment study is also carried out. Please refer specific condition no v of the EC and CRZ clearance for further details. |
| 13 | The MPSEZL shall contribute financially for any common study or project that may be proposed by this department for environment management / conservation / improvement for the Gulf of Kutchh. | Complied.<br><br>There are two studies prescribed by MoEF&CC. For further details regarding the same, please refer general condition no xi of the EC and CRZ clearance. |
| 14 | The construction debris and /or any other type of waste shall not be disposed of into the sea, creek or in the CRZ areas. The construction is over and shall be disposed off in | Complied.<br><br>All construction and operation activities as well as dredging and reclamation activities are being carried out as per the EIA report prepared by NIO. |

| Sr. No. | Specific Conditions | Compliance Status as on 31-03-2019 |
|---|---|---|
| | low lying areas in consultation with NIO, NEERI or any such institute of repute. | The construction debris, if any, is being used for area development outside CRZ area. For details about management of other types of wastes, please refer general condition no. iii of the EC and CRZ clearance. |
| 15 | 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 labors. | Compiled.<br><br>Construction work of proposed LPG terminal is going on.<br><br>Please refer general condition no ii of the EC and CRZ clearance for further details. |
| 16 | The MPSEZL shall regularly update their Local Oil Spill Contingency and Disaster Management Plan in consonance with the National Oil Spill and Disaster Contingency Plan and shall submit the same to this Department after having it vetted through the Indian Coast Guard. | Compiled.<br><br>Disaster Management Plan is updated regularly and the updated DMP was submitted as a part of compliance report for the period Apr'16 to Sep'16.<br><br>Oil spill contingency plan is in place to handle Tier 1 level oil spills considering different accident scenarios, and the vulnerable areas are identified and mitigation plan is prepared. Plan is being updated regularly and updated OSCRP is attached as **Annexure – 10**. |
| 17 | The MPSEZL shall participate and contribute for the Vessel Traffic Management System to be developed for the Gulf of Kutchh being developed. | Complied.<br><br>A VTS service for Gulf of Kutch is operated by Directorate General of Lighthouses and Lightships (DGLL), Govt. of India.<br><br>APSEZ is practicing well defined traffic control procedure. Marine Control of APSEZ provides traffic update to vessels in Mundra Port Limit on VHF Channel- 77. Arrival and departure information in Gulf of Kutch is provided to VTS information cell through an agent or directly by sending an e-mail to vtsmanagergulfofkutch @ yahoo.com and vtsgok@yahoo.com. |
| 18 | The MPSEZL shall bear the cost of external agency that may be appointed by this Department for | Being complied.<br><br>There are two studies prescribed by MoEF&CC. For |

| Sr. No. | Specific Conditions | Compliance Status as on 31-03-2019 |
|---|---|---|
| | supervision/monitoring of proposed activities and the environmental impacts of the proposed activities. | further details regarding the same, please refer general condition no xi of the EC and CRZ clearance. |

# Annexure – B
# Compliance Status of MoEF & CC Order dated 18.09.2015

Based on the report submitted by Sunita Narain committee, MoEF&CC issued a Show Cause Notice (SCN) to APSEZ vide their letter dated 30.09.2013. APSEZ replied to the SCN vide letter dated 14.10.2013. Further, an order (containing 10 directions) was issued by MoEF&CC vide their letter dated 18.09.2015. Compliance to these 10 directions is mentioned below.

| Sr. No. | Condition | Compliance Status |
|---|---|---|
| i | The proposal of extension of the validity of environmental clearance granted to the North Port vide letter dated 12.01.2009 will be considered separately at later stage. | Point Noted and agreed.<br><br>After receipt of this order, so far APSEZ has not done any application to MoEF&CC for the proposed North port. |
| ii | Bocha island, ecologically sensitive geomorphological features and areas in the island and creeks around the island will be declared as conservation zone action plan for its conservation must be prepared. M/s. APSEZ should provide necessary financial assistance for this purpose. | Complied<br><br>This reply covers condition no ii, iv and v.<br><br>Based on the MoEF&CC directions and finalization of ToR with GCZMA, APSEZ has entrusted NCSCM to carry out the detailed study. Scope of the study include the following:<br>• Detail bathymetry and topography survey of creeks<br>• Demarcation of mangrove areas and buffer zone<br>• Demarcation of HTL and CRZ areas with co-ordinates<br>• Preparation of a comprehensive and integrated conservation plan for protection of creeks and mangroves<br><br>Cost of the study as per the NCSCM proposal is 315.5 Lakh. 90% of the payment against the proposal value is already paid to NCSCM.<br><br>In order to complete the study, NCSCM has carried out number of site surveys which are mentioned below:<br>• Bathymetry survey of creeks<br>• Topography survey of intertidal areas<br>• Mangrove survey (health and area demarcation)<br>• Sampling of soil and water for analysis of physico-chemical and biological parameters<br>• Tide and currents data collection (including residence time of tidal water)<br>• Focus Group Discussions with the community in the close vicinity of the project area<br><br>In addition to the site surveys, NCSCM has |
| iv | A comprehensive and integrated study and protection of creeks/ mangrove area including buffer zone, mapping of co-ordinates, running length, HTL, CRZ boundary, will be put in place. The plan will take note of all the conditions of approvals granted to all the project proponents in this area e.g. the reported case of disappearance of mangroves near navinal creek. The preservation of entire area to maintain the fragile ecological condition will be a part of the plan in relation to the creeks, mangrove conservation and conservation of bocha island up to baradimata and others. | |
| v | NCSCM will prepare the plan in consultation with NIOT, PP and GCZMA. In recognition of the fact that the existing legal provisions under the E(P) Act 1986 do not provide for any authority to impose ERF by the government, the plan will be financed by the PP. the implementation will be carried out by GCZMA. The monitoring of the implementation will be carried by NCSCM. | |

| Sr. No. | Condition | Compliance Status |
|---|---|---|
| | | procured satellite images for analysis of mangrove cover.<br><br>The data collected (through site surveys and analysis of satellite maps) was used as input for mathematical modelling. The modelling studies were carried out to understand the impacts of the development activities. Based on the outcome of the modelling studies the necessary conservation plan for protection of creeks and mangrove areas is prepared.<br><br>Based on the final study report, outcome is summarized in to following points :<br>• There is no obstruction to any water stream (creeks / branches of creeks / rivers)<br>• Presently, mangrove cover in and around APSEZ is over 2340 ha. There is substantial growth in mangrove cover to the tune of 246 ha (comparison between 2011 and 2016-17)<br>• Mundra has undergone substantial development during this tenure. Hence it can be interpreted that the infrastructure development has not left any adverse impacts on ecology.<br><br>Now as directed, the study report is submitted to GCZMA (with a copy to MoEF&CC vide letter dated 04.06.2018) for their consideration and recommendation if any. Further request letter for necessary hearing has been submitted to GCZMA vide letter dated 4th Jan 2019. The approved action plan will be implemented by APSEZ under supervision of NCSCM. Compliance status of the implementation plan will be submitted to GCZMA on regular basis.<br><br>For demarcation of HTL and CRZ areas, NCSCM has prepared the draft CZMP maps (based on the MoEF&CC directions). The draft maps will be finalized by GCZMA and submitted to MoEF&CC for final acceptance. Once the maps are finalized, NCSCM will issue the final maps |

| Sr. No. | Condition | Compliance Status |
|---|---|---|
| | | for the project area of APSEZ. The said maps will then be submitted to GCZMA and MoEF&CC by APSEZ. |
| iii | The violations of specific condition of all the ECs and CRZ clearances, if any, will be examined and proceeded with the provisions of EP Act, 1986 independently. | Complied<br><br>Regional Officer, MoEF&CC, Bhopal visited APSEZ on 21-22 December'16 for monitoring the implementation of environmental safeguards. Last visit of APSEZ was done by Dr. HVC Chery Guntupally – Scientist, MoEF&CC Bhopal on 3rd May, 2018 for compliance verification. APSEZ provided all requisite information and documents required by the Regional Officer. During the said compliance verification visit, there was no major non-compliance observed.<br><br>It may also be noted that GPCB, Regional Office does regular site visit for various components. During the compliance period, one such site visit was carried out on 20.11.2018. During this visit as well, no major non-compliance was observed. |
| vi | There will be no development in the area restricted by the High court of Gujarat. APSEZ shall abide by the outcome of the PIL 12 of 2011 and other relevant cases. | Complied<br><br>Subject PIL has been disposed off by Hon'ble High Court vide their order dated 17.04.2015 and now there is no restriction on development in the subject area. The order reads as *"In view of the aforesaid discussion, we do not find any merit in this writ petition. This writ petition fails and is accordingly dismissed. No order as to cost."* Copy of the order was submitted along with last EC Compliance report for the period Apr'18 to Sep'18.<br><br>Considering the above status and in line to submission of compliance of all the directions under this order, this condition is closed. |
| vii | APSEZ will submit specific action plan to protect the livelihood of fishermen along with budget. | Complied.<br><br>Adani Foundation (AF) is the CSR arm of the Adani Group actively working for upliftment of the communities in the surroundings of various |

| Sr. No. | Condition | Compliance Status |
|---|---|---|
| | | project sites of Adani Group. AF has prepared a specific action plan to protect livelihood of fishermen at Mundra.<br><br>Various initiatives taken by Adani Foundation for protection of livelihood of the fisher folk community was submitted during compliance report submission for the period Oct'16 to Mar'17.<br><br>APSEZ is carrying out various initiatives specific to the Fisherfolk community which includes:<br>• Vidya Deep Yojana<br>• Vidya Sahay Yojana – Scholarship Support<br>• Adani Vidya Mandir<br>• Fisherman Approach in SEZ<br>• Machhimar Arogya Yojana<br>• Machhimar Kaushalya Vardhan Yojana<br>• Machhimar Sadhan Sahay Yojana<br>• Machhimar Awas Yojana<br>• Machhimar Shudhh Jal Yojana<br>• Sughad Yojana<br>• Machhimar Akshay kiran Yojana<br>• Machhimar Suraksha Yojana<br>• Machhimar Ajivika Uparjan Yojana<br>• Bandar Svachhata Yojana<br><br>These initiatives are discussed in detail in the report namely "Silent Transformation of Fisher folk at Mundra". Said report also includes the information related to the planned expenses to the tune of approx. 13.5 Cr. INR for various initiatives for the next five years (2016 – 2021). Copy of the same is already submitted to MoEF&CC vide our letter dated 10.09.2016. Further, details regarding the expenditure incurred against the commitment are attached as **Annexure – 11**.<br><br>Further, APSEZ is actively working with local community (including fishermen community) around the project area and provides required support for their livelihood and other concerns through the CSR arm – Adani Foundation. Brief information about activities in the main five |

<table>
<tr><th>Sr. No.</th><th>Condition</th><th>Compliance Status</th></tr>
<tr><td></td><td></td><td>
persuasions is mentioned below. Please refer Annexure – 4 for full details of CSR activities carried out by Adani Foundation in the Mundra region.
<table>
<tr><th>Area</th><th>Activity</th></tr>
<tr><td>Community Health</td><td>
<ul>
<li>The Adani Foundation runs two mobile health care units. Main objective of Mobile Van is to reduce travel time, hardships and expenses. Two mobile health care units cover 34 villages and 05 fishermen settlements. Around 109 types of general and lifesaving medicines are available in these units. Total patient was treated under this scheme during the year 2018-19: 19092 Nos. & 22256 Nos. through Rural Clinic</li>
<li>During the year 2018-19, total 10161 transactions were done by 8599 card holders of 66 villages of Mundra Taluka and they received cash less medical services under this project. The limit for the beneficiary was set to 30000/- within a period of 3 years.</li>
<li>Total 10161 OPDs were given medical treatment in various villages through rural dispensaries.</li>
<li>During this year, anthropometry study done for 6548 children. under "Suposhan" Project. Additionally, 965 FGD were conducted during this year.</li>
<li>During the year 2018-19, Specialty camps were organized and 4384 Patients were benefitted.</li>
</ul>
<table>
<tr><th>Project Details</th><th>Beneficiaries (Nos.)</th><th>Remarks</th></tr>
<tr><td>Mobile Van</td><td>19092</td><td>OPD Numbers</td></tr>
<tr><td>Rural Clinic</td><td>22256</td><td>OPD Numbers</td></tr>
<tr><td>Senior Citizen</td><td>10161</td><td>Transactions</td></tr>
<tr><td>Medical Camps</td><td>4384</td><td>Patients</td></tr>
<tr><td>Awareness Sessions</td><td>987</td><td>Participants</td></tr>
<tr><td>Needy Patients Support</td><td>1022</td><td>OPD/IPD</td></tr>
<tr><td>Shakti Raksha Project</td><td>624</td><td>Breast n cervix Cancer</td></tr>
<tr><td>Dialysis</td><td>5</td><td>Patients (2 times a week)</td></tr>
<tr><td>Suposhan</td><td>17025</td><td>Mundra and Bitta</td></tr>
</table>
</td></tr>
<tr><td>Sustainable Livelihood – Fisher folk</td><td>
<ul>
<li>Average 123 KL of water was supplied to 1086 households from different settlements on a daily basis under Machhimar Shudhh Jal Yojana.</li>
</ul>
</td></tr>
</table>
</td></tr>
</table>

| Sr. No. | Condition | Compliance Status | |
|---|---|---|---|
| | | | • Adani Foundation constructed four Balwadis for kids between the age group of 2.5 years to 5 years at different settlements under Vidya Deep Yojana.<br>• Participatory scholarship support for fisherman children studying in SMJ high school Luni and to above 12th standards Students. 80 percentage support given by Adani foundation and 20 percentage support by parents!<br>• RTG Crane Operator: **03 Fisherman Youth**<br>• Dori Work & Mud Work Training: **65 Women**<br>• Mangrove Plantation, moss cleaning, etc.: **6261 Man-days.**<br>• In addition to this, employment worth of **35787 man-days** has been provided till date. The Foundation has also supported Pagadiya fishermen as painting labours by providing them with employment and job in various fields.<br>• Total average **560 fishermen** were benefitted by Mobile Dispensary during last half year. Adani Foundation has extended financial assistance to more than **114 financially challenged patients** from the Fisher Folk Community in case of medical urgency during this year.<br>• The project for the senior citizens is popularly known as Vadil Swasthya Yojana and till date **350 senior citizens** from fisher folk community are enrolled in the scheme.<br><br>**<u>Fisherman Amenities work</u>**<br><br>391 Students : Education Support<br>134 Stunners : Adani Vidya Mandir<br>16 Fisherman : Alternate livelihood<br>78 Fisherwomen : Linkages for schemes<br>1312 Fisherman : Community Engagement<br>1086 Fisherman : Potable water provision<br>6261 Mandays : Mangroves Plantation<br>231 Fisherman : Capacity Building |
| | | Education | • Adani foundation adopted **17 government school** located at Mundra Taluka under the project **'UTTHAN'** a drive of quality education.<br>• To motivate children for schooling by providing the welcome kit / education kit and to create conducive children for " joyful learning" Environment for children for Learning during shala Praveshotsav Govt. has wide spread network of 111 Govt. primary schools in total **62 villages of Mundra Taluka, 3 villages of in Anjar taluka, YMC school, AVMB and two villages of Mandvi Taluka (118 Schools)** |

| Sr. No. | Condition | Compliance Status | |
|---|---|---|---|
| | | | every year on an average **2550 to 2700** children gets enrolled in 1st std in Taluka **For 2018-2019 total 2300 children** got enrolled & Adani foundation provided the "Enrollment kit" to all new enrollee in Taluka<br>• Total **3270 educational institutes** has visited Adani Port, Adani Power & Adani Wilmar and **236032 beneficiaries** of the project till date and **33932 beneficiaries** during current year.<br>• Along with quality education, the school also focuses on providing nutritious food, uniforms and other services to the children for free. Currently, **387 students**, from Std. 1 to Std. 10 are studying in the Adani Vidya Mandir. Out of these **134 children** come from the fisher folk community.<br>**Beneficiaries Details**<br>2598 Students : 17 Schools Utthan<br>2300 Enrollment Kit : 118 Schools<br>704 Students : Dignity of Workforce<br>345 Mothers : Mother's meet<br>5542 Students : 116 Institute Udaan<br>387 Students : Adani Vidya Mandir<br>206 Teachers : Guruvandana- I,II,III,IV |
| | | Rural Infrastructure | • Under Dignity of Drivers Project, Adani Foundation has constructed Resting Shed for Drivers entering in SEZ Premises. Total **50 beds** are constructed, drinking water and sanitation plus recreational – TV Facilities.<br>• Adani Foundation has constructed **45 Toilet block** and proper bathing place for labours.<br>• **Work Completed**<br>Road repairing various vasahat<br>Open shed at Juna Bandar<br>Sand Filling plot at JUNA BANDAR<br>Concrete Step ladder at Juna Bandar<br>House construction at Shekhadia<br>Two approach road 5000 meter Zarpara Fishermen and 5000 meter Luni Pagadiya<br>Drinking water storage tank 5000 ltr capacity bavdi Bandar -2, Juna Bandar -2, Kutdi Bandar -1<br>water pipe line installation at Wandi village 2000meter.<br>Basic amenities at Rampar Village Paver block 6000 LTR Storage tank and Boundary wall at community place.<br>Additional civil work in community hall<br>Open shed Gundiyali<br>Boundary wall in common place at Tragadi. |
| | | Skill | • Soft skill training – 362 Nos. |

| Sr. No. | Condition | Compliance Status |
|---|---|---|
| | | Development • Technical Training – 1457 Nos.<br>Budget for CSR Activity for the FY 2018-19 is to the tune of INR 1697 lakh. Out of which, Approx. INR 1624 lakh are spent during the year. |
| viii | APSEZ will voluntarily return the grazing land, if any, in their possession. | Point noted.<br><br>All lands are acquired through proper procedure prescribed by State Government. However APSEZ has voluntarily given 400 acres of land back to Zarpara village for the purpose of Gauchar. |
| Ix<br><br><br><br>x. | A regional strategic impact assessment report with a special focus on Mundra region will also be prepared. The cost towards these studies will also be borne by PP.<br><br>In the subject matter of thermal power plant, the proposed regional strategic Impact assessment analysis will take In to account salinity aspect along with Its potential environmental Impact to suggest future corrective actions as well as the guiding tool on extension and addition of the capacities. | Complied<br><br>This reply covers direction no ix and x.<br><br>Based on the ToR finalized by GCZMA (as per the instructions of MoEF&CC) for carrying out regional impact assessment study, APSEZ awarded the work to NABET accredited consultant M/s. Cholamandalam MS Risk Services Ltd. to carry out the studies as stated in these directions. Total cost of the study is approx. INR 1.3 cr. which is financed by APSEZ.<br><br>The stated study was carried out in following 3 phases<br>• Baseline data collection and review of the past EIA reports and clearances issued to APSEZ.<br>• Mathematical modelling and other technical studies for identification of potential impacts (for the year 2030) of the approved and existing project activities.<br>• Development of macro level EMP for the phase wise implementation of actionable points.<br><br>As part of the study, following modelling exercises / technical studies have been carried out to study the impacts on all environmental attributes:<br>• Ambient air quality<br>• Marine (Hydrodynamic, Thermal & Salinity |

| Sr. No. | Condition | Compliance Status |
|---|---|---|
| | | dispersion, Sediment transport)<br>• Noise level<br>• Traffic assessment<br>• Oil spill contingency plan<br>• Water resource and salinity ingress<br>• Land Use / Land Cover<br>• Socioeconomic, Regional infrastructure<br>• Waste management<br>• Ecology, Bio diversity and Fisheries<br>• Shoreline change assessment<br><br>Preparation of these reports require extensive use of modeling software and study of the available information / research reports to assess the impacts on individual attribute of environment. Based on the modeling outcomes and findings of the technical studies, a macro level environment management plan is prepared.<br><br>The study is recently concluded and the final report is submitted to GCZMA and MoEF&CC for their consideration vide our letter dated 30.04.2018. Details of the same were submitted along with last half yearly EC Compliance report for the period Apr'18 to Sep'18. Further request letter for necessary hearing has been submitted to GCZMA vide letter dated 4th Jan 2019. The recommendations mentioned in the EMP which are applicable to APSEZ will be implemented in phase wise manner as per the progress of development. |

# ANNEXURE – 1

**Details of Litigation:**

**Case No**: CA 9124 of 2011

**Case Name**: Kheti Vikas Seva Trust Vs UoI & Others

**Name of the Court**: Gujarat High Court

**Orders/directions of the Court, if any and its relevance with the proposed project:**

- The writ petition has been dismissed by the Gujarat High Court on 17th April 2015.
- The Hon'ble Supreme Court of India on 18.3.2016 dismissed the appeal against the said order dated 17th April, 2015 of the Gujarat High Court.
- However, an application filed by the petitioner alleging non-compliance of an order of the Gujarat HC dated 12th July 2011 prohibiting the cutting of mangroves and other forests during the pendency of the petition without permission of the state forest and environment department in relation to the writ petition is still pending

**Case No**: SLP 28788 of 2016

**Case Name**: Pravinsinh Bhurabhai Chauhan Vs State of Gujarat & Others

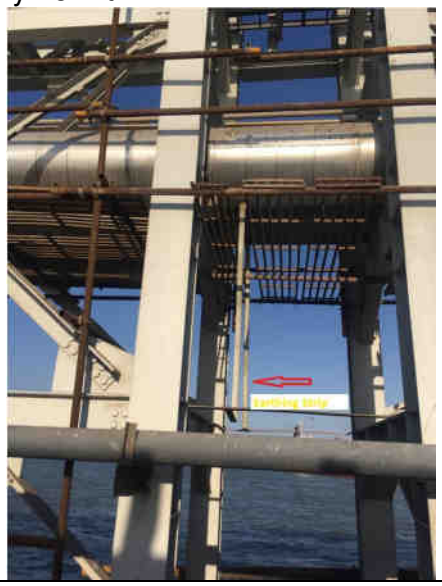
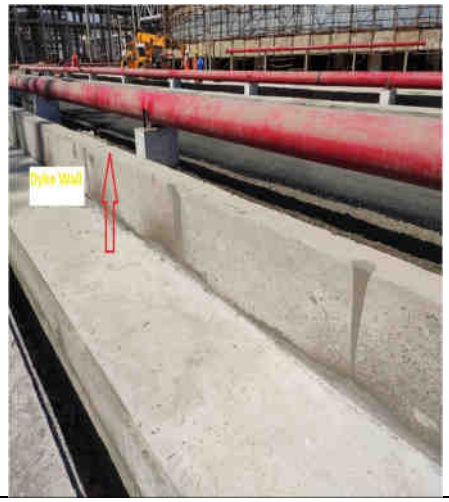
**Name of the Court**: Supreme Court

**Orders/directions of the Court, if any and its relevance with the proposed project:**

- In view of the affidavits filed by MOEF, and Govt of Gujarat the High Court dismissed the petition on 18.2.2015.
- The petitioner filed a special leave to appeal before the Supreme Court of India, challenging the order dated 18.2.2015 of Gujarat High Court and the same is pending.
- Sunita Narayan committee was appointed to study the area. Report was prepared by committee and submitted to Hon'ble Supreme Court.
- Matter pending at Supreme court

# ANNEXURE – 2

## Compliance Report of Quantitative Risk Assessment Recommendatios

| Sr. No. | Recommendations | Compliance Status |
|---|---|---|
| 1 | Selection of the loading arms and commissioning checks to ensure proper operation of the PERC in the event of ESD actuation (maximum time shall not exceed more than 2 min for complete isolation, loading arm release and ship pumps stop in case of hydrocarbon leak) | Available, Yet to be Commissioned. |
| 2 | All flanges shall be connected for bonding for electrical continuity. | Earthing of piping /Flanges has been done at every 25 Mtr.  |
| 3 | Kerb wall height shall be minimum 30 cm but shall not exceed 60 cm. | Dyke wall constructed conformity with OISD norms  |
| 4 | Leak detection systems based on | Available, But yet to be commissioned. |

| | | |
|---|---|---|
| | pressure, temperature and flow | |
| 5 | A suitable continuous back-up power supply shall be provided for the control system and operation of ROVs both at jetty end and tank end | 2MVA capacity of Emergency Diesel Generator installed fulfilling with electrical rules   |
| 6 | Consider HAZOP and SIL study before commissioning the facility and concerns addressed | HAZOP and SIL study has already been done and project is ready for commissioning  |
| 7 | Ensure CCTV coverage of critical locations and remote monitoring is done continuously | 56 Nos. CCTV camera installation has been planned to install and be covered all locations inside the plant. |

# ANNEXURE – 3

# Details of Greenbelt development at APSEZ, Mundra

| LOCATION | Total Green Zone Detail Till Up to March - 2019 | | | | |
|---|---|---|---|---|---|
| | Area (In Ha.) | Trees (Nos.) | Palm (Nos.) | Shrubs (SQM) | Lawn (SQM) |
| SV COLONY | 69.53 | 32480.00 | 7298.00 | 68327.00 | 95019.00 |
| PORT & NON SEZ | 79.87 | 139992.00 | 19205.00 | 74210.78 | 61295.18 |
| SEZ | 114.72 | 227835.00 | 17302.00 | 220583.60 | 28162.03 |
| MITAP | 2.48 | 8168.00 | 33.00 | 3340.00 | 4036.00 |
| WEST PORT | 86.04 | 186827.00 | 51342.00 | 24112.00 | 22854.15 |
| AGRI PARK | 8.94 | 17244.00 | 1332.00 | 5400.00 | 2121.44 |
| SOUTH PORT | 14.25 | 25530.00 | 3470.00 | 3882.00 | 3327.26 |
| Samundra Township | 55.63 | 52481.00 | 11818.00 | 20078.07 | 46571.67 |
| Productive Farming (Vadala Farm) | 23.79 | 27976.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL (APSEZL)** | **455.23** | **718533.00** | **111800.00** | **419933.45** | **263386.73** |

# Details of Mangrove Afforstation done by APSEZ

| Sl. no. | Location | Area (ha) | Duration | Species | Implementation agency |
|---|---|---|---|---|---|
| 1 | Mundra Port | 24.0 | - | Avicennia marina | Dr. Maity, Mangrove consultant of India |
| 2 | Mundra Port | 25.0 | - | Avicennia marina | Dr. Maity, Mangrove consultant of India |
| 3 | Luni/Hamirmora (Mundra, Kutch) | 160.8 | 2007 - 2015 | Avicennia marina, Rhizophora mucronata, Ceriops tagal | GUIDE, Bhuj |
| 4 | Kukadsar (Mundra, Kutch) | 66.5 | 2012 - 2014 | Avicennia marina | GUIDE, Bhuj |
| 5 | Forest Area (Mundra) | 298.0 | 2011 - 2013 | Avicennia marina | - |
| 6 | Jangi Village (Bhachau, Kutch) | 50.0 | 2012 - 2014 | Avicennia marina | GUIDE, Bhuj |
| 7 | Jakhau Village (Abdasa, Kutch) | 310.6 | 2007-08 & 2011-13 | Avicennia marina, Rhizophora mucronata, Ceriops tagal | GUIDE, Bhuj |
| 8 | Sat Saida Bet (Kutch) | 255.0 | 2014-15 & 2016-17 | Avicennia marina & Bio diversity | GUIDE, Bhuj |
| 9 | Dandi Village (Navsari) | 800.0 | 2006 - 2011 | Avicennia marina, Rhizophora mucronata, Ceriops tagal | SAVE, Ahmedabad |
| 10 | Talaza Village (Bhavnagar) | 50.0 | 2011-12 | Avicennia marina | SAVE, Ahmedabad |
| 11 | Narmada Village (Bhavnagar) | 250.0 | 2014 - 2015 | Avicennia marina | SAVE, Ahmedabad |
| 12 | Malpur Village (Bharuch) | 200.0 | 2012-14 | Avicennia marina | SAVE, Ahmedabad |
| 13 | Kantiyajal Village (Bharuch) | 50.0 | 2014-15 | Avicennia marina | SAVE, Ahmedabad |
| 14 | Devla Village (Bharuch) | 150.0 | 210-16 | Avicennia marina | SAVE, Ahmedabad |
| 15 | Village Tala Talav (Khambhat, Anand) | 100.0 | 2015 - 2016 | Avicennia marina | SAVE, Ahmedabad |
| 16 | Village Tala Talav (Khambhat, Anand) | 38.0 | 2015 - 2016 | Avicennia marina | GEC, Gandhinagar |
| 17 | Aliya Bet, Village Katpor (Hansot, Bharuch) | 62.0 | 2017-18 | Avicennia marina & Rhizophora spp. | GEC, Gandhinagar |
| **Total Mangrove Plantation:** | | **2889.90 Ha** | | | |

# ANNEXURE – 4

# Adani Foundation, Mundra

adani Foundation

# ANNUAL REPORT 2018-19

For a better tomorrow

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

# Our Journey

The year 2018-19 has passed off with passion and courage to work for the commitment given to the community. It is essential that sustained growth is achieved at rural level along with the industrial development. This can be made possible by involving more and more people in the rural development programme.

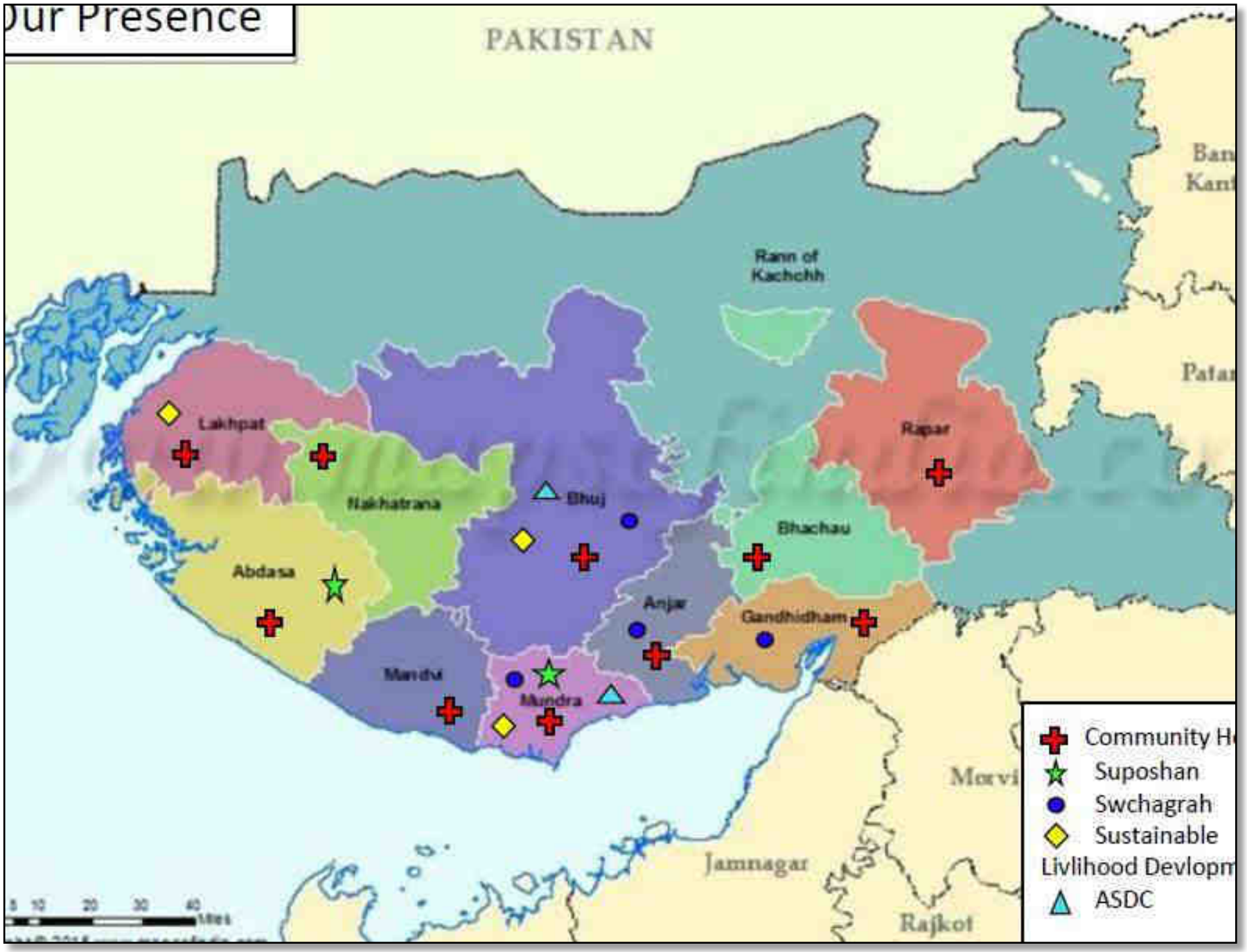
Since 1996, The Adani Foundation Mundra is committed to the cause of the deprived and underprivileged. It has been working relentlessly across 6 Talukas, covering 81 villages, to uplift the lives of more than 42,000 families with a multi-faceted approach.

This year conceded with more streamline projects of Education i.e. Utthan – to enhance primary education of 17 schools of Mundra, milestone achievement in malnourishment project, Launched Swachhagraha in four talukas and 400 schools of Kutchh, considerable impact created by fisherman amenities projects and new era defined in agriculture projects i.e. tissue culture and fodder sustainability .

The people of Kutch, especially that of Mundra, have generously supported the activities carried out by the Adani Group or else this wouldn't have been possible. Their determination, understanding and commitment have strengthened the development even more.

Thanks to Mr. Rakshit Shah and Mr. Avinash Rai for being mentor of the team Always !

Our Achievement would not be possible without the ultimate support by Mr. P N Roy Chaudhry, Executive Director - AF and plentiful faith and passionate support by Dr. (Mrs.) Priti G Adani, Chairperson– Adani Foundation


Our Presence
PAKISTAN
Rann of Kachchh
Lakhpat
Nakhatrana
Bhuj
Abdasa
Anjar
Bhachau
Rapar
Gandhidham
Mandvi
Mundra
Jamnagar
Rajkot
Community H
Suposhan
Swchagrah
Sustainable
Livlihood Devlopm
ASDC

# INDEX

# Education

## Beneficiaries Detail

- 2598 Students : 17 Schools Utthan
- 2300 Enrollment Kit : 118 Schools
- 704 Students : Dignity of Workforce
- 345 Mothers : Mother's meet
- 5542 Students : 116 Institute Udaan
- 387 Students : Adani Vidya Mandir
- 206 Teachers : Guruvandana- I,II,III,IV

# Project Utthan

**Project Utthan :** Adani foundation has been promoting various educational and human initiatives in education, community health, sustainable livelihood and Rural Infrastructure.

In this context with an aim to enhance the quality of primary education in Kutch district, Adani foundation adopted 17 government school located at Mundra Taluka under the project 'UTTHAN' a drive of quality education.

Adani foundation is expected to achieve visible and measurable important in scholastic area.

Adani foundation will be focusing to bring the positive evidences of change in the personal, behavior and academic development of the students.

# Kick Start of "Utthan"

School improvement and teachers development is a multilayered approach. Therefore, school reform and initiative need to be carefully planned and executed by involving all stakeholders. In the process of implementing school improvement programme, teachers play critical role in institutionalizing change initiative.

A number of activities have been taken into account bring about change and enhance quality education in schools by Government, NGO and CSR,

From Year 2018 – Government of Gujrat has given responsibility through memorandum of understanding of 17 Schools for academic and overall development of school under Project "Uthhan" to Adani Foundation. Many workshops and training programmes are organized to improve the quality of education and support government schools.

In Utthan, main focus on upbringing of students (Priya Vidhyarthi) to the minimum level of reading, writing and counting (Vachan, Lekhan and Ganan). For making this mission successful, para teacher is appointed for each school.

Apart from this, English is introduced from standard first to create strong base. Also distributed science kit, sports kit, music kit to all 17 schools along with library cupboard and 100 books.

Smart class is given to all 17 schools with proper training to teachers for optimum utilization.

## Objective of "Utthan"

- To improve basic knowledge of Math, Languages, English and Computer among students of Govt. schools.
- To Raise Minimum Level of weak students

## Output of "Utthan"

- Increase enrolment ratio of students to 100%
- 100% regular present of students in school
- To improve their arithmetic, reading capacity in various languages, English etc.
- To increase confidence level of students
- Involvement of local community, village leaders and local Govt. through various activities

## Outcome of "Utthan"

- Students of class 1th to 7th in government schools will take interest in activity based learning.
- Community and teachers will be positive and satisfy from this education project.
- Increase interest of students in school, they develop knowledge and understand importance of library.
- Education friendly environment development in school as well as in community.

## Expected impact of "Utthan"

- Vachan, Ganan and Lekhan strengthening in Priya students
- Education department of Gujarat government will include activity based learning in regular course curriculum.

## Implementation Partners of "Utthan"

DPEO/TEPO/BRC will provide guidance for implementation and experts will visit on an interval of 6 months to evaluate the project.

## Proposed Activities "Utthan"

- Training of Government School Staff
- Reading, Writing and Maths improvement as per Gunotsav Data
- Development of Teaching Learning Material
- English Language
- Role Model Activity in assembly
- Reading Corner Activities
- Monitoring and Evaluation

# Shala Praveshotsav

To motivate children for schooling by providing the welcome kit / education kit and to create conducive children for " joyful learning" Environment for children for Learning during shala Praveshotsav Govt. has wide spread network of 111 Govt. primary schools in total 62 villages of Mundra Taluka, 3 villages of in Anjar taluka, YMC school, AVMB and two villages of Mandvi Taluka (118 Schools) every year on an average 2550 to 2700 children gets enrolled in 1st std in Taluka For 2018-2019 total 2300 children got enrolled & Adani foundation provided the "Enrollment kit" to all new enrollee in Taluka

# Mother's Meet

To motivate parents to maintain regularity of school, health hygiene and cleanliness we scheduled 3 mothers meet per week, which is really beneficial for student's overall growth. We arrange quiz completion for mother's to update their general knowledge.

udaan
get inspired

| Summary of year 2018-19 for Project "UDAAN" | | | | | | |
|---|---|---|---|---|---|---|
| NO. | MONTH | SCHOOL/ COLLEGE | BOYS | GIRLS | TEACHERS | TOTAL |
| 1 | Apr -18 | 27 | 1381 | 515 | 108 | 2004 |
| 2 | May -18 | 31 | 1107 | 827 | 105 | 2039 |
| 3 | June - 18 | 30 | 1333 | 579 | 107 | 2019 |
| 4 | July - 18 | 29 | 1280 | 727 | 116 | 2123 |
| 5 | Aug -18 | 29 | 1256 | 770 | 109 | 2135 |
| 6 | Sep - 18 | 28 | 1317 | 606 | 107 | 2030 |
| 7 | Oct -18 | 29 | 1318 | 682 | 107 | 2107 |
| 8 | Nov - 18 | 26 | 1045 | 575 | 87 | 1707 |
| 9 | Dec - 18 | 33 | 1052 | 928 | 110 | 2090 |
| 10 | Jan - 19 | 31 | 1250 | 763 | 113 | 2126 |
| 11 | Feb - 19 | 31 | 1196 | 577 | 96 | 1869 |
| 12 | Mar - 19 | 31 | 1274 | 585 | 104 | 1963 |
| Total | | 355 | 14809 | 8134 | 1269 | 24212 |
| | Local 2018-19 | 201 | 5543 | 3710 | 467 | 9720 |
| | | | | | Total | 33932 |

## Project UDAAN

Mundra has created a position for itself by creating capacities in Port Handling, Edible Oil Refining and Power Generation. With a vision to familiarize, educate and inspire the future generation to become successful business leader, engineers, managers and other professionals, the Adani Foundation organizes Education Exposure visits to Mundra for High schools and educational institutes in Various parts of Gujrat.

Total 3270 educational institutes has visited and 236032 beneficiaries of the project till date and 33932 beneficiaries during current year.

# Adani Vidya Mandir, Bhadreshwar

| Class | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|---|---|---|---|
| 1st | 53 | 40 | 45 | 41 | 38 | 40 | 40 |
| 2nd | 26 | 68 | 46 | 41 | 39 | 37 | 37 |
| 3rd | 27 | 40 | 73 | 45 | 37 | 39 | 39 |
| 4th | | 39 | 48 | 70 | 44 | 36 | 36 |
| 5th | | | 37 | 46 | 58 | 39 | 39 |
| 6th | | | 37 | 36 | 46 | 58 | 58 |
| 7th | | | 34 | 37 | 35 | 44 | 44 |
| 8th | | | 39 | 34 | 36 | 34 | 34 |
| 9th | | | | 38 | 38 | 30 | 30 |
| 10th | | | | | 23 | 27 | 30 |
| Total | 106 | 187 | 359 | 387 | 394 | 384 | 387 |

In Bhadreshwar, Mundra, the Adani Vidyamandir has completely revolutionized the education scenario. Only the children of families with an income of less than 1.5 lakh are admitted to this school. Along with quality education, the school also focuses on providing nutritious food, uniforms and other services to the children for free. Currently, 387 students, from Std. 1 to Std. 10 are studying in the school. Out of these 134 children come from the fisher folk community. Many students are the first generation in their families to attend school.


## AVMB Std.-10 Second Batch Result 2018-19

Adani Vidya Mandir Bhadreshwar achievement in Gujrat Board Standard 10th Examination Result 92% (25 students have passed the examination out of 27). Adani Foundation will take all responsibility of further study of students with respect to their interest.

| AVMB STD - 10 SECOND BATCH RESULT | | |
|---|---|---|
| Year 2017-2018 | | |
| SR NO | GRADE | STUDENTS |
| 1 | Above 80 % | 1 |
| 2 | Above 70 % | 3 |
| 3 | Above 60 % | 5 |
| 4 | Above 50 % | 9 |
| 5 | Above 40 % | 7 |
| 6 | Fail | 2 |
| | TOTAL | 27 |

# ENVIRONMENT SUSTANABILITY

The Environment Impact Assessment (EIA) Notification, 2006, issued under the Environment (Protection) Act, 1986, as amended from time to time, prescribes the process for granting prior environment clearance (EC) in respect of cevoain development projects/activities listed out in the Schedule to the Notification.

Sustainable development has many important facets/components like social, economic, environmental, etc. these components are closely interrelated and mutually re-enforcing. Under Corporate Environmental responsibility 10 km radious villages from SEZ Boundaries.

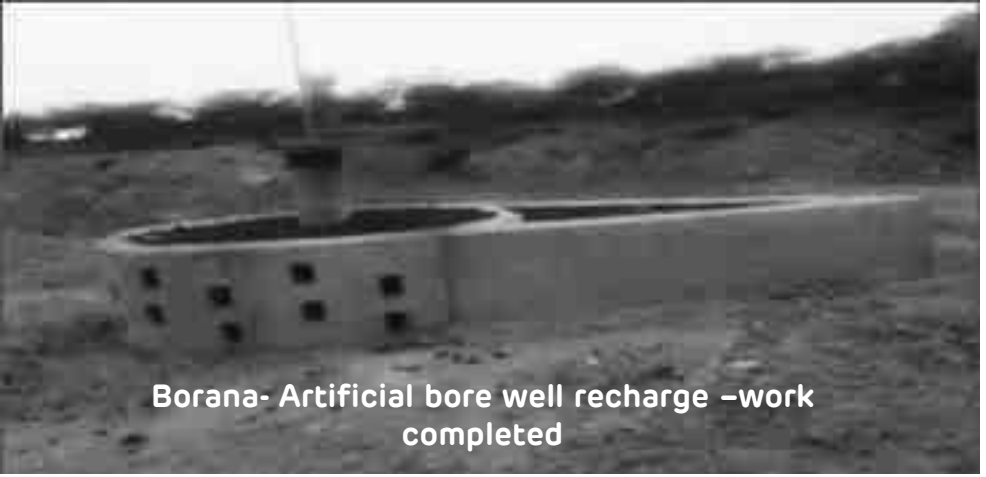
To make connections between human actions and the level of biological diversity found within a habitat and/or ecosystem, this year we launch project "Sanrakshan" in coordination with GUIDE. MOU has been signed with Dr. Thivakaran – GUIDE for conservation of five spices of mangroves.

# SUJLAM SUFLAM JAL ABHIYAN

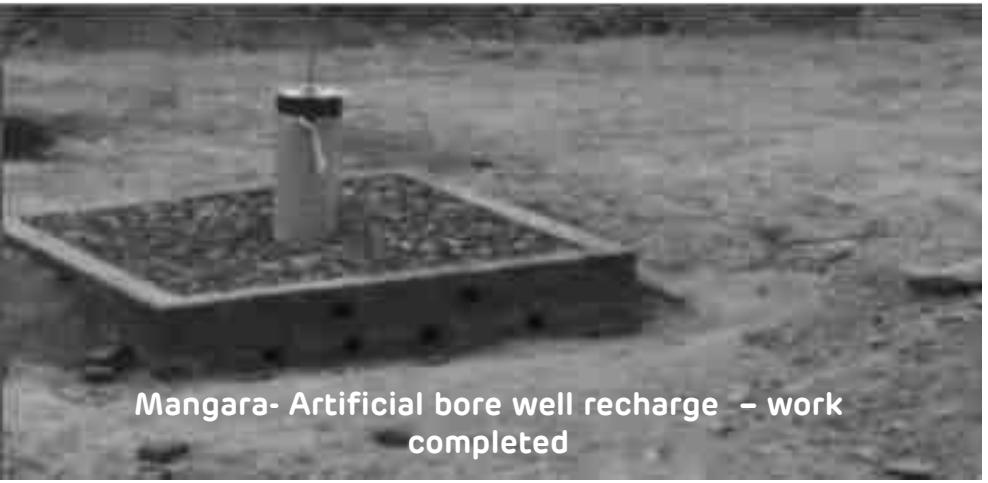
The state government announced its 31-day water conservation drive called 'Sujlam Suflam Jal Abhiyan'. The campaign was launched on "Gujarat Gaurav Din" on May 1, which is the foundation day of Gujarat state. Moreover, the government aims to revive 32 rivers in the state and also to create storage capacity in existing village pond.

Inauguration by GOG Hon'ble Minister, MLA and DM Kutch and other guest day on 1st may at Gundala village taluka Mundra by Adani foundation, Mundra

During 1st may to 31st may AF Mundra had completed deepening work in 26 pond works as per given target by District Collector Kutch in 19 villages . Total excavation done 51723 Cum. Total storage capacity created 51.72 million liters. These works done as per government guidelines.



Borana- Artificial bore well recharge –work completed



Mangara- Artificial bore well recharge – work completed

Dhrub- pond deepening work – work completed

# PARTICIPATORY GROUND WATER MANAGEMENT

At the turn of millennium, the state watched with growing alarm the steady depletion of its ground water and launched massive drive to achieve water security in Mundra region. As a part of pre monsoon activities with ACT (Arid Communities and Technologies – NGO) we have carried out following work. But, due to negligible rainfall we are not able to find out outcome of this project.

# PROJECT "SANRAKSHAN" - BIODIVERSITY

The mangrove biodiversity enrichment project in and around Adani ports special economic zone limited (APSEZL) aims to introduce select true mangrove species on a pilot scale in suitable coastal belts and assess their survival. Because this project is the first of its kind, the expected survival rate is between 20-30%.

The project is currently in its initial stages of establishing nurseries and sowing seeds of several different species brought in from multiple locations in and outside of Gujarat state. These nurseries have been developed in tidal flats near the village of Luni, Kutchh, Gujarat.

The mangrove seeds/propagules) for the establishment of the nursery were brought in from various locations in India, namely, Machilipatnam (Andhra Pradesh), Pondicherry (Tamil Nadu), Parangipettai (Pichavaram Mangroves, Tamil Nadu), Kandla (Gujarat) and Jamnagar (Gujarat).

In most of these locations, there is adequate fresh water supply available due to high/substantial rainfall and/or presence of major rivers (also important river confluences and deltas that give rise to a thriving estuarine environment). Consequently, the mangrove species that successfully grow in those regions are adapted to a low-salinity environment (where salinity is approximately 20 ppt) against that of 37-44 ppt prevailing in Kutchh coastal waters. Furthermore, the species selected to establish the biodiversity enrichment project also belong to this group of mangrove species. This subsequently creates a challenge for the team heading this project because the Kachchh region does not provide adequate salinity ranges for survival of most of these species. In fact, it provides an extremely harsh saline environment (salinity can range up to as high as 44 ppt during summer).

Considering the above-mentioned scenario, the site selection criteria, need for species of high salinity tolerance and studying their natural occurrence in Kutchh becomes critical in ensuring a substantial survival rate of the mangrove species selected to potentially successfully establish a diverse and resilient mangrove community in the Kutchh region.

Furthermore, a highly diverse set of mangrove species will ensure resilience in the face of changing climate and could probably provide as a thriving gene pool and seed bank in the future for the Kutchh region.

## Table 1: NURSERY STATUS AS OF SEPTEMBER 2018

| Sr. No. | SPECIES | LOCATION (FROM) | SITE | DATE OF ARRIVAL IN BHUJ | DATE OF SOWING | NO. OF SEED-BAGS ESTABLISHED | NO. OF SEEDS IN EACH BAG | TOTAL NO. OF SEEDS SOWN | APPROX. SURVIVAL RATE TILL DATE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | *Aegiceros corniculatum* | Parangipettai | | Sept 21 | Sept 25 | 2000 | 2 | 4000 | |
| | | Kandla | | | | | | | |
| 2 | *Excoecaria agallocha* | Pondicherry | | Sept 22 | Sept 26 | 4000 | 10 | 40000 | |
| 3 | *Rhizophora apiculata* | Machilipatnam | | Sept 22 | Sept 26 | 4000 | 1 | 4000 | |
| 4 | *Ceriops decantra* | Parangipettai | | Sept 21 | Sept 25 | | | | |
| | | Machilipatnam | | Sept 22 | Sept 26 | | | | |
| 5 | *Bruguiera gymnorhiza* | | | | | | | | |
| 6 | *Xylocarpus moluccensis* | Machilipatnam | | Sept 22 | Sept 26 | 1360 | 1 | 1360 | |
| 7 | *Bruguiera cylindrica* | Machilipatnam | | Sept 22 | Sept 26 | 1500 | 1 | 1500 | |
| 8 | *Ceriops tagal* | Jamnagar | | Sept 15 | | | | | |

# Community Health Mundra

| Project Details | Beneficiaries (Nos.) | Remarks |
|---|---|---|
| Mobile Van | 19092 | OPD Numbers |
| Rural Clinic | 22256 | OPD Numbers |
| Senior Citizen | 10161 | Transactions |
| Medical Camps | 4384 | Patients |
| Awareness Sessions | 987 | Participants |
| Needy Patients Support | 1022 | OPD/IPD |
| Shakti Raksha Project | 624 | Breast n cervix Cancer |
| Dialysis | 5 | Patients (2 times a week) |
| Suposhan | 17025 | Mundra and Bitta |

Total beneficiaries : 75556

## Healthy mind remain in  healthy body which create healthy community to make healthy Nation.

Adani Foundation relentlessly working  for community in health core area through various kind of activities i.e. Mobile Dispensaries, Rural Clinics, Special Innovative Projects - Health Card to Senior Citizens, “SuPoshan”- Fighting to Mal nourishment in Mundra  and support to dialysis patients projects. Adani Foundation also organizes special medical camps during disease outbreak.

# Mobile Dispensaries & Rural Clinics


The population of Mundra block is spread over various villages. Due to inadequate transportation facilities, the villagers have to face many hardships even for reaching to the doctor in case of common diseases.
The medical expenses and zero earning per day add surplus to their hardships.
To help them in the above mentioned health related problems, the service of mobile medical van has been started by the Adani Foundation in Mundra block. In big villages, rural dispensaries have been started considering their population and area.
The Adani Foundation runs mobile health care units. Main objective of Mobile Van is to reduce travel time, hardships and expenses. Mobile health care units cover 34 villages and 05 fishermen settlements. Around 109 types of general and life saving medicines are available in these units. It has turned out to be a boon for women and children as the service is availed at their door - step.

| Month | Mobile Van | Rural Clinic |
|---|---|---|
| Apr-18 | 1508 | 1466 |
| May-18 | 1397 | 1491 |
| Jun-18 | 1236 | 1533 |
| Jul-18 | 1523 | 2166 |
| Aug-18 | 1512 | 2103 |
| Sep-18 | 1796 | 1726 |
| Oct-18 | 1832 | 2068 |
| Nov-18 | 1386 | 1628 |
| Dec-18 | 1897 | 2187 |
| Jan-19 | 1684 | 2013 |
| Feb-19 | 1743 | 2037 |
| Mar-19 | 1578 | 1821 |
| Total | 19092 | 22256 |

# Mobile Dispensaries & Rural Clinics

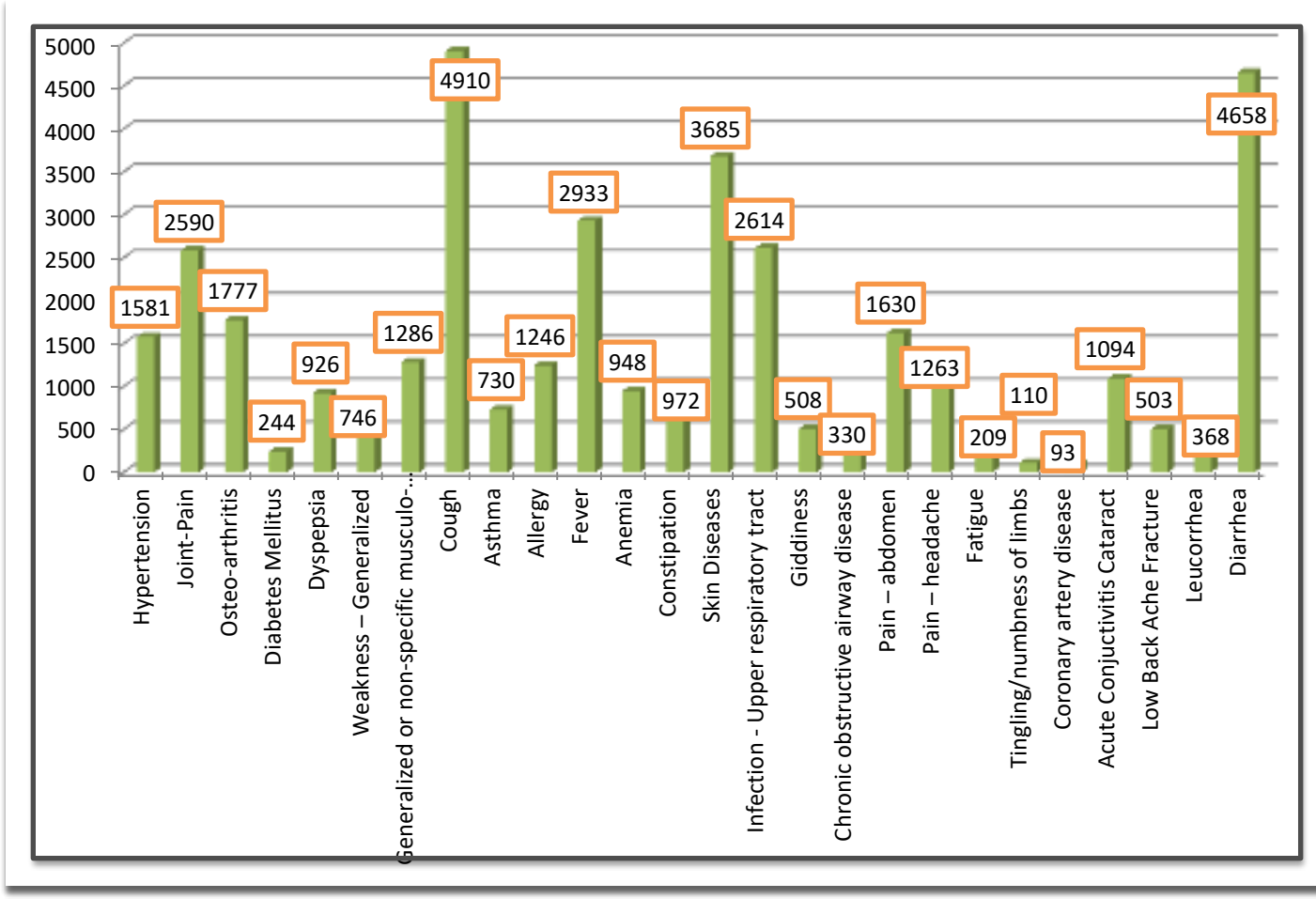

The Adani Foundation operates Rural Dispensaries in 08 villages of Mundra block, 03 villages of Anjar block and 01 village of Mandvi block along with one at Rangoli gate. At these dispensaries, health services are provided free of charge for two hours daily by a doctor and a volunteer.

| Sr.No | Villages Name | Total |
|---|---|---|
| 1 | Rangoli Gate | 510 |
| 2 | Luni | 6,203 |
| 3 | Wandh | 1,272 |
| 4 | Siracha | 3,794 |
| 5 | Vadala | 1,513 |
| 6 | Bhadreshwar | 1,411 |
| 7 | Tuna | 743 |
| 8 | Vandi | 1,443 |
| 9 | Rampar | 519 |
| 10 | Tunda | 831 |
| 11 | Tragadi | 893 |
| 12 | Navinal | 1,732 |
| 13 | Labour Colony | 53 |
| Total | | 22,256 |

# Mobile Dispensaries & Rural Clinics

| Diagnosis | MV | RC | Total |
|---|---|---|---|
| Hypertension | 664 | 917 | 1581 |
| Joint-Pain | 978 | 1612 | 2590 |
| Osteo-arthritis | 979 | 798 | 1777 |
| Diabetes Mellitus | 72 | 172 | 244 |
| Dyspepsia | 699 | 227 | 926 |
| Weakness – Generalized | 164 | 582 | 746 |
| Generalized or non-specific musculo-skeletal pain | 430 | 856 | 1286 |
| Cough | 2478 | 2432 | 4910 |
| Asthma | 292 | 438 | 730 |
| Allergy | 266 | 980 | 1246 |
| Fever | 1404 | 1529 | 2933 |
| Anemia | 525 | 423 | 948 |
| Constipation | 406 | 566 | 972 |
| Skin Diseases | 1980 | 1705 | 3685 |
| Infection - Upper respiratory tract | 899 | 1715 | 2614 |
| Giddiness | 220 | 288 | 508 |
| Chronic obstructive airway disease | 36 | 294 | 330 |
| Pain – abdomen | 703 | 927 | 1630 |
| Pain – headache | 589 | 674 | 1263 |
| Fatigue | 93 | 116 | 209 |
| Tingling/numbness of limbs | 25 | 85 | 110 |
| Coronary artery disease | 16 | 77 | 93 |
| Acute Conjuctivitis Cataract | 831 | 263 | 1094 |
| Low Back Ache Fracture | 333 | 170 | 503 |
| Leucorrhea | 298 | 70 | 368 |
| Diarrhea | 2134 | 2524 | 4658 |
| **Total** | **17514** | **20440** | **37954** |

MV & RC Disease specific pattern reported in the month April-18 to March-19



# Health Cards to Senior Citizens

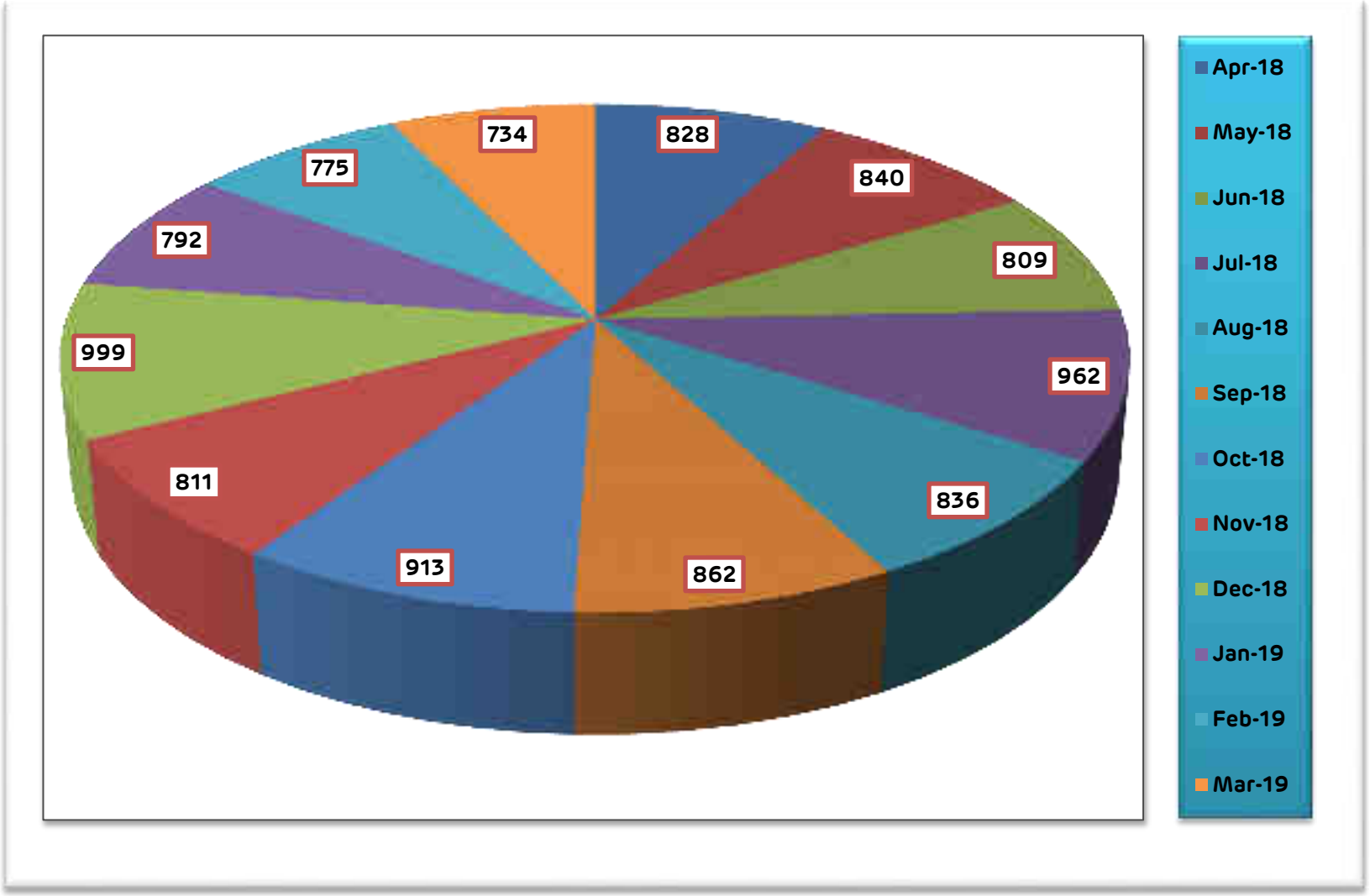
The major junctures of human life are - childhood, adulthood and old age. The first phase is well looked after by the parents and second phase is of self-reliant but the last phase is a dependent one. The needs of old people are less looked after. When people become old, they start living a life of aloofness and solitude. Therefore, the Adani Foundation has started the Adani Health Programme for the aged to look after their health. To address the health care issues related to ageing, AF launched a 3 year long pilot project – 'Adani Vadil Swasthya Yojna' on 20th February 2011 at Mundra and further extended the same for the next three years i.e. up to 2017. Under this Programme, the individuals aged 60 years and above are benefitted. Health Cards are issued to them with the purpose of providing adequate and timely treatment. The families consisting of aged ones with a yearly income of Rs. 2 lacs or more get a Blue Card. The Blue Card holders can avail diagnosis facility and treatment at a subsidized rate in the Adani hospitals, Mundra. The families with a yearly income of less than Rs. 2 lacs are issued a Green Card. Green Card holder aged people get treatment for illness in Adani hospitals, Mundra with an aid up to the limit of Rs. 50,000/- within a period of 3 years.

**During the year 2018-19, total 10161 transactions were done by 8599 card holders of 66 villages of Mundra Taluka.** They received cash less medical services under this project

Scheme is continue since eight years The third phase of this scheme was started in last year. The limit for the beneficiary was set to 30000/- within a period of 3 years. the senior citizens get emergency medical care at Adani Hospital, Mundra and they are referred to GAIMS

# Sr.Citizen card utilization status April-18 to March-19

| Month | OPD/IPD |
|---|---|
| Apr-18 | 828 |
| May-18 | 840 |
| Jun-18 | 809 |
| Jul-18 | 962 |
| Aug-18 | 836 |
| Sep-18 | 862 |
| Oct-18 | 913 |
| Nov-18 | 811 |
| Dec-18 | 999 |
| Jan-19 | 792 |
| Feb-19 | 775 |
| Mar-19 | 734 |
| **Total** | **10161** |



# Suposhan

Suposhan Project endeavors to address the issue of vicious cycle of Malnutrition and Anemia with a life cycle approach that includes community based management. The project is more focused on preventive measures.

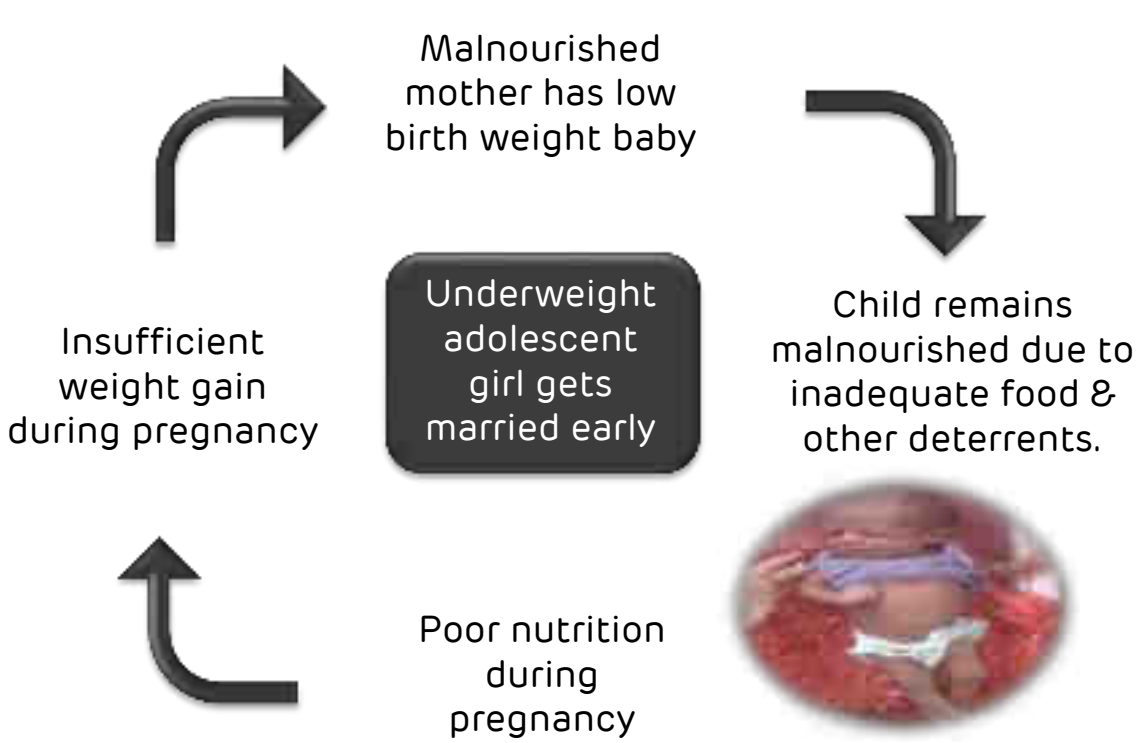
Objective of the Project is to reduce occurrence of malnutrition and anemia. For successful implementation of the project, "Sangini – Village Health Volunteer" plays major role in the Project.

Mundra : 61 Villages

Bitta : 7 Villages

Beneficiaries : 17025

| No | Detail | Mundra | Bitta | Total |
|---|---|---|---|---|
| 1 | Anthropometric(Children) | 5901 | 647 | 6548 |
| 2 | Adolescent – HB Testing | 2950 | 395 | 3345 |
| 3 | RPA – HB Testing | 5884 | 1109 | 6993 |
| 4 | SAM / MAM to NORMAL | 104 | 35 | 139 |
| 5 | FGD | 737 | 228 | 965 |




A child's entire life is determined in large measures by the food given to him/her during his/her first five years because childhood is the period of rapid growth and development. Nutrition is one of the most influencing factors in this period. Malnutrition substantially raises the risk of infant and child deaths, and increases the vulnerability to a variety of diseases in later life.

Project Suposhan is initiated with the Motive ….

**Curb malnutrition amongst Children, Adolescent girls and Women in our CSR villages.**

- **To reduce malnutrition and anaemia amongst Children 95 % & adolescent girls and pregnant & lactating women by 70 % in three years**
- **Reduction IMR and MMR**
- **Support Awareness & Cover 100 % Vaccination taken by Child & women**.
- **<u>Interventions with ICDS and Taluka health Office</u>**

  - CMTC Center started again after our written request to DDO Office
  - Distribution of EDF( Energy Dense Food) by THO to 23 Children who are in SAM Category

# Community Engagement Activity

# Suposhan Saptah

The birth of a healthy newborn child is determined by the health of the mother. Mother's health, in turn, has its basis on her health status during adolescence. The health of a society, as a whole, thus depends on the health of the women, in all stages of their lives. Adani Foundation acknowledges this field of health and aims to address women's health, through their entire life cycle. These efforts have culminated in Project Suposhan, Adani Foundation Health initiative. Project aims to generate awareness in communities and facilitate the strengthening of the health systems and healthcare delivery platforms, with a specific focus on the mother and child. Project focuses on increasing health literacy in communities for mothers, child and adolescent health services through trained community health workers (Sangini), creating effective referral linkages to higher services. SuPoshan "Food Guidance Week" celebration systematized in all 61 villages in Mundra Taluka from 13th Nov – 20th Nov. Suposhan Food competition was organized in coordination with ICDS block and Supervisors, Sarpanch, ASHA workers and women leaders. The reason behind celebrating "Suposhan Food Guidance Week" is to make people aware about the importance of nourishment so that everyone is able to live healthy life. It involves community by · The importance of Nutrition and Balanced Diet · Importance of locally available food. · Preparing own variety nutritious dishes, · Folk songs on nutritious, · Slogans with actions, · Spreading awareness on different schemes, · Vaccination · Kitchen garden and · Exclusive Beast Feeding

# Specialty camp, General  Camp & Surgical Health Camp

| Sr.no. | Place | Villages Name | Total Patinets |
|---|---|---|---|
| 1 | Jat Malek Muslim & Maheshari Samuha Sadi At Mundra | Mundra | 178 |
| 2 | Maleria Camp Sukhpar Mundra | Mundra | 36 |
| 3 | Karva E Mustfa Hospital Health Camp | Mundra | 50 |
| 4 | Mahesh Nagar Primary School | Mundra | 190 |
| 5 | Muslim Jamat Samuh Sadi, Luni | Luni | 40 |
| 6 | Rotary Hall, Mundra Surgical Mega Camp | Mundra | 185 |
| 7 | Mithani Labour colony Health camp | Dhrub | 80 |
| 8 | Shri Swaminarayan Mandir-Baroi Boad | Baroi | 191 |
| 9 | Mithani Labour colony Health camp | Dhrub | 105 |
| 10 | Jain Derasar, Oshwal Seri | Mundra | 56 |
| 11 | Bava Gor Pir Uras Luni | Luni | 525 |
| 12 | Mundra Kadva Patidar Samajvadi Health Camp | Mundra | 92 |
| 13 | Nana Kapaya Primary school health camp with Rotry club | Nana Kapaya | 170 |
| 14 | Luni Maheshwari Samaj Samuh lagan | Luni | 517 |
| 15 | Bukhari pir uras | Mundra | 106 |
| 16 | Activity Hall Gundala | Gundala | 65 |
| 17 | Ashlambhai  Labour colony Health camp | Dhrub | 315 |
| 18 | sonal Bij Health Facility | Zarpara | 2 |
| 19 | Ayushman bharat camp Zarpara Panchyat | Zarpara | 19 |
| 20 | Kapilbhai  Labour colony Health camp | Dhrub | 140 |
| 21 | Surgical Mega Camp- Art-comace college | Mundra | 109 |
| 22 | Ayushman bharat camp Art-comace college | Mundra | 28 |
| 23 | Juna Bandar Health camp | Mundra | 105 |
| 24 | Eye checkup camp with THO & Rotry | Mundra | 388 |
| 25 | Vallabha vidyalay Health camp | Dhrab | 485 |
| 26 | General health camp | Juna bandar | 107 |
| **Total...** | | | **4384** |

# Urinary stone – Dialysis Treatment

Drinking water of Mundra contains high Fluoride (amount of salt). Hence, the proportion of patients with urinary stone and kidney failure is more . A project for patients who need dialysis is thus initiated so that the poor patients can receive the treatment at subsidized rates in the nearby, well-equipped hospitals. The main objective of providing dialysis treatment is to help the extremely needy patients to live a healthy life.

Total 5 Patients were being supported for regular dialysis (twice in a week) by participatory approach.

# Health Awareness season Programme

Awareness generation program play crucial role to creak and achieve social transformation for same to create awareness about Health and critical disease various kind of session had been organized.

| Sr.no. | Session Topic | Villages Name | Total Beneficiaries |
|---|---|---|---|
| 1 | Woman Health | Bocha | 35 |
| 2 | Brest & Cervical Cancer & Woman Health | Lifra | 20 |
| 3 | Brest & Cervical Cancer & Woman Health | Desalpar | 25 |
| 4 | Woman Health | Dhrub | 28 |
| 5 | Woman Health | Mundra | 125 |
| 6 | Health & Hygine awareness session | Mota Kandagara | 51 |
| 7 | Anaemic & Suposhan | Samaghogha | 50 |
| 8 | Beast Censor Awareness | Nani Bhujpur | 40 |
| 9 | Gyneac Awareness | Mundra | 28 |
| 10 | Beast Censor Awareness | Dhrub | 30 |
| 11 | Health & Hygiene awareness session | Pragpar-2 | 20 |
| 12 | Health & Hygiene awareness session | Wandh | 155 |
| 13 | Swain flu awareness season | Nana kapaya | 390 |
| **Total....** | | | **987** |

# Community Health Bhuj

- 5274 Patient Care and Coordination
- 48 Health Camps 25000 beneficiaries
- 543 Dead body referred by carry van
- 272 Ayushman Gold Card facilitation
- 631 Needy patient support
- 3560 Mahiti Setu
- 1137 Students School health Camps
- 36417 Direct Beneficiaries
- Covered 293 Villages

# Gujarat Adani Institute of Medical Sciences

Gujarat Adani Institute of Medical Science is the first Medical College of Kutch region. It started in partnership with Adani Group and Government of Gujrat in the year 2009. This college was affiliated by the Medical council of India in the year 2014 for the MBBS with 150 seats per year. Gujarat Adani Institute of Medical Science is affiliate with the first digital university "Krantiguru Shyamji Krishna Verma Kutch University". In GAIMS, currently 750 students are studying, The GAIMS Medical College is situated in heart of Bhuj city on a large plot of 27 acres.

A teaching hospital (G K General Hospital) with 700 beds is established with GAIMS in which patients of Kutch are getting subsidized medical facilities. The Hostel facility is also available for the students in the campus only. The accommodation facility is given to the staff of GAIMS.

- Adani Foundation Team has initiated coordination with GKGH hospital since 2014 and established a reception area for the smooth patient coordination and preparation for the social networking program.
- Adani Foundation organized **48 General Health Camps and Speciality Camps in various interior villages of Kutch in coordination with GKGH which created magical impact and benefitted 25000 patients.** Adani Foundation Bhuj Health team has also organized more than Eleven awareness camps and village level meetings at 293 villages of Kutch regarding services of GKGH.
- Dead body medical van – Dignity to death is one of the noble initiatives taken up by the Adani Foundation. If any death occurs in GKGH, dead bodies are shifted to the native village of the concerned in the Kutch District free of cost. Total 543 dead bodies privileged till now to different locations in Kutch.

# Patent Care and coordination

| Sr. No. | Month | Total Patient Special Care in OPD and IPD level |
|---|---|---|
| 1 | April to June | 1190 |
| 2 | July to September | 1507 |
| 3 | October to December | 1505 |
| 4 | January to March | 1072 |

In the financial year 18-19 we specially care total 5274 patients from our sites Mundra,bitta and tuna,

# Ayushman Yojana

As soon as Government announced for Ayushman Yojana, we started process to enroll Golden card to the eligible families by organizing camps at village level in each taluka

| Sr. No. | Month | Total no's ayushman card enrolment |
|---|---|---|
| 1 | December | 145 |
| 2 | January | 20 |
| 3 | February | 42 |
| 4 | March | 65 |
| | Total | 272 |

# Shakti Raksha – Preventive and Curative Breast and Survical Cancer

Adani hospital Mundra, Taluka health office, Indian Red Cross society and Adani foundation has initiated Shakti Raksha Project in which special gynecologist camp for detection of breast n survival camp and thalassemia testing for pregnant women at CHC MUNDRA. In first phase we have covered all PHC and susceptible cases has been referred for pep test and mammogram at GKGH, Bhuj.

In this project we have covered 103 villages of Mundra and Bhuj this year with curative measures. Most medicine will provided by Taluka health office.

We have covered total 624 patients and 120 cases were referred to GKGH Bhuj. In which two cases diagnosed with breast lump (not malignant).

| Sr.No | Place | Gaynec | Thelesmia testing | Total Beneficiary | GAMIS Refar Patients |
|---|---|---|---|---|---|
| 1 | Mundra CHC | 62 | 34 | 118 | 25 |
| 2 | Zarpara PHC | 26 | 6 | 32 | 5 |
| 3 | Moti Bhujpur PHC | 54 | 15 | 86 | 18 |
| 4 | Mota Kandagara PHC | 42 | 11 | 53 | 10 |
| 5 | Nani Tumbadi PHC | 55 | 14 | 69 | 12 |
| 6 | Vanki PHC | 48 | 7 | 55 | 8 |
| 7 | Ratadiya PHC | 79 | 11 | 90 | 17 |
| 8 | Bhadreshwar PHC | 52 | 14 | 66 | 11 |
| 9 | Adani Hospital Mundra | 183 | 0 | 183 | 11 |
| 10 | GEB PHC sub center | 23 | 0 | 23 | 3 |
| **Total....** | | **624** | **112** | **775** | **120** |


# School Health Camp

**``Safe child``**

Adani Foundation is regularly organizing health camps in primary government school with support of GKGH. Current year we have carried out check up of 1137 students in Bhuj Taluka.

| Month | Nos of camps | Nos of School students |
|---|---|---|
| August | 1 | 219 |
| September | 2 | 308 |
| November | 2 | 410 |
| December | 1 | 200 |
| Total | 6 | 1137 |

# Arogya Saptah (8th – 14th August 2018)

Adani foundation, Adani Hospital and GAIMS have Jointly Celebrated "Arogya Saptah" 8th to 14th August-2018 in Respect of 72th Independence of our country. Celebration included multi specialty camps, Workshops, truckers health check up, surgical camp on foundation day and adolescent fair at different part of district. Collector, DDO, Minister, MLA and other dignitaries from NGOs had remained present. Objective of the program was to avail health benefits at GKGH and also at Adani Hospital Mundra and Approximately 4500 people will be direct beneficiaries of the program. (2144 Direct beneficiaries)

| Day | Date | Event Name | Detail about Event | Beneficiaries |
|---|---|---|---|---|
| 1 | 8th August 2018 | Specialty Mega Camp | Specialist doctors i.e. Gynaecologist, Paediatrician, Nephrologists and general surgeon from GKGH had extended their services. | 218 |
| 2 | 9th August 2018 | Cervical/Brest cancer Screening & Awareness camp | In SOS gada village screening camp organize with preventive awareness session. 17 women critically suggested for further check up at GKGH. | 113 |
| 3 | 10th August 2018 | Haemoglobin Testing camp | Haemoglobin testing and awareness for de warming of 917 adolescent girls at Rapar village. | 917 |
| 4 | 11th August 2018 | 1. Surgical Mega Camp, Mundra<br>2. Roa accident Awareness programme, Nakhtrana | 1. Specialist Doctors from Adani hospital Mundra and Medical officers of Adani foundation had extended their services.<br>2. On occasion of Adani foundation ay session for Road accident awareness and safety including primary health check up camp was organized at Nakhatrana. | 223<br>172 |
| 5 | 12th August 2018 | Class-4 Staff CPR and first aid training | Class-4 Staff CPR and first aid training was organize in campus of G K general hospital for capacity building of staff and their motivation. | 181 |
| 6 | 13th August 2018 | Adolescent fair, Gadhashisha | Adolescent fair was organized at Gadhashisha high school in which lady gynaecologist had cleared doubts of the adolescent girls and given information. | 170 |
| 7 | 14th August 2018 | Asha Worker workshop | Capacity building workshop was organized for ASHA workers of urban and rural bhuj. | 150 |

# Arogya Saptah (19th – 28th January 2019)

Adani foundation, Adani Hospital and GAIMS have Jointly Celebrated "Arogya Saptah" 19th – 28th January 2019 in Respect of Republic day our country. Celebration included multi specialty camps, Workshops, truckers health check up, surgical camp on foundation day and adolescent fair at different part of district. Collector, DDO, Minister, MLA and other dignitaries from NGOs had remained present. Objective of the program was to avail health benefits at GKGH and also at Adani Hospital Mundra and Approximately 4500 people will be direct beneficiaries of the program. (Direct beneficiaries – 1342)

| Day | Date | Event Name | Detail about Event | Beneficiaries |
|---|---|---|---|---|
| 1 | 19th January 2019 | Workshop for Counseling for Overcome Exam fear. | Workshop Dr.Prutha Deshai (Psychiatrist) she explained about how to reduce Exam Fear and Stress. | 250 |
| 2 | 20th January 2019 | Cataract Detraction Camp | Cataract Detection Camp organized at khavda village. In this camp 12 patients were referred in GAIMS hospital Bhuj for further treatment. | 322 |
| 3 | 20th January 2019 | Surgical Camp Mundra | Specialist Doctors from Adani Hospital Mundra and Medical officers of Adani foundation had extended their services. | 78 |
| 4 | 21st January 2019 | Medical Checkup Camp Swaminarayan Temple | All Shankhyogini Women from Swaminarayan Temple Bhuj were examined by gynecologist and Total blood check up was organized. | 209 |
| 5 | 22nd January 2019 | Infection Control Awareness Training | Conducted Training on infection control and antibiotic medicine by Dr Gurudas Khilnani and Dr. Kashyap Buch . | 170 |
| 6 | 23rd January 2019 | Anganwadi worker and Asha Training | Training of ASHA and Anganwadi worker conducted by Dr. Hashmukh Chauhan and Dr. Shardul chorasiya. | 25 |
| 7 | 24th January 2019 | Multi Specialty Health Camp | Multi speciality Camp was organized at Rapar in which Gynec, Eye Specialist, physician and orthopaedic Doctors had extended their services | 203 |
| 8 | 25th January 2019 | Medical Checkup camp of journalist and family | This unique initiative covered all journalists of Kutchh for health check up and awareness sessions | 85 |

# Glimpse of health week







# Mahiti Setu

| Sr. No. | Month | Total |
|---|---|---|
| 1 | November | 814 |
| 2 | December | 814 |
| 3 | January | 764 |
| 4 | February | 889 |
| 5 | March | 279 |
| | | 3560 |

''Mahiti Setu''

Objective of Community resource center is to leverage the Government Schemes and making them accessible to community – It's a sustainable community connect!

Mahiti Setu has created trust and easy access to various government schemes – outreach will increase with time and awareness.

# SUSTAINABLE LIVELIHOOD DEVELOPMENT PROGRAM

Empowering lives and broadening their scope for economic opportunities, Adani Foundation's initiatives introduced under 'Sustainable Livelihood Development Program', have been founded on community based approaches. In the villages at Mundra Taluka, several communities are economically side-lined and weaker that depend on a sole income source or are unemployed. Sustainable livelihood projects have been launched to cater financial independence through building local partnerships, providing diverse livelihood avenues, inculcate the attitude to establish savings, equipping to earn and updating local skills by making use of existing resources to encourage self-reliant lifestyles. Participation is encouraged by launching specific projects for fishermen communities, farmers and cattle owners, youth and women.

# Fisherman Amenities work

- 391 Students : Education Support
- 134 Stunners : Adani Vidya Mandir *
- 16 Fisherman : Alternate livelihood
- 78 Fisherwomen : Linkages for schemes
- 1312 Fisherman : Community Engagement
- 1086 Fisherman : Potable water provision
- 6261 Mandays : Mangroves Plantation *
- 231 Fisherman : Capacity Building
- <u>3280 Direct Beneficiaries</u>

166 Fisherman for mangroves planation

AVMB beneficiaries can count seprately

# Education

Education is one of the most important stepping stones to bring about a unified development in any community. The Adani Foundation, through its rigorous surveys and assessments, could understand that it was education which should be taken up to bring about a real change in the status of the fisher folk communities. Following are some of the major education initiatives taken up by the foundation:

| Balvadi | | |
|---|---|---|
| Sr. | Village & Bandar | Children |
| 1 | Juna bandar | 55 |
| 2 | Luni | 25 |
| 3 | Zapara-Chhacha | 27 |
| 4 | Bavadi bandar | 30 |
| | Total | 137 |

# Vidya Deep Yojana

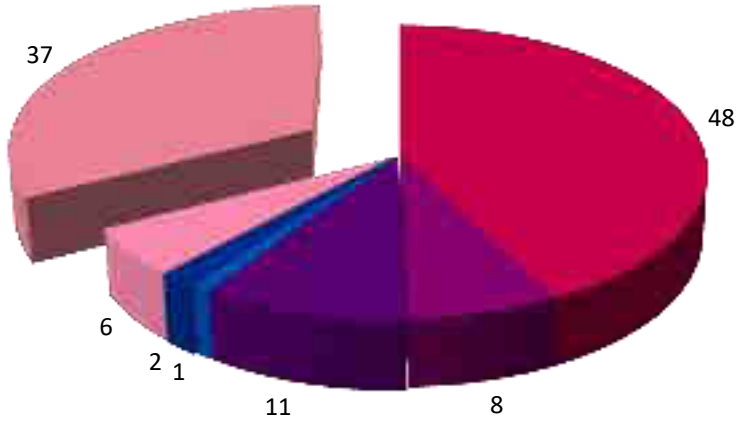
A great amount of efforts were put in developing school preparedness programmes by empowering 'Balwadis' at Fisher folk settlements. Under the Machhimar Vidya Deep Yojana, Adani Foundation constructed four Balwadis for kids between the age group of 2.5 years to 5 years at different settlements. The programme is inclusive of nutritious food, awareness on health, hygiene, cleanliness, discipline, regularity and development of basic age appropriate concepts.

# Vidya Sahay Yojana- Scholarship Support

Participatory scholarship support for fisherman children studying in SMJ high school Luni and to above 12th standards Students . 80 percentage support given by Adani foundation and 20 percentage support by parents! They willingly agree for the same.. We also encourage them for technical education for good job opportunities.. Total 66 students has been benefitted.

This year 68 students were given book support and 8 students were given cycle support for higher secondary study.

# Education Analysis




Rather than learn their children, fishermen joined them in their traditional business due to lack of awareness. But Since Adani foundation has started various kind of education initiative like Balwadi , Scholarship support, Cycle support, Book support, free education in AVMB, Transportation support, skill development training ,we bring them in the Ocean of education. By the job placement and motivation we can transform 37 fishermen youth life who have good job and others one continue their further study as below.

# Machhimar Arogya Yojana

A healthy person can work well and earn for his family. Hence it is necessary to provide medical facilities to cure and prevent them and to provide then the treatment of diseases prevailing among the people specially women; children and elderly person, especially due the lack of balanced nutritious diet.

Mobile Health Care Unit - the mobile dispensaries have been run by the Adani Foundation since 2009. The mobile dispensary is available not only in the Vasahats/Settlements but also near the coast where the fishermen, can avail the facilities as and when needed. **Total average 560 fishermen were benefitted by Mobile Dispensary during last half year**.

1. Apart from this, a number of subsidiary initiatives such as health awareness camps, medical check-ups, etc. are conducted by the Adani Foundation at frequent intervals, to provide the fisher folk community with the much needed and required information and assistance.
2. Medical Financial Support –Adani Foundation has extended financial assistance to more than **114 financially challenged patients** from the Fisher Folk Community in case of medical urgency during this year.
3. Health Card for Senior Citizen Project – This is one of the major and prominent and the most innovative project of the Adani Foundation. Under this scheme Health Cards were given to the to Senior Poverty Stricken Citizens to provide them financial support to combat with their health related needs. The project for the senior citizens is popularly known as **Vadil Swasthya Yojana and till date 350 senior citizens** from fisher folk community are enrolled in the scheme. Most of them keep these cards in their wallets with other important documents and cards.

## Machhimar Shudhh Jal Yojana

This scheme of providing potable water has helped in reducing the drudgery of women and contributed largely towards general wellbeing.
Water tank platforms have been constructed and tanks have been set up in order to provide clean potable drinking water to the community. Daily 1,18,000 Litres of water is supplied at different settlements.

| Potable Water | | |
|---|---|---|
| Sr. | Vasahat | Total liters/ day |
| 1 | Juna Bandar (By APSEZ) | 30,000 |
| 2 | Luni Bandar | 15,000 |
| 3 | Randh Bandar | 25,000 |
| 4 | Bavadi Bandar | 15,000 |
| 5 | Veera Bandar ( By AKBTPL) | 10,000 |
| 6 | Ghavarvaro Bandar (By AKBTPL) | 8,000 |
| 7 | Kutdi Bandar (By MSPVL) | 15,000 |
| | Total | 1,18,000 |

## Linkages with various Departments

Coordination with coast guard, Marine Department and Fisher folk for smooth Port operations Regular Meetings with fisherman for various innovate technology for fishing

## Machhimar Kaushalya Vardhan Yojana

Apart from providing formal education, special programmes were conducted to enhance youth employability. Based on the need of assessment, a number of trades were introduced by the Adani Skill Development Centre in Mundra, where the fisher folk youth could join and get vocational training for a number of technical and non-technical skills.

| Sr. No | Course Name | No of Students |
|---|---|---|
| 1 | Mud work Zarpara | 45 |
| 2 | Dori work, Navinal | 20 |
| 3 | Checker Cum RTG Crane Operator | 03 |
| | **Total** | **68** |

# Machhimar Ajivika Uparjan Yojana

The 'Ajivika Uparjan Yojana' was implemented to promote and support alternative livelihoods among the Fisher folk communities during the non-fishing months. The Foundation introduced 'Mangrove Nursery Development and Plantation' in the area as an alternate income generating activity for the people of the region. Both men and women received training on Mangrove plantation, moss cleaning, etc. as per requirements. The Foundation provided them with employment equivalent to 6261 man–days. In addition to this, employment worth of 35787 man-days has been provided till date. The Foundation has also supported Pagadiya fishermen as painting laborers by providing them with employment and job in various field.

# Innovative Project : Solar Tent Dryer

CIFT (Central Institute of Fisheries Technology) has been conducting a prototype study on Solar tent dryers with improved technology at their head quarters in Kochi, which is expected to be completed within a span of another three months. They may be able to upscale or replicate the technology once the study is completed. In all probability, they will provide the designs for the solar tent dryer for drying Bombay duck and / or Acetus Indicus with financial estimate by the first quarter of next year. Meanwhile the team from the HQ and Veravel centre can visit Mundra region for initial site visit and feasibility studies. CIFT requested our team to visit CIFT HQ at Kochi during coming months to assess the prototype model and understand more on other CIFT developed hybrid dryers

# Fisherman Cricket league

Adani foundation, MUNDRA organized Cricket Tournament " Sixth Adani Premiere League among Fishermen community to promote healthy Sportsmanship and harmonically transparent relationship. The Tournament had been played for 13 days at SVC (Shanti Vihar Cricket Ground) by 6 matches per Days with full of Audience, Total 65 Teams with 780 Fishermen youth were participated with 550Rs. Contribution per teams from Mundra, Anjar and Mandvi Block. The Final Match was played on 9.07.2018 and Pir Saheb (Religious Mentor), Rakshit sir (Executive Director- APSEZ ), Dr.A.k Vatsani (Deputy collector ,Bhuj) Mr. Mahesh Dafda (Assistant Director of Fisheries, Bhuj), Mrs. Pankti Shah(Unit CSR Head) ,AF staff and Fishermen Leaders remained present. The Final Match was so interesting and Salaya team becomes winner over Luni Team and more than 1200 Audience from various villages were present. The winner's trophy, Runners-up Trophy, Man of the Series, Man of the Match, Best Baller, and Best Bats-Man Trophy has been given to the Respective Teams and players. The 25000Rs, 15000Rs, 2100Rs, 1100Rs, and 500Rs, 500Rs Prize given to the above Respective Teams and Players from the Teams contribution.

# Sea weed culture

Sea weed culture as alternate livelihood for fishermen has been started as pilot base with Vivekananda Research and Training Institute.

To create Fishermen alternate livelihood seaweed raft have been installed at Juna Bandar. After successful results we will support for more raft to fisherman as off season employment.

Natural sea weed which is available at Luni coast and being obstacle in fish net is collected and linkages with VRTI for selling.

## Sorting Sieve : Time Saving for Fisher Women

During bulk fishing catch fisher women remain engage whole day to sort out fishes by hand this is time consuming and panic for them so, we provide wooden sorting sieve to sort out small fishes, which make them free from finger pain and time saving.

Adani foundation Mundra, Fisheries Department GOG & CMFRI(Central Marine Fisheries Research Institute) had organized sessions for alternate livelihood for fisher women, importance of savings, bank account and also usage of sieve for Fish sorting work along with 78 wooden sorting sieve distribution. Dr. Imelda Joseph, head & principal scientist of CMFRI, Cochin, Dr. Diu incharge of CMFRI, Veraval and their team had given guidance to all fisher women of Juna Bandar for alternate livelihood possibilities with examples.

## Fisherman Ramatotsav

To Development of physical and mental Development of youth Ramotsav week Program was organized at various Vasahat i.e Junabandar, Luni, Zarapara, Bavdi Bandar and Navinal for 1st to 10 th standers .

This year Total 485 children were participated and all were facilitated with school bag as well as 1st ,2nd and 3rd prize from each game.

| Fisherman Student Ramtotsav Programme-2018-19 | | | | | |
|---|---|---|---|---|---|
| Date- 07-02-2019 to 16-02-2019 | | | | | |
| Sr.No | Fishermen vasahat | Date | Students | Attendants | Total |
| 1 | Navinal | 07-02-2019 | 47 | 150 | 197 |
| 2 | Zarpara | 08-02-2019 | 94 | 250 | 344 |
| 3 | Zarpara( Chacha) | 08-02-2019 | 81 | 300 | 381 |
| 4 | Bavdibandar | 11-02-2019 | 69 | 200 | 269 |
| 5 | Lunibandar | 12-02-2019 | 60 | 200 | 260 |
| 6 | Junabandar | 15-02-2019 | 134 | 350 | 484 |
| Total | | | 485 | 1450 | 1935 |

# Agriculture & Animal Husbandry

- 755 Acre – 164 Farmers Drip Irrigation
- 380 Acre – 212 Farmers Maize Cultivation
- 56 Acre - 140 Farmers NB21
- 24 farmers Organic Farming
- 21 Numbers Bio gas Provision
- 387 IG Support and Sadhay Sahay
- 142 Central Govt. Scheme Beneficiaries
- 154 Pension Scheme Linkages
- 132 Women Empowerment Project
- **1364 Direct Beneficiaries**

# Drive for Technology to use in agriculture

Adani Foundation puts efforts in Mundra block for consistent betterment in livelihood sector. The organization has carried out remarkable activities in the agricultural and animal husbandry sectors.

- We have initiated Programme for Awareness of Farmers in collaboration with KVK. The outreach is approximate 80 farmers of 5 villages
- The purpose of this project is to initiate village wise integrated agricultural & allied development for sustaining agriculture and socio economic situation of farming community of Mundra block.

| **Agriculture Programme** | | |
|---|---|---|
| Sr.no | Village Name | Member |
| 1 | Zarapara | 40 |
| 2 | Zarapara | 42 |
| 3 | Siracha- | 26 |
| 4 | Navinal | 22 |
| 5 | Dhrub | 141 |
| | | 271 |

# Fodder Cultivation

The organization provides fodder during the time of scarcity and the last 3 months of summer every year. During this period, fodder is regularly sent to every village with the help of the local people. This has given stability to the families who earn their livelihood through animal husbandry.

In order to meet the demand of fodder, the Adani Foundation purchases it from the regional farmers. This gives them fair rates in return.

This year we have given 1,78,000 man fodder worth Rs. 402.00 Lacs approximately at Mundra, Lakhpat, Anjar, Abdasa and Rapar Taluka

But, For this Critical Condition some Sustainable Solution is required to find out

Fodder is the main issue as rainfall is very less in this region. Adani Foundation is working intensively in direction of fodder sustainability in three ways

1. Individual Fodder Cultivation Support – NB21 demonstration – Supported 140 Farmers of Dhrub and Zarpara
2. Drip Irrigation support Linkages with Fodder – First phase we will support drip irrigation in 22 villages and this linkages will help to convince them for NB21 at least in one acre land

3. Village Level Fodder Cultivation : Participatory Approach
   (a) Winter crop Cultivation – Support to 180 Individual (Supported for seeds of Makai for 180 acre land)
   (b) Winter Crop Cultivation – Support to Group of Farmers (200 acre of land with 32 farmers)

We are also planning for grassland development at Village Zarpara and Siracha in Gauchar with mutual understanding with Gram Panchayat.

**Win win situation of this project**

- Cost saving initiative: Financial saving by Rs. 7.23 lac in three months. (15%)
- Assured of green fodder and supply
- Empowerment of farmers by providing livelihood
- Increase of Green fodder cover
- Milk productivity enhancement
- Fulfilment of double the farmer income concept of Govt. of India
- Crop rotation increases the soil fertility

# PROJECT "DRIP IRRIGATION"

- **Basis of Requirements of Drip Irrigation**

The main source of livelihood being agriculture, the cultivators tend to use more and more underground water for irrigation. Underground waters have gone very highly saline. The use of such water for irrigation has made the soil also saline and the crop yields have dwindled.

- **Process of Drip Support**

Farmer have to applied in the prescribed form of Adani foundation with photograph.

Inspection and verification will be by AF representative.

Ration card, work order of G.G.R.C, 7/12 certificate and all bills must be attached.

Farmer will be informed by telephonic to have form query.

Primary information about farmer land will be received by telephone.

Farm visit within 10 days of after received of application and verified the installation of system as per map and material as per bill will be checked and get farmer feed back.

Verification report submitted to account office.

Payment within 20 days if all document is complete through net banking.

Farmer economic study after our support.

- **Villages of Drip Support**

Keeping in view the situation and request comes from community, once again **Drip irrigation support is planned in three phase. As a part of first phase, we are considering 22 potential villages. We have covered 164 farmers and 755 acre drip irrigation area.**

# Biogas

Biogas is a clean, non-polluting and low cost fuel. It contains about 55 to 75 percent methane, which is inflammable. Bio gas can be produced from cattle dung, human waste and other organic matter by a process called "Anaerobic digestion" which takes place in a biogas plant. The digested effluent, which comes out of the plant, is enriched manure.

The Multiple benefits of the biogas have changed many lives in rural areas. During this year 21 plants have been constructed. We are providing support addition to Government support to the beneficiary. (Under bio-gas scheme of government, the total cost is Rs.33, 500 out of which Rs.15, 000 will be granted by the government and out of the pending amount of Rs.18, 500 sum of Rs.10, 000 will be contributed by the Adani Foundation. The beneficiary will have to pay only Rs. 8, 500). Beneficiary women use the time, saved from cooking and fuelwood collection, to take up an additional economic activities.

Representation of Adani Foundation was invited as Guest of honor by Krishi Vigyan Kendra in 'Scientific Advisory Committee Meeting" . Main Objective of meeting was to study about present agricultural Scenario of Kutchh and new CROP Patter. Representative from ICAR ,GOG and Various NGO were present. We made presentation of our activities for sustainable agriculture in this forum.

# Agriculture Fair

Adani Foundation has Participated in District Level Agriculture Fair for three days in first week of January. We had show case various activities of Adani Foundation in field of Fodder Sustainability, Bio Gas Support, Cattle care, water conservation and Biodiversity.

**Adani Foundation was felicitated award for " To Develop Unique Model for Fodder Sustainability in Kutchh".**

State Minister Mr. Vasanbhai Ahir has inaugurated this event. By this platform we could able to connect with approximately 12000 farmers of Kutchh District by providing guidance for NB21 and Maize Cultivation. We have also given information about Saheli Mahila Gruh Udyog and could also our products i.e. Eco Friendly bags, Banana Wafers and Washing powder.

# Tissue Culture

Date is the Amrut Fal of Kutchh and Mainly best quality available in some villages in Mundra Taluka. To maintain quality uniformity Adani Foundation is planning for cultivate 4000 tissue cultured plants of elite varieties to the farmers of project area. For this, we will select best offshoots of elite plants from farmers fields in coordination with farmers groups. The selected planting materials will be given to identify tissue culture laboratory for developing tissue culture plants in 3 years. Hence, whole program is coordinating farmers participation basis having four party i.e. Tissue culture laboratory, Adani Foundation, KVK and farmers committee of project area. Major functions of all parties are as under;

• **TC Lab: Develop TC plantlets of elite varieties** • **Adani foundation: Financial support** • **KVK : Technical support to the program**

Farmers committee : Provide best planting materials for developing TC plants & contribution in distribution & provide nominal cost of plants. Hence, the farmers contribution in the program is 10 Lakh.

Ground work for this project is completed during current financial year i.e. Registration of 200 farmers, series of meeting with KVK and Anand University

# Project Swavlamban

Project Swavlamban Launched with blessings of differently abled people of MUNDRA TALUKA.

**Our objective is**

- To increase awareness about Government schemes for Divyang people, widows and senior citizens and coordinate them with Social Welfare Department, GoG
- After getting income generation equipment support - Proper training provision to make them self-reliant in true sense!!
- Adani Foundation is playing the role of facilitator in case of tie up with Government Scheme for Widows, Senior Citizens and Handicapped people. The identity cards are issued for the handicapped in coordination with Bhuj Samaj Suraksha Khata which is beneficial for them to get specific kit for their disability type. This year 154 beneficiaries linked up with pension scheme.
- The financial benefit of the senior citizen Yojana is Rs. 500 per month and the widow scheme is of Rs. 1250 per month. Jilla Samaj Suraksha Officer and team remain present every time.

| No | Type | Beneficiaries | Financial benefit |
|---|---|---|---|
| 1 | Disabled | 409 | 10,00,000 |
| 2 | Widow | 92 | 3,25,000 |
| 3 | Senior Citizen | 32 | 1,75,000 |
| | Total | 533 | 15,00,000 |

# Women Empowerment Projects

- In Kutch, the situation of women is miserable. Women are totally dependent on male members of family for their needs. Consumption of liquor is one of the main culprits in Kutch. Due to this evil prevalent among men many women are suffering.
- Considering this situation, We have started our training program with two major women's group of Villages near Adani Power and Adani Ports. Both the groups of women (**132 women in total)** successfully completed their training for preparing washing powder, phenyl, liquid for cleaning utensils and hand wash etc.
- We have selected 12 women groups having 132 members total, as per their ability for different work i.e. accounting, banking, leadership, marketing, administration etc.
- As a further step to bring sustainability, we thought to start a shop "Saheli Mahila Gruh Udyog" at Shantivan Colony.
- Main Perishable/ Non perishable items by Saheli are

1. Washing Powder
2. Phynayle
3. Dish wash liquid
4. Pickle of Bijora
5. Suf handicraft
6. Ahir Handicraft

# Women Empowerment Projects
# Step towards socio economic development

| No | Village | Group | Members | Saving Amount | Work |
|---|---|---|---|---|---|
| 1 | Mota Kandagra | Jay Mekran | 18 | 100 | Stitching |
| 2 | Mota Kandagra | Jay Momai | 10 | 200 | Stitching |
| 3 | Navinal | Vishwas | 14 | 100 | Stitching/Dori |
| 4 | Navinal | Chamunda | 10 | 100 | Phynayle making |
| 5 | Baroi | Adhar | 12 | 100 | Perishable items |
| 6 | Sadau | Vishwasi | 16 | 100 | Dhadki, Frames |
| 7 | Shekhadia | Sonal | 12 | 200 | Washing Powder |
| 8 | Mota Kapaya | Tejasvi | 10 | 100 | Eco friendly bags |
| 9 | Mundra | Meghdhanushya | 18 | 100 | Mud work |
| 10 | Mundra | Aaarambh | 20 | | Suf Handicraft |
| | | | 132 | 1100 | |

# Glimpse of Women Empowerment Projects

SHG Meetings in various Villages regarding record check , Loan , Interest detail also collect information for their hidden Skill.

एक शरुआत

aaarambh

Adani Foundation launched programme AAARAMBH to revive the dying art form of Suf in a ceremony in Mundra, Kutch. Under this project, Adani Foundation will facilitate the training of about 30 women in the handicraft and also help them with market linkages to ensure sustained livelihood for them. On the occasion, Adani Foundation also launched a website made by the women themselves to market their products.

Suf handicraft was practiced in Kutchh District, Gujarat. Due to lack of patrons this handicraft has been dwindling. Suf handicraft is painstaking embroidery based on the shape of a triangle. Suf is counted on the wrap and weft of the cloth in a surface satin stitch worked from the back. Each artisan imagines her design and then counts it out in reverse.

aaarambh

# International Women's Day

## International Women's Day Celebration Mundra


International Women's Day has been celebrated by the Adani Foundation, Mundra with Integrated Child Development Scheme. Chief Guest of the event was Mr. Komal Singh (Commandant Coast Guard) and Ms. Ami Rakshit Shah (APS School) .Distinguished Guest Mr. Vayda (Taluka Development Officer, Mundra)

On this momentous occasion the supervisors of ICDS were felicitated for their noble work. Adani Foundation also honored Eight women entrepreneurs who were supported by the Adani Foundation, Mundra for income generation.

The Adani Foundation Mundra was also facilitated by the ICDS for their remarkable work in field of women empowerment and Suposhan as well.

Additionally, In coordination with DDO, Kutchh Pradhanmantri Mandhan Yojana form filled up for @ 225 women – who will give benefit of pension of Rs. 3500 per month after age of 60 years. Our Suposhan Sangini remained present and guided about nutrition.

As a Matter of Celebration , Same Day ICDS Mundra got state level Mata Yashoda award at Gandhinagar for best Anganwadi work.

Total 300 women attended the programme with great enthusiasm and Zeal.


# International Women's Day Celebration Bhuj

International Women's Day has been celebrated by the Adani Foundation,  Bhuj with SOS Gada Village, Bhuj Engineering College as well as Army force Bhuj.  Chief Guest of the event was  Dr. Kunika Patel (Gynecologist GAIMS) and Dr. Rajendra Harnagar (Gynecologist GAIMS) and Distinguished Guest was  Mr. Mishra (Airport Authority, Bhuj)

As a part of Bhuj and Lakhpat CSR celebration International Women's Day in Various place Bhuj Engineering collage, SOS village and Bhuj Airport. Awareness for Breast  and cervical cancer, and health - hygiene. Total 230 women are benefitted in this awareness session. Also discussed about various psychological issues during menopause age and its solution.

# RURAL INFRASTRUCTURE DEVELOPMENT

**Building a strong community relationship is the key to progress of Adani Foundation. The programs such as Education, Health and Sustainable livelihood development play a very important role in building this strong relationship with the community. These three programs are incomplete without the inclusion of the Rural Infrastructure Development program.**

This year on path of sustainability, we have taken some steps as follows...

Under Dignity of Drivers Project, Adani Foundation has constructed Resting Shed for Drivers entering in SEZ Premises. Total 50 beds are constructed, drinking water and sanitation plus recreational – TV Facilities and will be charged minimum. Adani Foundation has handed over the project to ASSET Department – SEZ as a revenue generation model.

In this ceremony Mr. Avinash Rai (CEO- APSEZ), Mr. Rakshit Shah(Executive Director – APSEZ), Mr. Pritpal Sinh (Head – SEZ Operation) and other transporters remained present.

# RID – Dignity of Workforce

Present condition of migrated labour community of Adani port, power and Willmar is really matter of concern. They are living in pathetic condition. It is true that we cannot achieve our goal of development until we support to up bring lives of this community. Basic needs of this labour force needs to be address. In labour Vasahats they are not getting facility of pure drinking water, proper living condition, sanitation or proper living atmosphere. To build up trust and transparency in labour community, union labours and Smooth business operations and to create more efficiency by providing better living conditions Adani Foundation has constructed 45 Toilet block and proper bathing place for labours.

## Work Completed

- ✓ Road repairing various vasahat
- ✓ Open shed at Juna Bandar
- ✓ Sand Filling plot at JUNA BANDAR
- ✓ Concrete Step ladder at Juna Bandar
- ✓ House construction at Shekhadia
- ✓ Two approach road 5000 meter Zarpara Fishermen and 5000 meter Luni Pagadiya
- ✓ Drinking water storage tank 5000 ltr capacity bavdi Bandar -2, Juna Bandar -2, Kutdi Bandar -1
- ✓ water pipe line installation at Wandi village 2000meter.
- ✓ Basic amenities at Rampar Village Paver block 6000 LTR Storage tank and Boundary wall at community place.
- ✓ Additional civil work in community hall
- ✓ Open shed Gundiyali
- ✓ Boundary wall in common place at Tragadi.

Gathering Shed at Juna Bandatr

Balvadi Room Veera Bandar

Zarpara- strengthening of Road


An initiative by
adani
Foundation
Swachhagraha
सच्छाग्रह
स्वच्छता का सत्याग्रह

# Swachhagraha


Adani Foundation has launched project "Swachhagraha" Swachhata ka Satyagraha in the year 2015, to support the 'Swachh Bharat Abhiyan'. Falling in line with our Honorable Prime Minister's call for a Clean India, we launched this mass movement towards making our Nation litter free.

The programme draws inspiration from one of the largest mass movements - Satyagraha, which catalyzed action by winning over people's hearts through tremendous patience and resolve, instilling dignity and self-respect among our people. Swachhagraha aims to engage people and bring about a behavior change, where people get involved 'to create a culture of cleanliness'. Swachhagraha is inculcating behavior change education in cleanliness, sanitation, personal hygiene and civic consciousness amongst young minds.


Presently the Swachhagraha project is being implemented in 3000+ schools across 17 States. So far 3500+ teachers have been trained in behavior change education in schools, ranging from elite private schools to government municipal schools. The programme has directly involved over 57000+ students who have further reached out to their peers, parents and community through a variety of planned action projects and campaigns.

Mundra site- Adani Foundation launched Swachhagraha in 4 Blocks of Kutch District (Mundra, Anjar, Gandhidham, Bhuj). The Swachhagraha programme was launched in Bhujwith participation of over 450 Schools in Swachhagraha Prerak's Training Workshop with support of District Education Department, Kutch District. The programme was launched by Mrs. Shilin R. Adani, Trustee (Adani Foundation); Mr. Prabhav Joshi(DDO, Kutch), Mr. V.S.Gadhavi, (Director, Adani Foundation); Mrs. Sushama Oza, (Director, Adani Foundation); Mrs. Ami Rakshit Shah (Adani Public School); Mr. (Rakesh Vyas – DEO, Kutch); Mr. Sanjay Parmar (DPEO, Kutch) on 1st October 2018.


# SWACHHAGRAHA - ACTIVITIES


# Swachhagraha Marathon : Run Against Depression

Gujarat Adani Institute of Medical Sciences G K General Hospital and Student Counsel Organized the Bhuj Marathon. Theme of the marathon was Run against Depression and Swachhagraha.
Total more than 800 participants took part in this marathon with enthusiasm and zeal.


# International Coastal Clean up Day

Mundra Adani foundation MUNDRA has celebrated swachhagraha related International Coastal Clean up Day celebrated with Coast Guard" with theme swachhagraha.. School students, Coast Guard staff and Adani foundation staff had cleaned Mandvi beach and give a message of swachhagraha.. At the end information given about swachhagraha project

# Adani Skill Development Centre

Adani Skill Development Centre (ASDC) is playing a pivotal role in implementing sustainable development in the state.

Several miscellaneous industries exist in Kutch district. Adani Skill Development Centre has started a center in Mundra block so that the needs of these industries are fulfilled, the local youth is enrolled in various training / skill courses and the distance between the both is minimized.

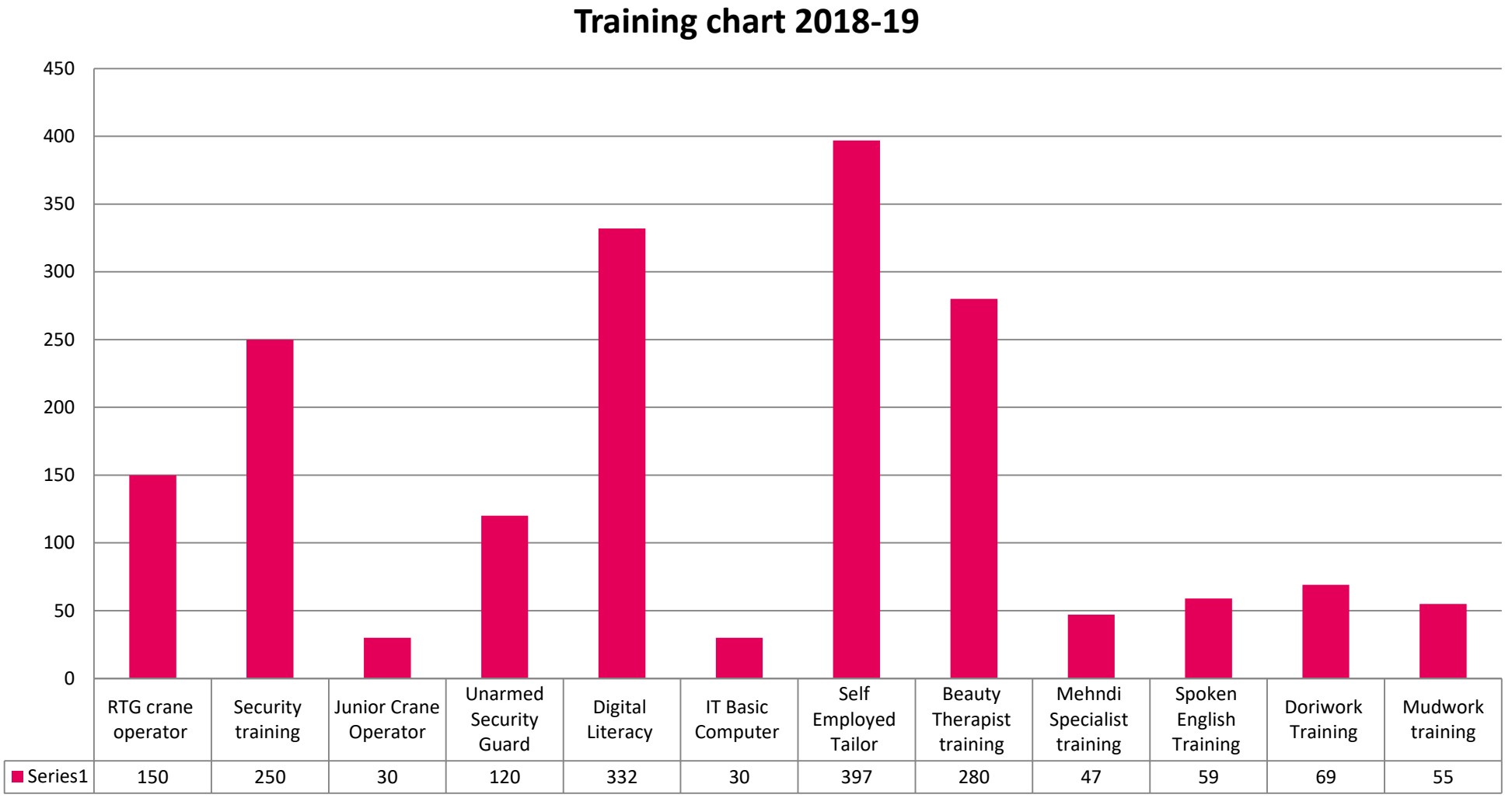
The objective of this center is to impart different kinds of training to the students of 10th, 12th, college or ITI from surrounding areas. Thus, various employment-oriented trainings are organized to optimize the skills, art and knowledge through proper guidance and direction.

**During this year Total 1819 people is given various trainings to enhance socio economic development.**

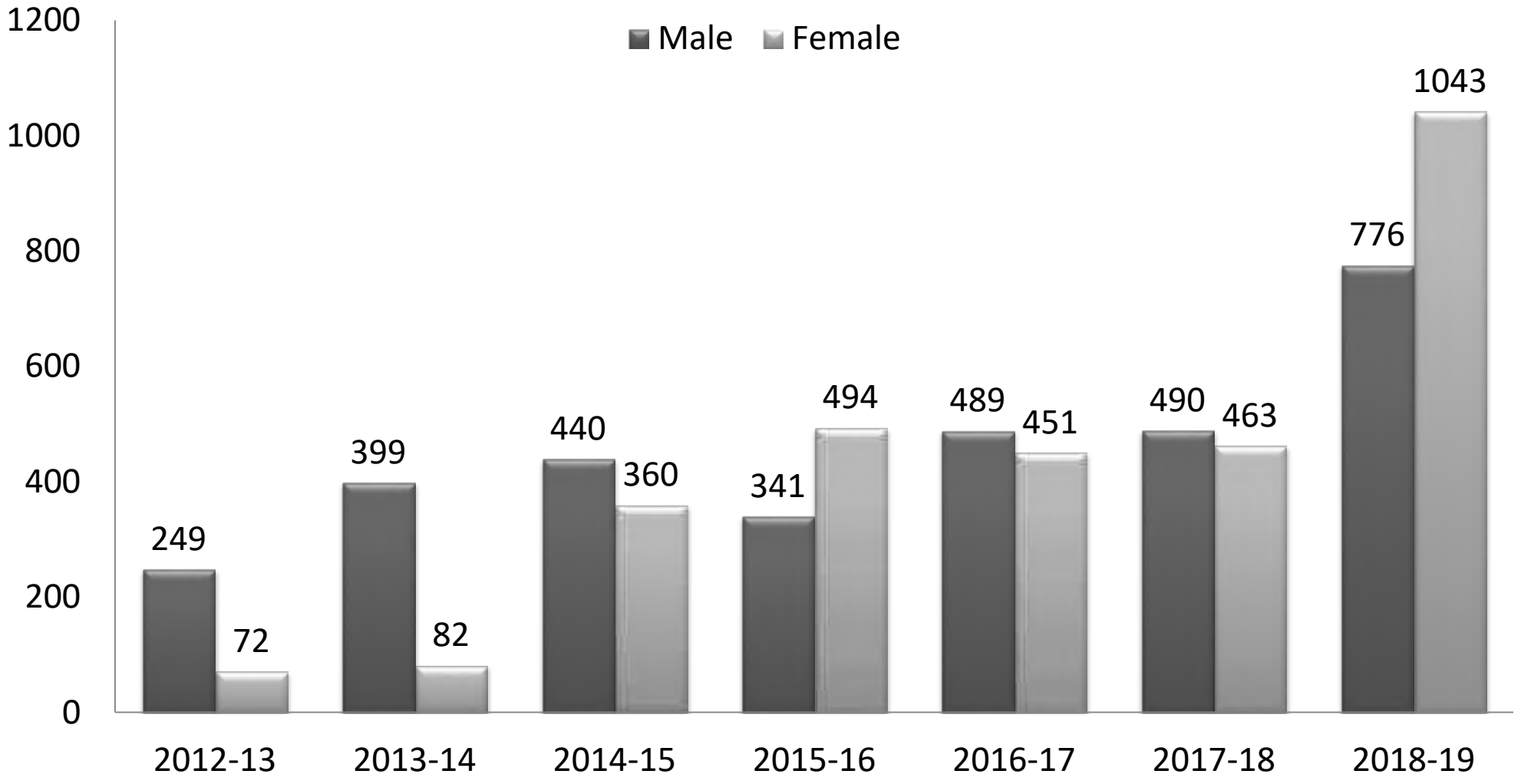
Out of which 1294 People are getting employment or Self Employment and average income up to Rs. 5200 per month. Digital literacy training is very helpful in coordinating with today's Digital world....

# In the year 2018-19, ASDC trained 1819 candidates at Mundra.

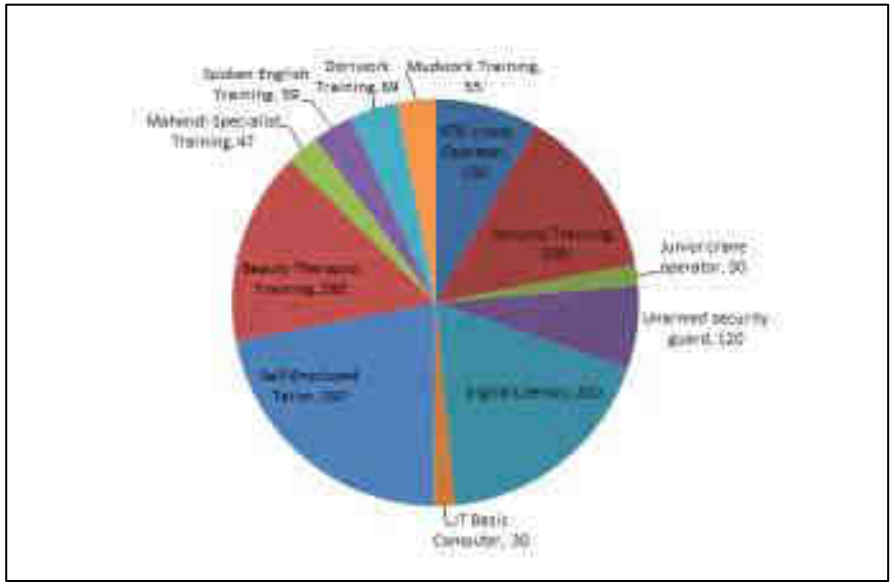
## THE YEAR IN REVIEW : KEY HIGHLIGHTS



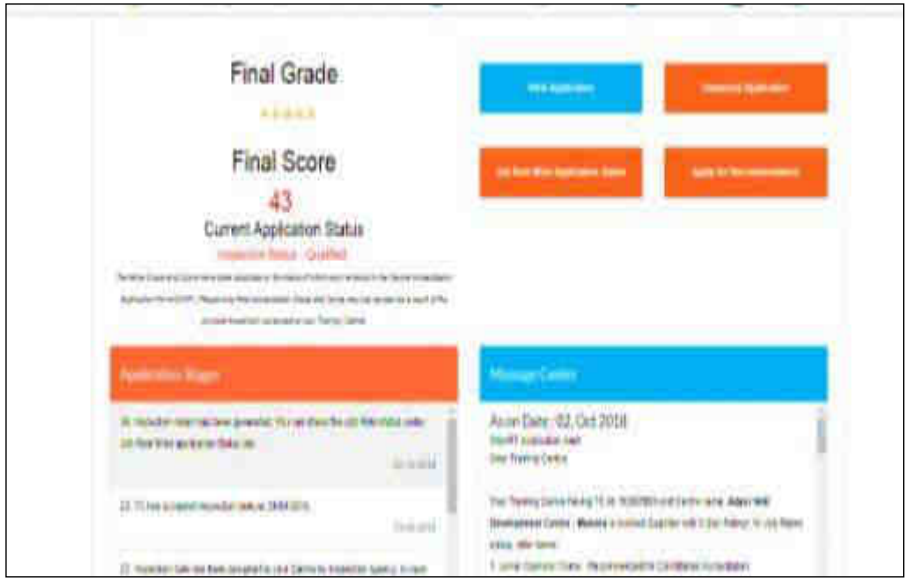
# OUR PROGRESS MUNDRA



# DETAILS OF VARIOUS TRAINING UNDERTAKEN




Adani skill development centre Mundra Placement figures of ASDC. Total 1294 people are getting employment after training with approximate ROI Rs. 5200 per month.




Adani skill development centre Mundra is qualified in NSDC with 5 star rating for job role junior crane operator and unarmed security guard.

## LAUNCHED "SAKSHAM" CENTER AT BAROI GUEST HOUSE

ASDC-Baroi (Mundra):- Adani skill development Center (ASDC) launched 'SAKSHAM' center at Baroi guest house in Mundra on 16th June 2018 to provide skill development training to youth in the Mundra.

An initiative of Adani foundation, the center in the Mundra city will benefit about more than 500 candidates every year in Beauty &Wellness course.

The center will provide skill development training to the youths in the age group of 14-40years initially in Beauty & Wellness course. Total enrolled for this training were 90 students.

## LAUNCHED "DIGITAL LITERACY" AT UTHHAN VILLAGES

Adani Skill Development center, Mundra has started digital literacy class in local village. 40 girls and boy are participated in first session. All village people are happy for this training in phase. We have also arrange evening batches to cover all people of various village.

Digital literacy training done through laptops and Tablets:-

1). The course duration is 26 days and number of hours is 52.

2). Per day training delivery hour is 2.

3). This is completely based on demonstrative and practical training methodologies.

4). The delivery is intended to be done through Desktops and Tablets

5). Attaching Also cover for payment banking topics .

# LAUNCHED "JUNIOR CRANE OPERATOR" COURSE UNDER PMKVY

On 6th December 2018 launching program was organized at Adani house for (1) Junior Operator crane (2) Unarmed Security guard

Total 30 beneficiaries identified and registered for Junior operator crane PMKVY portal. Mr. Vasant Gadhavi Sir (Director of Adani Foundation), Mr. Avinash Rai (CEO,APSEZ), Mr. Rakshit sir (ED APSEZ), and all HOD remained present and all motivated by their speech.

# STARTED UNARMED SECURITY GUARD COURSE UNDER PMKVY

Adani Skill Development Centre, Mundra received 120 candidates target of Unarmed Security guard training of PMKVY (NSDC). We have started 2 batch with 60 candidates of Unarmed security guard training at Adani Security training school at Mundra.

# Adani Skill Development Centre - Bhuj

One more feather added in Cap of Project Saksham – Adani Skill Development Center started in Bhuj.

PMKVY certification received with Four Star Rating in October 2018.

We have started Adani Skill Development Center at Campus of Gujrat Adani Institute of Medical Sciences with a main stream course of "General Duty Assistant". After that we started digital literacy, beauty and wellness plus stitching courses.

ASDC Bhuj got overwhelming response of district administration for organizing special batch for widows and coordinating for their placements.

We got prodigious rejoinder during training of visually impaired and hearing impaired students at Navchetan Andhjan Mandal Madhapar.

By the unique activities and coordination, ASDC Bhuj received huge amount of appreciation from media.

Total 663 Beneficiaries have taken training out of which 432 people are doing job or self employment.

# In the year 2018-19, ASDC trained 663 candidates at Bhuj.

| Training Details | Qtr.–1 | Qtr.–2 | Qtr.–3 | Qtr.–4 | Total |
|---|---|---|---|---|---|
| Digital Literacy | 0 | 27 | 58 | 175 | 260 |
| General Duty Assistant | 59 | 55 | 83 | 00 | 197 |
| Spoken English | 0 | 14 | 0 | 0 | 14 |
| Beauty & Wellness | 0 | 35 | 18 | 79 | 132 |
| Banking Related Training | 0 | 0 | 0 | 60 | 60 |
| **Total** | **59** | **131** | **159** | **295** | **663** |

# Event Celebration


# Teacher's Day Celebration : Guru Vandana

- Teacher's day Celebration - Guruvandana' Program was organized under esteemed presence of Shri Prabhav Joshi (District Development Officer) and teachers of 106 government primary schools with great enthusiasm.
- Objective of the programme was "healthy mind resides in a healthy body which is why a health checkup is scheduled for all the teachers which included BMI, BP, RBS, HB and vision test. Health check was done by Adani hospital Mundra.
- Followed by a motivational speech by Dr. Darshana Dhodakiya who is the Director of Bhasha Bhavan of Gujarati Subject, Throwing light on the principle that teachers cannot be trained in to be coming a teacher, but they are teachers because they actually are born teachers.
- Soft skill training by Ms. Riddhi Trivedi who is a highly skilled trainer from ASDC and would explain us the importance and need of soft skills. A highly thought provoking drama by students of 'Shekhadiya' school. And last but not the least session taken by Mr. Jatin Upadhyay.

# Utthan :
# Review and setting tone

To review and propel the Project Utthan was scheduled on 18th February 2019 at Kamandpur Primary School and Dhrub. Distinguished Guest of the Programme was Mr. Prabhav Joshi – District Development Officer, Kutch , Mr. Rakshit Shah - ED, Mundra , Shri Vasant Gadhavi, Director - Adani Foundation. SMC members of the School and villagers were gathered in Kamandpur Primary School.

DDO appreciated this unique initiative taken by Adani Foundation to enhance the level of Primary education of Kutch district. He is happy for the concept of Mothers' meet which is the keen area of this project for sending students on regular basis. He requested to all the mothers to send their ward in school daily. He especially recognized the installation of Smart Classroom in all the 17 School.

SMC members were highly appreciated the material support and introduction of English language in classes- 1 to 4 by the teachers which were appointed by Adani foundation. Principal briefed the project and shared his satisfaction towards this project on behalf of 17 School Principal.

Villagers are accepted Project Utthan with open handed and broad minded. Around 130 people were witnessed of this program.

# Uthhan : Anganwadi Upgradation

Under Project Utthan and part of early intervention Adani Foundation has upgraded Anganwadi infrastructure. To inauguration of the upgraded Anganwadi was scheduled on 18th February 2019 at Dhrub. Distinguished Guest of the Programme was Mr. Prabhav Joshi – District Development Officer, Kutch , Mr. Rakshit Shah - ED, Mundra , Shri Vasant Gadhavi, Director - Adani Foundation. ICDS members remained present to motivate the Anganwadi supervisors.


# Coastal Week Celebration with Indian Coast Guard

During celebration of coastal week - Safety and Security awareness program for fishermen while fishing as well as health check up camp and fishermen shed inauguration program was organized at Juna Badar with collaboration of Indian coast guard department. In this occasion Mamlatdar of Mundra, Commandant of coast guard and Mr. Ashvin Zinzuvadiya (Media : Kutchh Mitra) were present. Mainly they emphasized on national security as well as Personnel security in their speech.

Health camp was organized with support of Adani Hospital Mundra. Total 107 patients were benefitted by health check up camp and prize distributed to winner of Ramaotsav program.

# Fisher Folk Amenities..

Adani foundation, MUNDRA organized Cricket Tournament " Sixth Adani Premiere League among Fishermen community to promote healthy Sportsmanship and harmonically transparent relationship. The Tournament had been played for 13 days at SVC (Shanti Vihar Cricket Ground) by 6 matches per Days with full of Audience, Total 65 Teams with 780 Fishermen youth were participated with 550Rs. Contribution per teams from Mundra, Anjar and Mandvi Block. The Final Match was played on 9.07.2018 and Pir Saheb (Religious Mentor), Rakshit sir (Executive Director- APSEZ ), Dr. A.k Vatsani (Deputy collector ,Bhuj) Mr.Mahesh Dafda (Assistant Director of Fisheries, Bhuj), Mrs. Pankti Shah(Unit CSR Head) ,AF staff and Fishermen Leaders remained present. The Final Match was so interesting and Salaya team becomes winner over Luni Team and more than 1200 Audience from various villages were present. The winner's trophy, Runners-up Trophy, Man of the Series, Man of the Match, Best Baller, and Best Bats-Man Trophy has been given to the Respective Teams and players. The 25000Rs, 15000Rs, 2100Rs, 1100Rs, and 500Rs, 500Rs Prize given to the above Respective Teams and Players from the Teams contribution.

# Celebration of World Environment Day at High School, Moti Khakhar

- Plantation of 1111 trees in Moti Khakhar high school ground in coordination with forest department : Moti Khakhar is a Village in Mundra Taluka .It is located 19 KM from Mundra. School is constructed in year 2008 and it is with large ground. Principal requested Adani Foundation to support for tree plantation in area. As per size of ground we can plant more than 1000 plants. In addition, Soil condition is also appropriate. Adani Foundation contacted Forest Department for Tree plantation before monsoon and Forest Department supported for 4000 plants. After getting support from Forest Department – Adani Foundation supported for Drip and Fence for protection of plantation. On 5th June 2018, Adani Foundation Mundra planted 1111 trees at Moti Khakhar. Function was scheduled by Gram Panchayat. Mr. Vyas (District Education Officer),Mr. Anjan (DCF, Mundra), Mr. Saxena (COO, APSEZ),AF Team, students of the school and Village leaders remained present

# Talent Hunt:
# International Disability Day

Adani Foundation is working intensively for differently abled in Mundra Taluka since 4 years in coordination with District Social Welfare Department. Till date we could able to support more than 560 Divyang in Mundra Taluka .

In celebration of International disability day, Adani Foundation organized Music and Painting competition at Taluka Level and Zone Level.

For Winner s of Zone level – District level competition was organized on 3rd December 2018.

With the blessings of almighty, divine Start of the program with blessings speech of District social Defense officer and Laljibhai Prajapati of Navchetan Andhjan Mandal.

Total 675 people from different institutes remained present in inaugural session. All Divyang participants remained present with full preparation.

Some glimpse of the programme Second session of Talent Hunt - International Disability Day was prize distribution with musical celebration. District Collector Ms. Remya Mohan IAS, Mr. Prabhav Joshi IAS, Rakesh Vyas DEO, Mr Arvind District Social welfare officer remained present. Mr. Rakshit bhai Shah ED, APSEZ was with us throughout the program. All four categories got 3 prizes. District social defense officer had given certificate of appreciation to Adani Foundation Mundra..


# Talent Hunt : International Disability Day Glimpse












# Divine feeling towards Mata no Madh!!

Mata no Madh is a village in Lakhpat Taluka of Kutch district, Gujarat, India. The village lies surrounded by hills on both banks of a small stream and has a temple dedicated to Ashapura Mata, the household deity of former Jadeja rulers of Cutch State. She is also considered patron deity of Kutch. Many people are used to reach this Ashapura temple by feet from different parts of India. G K General hospital has organized health facility through at 10 locations on way of Mata Na Madh during Navaratri 5th to 11th oct.. In addition to medical facility, This health shibir will provide awareness of swachhagraha, swine flu and Beti bachavo as well The concept given by Shri Gadhvi Sir and implementation will be taken care by Dr. Chintan and Adani foundation health team.



# Employee Volunteering Programme

In a move first of its kind employees of the Adani Group have adopted all the students of the Vallabh Vidyalaya school in Mundra in their Employee Volunteering Programme (EVP). All the 704 children in the school are from families of migrant labourers working in various industries in and around Mundra. Children from migrant labourer families in addition to resource constraints at home also bear the disadvantage of unfamiliarity with local language and culture inhibiting participation in school.

Vallabh Vidyalaya by passes the language barrier as the medium of instruction is in Hindi and mostly the kids are from Hindi speaking families. "Thanks to Adani EVP financial resource constraint will be substantially relieved", Dharmendra Bhai who created the school from one shed institution gratefully acknowledged.

Energised by the inspiring leadership of Adani Foundation's Chairperson Dr. Priti Adani the Group employees handed over a collective cheque in an impressive function at the school premises. One student of Std. VII joyfully expressed, "Your benevolence will have indelible imprints and impact on our lives. Will remember you ever."

# Employee Volunteering Programme

Adani Group is deeply involved in all round social and economic development of the areas in and around Mundra. Adani EVP is context driven and employees have taken part in teaching, improving Aanganwadis, giving impetus to national Swachhata Mission and blood donation. The journey continues

# Employee Volunteering Programme

Dignity of workforce day was organized jointly of APSEZ (Adani ports n SEZ Limited), AWL(Adani Wilmar Limited), MSPVL (Mundra Solar Pvt Limited) Adani Hospital and Adani foundation at labour colony with medical camp and handing over of sanitation. more than 32 employees have volunteered in this event.

**1. Total OPD by Medical camp at Labour colony-315**

**2. Blanket Distribution to 800 workers**

In this event Mr. Sharad Sharna Head-AWL with staff, Bhaktbandhu DGM HR and Admin staff (APSEZ), Mr. Ganesh Sharma Head HR, President - Kutch Labour Union and Adani foundation team remained.



# Inauguration of Skill Development training program for Schedule cast beneficiaries

Another milestone reached on 28th Dec 2018, ASDC launched its program for schedule caste in the state of Gujarat. This program will train candidates in various vocational training educational course like Self employed tailor and Beauty & Wellness. Total 60 women/Girls participated in this training. This course is sponsored by Department of Social justice and Empowerment . It was inaugurated in the esteemed presence of Mr. V. S Gadhavi sir (Executive Director ASDC), Mr. Rakshitbhai Shah (ED of APSEZ, Mundra), Mr. K D Kapdiya (Director of Department of social justice and Empowerment), Mr. B P Soyantar (Dep. Director of Social justice and Empowerment, Gandhinagar), Mr. Dhangaru (Dep. Director of Social justice and Empowerment, Bhuj ), Mr. Jatin Trivedi (HOD of ASDC), Mrs. Pankti Shah (Unit CSR Head of AF Mundra), Mr. Javaid Akhatar (HR Manager of ASDC).




## SWACHHAGRAHA :
## At Gujrat Adani Institute of Medical Sciences

"Swachhagraha " – Project launched at Adani G K General Hospital to embed values of cleanliness in minds of the staff and community as well. Separate staff member is also appointed by HO team for the same. Mr. Gadhavi had launched swachhagraha by presenting insignia to Dr. Bhadarka' (Head, Adani GKGH).


## SAMVEDANA :
## Series of Motivational Sessions

To motivate and felicitate paramedical and nursing staff motivational session was organized with help of Ms. Hiral Pandya which is critical requirement of GKGH. She talked about behavior aspect as well as compassionate approach to patients.

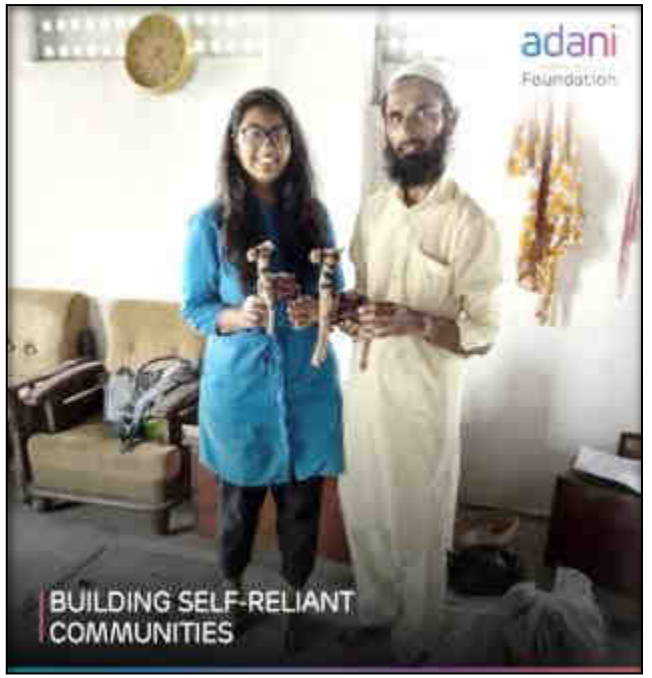
# NAMDA ON REVIVAL PATH

Even as a breakthrough is waiting to happen, five trainees were enrolled on Tuesday 5th Dec 17 by Adani Skill Development Centre (ASDC) for the age-old Namda craft, a dying art form of Kutchh district in Gujarat. First initiative of its kind, the skill development training on Namda is aimed at preparing a future generation of artisans for the historic art form.

Adani Foundation, the CSR wing of Adani Group had vowed to save Namda from extinction and bring back its past glory. Originally innovated by an artisan of Mughal Era in the 11th Century India, Namda craft was primarily practiced by the Pinjara and Mansuri communities and Sama Muslims native to Kutchh. Sans proper encouragement, marketing avenues and promotion, the art suffered a major setback with artisans gradually switching over to other professions for livelihood earning.

Till recently, when the Adani Foundation, Mundra team members approached Mansuri Karimbhai Umar bhai, perhaps the sole survivor of the craft in Kutchh, Namda was dying a natural death. As a good corporate citizen, the Adani Group initiated a move to protect the art form, as well to make it popular and sustainable.

The first step towards the enormous goal of reviving Namda, the training programme kicked started with lots of positivity and enthusiasm among the trainees, who are committed to put best efforts for bringing back the past glory for this craft. And the best part of the initiative is that, the Namda survivor himself would train the future-artisans.




**GREAT ACHIEVEMENT IS....**

**KARIM MANSOORI ONCE AN ORDINARY NAMDA ARTISAN IS NOW AN ENTERPRENUAR. THE ADANI FOUNDATION FEELS CONTENTIN REVIVING THE DYING NAMDA ART FORM AND SUPPORTING MANSURI IN STARTING HIS OWN BUSINESS.**

**HIS JOURNEY IS OFF TO TO A FLYING START AND WE WISH HIM ALL THE BEST.**

# Beneficiaries Speaks

# Utthan : Enhancing Quality of Education !!

Navinal is a small village of Mundra Taluka. The village boasts of the works done by the goodwill of the Mahajans.The village is inhabited by approximately 1000 people. Rameshbhai Sathwara , his wife Champaben along with their three sons are one of the families residing over here. Rameshbhai is a greengrocer and lives a contended life with his family. The eldest son 14 year old Haresh and the middle one 10 year old Lalji study with devotion and bring good result with god's grace and the blessings of the elders of the family. Their final result would bring a new ray of hope for the parents every year.

But the youngest son, Sanjay studying in class 3 could not read or write. Even after a lot of efforts nothing could not make him read and write. He himself did not even feel like reading or writing. It was meaningless to drag him into learning without his own willingness. The teachers also accepted Sanjay as a dull boy and didn't pay much attention.

But one August morning became august for this boy as it brought a bright ray of hope for him.

A new teacher who had come to teach students like Sanjay talked to Sanjay in his Kutchi mother tongue and this attitude of this teacher made the little boy go wonderstruck. The new teacher made them sing a lot of poems, showed a lot of colourful books and told them a lot of stories. Her attitude interested Sanjay and he willingly came ahead. He sat in the first raw and told the teacher about a lot of things including the beehive outside his home, his parents and elder brothers. What appealed Sanjay the most was the constant attention paid by the new teacher to him. The next day led Sanjay to the special classroom made for the students like him.

Thus, every morning became a new, exciting morning for him.

And today, the innovative rangoli making in shape of alphabets using the fallen tree leaves interested him so much that he got interested in writing letters. This interest led him to write alphabets and later words. Moreover, he got interested in co-curricular activities like reciting poems and colouring the pictures.

The factor that attracted him the most was the loving teacher and this teacher is Hansbai Gadhvi. A resident of Mundra itself Hansbai, studied at Adani Public School. She provides her services to Adani Foundation's Utthan programme.

The Utthan project is the result of the agreement under which Shri Bhupendra bhai Chudasama, the Minister of Education of Gujarat assigned the responsibility of improving the quality of Education to the Adani Foundation. And the responsibility has religiously been accepted by Shri V.S.Gadhvi Sir for the 17 government primary school. Shri Gadhvi Sir has taken it as a mission for the foundation to lead the below average students to the upper level. The teachers having command over Hindi, English and Kutchi have been providing their services in these schools.

The Utthan Project initiated in August 2018 has been heartily welcomed and appreciated by the students, parents and teachers of this area. Under this project, the children who are weak at reading, writing and basic calculation are taught in such innovative ways that their foundation becomes strong and they can come into mainstream level of their class.

The best characteristic of this project is introducing English language from the class 1. Talking about the co-curricular activities, these schools have been facilitated by libraries, smart class rooms and sports equipment.

The efforts are made with a hope that these children get the benefit of this teaching mission and move towards a happy, bright and prosperous future.

# Utthan : Enhancing Quality of Education !!

"Her eyes today had a shine so different, so divine, probably astral... was the shine real or an illusion? Or it was a simple result reflecting the efforts put in?"

These are the words of Siddhi Shah who is one of the teachers working as Utthan Sahayak in the Utthan project. She works in the Zarpara village, a village where the chief occupation is agriculture and this works as the chief reason behind the irregularity of children in attending school.

The area in and around Zarpara is quite vast and looking at this only the Government has approved 6 Government Primary Schools. But the scenario on the education side is still dismal. There is a long way to go to achieve the desired results. The teachers like Siddhi Shah who work as Utthan Sahayak have their role here. They play a key role in leading the children to school and bringing their academic level up.

Let's talk about what Siddhi Shah has to say about one such girl Prgna who studies in the Khoyadi Government Primary School.

Pragna's father Haribhai is in agriculture field and rearing cattle. This work cannot be carried ahead without the support given by the wife and thus the mother Malsriben too is busy helping the husband in his daily work along with shouldering the responsibilities of performing the household chores of a joint family and bringing up of her own three children. Hence, she finds it difficult to monitor the schooling of her children.

Pragna herself did not have much interest in studies and being the only girl child of the family, Pragna didn't take going to school seriously.

Siddhiben Shah would check the attendance registers daily and would go to meet the parents of those children who do not come to school regularly.

Pragna's irregular attendance was noticed by Siddhiben Shah and she decided to visit her home.

Once she visited her mother Malsriben and persuaded to send Prgna at school. This worked and Prgna started coming regularly. To her surprise, Siddhiben found that Pragna who was not at all interested in reading and writing could do Maths sums excellently well. Siddhiben used her interest in Maths and led her to reading and writing. Under Siddhiben's guidance, Pragna started with letters, words and with the passage of time she acquired fluency in reading flawlessly. It was like a test for the teacher and Pragna's reading fluently and with interest was the fruit the teacher's hard work bore.

And today when in the Saturday morning assembly, Siddhiben saw Pragna reading the newspaper fluently, she realized that it was her hard work that had borne fruit.

Siddhiben Shah is basically a computer engineer but her love for social work, especially in schools brought her to work in Utthan. The students studying in Adani Foundation and in the schools under the Utthan Project salute her dedication.

# Swavlamban :
# Pathways to become Self Reliant !!

Mina Ben is resident of Baroi village. She is widow and living with his two children who are studying in school. Adani foundation is coordinating with Jilla samaj Surakha department for availing various benefits of Government of Gujarat to widow women, differently abled and senior citizens of Mundra, Mandvi and Anjar Taluka. We did all procedure for Mina Ben for regular pension scheme.

Mina Ben was ready n passionate to start Gruh Udyog with loan support with 40 percent subsidy by Vajpayee Bankable scheme "With our efforts she got loan and now she will start Gruh Udyog of " Aggarbatti " with pre defined marketing linkages with Ashapura temple trust.

# Swavlamban : Pathways to become Self Reliant !!

Adam Bhai Bayad is living at Moti Khakhar Village He is differently abled and having wife and two children in his family. He is having one skill of mobile and computer repairing.
As per his request we allotted him one cabin for income generation. Now he is started to sale Mobile, Mobile accessories. Additionally he started repairing mobile and computer. By hard work he started earning considerable amount. Adam Bhai says "due to this support my children can study well and my quality of life is enhanced

Parvina ben is Divyang but strong lady. She is educated and use to work as a teacher primary school. She was using sticks to reach school. Adani Foundation had given support of tricycle for her comfortable transport.
She says "Adani Foundation is working as a great facilitator for needy people. This is true social work which has created very good imprint in heart of village people. God bless !

# Swavlamban : Pathways to become Self Reliant !!

As the wheels of her sewing machine keep moving, so as the dreams of a better life and empowerment enthuse Bhanuben overcome the physical deformities which came in the form an injury in the spinal cord during childhood. Both her legs were malfunctioned forcing dependence on calipers for movements.

Bhanuben Gangji Patariya of Bhujpur village lost her father when she was just 15 years old, and had very little understanding of the materialistic world and struggle of life. Poverty in the family compelled Bhanuben to drop school and do small odd household jobs of fellow villagers and sometimes accompany her mother as daily labour.

The sudden transition in life, from most adorable darling of her father to an unnoticed and uncared human being in the society, often disturbed the innocent mind of Bhanuben.

Few months back, Bhanuben had enrolled at Adani Skill Development Centre for stitching training, which she could successfully complete within the deadline due to a strong will power and aspiration to win over all odds in life. During her training period only she learnt about AF's Project Swavlamban and expressed the desire to be part of it.

Followed by proper counselling and guidance for self-sustainability, AF donated her one wheel chair and a sewing machine which helped Bhanuben change her life and build the self-confidence of stitching a bright future for her family. Now she earns an average of Rs. 2500 a month which takes care of the basic livelihood needs of her family.

Wearing a smile of satisfaction on her face and the pride of being self-sufficient, Bhanuben expresses her heart-felt gratitude to AF for standing by her during this critical juncture of life. She has become a ambassador to spread the message of all good works by AF in her locality. She is yet, another success story in the saga of sustainable CSR by AF.

# Swavlamban : Pathways to become Self Reliant !!

Her name is Sanjuben. Residing in Vadala village with her Divyang husband and 9 years old son. Her husband is working at one shop and trying for two ends meet. During Divyang Mahiti card Vitran by Mamlatdar office she came to know about project Swavlamban. She meet Kalyan Gadhvi who is community mobilizer in Adani foundation. Kalyanbhai had given information n support for Divyang pension scheme.

Since two years couple is getting pension which amount can be used for further study of their son. Additionally, Adani foundation supported her for tricycle in coordination with district social welfare department. Sanjuben is daily using tricycle to give tiffin to her husband. Small linkage can bring life transformation !!!

# Spruha : Motivating fisher folk for bright future !!

Fakir Mamad Hasan Vagher

24 year old from poor fisherman family was selected by AF To provide cricket coaching last year. he has completed successful training at Rajkot YB sport academy with excellent performance even in Kutch 23 selection. The YB academy organized honor ceremony and invited AF. On this occasion dignitaries and more than 400 peoples were present and they all appreciated noble support by Adani Foundation.

Fakir Mamad saying that he was playing on behalf of other team and earn RS 500 to 600 but after cricket coaching he get status and honor in Kutch cricket even in society and earn Rs 1500 to 2500 for each match.

# Spruha : Motivating fisher folk for bright future !!

Mamad Sakil Osman Ghani Adani Vidya Mandir – Bhadreshwar 'A High Leap by a Poor Child from the Fisher folk Community.....Towards Engineering Studies.....Through Adani Vidya Mandir' 2017-18 Name: Mamad Sakil Osman Ghani Father's Name: Osman Ghani Mother's Name: Halimaben Family: Brother (1) + Sisters (4) & Parents; total 8 members Occupation: Fishing Village: Luni; Taluka: Mundra; District: Kutchh In modern times along with its importance, education has also made changes in our lifestyle.

Adani Vidya Mandir, Bhadreshwar, is like a lighthouse giving a ray of hope in remote areas. It was established to provide education to children from socio-economically backward communities. The school provides high-quality education, nutritious food as well other kinds of facilities so that children's self-respect increases through the education. Speaking of students, Mamad Sakil was enrolled in the Std. 7, in 2014-15 in the Adani Vidya Mandir, Bhadreshwar. His father, Osman Ghani, is a fisherman. His family of eight members consists of his mother, his father, a brother and four sisters. They live in Luni Bandar.

From the beginning it was seen that he was a quiet, straightforward, humble and cultured boy. He also exhibits behavior with moral values. Everyone helped the family socio-economically. In the Adani Foundation with the help of Vijayhai and Ishwarbhai noted details of the family and found that nobody was educated. In such times of rising prices and inflation it is difficult to raise so many children. So the school management decided to take over and fulfil his basic necessities. Efforts for this child's educational success were made including counselling and guidance.

During his first year in the school, he participated in the running competition in the Khel Mahakumbh and came first in the district. In this way, he began to progress in not just education but also other areas. He started getting promoted to the next standard every year and eventually he reached Std. 10. With the help of the school in various ways and his own hard work, he successfully cleared Std. 10 with 77%. He stood second in the school. Now, the journey of his life has really started. He has started to see new and inconceivable dreams for his future career. Now, the Adani Foundation will be holding his hand to fulfil his dreams.

After completing studies of the Std. 10, he was gifted an android phone by the school principal, Smt. Lali madam, as he needed new technology to get admission for further studies. In this way all the obstacles have been removed from his career path. He has now taken admission in mechanical engineering in Bhuj Polytechnic, and the Adani Foundation has paid his entire fee. A new innings has started in his life. With his hard work he is making progress step-by-step. He has set a good example for other students. And we all hope that he will eventually become a strong financial support to his family.

# Adani Vadil Swasthaya Yojana: Holding Hands !!

Every human being has specific periods of the life wherein the childhood is for fun and the adulthood is spent for the family; remains old age to take care of health

Adani Foundation is holded hands of the senior citizens of Mundra

Manubha and his wife stay alone. Their son and daughters stay separately. They earn their living by grazing cattle. Manubha is having **respiratory disorder.** The source of income is very meager and that to dependent on rain. He had to borrow money from family friends or at times take on interest for taking basic treatment. His wife Shantaba also has blood sugar and hence she also requires medical assistance at times. The couple took **Adani Foundations'** ***Senior Citizen Health Card*** in 2015 by which they are able to save good amount, which was their medical expense every month.

"Adani Foundations' Senior Citizen Health Card is like a cure to our emotional, physical and psychological problem; in the times when we are completely lonely and handicap at age."....Says both of them while weeping.

# Adani Vadil Swasthaya Yojana: Holding Hands !!

Adani Foundation at Bhuj is aware of its social responsibilities to the surrounding community. Madhapar is a village approximately 28 km away from Bhuj wherein resides Aseembhai who was financially, health-wise and socially unstable until he availed help from AF at G K General Hospital Bhuj. Aseembhai settled in Madhapar 30 years ago. before 8 years, he lost his wife to heart attack.

His parents passed away when he was 3 years of age and the only surviving relative he could call his own was his brother who was also mentally-challenged. His problems did not end there as e suffered from high blood pressure and stress induced thyroid which required he took medication as long as he lived.

Slowly his body stopped reacting to the medicines and these did not work. One He got convulsions as a side effect of over dose of medicine. His neighbors took him to Adani G K G H Hospital. Adani Foundation staff took very good care of Aseembhai. For one month he admitted to hospital and daily staff members ask about his health.

When he got discharged he said

"Adani is Like my Second Son.. I get the services even without asking for it"

# Saksham Superhero's : Skill Development

My father is a working as a mechanic in ST workshop and his income was not sufficient for live life better so my mother also was working in different fields. I also was trying to find job for support to my family financially. One of my friends suggested me to visit Adani Skill Development Centre – Bhuj and join General Duty Assistant. When I visited center I got all the GDA related information from the staff, I took admission. During this course I learnt lots of Medical related things from the faculty I also was taught about Personality Development, Computer basics, Basic English, Interview Skills. During my practical for 1(one) month in GAIMS, I got chance to work in 4(four) wards. During my practical I learnt many things. After completing GDA course ASDC SAKSHAM is arrange interview At Adani GAIMS Hospital Bhuj. I attended interview and I was selected for physiotherapy section. I was offered monthly salary Rs.10000/- and join the job. After joining this job, I am glad that now I am a working woman and more then that I can help my family financially. With this job my life has become better than before. I would like to thanks Adani Skill Development Centre to give me this Opportunity and for making me SAKSHAM.

22 years old Dhanabai has completed Self Employed tailor course from ASDC in the month of June 2018. Now she start her own tailoring business at home and doing stitch ladies clothes.
At present she is earning Rs.6000/- Monthly.

# Saksham Superhero's : Skill Development

Bhand Navin Devjibhai is very fond of financial autonomy and self-sufficiency, a principle of life which he has got by virtue of his skill development training at Adani Skill Development Centre (ASDC), Mundra. A Commerce graduate from Mundra village, in the year 2017 Navin had enrolled himself at ASDC for the IT-Basic Computer training. He was unemployed and lacked the minimum confidence of facing any job interview as per his qualification.

As part of the well-designed training curriculum at ASDC, the 21-year old youth learnt skills of public speaking, professional manners, facing interviews etc. along with core subject of IT basic computer. The training helped Navin immensely and fetched him a company job with lucrative Rs. 10,000/- per month salary. Happy with his financial autonomy, he is now in a comfortable position to support his parents and three brothers.

My name is Ashok Maheswari from shedata village, Mundra.
My father is no more in this world so I was trying to find job for support to my family financially. One of my friends suggested me to visit Adani Skill Development Centre – Mundra and I have joined Checker cum RTG crane operator training for 3 months. After successfully my training I sent my resume in various port. One day I received call from aani port at katupalli in Chennai and I attended interview and I was selected for RTG crane Operator. And today my salary 20,000/- per month.

So, I can help my family financially. With this job my life has become better than before. I would like to thanks Adani Skill Development Centre to give me this Opportunity and for making me SAKSHAM.

# Saksham Superhero's : Skill Development

Manisha Patel, from Mundra, has completed Std. 12. Her parents are laborers, earning minimum wages. Manisha had always been a bright student in school, wanting to learn new things. Feeling restricted in life, she dreamt of doing something different. She wanted to have a successful career and be recognized by society. Hence, when she was advised by a close friend to join ASDC's Beauty & Wellness course, which is an NSDC certified course, she grabbed the opportunity. She came to the course with a fresh mind and ready to absorb all the knowledge. She actively participated in all activities. She was full of curiosity and questions, and this attitude enhanced her skills. She was extremely happy when the trainer appreciated her enthusiasm upon completion of the training.

She was delighted to open her beauty parlor. She had also undergone extra training in specific soft skills and business manners in order to handle customers. With these skills, she manages customers like a pro and runs her salon smoothly. Her family members, including her in-laws, were initially hesitant to let her join the course but soon relented upon seeing her enthusiasm and zeal for learning. They are quite proud of what she has achieved in such a short time.

Manisha and Shree Beauty Parlor are synonymous with high-standard beauty and wellness services in the Mundra locality. Her quality services and reasonable prices have increased her popularity and helped in attracting more customers. Today, she earns Rs. 12,000-15,000 per month. Her trainer, Ms. Rekha says, "She and many other candidates who completed their training at ASDC are ambassadors of Saksham. They strive to learn and grow by beating all odds. I am proud to be given this opportunity to groom and create skilled beauticians who can handle the ever-increasing standards of beauty treatments in a city like Mundra. I wish them the very best!"

# Saksham Superhero's : Skill Development

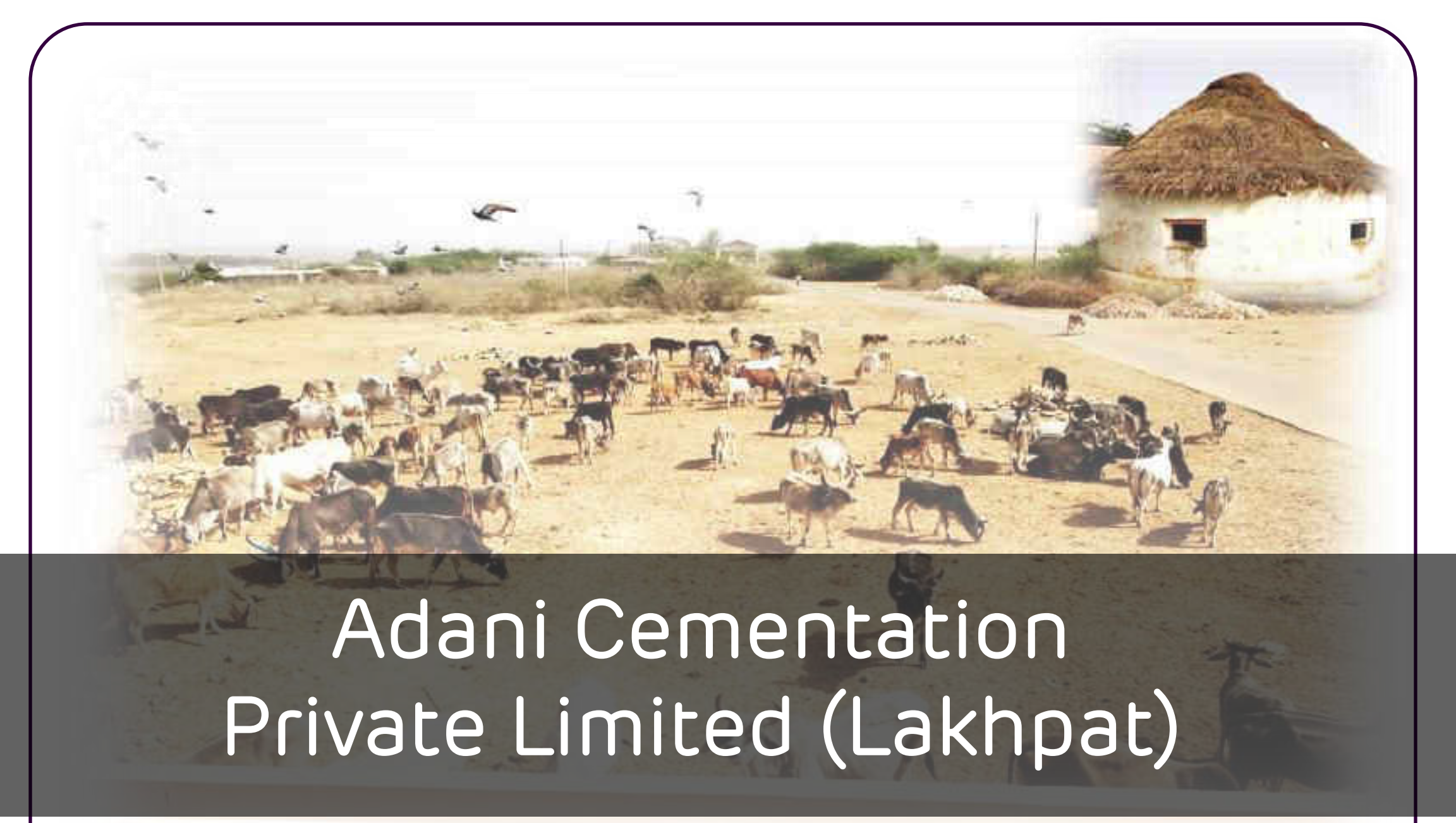
Lilbai koli- A youngest widow of the general duty assistant (GDA ) batch from Adani skill development center (ASDC) Bhuj is an epitome of courage and confidence. She is 22 years old with a one and half year old baby, and lives in a Mirjapur village, Bhuj.

She is 12th pass with Arts stream and used to love drawing and painting as her hobby. Her parents work as laborers and her sister cooks at home. She got married in 2016 and lost her husband in 2018.The most tragic thing is that she didn't even know the exact reason of her husband's sudden death. Happiness is transient, she faced many problems starting with loosing her husband, becoming single parent and loosing financial support from her in-laws which resulted in returning to her parents home.

When asked about her future plan she says "Talking about remarriage is a taboo in our village and culture. I want to be strong enough to work hard and give my son a healthy and happy Life".

Presently, Lilmai is pursuing her ,On the Job Training in G.K General Hospital. A girl who has never seen hospital is now learning technicalities of patient care in emergency ward.

A young novice is all set to become a successful patient care assistant with a single goal in life i.e 'To become economically stable enough to educate her child'. Lilbai expresses huge gratitude to Adani Foundation and ASDC Bhuj for giving her opportunity to study GDA course and help her get the job so that she no longer have to depend on anyone's help for herself or her child's future.

# Adani Cementation Private Limited (Lakhpat)

# Adani Cementation Private Limited (Lakhpat)

Adani Cementation Limited (ACL) proposes to setup an integrated cement project as Lakhpat Cement Works which includes Limestone Mine in 251.9 ha area, Cement Plant of rated production capacity of 10MMTPA Clinker and 3MMTPA of OPC/ PPC/ PSC/ COMPOSITE CEMENT in three phases, and a berthing jetty of 15MMTPA traffic capacity in phase wise manner in Taluka Lakhpat of District Kutch (Gujarat).

Project Public hearing will be in month of May 2019. For Smooth Execution of the Project we have started Participatory Rural Appraisal and Village Development Committee formation at three nearest villages (Koriyani, Kapurashi and Mundhvay) of our upcoming cement plant.

# Adani Cementation Private Limited (Lakhpat)

Kutchh is the biggest district in India and Lakhpat is far away from Bhuj which is main city of Kutchh. Health facilities are very poor as District hospital is around 150 Kms Away. Main livelihood is animal husbandry and daily wedge labour. Except GMDC , no big industrial set up is in Taluka.

Critical Issues are as under

1. Poor Health Facilities
2. Quality of Primary Education
3. Infrastructure of School
4. Livelihood options
5. Fodder and water Scarcity
6. Malnourishment

Adani Foundation will make five years plan to mitigate the issues with priories suggested by Village Development Committees. Detailed PRA including Demographic survey is taken up and submitted.

# Adani Green Energy (MP)Limited (Nakhtrana)

# Adani Green Energy (MP) Limited (Nakhtrana)

Adani Green Energy(MP) Limited (AGEMPL) proposes to setup an integrated wind energy project as Green Energy Works which includes Limestone 750 Mw, Through approx. 1250 windmill at Dayapar to Nakhtrana in District Kutch (Gujarat).

For Smooth Execution of the Project we have started Participatory Rural Appraisal and Village Development Committee formation at three nearest villages (Ratadiya, Muru and Ambara) of our upcoming Wind Energy Project.

# Adani Green Energy (MP)Limited (Nakhtrana)

Kutchh is the biggest district in India and Ratadiya (Nakhtrana) is 70 Km away from Bhuj which is main city of Kutchh. Health facilities are very poor as District hospital is around 70 Km Away. Main livelihood is Agriculture, animal husbandry and daily wedge labour. In Nakhatrana, No big industrial set up is in Taluka.

Critical Issues are as under

1. Poor Health Facilities
2. Quality of Primary Education
3. Infrastructure of School
4. Livelihood options
5. water Scarcity
6. Malnourishment

Adani Foundation will make five years plan to mitigate the issues with priories suggested by Village Development Committees. Detailed PRA including Demographic survey is taken up and submitted.

# Awards and Accolades

We are glad to announce our latest accolade- the Eminent Award 2018 platinum category presented at the Ek Kaam Desh Ke Naam award ceremony on 25th March , 2019 at New Delhi. The award was bestowed upon Adani Ports and SEZ Ltd, Mundra, for outstanding achievement in Corporate Social Responsibility, specifically " Adani Vadil Swasthaya Yojana - Health card to senior citizen ". The award was presented by Sh. Anil Baijal - Retired IAS & 21st Lieutenant Governor of New Delhi and was received by the Community health team of Adani Foundation, the CSR arm of the Adani Group.

Pleasure to share that

Adani Foundation have received

appreciation letter from

**Mr. Vijay Rupani (Chief Minister, Government of Gujrat)** for

commendable work for Project

Swavlamban in District Kutchh

વિજય રૂપાણી

Apro/Jm/2019/01/29/vj

તા. ૨૯-૦૧-૨૦૧૯

સ્નેહી શ્રી પંક્તિબેન,

નમસ્કાર.

વિશ્વ દિવ્યાંગ દિનની ઉજવણી અને અદાણી ફાઉન્ડેશન મુંદરા દ્વારા સ્વાવલંબન પ્રોજેક્ટના દિવ્યાંગાભિમુખ વિવિધ-કાર્યક્રમ અને પ્રવૃત્તિઓનો CD સહ અહેવાલ પ્રાપ્ત થયો. ધન્યવાદ.

સમાજમાં નિરાધાર-અસહાય અને દિવ્યાંગ વ્યક્તિઓનો હાથ પકડી, હામ અને સહકાર આપી, એમને જીવનની મુખ્યધારામાં લાવવાની ધરપત આપવી એ જ સાચી સેવા.

સુરક્ષા અને સહયોગમાં સરકાર તો ખડેપગે રહે જ છે ત્યારે સમાજસેવી સંસ્થાઓની સંવેદનશીલ સક્રિયતા સોનામાં સુગંધનું કાર્ય કરે છે. સૌને ધન્યવાદ. લાભાર્થી અને સ્પર્ધામાં વિજયી સૌ દિવ્યાંગોને પણ અભિનંદન.

આપનો,

(વિજય રૂપાણી)

To,
**Smt. Panktiben Shah,** *CSR Head*
Adani Foundation
Adani House, Port Road, Mundra, Kutch- 370 421.
Email: info@adanifoundation.com

# Awards and Accolades

Office of the Collector & District Magistrate - Kachchh
Jilla Seva Sadan, Bhuj-Mandvi Road,
Bhuj - Kachchh
email : collector-kch@gujarat.gov.in
Phone : (02832) - 250520
Dt : 11/05/2018

To,

*Adani Group*

Sub : *Letter of Appreciation*

Dear,

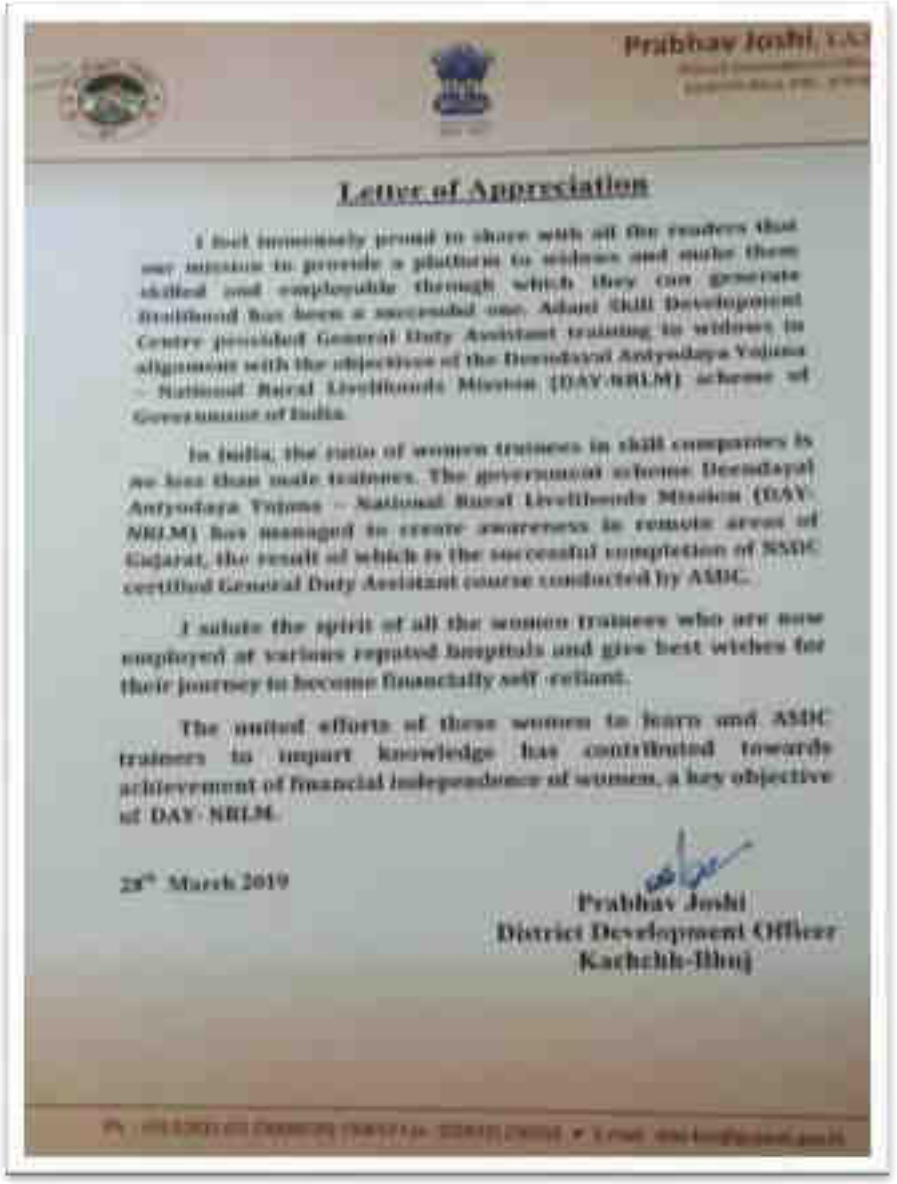
*I am sending this letter to extend my appreciation towards you and your whole team for your contribution in "Sujlam Suflam Jal Abhiyan - 2018" campaign of Government of Gujarat in a short span of time and that too in an efficient way. I must say that you have got a dedicated team professional in their approach with sheer dedication and sincerity.*

*you and your team have completed* **26** *works of* **Mundra Taluka** *under this campaign activities like deepening of water tanks, desilting of checkdams, desilting of recharge etc. by contributing 100% as corporate social responsibility.*

*I once again would like to congratulate you all on the successful completion of Sujlam Suflam Jal Abhiyan - 2018 and appreciate you for your generosity and support.*

*Warm Regards,*

(Ramya Mohan)
Collector - Kachchh



Prabhav Joshi, I.A.S

**Letter of Appreciation**

**I feel immensely proud to share with all the readers that our mission to provide a platform to widows and make them skilled and employable through which they can generate livelihood has been a successful one. Adani Skill Development Centre provided General Duty Assistant training to widows in alignment with the objectives of the Deendayal Antyodaya Yojana – National Rural Livelihoods Mission (DAY-NRLM) scheme of Government of India.**

**In India, the ratio of women trainees in skill companies is no less than male trainees. The government scheme Deendayal Antyodaya Yojana – National Rural Livelihoods Mission (DAY-NRLM) has managed to create awareness in remote areas of Gujarat, the result of which is the successful completion of SSDC certified General Duty Assistant course conducted by ASDC.**

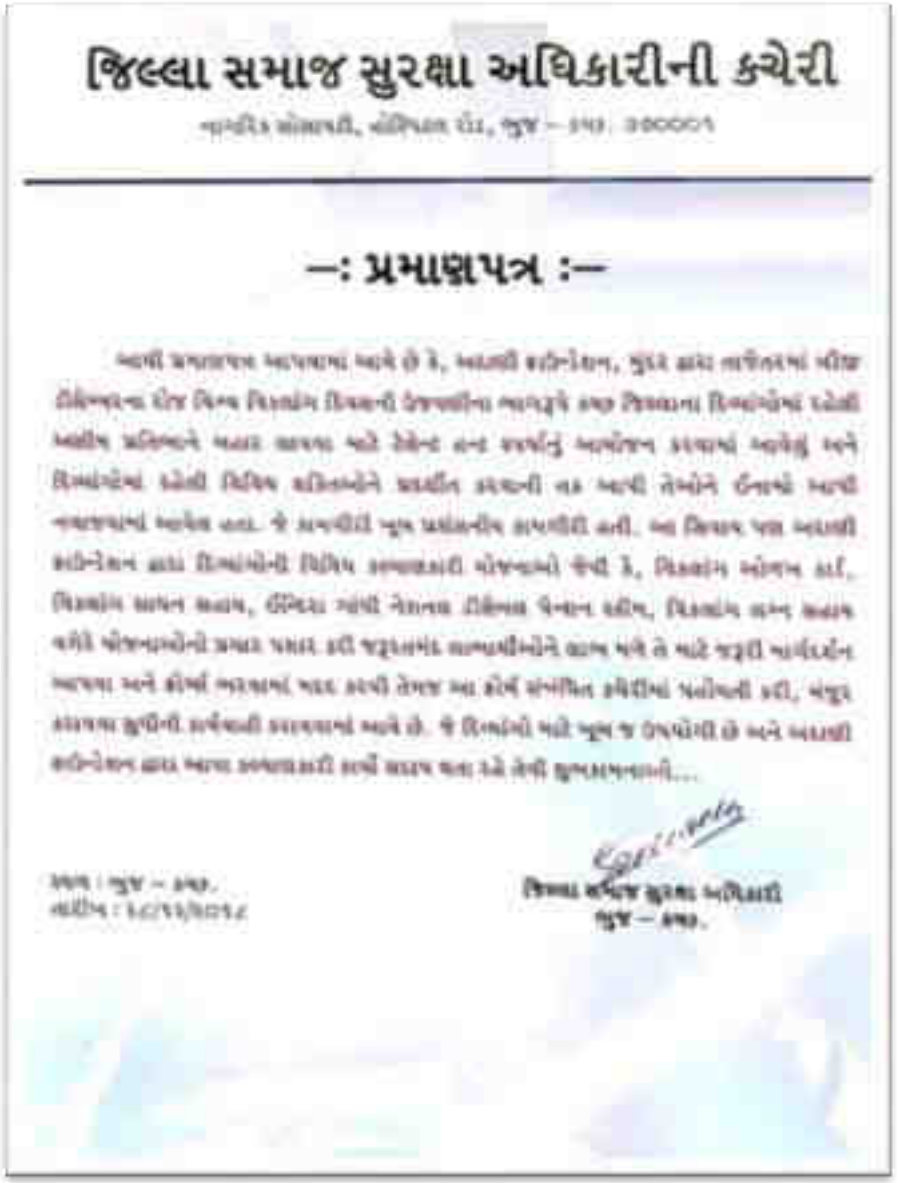
**I salute the spirit of all the women trainees who are now employed at various reputed hospitals and give best wishes for their journey to become financially self-reliant.**

**The united efforts of these women to learn and ASDC trainers to impart knowledge has contributed towards achievement of financial independence of women, a key objective of DAY-NRLM.**

**28th March 2019**

**Prabhav Joshi**
**District Development Officer**
**Kachchh-Bhuj**

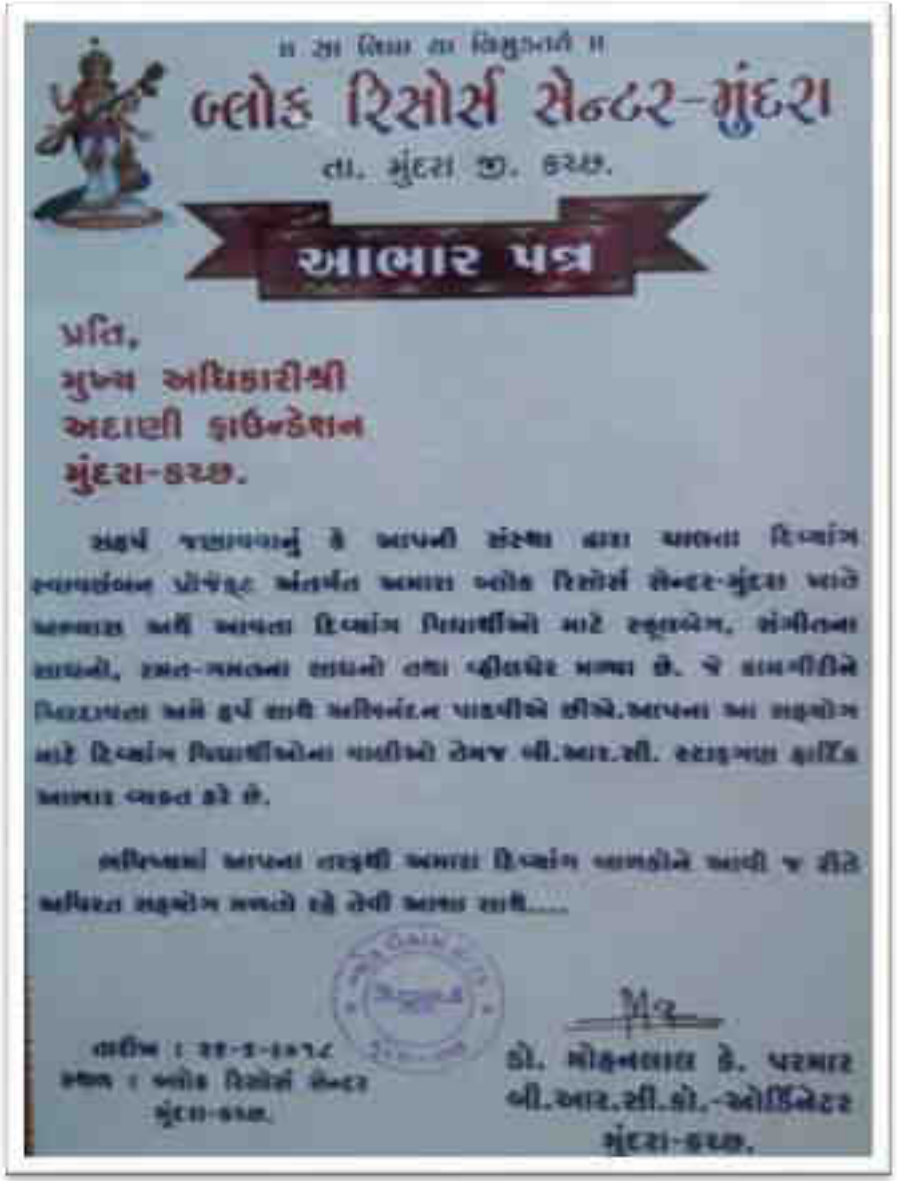
# Awards and Accolades



જિલ્લા સમાજ સુરક્ષા અધિકારીની કચેરી

—: પ્રમાણપત્ર :—

જિલ્લા કલેક્ટર સુરત અધિકારી
સુરત – ૩૯૫૦૦૧.



॥ ૐ વિઘ્ન હર વિઘ્નહર્તાય ॥

બ્લોક રિસોર્સ સેન્ટર-મુંદરા

તા. મુંદરા જી. કચ્છ.

આભાર પત્ર

પ્રતિ,
મુખ્ય અધિકારીશ્રી
અદાણી ફાઉન્ડેશન
મુંદરા-કચ્છ.

તારીખ : ૨૨-૨-૨૦૧૮
સ્થળ : બ્લોક રિસોર્સ સેન્ટર
મુંદરા-કચ્છ.

ડો. મોહનલાલ કે. પરમાર
બી.આર.સી.કો.-ઓર્ડિનેટર
મુંદરા-કચ્છ.

# ભદ્રેશ્વર ગામે અદાણી ગ્રુપના ચેરમેનના જન્મદિનની અનોખી ઉજવણ

અનોખો.૧૨ માં
આવેલી દિકરીને
કરવામાં આવી
૫૦૦ ડસ્ટબીન સ્વ
મિશનને સાર્થક
બનાવવા ગામલોકો
માટે આપવામાં આ
આમ વિવિધ
કાર્યો ત્રણે સંસ્થા
ઉપક્રમે યોજાઈ
ફાઉન્ડેશન
સાહ,દે વ
કલ્યાણ ગ
સરપંચ શ્રી
કારોબારી
પ્રદ્યુમનસિંહ
ગામના આ
હોવા છતાં
રહ્યા હતા.
સમગ્ર
બનાવવા
કિરણબેન
રમેશભાઈ

મુંદરા સમયસર પાણી માટે
સરકારી ઉ.મા.શાળા ભદ્રેશ્વર
મધ્યે ગૌતમભાઈ અદાણી
જન્મ દિવસ

## આયુષ્માન ભારત યોજના તળે ભુજોડીમાં મેડિકલ કેમ્પ યોજાયો

## તાલુકા હેલ્થ ઓફિસ મુન્દ્રા દ્વારા ઓરી અંગે શાળાના આચાર્યઓનો વર્કશ

## ભુજના ડો. આંબેડકર કન્યા છાત્રાલયને આર.ઓ. પ્લાન્ટ મળ્યો





## જીકે હોસ્પિ.માં કાલે માહિતી સેતુ કેન્દ્ર ખુલ્લું મુકાશે

### સરકારી યોજનાઓ વિશે વિનામૂલ્યે માહિતી અને ફોર્મ આપવામાં આવશે

આપવામા આવશે. આ ઉપરાંત
સરકારી યોજનાઓનો લાભ લેવા

## માંડવીમાં ગણિત-વિજ્ઞાન પ્રદર્શનમાં ૬૫ શાળાના છાત્રો દ્વારા એકસો વિવિધ કૃતિ પેશ કરાઇ

## મુન્દ્રા તાલુકામાં પ્રા. શિક્ષણના ઉર્ધ્વીકરણ અર્થે કરાર કરાયા

મુન્દ્રા

મુન્દ્રા તાલુકામાં શિક્ષણના ઉર્ધ્વીકરણ અર્થે અદાણી ફાઉન્ડેશન અને જિલ્લા પ્રાથમિક શિક્ષણ અધિકારી વચ્ચે કરાર કરવામાં આવ્યા છે.

પ્રાથમિક શિક્ષણની ગુણવત્તા વધે, વિદ્યાર્થીઓનો શિક્ષણ પ્રત્યેનો અભિગમ બદલાય

દ્વારા અદાણી ફાઉન્ડેશનને સુપરત કરાઈ છે. આ પ્રયાસ શિક્ષણ માટે ઉદ્દીપકનું કામ કરશે એમ જિલ્લા વિકાસ અધિકારીએ જણાવ્યું હતું. પ્રોજેક્ટ અન્વયે જિલ્લા શિક્ષણાધિકારીના માર્ગદર્શન હેઠળ શિક્ષણ ગુણવત્તા સુધારણાના તમામ પાસાઓને આવરી

શિક્ષણાધિકારી વચ્ચે
કરાર કરાયા હતા.
ન અંતર્ગત ચાલુ
ન્દ્રા તાલુકાની ૧૭
કામગીરી હાથ ધરવામાં આવશે. કરાર
સંજય પરમાર (જિલ્લા પા.
શિક્ષણાધિકારી), છાયાબેન ગઢવી
(ચેરમેન જિલ્લા શિક્ષણ સમિતિ) અને

ગુરુવંદના

૧૫

ાઈવરો સારવારની સાથે સાવચેતી પણ રાખે

શેખડીયા ગામને ગ્રીન વીલેજ

બનાવવાના કાર્યનો પ્રારંભ

નગર ખાતે તબીબી તપાસણ

નો ૨૦૦ દર્દીએ લાભ લીધો

વિનામૂલ્યે દવાઓ અપાઈ :

જરૂરતવાળા ભુજમાં તબ

શિક્ષક બનતા નથી પરંતુ જન્મે છે

'ગુરુવંદના' કાર્યક્રમમાં પ્રાથમિક

શાળાના ૧૦૬ શિક્ષકો જોડાયા

તાલુકાના તમામ શિક્ષકોની આરોગ્ય ચકાસણી કરાઈ

ઉચ્ચ અભ્યાસ, ડિગ્રી મેળવવા ઈચ્છુકોને અપાયો સહયોગ

લુણીમાં માછીમાર સમુદાયના તેજસ્વી

તારલાને રૂા.૫.૧૩ લાખની સ્કોલરશીપ

ધો.૯થી ૧૨ની વિદ્યાર્થીનીઓને ૧૦૦ ટકા ફી તથા

ભુજની અદાણી મેડિકલ કોલેજની

સામાજિક જવાબદારી સરાહનીય

અદાણી ફાઉ. દ્વારા ભુજના સ્લમ વિસ્તારની

શાળાઓમાં શૈક્ષણિક કીટનું કરાયું વિતરણ

ધો. ૧માં પ્રવેશ પામનાર બાળકોને પ્રોત્સાહિત કરાયા

મુંદરામાં મફત મેડિકલ

મુન્દ્રા તાલુકામાં ગુરૂવંદના કાર્યક્રમ

રાષ્ટ્રીય શૈક્ષિક મહાસંઘ, કચ્છ જિલ્લા મહિલા પાંખના ઉપક્રમે કાર્યક્રમ યોજાયો

ભીકાસિંહના ઘરમાં ચોરી થતા

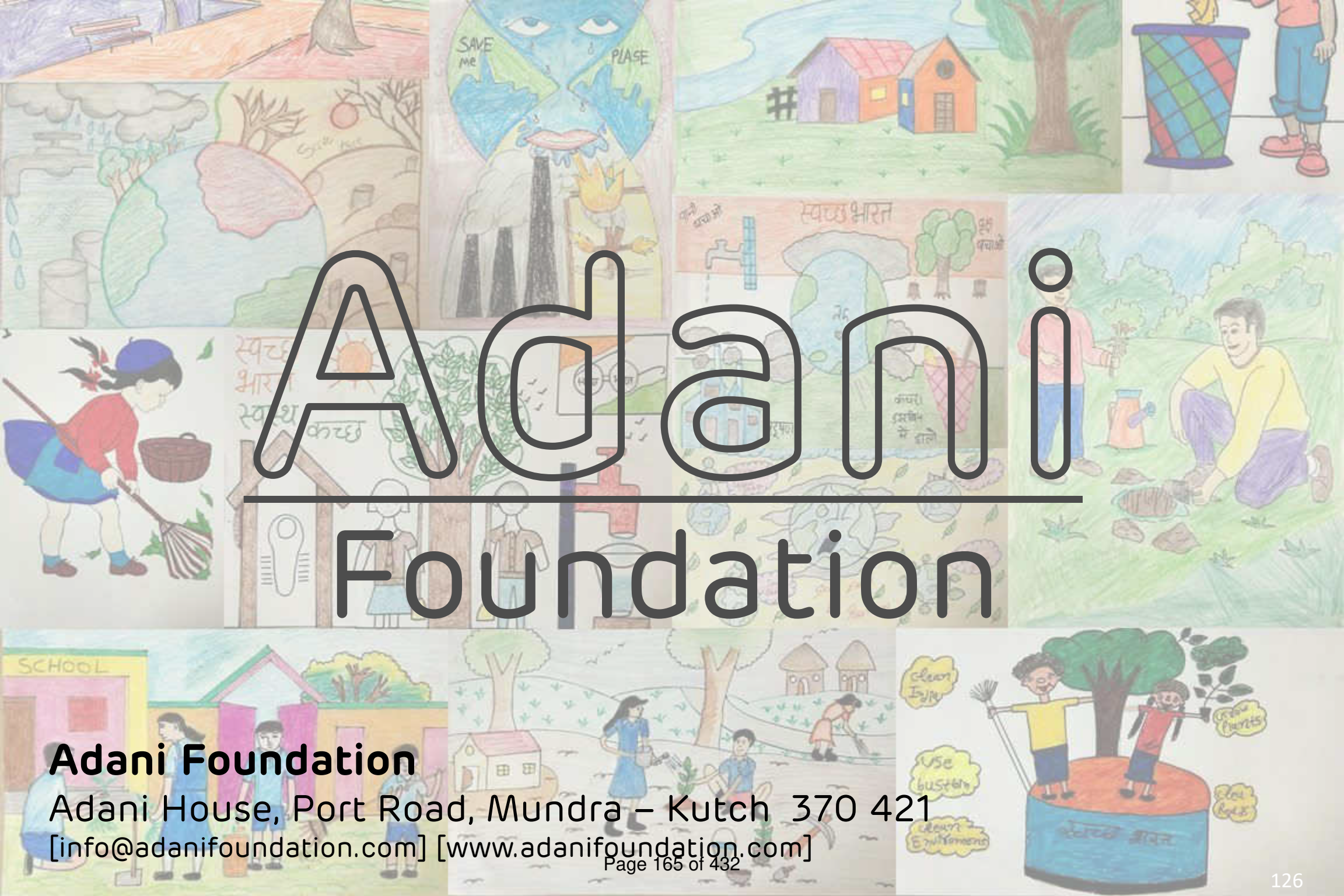
| No | Core Area | Beneficiaries | Remarks |
|---|---|---|---|
| 1 | Education | 5602 | Uthhan, Labour School, School Enrollment |
| 2 | Adani Vidya Mandir | 387 | School Students |
| 3 | UDAAN | 33932 | 116 Institute Visited |
| 4 | Adani Skill Dev. Center | 2482 | Mundra and Bhuj |
| 5 | Community health Mundra | 58531 | MHCU, Medical Camps, Senior Citizen |
| 6 | Community health Bhuj | 36417 | Health Camps, Mahiti Setu, patient care |
| 7 | SLD Fisherman | 3280 | Water, Education, Mangroves etc. |
| 8 | SLD Agriculture | 1232 | Drip Irrigation, Bio gas, tissue |
| 9 | SLD Women Empowerment | 132 | Saheli mahila gruh udyog – 12 SHG |
| 10 | Rural Infra. Development | 81098 | Pond deepening, AKBTPL, Labours work |
| 11 | Swachhagraha | 3711 | Mundra, Bhuj, Anjar and Gandhidham |
| 12 | Suposhan Mundra | 17025 | Adolescent, Children and RPA |
| 13 | Suposhan Bitta | 6450 | Adolescent, Children and RPA |
| 14 | Lakhpat | 512 | Cattle owner for fodder |

**Total Beneficiaries : 250791**

# Financial Overview

| Adani Foundation -Mundra | | | | |
|---|---|---|---|---|
| Executive Summary-Budget Utilization up to March-19 | | | | |
| | | | | (Rs. In Lacs) |
| Sr. No. | Budget Line Item | Approved Budget 2018-19 | Budget Utilizaton 2018-19 | % of utilization |
| A | Admin Expense | 67.55 | 55.44 | 82.07% |
| B. | Education | 67.85 | 59.11 | 87.12% |
| C. | Community Health | 243.21 | 203.88 | 83.83% |
| D. | Sustainable Livelihood Development | 505.87 | 624.68 | 123.49% |
| E | Rural Infrastructure Development | 326.34 | 231.81 | 71.03% |
| **TOTAL AF CSR Budget :** | | **1210.82** | **1174.93** | **97.04%** |
| F. | Adani Vidya Mandir - Bhadreshwar | 143.15 | 133.88 | 93.53% |
| **GRAND TOTAL_MUNDRA CSR WORKS 2018-19** | | **1353.97** | **1308.81** | **96.66%** |
| G. | Project Udaan_Mundra | 342.82 | 315.63 | 92.07% |
| **GRAND TOTAL_MUNDRA CSR+ PROJECT UDAAN** | | **1696.79** | **1624.44** | **95.74%** |

The Utilization will change slightly after receiving data upto first week of April 2019 due to few GRN is pending




# Adani

## Foundation

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

# ANNEXURE – 5

# "HALF YEARLYENVIRONMENTAL MONITORING REPORT"

## FOR

## ADANI PORTS AND SPECIAL ECONOMIC ZONE LIMITED
## TAL: MUNDRA, KUTCH, MUNDRA – 370 421

## MONITORING PERIOD:
## OCTOBER 2018 TO MARCH 2019

**PREPARED BY:**

**POLLUCON LABORATORIES PVT.LTD.**

**PLOT NO.5/6 "POLLUCON HOUSE", OPP. BALAJI INDUSTRIAL SOCIETY,
OLD SHANTINATH SILK MILL LANE, NEAR GAYTRI FARSAN MART,
NAVJIVAN CIRCLE, UDHANA MAGDALLA ROAD, SURAT-395007.
PHONE/FAX – (+91 261) 2455 751, 2601 106, 2601 224.
E-mail: pollucon@gmail.comweb: www.polluconlab.com**

**TC - 5945** **ISO 9001:2015** **ISO 14001:2015** **OHSAS 18001:2007**

# MARINE WATER MONITORING SUMMARY REPORT

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.07 | 8.01 | 8.21 | 8.18 | 8.12 | 8.09 | 8.16 | 8.1 | 8.21 | 8.19 | 8.13 | 8.05 | IS3025(P11)83Re.02 |
| 2 | Temperature | oC | 30.4 | 30.2 | 30.5 | 30.4 | 30.1 | 29.9 | 30 | 29.9 | 30.2 | 30 | 30.1 | 29 | IS3025(P9)84Re.02 |
| 3 | Total Suspended Solids | mg/L | 284 | 252 | 264 | 224 | 256 | 270 | 224 | 251 | 191 | 244 | 210 | 234 | IS3025(P17)84Re.02 |
| 4 | BOD (3 Days @ 27 °C) | mg/L | 4 | 3 | 5 | 3 | 4 | BDL * | 7.2 | BDL* | 4.8 | BDL* | 5.2 | BDL* | IS 3025 (P44)1993Re.03Edition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.4 | 6.1 | 6.2 | 5.9 | 6.1 | 5.8 | 6.2 | 5.9 | 6 | 5.8 | 6.1 | 5.9 | IS3025(P38)89Re.99 |
| 6 | Salinity | ppt | 34.4 | 34.1 | 34.8 | 34.2 | 34.9 | 34.6 | 34.5 | 34.7 | 35.4 | 35.7 | 35.6 | 35.9 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)5520 D |
| 8 | Nitrate as $NO_3$ | µmol/L | 5.8 | 5 | 8.58 | 7.79 | 6.3 | 4.68 | 18.51 | 10.77 | 10.22 | 8.53 | 8.4 | 6.3 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 1.4 | 1 | 1.78 | 1.25 | 1.24 | 1.1 | 1.55 | 1.27 | 0.56 | 0.42 | 1.33 | 1.08 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 2.64 | 2.15 | 2.23 | 2.04 | 2.96 | 2.14 | 3.83 | 3.35 | 2.82 | 2.51 | 2.64 | 2.42 | IS3025(P34)88Cla.2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 1.9 | 1.5 | 2.67 | 2.41 | 2.3 | 2.2 | 2.66 | 2.39 | 2.27 | 1.45 | 2.12 | 1.8 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 9.84 | 7.15 | 12.59 | 11.08 | 10.50 | 7.92 | 18.51 | 15.38 | 13.6 | 11.46 | 12.37 | 9.86 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 15 | 6 | 14 | 12 | 18 | 14.2 | 17 | 12 | 20 | 16 | 13 | 8 | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34712 | 34519 | 36212 | 35844 | 35920 | 35624 | 35690 | 35734 | 36218 | 36594 | 36730 | 37434 | IS3025(P16)84Re.02 |
| 15 | COD | mg/L | 14 | 10 | 18 | 12 | 15 | 6 | 24 | 7.0 | 27 | 19.0 | 23.6 | 11.4 | APHA(22nd Edi) 5520-D Open Reflux |
| A | **Flora and Fauna** | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L /day | 1.26 | 1.12 | 1.66 | 1.26 | 3.6 | 2.8 | 4.5 | 4 | 8.32 | 5.62 | 8.55 | 5.4 | APHA (22nd Edi) 10200-J |
| B | **Phytoplankton** | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | mg/$m^3$ | 2.06 | 1.69 | 2.21 | 2.11 | 2.7 | 2.2 | 2.67 | 2.15 | 3.38 | 2.79 | 2.64 | 2.33 | APHA (22nd Edi) 10200-H |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17.2 | Phaeophytin | mg/m$^3$ | 1.9 | 1.3 | 1.49 | 1.57 | 1.96 | 1.84 | 2.24 | 1.92 | 2.93 | 2.51 | 1.86 | 1.60 | APHA (22$^{nd}$Edi) 10200-H |
| 17.3 | Cell Count | No. x 10$^3$/L | 131 | 111 | 212 | 124 | 270 | 146 | 203 | 122 | 249 | 95 | 207 | 85 | APHA (22$^{nd}$ Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Coscino discus** *Nitzschia* *Rhizosolenia* *Navicula* *Biddulphia* -- | **Navicula** *Pleurosigma* *Nitzschia* -- -- -- | **Rhizosolenia sp.** *Navicula sp.* *Biddulphia sp.* *Cheatoceros sp.* *Ceratium* -- -- | **Nitzschia sp.** *Synedra sp.* *Cyclotella sp.* -- -- -- -- | Thallasiosira sp. Navicula sp. Biddulphia sp. -- | Nitzschia sp. Rhizosolenia sp. -- -- | Rhizosolenia sp. Navicula sp. Thallasiosira sp. Cosmarium | Coscinodiscus sp. Nitzschia sp. -- -- | *Rhizosolenia sp. Cheatoceros sp. Coscinodiscus sp.* -- | *Nitzschia sp. Synedra sp. Fragillaria sp.* -- | *Rhizosolenia sp. Navicula sp. Coscinodiscus sp. Thallasionema sp.* | *Nitzschia sp. Navicula sp.* -- -- | APHA (22$^{nd}$ Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX10$^3$/ 100 m$^3$ | 53 | | 66 | | 46 | | 61 | | 55 | | 48 | | APHA (22$^{nd}$ Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Foraminiferans Polychaetes Gastropods -- | | Polychaete Bivalves Ostracodes Gastropods | | Gastropods Decapods Crustaceans | | Copepods Mysids Bivalves -- | | Foraminiferans amphipods Gastropods | | Polychaetes Gastropods Crustaceans | | APHA (22$^{nd}$ Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 m$^3$ | 6.6 | | 7.25 | | 6.2 | | 4.8 | | 3.9 | | 5.6 | | APHA (22$^{nd}$ Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1300 | | 1840 | | 1880 | | 1840 | | 1760 | | 1820 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22$^{nd}$Edi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi.2.4 (2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

**H. T. Shah**

**Lab Manager**

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**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | NOVEMBER 2018 | DECEMBER 2018 | JANUARY 2019 | FEBRUARY 2019 | MARCH 2019 | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | |
| 1 | Organic Matter | % | 0.48 | 0.64 | 0.42 | 0.56 | 0.69 | 0.71 | FCO:2007 |
| 2 | Phosphorus as P | µg/g | 246 | 212 | 256 | 278 | 311 | 264 | APHA(22nd Edi) 4500 C |
| 3 | Texture | -- | Sandy | Sandy | Sandy | Sandy | Sandy | Sandy | -- |
| 4 | Petroleum Hydrocarbon | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | PLPL-TPH |
| 5 | **Heavy Metals** | | | | | | | | |
| 5.1 | Aluminum as Al | % | 5.35 | 5.18 | 4.9 | 5.2 | 4.98 | 5.24 | AAS APHA 3111 B |
| 5.2 | Total Chromium as $Cr^{+3}$ | µg/g | 190 | 210 | 164 | 170 | 235 | 270 | AAS 3111B |
| 5.3 | Manganese as Mn | µg/g | 1780 | 1698 | 1430 | 1286 | 1384 | 1258 | AAS APHA 3111 B |
| 5.4 | Iron as Fe | % | 5.1 | 4.82 | 5.2 | 4.9 | 5.32 | 4.89 | AAS APHA(22nd Edi)3111 B |
| 5.5 | Nickel as Ni | µg/g | 53 | 20.4 | 34 | 27 | 47 | 24.8 | AAS APHA(22nd Edi)3111 B |
| 5.6 | Copper as Cu | µg/g | 49 | 37 | 49 | 33 | 30 | 31.6 | AAS APHA(22nd Edi)3111 B |
| 5.7 | Zinc as Zn | µg/g | 318 | 348 | 230 | 310 | 291 | 270 | AAS APHA(22nd Edi)3111 B |
| 5.8 | Lead as Pb | µg/g | 3.8 | 1.9 | 2.6 | 3 | 2.8 | 1.98 | AAS APHA(22nd Edi)3111 B |
| 5.9 | Mercury as Hg | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | AAS APHA- 3112 B |
| 6 | **Benthic Organisms** | | | | | | | | |
| 6.1 | Macrobenthos | -- | Polychaetes<br>Decapods<br>-- | Mysids<br>Crustaceans<br>Decapods<br>Polychaetes | Crustaceans<br>Polychaetes<br>-- | Gastropods<br>mollusca<br>Decapods | Polychaetes<br>Crustaceans<br>-- | Polychaetes<br>Crustaceans<br>-- | APHA (22nd Edi) 10500-C |
| 6.2 | MeioBenthos | -- | Nematodes<br>Bryozoans<br>-- | Hydrozoan<br>Gastrotriches<br>--- | Bryozoans<br>--<br>-- | --<br>--<br>-- | Foraminiferans<br>Nematodes<br>-- | Foraminiferans<br>Hydrozoans<br>-- | APHA (22nd Edi) 10500-C |
| 6.3 | Population | no/m2 | 382 | 645 | 616 | 821 | 794 | 853 | APHA (22nd Edi) 10500-C |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.15 | 8.09 | 8.19 | 8.12 | 8.2 | 8.16 | 8.19 | 8.15 | 8.17 | 8.14 | 8.15 | 8.1 | IS3025(P11)83 Re.02 |
| 2 | Temperature | oC | 30.3 | 30 | 30.6 | 30.4 | 30.4 | 30.2 | 30 | 29.8 | 30.2 | 30 | 30.3 | 30 | IS3025(P9)84R e.02 |
| 3 | Total Suspended Solids | mg/L | 254 | 240 | 328 | 290 | 272 | 218 | 216 | 228 | 186 | 246 | 230 | 263 | IS3025(P17)84 Re.02 |
| 4 | BOD (3 Days @ 27 °C) | mg/L | 3 | BDL* | 4 | BDL* | 3 | BDL* | 5.0 | BDL* | 3.9 | BDL* | 5.3 | BDL* | IS 3025 (P44)1993Re.03 Edition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.4 | 6.2 | 6.2 | 5.9 | 6.6 | 6.1 | 6.1 | 5.9 | 6.2 | 5.8 | 6 | 5.7 | IS3025(P38)89 Re.99 |
| 6 | Salinity | ppt | 34.1 | 33.8 | 34.4 | 34.1 | 34.7 | 34.5 | 34.3 | 34.5 | 35.6 | 35.8 | 35.4 | 35.7 | APHA (22$^{nd}$Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22$^{nd}$Edi)5 520D |
| 8 | Nitrate as $NO_3$ | µmol/L | 8.5 | 7.2 | 7.55 | 6.34 | 5.8 | 6.4 | 8.16 | 5.87 | 7.2 | 6.29 | 7.96 | 5.84 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 1 | 0.6 | 1.23 | 1.16 | 1.5 | 0.8 | 0.98 | 0.69 | 0.58 | 0.81 | 0.84 | 0.99 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 2.4 | 1.8 | 9.28 | 8.98 | 11.4 | 8.2 | 3.89 | 3.6 | 2.6 | 2.4 | 2.7 | 2.5 | IS3025(P34)88 Cla.2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 2.45 | 1.6 | 2.78 | 2.14 | 2.56 | 2.4 | 2.39 | 2.07 | 2.4 | 1.74 | 2.3 | 1.86 | APHA(22$^{nd}$Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 11.9 | 9.6 | 18.06 | 16.49 | 18.70 | 15.40 | 13.03 | 10.16 | 10.37 | 9.5 | 11.5 | 9.33 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 6 | 2 | 12 | 4 | 15 | BDL* | 18 | BDL* | 23 | BDL* | 16 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34608 | 34416 | 35731 | 35296 | 36012 | 35940 | 35842 | 35964 | 36728 | 36943 | 36432 | 36936 | IS3025(P16)84 Re.02 |
| 15 | COD | mg/L | 12 | BDL* | 14 | BDL* | 12 | BDL* | 20.0 | BDL* | 17.0 | 6.8 | 24.8 | 8.0 | APHA(22$^{nd}$Edi) 5520-D Open Reflux |
| A | **Flora and Fauna** | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/ L/day | 1.57 | 1.3 | 2.07 | 1.68 | 2.6 | 1.8 | 5.4 | 4 | 7.98 | 5.26 | 7.65 | 4.72 | APHA (22nd Edi) 10200-J |
| B | **Phytoplankton** | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | mg/ $m^3$ | 1.6 | 0.968 | 2.25 | 1.33 | 1.94 | 1.2 | 2.42 | 1.98 | 3.4 | 2.8 | 3.12 | 2.31 | APHA (22$^{nd}$Edi) 10200-H |
| 17.2 | Phaeophytin | mg/ $m^3$ | 2.35 | 1.01 | 1.76 | 1.54 | 1.68 | 0.99 | 1.8 | 1.54 | 3.0 | 2.13 | 1.4 | 0.8 | APHA (22$^{nd}$Edi) 10200-H |
| 17.3 | Cell Count | No. x $10^3$/L | 150 | 106 | 198 | 134 | 172 | 80 | 203 | 99 | 231 | 87 | 219 | 74 | APHA (22$^{nd}$ Edi) 10200-H |

**H. T. Shah**

**Lab Manager**

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**Dr. Arun Bajpai**

**Lab Manager (Q)**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17.4 | Name of Group Number and name of group species of each group | -- | **Cheatoc erous** *Nitzschia Biddulphi a Thallasion ema Coscinodi scus Cyclotella* | **Melosira** *Navicula Fragillaria* -- -- -- | **Biddulph ia sp.** *Nitzschia sp. Cheatocer ous sp. Coscinodi scus sp. Fragillaria sp.* -- -- | **Nitzschi a sp.** *Navicula sp. Rhizosole nia sp.* -- -- -- -- | **Nitzschi a sp.** Thallasios ira sp. Cheatocer ous sp. Biddulphi a sp. | Nitzschia sp. Thallasiosi ra sp. -- -- | *Navicula sp. Bacteriast ram Cosmariu m Biddulphi a sp.* | *Nitzschia sp. Synedra sp.* -- -- | *Thallasion ema sp. Fragillaria sp. Closteriu m sp. Synedra sp.* | *Nitzschia sp. Biddulphia sp. Synedra sp.* -- | *Rhizosole nia sp. Biddulphi a sp. Navicula sp. Thallasion ema sp.* | *Thallasio nema sp. Nitzschia sp. Synedra sp.* -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX10 3/ 100 $m^3$ | 48 | | 57 | | 65 | 71 | | 58 | | 51 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Crustaceans Gastropods Polychaetes -- | | Hydrozoa Bivalves Foraminiferans Crustaceans | | Gastropods Crustaceans Chaetognathes | Copepods Gastropods Cyclops -- | | Chaetognathes Polychaetes Foraminiferans | | Polychaetes Gastropods Bivalves | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/10 0 $m^3$ | 4.94 | | 5.57 | | 5.8 | 5.1 | | 4.78 | | 4.29 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1450 | | 1620 | | 1680 | 1640 | | 1560 | | 1620 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | Absent | | Absent | | Absent | | APHA(22ndEdi)9 221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | Absent | | Absent | | Absent | | IS:1622:1981Ed i.2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

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**Lab Manager**

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**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | NOVEMBER 2018 | DECEMBER 2018 | JANUARY 2019 | FEBRUARY 2019 | MARCH 2019 | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | |
| 1 | Organic Matter | % | 0.56 | 0.84 | 0.51 | 0.62 | 0.72 | 0.68 | FCO:2007 |
| 2 | Phosphorus as P | µg/g | 214 | 232 | 220 | 278 | 319 | 246 | APHA(22nd Edi) 4500 C |
| 3 | Texture | -- | Sandy | Sandy | Sandy | Sandy | Sandy | Sandy | -- |
| 4 | Petroleum Hydrocarbon | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | PLPL-TPH |
| 5 | **Heavy Metals** | | | | | | | | |
| 5.1 | Aluminum as Al | % | 5.18 | 5.18 | 4.9 | 5.2 | 5.19 | 4.84 | AAS APHA 3111 B |
| 5.2 | Total Chromium as Cr+3 | µg/g | 164 | 152 | 184 | 190 | 213 | 201 | AAS 3111B |
| 5.3 | Manganese as Mn | µg/g | 1698 | 1366 | 1230 | 1350 | 1320 | 1298 | AAS APHA 3111 B |
| 5.4 | Iron as Fe | % | 5.06 | 5.1 | 4.92 | 5.1 | 4.83 | 4.94 | AAS APHA(22nd Edi)3111 B |
| 5.5 | Nickel as Ni | µg/g | 38 | 27 | 32 | 40 | 20 | 27.3 | AAS APHA(22nd Edi)3111 B |
| 5.6 | Copper as Cu | µg/g | 46 | 33 | 46 | 28 | 37 | 34.6 | AAS APHA(22nd Edi)3111 B |
| 5.7 | Zinc as Zn | µg/g | 260 | 218 | 240 | 298 | 278 | 204 | AAS APHA(22nd Edi)3111 B |
| 5.8 | Lead as Pb | µg/g | 2.9 | 3.1 | 2.1 | 3.4 | 1.9 | 2.32 | AAS APHA(22nd Edi)3111 B |
| 5.9 | Mercury as Hg | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | AAS APHA- 3112 B |
| 6 | **Benthic Organisms** | | | | | | | | |
| 6.1 | Macrobenthos | -- | Polychaetes<br>Chaetognaths<br>Mysids | Echinoderms<br>Bivalves<br>Polychaete worms | Echinoderms<br>Gastropods<br>-- | Gastropods<br>Crustaceans<br>-- | Polychaetes<br>Bivalves<br>-- | Crustaceans<br>Gastropods<br>-- | APHA (22nd Edi) 10500-C |
| 6.2 | MeioBenthos | -- | Copepods<br>Ostracodes<br>-- | Nematodes<br>---<br>--- | Copepods<br>--<br>-- | Ostracodes<br>--<br>-- | Foraminiferans<br>--<br>-- | Nematodes<br>Foraminiferans<br>-- | APHA (22nd Edi) 10500-C |
| 6.3 | Population | no/$m^2$ | 250 | 499 | 528 | 645 | 733 | 850 | APHA (22nd Edi) 10500-C |

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**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.11 | 8.07 | 8.25 | 8.12 | 8.18 | 8.11 | 8.14 | 8.12 | 8.19 | 8.16 | 8.13 | 8.06 | IS3025(P11)83Re.02 |
| 2 | Temperature | oC | 30.2 | 30 | 30.3 | 30.2 | 30.5 | 30.4 | 30.2 | 30.1 | 30.3 | 30.1 | 30.2 | 30 | IS3025(P9)84Re.02 |
| 3 | Total Suspended Solids | mg/L | 318 | 364 | 348 | 306 | 298 | 252 | 256 | 271 | 196 | 219 | 203 | 226 | IS3025(P17)84Re.02 |
| 4 | BOD (3 Days @ 27°C) | mg/L | BDL* | BDL* | 6 | BDL* | 4 | BDL* | 5.0 | BDL* | 5.9 | BDL* | 4.2 | BDL* | IS 3025 (P44)1993Re.03Edition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.2 | 5.8 | 6.1 | 5.7 | 6.4 | 6.2 | 6.1 | 6.0 | 6 | 5.8 | 6.1 | 5.9 | IS3025(P38)89Re.99 |
| 6 | Salinity | ppt | 33.9 | 33.7 | 34.6 | 34.3 | 35.2 | 35 | 34.9 | 35.1 | 35.4 | 35.7 | 35.6 | 35.9 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)5520D |
| 8 | Nitrate as $NO_3$ | µmol/L | 6.6 | 4.9 | 9.09 | 8.64 | 4.8 | 5.1 | 6.41 | 5.69 | 9.1 | 4.5 | 7.2 | 6.0 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 1.2 | 0.8 | 1.33 | 1.12 | 1.7 | 1.9 | 0.86 | 0.63 | 0.73 | 0.86 | 0.84 | 0.92 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 2.8 | 1.7 | 2.25 | 1.95 | 3.4 | 3.6 | 3.16 | 2.91 | 2.7 | 2.4 | 2.4 | 2.1 | IS3025(P34)88Cla.2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 2.59 | 1.8 | 3.21 | 2.78 | 2.8 | 2.6 | 2.7 | 2.4 | 1.76 | 1.36 | 1.62 | 1.21 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 10.6 | 7.4 | 12.68 | 11.72 | 9.90 | 10.60 | 10.42 | 9.23 | 12.53 | 7.74 | 10.46 | 9 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 24 | 10 | 17.4 | 12 | 19 | BDL* | 16 | 11.0 | 18.4 | BDL* | 15.3 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34418 | 34356 | 35218 | 35078 | 36118 | 35678 | 35670 | 35834 | 36679 | 36830 | 36516 | 37293 | IS3025(P16)84Re.02 |
| 15 | COD | mg/L | BDL* | BDL* | 14 | BDL* | 16 | 10 | 19.0 | 8.0 | 21 | BDL* | 22 | BDL* | APHA(22nd Edi) 5520-D Open Reflux |
| A | **Flora and Fauna** | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L /day | 1.23 | 1.08 | 1.98 | 1.64 | 2.84 | 2.76 | 4.2 | 3.8 | 8.3 | 6.4 | 7.2 | 5.17 | APHA (22nd Edi) 10200-J |
| B | **Phytoplankton** | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | mg/$m^3$ | 1.97 | 1.13 | 2.93 | 1.01 | 2.46 | 2.3 | 3.76 | 2.26 | 3.1 | 2.46 | 2.92 | 2.21 | APHA (22nd Edi) 10200-H |
| 17.2 | Phaeophytin | mg/$m^3$ | 1.59 | 0.865 | 1.22 | 0.43 | 1.8 | 1.2 | 2.2 | 1.3 | 2.35 | 1.5 | 2.18 | 0.5 | APHA (22nd Edi) 10200-H |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17.3 | Cell Count | No. x $10^3$/L | 141 | 66 | 204 | 72 | 190 | 84 | 161 | 73 | 224 | 96 | 197 | 59 | APHA (22nd Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Biddulphia** *Melosira* *synedra* *Navicula* *Nitzschia* **Cheatoc erous** | **Navicula** *Nitzschia* *Biddulphi a* *Melosira* -- **--** | **Biddulph ia sp.** *Pleurosig ma sp.* *Nitzschia sp.* *Cheatocer ous sp.* *Cyclotella sp.* *Diplones* -- | **Synedra sp.** *Coscinodi scus sp.* *Navicula sp.* -- -- -- -- | Nitzschia sp. Cheatocer ous sp. Rhizosole nia sp. Amphipro ra sp. | Navicula sp. Thallasios ira sp. Guinardia -- | *Coscinodi scus sp.* Rhizosole nia sp. Nitzschia sp. *Thallasios ira sp.* | *Navicula sp.* *Thallasios ira sp.* -- -- | *Thallasion ema sp.* *Nitzschia sp.* *Rhizosole nia sp.* *Coscinodi scus sp.* | *Synedra sp.* *Biddulphi a sp.* *Navicula sp.* -- | *Biddulphi a sp.* *Navicula sp.* *Thallasios ira sp.* *Coscinodi scus sp.* | *Nitzschia sp.* *Synedra sp.* *Biddulphi a sp.* -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX$10^3$/ 100 $m^3$ | 58 | | 63 | | 50 | | 64 | | 79 | | 59 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Copepods Polychaetes Crustaceans -- | | Cephalopods Ostracodes Bivalves Crustaceans | | Foraminiferans Ctenophores Ostracods | | Polychaete Gastropods Crustaceans -- | | Polychaetes Crustaceans Bivalves | | Polychaetes Bivalves -- | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 $m^3$ | 8.1 | | 8.7 | | 6.2 | | 5.6 | | 6.1 | | 5.85 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1700 | | 1980 | | 1880 | | 1820 | | 1860 | | 1780 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22ndEdi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi.2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

**H. T. Shah**

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**Lab Manager (Q)**

## RESULTS OF SEDIMENT ANALYSIS [M3 RIGHT SIDE OF BOCHA CREEK - N 22°46'530" E 069°41'690"]

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | NOVEMBER 2018 | DECEMBER 2018 | JANUARY 2019 | FEBRUARY 2019 | MARCH 2019 | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | |
| 1 | Organic Matter | % | 0.52 | 0.46 | 0.54 | 0.48 | 0.69 | 0.72 | FCO:2007 |
| 2 | Phosphorus as P | µg/g | 208 | 218 | 240 | 290 | 312 | 230 | APHA(22nd Edi) 4500 C |
| 3 | Texture | -- | Sandy | Sandy | Sandy | Sandy | Sandy | Sandy | -- |
| 4 | Petroleum Hydrocarbon | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | PLPL-TPH |
| 5 | **Heavy Metals** | | | | | | | | |
| 5.1 | Aluminum as Al | % | 5.1 | 4.9 | 4.86 | 5.2 | 4.97 | 5.12 | AAS APHA 3111 B |
| 5.2 | Total Chromium as $Cr^{+3}$ | µg/g | 174 | 198 | 130 | 168 | 218 | 150 | AAS 3111B |
| 5.3 | Manganese as Mn | µg/g | 1540 | 1614 | 1346 | 1240 | 1475 | 1136 | AAS APHA 3111 B |
| 5.4 | Iron as Fe | % | 4.9 | 4.2 | 4.82 | 5.1 | 4.96 | 5.14 | AAS APHA(22nd Edi)3111 B |
| 5.5 | Nickel as Ni | µg/g | 46.8 | 30.2 | 36 | 42 | 53 | 32 | AAS APHA(22nd Edi)3111 B |
| 5.6 | Copper as Cu | µg/g | 51.6 | 29 | 46 | 35 | 27 | 39 | AAS APHA(22nd Edi)3111 B |
| 5.7 | Zinc as Zn | µg/g | 296 | 250 | 234 | 310 | 219 | 250 | AAS APHA(22nd Edi)3111 B |
| 5.8 | Lead as Pb | µg/g | 3.3 | 2.6 | 2.9 | 2.2 | 1.7 | 2.16 | AAS APHA(22nd Edi)3111 B |
| 5.9 | Mercury as Hg | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | AAS APHA- 3112 B |
| 6 | **Benthic Organisms** | | | | | | | | |
| 6.1 | Macrobenthos | -- | Amphipods<br>Isopods<br>Polychaetes | Polychaete worms<br>Bivalves<br>Chaetognathes | Polychaete<br>Chaetognathes<br>Bivalves | Crustaceans<br>Polychaete<br>-- | Crustaceans<br>Gastropods<br>-- | Gastropods<br>Polychaetes<br>-- | APHA (22nd Edi) 10500-C |
| 6.2 | MeioBenthos | -- | Copepods<br>Foraminiferans<br>-- | Nematodes<br>Hydrozoan<br>--- | Copepods<br>--<br>-- | Nematodes<br>--<br>-- | Nematodes<br>hydrozoans<br>-- | Gastropods<br>Polychaetes<br>-- | APHA (22nd Edi) 10500-C |
| 6.3 | Population | no/$m^2$ | 279 | 557 | 587 | 704 | 853 | 824 | APHA (22nd Edi) 10500-C |

**H. T. Shah**

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**Dr. Arun Bajpai**

**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.18 | 8.05 | 8.17 | 8.06 | 8.07 | 8.03 | 8.1 | 8.08 | 8.14 | 8.13 | 8.13 | 8.1 | IS3025(P11)83Re.02 |
| 2 | Temperature | oC | 30 | 29.9 | 30.7 | 30.5 | 30.8 | 30.4 | 30.2 | 30.1 | 30.1 | 29.9 | 30.2 | 30 | IS3025(P9)84Re.02 |
| 3 | Total Suspended Solids | mg/L | 296 | 272 | 338 | 299 | 264 | 226 | 248 | 272 | 208 | 234 | 217 | 243 | IS3025(P17)84Re.02 |
| 4 | BOD (3 Days @ 27 °C) | mg/L | 4 | BDL* | 3 | BDL* | 4 | BDL* | 5.2 | BDL* | 6.4 | BDL* | 5.8 | BDL* | IS 3025 (P44)1993Re.03 Edition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.5 | 6 | 6.2 | 5.9 | 6.6 | 6.8 | 6.2 | 5.8 | 6.1 | 5.7 | 6.2 | 5.8 | IS3025(P38)89Re.99 |
| 6 | Salinity | ppt | 34.3 | 34.1 | 34.2 | 33.9 | 34.8 | 34.4 | 35 | 35.2 | 35.7 | 35.9 | 35.6 | 36 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)5520D |
| 8 | Nitrate as $NO_3$ | µmol/L | 7.8 | 6.2 | 11.45 | 9.91 | 10.2 | 9.4 | 13.37 | 11.67 | 10.77 | 9.56 | 8.52 | 5.46 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 3.4 | 2 | 1.47 | 1.23 | 1.60 | 1.5 | 0.96 | 0.78 | 0.78 | 1.12 | 0.83 | 0.94 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 2.75 | 2.1 | 2.46 | 2.27 | 2.40 | 2.8 | 3.43 | 3.2 | 2.9 | 2.6 | 2.6 | 2.4 | IS3025(P34)88Cla.2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 1.95 | 1.6 | 2.14 | 1.82 | 2.31 | 2.2 | 1.96 | 1.59 | 1.19 | 1.18 | 1.32 | 1.27 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 13.95 | 10.3 | 15.38 | 13.41 | 14.20 | 13.70 | 17.75 | 15.65 | 14.49 | 13.31 | 11.94 | 8.76 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 16 | 4 | 18 | 5 | 10 | BDL* | 14 | BDL* | 20 | BDL* | 17 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34692 | 34460 | 35384 | 35130 | 35816 | 35718 | 35946 | 36218 | 36734 | 36984 | 36581 | 37134 | IS3025(P16)84Re.02 |
| 15 | COD | mg/L | 14 | BDL* | 12 | BDL* | 14 | BDL* | 18.0 | 6.0 | 23.0 | 10.0 | 19.0 | 8.3 | APHA(22nd Edi) 5520-D Open Reflux |
| A | Flora and Fauna | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L/day | 2.25 | 1.35 | 2.36 | 1.71 | 3.64 | 2.9 | 4.5 | 3.3 | 8.43 | 5.58 | 7.42 | 4.38 | APHA (22nd Edi) 10200-J |
| B | Phytoplankton | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | mg/$m^3$ | 1.55 | 1.02 | 1.86 | 1.14 | 2.8 | 2.62 | 3.2 | 2.6 | 3.25 | 2.8 | 2.79 | 2.2 | APHA (22nd Edi) 10200-H |
| 17.2 | Phaeophytin | mg/$m^3$ | 0.94 | 0.64 | 1.44 | 0.88 | 1.68 | 1.52 | 2.4 | 1.1 | 2.1 | 2.2 | 1.33 | 0.96 | APHA (22nd Edi) 10200-H |

**H. T. Shah**

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POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17.3 | Cell Count | No. x $10^3$/L | 146 | 87 | 178 | 84 | 204 | 106 | 146 | 73 | 193 | 67 | 179 | 64 | APHA (22nd Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Nitzschia** *Navicula Coscinodiscus Rhizosolenia Thallasiosira* **--** | **Nitzschia** *Pleurosigma Navicula* -- -- -- | **Navicula sp.** *Biddulphia sp. Synedra sp. Rhizosolenia sp. Cyclotella sp.* -- -- | **Thallasiosira sp.** *Nitzschia sp. Pleurosigma sp.* -- -- -- | Gyrosigma sp. Cheatoceros sp. Fragillaria sp. Pleurosigma sp. | Nitzschia sp. Rhizosolenia sp. Thallasiosira sp. -- | *Navicula sp.* Biddulphia sp. Coscinodiscus sp. Rhizosolenia sp. | *Nitzschia sp. Thallasiosira sp.* Synedra sp. -- | *Rhizosolenia sp. Cheatoceros sp. Pleurosigma sp. Biddulphia sp.* | *Synedra sp. Biddulphia sp. Navicula sp.* -- | *Thallasiosira sp. Nitzschia sp. Coscinodiscus sp. Pleurosigma sp.* | *Synedra sp. Navicula sp. Cheatoceros sp.* -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX$10^3$/ 100 $m^3$ | 67 | | 59 | | 72 | | 64 | | 81 | | 73 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Polychaetes Gastropods Decapods -- | | Gastropods Bivalves Crustaceans Oligocheata | | Foraminiferans Ctenophores Polychaetes | | Gastropods Crustaceans Polychaete -- | | Foraminiferans Ostracods Polychaetes | | Gastropods Polychaetes Decapods | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 $m^3$ | 5.87 | | 6.05 | | 6.9 | | 5.5 | | 6.2 | | 4.94 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1600 | | 1870 | | 1820 | | 1840 | | 1840 | | 1860 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22nd Edi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi.2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

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**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | NOVEMBER 2018 | DECEMBER 2018 | JANUARY 2019 | FEBRUARY 2019 | MARCH 2019 | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | |
| 1 | Organic Matter | % | 0.48 | 0.64 | 0.52 | 0.68 | 0.56 | 0.67 | FCO:2007 |
| 2 | Phosphorus as P | µg/g | 224 | 178 | 240 | 310 | 259 | 218 | APHA(22nd Edi) 4500 C |
| 3 | Texture | -- | Sandy | Sandy | Sandy | Sandy | Sandy | Sandy | -- |
| 4 | Petroleum Hydrocarbon | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | PLPL-TPH |
| 5 | **Heavy Metals** | | | | | | | | |
| 5.1 | Aluminum as Al | % | 5.24 | 5.3 | 5.12 | 4.9 | 5.2 | 5.1 | AAS APHA 3111 B |
| 5.2 | Total Chromium as $Cr^{+3}$ | µg/g | 154 | 167 | 180 | 192 | 174 | 140 | AAS 3111B |
| 5.3 | Manganese as Mn | µg/g | 1590 | 1630 | 1346 | 1484 | 1376 | 1198 | AAS APHA 3111 B |
| 5.4 | Iron as Fe | % | 5.14 | 5.2 | 4.98 | 4.78 | 5.1 | 4.6 | AAS APHA(22nd Edi)3111 B |
| 5.5 | Nickel as Ni | µg/g | 58 | 74 | 42 | 60 | 31 | 39 | AAS APHA(22nd Edi)3111 B |
| 5.6 | Copper as Cu | µg/g | 44 | 44 | 52 | 39 | 45 | 33 | AAS APHA(22nd Edi)3111 B |
| 5.7 | Zinc as Zn | µg/g | 256 | 310 | 230 | 296 | 330 | 274 | AAS APHA(22nd Edi)3111 B |
| 5.8 | Lead as Pb | µg/g | 4.2 | 1.8 | 2.1 | 3.2 | 2.4 | 1.96 | AAS APHA(22nd Edi)3111 B |
| 5.9 | Mercury as Hg | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | AAS APHA- 3112 B |
| 6 | **Benthic Organisms** | | | | | | | | |
| 6.1 | Macrobenthos | -- | Polychaetes<br>Isopods<br>Mysids | Bivalves<br>Decapods<br>Polychaete worms | Decapods<br>Gastropods<br>-- | Gastropods<br>Mysids<br>-- | Polychaetes<br>Gastropods<br>-- | Crustaceans<br>Polychaetes<br>-- | APHA (22nd Edi) 10500-C |
| 6.2 | MeioBenthos | -- | Nematodes<br>Bryozoans<br>-- | Foraminiferans<br>Nematodes<br>--- | Foraminiferans<br>Bryozoans<br>-- | Nematodes<br>Bryozoans<br>-- | Foraminiferans<br>--<br>-- | Nematodes<br>Bryozoans<br>-- | APHA (22nd Edi) 10500-C |
| 6.3 | Population | no/$m^2$ | 294 | 528 | 556 | 673 | 824 | 882 | APHA (22nd Edi) 10500-C |

**H. T. Shah**

**Lab Manager**

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**Dr. Arun Bajpai**

**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.19 | 8.08 | 8.15 | 8.1 | 8.24 | 8.17 | 8.12 | 8.09 | 8.16 | 8.13 | 8.1 | 8.06 | IS3025(P11)83Re .02 |
| 2 | Temperature | oC | 30.5 | 30.3 | 30.4 | 30.2 | 30.6 | 30.3 | 31.1 | 30 | 30.2 | 30 | 3.01 | 30 | IS3025(P9)84Re. 02 |
| 3 | Total Suspended Solids | mg/L | 369 | 332 | 356 | 304 | 312 | 294 | 228 | 251 | 182 | 218 | 250 | 276 | IS3025(P17)84Re .02 |
| 4 | BOD (3 Days @ 27 °C) | mg/L | 5 | BDL* | 4 | BDL* | 5 | BDL* | 6.2 | BDL* | 8.3 | BDL* | 12.8 | BDL* | IS 3025 (P44)1993Re.03E dition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.4 | 6 | 6.2 | 5.8 | 6.2 | 6 | 6.1 | 5.9 | 6.2 | 6.0 | 6.1 | 5.9 | IS3025(P38)89Re .99 |
| 6 | Salinity | ppt | 34.5 | 34.1 | 34.3 | 34.1 | 34.6 | 34.3 | 34.8 | 35.1 | 35.5 | 35.9 | 35.6 | 35.8 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)55 20D |
| 8 | Nitrate as $NO_3$ | µmol/L | 10.4 | 6.2 | 9.37 | 7.79 | 7.4 | 6.2 | 8.2 | 7.2 | 3.45 | 2.12 | 6.84 | 4.7 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 5.1 | 3.4 | 1.96 | 1.57 | 2.1 | 2.4 | 1.5 | 1.3 | 1.47 | 0.87 | 1.36 | 1.94 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 2.8 | 2.4 | 3.71 | 3.34 | 2.7 | 2.9 | 3.6 | 3.3 | 1.75 | 1.59 | 1.58 | 1.35 | IS3025(P34)88Cl a.2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 2.36 | 1.8 | 2.67 | 2.14 | 2.85 | 2.45 | 2.1 | 1.8 | 1.04 | 1.49 | 1.3 | 1.5 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 18.3 | 12 | 15.04 | 12.71 | 12.20 | 11.50 | 13.41 | 11.95 | 6.67 | 4.6 | 9.78 | 6.99 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 12 | 6 | 16 | 8 | 18 | BDL* | 11 | BDL* | 18 | BDL* | 14.3 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34814 | 34518 | 35810 | 35334 | 35511 | 35273 | 35710 | 35994 | 36394 | 36996 | 36534 | 36840 | IS3025(P16)84Re .02 |
| 15 | COD | mg/L | 16 | BDL* | 13 | BDL* | 15 | BDL* | 21.0 | 10.0 | 26.0 | 7.0 | 15.0 | BDL* | APHA(22nd Edi) 5520-D Open Reflux |
| A | **Flora and Fauna** | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L /day | 1.55 | 1.21 | 1.95 | 1.32 | 2.46 | 2.1 | 4.1 | 2.8 | 7.42 | 5.62 | 8.1 | 5.17 | APHA (22nd Edi) 10200-J |
| B | **Phytoplankton** | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | mg/$m^3$ | 1.94 | 1.12 | 2.13 | 1.25 | 2.2 | 1.98 | 2.9 | 2.10 | 3.24 | 2.60 | 3.4 | 2.74 | APHA (22nd Edi) 10200-H |
| 17.2 | Phaeophytin | mg/$m^3$ | 2.18 | 0.7 | 0.96 | 0.7 | 1.6 | 0.86 | 1.8 | 1.1 | 2.45 | 1.44 | 2.77 | 1.97 | APHA (22nd Edi) |

**H. T. Shah**

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | 10200-H |
| 17.3 | Cell Count | No. x $10^3$/L | 150 | 106 | 192 | 106 | 202 | 124 | 193 | 89 | 240 | 73 | 210 | 60 | APHA (22nd Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Rhizosolenia** *Melosira* *Nitzschia* *Biddulphia* *Coscinodiscus* **Cyclotella** | **Pleurosigma** *Navicula* *Rhizosolenia* -- **--** -- | **Cyclotella sp.** *Nitzschia sp.* *Skeletonema sp.* *Cheatoceros sp.* *Pleurosigma sp.* *Biddulphia sp.* -- | **Navicula sp.** *Rhizosolenia sp.* *Synedra sp.* *Fragillaria sp.* -- -- -- | Thallasiosira sp. Coscinodiscus sp. Cyclotella sp. Ceratizam | Navicula sp. Biddulphia sp. Gyrosigma sp. -- | *Thallasiosira sp.* Nitzschia sp. Rhizosolenia sp. Coscinodiscus sp. | *Navicula sp.* Biddulphia sp. Thallasiosira sp. | *Synedra sp.* *Coscinodiscus sp.* *Biddulphia sp.* *Navicula sp.* | *Nitzschia sp.* *Pleurosigma sp.* *Skeletonema sp.* -- | *Nitzschia sp.* *Pleurosigma sp.* *Biddulphia sp.* *Coscinodiscus sp.* | *Thallasiosira sp.* *Skeletonema sp.* *Nitzschia sp.* -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX$10^3$/ 100 $m^3$ | 51 | | 56 | | 38 | | 63 | | 52 | | 60 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Hydrozoans Polychaetes Cheatocerous -- | | Polychaetes Decapods Crustaceans Fish Larve | | Ostracods Polychaetes Foraminiferans | | Polychaete Foraminiferans Ostracodes Decapods | | Polychaetes Bivalves Amphipods | | Foraminiferans Ostracodes Bivalves | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 $m^3$ | 9.6 | | 9.3 | | 5.6 | | 5.9 | | 4.3 | | 3.95 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1650 | | 1980 | | 1820 | | 1860 | | 1720 | | 1740 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22ndEdi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi. 2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | NOVEMBER 2018 | DECEMBER 2018 | JANUARY 2019 | FEBRUARY 2019 | MARCH 2019 | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | |
| 1 | Organic Matter | % | 0.7 | 0.74 | 0.52 | 0.68 | 0.82 | 0.63 | FCO:2007 |
| 2 | Phosphorus as P | µg/g | 216 | 283 | 210 | 296 | 319 | 270 | APHA(22nd Edi) 4500 C |
| 3 | Texture | -- | Sandy | Sandy | Sandy | Sandy | Sandy | Sandy | -- |
| 4 | Petroleum Hydrocarbon | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | PLPL-TPH |
| 5 | **Heavy Metals** | | | | | | | | |
| 5.1 | Aluminum as Al | % | 5.2 | 5.18 | 4.9 | 5 | 4.86 | 5.1 | AAS APHA 3111 B |
| 5.2 | Total Chromium as $Cr^{+3}$ | µg/g | 158 | 163 | 170 | 192 | 218 | 158 | AAS 3111B |
| 5.3 | Manganese as Mn | µg/g | 1710 | 1599 | 1248 | 1336 | 1492 | 1206 | AAS APHA 3111 B |
| 5.4 | Iron as Fe | % | 5 | 4.92 | 5.1 | 4.97 | 5.16 | 4.82 | AAS APHA(22nd Edi)3111 B |
| 5.5 | Nickel as Ni | µg/g | 62 | 34.6 | 26 | 48 | 40 | 21 | AAS APHA(22nd Edi)3111 B |
| 5.6 | Copper as Cu | µg/g | 56.4 | 50.2 | 64 | 42 | 33 | 48.4 | AAS APHA(22nd Edi)3111 B |
| 5.7 | Zinc as Zn | µg/g | 344 | 256 | 296 | 310 | 347 | 203 | AAS APHA(22nd Edi)3111 B |
| 5.8 | Lead as Pb | µg/g | 4.6 | 2.7 | 2 | 3.6 | 3.2 | 1.2 | AAS APHA(22nd Edi)3111 B |
| 5.9 | Mercury as Hg | µg/g | BDL* | BDL* | 0.01 | BDL* | BDL* | BDL* | AAS APHA- 3112 B |
| 6 | **Benthic Organisms** | | | | | | | | |
| 6.1 | Macrobenthos | -- | Hydrozoa<br>Gastropods<br>Mysids | Amphipods<br>Mysids<br>Bivalves | Gastropods<br>Bivalves<br>Echinoderms | Gastropods<br>Bivalves<br>-- | Gastropods<br>Brachyurans<br>-- | Bivalves<br>Gastropods<br>-- | APHA (22nd Edi) 10500-C |
| 6.2 | MeioBenthos | -- | Bruchyrans<br>Nematodes<br>-- | Hydrozoan<br>Foraminiferans<br>--- | Nematodes<br>--<br>-- | Foraminiferans<br>--<br>-- | Nematodes<br>--<br>-- | Foraminiferans<br>Brachyurans<br>-- | APHA (22nd Edi) 10500-C |
| 6.3 | Population | no/m2 | 397 | 469 | 557 | 616 | 733 | 850 | APHA (22nd Edi) 10500-C |

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.37 | 8.24 | 8.3 | 8.16 | 8.31 | 8.24 | 8.19 | 8.16 | 8.13 | 8.11 | 8.15 | 8.10 | IS3025(P11)83Re.02 |
| 2 | Temperature | oC | 30.4 | 30.2 | 30.5 | 30.3 | 30.8 | 30.5 | 30.6 | 30.4 | 30.2 | 30.1 | 30.3 | 30 | IS3025(P9)84Re.02 |
| 3 | Total Suspended Solids | mg/L | 342 | 296 | 370 | 308 | 348 | 314 | 270 | 286 | 208 | 231 | 274 | 296 | IS3025(P17)84Re.02 |
| 4 | BOD (3 Days @ 27°C) | mg/L | 7 | 3 | 8 | 2 | 5 | 3 | 7.4 | BDL* | 5.6 | BDL* | 5.9 | BDL* | IS 3025 (P44)1993Re.03Edition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.6 | 6.2 | 6.4 | 6.1 | 6.6 | 6.1 | 6.2 | 5.9 | 6.1 | 5.7 | 6.2 | 5.9 | IS3025(P38)89Re.99 |
| 6 | Salinity | ppt | 34 | 33.8 | 34.8 | 3 | 34.3 | 34.2 | 34.7 | 34.9 | 35.4 | 35.6 | 35.5 | 35.8 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | 34.5 | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)5520D |
| 8 | Nitrate as $NO_3$ | µmol/L | 7.9 | 5.2 | 6.68 | 5.23 | 6.2 | 5.4 | 7.2 | 6.8 | 5.78 | 4.23 | 8.34 | 6.9 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 1.6 | 1.2 | 1.57 | 1.47 | 1.2 | 1.6 | 1.39 | 0.78 | 1.24 | 1.47 | 1.56 | 1.73 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 2.8 | 2.4 | 2.98 | 2.41 | 3.1 | 2.4 | 3.5 | 3.1 | 2.36 | 2.08 | 2.51 | 2.3 | IS3025(P34)88Cla.2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 2.46 | 2.15 | 1.76 | 1.44 | 2.1 | 1.84 | 2.5 | 1.6 | 1.3 | 1.48 | 1.58 | 1.74 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 12.3 | 8.8 | 11.23 | 9.11 | 10.50 | 9.40 | 12.24 | 10.81 | 9.38 | 7.78 | 12.41 | 10.93 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 28 | 14 | 21 | 10 | 18 | BDL* | 14.8 | BDL* | 16 | BDL* | 9.4 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34327 | 34218 | 35930 | 35634 | 35227 | 35108 | 35698 | 35846 | 36274 | 36480 | 36570 | 36984 | IS3025(P16)84Re.02 |
| 15 | COD | mg/L | 22 | 15 | 25 | 11 | 18 | 10 | 26 | 12.0 | 21 | 7.0 | 15 | BDL* | APHA(22ndEdi) 5520-D Open Reflux |
| A | **Flora and Fauna** | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L /day | 1.75 | 1.14 | 2.58 | 1.91 | 2.94 | 2.5 | 4.23 | 3.78 | 7.31 | 4.77 | 7.87 | 5.62 | APHA (22nd Edi) 10200-J |
| B | **Phytoplankton** | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | mg/$m^3$ | 1.72 | 1.26 | 2.52 | 2.4 | 2.82 | 2.24 | 2.41 | 2.02 | 2.69 | 2.31 | 2.5 | 2.28 | APHA (22nd Edi) 10200-H |
| 17.2 | Phaeophytin | mg/$m^3$ | 1.86 | 0.502 | 1.49 | 1.03 | 2.36 | 1.96 | 1.86 | 1.3 | 2.27 | 2.12 | 1.2 | 1 | APHA (22nd Edi) 10200-H |

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**H. T. Shah**
**Lab Manager**

**Dr. Arun Bajpai**
**Lab Manager (Q)**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17.3 | Cell Count | No. x $10^3$/L | 151 | 97 | 178 | 104 | 270 | 130 | 187 | 99 | 201 | 87 | 231 | 76 | APHA (22nd Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Biddulphia** *Navicula Cheatoceros Nitzschia* ***Melosira*** *Gyrosigma* | **Navicula** *Synedra Melosira* -- -- -- | **Navicula sp.** *Cyclotella sp. Biddulphia sp. Surirella sp. Cheatoceros sp.* -- | **Fragillaria sp.** *Rhizosolenia sp. Navicula sp.* -- -- -- | Thallassiosira sp. Nitzschia sp. Coscinodiscus sp. Biddulphia sp. | Navicula sp. Cheatoceros sp. Gyrosigma sp. -- | *Thallassiosira sp. Biddulphia sp. Synedra sp. Pleurosigma sp.* | *Nitzschia sp.* Gyrosigma sp. *stauroneis* -- | *Cheatoceros sp. Rhizosolenia sp. Biddulphia sp. Navicula sp.* | *Nitzschia sp. Fragillaria sp. Navicula sp.* -- | *Cheatoceros sp. Rhizosolenia sp. Coscinodiscus sp. Thallassiosira sp.* | *Nitzschia sp. Gyrosigma sp. Fragillaria sp.* -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX$10^3$/ 100 $m^3$ | 44 | | 56 | | 68 | | 63 | | 51 | | 59 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Polychaetes Bivalves Decapods -- | | Copepods Mysids mollusca Echinoderms | | Siphonophores Gastropods Chaetognathes | | Gastropods mollusca Crustaceans -- | | Polychaetes Bivalves Ostracods | | Gastropods Copepods Bivalves | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 $m^3$ | 7.1 | | 7.8 | | 6.1 | | 5.15 | | 3.7 | | 3.45 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1820 | | 1740 | | 1860 | | 1800 | | 1840 | | 1820 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22nd Edi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi.2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.29 | 8.06 | 8.26 | 8.12 | 8.24 | 8.17 | 8.21 | 8.17 | 8.16 | 8.14 | 8.15 | 8.12 | IS3025(P11)83Re.02 |
| 2 | Temperature | oC | 30.5 | 30.2 | 30.3 | 30.1 | 31 | 30.8 | 30.9 | 30.6 | 30.1 | 29.9 | 30.2 | 30 | IS3025(P9)84Re.02 |
| 3 | Total Suspended Solids | mg/L | 298 | 242 | 318 | 276 | 382 | 319 | 264 | 283 | 204 | 276 | 228 | 263 | IS3025(P17)84Re.02 |
| 4 | BOD (3 Days @ 27 °C) | mg/L | 4 | 3 | 6 | BDL* | 3 | BDL* | 5.2 | BDL* | 7.8 | BDL* | 5.9 | BDL* | IS 3025 (P44)1993Re.03Edition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.4 | 5.6 | 6.3 | 5.9 | 6.4 | 6 | 6.2 | 6.1 | 6.6 | 6.2 | 6.1 | 5.8 | IS3025(P38)89Re.99 |
| 6 | Salinity | ppt | 34.3 | 34.1 | 34.4 | 34.1 | 34.1 | 33.9 | 34.5 | 34.7 | 35.3 | 35.7 | 35.6 | 35.9 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)5520D |
| 8 | Nitrate as $NO_3$ | µmol/L | 7.2 | 6 | 8.76 | 7.01 | 5.72 | 3.98 | 6.68 | 5.59 | 5.81 | 4.42 | 6.94 | 4.8 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 1.9 | 1.6 | 1.14 | 0.88 | 0.68 | 0.52 | 1.06 | 0.98 | 1.14 | 1.08 | 1.33 | 1.14 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 2.4 | 1.8 | 1.69 | 1.43 | 2.32 | 1.8 | 3.74 | 2.63 | 1.9 | 1.65 | 1.81 | 1.42 | IS3025(P34)88Cla.2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 2.68 | 1.95 | 2.46 | 1.87 | 1.9 | 1.72 | 2.28 | 2.63 | 1.07 | 2.47 | 1.24 | 1.37 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 11.5 | 9.4 | 11.59 | 9.32 | 8.72 | 6.30 | 11.49 | 9.21 | 8.85 | 7.15 | 10.08 | 7.36 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 30 | 20 | 28 | 20 | 24 | 17 | 14 | BDL* | 19 | BDL* | 15.2 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34772 | 34596 | 35618 | 35213 | 35418 | 34832 | 35684 | 35840 | 36320 | 36619 | 36498 | 37348 | IS3025(P16)84Re.02 |
| 15 | COD | mg/L | 20 | 10 | 18 | BDL* | 13 | BDL* | 19 | 7 | 25 | 6 | 19.8 | 7 | APHA(22nd Edi) 5520-D Open Reflux |
| A | Flora and Fauna | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L /day | 1.28 | 1.19 | 2.25 | 1.93 | 3.1 | 2.9 | 4.36 | 3.93 | 7.2 | 6 | 7.87 | 5.06 | APHA (22nd Edi) 10200-J |
| B | Phytoplankton | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | $mg/m^3$ | 2.14 | 1.12 | 2.54 | 1.05 | 2.84 | 1.84 | 2.9 | 2.41 | 3.2 | 2 | 2.76 | 2.2 | APHA (22nd Edi) 10200-H |
| 17.2 | Phaeophytin | $mg/m^3$ | 2.4 | 1.04 | 0.64 | 0.32 | 1.7 | 1.1 | 2.2 | 1.49 | 2.9 | 1.9 | 2 | 1.6 | APHA (22nd Edi) 10200-H |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17.3 | Cell Count | No. x $10^3$/L | 154 | 89 | 184 | 96 | 260 | 170 | 201 | 73 | 226 | 84 | 251 | 79 | APHA (22nd Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Rhizosolenia** *Melosira* *Navicula* *Nitzschia* **Coscinodiscus** -- | **Guinardia** *Synedra* *Nitzschia* -- -- **--** | **Navicula sp.** *Thallasiosira sp.* *Cyclotella sp.* *Synedra sp.* *Coscinodiscus sp.* -- | **Nitzschia sp.** *Rhizosolenia sp.* *Synedra sp.* -- -- -- | Navicula sp. Melosira sp. Thallasiosira sp. Rhizosolenia sp. | Nitzschia sp. Cheatoceros sp. Fragillaria sp. -- | Biddulphia sp. *Nitzschia sp.* Pleurosigma sp. *Thallasionema sp.* | Navicula sp. *Gyrosigma sp.* Synedra sp. -- | *Rhizosolenia sp.* *Biddulphia sp.* *Thallasiosira sp.* *Coscinodiscus sp.* | *Synedra sp.* *Nitzschia sp.* *Thallasiosira sp.* -- | *Biddulphia sp.* *Coscinodiscus sp.* *Thallasiosira sp.* *Gyrosigma sp.* | *Nitzschia sp.* *Pleurosigma sp.* *Fragillaria sp.* -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX$10^3$/ 100 $m^3$ | 49 | | 60 | | 76 | | 65 | | 59 | | 42 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Polychaetes Copepods Isopods Mysids | | Copepods Gastropods Bivalves Crustaceans | | Ctenophores Ostracods Gastropods | | Crustaceans Gastropods Decapods -- | | Copepods Polychaetes Bivalves | | Crustaceans Ostracods Copepods | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 $m^3$ | 6.55 | | 8.15 | | 6.92 | | 5.6 | | 4.8 | | 4.95 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1925 | | 2120 | | 1860 | | 1920 | | 1960 | | 1940 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22ndEdi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi. 2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | NOVEMBER 2018 | DECEMBER 2018 | JANUARY 2019 | FEBRUARY 2019 | MARCH 2019 | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|
| | | | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | SEDIMENT | |
| 1 | Organic Matter | % | 0.51 | 0.56 | 0.48 | 0.59 | 0.64 | 0.69 | FCO:2007 |
| 2 | Phosphorus as P | µg/g | 270 | 332 | 290 | 318 | 370 | 252 | APHA(22nd Edi) 4500 C |
| 3 | Texture | -- | Sandy | Sandy | Sandy | Sandy | Sandy | Sandy | -- |
| 4 | Petroleum Hydrocarbon | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | PLPL-TPH |
| 5 | **Heavy Metals** | | | | | | | | |
| 5.1 | Aluminum as Al | % | 5.28 | 5.16 | 4.96 | 4.84 | 4.7 | 4.93 | AAS APHA 3111 B |
| 5.2 | Total Chromium as $Cr^{+3}$ | µg/g | 216 | 298 | 280 | 230 | 248 | 218 | AAS 3111B |
| 5.3 | Manganese as Mn | µg/g | 1680 | 1534 | 1346 | 1276 | 1424 | 1240 | AAS APHA 3111 B |
| 5.4 | Iron as Fe | % | 5.14 | 4.85 | 5.1 | 5.2 | 4.86 | 4.92 | AAS APHA(22nd Edi)3111 B |
| 5.5 | Nickel as Ni | µg/g | 48 | 68 | 21 | 33 | 57 | 23.6 | AAS APHA(22nd Edi)3111 B |
| 5.6 | Copper as Cu | µg/g | 51 | 62.4 | 28 | 48 | 33 | 42.8 | AAS APHA(22nd Edi)3111 B |
| 5.7 | Zinc as Zn | µg/g | 286 | 324 | 260 | 271 | 302 | 268 | AAS APHA(22nd Edi)3111 B |
| 5.8 | Lead as Pb | µg/g | 4.7 | 3.2 | 2.18 | 3.3 | 2.8 | 1.9 | AAS APHA(22nd Edi)3111 B |
| 5.9 | Mercury as Hg | µg/g | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | AAS APHA- 3112 B |
| 6 | **Benthic Organisms** | | | | | | | | |
| 6.1 | Macrobenthos | -- | Crustaceans<br>Polychaetes<br>Chaetognaths | Polychaete worms<br>Bivalves<br>Crustaceans | Polychaete<br>Crustaceans<br>Gastropods | Gastropods<br>Echinoderms<br>-- | Gastropods<br>Polychaetes<br>-- | Polychaetes<br>Crustaceans<br>-- | APHA (22nd Edi) 10500-C |
| 6.2 | MeioBenthos | -- | Copepods<br>Bryozoans<br>-- | Nematodes<br>Hydrozoan<br>-- | --<br>--<br>-- | Nematodes<br>--<br>-- | Copepods<br>Foraminiferans<br>-- | Copepods<br>Nematodes<br>-- | APHA (22nd Edi) 10500-C |
| 6.3 | Population | no/$m^2$ | 265 | 411 | 559 | 647 | 824 | 794 | APHA (22nd Edi) 10500-C |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.19 | 8.06 | 8.24 | 8.11 | 8.17 | 8.15 | 8.12 | 8.09 | 8.2 | 8.17 | 8.15 | 8.1 | IS3025(P11)83Re .02 |
| 2 | Temperature | oC | 30.1 | 30 | 30.4 | 30.3 | 30.3 | 30.2 | 30.1 | 30 | 30.1 | 30 | 30.2 | 30 | IS3025(P9)84Re. 02 |
| 3 | Total Suspended Solids | mg/L | 382 | 316 | 364 | 304 | 319 | 287 | 246 | 281 | 199 | 218 | 236 | 253 | IS3025(P17)84Re .02 |
| 4 | BOD (3 Days @ 27 °C) | mg/L | 7 | 5 | 6 | BDL* | 4 | BDL* | 5.0 | BDL* | 6.7 | BDL* | 5.4 | BDL* | IS 3025 (P44)1993Re.03E dition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.6 | 5.9 | 6.5 | BDL* | 6.6 | 6.4 | 6.1 | 5.9 | 6.1 | 5.9 | 6.2 | 5.8 | IS3025(P38)89Re .99 |
| 6 | Salinity | ppt | 34.3 | 33.8 | 34.8 | 34.3 | 35.1 | 34.7 | 34.9 | 35.1 | 35.3 | 35.5 | 35.4 | 35.6 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)552 0D |
| 8 | Nitrate as $NO_3$ | µmol/L | 13.4 | 8.2 | 9.09 | 8.76 | 10.4 | 9.6 | 8.1 | 7.14 | 5.75 | 4.38 | 6.2 | 4.63 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 2.6 | 2 | 1.78 | 1.43 | 1.96 | 1.54 | 1.14 | 0.88 | 0.96 | 1.18 | 1.28 | 1.34 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 4.4 | 3.6 | 3.82 | 2.77 | 2.6 | 1.2 | 3.99 | 3.71 | 2.72 | 1.91 | 2.5 | 2.14 | IS3025(P34)88Cla .2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 2.5 | 2.4 | 1.82 | 1.29 | 2.16 | 1.75 | 2.13 | 1.81 | 1.84 | 1.36 | 1.7 | 1.46 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 20.4 | 13.8 | 14.69 | 12.96 | 14.96 | 12.34 | 13.23 | 11.72 | 9.43 | 7.47 | 9.98 | 8.11 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 35 | 24 | 28 | 16 | 16 | BDL* | 10 | BDL* | 8 | BDL* | 14.6 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34718 | 34448 | 35218 | 34972 | 35767 | 35415 | 35634 | 35410 | 36184 | 36474 | 36314 | 36679 | IS3025(P16)84Re .02 |
| 15 | COD | mg/L | 28 | 22 | 27 | BDL* | 16 | 10 | 18 | 11.0 | 23 | 6.0 | 19.6 | 7.4 | APHA(22nd Edi) 5520-D Open Reflux |
| A | **Flora and Fauna** | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L /day | 1.58 | 1.03 | 2.48 | 1.8 | 2.64 | 2.28 | 5.63 | 3.82 | 7.29 | 5.89 | 7.43 | 4.95 | APHA (22nd Edi) 10200-J |
| B | **Phytoplankton** | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | $mg/m^3$ | 1.9 | 1.57 | 1.62 | 1.78 | 2.4 | 1.96 | 3.6 | 2.70 | 3 | 2.54 | 3.6 | 2.79 | APHA (22nd Edi) 10200-H |
| 17.2 | Phaeophytin | $mg/m^3$ | 1.1 | 0.58 | 1.28 | 0.42 | 1.7 | 1.02 | 2.24 | 1.92 | 2.56 | 1.13 | 2.16 | 1.74 | APHA (22nd Edi) |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. Arun Bajpai**

**Lab Manager (Q)**

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | 10200-H |
| 17.3 | Cell Count | No. x $10^3$/L | 157 | 99 | 176 | 80 | 284 | 110 | 230 | 181 | 201 | 97 | 223 | 76 | APHA (22nd Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Nitzschia** *Thallasiosira Coscinodiscus Synedra Rhizosolenia* -- | **Nitzschia** *Navicula Fragillaria* -- -- -- | **Navicula sp.** *Thallasiosira sp. Coscinodiscus sp. Biddulphia sp. Rhizosolenia sp. Nitzschia sp. Navicula sp.* | **Nitzschia sp.** *Fragillaria sp. Synedra sp. Gyrosigma sp.* -- -- -- | **Rhizosolenia sp.** Nitzschia sp. Thallasiosira sp. -- | **Cheatoceros sp.** Biddulphia sp. Cyclotella sp. -- | *Navicula sp. Cheatoceros sp. Thallasionema sp.* -- | *Rhizosolenia sp. Skeletonema sp.* -- -- | *Cheatoceros sp. Nitzschia sp. Rhizosolenia sp. Coscinodiscus sp.* | *Navicula sp. Pleurosigma sp. Synedra sp.* -- | *Nitzschia sp. Thallasiosira sp. Coscinodiscus sp. Navicula sp.* | *Nitzschia sp. Rhizosolenia sp.* -- -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX$10^3$/ 100 $m^3$ | 45 | | 51 | | 62 | | 58 | | 62 | | 55 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Bivalves Polychaetes Decapods Foraminiferans | | Polychaetes Gastropods Nematodes Mysids | | Lamellibranches Ctenophores Polychaetes | | Gastropods molluscan Bivalves -- | | Gastropods molluscans Bivalves | | Gastropods Copepods Mysids | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 $m^3$ | 5.7 | | 6.6 | | 5.92 | | 4.3 | | 5 | | 2.95 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 1800 | | 1760 | | 1860 | | 1820 | | 1720 | | 1860 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22ndEdi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi. 2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

**H. T. Shah**

**Lab Manager**

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**Dr. Arun Bajpai**

**Lab Manager (Q)**

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

| SR. NO. | TEST PARAMETERS | UNIT | OCTOBER 2018 | | NOVEMBER 2018 | | DECEMBER 2018 | | JANUARY 2019 | | FEBRUARY 2019 | | MARCH 2019 | | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | SURFACE | BOTTOM | |
| 1 | pH | -- | 8.25 | 8.11 | 8.24 | 8.05 | 8.35 | 8.17 | 8.19 | 8.14 | 8.17 | 8.13 | 8.15 | 8.12 | IS3025(P11)83Re .02 |
| 2 | Temperature | oC | 30.3 | 30 | 30.1 | 29.8 | 30.6 | 30.3 | 30.2 | 30 | 30.2 | 29.9 | 30.2 | 30 | IS3025(P9)84Re. 02 |
| 3 | Total Suspended Solids | mg/L | 296 | 236 | 286 | 244 | 252 | 257 | 210 | 232 | 213 | 256 | 228 | 249 | IS3025(P17)84Re .02 |
| 4 | BOD (3 Days @ 27°C) | mg/L | 4 | 2 | 3 | BDL* | BDL* | BDL* | 5.0 | BDL* | 6.8 | BDL* | 4.5 | BDL* | IS 3025 (P44)1993Re.03E dition2.1 |
| 5 | Dissolved Oxygen | mg/L | 6.8 | 6 | 6.3 | 5.8 | 6.4 | 6.2 | 6.0 | 5.8 | 6.4 | 5.7 | 6.1 | 5.8 | IS3025(P38)89Re .99 |
| 6 | Salinity | ppt | 34.5 | 34.3 | 34.3 | 34.1 | 34.8 | 34.5 | 34.4 | 34.5 | 35.4 | 35.6 | 35.5 | 35.7 | APHA (22nd Edi) 2550 B |
| 7 | Oil & Grease | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | APHA(22nd Edi)5520D |
| 8 | Nitrate as $NO_3$ | µmol/L | 13.2 | 9.2 | 11.72 | 8.7 | 8.9 | 7.1 | 7.86 | 6.65 | 2.84 | 1.87 | 2.27 | 1.63 | IS3025(P34)88 |
| 9 | Nitrite as $NO_2$ | µmol/L | 3.4 | 2.8 | 1.98 | 1.74 | 1.15 | 2.45 | 1.49 | 1.1 | 0.43 | 0.37 | 0.68 | 0.89 | IS3025(P34)88 NEDA |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 4.6 | 4 | 3.39 | 2.87 | 4.6 | 3.9 | 3.85 | 3.54 | 2.37 | 1.99 | 2.2 | 1.93 | IS3025(P34)88Cla .2.3 |
| 11 | Phosphates as $PO_4$ | µmol/L | 2.95 | 2.16 | 2.36 | 1.82 | 2.5 | 2.41 | 2.23 | 1.86 | 0.98 | 0.9 | 0.84 | 0.72 | APHA(22nd Edi) 4500 C |
| 12 | Total Nitrogen | µmol/L | 21.1 | 16 | 17.09 | 13.31 | 14.65 | 12.45 | 13.21 | 11.29 | 5.64 | 4.23 | 5.15 | 4.45 | IS3025(P34)88 |
| 13 | Petroleum Hydrocarbon | µg/L | 32 | 10 | 25 | 12 | 16 | 10 | 14 | BDL* | 18.2 | BDL* | 13.5 | BDL* | PLPL-TPH |
| 14 | Total Dissolved Solids | mg/L | 34983 | 34649 | 35860 | 35648 | 35117 | 34992 | 35528 | 35664 | 36520 | 36796 | 36718 | 36984 | IS3025(P16)84Re .02 |
| 15 | COD | mg/L | 20 | 8 | 18 | BDL* | 10 | BDL* | 19 | 8 | 27 | 8 | 22.6 | 7 | APHA(22nd Edi) 5520-D Open Reflux |
| A | **Flora and Fauna** | | | | | | | | | | | | | | |
| 16 | Primary productivity | mgC/L /day | 1.71 | 1.57 | 2.11 | 2.04 | 3.2 | 2.6 | 5.1 | 3.3 | 7.09 | 4.6 | 5.62 | 3.37 | APHA (22nd Edi) 10200-J |
| B | **Phytoplankton** | | | | | | | | | | | | | | |
| 17.1 | Chlorophyll | mg/$m^3$ | 1.99 | 1.51 | 2.17 | 1.8 | 2.9 | 2.3 | 3.2 | 2.6 | 3.8 | 2.85 | 3.27 | 2.67 | APHA (22nd Edi) 10200-H |
| 17.2 | Phaeophytin | mg/$m^3$ | 1.6 | 1.44 | 1.6 | 1.46 | 2.2 | 1.96 | 2.5 | 1.5 | 2.7 | 1.4 | 2.56 | 1.54 | APHA (22nd Edi) 10200-H |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17.3 | Cell Count | No. x $10^3$/L | 173 | 90 | 198 | 112 | 230 | 170 | 217 | 213 | 213 | 96 | 236 | 81 | APHA (22nd Edi) 10200-H |
| 17.4 | Name of Group Number and name of group species of each group | -- | **Rhizosolenia** *Nitzschia* *Melosira* *Cyclotella* *Cosmarium* -- | **Amphiprora** *ceratium* *Nitzschia* -- -- -- | **Rhizosolenia sp.** *Nitzschia sp.* *Synedra sp.* *Biddulphia sp.* *coratizum sp.* *Melosira sp.* | **Nitzschia sp.** *Navicula sp.* *Fragillaria sp.* -- -- -- | **Rhizosolenia sp.** Navicula sp. Thallasiosira sp. Coscinodiscus sp. | **Nitzschia sp.** Cyclotella sp. Cheatoceous sp. -- | *Thallasiosira sp.* *Rhizosolenia sp.* *Coscinodiscus sp.* -- | *Navicula sp.* *Synedra sp.* *Fragillaria sp.* -- | *Coscinodiscus sp.* *Rhizosolenia sp.* *Thallasiosira sp.* *Synedra sp.* | *Synedra sp.* *Navicula sp.* *Gyrosigma a sp.* -- | *Coscinodiscus sp.* *Rhizosolenia sp.* *Fragillaria sp.* *Synedra sp.* | *Navicula sp.* *Pleurosigma sp.* *Biddulphia sp.* -- | APHA (22nd Edi) 10200-H |
| C | **Zooplanktons** | | | | | | | | | | | | | | |
| 18.1 | Abundance (Population) | noX$10^3$/ 100 $m^3$ | 43 | | 40 | | 58 | | 45 | | 64 | | 53 | | APHA (22nd Edi) 10200-G |
| 18.2 | Name of Group Number and name of group species of each group | -- | Foraminiferans Chaetognaths Gastropods -- | | Polychaetes Bivalves Crustaceans Copepods | | Bivalves Gastropods Crustaceans | | molluscan Crustaceans Gastropods -- | | Polychaetes molluscans | | Polychaetes Foraminiferans Bivalves | | APHA (22nd Edi) 10200-G |
| 18.3 | Total Biomass | ml/100 $m^3$ | 5.1 | | 5.6 | | 3.2 | | 4.4 | | 3.9 | | 3.4 | | APHA (22nd Edi) 10200-G |
| D | **Microbiological Parameters** | | | | | | | | | | | | | | |
| 19.1 | Total Bacterial Count | CFU/ml | 2100 | | 1870 | | 1860 | | 1850 | | 1720 | | 1820 | | IS 5402:2002 |
| 19.2 | Total Coliform | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | APHA(22nd Edi)9221-D |
| 19.3 | Ecoli | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS:1622:1981Edi. 2.4(2003-05) |
| 19.4 | Enterococcus | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 15186 :2002 |
| 19.5 | Salmonella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-3) |
| 19.6 | Shigella | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 1887 (P-7) |
| 19.7 | Vibrio | /ml | Absent | | Absent | | Absent | | Absent | | Absent | | Absent | | IS : 5887 (P-5) |

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## RESULTS OF ETP WATER OUTLET

| SR. NO. | PARAMETERS | UNIT | RESULTS OF ETP WATER OUTLET | | | | | | GPCB Limit | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 03/10/2018 | 11/05/2018 | 04/12/2018 | 04/01/2019 | 05/02/2019 | 04/03/2019 | | |
| 1 | Colour | Co-pt | 70 | 50 | 60 | 50 | 70 | 80 | **100** | IS3025(P4)83Re.02 |
| 2 | pH | -- | 7.1 | 7.52 | 8.4 | 7.3 | 8.1 | 7.45 | **6.5 TO 8.5** | IS3025(P11)83Re.02 |
| 3 | Temperature | °C | 32.4 | 30.8 | 31.2 | 30.8 | 31.6 | 31.9 | **40** | IS3025(P9)84Re.02 |
| 4 | Total Suspended Solids | mg/L | 34 | 25 | 39 | 52 | 72 | 64 | **100** | IS3025(P17)84Re.02 |
| 5 | Total Dissolved Solids | mg/L | 1024 | 1712 | 1698 | 1318 | 1560 | 1921 | **2100** | IS3025(P16)84Re.02 |
| 6 | COD | mg/L | 88 | 92 | 76 | 94 | 84 | 68 | **100** | APHA(22nd Edi) 5520-D Open Reflux |
| 7 | BOD (3 Days @ 27 °C) | mg/L | 26 | 18 | 20 | 24 | 20 | 19 | **30** | IS 3025 (P44)1993Re.03Edition2.1 |
| 8 | Chloride as Cl | mg/L | 429 | 510 | 529 | 399 | 489 | 596 | **600** | IS3025(P32)88Re.99 |
| 9 | Oil & Grease | mg/L | 3.8 | 2.4 | 3.2 | 2.4 | 4 | 7.8 | **10** | APHA(22nd Edi)5520D |
| 10 | Sulphate as $SO_4$ | mg/L | 72 | 110 | 98 | 112 | 156 | 172 | **1000** | APHA(22nd Edi)4500 $SO_4$ E |
| 11 | Ammonical Nitrogen as $NH_3$ | mg/L | 2.7 | 3.4 | 4.6 | 3.2 | 5.2 | 7.2 | **50** | IS3025(P34)88Cla.2.3 |
| 12 | Phenolic Compound | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | **1** | IS3025(P43)92Re.03 |
| 13 | Copper as Cu | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | **3** | AAS APHA(22nd Edi)3111 B |
| 14 | Lead as Pb | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | **0.1** | AAS APHA(22nd Edi)3111 B |
| 15 | Sulphide as S | mg/L | 1.8 | 1.4 | 1.1 | 1.4 | 1.8 | 1.2 | **2** | APHA(22nd Edi) 4500-S |
| 16 | Cadmium as Cd | mg/L | BDL* | BDL* | BDL* | BDL* | BDL* | BDL* | **2** | AAS APHA(22nd Edi)3111 B |
| 17 | Fluoride as F | mg/L | 0.75 | 0.65 | 0.45 | 0.5 | 0.6 | 0.5 | **2** | APHA(22nd Edi) 4500 F D SPANDS |

*Below detection limit

**H. T. Shah**
**Lab Manager**

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**Dr. Arun Bajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| ADANI PORT – T1 TERMINAL NR.MARINE BUILDING | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) $\mu g/m^3$ | Particulate Matter (PM 2.5) $\mu g/m^3$ | Sulphur Dioxide (SO2) $\mu g/m^3$ | Oxides of Nitrogen (NO2) $\mu g/m^3$ | Carbon Monoxide as CO $mg/m^3$ | Hydrocarbon as $CH_4$ $mg/m^3$ | Benzene as $C_6H_6$ $\mu g/m^3$ |
| 1 | 02/10/2018 | 84.33 | 43.68 | 13.61 | 20.68 | 0.70 | BDL* | BDL* |
| 2 | 05/10/2018 | 92.48 | 57.62 | 21.29 | 42.31 | 0.41 | BDL* | BDL* |
| 3 | 09/10/2018 | 89.64 | 39.44 | 14.36 | 35.61 | 0.39 | BDL* | BDL* |
| 4 | 12/10/2018 | 72.66 | 29.46 | 16.42 | 30.44 | 0.33 | BDL* | BDL* |
| 5 | 16/10/2018 | 87.60 | 48.35 | 24.29 | 39.35 | 0.57 | BDL* | BDL* |
| 6 | 19/10/2018 | 79.45 | 37.40 | 10.44 | 38.26 | 0.31 | BDL* | BDL* |
| 7 | 23/10/2018 | 86.30 | 45.39 | 19.44 | 32.51 | 0.17 | BDL* | BDL* |
| 8 | 26/10/2018 | 97.29 | 59.24 | 17.55 | 43.24 | 0.72 | BDL* | BDL* |
| 9 | 30/10/2018 | 88.40 | 40.27 | 18.42 | 27.50 | 0.49 | BDL* | BDL* |
| 10 | 02/11/2018 | 88.55 | 38.64 | 14.30 | 23.51 | 0.31 | BDL* | BDL* |
| 11 | 06/11/2018 | 96.60 | 58.46 | 20.32 | 35.65 | 0.36 | BDL* | BDL* |
| 12 | 09/11/2018 | 78.56 | 37.57 | 11.56 | 29.26 | 0.22 | BDL* | BDL* |
| 13 | 13/11/2018 | 85.61 | 49.23 | 19.60 | 32.49 | 0.52 | BDL* | BDL* |
| 14 | 16/11/2018 | 73.92 | 31.56 | 13.60 | 24.26 | 0.48 | BDL* | BDL* |
| 15 | 19/11/2018 | 95.34 | 52.32 | 15.66 | 30.52 | 0.11 | BDL* | BDL* |
| 16 | 21/11/2018 | 84.38 | 35.35 | 18.48 | 36.63 | 0.34 | BDL* | BDL* |
| 17 | 26/11/2018 | 79.37 | 42.60 | 8.64 | 28.49 | 0.87 | BDL* | BDL* |
| 18 | 28/11/2018 | 90.41 | 39.34 | 12.52 | 33.60 | 0.27 | BDL* | BDL* |
| 19 | 03/12/2018 | 85.65 | 48.24 | 9.69 | 31.71 | 0.27 | BDL* | BDL* |
| 20 | 05/12/2018 | 97.52 | 42.64 | 14.54 | 27.73 | 0.46 | BDL* | BDL* |
| 21 | 10/12/2018 | 87.38 | 50.67 | 22.71 | 33.25 | 0.87 | BDL* | BDL* |
| 22 | 12/12/2018 | 79.44 | 34.36 | 12.31 | 39.39 | 0.70 | BDL* | BDL* |
| 23 | 17/12/2018 | 92.47 | 44.25 | 21.34 | 42.65 | 0.50 | BDL* | BDL* |
| 24 | 19/12/2018 | 86.58 | 57.39 | 20.39 | 35.92 | 0.82 | BDL* | BDL* |
| 25 | 24/12/2018 | 99.55 | 40.66 | 11.31 | 32.48 | 0.76 | BDL* | BDL* |
| 26 | 26/12/2018 | 87.39 | 37.57 | 25.61 | 40.25 | 0.96 | BDL* | BDL* |
| 27 | 31/12/2018 | 83.56 | 55.37 | 13.62 | 45.38 | 0.18 | BDL* | BDL* |
| 28 | 02/01/2019 | 92.66 | 57.55 | 23.42 | 45.76 | 0.63 | BDL* | BDL* |
| 29 | 07/01/2019 | 88.35 | 39.59 | 15.59 | 43.59 | 0.90 | BDL* | BDL* |
| 30 | 09/01/2019 | 98.30 | 42.31 | 12.50 | 35.83 | 1.00 | BDL* | BDL* |

**Continue …**

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**Lab Manager**

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**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| ADANI PORT – T1 TERMINAL NR. (MARINE BUILDING) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr.No. | Date of Sampling | Particulate Matter (PM10) µg/m³ | Particulate Matter (PM 2.5) µg/m³ | Sulphur Dioxide (SO2) µg/m³ | Oxides of Nitrogen (NO2) µg/m³ | Carbon Monoxide as CO mg/m³ | Hydrocarbon as $CH_4$ mg/m³ | Benzene as $C_6H_6$ µg/m³ |
| 31 | 15/01/2019 | 89.40 | 52.44 | 10.24 | 38.64 | 0.37 | BDL* | BDL* |
| 32 | 16/01/2019 | 96.32 | 48.20 | 22.45 | 32.49 | 1.02 | BDL* | BDL* |
| 33 | 21/01/2019 | 86.50 | 36.54 | 14.53 | 46.55 | 0.23 | BDL* | BDL* |
| 34 | 23/01/2019 | 99.53 | 58.38 | 27.52 | 39.49 | 0.81 | BDL* | BDL* |
| 35 | 28/01/2019 | 83.64 | 46.55 | 16.25 | 29.43 | 0.97 | BDL* | BDL* |
| 36 | 30/01/2019 | 95.43 | 54.30 | 24.80 | 36.29 | 1.10 | BDL* | BDL* |
| 37 | 04/02/2019 | 76.51 | 32.38 | 13.59 | 39.36 | 0.30 | BDL* | BDL* |
| 38 | 06/02/2019 | 81.53 | 44.53 | 16.74 | 37.67 | 0.54 | BDL* | BDL* |
| 39 | 11/02/2019 | 94.37 | 56.48 | 19.88 | 43.45 | 0.74 | BDL* | BDL* |
| 40 | 13/02/2019 | 84.64 | 50.26 | 8.64 | 36.83 | 0.50 | BDL* | BDL* |
| 41 | 18/02/2019 | 90.58 | 33.20 | 11.26 | 38.65 | 0.78 | BDL* | BDL* |
| 42 | 20/02/2019 | 95.32 | 53.43 | 22.43 | 35.47 | 0.61 | BDL* | BDL* |
| 43 | 25/02/2019 | 74.60 | 41.65 | 12.48 | 24.27 | 0.93 | BDL* | BDL* |
| 44 | 27/02/2019 | 91.64 | 49.19 | 25.67 | 33.50 | 0.69 | BDL* | BDL* |
| 45 | 04/03/2019 | 77.51 | 42.43 | 22.73 | 36.48 | 0.60 | BDL* | BDL* |
| 46 | 06/03/2019 | 84.37 | 36.79 | 12.58 | 44.26 | 0.49 | BDL* | BDL* |
| 47 | 11/03/2019 | 74.36 | 38.23 | 18.22 | 41.63 | 0.39 | BDL* | BDL* |
| 48 | 13/03/2019 | 92.49 | 56.28 | 20.55 | 38.68 | 0.78 | BDL* | BDL* |
| 49 | 18/03/2019 | 69.46 | 32.42 | 15.30 | 35.38 | 0.23 | BDL* | BDL* |
| 50 | 20/03/2019 | 86.27 | 44.29 | 24.20 | 39.55 | 0.48 | BDL* | BDL* |
| 51 | 25/03/2019 | 78.30 | 40.25 | 13.64 | 25.41 | 0.63 | BDL* | BDL* |
| 52 | 27/03/2019 | 81.21 | 46.18 | 27.20 | 45.39 | 0.52 | BDL* | BDL* |
| | **TEST METHOD** | **IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)** | **Gravimetric-CPCB - Method (Vol.I,May-2011)** | **IS:5182(Part II):Improved West and Gaeke** | **IS:5182(Part VI):Modified Jacob & Hochheiser (NaOH-NaAsO2)** | **NDIR Digital Gas Analyzer** | **SOP: HC: GC/GCMS/Gas analyzer** | **IS 5182 (Part XI):2006/CPCB Method** |

*Below detection limit

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**Dr. Arun Bajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| NEAR FIRE STATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m³ | Particulate Matter (PM 2.5) µg/m³ | Sulphur Dioxide (SO2) µg/m³ | Oxides of Nitrogen (NO2) µg/m³ | Carbon Monoxide as CO mg/m³ | Hydrocarbon as $CH_4$ mg/m³ | Benzene as $C_6H_6$ µg/m³ |
| 1 | 02/10/2018 | 89.34 | 47.50 | 26.40 | 36.30 | 0.79 | BDL* | BDL* |
| 2 | 05/10/2018 | 97.69 | 50.58 | 14.61 | 33.49 | 0.62 | BDL* | BDL* |
| 3 | 09/10/2018 | 84.65 | 36.56 | 21.62 | 39.37 | 0.23 | BDL* | BDL* |
| 4 | 12/10/2018 | 79.35 | 33.44 | 11.60 | 26.46 | 0.52 | BDL* | BDL* |
| 5 | 16/10/2018 | 80.30 | 39.46 | 20.61 | 25.62 | 0.63 | BDL* | BDL* |
| 6 | 19/10/2018 | 93.67 | 45.63 | 18.39 | 41.32 | 0.45 | BDL* | BDL* |
| 7 | 23/10/2018 | 77.34 | 30.36 | 10.37 | 30.32 | 0.38 | BDL* | BDL* |
| 8 | 26/10/2018 | 92.63 | 53.57 | 24.25 | 37.20 | 0.90 | BDL* | BDL* |
| 9 | 30/10/2018 | 82.46 | 34.56 | 16.36 | 24.42 | 0.36 | BDL* | BDL* |
| 10 | 02/11/2018 | 82.31 | 36.74 | 12.98 | 18.49 | 0.21 | BDL* | BDL* |
| 11 | 06/11/2018 | 91.53 | 48.35 | 18.29 | 30.25 | 0.55 | BDL* | BDL* |
| 12 | 09/11/2018 | 89.32 | 40.58 | 16.35 | 34.62 | 0.46 | BDL* | BDL* |
| 13 | 13/11/2018 | 78.42 | 39.63 | 10.56 | 20.63 | 0.41 | BDL* | BDL* |
| 14 | 16/11/2018 | 85.72 | 35.66 | 17.52 | 28.76 | 0.45 | BDL* | BDL* |
| 15 | 19/11/2018 | 67.93 | 41.20 | 7.52 | 24.67 | 0.24 | BDL* | BDL* |
| 16 | 21/11/2018 | 57.81 | 24.50 | 8.52 | 32.37 | 0.53 | BDL* | BDL* |
| 17 | 26/11/2018 | 83.55 | 45.66 | 21.64 | 36.77 | 0.73 | BDL* | BDL* |
| 18 | 28/11/2018 | 61.33 | 23.64 | 19.22 | 27.51 | 0.47 | BDL* | BDL* |
| 19 | 03/12/2018 | 96.35 | 55.70 | 14.35 | 36.29 | 0.69 | BDL* | BDL* |
| 20 | 05/12/2018 | 79.66 | 33.89 | 17.64 | 25.53 | 0.30 | BDL* | BDL* |
| 21 | 10/12/2018 | 82.41 | 37.65 | 20.41 | 22.53 | 0.60 | BDL* | BDL* |
| 22 | 12/12/2018 | 92.39 | 53.56 | 16.67 | 29.48 | 0.53 | BDL* | BDL* |
| 23 | 17/12/2018 | 65.68 | 30.62 | 25.59 | 35.81 | 0.89 | BDL* | BDL* |
| 24 | 19/12/2018 | 80.47 | 42.85 | 23.46 | 30.35 | 0.78 | BDL* | BDL* |
| 25 | 24/12/2018 | 68.64 | 29.51 | 22.45 | 28.25 | 0.62 | BDL* | BDL* |
| 26 | 26/12/2018 | 91.18 | 51.20 | 10.51 | 38.29 | 0.57 | BDL* | BDL* |
| 27 | 31/12/2018 | 89.48 | 36.53 | 7.58 | 34.42 | 0.36 | BDL* | BDL* |
| 28 | 02/01/2019 | 74.69 | 46.32 | 26.55 | 40.53 | 0.98 | BDL* | BDL* |
| 29 | 07/01/2019 | 68.37 | 29.46 | 17.61 | 32.36 | 0.65 | BDL* | BDL* |
| 30 | 09/01/2019 | 78.50 | 35.37 | 23.58 | 28.65 | 0.72 | BDL* | BDL* |

**Continue ...**

**H. T. Shah**
**Lab Manager**

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**Dr. Arun Bajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| NEAR FIRE STATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr.No. | Date of Sampling | Particulate Matter (PM10) µg/m³ | Particulate Matter (PM 2.5) µg/m³ | Sulphur Dioxide (SO2) µg/m³ | Oxides of Nitrogen (NO2) µg/m³ | Carbon Monoxide as CO mg/m³ | Hydrocarbon as $CH_4$ mg/m³ | Benzene as $C_6H_6$ µg/m³ |
| 31 | 15/01/2019 | 85.60 | 48.62 | 19.31 | 41.26 | 0.87 | BDL* | BDL* |
| 32 | 16/01/2019 | 91.57 | 42.65 | 20.48 | 35.64 | 0.70 | BDL* | BDL* |
| 33 | 21/01/2019 | 60.43 | 24.50 | 8.68 | 38.54 | 0.45 | BDL* | BDL* |
| 34 | 23/01/2019 | 72.13 | 45.66 | 10.48 | 31.24 | 0.71 | BDL* | BDL* |
| 35 | 28/01/2019 | 67.50 | 36.32 | 18.20 | 25.50 | 0.44 | BDL* | BDL* |
| 36 | 30/01/2019 | 90.27 | 50.25 | 21.31 | 29.49 | 0.78 | BDL* | BDL* |
| 37 | 04/02/2019 | 54.78 | 23.55 | 7.58 | 32.49 | 0.60 | BDL* | BDL* |
| 38 | 06/02/2019 | 60.44 | 30.50 | 19.51 | 27.57 | 0.46 | BDL* | BDL* |
| 39 | 11/02/2019 | 86.36 | 52.23 | 24.57 | 37.57 | 0.97 | BDL* | BDL* |
| 40 | 13/02/2019 | 78.68 | 45.66 | 16.24 | 29.86 | 1.05 | BDL* | BDL* |
| 41 | 18/02/2019 | 69.34 | 28.43 | 15.61 | 24.35 | 0.87 | BDL* | BDL* |
| 42 | 20/02/2019 | 82.37 | 46.53 | 14.41 | 31.78 | 1.01 | BDL* | BDL* |
| 43 | 25/02/2019 | 59.81 | 31.49 | 18.59 | 21.28 | 0.52 | BDL* | BDL* |
| 44 | 27/02/2019 | 66.30 | 38.39 | 11.56 | 40.26 | 0.98 | BDL* | BDL* |
| 45 | 04/03/2019 | 73.28 | 39.55 | 19.19 | 40.30 | 0.50 | BDL* | BDL* |
| 46 | 06/03/2019 | 63.47 | 29.67 | 17.07 | 28.45 | 0.66 | BDL* | BDL* |
| 47 | 11/03/2019 | 55.35 | 26.78 | 21.26 | 38.75 | 0.36 | BDL* | BDL* |
| 48 | 13/03/2019 | 86.46 | 51.45 | 25.49 | 43.47 | 0.74 | BDL* | BDL* |
| 49 | 18/03/2019 | 51.44 | 20.46 | 8.68 | 25.32 | 0.44 | BDL* | BDL* |
| 50 | 20/03/2019 | 75.32 | 34.26 | 16.39 | 33.31 | 0.78 | BDL* | BDL* |
| 51 | 25/03/2019 | 58.68 | 27.36 | 20.57 | 22.50 | 0.39 | BDL* | BDL* |
| 52 | 27/03/2019 | 62.81 | 30.54 | 12.87 | 39.53 | 0.76 | BDL* | BDL* |
| | **TEST METHOD** | **IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)** | **Gravimetric-CPCB - Method (Vol.I,May-2011)** | **IS:5182(Part II):Improved West and Gaeke** | **IS:5182(Part VI):Modified Jacob & Hochheiser (NaOH-NaAsO2)** | **NDIR Digital Gas Analyzer** | **SOP: HC: GC/GCMS/Gas analyzer** | **IS 5182 (Part XI):2006/CPCB Method** |

*Below detection limit

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**Dr. Arun Bajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| ADANI HOUSE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m³ | Particulate Matter (PM 2.5) µg/m³ | Sulphur Dioxide (SO2) µg/m³ | Oxides of Nitrogen (NO2) µg/m³ | Carbon Monoxide as CO mg/m³ | Hydrocarbon as $CH_4$ mg/m³ | Benzene as $C_6H_6$ µg/m³ |
| 1 | 02/10/2018 | 62.57 | 31.51 | 18.73 | 24.53 | 0.40 | BDL* | BDL* |
| 2 | 05/10/2018 | 84.35 | 44.38 | 11.35 | 29.67 | 0.55 | BDL* | BDL* |
| 3 | 09/10/2018 | 79.63 | 35.34 | 16.22 | 31.22 | 0.20 | BDL* | BDL* |
| 4 | 12/10/2018 | 57.24 | 27.55 | 13.52 | 22.43 | 0.46 | BDL* | BDL* |
| 5 | 16/10/2018 | 72.80 | 38.44 | 10.83 | 30.58 | 0.41 | BDL* | BDL* |
| 6 | 19/10/2018 | 67.89 | 30.42 | 8.65 | 25.69 | 0.26 | BDL* | BDL* |
| 7 | 23/10/2018 | 58.64 | 23.50 | 12.37 | 19.40 | 0.33 | BDL* | BDL* |
| 8 | 26/10/2018 | 71.58 | 38.63 | 15.62 | 26.19 | 0.50 | BDL* | BDL* |
| 9 | 30/10/2018 | 65.65 | 29.38 | 9.61 | 20.60 | 0.22 | BDL* | BDL* |
| 10 | 02/11/2018 | 63.77 | 27.26 | 7.64 | 16.26 | 0.14 | BDL* | BDL* |
| 11 | 06/11/2018 | 80.35 | 43.62 | 12.46 | 20.25 | 0.33 | BDL* | BDL* |
| 12 | 09/11/2018 | 70.43 | 33.23 | 6.81 | 23.70 | 0.17 | BDL* | BDL* |
| 13 | 13/11/2018 | 69.32 | 30.45 | 8.46 | 18.64 | 0.50 | BDL* | BDL* |
| 14 | 16/11/2018 | 56.38 | 23.51 | 11.37 | 22.48 | 0.29 | BDL* | BDL* |
| 15 | 21/11/2018 | 53.45 | 20.65 | 13.47 | 26.83 | 0.42 | BDL* | BDL* |
| 16 | 26/11/2018 | 73.64 | 39.29 | 16.50 | 19.53 | 0.64 | BDL* | BDL* |
| 17 | 28/11/2018 | 58.42 | 26.88 | 17.26 | 21.24 | 0.37 | BDL* | BDL* |
| 18 | 03/12/2018 | 80.24 | 44.50 | 6.56 | 25.71 | 0.39 | BDL* | BDL* |
| 19 | 05/12/2018 | 68.32 | 29.36 | 19.59 | 21.60 | 0.21 | BDL* | BDL* |
| 20 | 10/12/2018 | 76.34 | 31.67 | 13.64 | 18.65 | 0.33 | BDL* | BDL* |
| 21 | 12/12/2018 | 61.25 | 38.82 | 10.19 | 24.61 | 0.44 | BDL* | BDL* |
| 22 | 17/12/2018 | 58.35 | 24.35 | 8.92 | 27.60 | 0.61 | BDL* | BDL* |
| 23 | 19/12/2018 | 89.32 | 48.62 | 12.48 | 20.37 | 0.56 | BDL* | BDL* |
| 24 | 24/12/2018 | 63.57 | 24.69 | 17.55 | 17.69 | 0.65 | BDL* | BDL* |
| 25 | 26/12/2018 | 82.68 | 46.31 | 14.46 | 22.68 | 0.73 | BDL* | BDL* |
| 26 | 31/12/2018 | 67.87 | 31.29 | 9.56 | 30.23 | 0.48 | BDL* | BDL* |
| 27 | 02/01/2019 | 65.56 | 37.35 | 9.64 | 30.34 | 0.77 | BDL* | BDL* |
| 28 | 07/01/2019 | 76.51 | 34.58 | 11.41 | 27.70 | 0.57 | BDL* | BDL* |
| 29 | 09/01/2019 | 69.32 | 30.75 | 18.67 | 20.46 | 0.85 | BDL* | BDL* |
| 30 | 15/01/2019 | 70.20 | 39.63 | 7.54 | 15.63 | 0.38 | BDL* | BDL* |

**Continue …**

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**Dr. Arun Bajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| ADANI HOUSE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Date of Sampling** | **Particulate Matter (PM10) µg/m³** | **Particulate Matter (PM 2.5) µg/m³** | **Sulphur Dioxide (SO2) µg/m³** | **Oxides of Nitrogen (NO2) µg/m³** | **Carbon Monoxide as CO mg/m³** | **Hydrocarbon as $CH_4$ mg/m³** | **Benzene as $C_6H_6$ µg/m³** |
| 31 | 16/01/2019 | 81.27 | 32.56 | 13.61 | 23.92 | 0.66 | BDL* | BDL* |
| 32 | 21/01/2019 | 74.35 | 29.57 | 10.41 | 33.55 | 0.55 | BDL* | BDL* |
| 33 | 23/01/2019 | 91.39 | 51.53 | 8.51 | 24.72 | 0.36 | BDL* | BDL* |
| 34 | 28/01/2019 | 62.34 | 27.51 | 14.41 | 17.66 | 0.50 | BDL* | BDL* |
| 35 | 30/01/2019 | 85.45 | 33.57 | 19.30 | 26.62 | 0.41 | BDL* | BDL* |
| 36 | 04/02/2019 | 62.47 | 26.37 | 10.36 | 28.69 | 0.84 | BDL* | BDL* |
| 37 | 06/02/2019 | 70.53 | 37.52 | 13.37 | 23.74 | 0.73 | BDL* | BDL* |
| 38 | 11/02/2019 | 54.68 | 22.38 | 16.50 | 25.49 | 0.40 | BDL* | BDL* |
| 39 | 13/02/2019 | 63.59 | 34.24 | 19.38 | 18.69 | 0.65 | BDL* | BDL* |
| 40 | 18/02/2019 | 58.64 | 24.86 | 17.53 | 17.60 | 1.09 | BDL* | BDL* |
| 41 | 20/02/2019 | 76.49 | 33.48 | 11.36 | 22.70 | 0.48 | BDL* | BDL* |
| 42 | 25/02/2019 | 53.40 | 23.43 | 15.19 | 29.27 | 0.76 | BDL* | BDL* |
| 43 | 27/02/2019 | 84.28 | 45.30 | 7.54 | 26.54 | 0.47 | BDL* | BDL* |
| 44 | 04/03/2019 | 65.65 | 35.33 | 14.52 | 33.49 | 0.64 | BDL* | BDL* |
| 45 | 06/03/2019 | 54.35 | 25.62 | 21.54 | 21.75 | 0.82 | BDL* | BDL* |
| 46 | 11/03/2019 | 66.24 | 33.69 | 15.65 | 24.40 | 0.53 | BDL* | BDL* |
| 47 | 13/03/2019 | 50.22 | 23.47 | 18.39 | 28.52 | 0.26 | BDL* | BDL* |
| 48 | 18/03/2019 | 56.86 | 27.55 | 11.85 | 32.50 | 0.62 | BDL* | BDL* |
| 49 | 20/03/2019 | 70.42 | 41.22 | 12.36 | 25.79 | 0.33 | BDL* | BDL* |
| 50 | 25/03/2019 | 51.28 | 24.52 | 17.50 | 34.57 | 0.54 | BDL* | BDL* |
| 51 | 27/03/2019 | 75.59 | 39.62 | 8.91 | 29.50 | 0.34 | BDL* | BDL* |
| | **TEST METHOD** | **IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)** | **Gravimetric-CPCB - Method (Vol.I,May-2011)** | **IS:5182(Part II):Improved West and Gaeke** | **IS:5182(Part VI):Modified Jacob & Hochheiser (NaOH-NaAsO2)** | **NDIR Digital Gas Analyzer** | **SOP: HC: GC/GCMS/Gas analyzer** | **IS 5182 (Part XI):2006/CPCB Method** |

*Below detection limit

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**Dr. Arun Bajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| CT-3 DG HOUSE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr.No. | Date of Sampling | Particulate Matter (PM10) µg/m³ | Particulate Matter (PM 2.5) µg/m³ | Sulphur Dioxide (SO2) µg/m³ | Oxides of Nitrogen (NO2) µg/m³ | Carbon Monoxide as CO mg/m³ | Hydrocarbon as $CH_4$ mg/m³ | Benzene as $C_6H_6$ µg/m³ |
| 1 | 02/10/2018 | 71.67 | 26.35 | 15.66 | 28.39 | 0.53 | BDL* | BDL* |
| 2 | 05/10/2018 | 63.62 | 38.23 | 19.61 | 37.34 | 0.29 | BDL* | BDL* |
| 3 | 09/10/2018 | 75.64 | 33.71 | 11.66 | 26.32 | 0.57 | BDL* | BDL* |
| 4 | 12/10/2018 | 50.32 | 20.45 | 8.28 | 18.35 | 0.42 | BDL* | BDL* |
| 5 | 16/10/2018 | 65.70 | 30.50 | 12.41 | 34.55 | 0.50 | BDL* | BDL* |
| 6 | 19/10/2018 | 57.40 | 27.35 | 16.21 | 21.31 | 0.22 | BDL* | BDL* |
| 7 | 23/10/2018 | 68.20 | 41.62 | 6.56 | 24.70 | 0.26 | BDL* | BDL* |
| 8 | 26/10/2018 | 85.46 | 50.32 | 13.32 | 29.36 | 0.69 | BDL* | BDL* |
| 9 | 30/10/2018 | 73.38 | 25.68 | 10.24 | 16.37 | 0.50 | BDL* | BDL* |
| 10 | 02/11/2018 | 73.41 | 40.26 | 8.40 | 13.59 | 0.40 | BDL* | BDL* |
| 11 | 06/11/2018 | 85.32 | 45.44 | 11.45 | 23.61 | 0.44 | BDL* | BDL* |
| 12 | 09/11/2018 | 54.62 | 26.44 | 14.54 | 17.58 | 0.15 | BDL* | BDL* |
| 13 | 13/11/2018 | 64.31 | 35.26 | 20.22 | 28.40 | 0.31 | BDL* | BDL* |
| 14 | 16/11/2018 | 50.35 | 20.40 | 6.62 | 14.65 | 0.25 | BDL* | BDL* |
| 15 | 19/11/2018 | 86.12 | 48.66 | 18.57 | 35.26 | 0.18 | BDL* | BDL* |
| 16 | 21/11/2018 | 75.86 | 31.62 | 15.45 | 30.62 | 0.30 | BDL* | BDL* |
| 17 | 26/11/2018 | 69.43 | 38.44 | 19.29 | 25.51 | 0.57 | BDL* | BDL* |
| 18 | 28/11/2018 | 79.63 | 34.51 | 9.63 | 19.67 | 0.66 | BDL* | BDL* |
| 19 | 03/12/2018 | 60.76 | 31.66 | 12.66 | 20.84 | 0.23 | BDL* | BDL* |
| 20 | 05/12/2018 | 81.62 | 34.64 | 9.27 | 17.63 | 0.58 | BDL* | BDL* |
| 21 | 10/12/2018 | 70.60 | 29.42 | 18.85 | 30.45 | 0.47 | BDL* | BDL* |
| 22 | 12/12/2018 | 55.90 | 42.87 | 6.55 | 36.55 | 0.80 | BDL* | BDL* |
| 23 | 17/12/2018 | 85.78 | 39.39 | 13.69 | 31.61 | 0.55 | BDL* | BDL* |
| 24 | 19/12/2018 | 93.82 | 53.63 | 10.68 | 26.39 | 0.66 | BDL* | BDL* |
| 25 | 24/12/2018 | 88.60 | 37.28 | 8.62 | 21.66 | 0.52 | BDL* | BDL* |
| 26 | 26/12/2018 | 77.17 | 33.44 | 16.61 | 32.60 | 0.86 | BDL* | BDL* |
| 27 | 31/12/2018 | 94.32 | 52.47 | 19.51 | 38.46 | 0.26 | BDL* | BDL* |
| 28 | 02/01/2019 | 98.69 | 51.52 | 15.40 | 35.33 | 0.69 | BDL* | BDL* |
| 29 | 07/01/2019 | 82.58 | 36.46 | 7.22 | 39.28 | 1.03 | BDL* | BDL* |
| 30 | 09/01/2019 | 92.38 | 46.84 | 9.21 | 24.57 | 0.64 | BDL* | BDL* |

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**Dr. Arun Bajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| CT-3 DG HOUSE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sr.No.** | **Date of Sampling** | **Particulate Matter (PM10) µg/m³** | **Particulate Matter (PM 2.5) µg/m³** | **Sulphur Dioxide (SO2) µg/m³** | **Oxides of Nitrogen (NO2) µg/m³** | **Carbon Monoxide as CO mg/m³** | **Hydrocarbon as $CH_4$ mg/m³** | **Benzene as $C_6H_6$ µg/m³** |
| 31 | 15/01/2019 | 76.30 | 56.32 | 13.38 | 21.60 | 0.29 | BDL* | BDL* |
| 32 | 16/01/2019 | 85.32 | 38.24 | 11.35 | 29.25 | 0.86 | BDL* | BDL* |
| 33 | 21/01/2019 | 79.66 | 33.64 | 23.37 | 42.71 | 0.32 | BDL* | BDL* |
| 34 | 23/01/2019 | 87.64 | 55.74 | 16.34 | 36.89 | 1.07 | BDL* | BDL* |
| 35 | 28/01/2019 | 75.60 | 42.17 | 21.59 | 40.35 | 0.74 | BDL* | BDL* |
| 36 | 30/01/2019 | 80.47 | 39.31 | 20.36 | 33.33 | 0.42 | BDL* | BDL* |
| 37 | 04/02/2019 | 69.64 | 29.50 | 20.40 | 37.40 | 0.41 | BDL* | BDL* |
| 38 | 06/02/2019 | 75.62 | 40.55 | 6.61 | 32.65 | 0.96 | BDL* | BDL* |
| 39 | 11/02/2019 | 59.32 | 34.51 | 13.64 | 29.51 | 0.85 | BDL* | BDL* |
| 40 | 13/02/2019 | 94.53 | 55.49 | 11.58 | 43.90 | 0.37 | BDL* | BDL* |
| 41 | 18/02/2019 | 80.96 | 36.46 | 8.78 | 20.43 | 0.90 | BDL* | BDL* |
| 42 | 20/02/2019 | 72.68 | 30.66 | 18.42 | 28.33 | 0.55 | BDL* | BDL* |
| 43 | 25/02/2019 | 66.25 | 33.56 | 21.57 | 33.73 | 0.94 | BDL* | BDL* |
| 44 | 27/02/2019 | 76.83 | 39.48 | 14.18 | 30.29 | 0.89 | BDL* | BDL* |
| 45 | 04/03/2019 | 85.32 | 49.45 | 10.49 | 27.52 | 0.56 | BDL* | BDL* |
| 46 | 06/03/2019 | 74.82 | 32.44 | 7.65 | 23.47 | 0.71 | BDL* | BDL* |
| 47 | 11/03/2019 | 67.63 | 30.42 | 23.43 | 36.48 | 0.62 | BDL* | BDL* |
| 48 | 13/03/2019 | 55.68 | 33.68 | 15.70 | 32.52 | 0.69 | BDL* | BDL* |
| 49 | 18/03/2019 | 62.49 | 24.37 | 21.37 | 42.50 | 0.32 | BDL* | BDL* |
| 50 | 20/03/2019 | 90.41 | 39.39 | 19.49 | 30.56 | 0.44 | BDL* | BDL* |
| 51 | 25/03/2019 | 83.32 | 44.24 | 24.26 | 38.37 | 0.74 | BDL* | BDL* |
| 52 | 27/03/2019 | 69.45 | 35.46 | 16.25 | 34.33 | 0.55 | BDL* | BDL* |
| | **TEST METHOD** | **IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)** | **Gravimetric-CPCB - Method (Vol.I,May-2011)** | **IS:5182(Part II):Improved West and Gaeke** | **IS:5182(Part VI):Modified Jacob & Hochheiser (NaOH-NaAsO2)** | **NDIR Digital Gas Analyzer** | **SOP: HC: GC/GCMS/Gas analyzer** | **IS 5182 (Part XI):2006/CPCB Method** |

*Below detection limit

**H. T. Shah**
**Lab Manager**

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**Dr. Arun Bajpai**
**Lab Manager (Q)**

# RESULTS OF NOISE LEVEL MONITORING

## Result of Noise level monitoring [Day Time]

| SR. NO. | Name of Location | T1 TERMINAL NR.MARINE BUILDING | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 16/10/2018 | 16/11/2018 | 14/12/2018 | 04/01/2019 | 25/02/2019 | 18/03/2019 |
| 1 | 6:00-7:00 | 67.2 | 67.3 | 63.1 | 68.4 | 65.8 | 68.1 |
| 2 | 7:00-8:00 | 66.5 | 66.4 | 68.7 | 65.2 | 69.4 | 62.8 |
| 3 | 8:00-9:00 | 63.9 | 62.4 | 69.1 | 66.8 | 61.4 | 63.4 |
| 4 | 9:00-10:00 | 66.5 | 64.5 | 62.8 | 70.2 | 62.5 | 69.9 |
| 5 | 10:00-11:00 | 61.7 | 61.6 | 65.8 | 62.8 | 68.4 | 72.4 |
| 6 | 11:00-12:00 | 66.2 | 64.3 | 70.4 | 68.3 | 65.2 | 74.1 |
| 7 | 12:00-13:00 | 68.7 | 65.7 | 69.7 | 63.7 | 60.4 | 70.1 |
| 8 | 13:00-14:00 | 70.6 | 68.2 | 65.7 | 62.9 | 67.4 | 66.4 |
| 9 | 14:00-15:00 | 71.9 | 72.5 | 63.1 | 68.5 | 63.4 | 68.4 |
| 10 | 15:00-16:00 | 70.3 | 67.9 | 62.8 | 65.1 | 62.4 | 62.8 |
| 11 | 16:00-17:00 | 62.3 | 62.9 | 68.4 | 70.3 | 68.1 | 65.6 |
| 12 | 17:00-18:00 | 64.7 | 65.6 | 65.5 | 71.8 | 61.4 | 68.8 |
| 13 | 18:00-19:00 | 64.6 | 64.6 | 69.1 | 69.4 | 60.8 | 64.1 |
| 14 | 19:00-20:00 | 63.6 | 65.7 | 62.8 | 62.8 | 69.4 | 63.4 |
| 15 | 20:00-21:00 | 64.9 | 67.7 | 65.0 | 65.1 | 70.6 | 68.9 |
| 16 | 21:00-22:00 | 70.1 | 73.0 | 66.7 | 62.5 | 72.4 | 66.8 |
| Day Time Limit* | | 75 Leq dB(A) | | | | | |

## Result of Noise level monitoring [Night Time]

| SR. NO. | Name of Location | T1 TERMINAL NR.MARINE BUILDING | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| 1 | Sampling Date & Time | 16/10/2018 & 17/10/2018 | 16/11/2018 & 17/11/2018 | 14/12/2018 & 15/12/2018 | 04/01/2019 & 05/01/2019 | 25/02/2019 & 26/02/2019 | 18/03/2019 & 19/03/2019 |
| 2 | 22:00-23:00 | 69.5 | 67.8 | 63.8 | 63.1 | 63.1 | 65.1 |
| 3 | 23:00-00:00 | 66.5 | 64.4 | 65.7 | 61.8 | 65.3 | 60.8 |
| 4 | 00:00-01:00 | 64.4 | 66.9 | 64.1 | 65.1 | 66.3 | 68.4 |
| 5 | 01:00-02:00 | 61.9 | 61.6 | 62.8 | 68.7 | 62.4 | 67.4 |
| 6 | 02:00-03:00 | 58.3 | 60.8 | 63.7 | 65.4 | 62.7 | 68.4 |
| 7 | 03:00-04:00 | 66.1 | 65.6 | 63.9 | 62.9 | 68.3 | 65.1 |
| 8 | 04:00-05:00 | 62.8 | 60.8 | 69.8 | 69.4 | 65.3 | 62.5 |
| 9 | 05:00-06:00 | 64.7 | 66.6 | 62.7 | 68.5 | 66.2 | 66.1 |
| Night Time Limit* | | 70 Leq dB(A) | | | | | |

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-7

Dr. Arun Bajpai
Lab Manager (Q)

## RESULTS OF NOISE LEVEL MONITORING

### Result of Noise level monitoring [Day Time]

| SR. NO. | Name of Location | NEAR FIRE STATION | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 12/10/2018 | 20/11/2018 | 04/12/2018 | 16/01/2019 | 04/02/2019 | 11/03/2019 |
| 1 | 6:00-7:00 | 62.0 | 62.3 | 65.4 | 62.5 | 68.4 | 68.1 |
| 2 | 7:00-8:00 | 63.8 | 61.2 | 66.3 | 68.4 | 62.1 | 62.7 |
| 3 | 8:00-9:00 | 69.2 | 69.3 | 66.9 | 72.4 | 65.4 | 65.1 |
| 4 | 9:00-10:00 | 67.5 | 69.1 | 67.4 | 74.1 | 73.1 | 65.9 |
| 5 | 10:00-11:00 | 63.4 | 62.5 | 63.2 | 70.4 | 64.1 | 68.2 |
| 6 | 11:00-12:00 | 61.8 | 64.5 | 62.4 | 69.9 | 68.1 | 63.7 |
| 7 | 12:00-13:00 | 68.1 | 70.7 | 67.4 | 63.4 | 62.4 | 65.4 |
| 8 | 13:00-14:00 | 62.5 | 61.7 | 65.3 | 60.4 | 68.4 | 62.8 |
| 9 | 14:00-15:00 | 61.1 | 61.5 | 62.5 | 62.4 | 62.4 | 69.1 |
| 10 | 15:00-16:00 | 67.1 | 64.9 | 68.4 | 64.5 | 69.4 | 67.1 |
| 11 | 16:00-17:00 | 69.0 | 71.4 | 68.3 | 65.1 | 61.4 | 63.4 |
| 12 | 17:00-18:00 | 67.7 | 67.2 | 68.7 | 63.4 | 60.4 | 69.1 |
| 13 | 18:00-19:00 | 64.6 | 65.4 | 64.3 | 62.5 | 62.7 | 71.1 |
| 14 | 19:00-20:00 | 64.7 | 66.3 | 62.7 | 63.4 | 68.4 | 68.1 |
| 15 | 20:00-21:00 | 65.2 | 63.3 | 65.8 | 65.2 | 64.3 | 65.2 |
| 16 | 21:00-22:00 | 61.4 | 64.5 | 63.6 | 66.8 | 61.5 | 68.1 |
| Day Time Limit* | | 75 Leq dB(A) | | | | | |

### Result of Noise level monitoring [Night Time]

| SR. NO. | Name of Location | NEAR FIRE STATION | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| 1 | Sampling Date & Time | 12/10/2018 & 13/10/2018 | 20/11/2018 & 21/11/2018 | 04/12/2018 & 05/12/2018 | 16/01/2019 & 17/01/2019 | 04/02/2019 & 05/02/2019 | 11/03/2019 & 12/03/2019 |
| 2 | 22:00-23:00 | 68.0 | 68.4 | 64.1 | 63.2 | 67.3 | 65.1 |
| 3 | 23:00-00:00 | 59.8 | 60.1 | 63.4 | 59.4 | 64.2 | 68.7 |
| 4 | 00:00-01:00 | 67.6 | 66.3 | 62.1 | 60.3 | 65.3 | 59.4 |
| 5 | 01:00-02:00 | 60.8 | 59.6 | 60.4 | 60.3 | 62.1 | 60.8 |
| 6 | 02:00-03:00 | 62.8 | 65.8 | 68.4 | 65.3 | 67.3 | 63.1 |
| 7 | 03:00-04:00 | 65.6 | 65.1 | 63.4 | 62.3 | 66.3 | 62.4 |
| 8 | 04:00-05:00 | 64.9 | 67.5 | 65.4 | 60.2 | 63.9 | 60.4 |
| 9 | 05:00-06:00 | 60.8 | 58.7 | 67.1 | 62.4 | 61.5 | 60.8 |
| Night Time Limit* | | 70 Leq dB(A) | | | | | |

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-7

Dr. Arun Bajpai
Lab Manager (Q)

## RESULTS OF NOISE LEVEL MONITORING

### Result of Noise level monitoring [Day Time]

| SR. NO. | Name of Location | ADANI HOUSE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 02/10/2018 | 13/11/2018 | 18/12/2018 | 02/01/2019 | 15/02/2019 | 01/03/2019 |
| 1 | 6:00-7:00 | 65.0 | 62.6 | 60.3 | 60.3 | 62.5 | 65.4 |
| 2 | 7:00-8:00 | 67.7 | 68.1 | 63.4 | 63.4 | 68.4 | 62.8 |
| 3 | 8:00-9:00 | 67.1 | 68.7 | 62.3 | 62.3 | 68.1 | 68.1 |
| 4 | 9:00-10:00 | 73.0 | 71.8 | 67.4 | 67.4 | 63.4 | 72.1 |
| 5 | 10:00-11:00 | 72.4 | 71.3 | 65.6 | 65.6 | 72.4 | 71.5 |
| 6 | 11:00-12:00 | 64.6 | 62.8 | 68.4 | 68.4 | 70.4 | 69.4 |
| 7 | 12:00-13:00 | 60.3 | 59.5 | 70.4 | 70.4 | 70.9 | 65.2 |
| 8 | 13:00-14:00 | 65.5 | 69.0 | 65.3 | 65.3 | 68.1 | 62.8 |
| 9 | 14:00-15:00 | 64.4 | 67.4 | 69.4 | 69.4 | 62.4 | 62.8 |
| 10 | 15:00-16:00 | 62.5 | 65.3 | 69.7 | 69.7 | 65.1 | 62.1 |
| 11 | 16:00-17:00 | 71.1 | 72.8 | 67.3 | 67.3 | 62.8 | 65.1 |
| 12 | 17:00-18:00 | 69.9 | 72.0 | 65.3 | 65.3 | 66.8 | 69.1 |
| 13 | 18:00-19:00 | 70.9 | 70.0 | 63.8 | 63.8 | 69.4 | 63.4 |
| 14 | 19:00-20:00 | 63.1 | 60.9 | 64.3 | 64.3 | 62.1 | 65.1 |
| 15 | 20:00-21:00 | 57.9 | 56.0 | 67.4 | 67.4 | 68.4 | 61.8 |
| 16 | 21:00-22:00 | 64.9 | 62.4 | 63.8 | 63.8 | 68.2 | 60.4 |
| Day Time Limit* | | 75 Leq dB(A) | | | | | |

### Result of Noise level monitoring [Night Time]

| SR. NO. | Name of Location | ADANI HOUSE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| 1 | Sampling Date & Time | 02/10/2018 & 03/10/2018 | 13/11/2018 & 14/11/2018 | 18/12/2018 & 19/12/2018 | 02/01/2019 & 03/01/2019 | 15/02/2019 & 16/02/2019 | 01/03/2019 & 02/03/2019 |
| 2 | 22:00-23:00 | 67.8 | 69.5 | 60.4 | 67.4 | 60.4 | 62.5 |
| 3 | 23:00-00:00 | 66.8 | 64.4 | 65.1 | 68.3 | 65.1 | 65.1 |
| 4 | 00:00-01:00 | 64.3 | 66.8 | 65.4 | 63.2 | 65.4 | 65.7 |
| 5 | 01:00-02:00 | 63.8 | 64.0 | 61.8 | 60.1 | 61.8 | 60.8 |
| 6 | 02:00-03:00 | 62.3 | 61.2 | 63.4 | 60.4 | 63.4 | 60.7 |
| 7 | 03:00-04:00 | 62.0 | 61.2 | 62.4 | 62.4 | 62.4 | 62.4 |
| 8 | 04:00-05:00 | 61.3 | 60.1 | 65.7 | 65.3 | 65.7 | 58.1 |
| 9 | 05:00-06:00 | 61.3 | 63.8 | 67.1 | 63.6 | 67.1 | 61.8 |
| Night Time Limit* | | 70 Leq dB(A) | | | | | |

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Lab Manager

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Dr. Arun Bajpai
Lab Manager (Q)

## RESULTS OF NOISE LEVEL MONITORING

### Result of Noise level monitoring [Day Time]

| SR. NO. | Name of Location | CT-3 DG HOUSE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 05/10/2018 | 23/11/2018 | 21/12/2018 | 10/01/2019 | 27/02/2019 | 07/03/2019 |
| 1 | 6:00-7:00 | 56.7 | 56.0 | 58.1 | 62.7 | 58.4 | 61.2 |
| 2 | 7:00-8:00 | 59.2 | 59.2 | 60.1 | 65.2 | 60.4 | 68.7 |
| 3 | 8:00-9:00 | 62.2 | 65.1 | 59.7 | 61.4 | 69.7 | 65.2 |
| 4 | 9:00-10:00 | 65.4 | 66.7 | 63.4 | 60.8 | 64.0 | 64.3 |
| 5 | 10:00-11:00 | 66.1 | 67.3 | 65.7 | 65.2 | 61.5 | 63.8 |
| 6 | 11:00-12:00 | 65.3 | 65.6 | 69.7 | 63.1 | 62.4 | 69.9 |
| 7 | 12:00-13:00 | 69.1 | 71.3 | 65.1 | 61.8 | 61.8 | 62.7 |
| 8 | 13:00-14:00 | 69.8 | 71.4 | 62.4 | 65.9 | 64.7 | 62.3 |
| 9 | 14:00-15:00 | 64.3 | 65.6 | 68.7 | 68.2 | 62.8 | 65.1 |
| 10 | 15:00-16:00 | 61.8 | 62.5 | 68.4 | 67.4 | 61.8 | 65.4 |
| 11 | 16:00-17:00 | 65.4 | 67.4 | 67.1 | 64.3 | 63.4 | 65.3 |
| 12 | 17:00-18:00 | 66.8 | 64.5 | 65.8 | 63.5 | 61.8 | 68.1 |
| 13 | 18:00-19:00 | 60.8 | 62.2 | 63.8 | 65.5 | 67.4 | 64.2 |
| 14 | 19:00-20:00 | 64.7 | 62.1 | 66.1 | 66.1 | 61.9 | 62.8 |
| 15 | 20:00-21:00 | 59.2 | 62.5 | 69.1 | 61.4 | 65.1 | 65.1 |
| 16 | 21:00-22:00 | 67.0 | 67.5 | 65.8 | 65.2 | 62.4 | 63.4 |
| Day Time Limit* | | 75 Leq dB(A) | | | | | |

### Result of Noise level monitoring [Night Time]

| SR. NO. | Name of Location | CT-3 DG HOUSE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| 1 | Sampling Date & Time | 05/10/2018 & 06/10/2018 | 23/11/2018 & 24/11/2018 | 21/12/2018 & 22/12/2018 | 10/01/2019 & 11/01/2019 | 27/02/2019 & 28/02/2019 | 07/03/2019 & 08/03/2019 |
| 2 | 22:00-23:00 | 62.0 | 60.9 | 68.7 | 65.1 | 65.1 | 63.1 |
| 3 | 23:00-00:00 | 64.7 | 66.9 | 65.1 | 59.8 | 59.8 | 68.4 |
| 4 | 00:00-01:00 | 58.7 | 60.5 | 62.8 | 57.4 | 57.4 | 64.1 |
| 5 | 01:00-02:00 | 64.5 | 66.3 | 68.4 | 60.4 | 60.4 | 60.4 |
| 6 | 02:00-03:00 | 63.2 | 66.0 | 64.9 | 61.4 | 61.4 | 62.8 |
| 7 | 03:00-04:00 | 66.3 | 66.0 | 69.1 | 58.7 | 58.7 | 64.7 |
| 8 | 04:00-05:00 | 66.1 | 67.7 | 67.5 | 58.1 | 58.1 | 66.1 |
| 9 | 05:00-06:00 | 59.0 | 58.2 | 68.2 | 60.4 | 60.4 | 63.7 |
| Night Time Limit* | | 70 Leq dB(A) | | | | | |

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# RESULT OF STACK MONITORING

| SR. NO. | TEST PARAMETERS | UNIT | STD. LIMIT | THERMIC FLUID HEATER (BITUMEN-01) | THERMIC FLUID HEATER (BITUMEN-02) | HOT WATER SYSTEM-1 | HOT WATER SYSTEM-2 | TEST METHOD |
|---|---|---|---|---|---|---|---|---|
| | | | | **OCTOBER 2018** | | | | |
| 1 | Particulate Matter | $mg/Nm^3$ | **150** | 19.37 | -- | 16.83 | -- | IS:11255 (Part-I):1985 |
| 2 | Sulfur dioxide | ppm | **100** | 3.94 | -- | 5.91 | -- | IS:11255 (Part-II):1985 |
| 3 | Oxides of Nitrogen | ppm | **50** | 23.70 | -- | 34.60 | -- | IS:11255 (Part-VII):2005 |
| | | | | **NOVEMBER 2018** | | | | |
| 1 | Particulate Matter | $mg/Nm^3$ | **150** | 23.54 | -- | 19.63 | 14.28 | IS:11255 (Part-I):1985 |
| 2 | Sulfur dioxide | ppm | **100** | 2.93 | -- | 6.68 | 4.86 | IS:11255 (Part-II):1985 |
| 3 | Oxides of Nitrogen | ppm | **50** | 28.49 | -- | 39.45 | 32.79 | IS:11255 (Part-VII):2005 |
| | | | | **DECEMBER 2018** | | | | |
| 1 | Particulate Matter | $mg/Nm^3$ | **150** | 20.40 | -- | 16.38 | -- | IS:11255 (Part-I):1985 |
| 2 | Sulfur dioxide | ppm | **100** | 3.89 | -- | 5.44 | -- | IS:11255 (Part-II):1985 |
| 3 | Oxides of Nitrogen | ppm | **50** | 31.19 | -- | 35.67 | -- | IS:11255 (Part-VII):2005 |
| | | | | **JANUARY 2019** | | | | |
| 1 | Particulate Matter | $mg/Nm^3$ | **150** | 24.57 | -- | -- | 18.33 | IS:11255 (Part-I):1985 |
| 2 | Sulfur dioxide | ppm | **100** | 4.70 | -- | -- | 5.67 | IS:11255 (Part-II):1985 |
| 3 | Oxides of Nitrogen | ppm | **50** | 34.60 | -- | -- | 38.27 | IS:11255 (Part-VII):2005 |
| | | | | **FEBRUARY 2019** | | | | |
| 1 | Particulate Matter | $mg/Nm^3$ | **150** | 18.75 | 16.51 | 20.62 | -- | IS:11255 (Part-I):1985 |
| 2 | Sulfur dioxide | ppm | **100** | 5.22 | 4.81 | 6.60 | -- | IS:11255 (Part-II):1985 |
| 3 | Oxides of Nitrogen | ppm | **50** | 32.35 | 28.65 | 38.65 | -- | IS:11255 (Part-VII):2005 |
| | | | | **MARCH 2019** | | | | |
| 1 | Particulate Matter | $mg/Nm^3$ | **150** | 16.83 | -- | 24.62 | -- | IS:11255 (Part-I):1985 |
| 2 | Sulfur dioxide | ppm | **100** | 4.64 | -- | 5.66 | -- | IS:11255 (Part-II):1985 |
| 3 | Oxides of Nitrogen | ppm | **50** | 30.44 | -- | 35.59 | -- | IS:11255 (Part-VII):2005 |

*Below detection limit
Results on 11 % $O_2$ Correction when Oxygen is greater than 11 %. And 12% $CO_2$correction when $CO_2$is less thsn 12%

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**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

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**Lab Manager (Q)**

# Minimum Detection Limit [MDL]

| Ambient Air Parameters | | |
|---|---|---|
| **Sr. No.** | **Test Parameter** | **MDL** |
| 1 | Particulate Matter (PM10) (µg/$m^3$) | 10 |
| 2 | Particulate Matter (PM 2.5) (µg/$m^3$) | 10 |
| 3 | Sulphur Dioxide ($SO_2$) (µg/$m^3$) | 5 |
| 4 | Oxides of Nitrogen (µg/$m^3$) | 5 |
| 5 | Hydrogen Sulphide as $H_2S$ (µg/$m^3$) | 6 |

| Stack Parameters | | |
|---|---|---|
| **Sr.No.** | **Test Parameter** | **MDL** |
| 1 | Particulate Matter (mg/$Nm^3$) | 10 |
| 2 | Sulphur Dioxide (ppm) | 1.52 |
| 3 | Oxides of Nitrogen (ppm) | 2.65 |
| 4 | Carbon Monoxide (mg/$Nm^3$) | 0.1 |
| 5 | Haydro Carbon NMHC (ppm) | 1.0 |

| Sea Water Parameters | | | |
|---|---|---|---|
| **SR. NO.** | **TEST PARAMETERS** | **UNIT** | **MDL** |
| 1 | pH | -- | 2 |
| 2 | Temperature | °C | 2 |
| 3 | Total Suspended Solids | mg/L | 2 |
| 4 | BOD (3 Days @ 27 °C) | mg/L | 1 |
| 5 | Dissolved Oxygen | mg/L | 0.1 |
| 6 | Salinity | ppt | 1 |
| 7 | Oil & Grease | mg/L | 2 |
| 8 | Nitrate as $NO_3$ | µmol/L | 0.5 |
| 9 | Nitrite as $NO_2$ | µmol/L | 0.01 |
| 10 | Ammonical Nitrogen as $NH_3$ | µmol/L | 0.2 |
| 11 | Phosphates as $PO_4$ | µmol/L | 0.5 |
| 12 | Petroleum Hydrocarbon | µg/L | 1 |
| 13 | Total Dissolved Solids | mg/L | 10 |
| 14 | COD | mg/L | 3 |
| 15 | Primary productivity | mgC/L/day | 0.1 |
| 16 | Chlorophyll | mg/$m^3$ | 0.1 |
| 17 | Phaeophytin | mg/$m^3$ | 0.1 |
| 18 | Cell Count | No. x $10^3$/L | 1 |

| Sea Sediment Parameters | | | |
|---|---|---|---|
| **SR. NO.** | **TEST PARAMETERS** | **UNIT** | **MDL** |
| 1 | Organic Matter | % | 0.1 |
| 2 | Phosphorus as P | µg/g | 1 |
| 3 | Petroleum Hydrocarbon | µg/g | 1 |
| 4 | Aluminum as Al | % | 0.1 |
| 5 | Manganese as Mn | µg/g | 1 |
| 6 | Mercury as Hg | µg/g | 0.1 |

**H. T. Shah**
**Lab Manager**

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**Dr. Arun Bajpai**
**Lab Manager (Q)**

| STP Water parameter(mg/L) | | |
|---|---|---|
| **Sr. No.** | **Test parameter** | **MDL** |
| 1 | pH | 2 |
| 2 | Total Suspended Solids (mg/L) | 2 |
| 3 | BOD (3 days @ 270 C) (mg/L) | 1 |
| 4 | Residual Chlorine (mg/L) | 0.2 |
| 5 | Fecal Coliform (MPN INDEX/100 mL) | 1.8 |

| ETP Water Parameters | | | |
|---|---|---|---|
| **SR. NO.** | **TEST PARAMETERS** | **UNIT** | **MDL** |
| 1 | Colour | Co-pt | 2 |
| 2 | pH | -- | 2 |
| 3 | Temperature | $^{o}C$ | 2 |
| 4 | Total Suspended Solids | mg/L | 2 |
| 5 | Total Dissolved Solids | mg/L | 10 |
| 6 | COD | mg/L | 3 |
| 7 | BOD (3 Days @ 27 $^{o}C$) | mg/L | 1 |
| 8 | Chloride as Cl | mg/L | 1 |
| 9 | Oil & Grease | mg/L | 2 |
| 10 | Sulphate as $SO_4$ | mg/L | 1 |
| 11 | Ammonical Nitrogen as $NH_3$ | mg/L | 0.2 |
| 12 | Phenolic Compound | mg/L | 0.005 |
| 13 | Copper as Cu | mg/L | 0.01 |
| 14 | Lead as Pb | mg/L | 0.01 |
| 15 | Sulphide as S | mg/L | 0.1 |
| 16 | Cadmium as Cd | mg/L | 0.002 |
| 17 | Fluoride as F | mg/L | 0.05 |

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**Dr. Arun Bajpai**
**Lab Manager (Q)**

# "HALF YEARLYENVIRONMENTAL MONITORING REPORT"

## FOR

## WATER FRONT DEVELOPMENT PROJECT [WEST PORT]
## ADANI PORTS AND SPECIAL ECONOMIC ZONE LIMITED
## TAL: MUNDRA, KUTCH, MUNDRA – 370 421

**MONITORING PERIOD:**
## OCTOBER 2018 TO MARCH 2019

**PREPARED BY:**

**POLLUCON LABORATORIES PVT.LTD.**

**PLOT NO.5/6 "POLLUCON HOUSE", OPP. BALAJI INDUSTRIAL SOCIETY,
OLD SHANTINATH SILK MILL LANE, NEAR GAYTRI FARSAN MART,
NAVJIVAN CIRCLE, UDHANA MAGDALLA ROAD, SURAT-395007.
PHONE/FAX – (+91 261) 2455 751, 2601 106, 2601 224.
E-mail: pollucon@gmail.com Web: www.polluconlab.com**

**TC - 5945 ISO 9001:2015 ISO 14001:2015 OHSAS 18001:2007**

# RESULTS OF STP WATER OUTLET

| SR. NO | TEST PARAMETERS | Unit | West Basin STP Outlet | | | | | | GPCB permissible Limit | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | October-18 | | November-18 | | December-18 | | | |
| | | | 04/10/2018 | 20/10/2018 | 03/11/2018 | 19/11/2018 | 04/12/2018 | 17/12/2018 | | |
| 1 | pH | -- | 7.10 | 6.85 | 7.30 | 7.44 | 7.18 | 7.65 | -- | IS3025(P11)83Re.02 |
| 2 | Total Suspended Solids | mg/L | 14 | 10 | 24 | 12 | 24 | 17 | 30 | IS3025(P17)84Re.02 |
| 3 | BOD (3 days @ 270 C) | mg/L | 15 | 12 | 10 | 18 | 14 | 10 | 20 | IS 3025 (P44)1993Re.03Edition2.1 |
| 4 | Residual Chlorine | mg/L | 0.8 | 0.6 | -- | -- | 0.8 | 0.6 | Min 0.5 | APHA(22ndEdi)4500 Cl |
| 5 | Fecal Coliform | MPN/100 mL | 350 | 540 | 350 | 430 | 280 | 240 | < 1000 | APHA (22ndEdi) 9221 C&E |

| SR. NO | TEST PARAMETERS | Unit | West Basin STP Outlet | | | | | | GPCB permissible Limit | TEST METHOD |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | January-19 | | February-19 | | March-19 | | | |
| | | | 03/01/2019 | 18/01/2019 | 04/02/2019 | 18/02/2019 | 04/03/2019 | 18/03/2019 | | |
| 1 | pH | -- | 7.15 | 8.10 | 7.50 | 7.96 | 9.05 | 7.56 | -- | IS3025(P11)83Re.02 |
| 2 | Total Suspended Solids | mg/L | 21 | 24 | 27 | 16 | 21 | 23 | 30 | IS3025(P17)84Re.02 |
| 3 | BOD (3 days @ 270 C) | mg/L | 12 | 14 | 15 | 10 | 12 | 6.0 | 20 | IS 3025 (P44)1993Re.03Edition2.1 |
| 4 | Residual Chlorine | mg/L | 0.6 | 0.5 | 1.0 | 0.6 | 0.8 | 0.5 | Min 0.5 | APHA(22ndEdi)4500 Cl |
| 5 | Fecal Coliform | MPN/100 mL | 220 | 350 | 240 | 540 | 210 | 350 | < 1000 | APHA (22ndEdi) 9221 C&E |

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. ArunBajpai**
**Lab Manager (Q)**

## RESULT OF AMBIENT AIR QUALITY MONITORING

| WEST PORT – PMC OFFICE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m3 | Particulate Matter (PM2.5) µg/m3 | Sulphur Dioxide (SO2) µg/m3 | Oxides of Nitrogen (NO2) µg/m3 | Carbon Monoxide as (CO) mg/m3 | Hydrocarbon as (CH4) mg/m3 | Benzene as (C6H6) µg/m3 |
| 1 | 01/10/2018 | 58.73 | 25.85 | 17.33 | 24.33 | 0.56 | BDL* | BDL* |
| 2 | 04/10/2018 | 88.62 | 48.33 | 15.52 | 28.29 | 0.89 | BDL* | BDL* |
| 3 | 08/10/2018 | 74.66 | 31.58 | 19.39 | 32.47 | 0.74 | BDL* | BDL* |
| 4 | 11/10/2018 | 84.96 | 45.29 | 10.89 | 26.21 | 0.45 | BDL* | BDL* |
| 5 | 15/10/2018 | 70.50 | 37.57 | 16.55 | 35.77 | 0.37 | BDL* | BDL* |
| 6 | 18/10/2018 | 56.37 | 22.44 | 7.55 | 29.30 | 0.43 | BDL* | BDL* |
| 7 | 22/10/2018 | 64.56 | 28.42 | 20.30 | 23.68 | 0.54 | BDL* | BDL* |
| 8 | 25/10/2018 | 78.32 | 35.32 | 11.66 | 27.52 | 0.71 | BDL* | BDL* |
| 9 | 29/10/2018 | 81.55 | 38.35 | 14.19 | 20.62 | 0.48 | BDL* | BDL* |
| 10 | 01/11/2018 | 80.37 | 33.53 | 11.51 | 17.46 | 0.32 | BDL* | BDL* |
| 11 | 05/11/2018 | 71.28 | 39.56 | 9.57 | 21.57 | 0.47 | BDL* | BDL* |
| 12 | 08/11/2018 | 87.43 | 42.32 | 15.63 | 31.22 | 0.27 | BDL* | BDL* |
| 13 | 12/11/2018 | 67.33 | 32.74 | 13.35 | 27.57 | 0.23 | BDL* | BDL* |
| 14 | 15/11/2018 | 89.37 | 36.58 | 18.68 | 36.55 | 0.31 | BDL* | BDL* |
| 15 | 19/11/2018 | 81.23 | 43.56 | 16.49 | 19.33 | 0.34 | BDL* | BDL* |
| 16 | 21/11/2018 | 70.85 | 29.73 | 14.51 | 24.59 | 0.57 | BDL* | BDL* |
| 17 | 26/11/2018 | 65.33 | 37.57 | 12.27 | 29.73 | 0.36 | BDL* | BDL* |
| 18 | 28/11/2018 | 75.38 | 41.25 | 8.26 | 26.60 | 0.53 | BDL* | BDL* |
| 19 | 03/12/2018 | 71.20 | 40.30 | 16.57 | 33.63 | 0.40 | BDL* | BDL* |
| 20 | 05/12/2018 | 82.69 | 44.47 | 10.41 | 19.59 | 0.42 | BDL* | BDL* |
| 21 | 10/12/2018 | 77.56 | 33.86 | 12.63 | 35.45 | 0.30 | BDL* | BDL* |
| 22 | 12/12/2018 | 96.29 | 55.37 | 17.29 | 38.37 | 0.60 | BDL* | BDL* |
| 23 | 17/12/2018 | 76.34 | 27.42 | 14.52 | 26.66 | 0.85 | BDL* | BDL* |
| 24 | 19/12/2018 | 68.23 | 41.25 | 18.65 | 22.54 | 0.23 | BDL* | BDL* |
| 25 | 24/12/2018 | 84.63 | 38.44 | 7.59 | 29.53 | 0.77 | BDL* | BDL* |
| 26 | 26/12/2018 | 70.33 | 43.56 | 11.26 | 30.56 | 0.53 | BDL* | BDL* |
| 27 | 31/12/2018 | 86.36 | 35.68 | 15.62 | 23.69 | 0.25 | BDL* | BDL* |
| 28 | 02/01/2019 | 83.50 | 49.55 | 13.59 | 28.74 | 0.73 | BDL* | BDL* |
| 29 | 07/01/2019 | 96.32 | 52.56 | 20.44 | 41.44 | 0.60 | BDL* | BDL* |
| 30 | 09/01/2019 | 89.57 | 36.38 | 17.65 | 32.59 | 0.80 | BDL* | BDL* |

**Continue...**

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**H. T. Shah**
**Lab Manager**

**Dr. ArunBajpai**
**Lab Manager (Q)**

| WEST PORT – PMC OFFICE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m3 | Particulate Matter (PM2.5) µg/m3 | Sulphur Dioxide (SO2) µg/m3 | Oxides of Nitrogen (NO2) µg/m3 | Carbon Monoxide as (CO) mg/m3 | Hydrocarbon as (CH4) mg/m3 | Benzene as (C6H6) µg/m3 |
| 31 | 15/01/2019 | 91.30 | 50.29 | 15.43 | 37.71 | 0.49 | BDL* | BDL* |
| 32 | 16/01/2019 | 75.38 | 30.18 | 19.56 | 25.37 | 0.26 | BDL* | BDL* |
| 33 | 21/01/2019 | 62.35 | 27.38 | 21.37 | 29.66 | 0.39 | BDL* | BDL* |
| 34 | 23/01/2019 | 77.58 | 44.31 | 11.31 | 34.61 | 0.62 | BDL* | BDL* |
| 35 | 28/01/2019 | 87.62 | 47.53 | 10.43 | 21.65 | 0.53 | BDL* | BDL* |
| 36 | 30/01/2019 | 79.49 | 34.23 | 14.31 | 39.29 | 0.38 | BDL* | BDL* |
| 37 | 04/02/2019 | 58.63 | 20.56 | 18.31 | 25.93 | 0.45 | BDL* | BDL* |
| 38 | 06/02/2019 | 89.67 | 49.43 | 14.57 | 36.87 | 0.77 | BDL* | BDL* |
| 39 | 11/02/2019 | 76.35 | 35.43 | 12.34 | 22.53 | 0.95 | BDL* | BDL* |
| 40 | 13/02/2019 | 85.47 | 46.25 | 23.40 | 32.58 | 0.62 | BDL* | BDL* |
| 41 | 18/02/2019 | 91.34 | 52.48 | 21.60 | 27.70 | 1.01 | BDL* | BDL* |
| 42 | 20/02/2019 | 79.34 | 31.50 | 13.25 | 33.47 | 0.57 | BDL* | BDL* |
| 43 | 25/02/2019 | 81.96 | 47.48 | 7.71 | 18.37 | 0.36 | BDL* | BDL* |
| 44 | 27/02/2019 | 73.71 | 41.54 | 15.34 | 29.42 | 0.81 | BDL* | BDL* |
| 45 | 04/03/2019 | 61.47 | 36.42 | 9.36 | 23.50 | 0.25 | BDL* | BDL* |
| 46 | 06/03/2019 | 82.19 | 38.36 | 24.38 | 30.41 | 0.79 | BDL* | BDL* |
| 47 | 11/03/2019 | 79.67 | 34.40 | 16.24 | 40.75 | 0.60 | BDL* | BDL* |
| 48 | 13/03/2019 | 68.24 | 41.50 | 13.28 | 25.41 | 0.71 | BDL* | BDL* |
| 49 | 18/03/2019 | 50.39 | 21.80 | 20.52 | 29.56 | 0.34 | BDL* | BDL* |
| 50 | 20/03/2019 | 72.32 | 40.88 | 14.48 | 36.37 | 0.41 | BDL* | BDL* |
| 51 | 25/03/2019 | 52.63 | 26.22 | 8.71 | 20.51 | 0.27 | BDL* | BDL* |
| 52 | 27/03/2019 | 64.51 | 37.49 | 17.30 | 33.49 | 0.63 | BDL* | BDL* |
| | **TEST METHOD** | **IS:5182 (Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)** | **Gravimetric-CPCB - Method (Vol.I,May-2011)** | **IS:5182(Part II):Improved West and Gaeke** | **IS:5182(Part VI):Modified Jacob &Hochheiser (NaOH-NaAsO2)** | **NDIR Digital Gas Analyzer** | **SOP: HC: GC/GCMS/Gas analyzer** | **IS 5182 (Part XI):2006/CPCB Method** |

**H. T. Shah**

**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. ArunBajpai**

**Lab Manager (Q)**

| WEST PORT - HORTI CULTURE CABIN | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m3 | Particulate Matter (PM2.5) µg/m3 | Sulphur Dioxide (SO2) µg/m3 | Oxides of Nitrogen (NO2) µg/m3 | Carbon Monoxide as (CO) mg/m3 | Hydrocarbon as (CH4) mg/m3 | Benzene as (C6H6) µg/m3 |
| 1 | 01/10/2018 | 50.38 | 21.33 | 12.42 | 16.44 | 0.49 | BDL* | BDL* |
| 2 | 04/10/2018 | 72.40 | 40.57 | 10.56 | 18.63 | 0.69 | BDL* | BDL* |
| 3 | 08/10/2018 | 82.41 | 35.64 | 13.66 | 26.32 | 0.55 | BDL* | BDL* |
| 4 | 11/10/2018 | 90.58 | 48.60 | 7.31 | 20.35 | 0.30 | BDL* | BDL* |
| 5 | 15/10/2018 | 58.70 | 27.52 | 11.34 | 29.62 | 0.47 | BDL* | BDL* |
| 6 | 18/10/2018 | 69.35 | 37.52 | 9.44 | 22.63 | 0.73 | BDL* | BDL* |
| 7 | 22/10/2018 | 71.73 | 32.54 | 14.38 | 28.36 | 0.34 | BDL* | BDL* |
| 8 | 25/10/2018 | 59.66 | 26.48 | 6.53 | 25.45 | 0.65 | BDL* | BDL* |
| 9 | 29/10/2018 | 62.64 | 30.24 | 16.27 | 23.33 | 0.44 | BDL* | BDL* |
| 10 | 01/11/2018 | 59.73 | 22.59 | 15.62 | 21.26 | 0.30 | BDL* | BDL* |
| 11 | 05/11/2018 | 68.33 | 35.75 | 6.78 | 32.67 | 0.42 | BDL* | BDL* |
| 12 | 08/11/2018 | 72.65 | 34.59 | 8.42 | 27.58 | 0.21 | BDL* | BDL* |
| 13 | 12/11/2018 | 56.41 | 27.77 | 11.56 | 24.46 | 0.55 | BDL* | BDL* |
| 14 | 15/11/2018 | 78.68 | 24.54 | 7.27 | 16.31 | 0.19 | BDL* | BDL* |
| 15 | 19/11/2018 | 77.45 | 39.64 | 12.56 | 26.40 | 0.23 | BDL* | BDL* |
| 16 | 21/11/2018 | 65.66 | 26.36 | 22.51 | 29.33 | 0.44 | BDL* | BDL* |
| 17 | 26/11/2018 | 58.64 | 33.77 | 9.28 | 15.70 | 0.31 | BDL* | BDL* |
| 18 | 28/11/2018 | 70.24 | 31.53 | 14.55 | 20.57 | 0.36 | BDL* | BDL* |
| 19 | 03/12/2018 | 77.56 | 36.42 | 8.67 | 29.37 | 0.14 | BDL* | BDL* |
| 20 | 05/12/2018 | 63.50 | 28.39 | 13.50 | 26.63 | 0.39 | BDL* | BDL* |
| 21 | 10/12/2018 | 58.68 | 25.45 | 10.25 | 32.66 | 0.52 | BDL* | BDL* |
| 22 | 12/12/2018 | 82.41 | 45.31 | 9.38 | 19.63 | 0.27 | BDL* | BDL* |
| 23 | 17/12/2018 | 70.58 | 32.48 | 19.51 | 30.63 | 0.65 | BDL* | BDL* |
| 24 | 19/12/2018 | 85.36 | 50.44 | 16.60 | 34.64 | 0.41 | BDL* | BDL* |
| 25 | 24/12/2018 | 75.39 | 33.39 | 12.48 | 24.56 | 0.53 | BDL* | BDL* |
| 26 | 26/12/2018 | 62.67 | 38.61 | 7.59 | 17.65 | 0.45 | BDL* | BDL* |
| 27 | 31/12/2018 | 81.56 | 24.37 | 11.61 | 28.42 | 0.55 | BDL* | BDL* |
| 28 | 02/01/2019 | 76.80 | 44.15 | 21.72 | 33.66 | 0.84 | BDL* | BDL* |
| 29 | 07/01/2019 | 86.32 | 40.80 | 10.25 | 21.70 | 0.34 | BDL* | BDL* |
| 30 | 09/01/2019 | 79.30 | 31.24 | 14.33 | 26.41 | 0.61 | BDL* | BDL* |

**Continue...**

**H. T. Shah**
**Lab Manager**

POLLUCON LABORATORIES PVT. LTD. SURAT-7

**Dr. ArunBajpai**
**Lab Manager (Q)**

| WEST PORT - HORTI CULTURE CABIN | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m3 | Particulate Matter (PM2.5) µg/m3 | Sulphur Dioxide (SO2) µg/m3 | Oxides of Nitrogen (NO2) µg/m3 | Carbon Monoxide as (CO) mg/m3 | Hydrocarbon as (CH4) mg/m3 | Benzene as (C6H6) µg/m3 |
| 31 | 15/01/2019 | 82.50 | 42.48 | 9.34 | 31.63 | 0.40 | BDL* | BDL* |
| 32 | 16/01/2019 | 92.31 | 54.25 | 16.78 | 38.71 | 0.52 | BDL* | BDL* |
| 33 | 21/01/2019 | 69.37 | 32.40 | 6.28 | 32.44 | 0.76 | BDL* | BDL* |
| 34 | 23/01/2019 | 56.84 | 36.71 | 13.55 | 19.64 | 0.33 | BDL* | BDL* |
| 35 | 28/01/2019 | 63.63 | 39.31 | 20.41 | 27.33 | 0.56 | BDL* | BDL* |
| 36 | 30/01/2019 | 59.39 | 25.49 | 11.57 | 24.64 | 0.27 | BDL* | BDL* |
| 37 | 04/02/2019 | 64.53 | 28.59 | 6.57 | 29.68 | 0.49 | BDL* | 2.23 |
| 38 | 06/02/2019 | 54.31 | 23.26 | 8.68 | 18.51 | 0.44 | BDL* | BDL* |
| 39 | 11/02/2019 | 71.53 | 42.54 | 18.58 | 28.64 | 0.29 | BDL* | BDL* |
| 40 | 13/02/2019 | 80.37 | 37.45 | 7.54 | 25.77 | 0.71 | BDL* | BDL* |
| 41 | 18/02/2019 | 72.54 | 30.66 | 12.65 | 22.84 | 0.82 | BDL* | BDL* |
| 42 | 20/02/2019 | 55.63 | 22.30 | 10.21 | 26.83 | 0.34 | BDL* | BDL* |
| 43 | 25/02/2019 | 68.48 | 39.48 | 17.36 | 30.70 | 0.72 | BDL* | BDL* |
| 44 | 27/02/2019 | 53.62 | 32.48 | 9.33 | 16.60 | 0.42 | BDL* | BDL* |
| 45 | 04/03/2019 | 78.61 | 44.57 | 16.41 | 37.64 | 0.55 | BDL* | BDL* |
| 46 | 06/03/2019 | 66.39 | 28.68 | 13.32 | 25.67 | 0.62 | BDL* | BDL* |
| 47 | 11/03/2019 | 52.60 | 25.28 | 9.17 | 21.60 | 0.35 | BDL* | BDL* |
| 48 | 13/03/2019 | 63.24 | 35.63 | 21.57 | 31.71 | 0.30 | BDL* | BDL* |
| 49 | 18/03/2019 | 59.36 | 26.32 | 17.61 | 26.29 | 0.39 | BDL* | BDL* |
| 50 | 20/03/2019 | 49.62 | 23.46 | 11.61 | 29.48 | 0.27 | BDL* | BDL* |
| 51 | 25/03/2019 | 62.36 | 29.42 | 19.46 | 35.72 | 0.57 | BDL* | BDL* |
| 52 | 27/03/2019 | 47.35 | 19.53 | 10.40 | 18.53 | 0.37 | BDL* | BDL* |
| | **TEST METHOD** | **IS:5182 (Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)** | **Gravimetric-CPCB - Method (Vol.I,May-2011)** | **IS:5182(Part II):Improved West and Gaeke** | **IS:5182(Part VI):Modified Jacob &Hochheiser (NaOH-NaAsO2)** | **NDIR Digital Gas Analyzer** | **SOP: HC: GC/GCMS/Gas analyzer** | **IS 5182 (Part XI):2006/CPCB Method** |

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

**H. T. Shah**
**Lab Manager**

**Dr. ArunBajpai**
**Lab Manager (Q)**

| WEST PORT - MAIN GATE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m3 | Particulate Matter (PM2.5) µg/m3 | Sulphur Dioxide (SO2) µg/m3 | Oxides of Nitrogen (NO2) µg/m3 | Carbon Monoxide as (CO) mg/m3 | Hydrocarbon as (CH4) mg/m3 | Benzene as (C6H6) µg/m3 |
| 1 | 01/10/2018 | 76.51 | 33.68 | 23.60 | 30.22 | 0.68 | BDL* | BDL* |
| 2 | 04/10/2018 | 94.49 | 54.38 | 20.41 | 34.26 | 0.96 | BDL* | BDL* |
| 3 | 08/10/2018 | 89.89 | 42.67 | 25.33 | 39.45 | 0.79 | BDL* | BDL* |
| 4 | 11/10/2018 | 95.39 | 51.25 | 16.59 | 29.42 | 0.87 | BDL* | BDL* |
| 5 | 15/10/2018 | 90.80 | 47.54 | 19.59 | 41.84 | 0.64 | BDL* | BDL* |
| 6 | 18/10/2018 | 96.30 | 53.68 | 13.35 | 36.27 | 0.98 | BDL* | BDL* |
| 7 | 22/10/2018 | 79.35 | 41.52 | 22.40 | 20.44 | 0.88 | BDL* | BDL* |
| 8 | 25/10/2018 | 83.59 | 46.34 | 15.32 | 33.51 | 0.77 | BDL* | BDL* |
| 9 | 29/10/2018 | 92.61 | 55.62 | 18.53 | 31.27 | 0.62 | BDL* | BDL* |
| 10 | 01/11/2018 | 90.34 | 39.29 | 20.49 | 36.52 | 0.41 | BDL* | BDL* |
| 11 | 05/11/2018 | 78.50 | 41.20 | 24.54 | 26.36 | 0.46 | BDL* | BDL* |
| 12 | 08/11/2018 | 96.38 | 45.88 | 10.34 | 38.52 | 0.62 | BDL* | BDL* |
| 13 | 12/11/2018 | 86.53 | 53.63 | 17.56 | 33.57 | 0.39 | BDL* | BDL* |
| 14 | 15/11/2018 | 92.56 | 38.38 | 22.43 | 42.87 | 0.47 | BDL* | BDL* |
| 15 | 19/11/2018 | 89.63 | 47.54 | 19.25 | 29.48 | 0.56 | BDL* | 2.15 |
| 16 | 21/11/2018 | 77.54 | 32.87 | 26.17 | 44.43 | 0.61 | BDL* | BDL* |
| 17 | 26/11/2018 | 94.31 | 52.51 | 18.48 | 24.73 | 0.44 | BDL* | BDL* |
| 18 | 28/11/2018 | 83.81 | 40.29 | 21.21 | 32.34 | 0.87 | BDL* | BDL* |
| 19 | 03/12/2018 | 83.65 | 47.58 | 10.19 | 38.61 | 0.90 | BDL* | BDL* |
| 20 | 05/12/2018 | 92.43 | 39.50 | 18.54 | 33.54 | 0.60 | BDL* | BDL* |
| 21 | 10/12/2018 | 86.33 | 41.24 | 15.68 | 45.70 | 0.94 | BDL* | BDL* |
| 22 | 12/12/2018 | 90.69 | 52.68 | 20.39 | 41.42 | 0.73 | BDL* | 2.01 |
| 23 | 17/12/2018 | 84.38 | 42.40 | 23.44 | 36.82 | 0.98 | BDL* | BDL* |
| 24 | 19/12/2018 | 96.61 | 55.62 | 26.61 | 27.65 | 0.69 | BDL* | BDL* |
| 25 | 24/12/2018 | 91.27 | 56.28 | 19.37 | 34.56 | 0.87 | BDL* | BDL* |
| 26 | 26/12/2018 | 88.66 | 48.74 | 17.52 | 25.54 | 0.64 | BDL* | BDL* |
| 27 | 31/12/2018 | 97.31 | 43.64 | 24.79 | 37.74 | 0.77 | BDL* | 2.41 |
| 28 | 02/01/2019 | 88.69 | 54.30 | 25.38 | 39.54 | 0.94 | BDL* | 2.04 |
| 29 | 07/01/2019 | 83.41 | 49.45 | 22.32 | 46.29 | 1.09 | BDL* | 2.17 |
| 30 | 09/01/2019 | 97.66 | 44.56 | 20.23 | 37.28 | 0.88 | BDL* | BDL* |

**Continue...**

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-7

Dr. ArunBajpai
Lab Manager (Q)

| WEST PORT - MAIN GATE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr. No. | Date of Sampling | Particulate Matter (PM10) µg/m3 | Particulate Matter (PM2.5) µg/m3 | Sulphur Dioxide (SO2) µg/m3 | Oxides of Nitrogen (NO2) µg/m3 | Carbon Monoxide as (CO) mg/m3 | Hydrocarbon as (CH4) mg/m3 | Benzene as (C6H6) µg/m3 |
| 31 | 15/01/2019 | 95.30 | 58.56 | 11.30 | 43.64 | 0.98 | BDL* | BDL* |
| 32 | 16/01/2019 | 89.27 | 45.63 | 28.46 | 30.80 | 0.89 | BDL* | 2.06 |
| 33 | 21/01/2019 | 77.69 | 38.67 | 24.43 | 40.61 | 1.04 | BDL* | 2.58 |
| 34 | 23/01/2019 | 94.21 | 52.80 | 18.46 | 28.38 | 0.96 | BDL* | BDL* |
| 35 | 28/01/2019 | 81.21 | 43.35 | 15.70 | 35.65 | 0.79 | BDL* | BDL* |
| 36 | 30/01/2019 | 91.56 | 37.68 | 17.14 | 44.62 | 0.94 | BDL* | BDL* |
| 37 | 04/02/2019 | 74.56 | 35.56 | 21.53 | 38.48 | 1.08 | BDL* | 2.83 |
| 38 | 06/02/2019 | 80.45 | 42.69 | 17.62 | 40.29 | 1.01 | BDL* | 2.38 |
| 39 | 11/02/2019 | 92.41 | 53.47 | 23.46 | 33.90 | 1.05 | BDL* | 2.30 |
| 40 | 13/02/2019 | 89.53 | 49.28 | 9.61 | 42.40 | 1.02 | BDL* | BDL* |
| 41 | 18/02/2019 | 96.38 | 56.24 | 16.35 | 29.47 | 1.12 | BDL* | BDL* |
| 42 | 20/02/2019 | 84.31 | 39.66 | 15.78 | 37.58 | 0.97 | BDL* | BDL* |
| 43 | 25/02/2019 | 71.56 | 34.69 | 13.54 | 35.64 | 1.03 | BDL* | BDL* |
| 44 | 27/02/2019 | 88.38 | 51.56 | 22.32 | 39.52 | 0.85 | BDL* | BDL* |
| 45 | 04/03/2019 | 92.54 | 54.30 | 29.40 | 31.28 | 0.58 | BDL* | BDL* |
| 46 | 06/03/2019 | 86.38 | 44.60 | 18.66 | 34.56 | 0.86 | BDL* | BDL* |
| 47 | 11/03/2019 | 69.33 | 37.68 | 20.28 | 45.42 | 0.78 | BDL* | BDL* |
| 48 | 13/03/2019 | 82.64 | 52.64 | 26.57 | 37.69 | 0.80 | BDL* | 2.34 |
| 49 | 18/03/2019 | 76.46 | 30.46 | 23.58 | 33.54 | 0.64 | BDL* | BDL* |
| 50 | 20/03/2019 | 88.39 | 46.50 | 17.28 | 43.47 | 0.71 | BDL* | BDL* |
| 51 | 25/03/2019 | 94.34 | 32.25 | 14.34 | 40.30 | 0.45 | BDL* | BDL* |
| 52 | 27/03/2019 | 79.60 | 45.30 | 24.35 | 35.61 | 0.57 | BDL* | BDL* |
| | TEST METHOD | IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011) | Gravimetric-CPCB - Method (Vol.I,May-2011) | IS:5182 (Part II):Improved West and Gaeke | IS:5182 (Part VI):Modified Jacob &Hochheiser (NaOH-NaAsO2) | NDIR Digital Gas Analyzer | SOP: HC: GC/GCMS/Gas analyzer | IS 5182 (Part XI):2006/CPCB Method |

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-7.

Dr. ArunBajpai
Lab Manager (Q)

# RESULTS OF NOISE LEVEL MONITORING

## Result of Noise level monitoring [Day Time]

| SR. NO. | Name of Location | WEST PORT - PMC OFFICE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 22/10/2018 | 26/11/2018 | 17/12/2018 | 23/01/2019 | 06/02/2019 | 06/03/2019 |
| 1 | 6:00-7:00 | 66.1 | 65.7 | 59.6 | 62.1 | 60.3 | 59.1 |
| 2 | 7:00-8:00 | 58.2 | 57.3 | 57.1 | 68.4 | 63.0 | 62.8 |
| 3 | 8:00-9:00 | 65.0 | 63.1 | 62.4 | 65.1 | 65.5 | 63.1 |
| 4 | 9:00-10:00 | 70.5 | 72.4 | 65.1 | 69.4 | 68.4 | 61.4 |
| 5 | 10:00-11:00 | 72.9 | 73.3 | 69.1 | 63.4 | 67.4 | 65.5 |
| 6 | 11:00-12:00 | 68.8 | 69.8 | 69.8 | 65.1 | 67.2 | 66.7 |
| 7 | 12:00-13:00 | 69.4 | 69.7 | 65.4 | 62.8 | 64.1 | 70.9 |
| 8 | 13:00-14:00 | 69.7 | 68.6 | 62.4 | 65.7 | 68.8 | 68.1 |
| 9 | 14:00-15:00 | 60.1 | 57.6 | 62.8 | 68.1 | 70.2 | 66.4 |
| 10 | 15:00-16:00 | 63.8 | 64.7 | 65.3 | 66.1 | 66.2 | 68.1 |
| 11 | 16:00-17:00 | 63.7 | 65.8 | 63.4 | 66.8 | 64.2 | 62.4 |
| 12 | 17:00-18:00 | 65.3 | 66.1 | 61.7 | 69.1 | 64.1 | 61.3 |
| 13 | 18:00-19:00 | 62.1 | 64.2 | 61.5 | 70.4 | 68.3 | 63.8 |
| 14 | 19:00-20:00 | 65.5 | 69.0 | 65.2 | 68.1 | 72.3 | 65.9 |
| 15 | 20:00-21:00 | 59.0 | 58.3 | 65.8 | 63.4 | 70.2 | 61.7 |
| 16 | 21:00-22:00 | 68.8 | 69.3 | 61.8 | 65.4 | 68.5 | 62.8 |
| Day Time Limit* | | 75 Leq dB(A) | | | | | |

## Result of Noise level monitoring [Night Time]

| SR. NO. | Name of Location | WEST PORT - PMC OFFICE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 22/10/2018 & 23/10/2018 | 26/11/2018 & 27/11/2018 | 17/12/2018 & 18/12/2018 | 23/01/2019 & 24/01/2019 | 06/02/2019 & 07/02/2019 | 06/03/2019 & 07/03/2019 |
| 1 | 22:00-23:00 | 66.4 | 64.1 | 68.5 | 61.1 | 64.2 | 65.4 |
| 2 | 23:00-00:00 | 59.0 | 61.0 | 63.5 | 65.1 | 57.4 | 61.2 |
| 3 | 00:00-01:00 | 65.6 | 64.4 | 60.6 | 62.8 | 60.4 | 62.7 |
| 4 | 01:00-02:00 | 62.9 | 64.2 | 62.5 | 63.6 | 64.2 | 60.8 |
| 5 | 02:00-03:00 | 64.1 | 64.7 | 64.7 | 63.9 | 57.3 | 57.2 |
| 6 | 03:00-04:00 | 57.1 | 60.1 | 61.5 | 65.1 | 63.2 | 56.4 |
| 7 | 04:00-05:00 | 59.5 | 60.2 | 61.9 | 60.4 | 60.3 | 60.4 |
| 8 | 05:00-06:00 | 60.5 | 59.8 | 62.6 | 61.8 | 62.8 | 61.4 |
| Night Time Limit* | | 70 Leq dB(A) | | | | | |

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-7

Dr. ArunBajpai
Lab Manager (Q)

## Result of Noise level monitoring [Day Time]

| SR. NO. | Name of Location | WEST PORT - HORTI CULTURE CABIN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 11/10/2018 | 19/11/2018 | 06/12/2018 | 09/01/2019 | 20/02/2019 | 13/03/2019 |
| 1 | 6:00-7:00 | 59.8 | 58.2 | 62.1 | 58.4 | 58.3 | 65.2 |
| 2 | 7:00-8:00 | 61.1 | 63.5 | 65.1 | 62.4 | 62.5 | 62.4 |
| 3 | 8:00-9:00 | 55.9 | 55.1 | 62.1 | 60.4 | 68.3 | 66.1 |
| 4 | 9:00-10:00 | 59.2 | 58.6 | 59.4 | 62.4 | 65.1 | 62.6 |
| 5 | 10:00-11:00 | 64.1 | 66.0 | 61.4 | 64.5 | 65.7 | 62.8 |
| 6 | 11:00-12:00 | 60.7 | 63.3 | 60.8 | 63.5 | 68.2 | 69.4 |
| 7 | 12:00-13:00 | 65.2 | 62.8 | 60.7 | 65.1 | 62.4 | 68.1 |
| 8 | 13:00-14:00 | 63.8 | 60.9 | 65.4 | 69.4 | 64.8 | 66.2 |
| 9 | 14:00-15:00 | 61.8 | 63.3 | 63.1 | 64.2 | 64.1 | 66.9 |
| 10 | 15:00-16:00 | 60.3 | 59.6 | 63.8 | 62.5 | 60.2 | 65.1 |
| 11 | 16:00-17:00 | 61.6 | 61.8 | 63.7 | 70.1 | 62.4 | 61.4 |
| 12 | 17:00-18:00 | 58.7 | 60.2 | 60.4 | 62.5 | 62.8 | 63.4 |
| 13 | 18:00-19:00 | 65.7 | 64.5 | 69.7 | 65.3 | 68.3 | 63.8 |
| 14 | 19:00-20:00 | 64.6 | 63.4 | 67.0 | 69.4 | 65.1 | 63.4 |
| 15 | 20:00-21:00 | 66.9 | 66.4 | 61.8 | 64.1 | 62.1 | 68.1 |
| 16 | 21:00-22:00 | 61.6 | 58.7 | 63.4 | 63.8 | 61.2 | 65.1 |
| Day Time Limit* | | 75 Leq dB(A) | | | | | |

## Result of Noise level monitoring [Night Time]

| SR. NO. | Name of Location | WEST PORT - HORTI CULTURE CABIN | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 11/10/2018 & 12/10/2018 | 19/11/2018 & 20/11/2018 | 06/12/2018 & 07/12/2018 | 09/01/2019 & 10/01/2019 | 20/02/2019 & 21/02/2019 | 13/03/2019 & 14/03/2019 |
| 1 | 22:00-23:00 | 62.3 | 61.7 | 60.4 | 65.9 | 62.4 | 62.1 |
| 2 | 23:00-00:00 | 61.8 | 60.1 | 65.1 | 63.3 | 65.1 | 65.4 |
| 3 | 00:00-01:00 | 60.5 | 62.6 | 60.7 | 60.1 | 60.7 | 61.8 |
| 4 | 01:00-02:00 | 62.1 | 64.0 | 59.4 | 58.3 | 59.4 | 69.1 |
| 5 | 02:00-03:00 | 63.1 | 65.9 | 61.0 | 60.3 | 61.0 | 64.8 |
| 6 | 03:00-04:00 | 58.1 | 59.7 | 62.4 | 62.3 | 62.4 | 63.1 |
| 7 | 04:00-05:00 | 57.9 | 58.1 | 61.7 | 60.3 | 61.7 | 65.8 |
| 8 | 05:00-06:00 | 59.4 | 61.4 | 58.1 | 60.1 | 58.1 | 67.1 |
| Night Time Limit* | | 70 Leq dB(A) | | | | | |

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-7

Dr. ArunBajpai
Lab Manager (Q)

## Result of Noise level monitoring [Day Time]

| SR. NO. | Name of Location | WEST PORT - MAIN GATE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 08/10/2018 | 05/11/2018 | 10/12/2018 | 21/01/2019 | 11/02/2019 | 04/03/2019 |
| 1 | 6:00-7:00 | 58.3 | 57.8 | 63.1 | 62.5 | 65.4 | 63.5 |
| 2 | 7:00-8:00 | 65.1 | 64.7 | 65.1 | 60.4 | 63.1 | 68.1 |
| 3 | 8:00-9:00 | 64.4 | 62.1 | 69.1 | 68.1 | 68.2 | 66.1 |
| 4 | 9:00-10:00 | 65.4 | 64.7 | 73.1 | 72.1 | 67.1 | 72.5 |
| 5 | 10:00-11:00 | 73.9 | 71.4 | 74.1 | 74.1 | 67.8 | 74.1 |
| 6 | 11:00-12:00 | 71.3 | 69.5 | 70.1 | 70.5 | 73.5 | 70.5 |
| 7 | 12:00-13:00 | 73.4 | 74.0 | 65.1 | 68.1 | 70.2 | 70.9 |
| 8 | 13:00-14:00 | 67.2 | 67.2 | 60.1 | 62.4 | 70.2 | 62.4 |
| 9 | 14:00-15:00 | 63.1 | 64.0 | 60.7 | 65.6 | 62.4 | 65.1 |
| 10 | 15:00-16:00 | 64.3 | 67.0 | 64.1 | 63.1 | 65.2 | 68.7 |
| 11 | 16:00-17:00 | 59.4 | 62.4 | 61.5 | 64.2 | 56.1 | 64.3 |
| 12 | 17:00-18:00 | 68.4 | 67.3 | 68.4 | 62.5 | 65.7 | 66.3 |
| 13 | 18:00-19:00 | 69.1 | 70.6 | 62.4 | 65.8 | 68.2 | 66.1 |
| 14 | 19:00-20:00 | 63.4 | 62.1 | 65.1 | 66.1 | 66.1 | 65.8 |
| 15 | 20:00-21:00 | 59.9 | 58.2 | 65.9 | 62.1 | 61.8 | 63.4 |
| 16 | 21:00-22:00 | 68.7 | 68.7 | 61.4 | 63.4 | 63.2 | 69.9 |
| Day Time Limit* | | 75 Leq dB(A) | | | | | |

## Result of Noise level monitoring [Night Time]

| SR. NO. | Name of Location | WEST PORT - MAIN GATE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Result [Leq dB(A)] | | | | | |
| | Sampling Date & Time | 08/10/2018 & 09/10/2018 | 05/11/2018 & 06/11/2018 | 10/12/2018 & 11/12/2018 | 21/01/2019 & 22/01/2019 | 11/02/2019 & 12/02/2019 | 04/03/2019 & 05/03/2019 |
| 1 | 22:00-23:00 | 64.5 | 65.0 | 62.1 | 65.3 | 62.1 | 63.1 |
| 2 | 23:00-00:00 | 63.4 | 65.7 | 60.4 | 63.3 | 60.4 | 68.1 |
| 3 | 00:00-01:00 | 61.5 | 61.8 | 65.2 | 60.4 | 65.2 | 66.1 |
| 4 | 01:00-02:00 | 64.3 | 62.6 | 61.8 | 60.2 | 61.8 | 66.8 |
| 5 | 02:00-03:00 | 63.5 | 66.3 | 68.4 | 61.3 | 68.4 | 67.2 |
| 6 | 03:00-04:00 | 61.7 | 60.4 | 64.7 | 64.3 | 64.7 | 65.5 |
| 7 | 04:00-05:00 | 64.3 | 66.9 | 63.1 | 67.3 | 63.1 | 69.8 |
| 8 | 05:00-06:00 | 62.7 | 61.8 | 60.8 | 63.4 | 60.8 | 64.1 |
| Night Time Limit* | | 70 Leq dB(A) | | | | | |

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# RESULTS OF D.G. STACK MONITORING

| | | | 25/11/2018 | 19/12/2018 | 19/12/2018 | |
|---|---|---|---|---|---|---|
| SR. NO. | TEST PARAMETERS | Unit | West Basin | | GPCB Limit | Test Method |
| | | | D.G. Set-1 (1500 KVA) | D.G. Set-2 (1500 KVA) | | |
| 1 | Particulate Matter | $mg/Nm^3$ | 27.81 | 24.27 | 150 | IS:11255 (Part-I):1985 |
| 2 | Sulphur Dioxide | ppm | 5.49 | 4.33 | 100 | IS:11255 (Part-II):1985 |
| 3 | Oxide of Nitrogen | ppm | 31.19 | 27.61 | 50 | IS:11255 (Part-VII):2005 |
| 4 | Carbon Monoxide | $mg/m^3$ | 15.5 | 12.0 | Not Specified | Digital Gas Analyzer |
| 5 | Hydro Carbon NMHC | ppm | BDL* | BDL* | Not Specified | Gas Chromatography |

*DG sets are used as standby, so stack monitoring is done on quarterly basis. Results on 15 % O2 Correction when Oxygen is greater than 15 %

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# MINIMUM DETECTION LIMIT [MDL]

| Ambient Air Parameter | | |
|---|---|---|
| **Sr. No.** | **Test parameter** | **MDL** |
| 1 | Particulate Matter (PM10) ($\mu g/m^3$) | 10 |
| 2 | Particulate Matter (PM 2.5) ($\mu g/m^3$) | 10 |
| 3 | Sulphur Dioxide ($SO_2$) ($\mu g/m^3$) | 5 |
| 4 | Oxides of Nitrogen($\mu g/m^3$) | 5 |
| 5 | Carbon Monoxide as CO ($mg/m^3$) | 0.1 |
| 6 | Hydrocarbon as $CH_4$ ($\mu g/m^3$) | 150 |
| 7 | Benzene as $C_6H_6$ ($mg/m^3$) | 2 |

| STP Water parameter(mg/L) | | |
|---|---|---|
| **Sr. No.** | **Test parameter** | **MDL** |
| 1 | pH | 2 |
| 2 | Total Suspended Solids (mg/L) | 2 |
| 3 | BOD (3 days @ 270 C) (mg/L) | 1 |
| 4 | Residual Chlorine (mg/L) | 0.2 |
| 5 | Fecal Coliform (MPN INDEX/100 mL) | 1.8 |

| Stack Parameters | | |
|---|---|---|
| **Sr.No.** | **Test Parameter** | **MDL** |
| 1 | Particulate Matter ($mg/Nm^3$) | 10 |
| 2 | Sulphur Dioxide (ppm) | 1.52 |
| 3 | Oxides of Nitrogen (ppm) | 2.65 |
| 4 | Carbon Monoxide ($mg/Nm^3$) | 0.1 |
| 5 | Haydro Carbon NMHC (ppm) | 1.0 |

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# ENVIRONMENTAL MONITORING REPORT

## AMBIENT AIR QUALITY, STACK EMISSION, WATER QUALITY AND NOISE MONITORING

**Period: October 2018 - December 2018**

**For**

**M/S. ADANI POWER (MUNDRA) LIMITED**

**At**
**Tunda & Siracha,**
**Tal. Mundra, Dist.: Kutch.**
**KUTCH, GUJARAT – 370 435**

**Prepared By:**

UniStar Environment & Research Labs Pvt. Ltd.

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| QUALITY CONTROL | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Name of Publication** | Environmental Quality Monitoring Report for the Quarter October 2018 - December 2018 | | | | | | |
| **Project Number** | 03 | **Report No.** | UERL/ENV/OCT/ 10-12/2018 | **Version** | 1 | **Released** | January 2019 |
| **Project Coordinator** | Mr. Bhavin Patel | | | | | | |
| **Prepared By** | Miss. Shweta A. Rana | | | | | | |
| **Checked By** | Mr. Jaivik Tandel | | | | | | |
| **DISCLAIMER** | | | | | | | |
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**FOR**
**UniStar Environment and**
**Research Labs Pvt. Ltd.**

**Mr. Jaivik Tandel**
**(Authorized By)**

UNISTAR ENVIRONMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI

## CONTENTS

LIST OF GRAPHS

## EXECUTIVE SUMMARY

Adani Power (Mundra) Limited (APMuL) has total generation capacity of 4620MW in phased manner at Mundra Thermal (coal Based) Power Plant near Village Tunda in Mundra, District Kutch, and Gujarat. The phased wise development being undertaken for ultimate capacity of power plant is shown below.

- First Phase : 2 x 330 MW
- Second Phase : 2 x 330 MW + 2 x 660 MW
- Third Phase : 3 x 660 MW

The Thermal Power Plant is located near Village Tunda, Mundra Taluka in Kutch District. The Site is closed to the sea, making cooling water perennially available for the power plant. The Power Plant is based on supercritical technology using imported coal.

All three phase of the power plant is operational and as the part of the compliance to the statutory requirement, M/s. Adani Power (Mundra) Limited has entrusted the environmental quality monitoring study for the area surrounding the power plant. Adani Power (Mundra) Limited Implemented ISO-14001:2015 Environment Management System (EMS) and Accreditation of NABL in Environmental Laboratory (ISO/IEC 17025:2005) dated: 09.02.2017 vide Certificate No. TC-5215.

Various environmental parameters have been monitored during the period of October 2018-December 2018.The detail of the environmental parameters along with frequency of monitoring is shown in subsequent sections.

## 1. ENVIRONMENTAL PARAMETERS

| Sr. No. | Environmental Indices | Parameter | No. of Location and Monitoring. | Frequency of Sampling |
|---|---|---|---|---|
| 1. | Ambient Air Quality | $PM_{10}$, $PM_{2.5}$, Sulphur Dioxide and Nitrogen Dioxide | Three Location | Twice a week |
| 2. | Ambient Air Quality | $PM_{10}$, $PM_{2.5}$, Sulphur Dioxide, Nitrogen Dioxide, Ozone and Mercury | Two Location | Once in a month |
| 3. | Stack Monitoring | PM, Sulphur Dioxide, Oxide of Nitrogen and Hg | Nine Location | Once in a month |
| 4. | Meteorological Monitoring | Wind rose, Wind speed, Wind direction, Rainfall, Temperature, Relative Humidity | One location | Round the clock |
| 5. | Surrounding Villages Ground Water Analysis | Colour, Odour, Taste, Turbidity, Dissolved Solids, pH value, Total Hardness, Calcium, Boron, Copper, Iron, Manganese, Chloride, Sulphate, Nitrate, Fluoride, Phenolic Compounds, Mercury, Cadmium, Selenium, Arsenic, Cyanide, Lead, Zinc, Anionic Detergents as MBAS, Chromium Cr+6, Mineral Oil, MPN Index for Coliform Bacteria per 100 ml, Residual Free Chlorine, Aluminium, Alkalinity, Magnesium as Mg, Escherichia Coli in 250 ml. | Five Location | Once in Quarter |
| 6. | Effluent Water Sample | pH, Temperature, colour, SS, O & G, BOD3, COD, Chlorides, TDS, Sulphates, Ammonical Nitrogen, % Sodium, Sodium Absorption Ratio, Sulphides, Total Chromium, Hexavalent Chromium, Copper, Lead, Zinc, Free available chlorine, Phosphate, Iron | Four Location | Once in a month / Quarter |
| 7. | STP Water Analysis | pH, Residual Chlorine, SS, BOD, COD, Faecal coliform | Three Location | Once in month/ Quarter |
| 8. | Borwell water Near Ash Dyke Area | pH @ 25 ° C, Conductivity (µS), Chloride as $Cl^-$ Salinity (ppt), Total Dissolved Solids, Carbonate as CaCO3, Bicarbonate as CaCO3, Mercury as Hg,Arsenic as As, Lead as Pb, Chromium as Cr, Cadmium as Cd. | Four Location | Once in a Quarter |
| 9. | Surrounding Villages Soil Analysis | Magnesium as Mg %, Molybdenium as Mo in ppm, Phosphorus as P %, Calcium as Ca %, Zinc as Zn, Manganese as Mn, Potassium as K%, Nitrogen as N%, Iron as Fe%, Copper as Cu, Boron as B, Sulphurin %, Chloride as Cl%. | Five Location | Once in Six Month |
| 10. | Noise Level Monitoring | Noise level monitoring in dB(A) | 10 Location | Once in a Quarter |

## 1.1 AMBIENT AIR QUALITY

The scenario of the Ambient Air Quality in the study region has been assessed through a network of 5locations of Ambient Air Quality Monitoring. The design of monitoring network in the air quality surveillance program was based on the following considerations.

- Topography / Terrain of the study area.
- Human Settlements
- Wind pattern
- Health status
- Representation of regional Background levels.
- Accessibility of monitoring site.
- Resource availability.

Pre-calibrated Respirable Dust Samplers ($PM_{10}$) & Fine Dust Samplers ($PM_{2.5}$) have been used for monitoring the existing AAQM Status. Maximum, Minimum, Average, Standard Deviation and percentile have been computed from the raw data collected at all individual sampling stations to represents the Ambient Air Quality Status.

The significant parameters viz., $PM_{10}$, $PM_{2.5}$, Sulphur Dioxide ($SO_2$) and Oxides of Nitrogen ($NO_2$) and Mercury were monitored within the study area of 5 km from the site.

## 1.2 FLUE GAS MONITORING

All three phases of the Thermal Power Plant is in operation. The flue gas emission from stack attached to individual boiler is monitored once in month during the monitoring period.

## 1.3 WATER QUALITY MONITORING

The water quality parameters as per IS: 10500 for water resource within the study area have been used for describing the water environment and assessing the impacts on it.

Groundwater samples of nearby villages were collected at five locations the parameters of prime importance selected under physicochemical characteristics were estimated to describe the baseline environmental status of the water resources during the monitoring period. Four bore well samples surrounding the ash dyke area were collected during the month of October2018 along with outfall water sample.

## 1.4 AMBIENT NOISE LEVEL MONITORING

The Ambient Noise levels within the plant premises were relocated at a different location (10 nos.) For the implementation of effective noise control programs.

## 1.5 MICROMETEOROLOGY

Meteorological parameters are important factors in the study of Air Pollution. The Transport and diffusion of the pollutants in the atmosphere are governed by meteorological factors.

Primary / Basic Meteorological Parameters

- Wind Velocity
- Wind Direction

Since the dispersion and diffusion of pollutants mainly depend on the above factors hence these factors are considered as primary meteorological parameters.

Secondary Meteorological Parameters

- Relative Humidity
- Ambient Temperature

The above-said factors are considered as secondary factors since these factors control the dispersion of the pollutant indirectly by affecting the primary factors.

### 1.5.1 Wind Rose Diagram

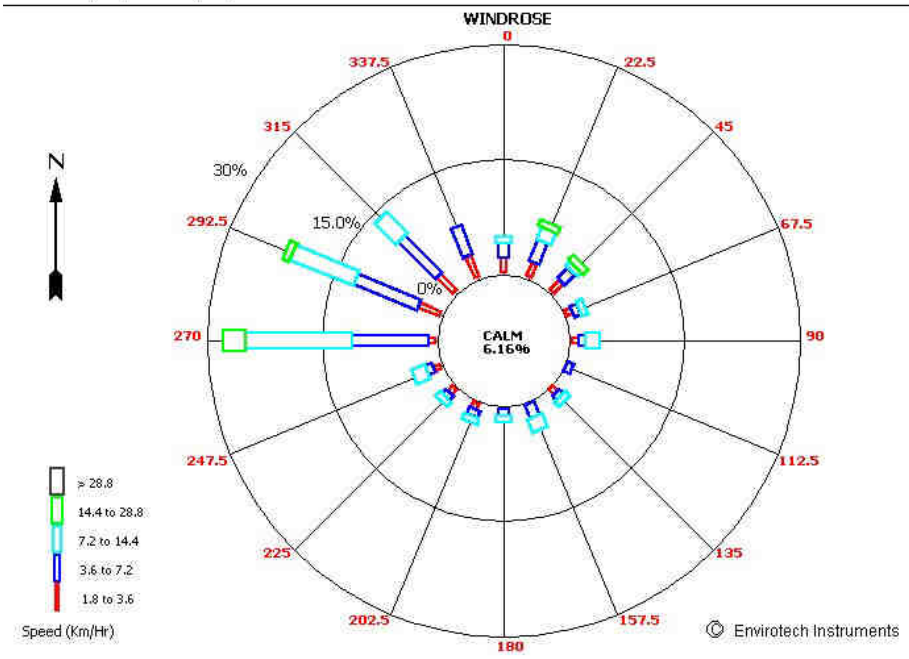
| | | | | | |
|---|---|---|---|---|---|
| **Project** | : | **Adani Power (Mundra) Limited (APMuL)** | **Period** | : | October2018 to December2018 |
| **Location** | : | **Village – Tunda, Dist. - Kutch** | | | |

| | |
|---|---|
| **Wind Direction** | **NE** |
| **Average Wind Speed** | **6.1 km/hr.** |
| **Percentage Occurrence of Calm Winds (<1.7 Km/Hr)** | **9.82 %** |

**ADANI POWER (MUNDRA) LIMITED – MUNDRA WINDROSE FOR THE SEASON OF Oct to Dec. 2018**

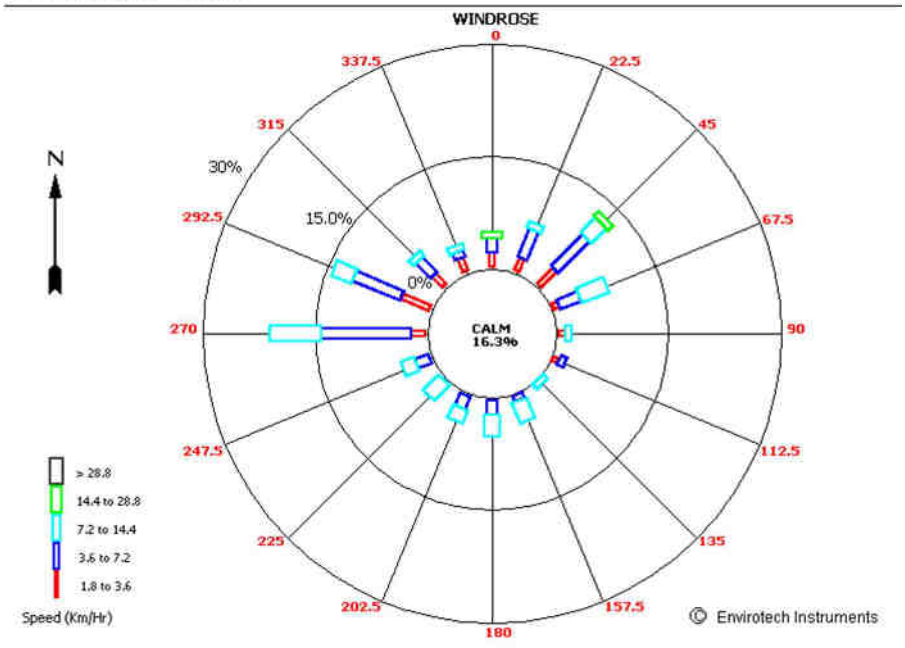
Time : 00:00 - 23:00
Date : 01/10/18 - 31/10/18

Adani Power (Mundra) Limited



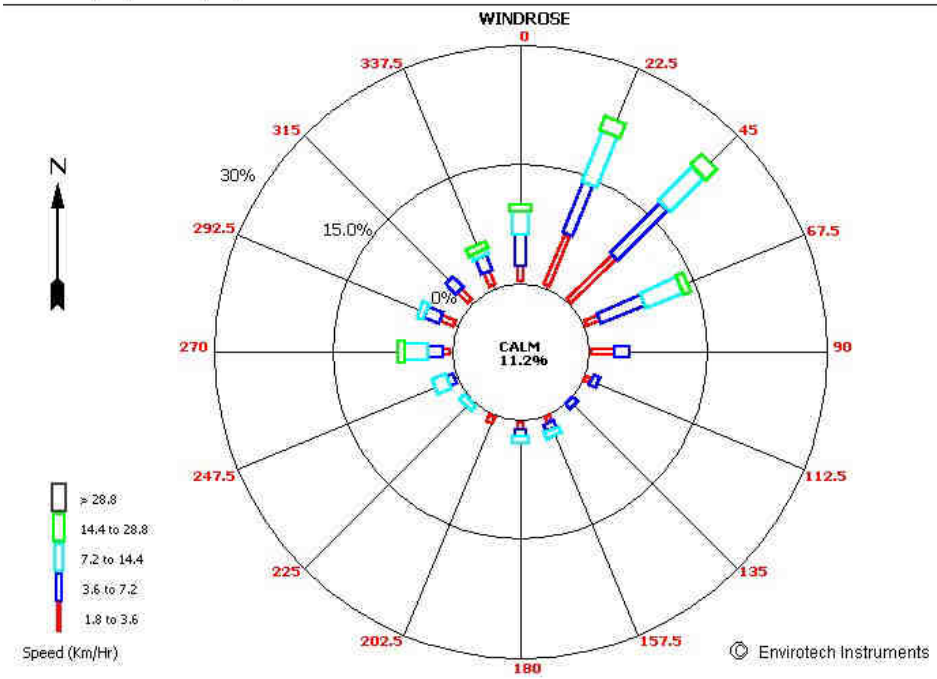

Time : 00:00 - 23:00
Date : 02/11/18 - 30/11/18

ADANI POWER (MUNDRA) LIMITED



Time : 00:00 - 23:00
Date : 01/12/18 - 31/12/18

ADANI POWER (MUNDRA) LIMITED



## 2 SCOPE & METHODOLOGY ADOPTED FOR ENVIRONMENTAL MONITORING

### 2.1 Introduction

The scope of the study includes detailed characterization of various environmental like air, water and noise within an area of 5 km radius in and around the power plant area at pump house, erector house, and surrounding villages named as Siracha, Wandh and Kandagara of Dist. Kutch.

The above mentioned environmental components were monitored at the study area and frequency of monitoring, number of samples along with methodology is as shown in below table.

### 2.2 Scope and Methodology for Monitoring of Various Environmental Attributes

| Sr. No | Environmental Attributes | Sampling Locations | Sampling Parameters | Sampling Frequency | Total No of samples | Methodology |
|---|---|---|---|---|---|---|
| 1 | Ambient Air Quality | 5 | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$,$O_3$, Mercury | Twice a week (24 hourly Samples) | 120 | IS : 5182 & Reference APHA(AIR) |
| 2 | Flue Gas Stack Analysis | Unit 1 to 9 Boiler | PM, $SO_2$, NOx | Once in month | 27 | As per IS : 11255 |
| 3 | Surrounding Villages Ground Water Analysis | 5 water sample | Test specification as per IS : 10500 - 1991 | Once in Quarter | 5 | AS per APHA Method |
| 4 | Water Quality of Intake & Outfall for APMuL | 1 | As per CTO | Once in month | 6 | As Per APHA Method |
| 5 | STP Outlet | 1 | As per CTO | Once in month | 3 | As Per APHA Method |
| 6 | Bore well water Near Ash Dyke Area | 4 | Test specification as per IS : 10500 - 1991 | Once in Quarter | 4 | As Per APHA Method |
| 7 | Cooling Tower Blow down Water Sample | 9 | As per CTO | Once in Half yearly | 9 | As Per APHA Method |
| 8 | Condensate Cooling Tower Water Sample | 9 | As per CTO | Once in Half yearly | 9 | As Per APHA Method |

# 3 ENVIRONMENAT AIR QUALITY AND FLUE GAS MONITORING

The principle objective of the ambient air quality was to assess the existing levels of the air pollution as well as the regional background concentration in the plant area. Air pollution forms important and critical factors to study the environmental issues in the study areas. Thus, air quality has to be frequently monitored to know the extent of pollution due to power plant activity and other ancillary activities.

Flue gas monitoring analysis has been conducted by UniStar Environment and Research Labs Pvt. Ltd. Details are provided in Section 3.2.

## 3.1 Ambient Air Monitoring Data

### 3.1.1 Details of Ambient Air Quality Monitoring Stations

The detail of the ambient air monitoring locations including the distance from the project site with direction is as shown below.

| S.No. | Code | Name of sampling location | Distance |
|---|---|---|---|
| 1 | A - 1 | Nr.20 MLD Plant | 0 Km |
| 2 | A - 2 | Nr. Shantiniketan-1 | 0 Km |
| 3 | A - 3 | Kandagara Village | 3 km (NW) |
| 4 | A - 4 | Siracha Village | 3.5 km (NE) |
| 5 | A - 5 | Wandh Village | 3.0 km (SW) |

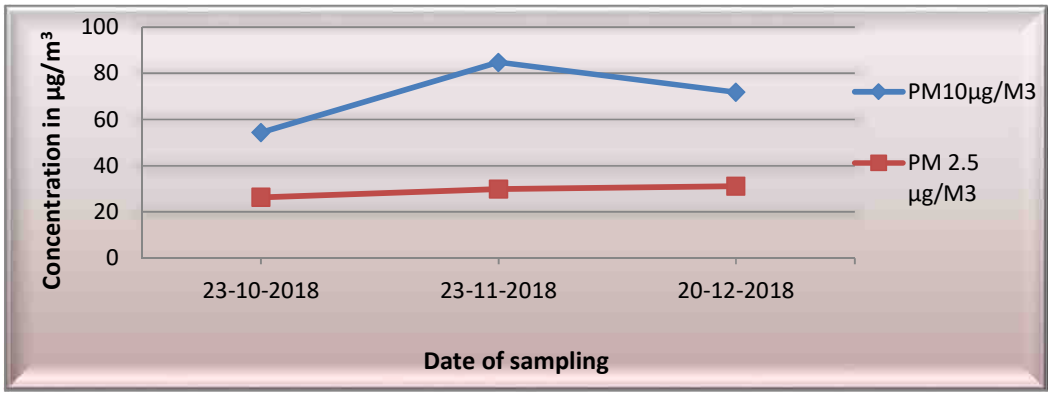
### 3.1.2 Location: Nr.20 MLD Plant

The Sampling station was located in the core zone in Company premises. The Respirable Dust Sampler ($PM_{10}$) & ($PM_{2.5}$) Sampler were placed at a height of 3 m above the ground level. Assess present pollution level the observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during monitoring period (October2018–December 2018) are as follows:

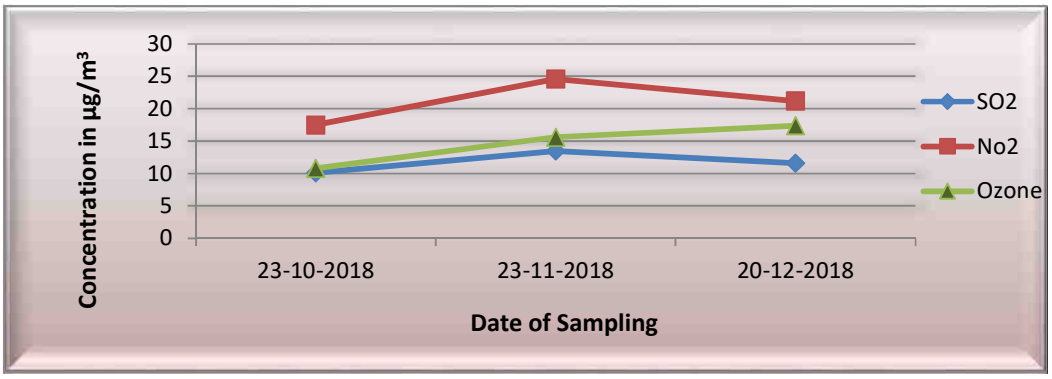
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 84.8 | 31.2 | 13.5 | 24.6 | 17.4 |
| Minimum Value | 54.4 | 26.4 | 10.1 | 17.5 | 10.8 |
| Average Value | 70.3 | 29.2 | 11.7 | 21.1 | 14.6 |
| Standard Deviation | 15.3 | 2.5 | 1.7 | 3.6 | 3.4 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: $\mu g/m^3$

**Graph 1 : Particulate Matter Level Nr.20 MLD Plant**




**Graph 2: SO2, NO2 and $O_3$ Nr.20 MLD Plant**



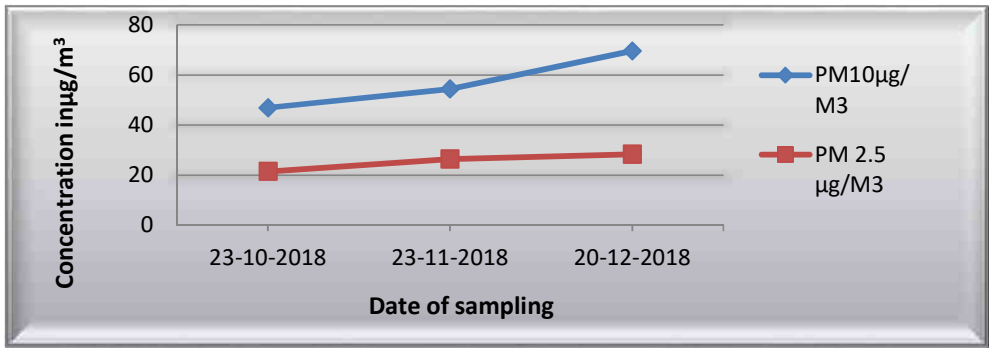
### 3.1.3 Location: Nr. Shantiniketan-1

The Sampling station was located in the core zone in company premises. The Respirable Dust Sampler$PM_{10}$ & $PM_{2.5}$Sampler were placed at a height of 3 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during monitoring period (October2018–December 2018) are as follows

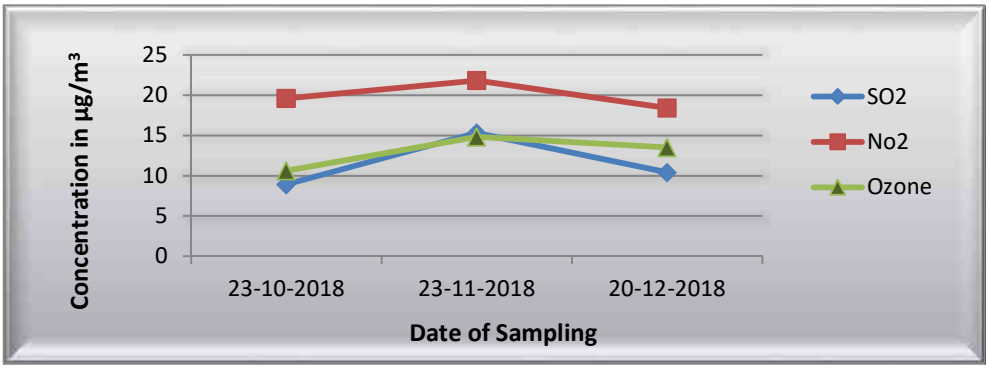
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 69.6 | 28.3 | 15.3 | 21.8 | 14.8 |
| Minimum Value | 46.9 | 21.5 | 8.9 | 18.4 | 10.6 |
| Average Value | 57.0 | 25.4 | 11.5 | 19.9 | 12.9 |
| Standard Deviation | 11.6 | 3.5 | 3.3 | 1.7 | 2.1 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: µg/$m^3$

**Graph 3: Particulate Matter Level Nr. Shantiniketan-1**




**Graph 4 : SO2, NO2 and $O_3$ Nr. Shantiniketan-1**



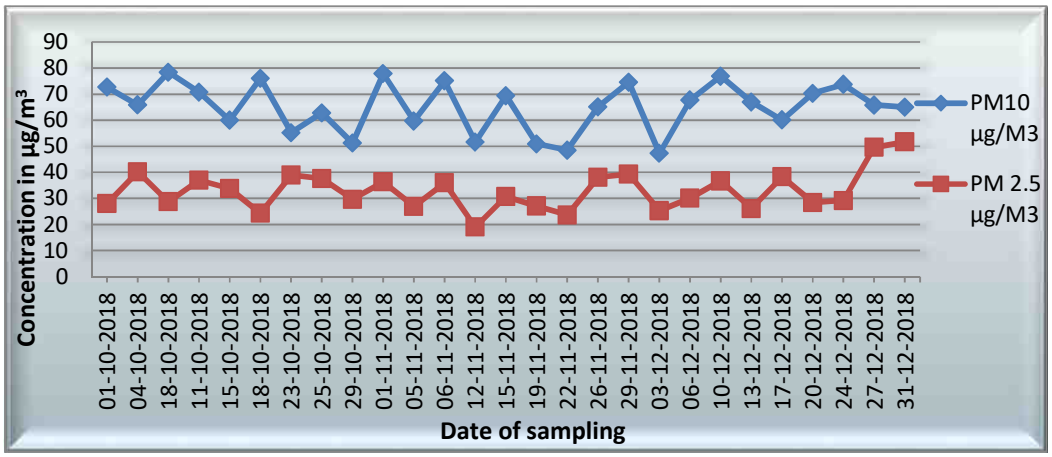
### 3.1.4 Location: Kandagara Village

The Sampling station was located in the core zone. The Station is located at about 3 km away in Northwest Direction from the Company premises. The Respirable Dust Sampler ($PM_{10}$) & $PM_{2.5}$Sampler were placed at a height of 1.5 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during the monitoring period (October2018–December 2018) are as follows.

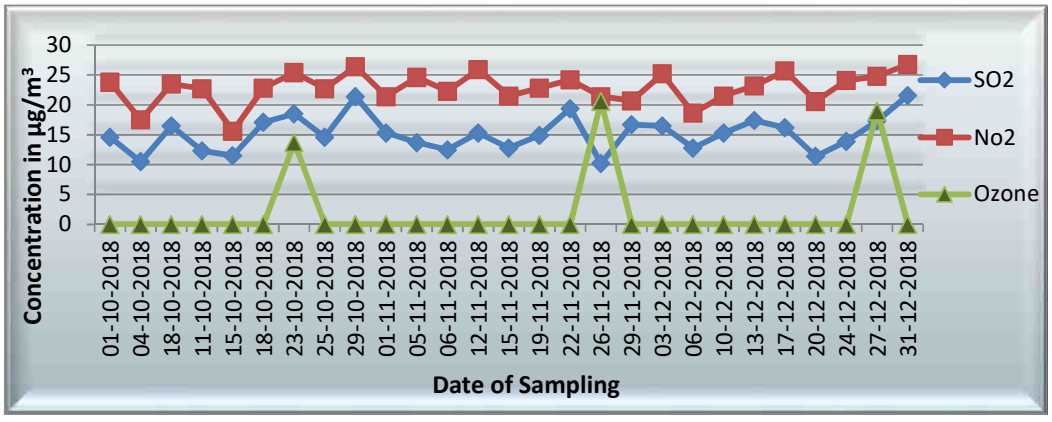
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 78.4 | 51.7 | 21.6 | 26.8 | 20.6 |
| Minimum Value | 47.3 | 19 | 10.2 | 15.6 | 0 |
| Average Value | 65.2 | 33.0 | 15.2 | 22.8 | 1.9 |
| Standard Deviation | 9.5 | 7.6 | 3.0 | 2.7 | 5.7 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: µg/m$^3$

**Graph 5: Particulate Matter Level Kandagara Village**




**Graph 6 : SO2, NO2 and $O_3$ Level Kandagara Village**



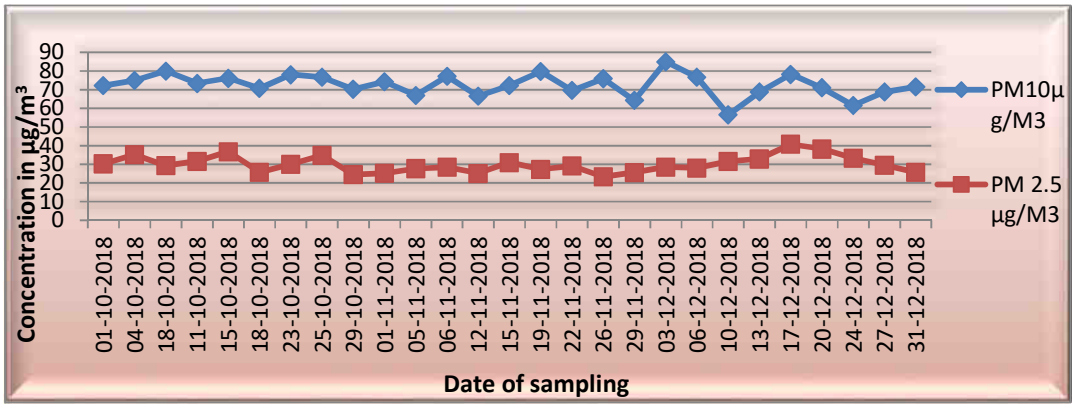
### 3.1.5 Location: Siracha Village

The Sampling station was located in the Siracha village. The Station is located at about 3.5 km away in Northwest Direction from the core zone area. The Respirable Dust Sampler & $PM_{2.5}$ was placed at a height of 3.0 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during the monitoring period (October2018–December 2018) are as follows.

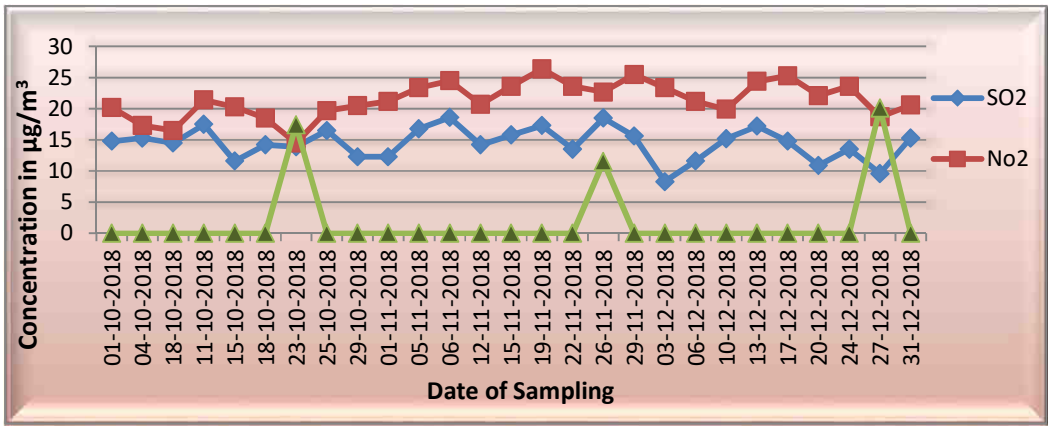
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 85 | 40.8 | 18.6 | 26.4 | 20.1 |
| Minimum Value | 56.6 | 23.4 | 8.3 | 14.5 | 0 |
| Average Value | 72.5 | 30.0 | 14.4 | 21.5 | 1.8 |
| Standard Deviation | 6.1 | 4.4 | 2.6 | 2.9 | 5.3 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units:$\mu g/m^3$

**Graph 7 : Particulate Matter Level Siracha Village**




**Graph 8 : $SO_2$, $NO_2$ and $O_3$ Level Siracha Village**



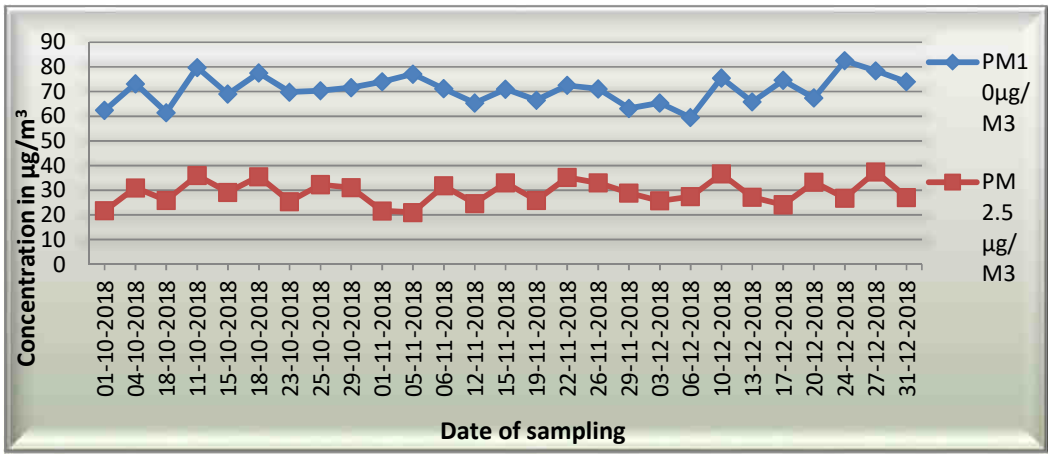
### 3.1.6 Location: Wandh Village

The Sampling station was located in the core zone in Wandh village. The Station is located at about 3.0 km away in Southwest Direction from the Company premises. The Respirable Dust Sampler Was placed at a height of 3.0 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during the monitoring period (October2018–December 2018) are as follows.

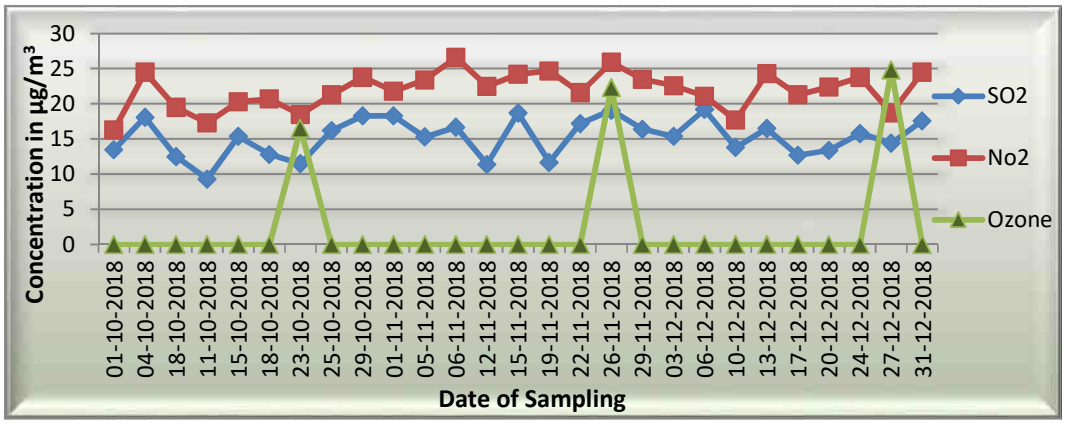
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 82.5 | 37.5 | 19.2 | 26.6 | 24.8 |
| Minimum Value | 59.5 | 21 | 9.3 | 16.3 | 0 |
| Average Value | 70.7 | 29.2 | 15.2 | 22.0 | 2.3 |
| Standard Deviation | 5.8 | 4.8 | 2.7 | 2.7 | 6.8 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: $\mu g/m^3$

**Graph 9 : Particulate Matter Level Wandh Village**




**Graph 10 : $SO_2$, $NO_2$ and $O_3$ Level Wandh Village**



### 3.1.7 Ambient Air Quality Monitoring (Parameters- Mercury & Ozone)

| Location | October -18 | | | November-18 | | | December-18 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Date | Ozone ($O_3$) µg/m3 | Mercury (Hg) µg/m3 | Date | Ozone ($O_3$) µg/m3 | Mercury (Hg) µg/m3 | Date | Ozone ($O_3$) µg/m3 | Mercury (Hg) µg/m3 |
| **Village Kandagara** | 22.10.18 | 13.7 | BDL | 26.11.18 | 20.6 | BDL | 27.12.18 | 18.9 | BDL |
| **Village Wandh** | 24.10.18 | 16.5 | BDL | 26.11.18 | 22.3 | BDL | 27.12.18 | 24.8 | BDL |
| **Village Siracha** | 23.10.18 | 17.4 | BDL | 26.11.18 | 11.5 | BDL | 27.12.18 | 20.1 | BDL |
| **Nr. 20 MLD Plant** | 23.10.18 | 10.8 | BDL | 23.11.18 | 15.6 | BDL | 20.12.18 | 17.4 | BDL |
| **Nr. Shantiniketan-1** | 23.10.18 | 10.6 | BDL | 23.11.18 | 14.8 | BDL | 20.12.18 | 13.5 | BDL |

**Remark**: Calibrated equipment & instruments were used during monitoring & analysis of above identified sample.

**Analysis Method Reference :**

Hg : AAS by VGA Method -3112 B APHA 22 Edition : BDL Limit **Hg** : 2 ppb

$O_3$ : IS - 5182 (part 9) 2009 Ozone BDL limit: 5 µg/$m^3$

### 3.2 Flue Gas Monitoring Data

ISO kinetic Stack monitoring has been carried out by UniStar environment & Research Pvt. Ltd.

| Date | Location | PM in mg/Nm$^3$ | $SO_2$ in mg/ Nm$^3$ | $NO_x$ in mg/ Nm$^3$ |
|---|---|---|---|---|
| 08-10-2018 | Boiler (Unit - 1) | 44.3 | 695.3 | 306.8 |
| 01-11-2018 | Boiler (Unit - 1) | 41.1 | 799 | 290.2 |
| 06-12-2018 | Boiler (Unit - 1) | 45.7 | 570.4 | 282.8 |
| 08-10-2018 | Boiler (Unit - 2) | 31.5 | 735.6 | 281.4 |
| 01-11-2018 | Boiler (Unit - 2) | 43 | 843.8 | 298 |
| 06-12-2018 | Boiler (Unit - 2) | 40.2 | 698.3 | 306 |
| 09-10-2018 | Boiler (Unit - 3) | 41.4 | 842.4 | 319.7 |
| 05-11-2018 | Boiler (Unit - 3) | 37.6 | 629.9 | 279.6 |
| 07-12-2018 | Boiler (Unit - 3) | 35.9 | 765.8 | 324.7 |
| 09-10-2018 | Boiler (Unit - 4) | 36.5 | 728.4 | 334.2 |
| 05-11-2018 | Boiler (Unit - 4) | 33.3 | 778.7 | 308.7 |
| 07-12-2018 | Boiler (Unit - 4) | 38.7 | 789.4 | 297.7 |
| 08-12-2018 | Boiler (Unit - 5) | 36.9 | 651.9 | 283.9 |
| 08-12-2018 | Boiler (Unit - 6) | 38.2 | 557.7 | 263.8 |
| 15-10-2018 | Boiler (Unit - 7) | 39.4 | 153.8 | 294.8 |
| 24-11-2018 | Boiler (Unit - 7) | 31.4 | 163.8 | 220.1 |
| 24-12-2018 | Boiler (Unit - 7) | 34.6 | 172.1 | 307.4 |
| 15-10-2018 | Boiler (Unit - 8) | 32.8 | 166.4 | 339.4 |
| 24-11-2018 | Boiler (Unit - 8) | 37.2 | 169.4 | 264.7 |
| 24-12-2018 | Boiler (Unit -8) | 38.1 | 140.1 | 285.4 |
| 15-10-2018 | Boiler (Unit - 9) | 42.7 | 144.5 | 286.7 |
| 24-12-2018 | Boiler (Unit - 9) | 34.9 | 154.3 | 257.9 |
| **Permissible Limits** | | **50** | **<500 MWH-600<br>>500 MWH-200** | **300** |

## 3.3 Water Quality Monitoring

**3.3.1 Location: Tunda Village Water Sample** **DATE: 17/10/2018**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.28 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odor | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 88.2 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 15.7 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 11.9 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1504 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 435.1 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 541.3 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 196.1 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 2.7 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.30 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.72 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 08 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.2 Location: Kandagara Village Water Sample** **DATE: 17/10/2018**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.21 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odor | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 117.6 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 23.6 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 14.3 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1740 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 544.4 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 517.8 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 142.2 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 3.8 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.34 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.75 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | N.D.(MDL:0.001) |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | N.D. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | N.D.(MDL:0.01) |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | N.D. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | N.D.(MDL:0.003) |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | N.D. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | N.D.(MDL:0.1) |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | N.D. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | N.D. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | N.D. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | N.D.(MDL:0.001) |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 06 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.3Location: Siracha Village Water Sample** **DATE: 17/10/2018**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.18 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odour | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 372.4 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 58.9 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 54.8 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1820 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 343.8 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 530.1 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 231.8 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 1.6 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.36 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.84 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 08 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.4 Location: Navinal Village Water Sample** **DATE: 17/10/2018**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.09 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Colour | Pt-Co | 10 | 5 | 15 |
| 3 | Odour | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 176.4 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 27.5 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 26.2 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1764 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 568.2 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 494.0 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 184.0 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 3.4 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.34 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.82 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 08 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.5Location: Desalpur Village Water Sample** **DATE: 17/10/2018**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 7.90 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odor | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 215.6 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 31.4 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 33.3 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1680 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 482.3 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 483.8 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 196.8 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 3.1 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.36 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.85 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 10 | 100 CFU/ml | 100 CFU/ml |

Note: Colour = 1(10) = 10 APHA, BDL= Below Detection Limit. N.D. = Not Detected

## 3.4 Water Quality Monitoring – Plant area

### 3.4.1 Location: Outfall Channel

| Sr. No. | Parameter | Unit | Date of sampling | | |
|---|---|---|---|---|---|
| | | | 11/10/2018 | 19/11/2018 | 04/12/2018 |
| 1 | pH @ 25 | -- | 7.36 | 7.28 | 7.36 |
| 2 | Temperature | $^0$C ( Intake) | 30.5 | 29.0 | 26.5 |
| | | $^0$C ( Outfall) | 33.5 | 30.5 | 29.5 |
| | | $^0$C ( Differential) | 3.0 | 2.5 | 3.0 |
| 3 | Color | Pt. CO. Scale | 20 | 20 | 20 |
| 4 | Total Suspended Solids | mg/L | 16 | 14 | 10 |
| 5 | Oil & Grease | mg/L | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) |
| 6 | Ammonical Nitrogen | mg/L | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) |
| 7 | Sulphide as S-2 | mg/L | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 8 | Total Chromium | mg/L | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 9 | Hexavalent Chromium as Cr+6 | mg/L | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 10 | Phosphate as $PO_4$ | mg/L | 0.27 | 0.29 | 0.22 |
| 11 | Lead as Pb | mg/L | 0.016 | 0.012 | 0.018 |
| 12 | Copper as Cu | mg/L | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 13 | Zinc as Zn | mg/L | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 14 | Iron (as Fe) | mg/L | 0.193 | 0.202 | 0.186 |
| 15 | Chemical Oxygen Demand(COD) | mg/L | 69.1 | 61.4 | 54.2 |
| 16 | Biochemical Oxygen Demand (BOD) | mg/L | 16 | 14 | 17 |

Note:BDL= Below Detection Limit. N.D. = Not Detected

### 3.4.2 Location: STP Outlet Water Sample;

| Sr. No. | Parameter | Unit | SPCB Limit | Date of sampling | | |
|---|---|---|---|---|---|---|
| | | | | 11/10/2018 | 19/11/2018 | 04/12/2018 |
| 1 | pH @ 25 ° C | -- | **6.5-8.5** | 7.92 | 7.96 | 7.74 |
| 2 | Total Suspended Solids | mg/L | **30** | 22 | 26 | 22 |
| 3 | Residual Chlorine | mg/L | **0.5 Min.** | 0.61 | 0.67 | 0.71 |
| 4 | Biochemical Oxygen Demand (BOD) | mg/L | **20** | 12 | 15 | 13 |
| 5 | Fecal Coliform | CFU/100 ml | **<1000** | 78 | 70 | 66 |

**3.4.3 Location: ETP Outlet Water Sample;**

| S.N | Parameter | Unit | SPCB Limit | Date of sampling | | |
|---|---|---|---|---|---|---|
| | | | | 11/10/2018 | 19/11/2018 | 04/12/2018 |
| 1 | pH @ 25 | -- | **6.5 – 8.5** | 7.42 | 7.51 | 7.42 |
| 2 | Temperature | ° C | **40 Max.** | 32 | 31 | 30 |
| 3 | Color | Pt. CO. Scale | **100 Max.** | 40 | 40 | 40 |
| 4 | Total Suspended Solids | mg/L | **100 Max.** | 10 | 14 | 10 |
| 5 | Oil & Grease | mg/L | **10 Max.** | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) |
| 6 | Chemical Oxygen Demand (COD) | mg/L | **100 Max.** | 15.1 | 21.3 | 38.3 |
| 7 | Biochemical Oxygen Demand (BOD) | mg/L | **30 Max.** | 4 | 6 | 12 |
| 8 | Chloride as $Cl^-$ | mg/L | **600 Max.** | 397.1 | 425.5 | 447.3 |
| 9 | Total Dissolved Solids | mg/L | **2100 Max.** | 1342 | 1562 | 1344 |
| 10 | Sulphate as $SO_4$ | mg/L | **1000 Max.** | 51.1 | 69.3 | 82.1 |
| 11 | Ammonical Nitrogen | mg/L | **50 Max.** | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) |
| 12 | % Sodium(Na) | mg/L | **60 Max.** | 45.2 | 47.1 | 49.6 |
| 13 | Sodium Absorption Ratio(SAR) | mg/L | **26 Max.** | 8.7 | 10.3 | 12.5 |
| 14 | Sulphide as $S^{-2}$ | mg/L | **02 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 15 | Total Chromium | mg/L | **02 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 16 | Hexavalent Chromium as Cr+6 | mg/L | **0.1 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 17 | Phosphate as $PO_4$ | mg/L | **5.0 Max.** | BDL(MDL:0.1) | BDL(MDL:0.1) | BDL(MDL:0.1) |
| 18 | Copper as Cu | mg/L | **03 Max.** | 0.052 | 0.063 | 0.078 |
| 19 | Lead as Pb | mg/L | **0.1 Max.** | 0.055 | 0.071 | 0.086 |
| 20 | Zinc as Zn | mg/L | **05 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 21 | Residual Free Chlorine | mg/L | **0.5 Max.** | BDL(MDL:0.2) | BDL(MDL:0.2) | BDL(MDL:0.2) |
| 22 | Iron (as Fe) | mg/L | **1.0 Max.** | BDL(MDL:0.1) | BDL(MDL:0.1) | BDL(MDL:0.1) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.4Location: Bore-well – 1(Nr. Emergency Ash Pond)** **Date: 16/10/2018**

| Sr.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 7.99 |
| 2 | Conductivity (µS) | - | 16008 |
| 3 | Chloride as $Cl^-$ | mg/L | 4483 |
| 4 | Salinity (ppt) | mg/L | 8.1 |
| 5 | Total Dissolved Solids | mg/L | 10245.0 |
| 6 | Carbonate as CaCO3 | mg/L | 27.6 |
| 7 | Bicarbonate as CaCO3 | mg/L | 145.6 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | 0.082 |
| 13 | Iron (as Fe) | mg/L | 0.892 |
| 14 | Zinc (as Zn) | mg/L | 0.228 |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.5Location: Bore-well – 2(Nr. Emergency Ash Pond)** **Date: 16/10/2018**

| S.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 8.05 |
| 2 | Conductivity (µS) | - | 17225 |
| 3 | Chloride as $Cl^-$ | mg/L | 4262 |
| 4 | Salinity (ppt) | mg/L | 7.7 |
| 5 | Total Dissolved Solids | mg/L | 11024 |
| 6 | Carbonate as CaCO3 | mg/L | 40.1 |
| 7 | Bicarbonate as CaCO3 | mg/L | 116.5 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | BDL(MDL:0.01) |
| 13 | Iron (as Fe) | mg/L | BDL(MDL:0.003) |
| 14 | Zinc (as Zn) | mg/L | BDL(MDL:0.01) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.6Location: Bore-well – 3 (Nr. Emergency Ash Pond)** **Date: 16/10/2018**

| Sr.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 7.89 |
| 2 | Conductivity (µS) | - | 14602 |
| 3 | Chloride as $Cl^-$ | mg/L | 4317 |
| 4 | Salinity (ppt) | mg/L | 7.8 |
| 5 | Total Dissolved Solids | mg/L | 9345 |
| 6 | Carbonate as CaCO3 | mg/L | 28.7 |
| 7 | Bicarbonate as CaCO3 | mg/L | 104.9 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | BDL(MDL:0.01) |
| 13 | Iron (as Fe) | mg/L | BDL(MDL:0.003) |
| 14 | Zinc (as Zn) | mg/L | BDL(MDL:0.01) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.7 Location: Bore-well – 4(Nr. Emergency Ash Pond)** **Date: 16/10/2018**

| Sr.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 8.08 |
| 2 | Conductivity (µS) | - | 16164 |
| 3 | Chloride as $Cl^-$ | mg/L | 4649 |
| 4 | Salinity (ppt) | mg/L | 8.4 |
| 5 | Total Dissolved Solids | mg/L | 10345 |
| 6 | Carbonate as CaCO3 | mg/L | 21.7 |
| 7 | Bicarbonate as CaCO3 | mg/L | 148.4 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | BDL(MDL:0.01) |
| 13 | Iron (as Fe) | mg/L | BDL(MDL:0.003) |
| 14 | Zinc (as Zn) | mg/L | BDL(MDL:0.01) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

### 3.4.8 Location: Cooling Tower Blow down Water Sample

| S.No. | Parameter | Unit | Limit | Results | | | |
|---|---|---|---|---|---|---|---|
| | | | | Unit-1 | Unit-2 | Unit-3 | Unit-4 |
| Date of Sampling ⟹ | | | | 04/12/2018 | 04/12/2018 | 04/12/2018 | 04/12/2018 |
| 1 | pH @ 25 ° C | -- | - | 8.02 | 8.14 | 8.05 | 8.12 |
| 2 | Free available Chlorine | ° C | Min. 0.5 | 0.65 | 0.71 | 0.74 | 0.74 |
| 3 | Zinc as Zn | Pt. CO. Scale | 1.0 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 4 | Hexavalent Chromium as Cr+6 | mg/L | 0.1 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 5 | Total Chromium as Cr | mg/L | 0.2 | 0.062 | 0.059 | 0.067 | 0.069 |
| 6 | Phosphate as P | mg/L | 5.0 | 0.47 | 0.63 | 0.65 | 0.63 |

| S.No. | Parameter | Unit | Limit | Results | | | |
|---|---|---|---|---|---|---|---|
| | | | | Unit-5 | Unit-6 | Unit-7 | Unit-8 |
| Date of Sampling ⟹ | | | | 04/12/2018 | 04/12/2018 | 04/12/2018 | 04/12/2018 |
| 1 | pH @ 25 ° C | -- | - | 8.09 | 8.08 | 8.10 | 8.08 |
| 2 | Free available Chlorine | ° C | Min. 0.5 | 0.72 | 0.75 | 0.79 | 0.74 |
| 3 | Zinc as Zn | Pt. CO. Scale | 1.0 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 4 | Hexavalent Chromium as Cr+6 | mg/L | 0.1 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 5 | Total Chromium as Cr | mg/L | 0.2 | 0.051 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 6 | Phosphate as P | mg/L | 5.0 | 0.43 | 0.42 | 0.56 | 0.53 |

### 3.4.9 Location: Condensate Cooling Tower Water Sample

| S.No. | Parameter | Unit | Limit | Results | | | |
|---|---|---|---|---|---|---|---|
| | | | | Unit-1 | Unit-2 | Unit-3 | Unit-4 |
| Date of Sampling ⟹ | | | | 04/12/2018 | 04/12/2018 | 04/12/2018 | 04/12/2018 |
| 1 | pH @ 25 ° C | -- | **6.5 to 8.5** | 8.11 | 8.02 | 8.05 | 8.06 |
| 2 | Temperature $^0$C ( Intake) | $^0$C | -- | 30.6 | 30.4 | 31 | 31.6 |
| | Temperature $^0$C ( Outlet) | $^0$C | -- | 33.6 | 33.2 | 33.6 | 34.2 |
| | Temperature $^0$C ( Differential) | $^0$C | **7** | 3.0 | 2.8 | 2.6 | 2.6 |
| 3 | Free available Chlorine | mg/L | **Min 0.5** | 0.71 | 0.65 | 0.77 | 0.66 |

| S.No. | Parameter | Unit | Limit | Results | | | |
|---|---|---|---|---|---|---|---|
| | | | | Unit-5 | Unit-6 | Unit-7 | Unit-8 |
| Date of Sampling ⟹ | | | | 04/12/2018 | 04/12/2018 | 04/12/2018 | 04/12/2018 |
| 1 | pH @ 25 ° C | -- | **6.5 to 8.5** | 8.10 | 8.14 | 8.15 | 8.18 |
| 2 | Temperature $^0$C ( Intake) | $^0$C | -- | 30.4 | 30.6 | 30.2 | 31.2 |
| | Temperature $^0$C ( Outlet) | $^0$C | -- | 33.6 | 33.2 | 33.4 | 34.2 |
| | Temperature $^0$C ( Differential) | $^0$C | **7** | 3.2 | 2.6 | 3.2 | 3.0 |
| 3 | Free available Chlorine | mg/L | **Min 0.5** | 0.72 | 0.65 | 0.69 | 0.74 |

**3.4.10 Location: Boiler Blow Down Water Sample** **DATE:04/12/2018**

| S.No. | Parameter | Unit | Limit | Results | | | |
|---|---|---|---|---|---|---|---|
| | | | | Unit -1 | Unit -2 | Unit -3 | Unit -4 |
| 1 | Total Suspended Solids | mg/L | **100** | BDL(MDL:4.0) | BDL(MDL:4.0) | BDL(MDL:4.0) | BDL(MDL:4.0) |
| 2 | Oil & Grease | mg/L | **10** | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) |
| 3 | Total Copper as Cu | mg/L | **1.0** | 0.009 | 0.008 | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 4 | Total Iron (as Fe) | mg/L | **1.0** | 0.028 | 0.032 | 0.042 | 0.041 |

## 4 AMBIENT NOISE LEVEL MONITORING

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise generated by the operation activities around it. Noise monitoring has been conducted at 10 locations within the periphery of industry premises.

- **Date of Monitoring: 09.10.2018**

**Result**

| Sr. No. | Location | Noise Level dB(A) | | | |
|---|---|---|---|---|---|
| | | Sampling Time | Day Time dB(A) 06 am - 10 pm | Sampling Time | Night Time dB(A) 10 pm - 06 am |
| | | | Limit 75 dB(A) | | Limit 70 dB(A) |
| 1. | Nr. LDO Pump House | 10:16 am - 12:45 pm | 63.2 | 22:08 pm - 23:49 pm | 60.4 |
| 2. | Nr. 20 MLD Plant | | 61.4 | | 60.2 |
| 3. | Nr. Pump House | | 65.2 | | 64.7 |
| 4. | Nr. Coal Handling plant | | 64.3 | | 63.6 |
| 5. | Nr. Gate No.4 | | 60.1 | | 59.6 |
| 6. | Nr. Integrated Ash Silo | | 69.8 | | 63.6 |
| 7. | Nr. Main Gate | | 62.3 | | 61.9 |
| 8. | Nr. APCH Building | | 60.7 | | 60.4 |
| 9. | Nr. Shantiniketan-I | | 64.4 | | 60.4 |
| 10. | Nr.OHC Building | | 65.0 | | 61.8 |

***Remark:*** Calibrated instruments were used during monitoring of above identified sample.

- **Date of Monitoring: 11.12.2018**

**Result**

| Sr. No. | Location | Noise Level dB(A) | | | |
|---|---|---|---|---|---|
| | | Sampling Time | Day Time dB(A) 06 am - 10 pm | Sampling Time | Night Time dB(A) 10 pm - 06 am |
| | | | Limit 75 dB(A) | | Limit 70 dB(A) |
| 1. | Nr. LDO Pump House | 11:25 am - 13:10 pm | 60.3 | 22:20 pm -23:50 pm | 56.3 |
| 2. | Nr. 20 MLD Plant | | 59.6 | | 57.2 |
| 3. | Nr. Pump House | | 63.8 | | 59.0 |
| 4. | Nr. Coal Handling plant | | 62.3 | | 56.3 |
| 5. | Nr. Gate No.4 | | 60.1 | | 56.7 |
| 6. | Nr. Integrated Ash Silo | | 66.7 | | 61.6 |
| 7. | Nr. Main Gate | | 61.3 | | 59.7 |
| 8. | Nr. APCH Building | | 59.4 | | 56.8 |
| 9. | Nr. Shantiniketan-I | | 63.2 | | 58.9 |
| 10. | Nr.OHC Building | | 60.1 | | 59.9 |

***Remark:*** Calibrated instruments were used during monitoring of above identified sample.

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adani

# ENVIRONMENTAL MONITORING REPORT

## AMBIENT AIR QUALITY, STACK EMISSION, WATER QUALITY AND NOISE MONITORING

**Period: January 2019 - March 2019**

**For**

## M/S. ADANI POWER (MUNDRA) LIMITED

**At**
**Tunda & Siracha,**
**Tal. Mundra, Dist.: Kutch.**
**KUTCH, GUJARAT – 370 435**

**Prepared By**

UniStar
Environment & Research Labs Pvt. Ltd.

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| QUALITY CONTROL | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Name of Publication** | Environmental Quality Monitoring Report for the Quarter January 2019 - March 2019 | | | | | | |
| **Project Number** | 03 | **Report No.** | UERL/ENV/JAN/ 1-3/2019 | **Version** | 1 | **Released** | April 2019 |
| **Project Coordinator** | Mr. Bhavin Patel | | | | | | |
| **Prepared By** | Miss. Shweta A. Rana | | | | | | |
| **Checked By** | Mr. Jaivik Tandel | | | | | | |
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**FOR**
**UniStar Environment and**
**Research Labs Pvt. Ltd.**

**Mr. Jaivik Tandel**
**(Authorized By)**

UNISTAR ENVIROMENT & RESEARCH LABS PVT. LTD. GUJARAT VAPI

## CONTENTS

LIST OF GRAPHS

## EXECUTIVE SUMMARY

Adani Power (Mundra) Limited (APMuL) has total generation capacity of 4620MW in phased manner at Mundra Thermal (coal Based) Power Plant near Village Tunda in Mundra, District Kutch, and Gujarat. The phased wise development being undertaken for ultimate capacity of power plant is shown below.

- First Phase : 2 x 330 MW
- Second Phase : 2 x 330 MW + 2 x 660 MW
- Third Phase : 3 x 660 MW

The Thermal Power Plant is located near Village Tunda, Mundra Taluka in Kutch District. The Site is closed to the sea, making cooling water perennially available for the power plant. The Power Plant is based on supercritical technology using imported coal.

All three phase of the power plant is operational and as the part of the compliance to the statutory requirement, M/s. Adani Power (Mundra) Limited has entrusted the environmental quality monitoring study for the area surrounding the power plant. Adani Power (Mundra) Limited Implemented ISO-14001:2015 Environment Management System (EMS) and Accreditation of NABL in Environmental Laboratory (ISO/IEC 17025:2005) vide Certificate No. TC-5215.

Various environmental parameters have been monitored during the period of January 2019-March 2019.The detail of the environmental parameters along with frequency of monitoring is shown in subsequent sections.

## 1. ENVIRONMENTAL PARAMETERS

| Sr. No. | Environmental Indices | Parameter | No. of Location and Monitoring. | Frequency of Sampling |
|---|---|---|---|---|
| 1. | Ambient Air Quality | $PM_{10}$, $PM_{2.5}$, Sulphur Dioxide and Nitrogen Dioxide | Three Location | Twice a week |
| 2. | Ambient Air Quality | $PM_{10}$, $PM_{2.5}$, Sulphur Dioxide, Nitrogen Dioxide, Ozone and Mercury | Two Location | Once in a month |
| 3. | Stack Monitoring | PM, Sulphur Dioxide, Oxide of Nitrogen and Hg | Nine Location | Once in a month |
| 4. | Meteorological Monitoring | Wind rose, Wind speed, Wind direction, Rainfall, Temperature, Relative Humidity | One location | Round the clock |
| 5. | Surrounding Villages Ground Water Analysis | Colour, Odour, Taste, Turbidity, Dissolved Solids, pH value, Total Hardness, Calcium, Boron, Copper, Iron, Manganese, Chloride, Sulphate, Nitrate, Fluoride, Phenolic Compounds, Mercury, Cadmium, Selenium, Arsenic, Cyanide, Lead, Zinc, Anionic Detergents as MBAS, Chromium Cr+6, Mineral Oil, MPN Index for Coliform Bacteria per 100 ml, Residual Free Chlorine, Aluminium, Alkalinity, Magnesium as Mg, Escherichia Coli in 250 ml. | Five Location | Once in Quarter |
| 6. | Effluent Water Sample | pH, Temperature, colour, SS, O & G, BOD3, COD, Chlorides, TDS, Sulphates, Ammonical Nitrogen, % Sodium, Sodium Absorption Ratio, Sulphides, Total Chromium, Hexavalent Chromium, Copper, Lead, Zinc, Free available chlorine, Phosphate, Iron | Four Location | Once in a month / Quarter |
| 7. | STP Water Analysis | pH, Residual Chlorine, SS, BOD, COD, Faecal coliform | Three Location | Once in month/ Quarter |
| 8. | Borwell water Near Ash Dyke Area | pH @ 25 ° C, Conductivity (µS), Chloride as $Cl^-$ Salinity (ppt), Total Dissolved Solids, Carbonate as CaCO3, Bicarbonate as CaCO3, Mercury as Hg,Arsenic as As, Lead as Pb, Chromium as Cr, Cadmium as Cd. | Four Location | Once in a Quarter |
| 9. | Surrounding Villages Soil Analysis | Magnesium as Mg %, Molybdenium as Mo in ppm, Phosphorus as P %, Calcium as Ca %, Zinc as Zn, Manganese as Mn, Potassium as K%, Nitrogen as N%, Iron as Fe%, Copper as Cu, Boron as B, Sulphurin %, Chloride as Cl%. | Five Location | Once in Six Month |
| 10. | Noise Level Monitoring | Noise level monitoring in dB(A) | 10 Location | Once in a Quarter |

## 1.1 AMBIENT AIR QUALITY

The scenario of the Ambient Air Quality in the study region has been assessed through a network of 5locations of Ambient Air Quality Monitoring. The design of monitoring network in the air quality surveillance program was based on the following considerations.

- Topography / Terrain of the study area.
- Human Settlements
- Wind pattern
- Health status
- Representation of regional Background levels.
- Accessibility of monitoring site.
- Resource availability.

Pre-calibrated Respirable Dust Samplers ($PM_{10}$) & Fine Dust Samplers ($PM_{2.5}$) have been used for monitoring the existing AAQM Status. Maximum, Minimum, Average, Standard Deviation and percentile have been computed from the raw data collected at all individual sampling stations to represents the Ambient Air Quality Status.

The significant parameters viz., $PM_{10}$, $PM_{2.5}$, Sulphur Dioxide ($SO_2$) and Oxides of Nitrogen ($NO_2$) and Mercury were monitored within the study area of 5 km from the site.

## 1.2 FLUE GAS MONITORING

All three phases of the Thermal Power Plant is in operation. The flue gas emission from stack attached to individual boiler is monitored once in month during the monitoring period.

## 1.3 WATER QUALITY MONITORING

The water quality parameters as per IS: 10500 for water resource within the study area have been used for describing the water environment and assessing the impacts on it.

Groundwater samples of nearby villages were collected at five locations the parameters of prime importance selected under physicochemical characteristics were estimated to describe the baseline environmental status of the water resources during the monitoring period. Four bore well samples surrounding the ash dyke area were collected during the month of January 2019 along with outfall water sample.

## 1.4 AMBIENT NOISE LEVEL MONITORING

The Ambient Noise levels within the plant premises were relocated at a different location (10 nos.) For the implementation of effective noise control programs.

## 1.5 MICROMETEOROLOGY

Meteorological parameters are important factors in the study of Air Pollution. The Transport and diffusion of the pollutants in the atmosphere are governed by meteorological factors.

Primary / Basic Meteorological Parameters

- Wind Velocity
- Wind Direction

Since the dispersion and diffusion of pollutants mainly depend on the above factors hence these factors are considered as primary meteorological parameters.

Secondary Meteorological Parameters

- Relative Humidity
- Ambient Temperature

The above-said factors are considered as secondary factors since these factors control the dispersion of the pollutant indirectly by affecting the primary factors.

### 1.5.1 Wind Rose Diagram

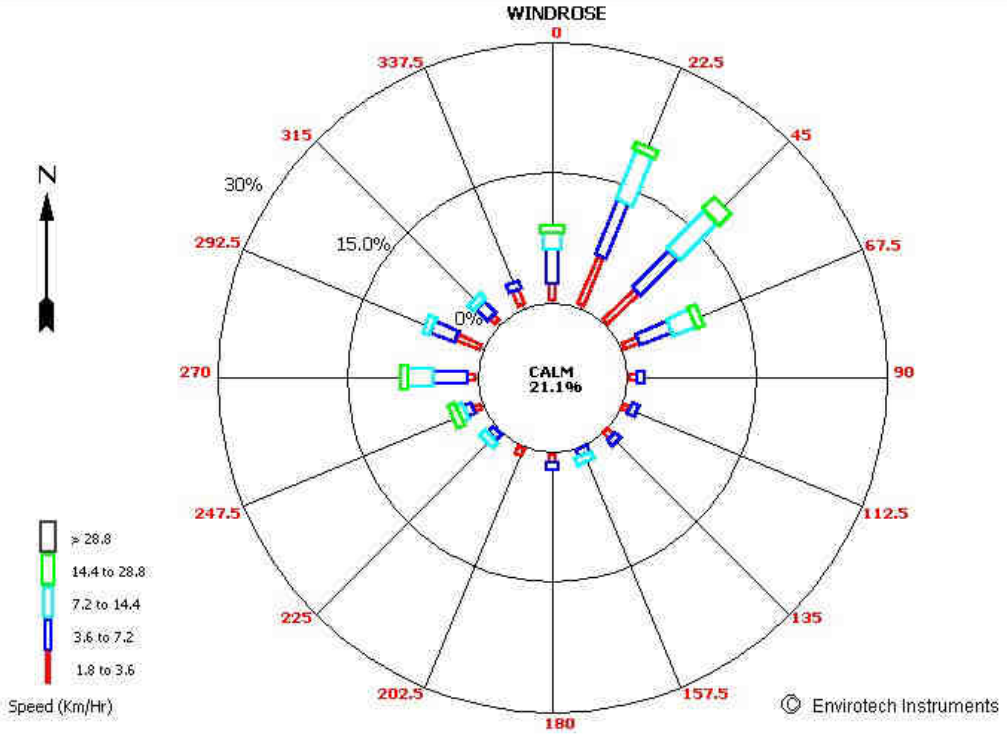
| | | | | | |
|---|---|---|---|---|---|
| **Project** | : | **Adani Power (Mundra) Limited (APMuL)** | **Period** | : | January 2019 to March 2019 |
| **Location** | : | **Village – Tunda, Dist. - Kutch** | | | |

| | |
|---|---|
| **Wind Direction** | **NE** |
| **Average Wind Speed** | **7.4 km/hr.** |
| **Percentage Occurrence of Calm Winds (<1.7 Km/Hr)** | **10.82 %** |

**ADANI POWER (MUNDRA) LIMITED – MUNDRA WINDROSE FOR THE SEASON OF Jan to Mar. 2019**

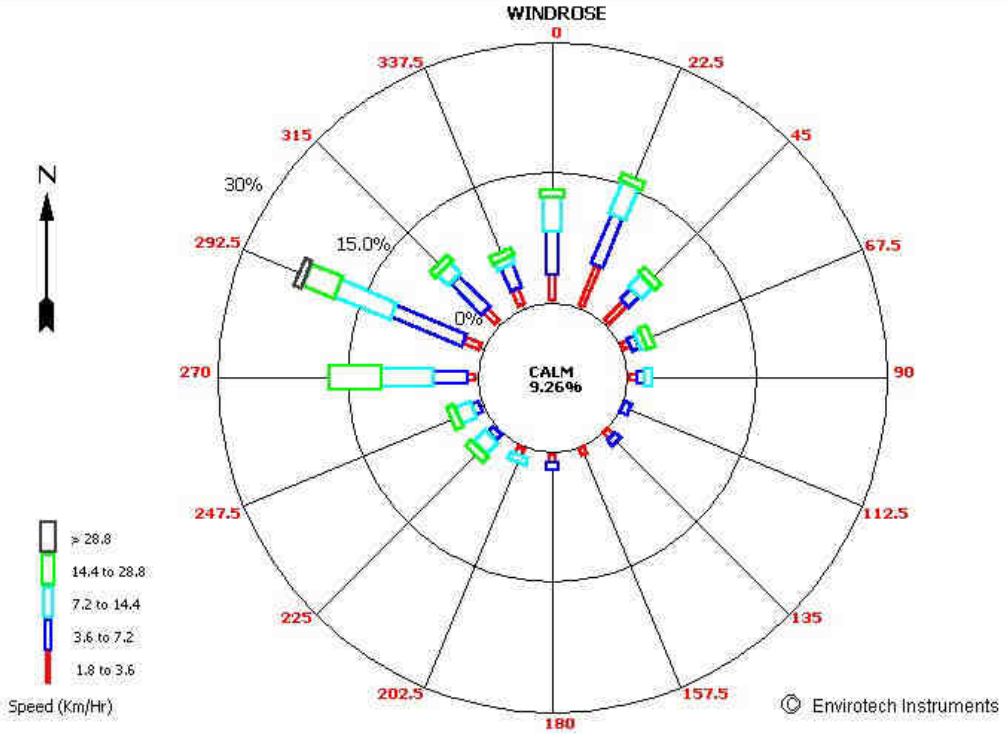
Time : 00:00 - 23:00
Date : 01/01/19 - 31/01/19

Adani Power( Mundra) Limited



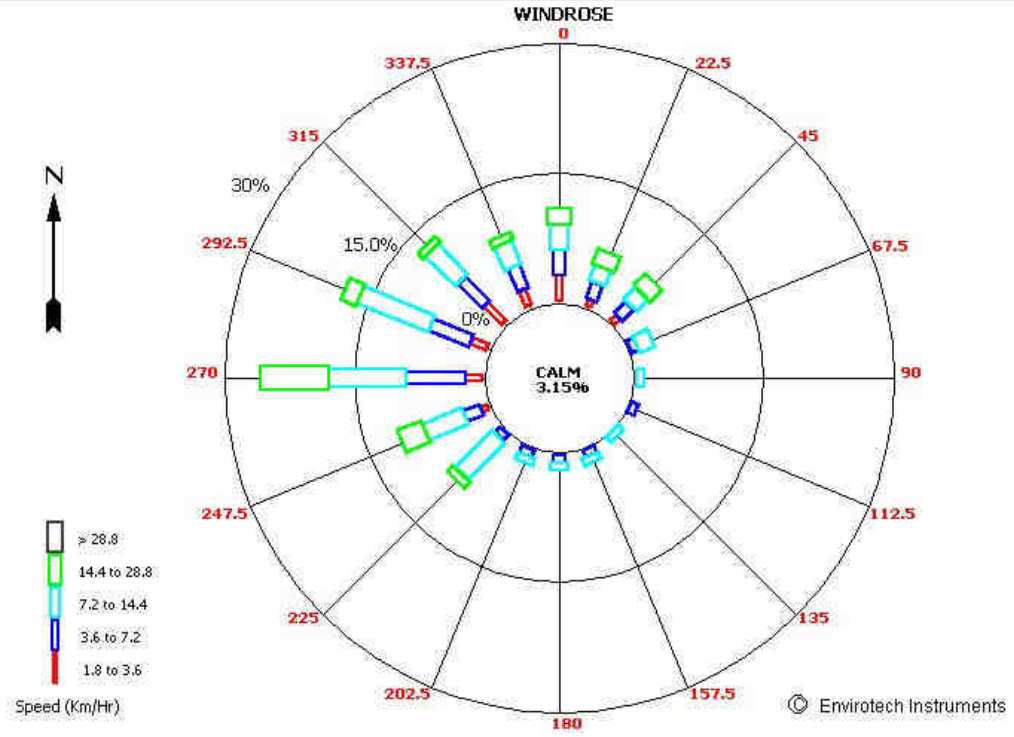

Time : 00:00 - 23:00
Date : 01/02/19 - 27/02/19

Adani Power (Mundra) Limited



Time : 00:00 - 23:00
Date : 01/03/19 - 31/03/19

Adani Power( Mundra) Limited



## 2 SCOPE & METHODOLOGY ADOPTED FOR ENVIRONMENTAL MONITORING

### 2.1 Introduction

The scope of the study includes detailed characterization of various environmental like air, water and noise within an area of 5 km radius in and around the power plant area at pump house, erector house, and surrounding villages named as Siracha, Wandh and Kandagara of Dist. Kutch.

The above mentioned environmental components were monitored at the study area and frequency of monitoring, number of samples along with methodology is as shown in below table.

### 2.2 Scope and Methodology for Monitoring of Various Environmental Attributes

| Sr. No | Environmental Attributes | Sampling Locations | Sampling Parameters | Sampling Frequency | Total No of samples | Methodology |
|---|---|---|---|---|---|---|
| 1 | Ambient Air Quality | 5 | $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$,$O_3$, Mercury | Twice a week (24 hourly Samples) | 120 | IS : 5182 & Reference APHA(AIR) |
| 2 | Flue Gas Stack Analysis | Unit 1 to 9 Boiler | PM, $SO_2$, NOx | Once in month | 27 | As per IS : 11255 |
| 3 | Surrounding Villages Ground Water Analysis | 5 water sample | Test specification as per IS : 10500 - 1991 | Once in Quarter | 5 | AS per APHA Method |
| 4 | Water Quality of Intake & Outfall for APMuL | 1 | As per CTO | Once in month | 6 | As Per APHA Method |
| 5 | STP Outlet | 1 | As per CTO | Once in month | 3 | As Per APHA Method |
| 6 | Bore well water Near Ash Dyke Area | 4 | Test specification as per IS : 10500 - 1991 | Once in Quarter | 4 | As Per APHA Method |
| 7 | Cooling Tower Blow down Water Sample | 9 | As per CTO | Once in Half yearly | 9 | As Per APHA Method |
| 8 | Condensate Cooling Tower Water Sample | 9 | As per CTO | Once in Half yearly | 9 | As Per APHA Method |

# 3 ENVIRONMENAT AIR QUALITY AND FLUE GAS MONITORING

The principle objective of the ambient air quality was to assess the existing levels of the air pollution as well as the regional background concentration in the plant area. Air pollution forms important and critical factors to study the environmental issues in the study areas. Thus, air quality has to be frequently monitored to know the extent of pollution due to power plant activity and other ancillary activities.

Flue gas monitoring analysis has been conducted by UniStar Environment and Research Labs Pvt. Ltd. Details are provided in Section 3.2.

## 3.1 Ambient Air Monitoring Data

### 3.1.1 Details of Ambient Air Quality Monitoring Stations

The detail of the ambient air monitoring locations including the distance from the project site with direction is as shown below.

| S.No. | Code | Name of sampling location | Distance |
|---|---|---|---|
| 1 | A - 1 | Nr.20 MLD Plant | 0 Km |
| 2 | A - 2 | Nr. Shantiniketan-1 | 0 Km |
| 3 | A - 3 | Kandagara Village | 3 km (NW) |
| 4 | A - 4 | Siracha Village | 3.5 km (NE) |
| 5 | A - 5 | Wandh Village | 3.0 km (SW) |

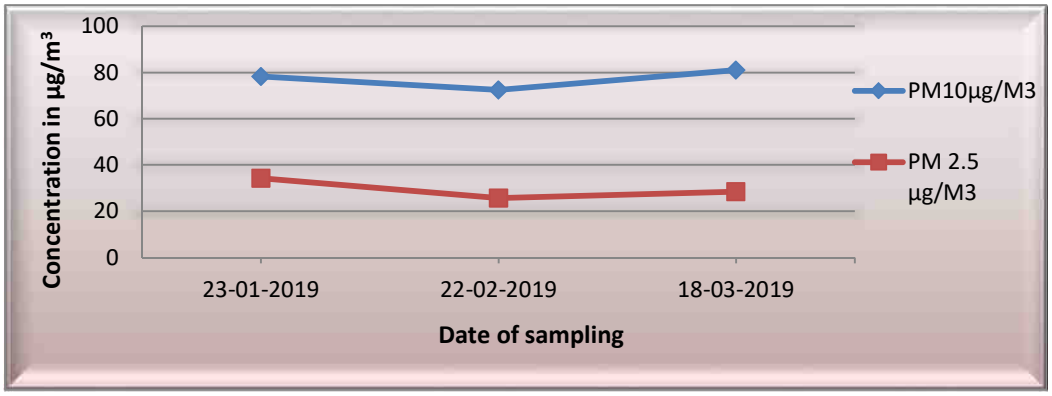
### 3.1.2 Location: Nr.20 MLD Plant

The Sampling station was located in the core zone in Company premises. The Respirable Dust Sampler ($PM_{10}$) & ($PM_{2.5}$) Sampler were placed at a height of 3 m above the ground level. Assess present pollution level the observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during monitoring period (January 2019 - March 2019) are as follows:

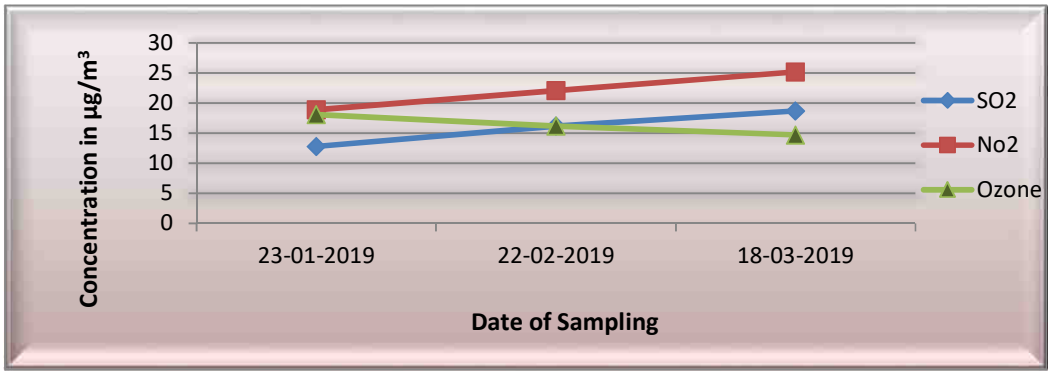
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 81.1 | 34.3 | 18.7 | 25.2 | 18.1 |
| Minimum Value | 72.5 | 25.7 | 12.8 | 18.9 | 14.7 |
| Average Value | 77.3 | 29.5 | 15.9 | 22.1 | 16.3 |
| Standard Deviation | 4.4 | 4.4 | 3.0 | 3.2 | 1.7 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: $\mu g/m^3$

**Graph 1 : Particulate Matter Level Nr.20 MLD Plant**




**Graph 2: SO2, NO2 and $O_3$ Nr.20 MLD Plant**



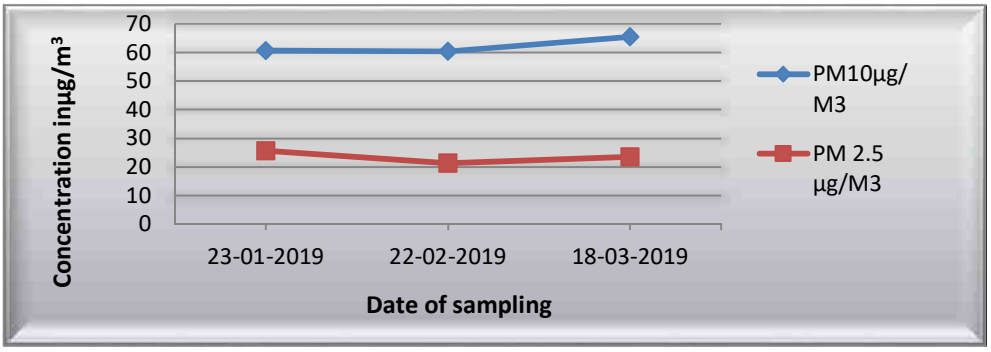
### 3.1.3 Location: Nr. Shantiniketan-1

The Sampling station was located in the core zone in company premises. The Respirable Dust Sampler$PM_{10}$ & $PM_{2.5}$Sampler were placed at a height of 3 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during monitoring period (January 2019 - March 2019) are as follows

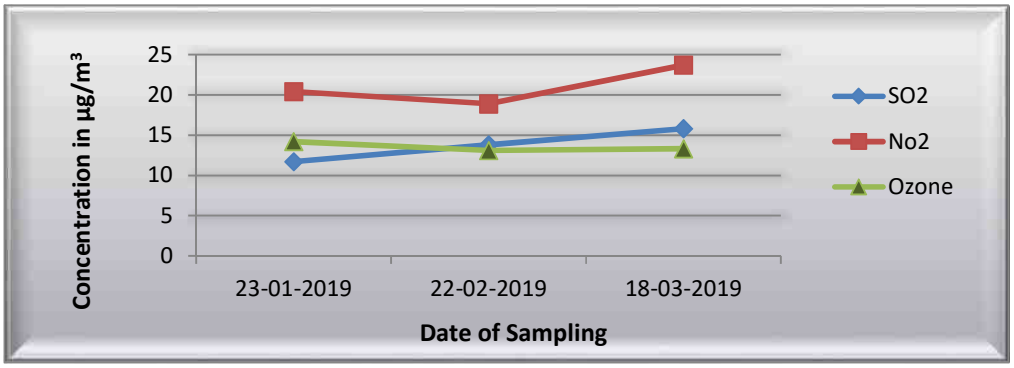
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 65.5 | 25.7 | 15.8 | 23.7 | 14.2 |
| Minimum Value | 60.4 | 21.3 | 11.7 | 18.9 | 13.1 |
| Average Value | 62.2 | 23.5 | 13.8 | 21.0 | 13.5 |
| Standard Deviation | 2.9 | 2.2 | 2.1 | 2.5 | 0.5 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: µg/$m^3$

**Graph 3: Particulate Matter Level Nr. Shantiniketan-1**




**Graph 4 : SO2, NO2 and $O_3$ Nr. Shantiniketan-1**



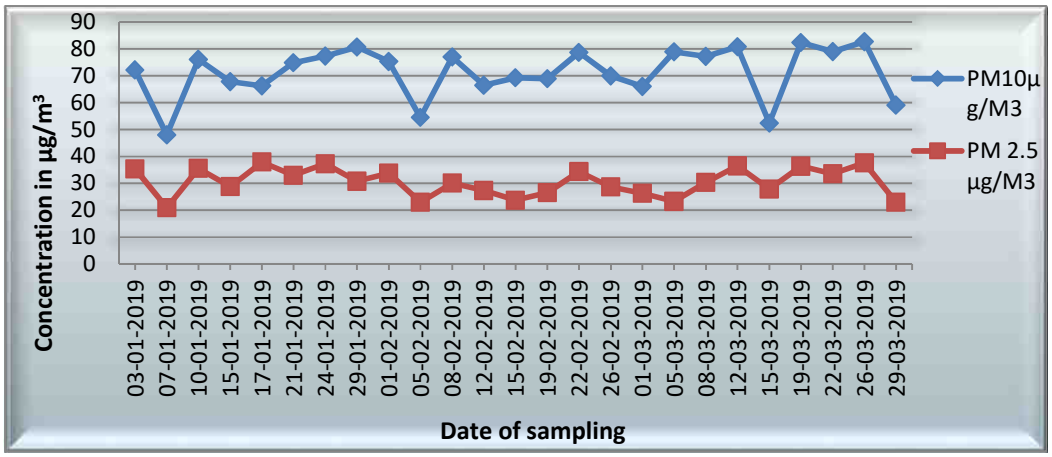
### 3.1.4 Location: Kandagara Village

The Sampling station was located in the core zone. The Station is located at about 3 km away in Northwest Direction from the Company premises. The Respirable Dust Sampler ($PM_{10}$) & $PM_{2.5}$Sampler were placed at a height of 1.5 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during the monitoring period (January 2019 - March 2019) are as follows.

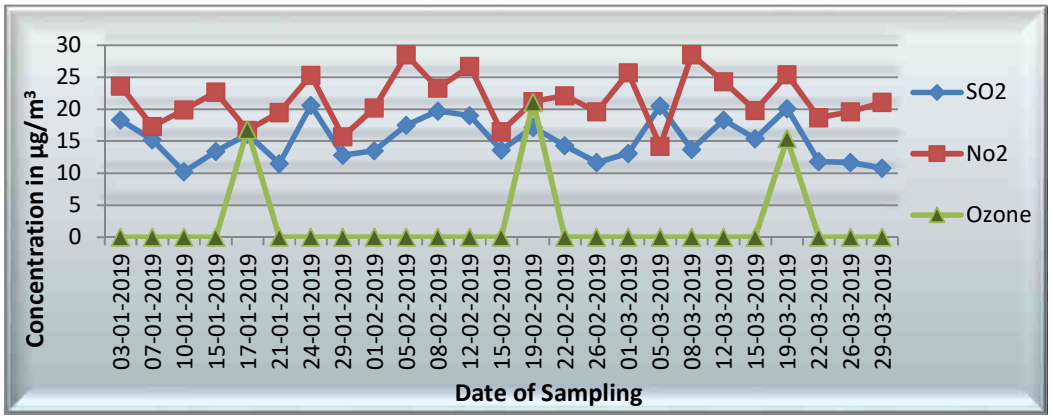
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 82.7 | 37.9 | 20.6 | 28.5 | 21.1 |
| Minimum Value | 48 | 20.9 | 10.2 | 14.2 | 0 |
| Average Value | 71.3 | 30.5 | 15.2 | 21.4 | 2.1 |
| Standard Deviation | 9.6 | 5.3 | 3.3 | 3.9 | 5.9 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: $\mu g/m^3$

**Graph 5: Particulate Matter Level Kandagara Village**




**Graph 6 : SO2, NO2 and $O_3$ Level Kandagara Village**



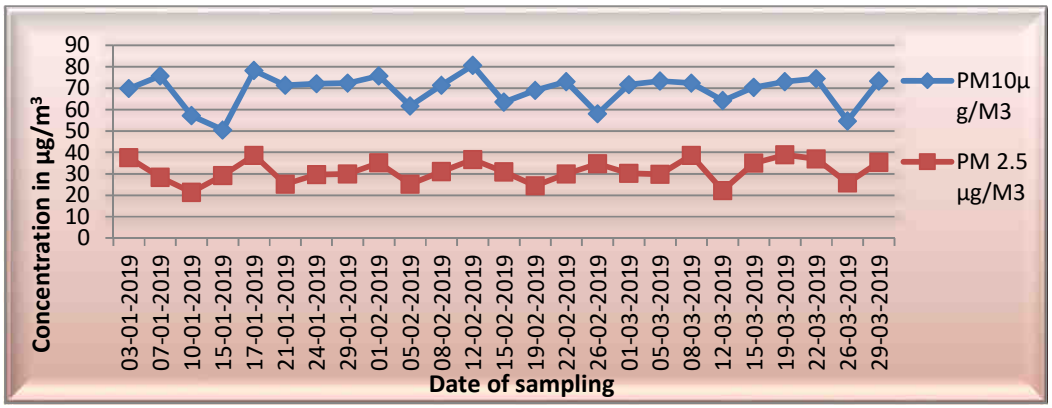
### 3.1.5 Location: Siracha Village

The Sampling station was located in the Siracha village. The Station is located at about 3.5 km away in Northwest Direction from the core zone area. The Respirable Dust Sampler & $PM_{2.5}$ was placed at a height of 3.0 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during the monitoring period (January 2019 - March 2019) are as follows.

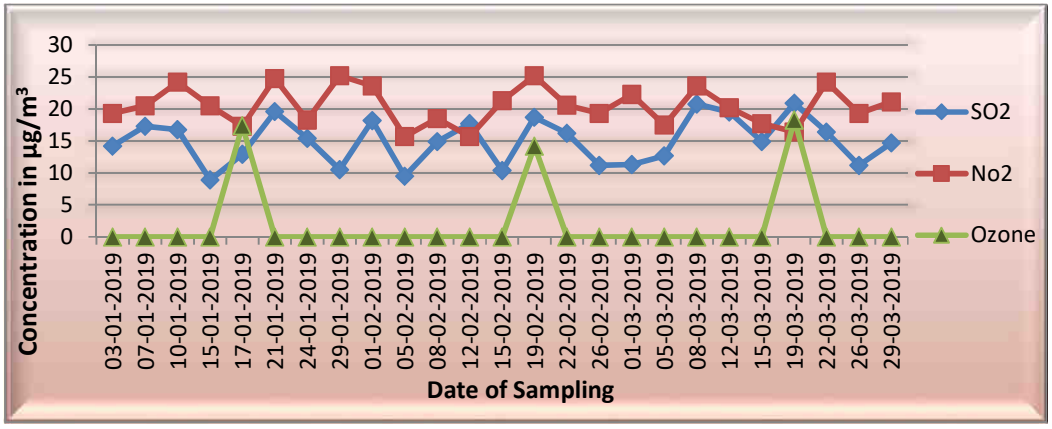
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 80.6 | 38.9 | 20.9 | 25.2 | 18.3 |
| Minimum Value | 50.5 | 21.4 | 8.9 | 15.7 | 0 |
| Average Value | 69.1 | 31.2 | 15.0 | 20.5 | 1.9 |
| Standard Deviation | 7.6 | 5.3 | 3.6 | 3.0 | 5.5 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units:µg/$m^3$

**Graph 7 : Particulate Matter Level Siracha Village**




**Graph 8 : $SO_2$, $NO_2$ and $O_3$ Level Siracha Village**



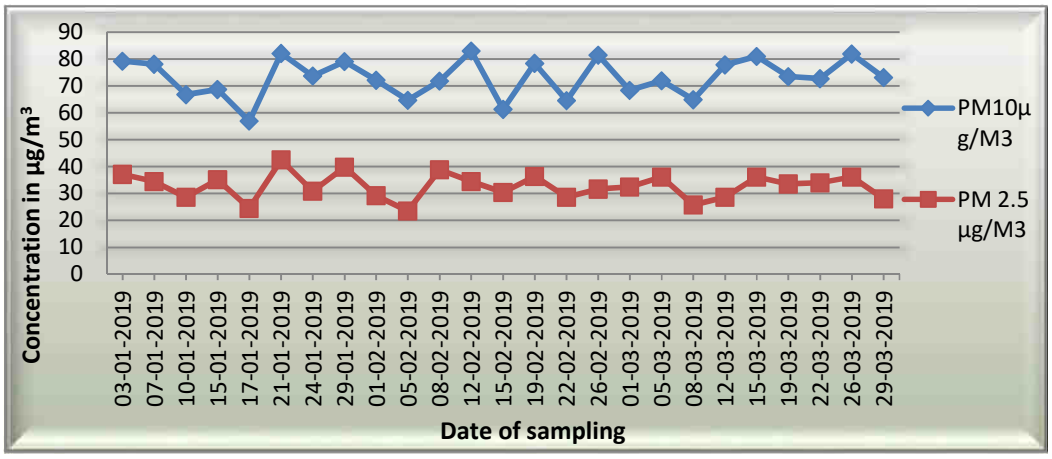
### 3.1.6 Location: Wandh Village

The Sampling station was located in the core zone in Wandh village. The Station is located at about 3.0 km away in Southwest Direction from the Company premises. The Respirable Dust Sampler Was placed at a height of 3.0 m above the ground level. The observed levels of $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$ and $O_3$ collected during the monitoring period (January 2019 - March 2019) are as follows.

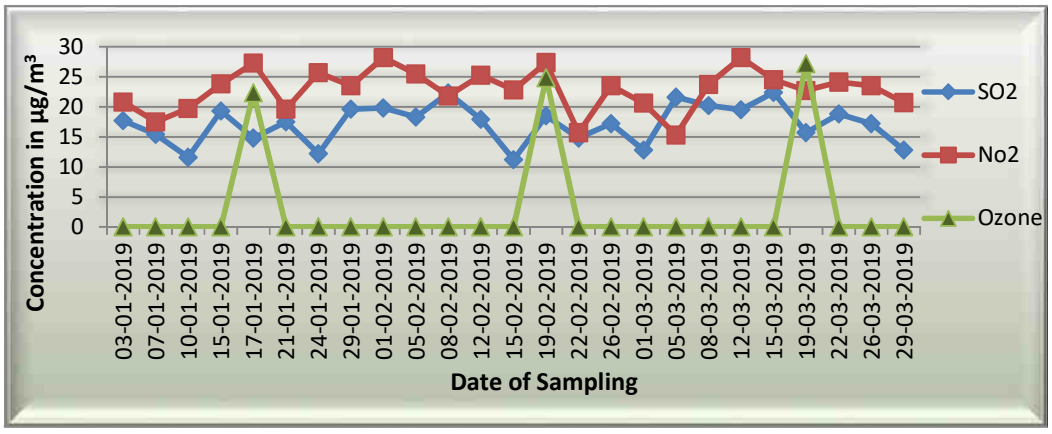
| Observations | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | $NO_2$ | $O_3$ |
|---|---|---|---|---|---|
| Maximum Value | 83 | 42.5 | 22.4 | 28.2 | 27.2 |
| Minimum Value | 56.9 | 23.5 | 11.2 | 15.3 | 0 |
| Average Value | 73.1 | 32.7 | 17.2 | 22.9 | 2.9 |
| Standard Deviation | 7.2 | 4.8 | 3.3 | 3.5 | 8.2 |
| Permissible Limits | **100** | **60** | **80** | **80** | **100** |

Units: $\mu g/m^3$

**Graph 9 : Particulate Matter Level Wandh Village**




**Graph 10 : $SO_2$, $NO_2$ and $O_3$ Level Wandh Village**



### 3.1.7 Ambient Air Quality Monitoring (Parameters- Mercury & Ozone)

| Location | January - 19 | | | February - 19 | | | March - 19 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Date | Ozone ($O_3$) µg/m3 | Mercury (Hg) µg/m3 | Date | Ozone ($O_3$) µg/m3 | Mercury (Hg) µg/m3 | Date | Ozone ($O_3$) µg/m3 | Mercury (Hg) µg/m3 |
| **Village Kandagara** | 17-01-19 | 16.8 | BDL | 19-02-19 | 21.1 | BDL | 19-03-19 | 15.4 | BDL |
| **Village Wandh** | 17-01-19 | 22.3 | BDL | 19-02-19 | 24.8 | BDL | 19-03-19 | 27.2 | BDL |
| **Village Siracha** | 17-01-19 | 17.4 | BDL | 19-02-19 | 14.2 | BDL | 19-03-19 | 18.3 | BDL |
| **Nr. 20 MLD Plant** | 23-01-19 | 18.1 | BDL | 22-02-19 | 16.2 | BDL | 18-03-19 | 14.7 | BDL |
| **Nr. Shantiniketan-1** | 23-01-19 | 14.2 | BDL | 22-02-19 | 13.1 | BDL | 18-03-19 | 13.3 | BDL |

**Remark**: Calibrated equipment & instruments were used during monitoring & analysis of above identified sample.

**Analysis Method Reference :**

Hg : AAS by VGA Method -3112 B APHA 22 Edition : BDL Limit **Hg** : 2 ppb

$O_3$ : IS - 5182 (part 9) 2009 Ozone BDL limit: 5 µg/$m^3$

### 3.2 Flue Gas Monitoring Data

ISO kinetic Stack monitoring has been carried out by UniStar environment & Research Pvt. Ltd.

| Date | Location | PM in mg/Nm$^3$ | $SO_2$ in mg/ Nm$^3$ | $NO_x$ in mg/ Nm$^3$ |
|---|---|---|---|---|
| 09-01-2019 | Boiler (Unit - 1) | 41.4 | 511 | 308.1 |
| 13-02-2019 | Boiler (Unit - 1) | 34.8 | 648 | 254.2 |
| 11-03-2019 | Boiler (Unit - 1) | 39.4 | 563 | 274.8 |
| 09-01-2019 | Boiler (Unit - 2) | 35.5 | 728.8 | 263.4 |
| 13-02-2019 | Boiler (Unit - 2) | 38.4 | 545.8 | 263.4 |
| 11-03-2019 | Boiler (Unit - 2) | 44.8 | 701.8 | 269.2 |
| 11-01-2019 | Boiler (Unit - 3) | 45.1 | 585.7 | 322.4 |
| 18-02-2019 | Boiler (Unit - 3) | 30.8 | 712.8 | 336.7 |
| 15-03-2019 | Boiler (Unit - 3) | 33.1 | 679.4 | 311.4 |
| 11-01-2019 | Boiler (Unit - 4) | 41.9 | 772.1 | 277.4 |
| 18-02-2019 | Boiler (Unit - 4) | 33 | 458.3 | 249.3 |
| 15-03-2019 | Boiler (Unit - 4) | 35.2 | 559 | 247 |
| 15-01-2019 | Boiler (Unit - 5) | 33.2 | 668.2 | 325.8 |
| 08-02-2019 | Boiler (Unit - 5) | 38.7 | 568.2 | 308.3 |
| 18-03-2019 | Boiler (Unit - 5) | 32 | 612 | 321.4 |
| 15-01-2019 | Boiler (Unit - 6) | 38.5 | 594.3 | 273.5 |
| 08-02-2019 | Boiler (Unit - 6) | 43.7 | 614.7 | 289.1 |
| 18-03-2019 | Boiler (Unit - 6) | 27.1 | 563 | 249.5 |
| 10-01-2019 | Boiler (Unit - 7) | 36.7 | 171.2 | 279.1 |
| 09-02-2019 | Boiler (Unit - 7) | 33.4 | 161.9 | 340.2 |
| 19-03-2019 | Boiler (Unit - 7) | 42.6 | 146.6 | 227.5 |
| 10-01-2019 | Boiler (Unit - 8) | 32.6 | 148.3 | 328.9 |
| 08-02-2019 | Boiler (Unit - 8) | 38.6 | 136.8 | 282.4 |
| 19-03-2019 | Boiler (Unit -8) | 39.1 | 130.2 | 305.8 |
| 10-01-2019 | Boiler (Unit - 9) | 33.9 | 162.4 | 292.7 |
| 09-02-2019 | Boiler (Unit - 9) | 32.2 | 159.6 | 292.7 |
| 19-03-2019 | Boiler (Unit - 9) | 38.5 | 139.8 | 220.1 |
| **Permissible Limits** | | **50** | **<500 MWH-600 >500 MWH-200** | **300** |

## 3.3 Water Quality Monitoring

**3.3.1 Location: Tunda Village Water Sample** **DATE: 04/01/2019**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.15 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odor | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 124.2 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 21.6 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 17.1 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1692 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 396.3 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 563.3 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 224.1 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 3.6 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.34 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.89 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 10 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.2 Location: Kandagara Village Water Sample** **DATE: 04/01/2019**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.09 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odor | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 162.0 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 28.1 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 22.3 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1896 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 496.3 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 539.6 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 178.6 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 4.7 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.36 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.89 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | N.D.(MDL:0.001) |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | N.D. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | N.D.(MDL:0.01) |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | N.D. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | N.D.(MDL:0.003) |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | N.D. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | N.D.(MDL:0.1) |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | N.D. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | N.D. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | N.D. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | N.D.(MDL:0.001) |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 10 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.3Location: Siracha Village Water Sample** **DATE: 04/01/2019**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.06 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odour | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 324.0 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 62.8 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 40.7 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1682 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 322.2 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 496.8 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 214.4 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 2.1 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.34 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.77 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 06 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.4 Location: Navinal Village Water Sample** **DATE: 04/01/2019**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 8.14 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Colour | Pt-Co | 10 | 5 | 15 |
| 3 | Odour | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 183.6 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 32.5 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 24.9 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1866 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 536.3 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 525.3 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 202.1 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 4.2 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.36 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.77 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 06 | 100 CFU/ml | 100 CFU/ml |

Note: BDL= Below Detection Limit. N.D. = Not Detected

**3.3.5Location: Desalpur Village Water Sample** **DATE: 04/01/2019**

| Sr. No. | Parameter | Unit | Results | Desirable Limits | Permissible limit in the absence of alternate source |
|---|---|---|---|---|---|
| 1 | pH @ 25 | - | 7.96 | 6.5 – 8.5 | 6.5 – 8.5 |
| 2 | Color | Pt-Co | 10 | 5 | 15 |
| 3 | Odor | mg/L | Agreeable | Unobjectionable | Unobjectionable |
| 4 | Taste | mg/L | Agreeable | Agreeable | Agreeable |
| 5 | Turbidity(NTU) | mg/L | BDL(MDL:0.1) | 1 NTU | 5 NTU |
| 6 | Total Hardness as $CaCO_3$ | mg/L | 237.6 | 200 mg/lit. | 600 mg/lit. |
| 7 | Calcium as Ca | mg/L | 43.3 | 75 mg/lit. | 200 mg/lit. |
| 8 | Magnesium as Mg | mg/L | 31.5 | 30 mg/lit. | 100 mg/lit. |
| 9 | Total Dissolved Solids | mg/L | 1778 | 500 mg/lit. | 2000 mg/lit. |
| 10 | Total Alkalinity | mg/L | 505.6 | 200 mg/lit. | 600 mg/lit. |
| 11 | Chloride as $Cl^-$ | mg/L | 514.4 | 250 mg/lit. | 1000 mg/lit. |
| 12 | Sulphate as $SO_4^{-2}$ | mg/L | 226.3 | 200 mg/lit. | 400 mg/lit. |
| 13 | Nitrate as $NO_3$ | mg/L | 4.9 | 45 mg/lit. | 45 mg/lit. |
| 14 | Copper as Cu | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 1.5 mg/lit. |
| 15 | Manganese as Mn | mg/L | BDL(MDL:0.1) | 0.1 mg/lit. | 0.3 mg/lit. |
| 16 | Iron as Fe | mg/L | BDL(MDL:0.1) | 0.3 mg/lit. | 0.3 mg/lit. |
| 17 | Residual Free Chlorine | mg/L | 0.38 | 0.2 mg/lit. | 1.0 mg/lit. |
| 18 | Fluoride as F | mg/L | 0.82 | 1.0 mg/lit. | 1.5 mg/lit. |
| 19 | Zinc as Zn | mg/L | BDL(MDL:0.05) | 5 mg/lit. | 15 mg/lit. |
| 20 | Phenolic Compound | mg/L | BDL(MDL:0.01) | 0.001 mg/lit. | 0.002 mg/lit. |
| 21 | Mercury as Hg | mg/L | BDL(MDL:0.001) | 0.001 mg/lit. | 0.001 mg/lit. |
| 22 | Cadmium as Cd | mg/L | BDL(MDL:0.003) | 0.003 mg/lit. | 0.003 mg/lit. |
| 23 | Selenium as Se | mg/L | N.D. | 0.01 mg/lit. | 0.01 mg/lit. |
| 24 | Arsenic as as | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.05 mg/lit. |
| 25 | Cyanide as CN | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 26 | Lead as Pb | mg/L | BDL(MDL:0.01) | 0.01 mg/lit. | 0.01 mg/lit. |
| 27 | Anionic Detergent | mg/L | N.D. | 0.2 mg/lit. | 1.0 mg/lit. |
| 28 | Hexavalent Chromium | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 29 | Mineral Oil | mg/L | N.D. | 0.5 mg/lit. | 0.5 mg/lit. |
| 30 | Aluminum as Al | mg/L | N.D. | 0.03 mg/lit. | 0.2 mg/lit. |
| 31 | Boron as B | mg/L | N.D. | 0.5 mg/lit. | 1 mg/lit. |
| 32 | Total Chromium as Cr | mg/L | BDL(MDL:0.05) | 0.05 mg/lit. | 0.05 mg/lit. |
| 33 | Total Coliform | (CFU/100 ml) | Absent | Absent | Absent |
| 34 | E. coli | (CFU/100 ml) | Absent | Absent | Absent |
| 35 | Total Bacterial Count | (CFU/ml) | 04 | 100 CFU/ml | 100 CFU/ml |

Note: Colour = 1(10) = 10 APHA, BDL= Below Detection Limit. N.D. = Not Detected

## 3.4 Water Quality Monitoring – Plant area

### 3.4.1 Location: Outfall Channel

| Sr. No. | Parameter | Unit | Date of sampling |
|---|---|---|---|
| | | | 07/01/2019 |
| 1 | pH @ 25 | -- | 7.42 |
| 2 | Temperature | $^0$C ( Intake) | 24.5 |
| | | $^0$C ( Outfall) | 27.5 |
| | | $^0$C ( Differential) | 3.0 |
| 3 | Color | Pt. CO. Scale | 20 |
| 4 | Total Suspended Solids | mg/L | 10 |
| 5 | Oil & Grease | mg/L | BDL(MDL:2.0) |
| 6 | Ammonical Nitrogen | mg/L | BDL(MDL:2.0) |
| 7 | Sulphide as S-2 | mg/L | BDL(MDL:0.05) |
| 8 | Total Chromium | mg/L | BDL(MDL:0.05) |
| 9 | Hexavalent Chromium as Cr+6 | mg/L | BDL(MDL:0.05) |
| 10 | Phosphate as $PO_4$ | mg/L | 0.21 |
| 11 | Lead as Pb | mg/L | 0.011 |
| 12 | Copper as Cu | mg/L | BDL(MDL:0.05) |
| 13 | Zinc as Zn | mg/L | BDL(MDL:0.05) |
| 14 | Iron (as Fe) | mg/L | 0.167 |
| 15 | Chemical Oxygen Demand(COD) | mg/L | 51.1 |
| 16 | Biochemical Oxygen Demand (BOD) | mg/L | 14 |

Note:BDL= Below Detection Limit. N.D. = Not Detected

### 3.4.2 Location: STP Outlet Water Sample;

| Sr. No. | Parameter | Unit | SPCB Limit | Date of sampling | | |
|---|---|---|---|---|---|---|
| | | | | 07/01/2019 | 12/02/2019 | 16/03/2019 |
| 1 | pH @ 25 ° C | -- | **6.5-8.5** | 7.65 | 7.52 | 7.41 |
| 2 | Total Suspended Solids | mg/L | **30** | 26 | 22 | 26 |
| 3 | Residual Chlorine | mg/L | **0.5 Min.** | 0.73 | 0.67 | 0.58 |
| 4 | Biochemical Oxygen Demand (BOD) | mg/L | **20** | 14 | 10 | 14 |
| 5 | Fecal Coliform | CFU/100ml | **<1000** | 84 | 78 | 86 |

**3.4.3 Location: ETP Outlet Water Sample;**

| S.N | Parameter | Unit | SPCB Limit | Date of sampling | | |
|---|---|---|---|---|---|---|
| | | | | 07/01/2019 | 12/02/2019 | 16/03/2019 |
| 1 | pH @ 25 | -- | **6.5 – 8.5** | 8.15 | 8.14 | 8.05 |
| 2 | Temperature | ° C | **40 Max.** | 30 | 31 | 32 |
| 3 | Color | Pt. CO. Scale | **100 Max.** | 20 | 40 | 40 |
| 4 | Total Suspended Solids | mg/L | **100 Max.** | 24 | 18 | 26 |
| 5 | Oil & Grease | mg/L | **10 Max.** | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) |
| 6 | Chemical Oxygen Demand (COD) | mg/L | **100 Max.** | 34.1 | 26.5 | 31.2 |
| 7 | Biochemical Oxygen Demand (BOD) | mg/L | **30 Max.** | 10 | 8 | 10 |
| 8 | Chloride as $Cl^-$ | mg/L | **600 Max.** | 485.5 | 466.3 | 493.3 |
| 9 | Total Dissolved Solids | mg/L | **2100 Max.** | 1560 | 1606 | 1786 |
| 10 | Sulphate as $SO_4$ | mg/L | **1000 Max.** | 74.1 | 77.1 | 102.2 |
| 11 | Ammonical Nitrogen | mg/L | **50 Max.** | BDL(MDL:2.0) | BDL(MDL:2.0) | BDL(MDL:2.0) |
| 12 | % Sodium(Na) | mg/L | **60 Max.** | 56.2 | 56.7 | 58.3 |
| 13 | Sodium Absorption Ratio(SAR) | mg/L | **26 Max.** | 9.1 | 8.5 | 10.2 |
| 14 | Sulphide as $S^{-2}$ | mg/L | **02 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 15 | Total Chromium | mg/L | **02 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 16 | Hexavalent Chromium as Cr+6 | mg/L | **0.1 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 17 | Phosphate as $PO_4$ | mg/L | **5.0 Max.** | 0.53 | 0.44 | 0.53 |
| 18 | Copper as Cu | mg/L | **03 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 19 | Lead as Pb | mg/L | **0.1 Max.** | BDL(MDL:0.01) | BDL(MDL:0.01) | BDL(MDL:0.01) |
| 20 | Zinc as Zn | mg/L | **05 Max.** | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 21 | Residual Free Chlorine | mg/L | **0.5 Max.** | BDL(MDL:0.2) | BDL(MDL:0.2) | BDL(MDL:0.2) |
| 22 | Iron (as Fe) | mg/L | **1.0 Max.** | BDL(MDL:0.1) | BDL(MDL:0.1) | BDL(MDL:0.1) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.4Location: Bore-well – 1(Nr. Emergency Ash Pond)** **Date: 04/01/2019**

| Sr.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 8.03 |
| 2 | Conductivity (µS) | - | 17072 |
| 3 | Chloride as $Cl^-$ | mg/L | 4625.1 |
| 4 | Salinity (ppt) | mg/L | 8.3 |
| 5 | Total Dissolved Solids | mg/L | 10926 |
| 6 | Carbonate as CaCO3 | mg/L | 29.1 |
| 7 | Bicarbonate as CaCO3 | mg/L | 147.3 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | BDL(MDL:0.003) |
| 13 | Iron (as Fe) | mg/L | BDL(MDL:0.1) |
| 14 | Zinc (as Zn) | mg/L | BDL(MDL:0.05) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.5Location: Bore-well – 2(Nr. Emergency Ash Pond)** **Date: 04/01/2019**

| S.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 8.12 |
| 2 | Conductivity (µS) | - | 18969 |
| 3 | Chloride as $Cl^-$ | mg/L | 4456 |
| 4 | Salinity (ppt) | mg/L | 8.1 |
| 5 | Total Dissolved Solids | mg/L | 12140 |
| 6 | Carbonate as CaCO3 | mg/L | 43.3 |
| 7 | Bicarbonate as CaCO3 | mg/L | 123.2 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | BDL(MDL:0.003) |
| 13 | Iron (as Fe) | mg/L | BDL(MDL:0.1) |
| 14 | Zinc (as Zn) | mg/L | BDL(MDL:0.05) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.6Location: Bore-well – 3 (Nr. Emergency Ash Pond)** **Date: 04/01/2019**

| Sr.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 8.01 |
| 2 | Conductivity (µS) | - | 15954 |
| 3 | Chloride as $Cl^-$ | mg/L | 4526 |
| 4 | Salinity (ppt) | mg/L | 8.2 |
| 5 | Total Dissolved Solids | mg/L | 10210 |
| 6 | Carbonate as CaCO3 | mg/L | 30.2 |
| 7 | Bicarbonate as CaCO3 | mg/L | 116.5 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | BDL(MDL:0.003) |
| 13 | Iron (as Fe) | mg/L | BDL(MDL:0.1) |
| 14 | Zinc (as Zn) | mg/L | BDL(MDL:0.05) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

**3.4.7 Location: Bore-well – 4(Nr. Emergency Ash Pond)** **Date: 04/01/2019**

| Sr.No. | Parameter | Unit | Results |
|---|---|---|---|
| 1 | pH @ 25 ° C | - | 8.15 |
| 2 | Conductivity (µS) | - | 17854 |
| 3 | Chloride as $Cl^-$ | mg/L | 4785 |
| 4 | Salinity (ppt) | mg/L | 8.6 |
| 5 | Total Dissolved Solids | mg/L | 11426 |
| 6 | Carbonate as CaCO3 | mg/L | 24.3 |
| 7 | Bicarbonate as CaCO3 | mg/L | 162.3 |
| 8 | Mercury as Hg | mg/L | BDL(MDL:0.001) |
| 9 | Arsenic as As | mg/L | BDL(MDL:0.01) |
| 10 | Lead as Pb | mg/L | BDL(MDL:0.01) |
| 11 | Chromium as Cr | mg/L | BDL(MDL:0.05) |
| 12 | Cadmium as Cd | mg/L | BDL(MDL:0.003) |
| 13 | Iron (as Fe) | mg/L | BDL(MDL:0.1) |
| 14 | Zinc (as Zn) | mg/L | BDL(MDL:0.05) |

**Note: N.D.** = Not Detected, **MDL** = Minimum Detection Limit

### 3.4.8 Location: Cooling Tower Blow down Water Sample

| S.No. | Parameter | Unit | Limit | Results | | | |
|---|---|---|---|---|---|---|---|
| | | | | Unit-1 | Unit-2 | Unit-3 | Unit-4 |
| Date of Sampling ⟹ | | | | 16/03/2019 | 16/03/2019 | 16/03/2019 | 16/03/2019 |
| 1 | pH @ 25 ° C | -- | - | 8.10 | 8.21 | 8.11 | 8.08 |
| 2 | Free available Chlorine | ° C | Min. 0.5 | 0.78 | 0.83 | 0.86 | 0.89 |
| 3 | Zinc as Zn | Pt. CO. Scale | 1.0 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 4 | Hexavalent Chromium as Cr+6 | mg/L | 0.1 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 5 | Total Chromium as Cr | mg/L | 0.2 | 0.075 | 0.067 | 0.082 | 0.078 |
| 6 | Phosphate as P | mg/L | 5.0 | 0.56 | 0.72 | 0.74 | 0.55 |

| S.No | Parameter | Unit | Limit | Results | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Unit-5 | Unit-6 | Unit-7 | Unit-8 | Unit-9 |
| Date of Sampling ⟹ | | | | 16/03/2019 | 16/03/2019 | 16/03/2019 | 16/03/2019 | 16/03/2019 |
| 1 | pH @ 25 ° C | -- | - | 8.17 | 8.14 | 8.16 | 8.02 | 8.14 |
| 2 | Free available Chlorine | ° C | Min. 0.5 | 0.83 | 0.67 | 0.67 | 0.81 | 0.63 |
| 3 | Zinc as Zn | Pt. CO. Scale | 1.0 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 4 | Hexavalent Chromium as Cr+6 | mg/L | 0.1 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 5 | Total Chromium as Cr | mg/L | 0.2 | 0.067 | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) | BDL(MDL:0.05) |
| 6 | Phosphate as P | mg/L | 5.0 | 0.52 | 0.33 | 0.44 | 0.62 | 0.45 |

### 3.4.9 Location: Condensate Cooling Tower Water Sample

| S.No. | Parameter | Unit | Limit | Results | | | |
|---|---|---|---|---|---|---|---|
| | | | | Unit-1 | Unit-2 | Unit-3 | Unit-4 |
| Date of Sampling ⟹ | | | | 16/03/2019 | 16/03/2019 | 16/03/2019 | 16/03/2019 |
| 1 | pH @ 25 ° C | -- | **6.5 to 8.5** | 8.11 | 8.08 | 8.10 | 8.02 |
| 2 | Temperature $^0$C ( Intake) | $^0$C | -- | 30.6 | 29.6 | 30 | 30.7 |
| | Temperature $^0$C ( Outlet) | $^0$C | -- | 33.6 | 32.5 | 32.8 | 33.5 |
| | Temperature $^0$C ( Differential) | $^0$C | **7** | 3.0 | 2.9 | 2.8 | 2.8 |
| 3 | Free available Chlorine | mg/L | **Min 0.5** | 0.63 | 0.74 | 0.71 | 0.74 |

| S.No. | Parameter | Unit | Limit | Results | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Unit-5 | Unit-8 | Unit-7 | Unit-8 | Unit-9 |
| Date of Sampling ⟹ | | | | 16/03/2019 | 16/03/2019 | 16/03/2019 | 16/03/2019 | 16/03/2019 |
| 1 | pH @ 25 ° C | -- | **6.5 to 8.5** | 8.16 | 8.09 | 8.08 | 8.11 | 8.15 |
| 2 | Temperature $^0$C ( Intake) | $^0$C | -- | 29.7 | 30.3 | 30.1 | 30.6 | 30.5 |
| | Temperature $^0$C ( Outlet) | $^0$C | -- | 32.7 | 33.1 | 33.1 | 33.5 | 33.6 |
| | Temperature $^0$C ( Differential) | $^0$C | **7** | 3.0 | 2.8 | 3.0 | 2.9 | 3.1 |
| 3 | Free available Chlorine | mg/L | **Min 0.5** | 0.65 | 0.69 | 0.74 | 0.78 | 0.65 |

### 3.5 Soil Quality Monitoring: Date: 04/01/2019

| Locations of soil sampling ⇨ | | | Kandagara | Tunda | Desalpur | Siracha | Navinal |
|---|---|---|---|---|---|---|---|
| Sr. No. | Parameter | Unit | Results | | | | |
| 1 | Magnesium as Mg | % | 0.0041 | 0.0035 | 0.0039 | 0.0032 | 0.0031 |
| 2 | Molybdenum as Mo | % | N.D. | N.D. | N.D. | N.D. | N.D. |
| 3 | Phosphorous as P | % | 0.342 | 0.352 | 0.296 | 0.385 | 0.239 |
| 4 | Calcium as Ca | % | 0.0079 | 0.0065 | 0.0071 | 0.0074 | 0.0042 |
| 5 | Zinc as Zn | % | N.D. | N.D. | N.D. | N.D. | N.D. |
| 6 | Manganese as Mn | % | 0.0018 | 0.0020 | 0.0036 | 0.0019 | N.D. |
| 7 | Potassium as K | % | 0.0041 | 0.0114 | 0.0042 | 0.0219 | 0.0044 |
| 8 | Nitrogen as N | % | 0.0074 | 0.0241 | 0.0082 | 0.0115 | 0.0078 |
| 9 | Iron as Fe | % | 0.0129 | 0.0236 | 0.0073 | 0.0244 | 0.0103 |
| 10 | Copper as Cu | % | N.D. | N.D. | N.D. | N.D. | N.D. |
| 11 | Boron as B | % | N.D. | N.D. | N.D. | N.D. | N.D. |
| 12 | Sulphur | % | 0.0042 | 0.0092 | 0.0074 | 0.0108 | 0.0065 |
| 13 | Chlorides as Cl | % | 0.0082 | 0.0141 | 0.0214 | 0.0563 | 0.0471 |

**Note: N.D.** = Not Detected,

## 4 AMBIENT NOISE LEVEL MONITORING

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise generated by the operation activities around it. Noise monitoring has been conducted at 10 locations within the periphery of industry premises.

- **Date of Monitoring: 05/01/2019**

**Result**

| Sr. No. | Location | Noise Level dB(A) | | | |
|---|---|---|---|---|---|
| | | Sampling Time | Day Time dB(A) 06 am - 10 pm | Sampling Time | Night Time dB(A) 10 pm - 06 am |
| | | | Limit 75 dB(A) | | Limit 70 dB(A) |
| 1. | Nr. LDO Pump House | 10:40 am -11:50am | 61.5 | 22:05 pm -23:20pm | 55.1 |
| 2. | Nr. 20 MLD Plant | | 65.6 | | 58.1 |
| 3. | Nr. Pump House | | 58.8 | | 56.5 |
| 4. | Nr. Coal Handling plant | | 60.2 | | 54.5 |
| 5. | Nr. Gate No.4 | | 52.6 | | 51.9 |
| 6. | Nr. Integrated Ash Silo | | 64.1 | | 57.3 |
| 7. | Nr. Main Gate | | 58.2 | | 55.9 |
| 8. | Nr. APCH Building | | 63.3 | | 54.2 |
| 9. | Nr. Shantiniketan-I | | 56.4 | | 55.7 |
| 10. | Nr.OHC Building | | 60.3 | | 59.3 |

***Remark:*** Calibrated instruments were used during monitoring of above identified sample.

- **Date of Monitoring: 12.02.2019**

**Result**

| Sr. No. | Location | Noise Level dB(A) | | | |
|---|---|---|---|---|---|
| | | Sampling Time | Day Time dB(A) 06 am - 10 pm | Sampling Time | Night Time dB(A) 10 pm - 06 am |
| | | | Limit 75 dB(A) | | Limit 70 dB(A) |
| 1. | Nr. LDO Pump House | 11:00 am -12:45pm | 65.9 | 22:00 pm -23:15pm | 64.4 |
| 2. | Nr. 20 MLD Plant | | 60.8 | | 60.1 |
| 3. | Nr. Pump House | | 62.2 | | 61.7 |
| 4. | Nr. Coal Handling plant | | 61.4 | | 60.3 |
| 5. | Nr. Gate No.4 | | 59.7 | | 58.6 |
| 6. | Nr. Integrated Ash Silo | | 66.4 | | 62.0 |
| 7. | Nr. Main Gate | | 61.0 | | 60.5 |
| 8. | Nr. APCH Building | | 59.2 | | 56.3 |
| 9. | Nr. Shantiniketan-I | | 60.5 | | 59.6 |
| 10. | Nr.OHC Building | | 63.0 | | 62.2 |

***Remark:*** Calibrated instruments were used during monitoring of above identified sample.

- **Date of Monitoring: 05.03.2019**

**Result**

| Sr. No. | Location | Noise Level dB(A) | | | |
|---|---|---|---|---|---|
| | | Sampling Time | Day Time dB(A) 06 am - 10 pm | Sampling Time | Night Time dB(A) 10 pm - 06 am |
| | | | Limit 75 dB(A) | | Limit 70 dB(A) |
| 1. | Nr. LDO Pump House | 11:05 am -12:40pm | 61.7 | 22:05 pm -23:20pm | 56.6 |
| 2. | Nr. 20 MLD Plant | | 65.1 | | 55.7 |
| 3. | Nr. Pump House | | 60.5 | | 57.8 |
| 4. | Nr. Coal Handling plant | | 60.7 | | 57.9 |
| 5. | Nr. Gate No.4 | | 57.1 | | 56.9 |
| 6. | Nr. Integrated Ash Silo | | 62.9 | | 60.7 |
| 7. | Nr. Main Gate | | 60.1 | | 57.2 |
| 8. | Nr. APCH Building | | 61.3 | | 57.4 |
| 9. | Nr. Shantiniketan-I | | 58.7 | | 56.9 |
| 10. | Nr.OHC Building | | 58.4 | | 54.8 |

**Remark:** Calibrated instruments were used during monitoring of above identified sample.

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adani

# MARINE MONITORING REPORT

March– 2019(Pre Monsoon)

FOR

M/s. ADANI POWER (MUNDRA) LIMITED

At

Tunda & Siracha,
Tal. Mundra, Dist.: Kutch.
KUTCH, GUJARAT – 370 435

Prepared by

UniStar
Environment & Research Labs Pvt. Ltd.

# PREFACE

**M/s. Adani Power (Mundra) Limited (APMuL)** is a subsidiary company of Adani Group engaged in imported coal based thermal power plant at Mundra near village Tunda&Siracha, Taluka Mundra District Kutch, Gujarat has entrusted the work of carrying out Marine Monitoring to **M/s. UniStar Environment and Research Labs Pvt. Ltd., Vapi.**

Adani Power (Mundra) Limited has commissioned the first supercritical 660 MW unit in the country, engaged in imported coal based thermal power plant with capacity of 4620 MW at Mundra near village Tunda&Siracha, Taluka Mundra District Kutch, Gujarat. Has entrusted the work of carrying out Marine Monitoring to **M/S.UniStar Environment and Research Labs Pvt. Ltd., Vapi.**

The marine monitoring involves Physio-chemical and biological analysis of Marine water. Marine water quality of Sub-tidal and Intertidal regions, Flora and Fauna analysis in marine water area and Benthos in inter-tidal and sub-tidal analysis for the coastal area near Adani Power plant (Mundra) Limited. Water sample are collected from five location (station) and Benthos sample are collected from High water and low water transect area. Samples are brought to the laboratory by field sampling team and the analysis was carried out in our laboratory and the results are presented in this report.

These Marine Monitoring reports provide a data obtained from monitoring and analysis activities undertaken during March 2019.

Date: 27/03/2019

**M/S.UniStar Environment and**
**Research Labs Pvt. Ltd.**
White house, Char Rasta,
Vapi-396 191

| Sampling by | Report Prepared By | Approved by |
|---|---|---|
| (Bhavin Patel) | (Shweta Rana) | (Jaivik Tandel) |

adani

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# INTRODUCTION

## 1.1 Background

Adani Power (Mundra) Limited (APMuL) is engaged in imported coal based thermal power plant with capacity of 4620 MW at Mundra near village Tunda&Siracha, Taluka Mundra District Kutch, Gujarat.

Adani Power (Mundra) Limited (APMuL) is largest single location private coal based power plant in the world it is created history by synchronizing the first super-critical technology based 660MW generating unit at Mundra. This is not only the first super-critical generating unit in the country but also the fastest project implementation ever by any power developer in the country. The Phase III of the Mundra Project, which is based on supercritical technology, has received 'Clean Development Mechanism (CDM) Project' certification from United Nations Framework Convention on Climate Change (UNFCCC). This is the world's first thermal project based on supercritical technology to be registered as CDM Project under UNFCCC.

Adani Power (Mundra) Limited (APMuL) assessing marine environment it involves Physio-chemical and biological analysis of Marine water. Marine water quality of Sub-tidal and Intertidal regions, Flora Phytoplankton's and Phytopigments and Fauna analysis in marine water area it includes Zooplanktons, Benthos in inter-tidal and sub-tidal analysis for the coastal area near power plant marine outfall water mixing and Sea intake, with special reference to intake channel and seawater discharge.

This report is prepare by the **M/S.UniStar Environment and Research Labs Pvt. Ltd**., at the instance of APMuL and addresses the marine environmental issues related to the APMuL's operational power plant.

## 1.2 Objectives:

a) Physico chemical seawater parameter to be analyzed for understands the water quality in study area.
b) Sediment samples will be analyzed for estimate selected trace metals.
c) The prevailing marine biological status of the study area is evaluated based on the quantitative and qualitative data on marine life namely Phytoplankton, zooplankton, Chlorophyll & Pheophytin, Sub-tidal/ intertidal Macro benthos.
d) To recommend adequate marine environmental management measures

## 1.3 Study program:

**Period:**

The field investigation is completed during March 2019 and sampling team was planned in such a manner so as to get a detailed picture of the marine environment characteristics of the study area and Sampling and analysis for marine environment has been carried out by **M/S.UniStar Environment and Research Labs Pvt. Ltd**.

**Study Station locations:**

A total of five subtidal station and three intertidal transects was selected for the sampling, here we are given exact location and their position were sampled.

**Table 1: Station locations and co ordinates**

| Subtidal Station | | | |
|---|---|---|---|
| **Station** | **Locations** | **Co ordinates** | |
| 1 | Intake point | 22°47’56”N | 69°32’23”E |
| 2 | Mouth of intake point | 22°47’26”N | 69°32’28”E |
| 3 | West port area | 22°45’47”N | 69°36’36”E |
| 4 | Outfall area | 22°44’37”N | 69°37’12”E |
| 5 | Outfall area | 22°44’44”N | 69°36’41”E |

| Intertidal transect | | | |
|---|---|---|---|
| I | High Tide water level | 22°63’43.1”N | 69°46’31.3”E |
| | Low Tide water level | 22°46’52.2”N | 69°72’48.4”E |
| II | High Tide water level | 22°68’47.3”N | 69°52’38.0”E |
| | Low Tide water level | 22°51’38.0”N | 69°56’29.2”E |
| III | High Tide water level | 22°56’41.1”N | 69°47’34.1”E |
| | Low Tide water level | 22°74’58.2”N | 69°57’42.2”E |

**Figure 1.1: Study marine stations location map**

## 1.4 Sampling

**a) Sampling frequency:**

All Sampling subtidal stations were monitored during flood to ebb. Water samples were collected in duplicate (surface and bottom) for assessing water quality and marine biological characteristics.

Intertidal sampling was completed during low tide, for assessed Macro benthic fauna samples were collect in duplicate from each transects.

**b) Sampling methodology:**

- Niskin (5 litre capacity) with a mechanism for closing at a desired depth using messenger was used for collecting sub–surface water samples. Sampling at the surface was done using a clean polyethylene bucket. Known volume of water sample (1 L) was preserved with 4% Lugol's iodine solution.
- For the analysis of Benthos, sub tidal sediment samples were collected using Van-veen grab covering an area of 0.04 $m^2$. Intertidal samples were collected using metal quadrant. Samples were sieved with 500 µ metal sieve and preserved with Rose Begal-Formalin solution.
- For Zooplankton oblique hauls were made using Heron Tranter net attached with calibrated flow meter. After collection, samples were preserved with 5% formalin.

**C) Methods of analysis:**

**I) Physicochemical Parameter**: Samples were analyses by using analytical methods for estimations of Temperature, Turbidity, PH, SS, Salinity, DO, BOD, COD, Phosphate, Total nitrogen, Nitrite, Nitrate, Phenols and PHc.

**II) Biological Samples**: Phytoplankton, Zooplankton and Macro benthos.

**a) Phytoplankton:** Sample for cell count was preserved in Lugol's iodine solution, and identification of phytoplankton was done under a compound microscope using Sedgwick Rafter slide.

**b) Chlorophyll:** For the estimation of chlorophyll *a* and Pheophytin, the extinction of the acetone extract was measured using Turner Flurometer before and after treatment with dilute acid respectively.

**c) Zooplankton:** Volume (biomass) was obtained by displacement method. A portion (25-50 %) of the sample was analyzed under a microscope for faunal composition and population count.

**d) Benthos:** The total Macro benthos population (sub tidal& intertidal) was estimated as number of 1 $m^2$ area and biomass on wet weight basis.

# WATER QUALITY

## 2.1 Marine Water quality:

Sea water samples have been collected during March 2019(Pre Monsoon)

From Five locations, which are listed in Table 2

**Table 2: Water sampling locations, March 2019(Pre Monsoon)**

| Station no. | Location | Tide |
|---|---|---|
| 1 | Intake point | Flood |
| 2 | Intake point | Ebb to Flood |
| 3 | West port area | Flood to Ebb |
| 4 | Outfall area | Flood |
| 5 | Outfall area | Flood to Ebb |

**2.2 Physico chemical Water analysis result:**

All the water sampled, which is collected by sampling team is brought to the lab for Physico chemical analysis. The marine water quality at different collected stations are measured during this investigation is presented in Table No.3

**Table: 3 Physico chemical Water Analysis Result**

| Sr. No. | Parameters | Station 1 | | Station 2 | | Test Method Permissible |
|---|---|---|---|---|---|---|
| | | Surface | Bottom | Surface | Bottom | |
| **PHYSICAL QUALITY** | | | | | | |
| 1. | pH @ 25 ° C | 8.10 | 8.03 | 7.95 | 8.04 | IS 3025(Part 11)1983 |
| 2. | Temperature ($^0$C ) | 31 | 30.5 | 31 | 30 | IS 3025(Part 9)1984 |
| 3. | Turbidity (NTU) | 1 | 1 | 1 | 1 | IS 3025(Part 10)1984 |
| **CHEMICAL QUALITY** | | | | | | |
| 1. | Total Suspended Solids (mg/l) | 65 | 72 | 68 | 76 | (APHA 23rd Ed.,2017,2540-D) |
| 2. | Biochemical Oxygen Demand (BOD) (mg/l) | 3.8 | 4.6 | 4.4 | 5.2 | IS 3025(Part 44)1993Amd.01 |
| 3. | Sulphate as $SO_4$(mg/l) | 3620 | 3500 | 3400 | 3300 | (APHA 23rd Ed.,2017,4500-SO4 E) |
| 4. | Ammonical Nitrogen(µmol/l) | 3.7 | 4.3 | 4.9 | 3.7 | (APHA 23rd Ed.,2017,4500-NH3 B) |
| 5. | Salinity (ppt) | 36 | 37.5 | 37.6 | 38.2 | By Calculation |
| 6. | Dissolved Oxygen (mg/l) | 4.3 | 4.7 | 5.0 | 5.4 | IS 3025(Part 38)1989, |
| 7. | Total Nitrogen (µmol/l) | 16.12 | 16.12 | 16.12 | 11.28 | (APHA 23rd Ed.,2017,4500-O,B), |
| 8. | Dissolved Phosphate (µmol/l) | 0.9 | 0.6 | 0.8 | 1.1 | APHA 23rd Ed.,2017,4500 NH3 - B |
| 9. | Nitrate (µmol/l) | 16.12 | 16.12 | 16.12 | 11.28 | (APHA 23rd Ed.,2017,4500-P,D) |
| 10. | Nitrite (µmol/l) | 0.5 | 0.3 | 0.2 | 0.6 | (APHA 23rd Ed.,2017,4500 NO3-B) |
| 11. | Phenol(µg/l) | BDL(MDL :0.01) | BDL(MDL:0.01) | BDL(MDL:0.01) | BDL(MDL:0.01) | APHA 23rd Ed.,2017,4500NO2B |
| 12. | PHc (ppb) | N.D. | N.D. | N.D. | N.D. | IS 3025(Part 43)1992Amd.02 |

Note: MDL = Minimum Detection Limit (MDL: 0.01) and N.D. = Not detectable

| Sr. No | Parameters | Station 3 | | Station 4 | | Test Method Permissible |
|---|---|---|---|---|---|---|
| | | Surface | Bottom | Surface | Bottom | |
| **PHYSICAL QUALITY** | | | | | | |
| 1. | pH @ 25 ° C | 8.12 | 7.90 | 8.15 | 8.04 | IS 3025(Part 11)1983 |
| 2. | Temperature $^0$C | 31 | 30.5 | 30.5 | 30 | IS 3025(Part 9)1984 |
| 3. | Turbidity (NTU) | 0.1 | 1 | 0.1 | 1 | IS 3025(Part 10)1984 |
| **CHEMICAL QUALITY** | | | | | | |
| 1. | Total Suspended Solids (mg/l) | 69 | 72 | 82 | 84 | (APHA 23rd Ed.,2017,2540-D) |
| 2. | Biochemical Oxygen Demand (BOD) (mg/l) | 4.5 | 4.8 | 5.4 | 5.2 | IS 3025(Part 44)1993Amd.01 |
| 3. | Sulphate as $SO_4$(mg/l) | 2860 | 2689 | 3150 | 3260 | (APHA 23rd Ed.,2017,4500-SO4 E) |
| 4. | Ammonical Nitrogen(µmol/l) | 4.9 | 4.9 | 4.3 | 4.3 | (APHA 23rd Ed.,2017,4500-NH3 B) |
| 5. | Salinity (ppt) | 36.5 | 36.8 | 36.4 | 37.2 | By Calculation |
| 6. | Dissolved Oxygen (mg/l) | 5.6 | 5.05 | 5.4 | 5.6 | IS 3025(Part 38)1989, |
| 7. | Total Nitrogen (µmol/l) | 14.51 | 17.74 | 11.28 | 12.90 | (APHA 23rd Ed.,2017,4500-O,B), |
| 8. | Dissolved Phosphate (µmol/l) | 1.0 | 1.5 | 1.3 | 1.1 | APHA 23rd Ed.,2017,4500 NH3 - B |
| 9. | Nitrate (µmol/l) | 14.51 | 17.74 | 11.28 | 12.90 | (APHA 23rd Ed.,2017,4500-P,D) |
| 10. | Nitrite (µmol/l) | 0.5 | 0.6 | 0.5 | 0.5 | (APHA 23rd Ed.,2017,4500 NO3-B) |
| 11. | Phenol(µg/l) | 32.2 | 34.5 | 22.4 | 26.5 | APHA 23rd Ed.,2017,4500NO2B |
| 12. | PHc (ppb) | N.D. | N.D. | N.D. | N.D. | IS 3025(Part 43)1992Amd.02 |

Note: MDL = Minimum Detection Limit (MDL: 0.01) and N.D. = Not detectable

| Sr. No. | Parameters | Station 5 | | Test Method Permissible |
|---|---|---|---|---|
| | | Surface | Bottom | |
| **PHYSICAL QUALITY** | | | | |
| 1. | pH @ 25 ° C | 8.23 | 8.00 | IS 3025(Part 11)1983 |
| 2. | Temperature ( $^0$C ) | 30.5 | 30 | IS 3025(Part 9)1984 |
| 3. | Turbidity (NTU) | 0.1 | 1 | IS 3025(Part 10)1984 |
| **CHEMICAL QUALITY** | | | | |
| 1. | Total Suspended Solids | 42 | 66 | (APHA 23rd Ed.,2017,2540- D) |
| 2. | Biochemical Oxygen Demand (BOD) (mg/l) | 3.4 | 5.3 | IS 3025(Part 44)1993Amd.01 |
| 3. | Sulphate as $SO_4$ (mg/l) | 4222 | 3648 | (APHA 23rd Ed.,2017,4500-SO4 E) |
| 4. | Ammonical Nitrogen(µmol/l) | 1.26 | 1.12 | (APHA 23rd Ed.,2017,4500-NH3 B) |
| 5. | Salinity (ppt) | 35.0 | 35.6 | By Calculation |
| 6. | Dissolved Oxygen (mg/l) | 6.7 | 6.0 | IS 3025(Part 38)1989, |
| 7. | Total Nitrogen (µmol/l) | 11.28 | 11.28 | (APHA 23rd Ed.,2017,4500-O,B), |
| 8. | Dissolved Phosphate (µmol/l) | 1.2 | 1.6 | APHA 23rd Ed.,2017,4500 NH3 - B |
| 9. | Nitrate (µmol/l) | 11.28 | 11.28 | (APHA 23rd Ed.,2017,4500-P,D) |
| 10. | Nitrite (µmol/l) | 0.8 | 0.6 | (APHA 23rd Ed.,2017,4500 NO3-B) |
| 11. | Phenol(µg/l) | 36.2 | 42.6 | APHA 23rd Ed.,2017,4500NO2B |
| 12. | PHc(ppb) | N.D. | N.D. | IS 3025(Part 43)1992Amd.02 |

Note: MDL = Minimum Detection Limit (MDL: 0.01) and N.D. = Not detectable

**a) Temperature:** Marine water temperature of the study area was checked on site, so surface & bottom water temperature observed in the study area in range between 30$^0$C to 31$^0$C. The water temperature generally varied in accordance with the prevailing air temperature, tidal activity and seasonal variation.

**b) pH:** The pH of the water is generally buffering effect, influenced by the freshwater and anthropogenic discharge from land. The observed pH in the study area in range of 7.95 to 8.23 at surface level and 7.90 to 8.04 at bottom level.

**c) Salinity:** Salinity which is an indicator of seawater, the standard average salinity of sea water is 35 to 38 ppt, which is variable depending on the riverine flow, any fresh water discharge from landward side, rainy season and temperature in study area. Average salinity (ppt) for monsoon study is 35.0 to 37.6 ppt at surface water as well as 35.6 to 38.2 ppt at bottom water.

**d) DO & BOD:** High Dissolve oxygen level is measured of good oxidizing conditions in an aquatic environment. In unpolluted waters equilibrium is maintained between its generation through photosynthesis and dissolution from the atmosphere, and consumption by the respiration and decay of organic matter in a manner that Dissolve oxygen levels are close to or above saturation value.

Dissolve oxygen level of the study area is varied from 4.3 mg/l to 6.7 mg/l at water surface level & 4.7 mg/l to 6.0 mg/l at water bottom level. The comparison of average Dissolve oxygen value of monsoon period is 5.4 mg/l which show the good oxidizing conditions in study area aquatic environment.

BOD was generally indicating effective consumption of oxidisable matter in that water body. BOD of the study area is varied from 3.4 to 5.4mg/l at water surface level and 4.6 to 5.3mg/l at water bottom level.

**e) Nutrients:** Dissolved phosphorus and nitrogen compounds serve as the nutrients for phytoplankton which is the primary producer in aquatic food chain. Phosphorous compounds are present predominantly as reactive phosphate while combined nitrogen is present as nitrate, nitrite and ammonium species. So nutrient concentration (phosphate – nitrate - nitrite) in the study area is Phosphate range 0.80 to 1.3 µmol/l in at Surface water and 0.6 to 1.6 µmol/l at Bottom water , Nitrate range 11.28 to 16.12 µmol/l in surface water and 11.28 to 17.74 µmol/l at bottom water, Nitrite range 0.2 to 0.8 µmol/l in surface level and 0.3 to 0.6 µmol/l at bottom level. This nutrient concentration values indicate water healthiness.

**f) PHc and phenol:** The observed Phenol in the study area in range of 0.0 to 36.4 µg/l at surface level and 0.0 to 42.6 µg/l at bottom level. The level of PHc was below detection level

which indicates in significant influence of anthropogenic inputs on the water body in study area

**g) Total suspended solids**: The suspended solids generally constitute clay, silt and sand from the bed sediment and that from the upstream as well as contributed through shore erosion. Anthropogenic discharges also contribute to suspended solids in the form of contaminates such as oil and solid waste in polluted area. Suspended solids in the study area are little variable, surface area range observed 42 to 80mg/l as well as bottom area range is 66 to 84mg/l.

## BIOLOGICAL CHARACTERISTICS (BIODIVERSITY STUDIES):

Marine environment is unique ecosystems involve the complex interaction between abiotic and biotic components. Any change in the abiotic factors leads to change in aquatic organisms (biotic factor). The human interventions always compromise the health of marine ecosystem by disturbing the ecological balance. Hence the assessment of the biotic components along with abiotic factors is an integral part of Environmental assessment and monitoring study. During the present study at APL the abundance and distribution of marine organisms (plankton and benthos) were studied as part of routine environmental monitoring.

### 3.1 Planktonic Forms:

The name plankton is derived from the Greek word “planktons”, meaning “wanderer” or “drifter”. While some forms of plankton are capable of independent movement and can swim up to several hundred meters in a single day, their position is primarily determined by currents in the body of water they inhabit. By definition, organisms classified as "plankton" are unable to resist ocean currents. Plankton is primarily divided into broad functional groups:

1. Phytoplankton
2. Zooplankton

This scheme divides the plankton community into broad producer and consumer groups.

**a) Phytoplankton:**

The organisms responsible for primary production in all aquatic ecosystems are known as “phytoplankton.” These miraculous microscopic organisms not only form the base of life in our oceans, but also produce up to 90% of the oxygen in our atmosphere.

Phytoplankton is microscopic plants that live in the ocean, freshwater and other terrestrial based water systems. There are many species of phytoplankton, each of which has a characteristic shape, size and function. Marine species of phytoplankton grow abundantly in oceans around the world and are the foundation of the marine food chain. Marine Phytoplankton is the producing (autotrophic) component in the ocean. There are fourteen classes of phytoplankton. Each class of phytoplankton contains unique attributes in size, cell structure, nutrients and function.

**b) Zooplankton:**

Zooplankton are the consumer organism, incapable of making its own food from light or inorganic compounds, and feeds on organisms or the remains of other organisms to get the energy necessary for survival. They are primarily depends on the phytoplankton and other small organisms groups for their nutritional needs.

### 3.2 Significance of Phytoplankton and Zooplankton:

Phytoplankton are the major primary producers of organic matter in the aquatic ecosystem. They contribute up to 90% in primary productivity in the Oceanic environment. As part of photosynthesis process they produce organic compounds from carbon dioxide with the help of sunlight and inorganic compound. Collectively, they directly or indirectly support the entire animal population, and thus form the basis of most marine food webs. Phytoplankton also helps in the carbon dioxide sequestration process. The significance of zooplanktons is found in their role in transferring biological production from phytoplankton to large organisms in the marine food web and to the sea floor. A large number of phytoplankton species are grazed upon by the microscopic protozoan, tunicates, copepods and other crustaceans. These in turn become food for other animals further linking the food web. Therefore, variability in the reproduction of copepods would affect the survival of young fish that depend on them.

**Table: 4 Test methods for Phytoplankton & Zooplankton analysis**

| Sr. no. | Test performed | Method |
|---|---|---|
| 1 | Phytoplankton | APHA, Edition 21, Part 10000, 10200 F |
| 2 | Zooplankton | APHA, Edition 21, Part 10000, 10200 G |

## 3.3 Phytoplankton:

Phytoplankton sampling was carried out at 5 stations. At each station water samples were collected from surface and bottom waters. The sampling location is given in following table.5

**Table 5: Phytoplankton Sampling Station**

| Station | Location | Co ordinates | | Water depth | Tide |
|---|---|---|---|---|---|
| 1 | Intake point | 22°58'40.5"N | 69°62'37.0"E | 6 m | Flood |
| 2 | Intake point | 22°62'32.2"N | 69°52'32.1"E | 6.5 m | Ebb - Flood |
| 3 | West port area | 22°56'49.0"N | 69°47'25.3"E | 12 m | Flood - Ebb |
| 4 | Outfall area | 22°74'41.7"N | 69°60'98.5"E | 5 m | Flood |
| 5 | Outfall area | 22°60'39.2"N | 69°34'52.0"E | 6 m | Flood - Ebb |

A Niskin sampler with a closing mechanism at a desired depth was used for collecting sub surface water samples. Surface samples were collected using a clean polyethylene bucket. Samples were stored in amber colored plastic containers fitted with inert cap liners. Further Lugol's solution was added to preserve the phytoplankton cells for further enumeration. The identification of phytoplankton were carried out under a microscope using Sedgwick Rafter slide.

### 3.3.1 Microscopic Observations

For phytoplankton enumeration 0.5 ml of the sample was taken on Sedgwick-Rafter counting cells. The identification was done using a microscope under 40X or 100X magnification. The standard keys given by Desikachary, 1959; Sournia, 1974; Tomas 1997; Horner, 2002 were used for the identification of phytoplankton cells. Species were identified to a genus level.

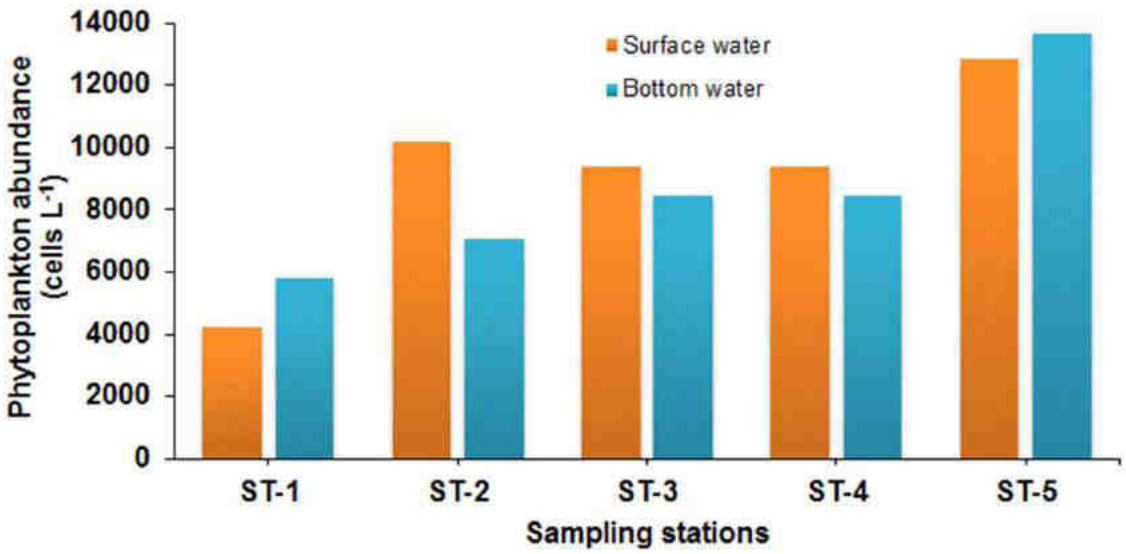
### 3.3.2 Phytoplankton Diversity

Phytoplankton sampling was carried out at 5 stations throughout the sampling period. A maximum 25 phytoplankton genera, Amphidinum, *Amphora*, *Bacteriastrum*, Ceratium, Cerataulina, *Chaetoceros*, Coretron, *Coscinodiscus*, *Cylindrotheca*, *Ditylum, Dinophysis, Fragilaria, Gunardia, Hemialus*, *Lauderia, Leptocylindrus, Melosera, Meuneria, Navicula, Nitzschia*, *Noctiluca*, *Odontella, Pleurosigma, Protoperidinium,* Pseudonitzschia, *Rhizosolenia*, *Scrippsiella*, *Surirella*, *Thalassionema* and *Thalassiosira* were identified at Station 4 (ST-4) during the study period. At station 5 (ST-5) minimum of 17 phytoplankton genera, *Ceratium, Chaetoceros*, *Coscinodiscus*, *Cylindrotheca*, *Ditylum*, *Gunardia*, *Hemialus*, *Lauderia*, *Leptocylindrus*, *Melocera*, *Navicula*, *Odontella*, *Pleurosigma*, *Rhizosolenia*, *Surirella*, *Thalassionema* and *Thalassiosira were* identified from the preserved samples.

The phytoplankton abundance in the study region was ranged from 4212 to 13674 cells $L^{-1}$. Highest phytoplankton abundance was observed at the ST-5 bottom water. However, lowest phytoplankton abundance was observed at the ST-1 surface water (Table: 6; Graph: 1.2)

**Table 6: Total abundance & groups of phytoplankton at the sampling stations**

| Station | Abundance (cells $L^{-1}$) | | Genera count | Phytoplankton groups observed in both surface and bottom water |
|---|---|---|---|---|
| | Surface | Bottom | | |
| ST-1 | 4212 | 5800 | 19 | *Cerataulina*, *Chaetoceros*, *Coscinodiscus*, *Cylindrotheca*, *Ditylum*, *Dinophysis*, *Fragilaria*, *Leptocylindrus*, *Melosera*, *Meuneria*, *Navicula*, *Odontella*, *Pleurosigma*, *Protoperidinium*, Pseudonitzschia, *Rhizosolenia*, *Skeletonema*, *Thalassionema* and *Thalassiosira*. |
| ST-2 | 10176 | 7052 | 22 | *Amphora*, *Cerataulina*, *Chaetoceros*, *Coscinodiscus*, *Cylindrotheca*, *Ditylum*, *Fragilaria*, *Gunardia*, *Lauderia*, *Leptocylindrus*, *Melosira*, *Meuneria*, *Navicula*, *Odontella*, *Pleurosigma*, *Protoperidinium*, *Pseudonitzschia*, *Rhizosolenia*, *Skeletonema*, *Surirella*, *Thalassionema* and *Thalassiosira*. |
| ST-3 | 9400 | 8470 | 19 | *Amphora*, *Bacteriastrum*, *Chaetoceros*, Corethron, *Coscinodiscus*, *Cylindrotheca*, *Ditylum*, *Lauderia*, *Melosira*, *Navicula*, *Nitzschia*, *Odontella*, *Pleurosigma*, *Pseudonitzschia*, *Rhizosolenia*, *Skeletonema*, *Surirella*, *Thalassionema* and *Thalassiosira*. |
| ST-4 | 9400 | 8470 | 23 | *Amphidinium*, *Amphora*, *Bacteriastrum*, *Ceratium*, *Cerataulina*, *Chaetoceros*, *Coscinodiscus*, *Cylindrotheca*, *Ditylum*, *Gunardia*, *Hemialus*, *Lauderia*, *Melosira*, *Navicula*, *Odontella*, *Pleurosigma*, *Pseudonitzschia*, *Rhizosolenia*, *Scrippsiella*, *Skeletonema*, *Surirella*, *Thalassionema* and *Thalassiosira*. |
| ST-5 | 12864 | 13674 | 17 | *Ceratium*, *Chaetoceros*, *Coscinodiscus*, *Cylindrotheca*, *Ditylum*, *Gunardia*, *Hemialus*, *Lauderia*, *Leptocylindrus*, *Melocera*, *Navicula*, *Odontella*, *Pleurosigma*, *Rhizosolenia*, *Surirella*, *Thalassionema* and *Thalassiosira*. |




**Graph 1.2: Abundance of phytoplankton (cells $L^{-1}$) observed in surface and bottom waters at the sampling stations.**

***Ditylum sp.***

***Coscinodiscus sp.***

***Pleurodigma sp.***

***Rhizosolenia sp.***

**1.3 Microphotographs of phytoplankton reported at sampling stations**

### 3.4 Zooplankton:

Zooplankton samples were collected at 5 selected locations. The sampling details are given in following table 7.

**Table 7: Zooplankton Sampling Station**

| Station | Location | Co ordinates | | Water depth | Tide |
|---|---|---|---|---|---|
| 1 | Intake point | 22°58'40.5"N | 69°62'37.0"E | 6 m | Flood |
| 2 | intake point | 22°62'32.2"N | 69°52'32.1"E | 6.5 m | Ebb - Flood |
| 3 | West port area | 22°56'49.0"N | 69°47'25.3"E | 12 m | Flood - Ebb |
| 4 | Outfall area | 22°74'41.7"N | 69°60'98.5"E | 5 m | Flood |
| 5 | Outfall area | 22°60'39.2"N | 69°34'52.0"E | 6 m | Flood - Ebb |

Oblique hauls for Zooplankton were made using Heron Tranter net with calibrated flow meter. Samples were preserved with formalin and stored in plastic containers with inert cap liners till further analysis.

#### 3.4.1 Microscopic Observations

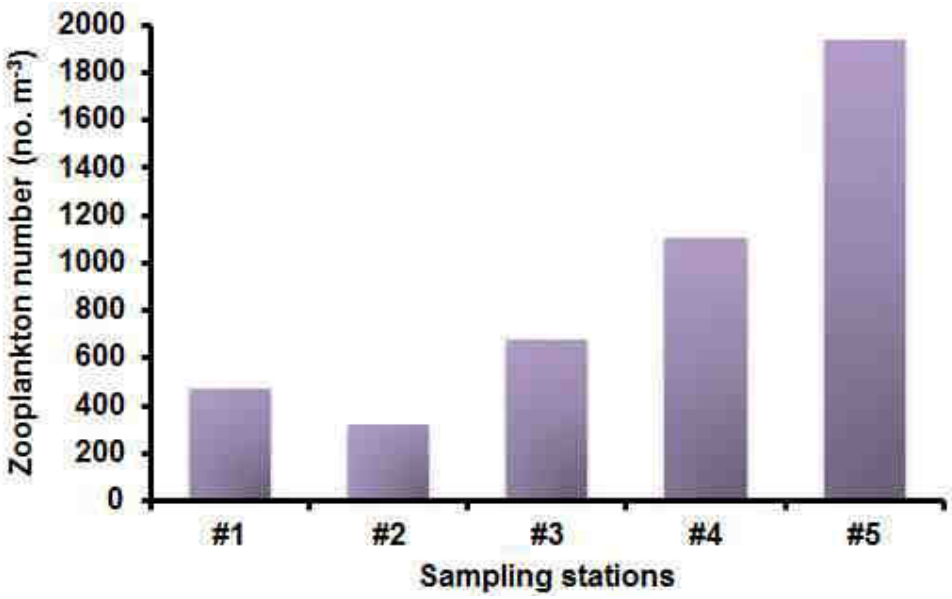
For quantification of zooplankton, 0.5 ml of the sample was taken in zooplankton counting chamber. The identification was carried out under Stereomicroscope at 45X or 100X magnification. The zooplanktons were identified using standard identification keys given by Kasturirangan 1963; Santhanam and Srinivasan, 1994 and Conway et al., 2003 etc. Species were identified to group level.

#### 3.4.2 Zooplankton Diversity

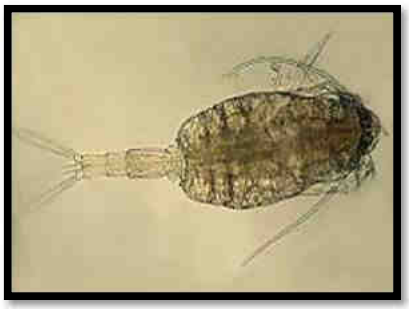
Zooplankton samples were collected from 5 stations located around APL plant, Mundra. Samples were collected during March 2019. A maximum 6 genera of Zooplankton Copepod, Copepod nauplii, Decapoda, Gastropod larvae, Fish egg and Okiopleura, were identified from 5 stations. A minimum 3 genera of zooplankton were recorded at ST-1. At ST-4 and ST-5 zooplankton species belonging to 6 genera, Copepod, Copepod nauplii, Okiopleura, Decapoda, Fish egg and Gastropod larvae were observed. Abundance of zooplankton was ranged in between 324 to 1941 no.$m^{-3}$. ST-2 was characterized by lowest zooplankton abundance (324 no. $m^{-3}$) and biomass (0.094 ml $m^{-3}$), whereas highest were recorded at ST-5 abundance (1941 no. $m^{-3}$) and biomass (0.183 ml $m^{-3}$) (Table no. 8).

**Table 8: Total abundance, biomass and groups of zooplankton at the sampling stations**

| Station | Biomass ($m/m^{-3}$) | Population (no. $m^{-3}$) | Total groups | Zooplankton groups observed in the study |
|---|---|---|---|---|
| ST-1 | 0.121 | 475 | 3 | Copepod, Fish egg and Decapod larvae |
| ST-2 | 0.094 | 324 | 4 | Copepod, Okiopleura, Decapoda and Fish egg |
| ST-3 | 0.167 | 680 | 4 | Copepod, Copepod nauplii, Decapoda and Fish egg |
| ST-4 | 0.139 | 1180 | 6 | Copepod, Copepod nauplii, Okiopleura, Decapoda, Fish egg and Gastropod larvae |
| ST-5 | 0.183 | 1941 | 6 | Copepod, Copepod nauplii, Okiopleura, Decapoda, Fish egg and Gastropod larvae |




**Graph 1.4: Total number of zooplankton (no. $m^{-3}$) at the sampling stations.**



*Copepod*

*Copepod nauplii*

**1.5 Microphotographs of zooplanktons reported at sampling stations**

### 3.5 Benthic Fauna

The benthic zone is the ecological region at the lowest level of a water (such as an ocean or a lake) which include the sediment surface and some sub-surface layers. The superficial layer of sediment is an integral part of the benthic zone, as it influences greatly the biological activity which takes place there. Organisms living in this zone are called benthos. They generally live in close relationship with the substrate bottom; many such organisms are attached to the bottom. Some benthic organisms are mainly dwelling at the bottom of the substratum but at times may travel upwards in the water column. They may also occupy rock crevices, organic debris and other microhabitat at the bottom. The benthic invertebrates ranges from microscopic (e.g. micro invertebrates, <10 microns) to a few tens of centimeters or more in length (e.g. macro invertebrates, >50 cm).

Benthic organisms are morphologically different from that planktonic organisms. Many are adapted to live on the substrate (bottom). In benthic habitats they can be considered as dominant creatures. These organisms adapted to deep-water pressure so cannot survive in the upper parts of the water column. Since light does not penetrate very deep ocean-water, the benthic organisms often depends on the organic matter falling from the upper water column as their main energy source. This dead and decaying matter sustains the benthic food chain. The most benthic organisms in are scavengers or detritivores. These organisms by virtue of being relatively stationary, are constantly exposed to changes undergoing in overlying water, and hence, respond very well to aquatic pollution. The macro benthic population is very sensitive to environmental perturbation and is highly influenced by the physicochemical characteristics of water, nature of substratum, food, predation and other

factors. The density of benthic invertebrates also fluctuates widely with the changes in the season.

### 3.5.1 Significance of benthic macro invertebrates

The biomass of benthic organisms in estuaries and coastal embayment is often high. It declines if communities are affected by prolonged periods of poor water quality especially when anoxia and hypoxia are common. Burrowing and tube-building by deposit-feeding benthic organisms (bioturbators) helps to mix the sediment and enhances decomposition of organic matter. Nitrification and denitrification are also enhanced because a range of oxygenated and anoxic micro-habitats are created. For example, the area of oxic-anoxic boundaries and the surface area available for diffusive exchange are increased by tube-building macro invertebrates. Loss of nitrification and denitrification (and increased ammonium efflux from sediment) in coastal and estuarine systems is an important cause of hysteresis, which can cause a shift from clear water to a turbid state.

The loss of benthic suspension-feeders can further enhance turbidity levels because these organisms filter suspended particles including planktonic algae, and they enhance sedimentation rates through bio deposition (*i.e.* voiding of their wastes and unwanted food). Changes in the macro fauna (and flora) cause changes in nutrient storage pools. Macro fauna are also important constituents of fish diets and thus are an important link for transferring energy and nutrients between trophic levels, also driving pelagic fish and crustacean production. For these reasons the benthic organisms are extremely important indicators of environmental change.

### 3.5.2 Methodology

To enumerate the macro-benthic population sediment samples were collected from 5 sub-tidal and 3 inter-tidal transects. The details are as mentioned in the table (10 & 11). Sample was collected in the month of March 2019.

**Table 9: Test method for Benthos analysis**

| Sr. No | Test performed | Method |
|---|---|---|
| 1 | Benthos | APHA, Edition 21, Part 10000,10500 A-10500 D |

**Table 10: Sub-tidal Benthos Sampling Sites**

| Station | Location | Co ordinates | | Sediment quality |
|---|---|---|---|---|
| 1 | Intake point | 22°47'56"N | 69°32'23"E | Silty clay |
| 2 | intake point | 22°47'26"N | 69°32'28"E | Silty clay |
| 3 | West port area | 22°45'47"N | 69°36'36"E | Silty clay |
| 4 | Outfall area | 22°44'37"N | 69°37'12"E | Sandy |
| 5 | Outfall area | 22°44'44"N | 69°36'41"E | Silty clay |

**Table 11: Intertidal Benthos Sampling Sites**

| Transect | Location | Co ordinates | Intertidal expose area (m) | Sediment quality |
|---|---|---|---|---|
| I | High water level | 22°63'43.1"N 69°46'31.3"E | 42 m | Sandy |
| | Low water level | 22°46'52.2"N 69°72'48.4"E | | Silty-sand |
| II | High water level | 22°68'47.3"N 69°52'38.0"E | 54 m | Sandy |
| | Low water level | 22°51'38.0"N 69°56'29.2"E | | Silty-sand |
| III | High water level | 22°56'41.1"N 69°47'34.1"E | 47 m | Sandy |
| | Low water level | 22°74'58.2"N 69°57'42.2"E | | Sandy |

For the analysis of Benthos subtidal sediment samples were collected using Van- veen grab as well as intertidal samples were collected using metal quadrant.
The total Macro benthos population (sub tidal & intertidal) was estimated as number of 1 $m^2$ area and biomass on wet weight basis.

### 3.5.3 Handling and Preservation

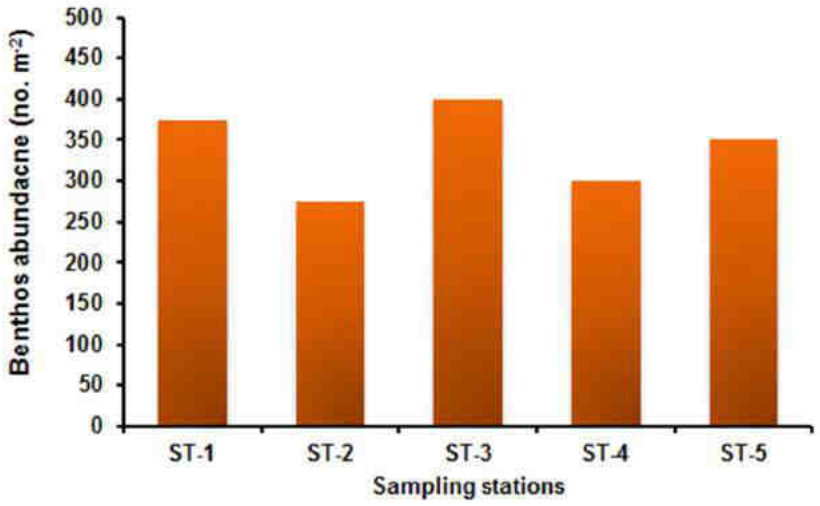
The samples were first sieved with 500 µ size metal sieve and then washed with sea water. Sieving yields residual mixture of benthic organisms and detritus matter. The organisms were handpicked using forceps and paint brush. After sorting, macro benthic organisms were identified to the group level. Organisms were preserved in 10% formalin.

### 3.5.4 Identification

Identification of the organisms was done under stereo-microscope. Day, 1967, Fauchald, 1977 were used as standard reference for identification of the macro invertebrates.

### 3.5.5 Benthic Diversity

Benthic invertebrates in the present study area were distributed on the surface of bed forms i.e. sandy and Silty clay in nature. The abundance and diversity, species composition of benthic invertebrates were recorded which is the indicators of changing environmental conditions. A total 5 sub tidal stations and 3 intertidal transect were distributed throughout the sampling effort. Samples were collected during December 2018.




**Graph 1.6: Abundance of subtidal macrobenthos (no. $m^{-2}$).**

**Sub tidal region:**

- A maximum 3 group of *Polychaeta*, Isopoda and Sipunculids identified from St-3. At ST-5 Amphipoda also reported along with *Polychaeta* and Isopoda. A minimum of 2 benthos groups were recorded at ST-1, ST-2 and ST-4.
- In the sub-tidal region macro benthos abundance was higher at ST-1 (375 no. $m^{-2}$), whereas lowest abundance was recorded at ST-2 (275 no. $m^{-2}$). Higher macrobenthic biomass was recorded at ST-2 (6.293 mg. $m^{-2}$) as compared to other stations (Table: 12).

**Table 12: Standing stock and abundance of sub tidal macro benthos**

| Station | Biomass (mg. $m^{-2}$) | Abundance (no. $m^{-2}$) | Total Group (No.) | Major Group |
|---|---|---|---|---|
| ST-1 | 0.525 | 375 | 2 | Bivalvia, Polychaeta, Isopoda, Amphipoda and Sipunculids |
| ST-2 | 6.293 | 275 | 2 | Polychaeta and Amphipoda |
| ST-3 | 2.79 | 400 | 3 | Polychaeta, Isopoda, and Sipunculids |
| ST-4 | 4.133 | 300 | 2 | Bivalvia, Polychaeta, Isopoda, Foraminifera and Cumacea |
| ST-5 | 6.13 | 350 | 3 | Polychaeta, Isopoda and Amphipoda |

**Table 13: Standing stock and abundance of intertidal macro benthos**

| Station | Biomass (mg. $m^{-2}$) | Abundance (no. $m^{-2}$) | Total Group | Macro benthic groups observed in the study |
|---|---|---|---|---|
| IT-1 (LW) | 6.302 | 375 | 3 | Polychaeta, Isopoda and Amphipoda. |
| IT-1 (HW) | 0.137 | 100 | 3 | Polychaeta, Amphipoda and Barnacle |
| IT-2 (LW) | 0.071 | 75 | 3 | Bivalvia, Polychaeta and Sipunculids. |
| IT-2 (HW) | 0.025 | 25 | 1 | Polychaeta |
| IT-3 (LW) | - | - | - | Dead bivalve and gastropod shells. |
| IT-3 (HW) | - | - | - | Dead bivalve and gastropod shells. |

**Note: LW-low water during low tide; HW: high water during high tide**

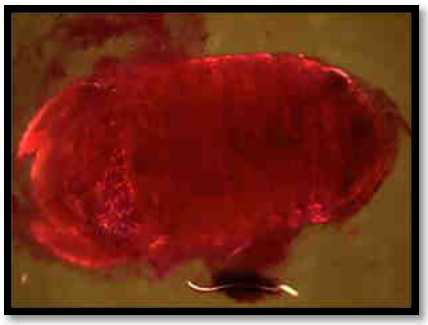
**Inter tidal region:**

- Three benthic groups were identified at stations, IT-1 (LW), IT-2 (LW) and IT-2 (HW). Organisms belongs to benthic group *Polychaeta, Isopoda and Amphipoda* were identified from IT-1 (LW) and IT-2 (HW), whereas at station IT-2 (LW) only Amphipods were reported instead of Bivalvs. At IT-3 (HW) only one group of organism belongs to Bivalvia was observed.
- The highest macro benthos abundance (175 no. $m^{-2}$) was reported at IT-1 (LW). Highest biomass (0.002 mg. $m^{-2}$) was recorded at IT-2 (LW) (Table: 13).

***Polychaetes***

***Polychaeta***

***Amphipoda***



***Isopoda***

**1.7 Microphotographs of macro benthic organisms.**

## 3.6 Phytoplankton pigments (Chlorophyll and Pheophytin)

**Chlorophyll and Pheophytin concentration:**

Marine phytoplankton contains the essential as well as accessory pigment similar as that of terrestrial plants. Chlorophyll is the essential photosynthetic, green molecule responsible for energy fixation in the process of photosynthesis. The energy fixed by the phytoplankton gets transfer to higher tropic level in the food web through grazing process by the consumers. Chlorophyll is a measure of algal biomass and it acts as an empirical link between nutrient concentrations.

Algal chlorophyll forms a series of degradation products upon degradation. In addition to Chlorophyll the naturally occurring pigments in algal cells, a filtered water sample will also contain colored degradation products of these pigments. The nature of these degradation products depends on which part of the chlorophyll molecule that is affected. As chlorophyll degrades, the initial step is either the loss of the magnesium from the center of the molecule or the loss of the phytol tail. This results in the formation of the molecule, *phaeophytin*. Depending on the parent molecule a number of distinct molecules like

phaeophytins, chlorophyllides, and pheophorbides can be produced. Thus in addition to Chlorophyll *a* filtered sea water contains colored degradation products of phytoplankton pigments.

**Figure 1.8 : The Degradation Pathways Of Chlorophyll**

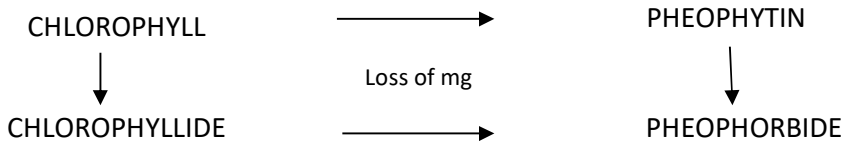



**Table 14: Method of analysis for Chlorophyll a and Pheophytin**

| Sr. no | Test performed | Method |
|---|---|---|
| 1 | Chlorophyll *a* and Pheophytin | APHA, Edition 21, Part 10000, 10200 H (with some modification) |

**3.6.1 Estimation of Chlorophyll *a* and Pheophytin:**

- Sampling locations were same as that of the plankton samples. Surface water samples were collected in clean plastic dark bottles.
- Water samples were filtered through Whattman glass microfiber filters (GF/F: 47 mm) and paper was macerated in 90% acetone and one night stored in the dark at 4ºC.
- The extraction slurry was transferred to 15 ml centrifugation tube and centrifuged at ~2000 rpm for 10 min.
- The extract was decanted into a 15 ml centrifuge tube, volume was adjusted to 10 ml with 90% acetone.
- Clarified extract was transferred to cuvette. Chlorophyll florescence was measured using Turner Flurometer.
- The extract was then acidified in the cuvette with 0.1 ml of 0.1 N $NH_4Cl$. The acidified extract is gently agitated and phaeophytin florescence was measured using Turner Flurometer (after acidification).

**3.6.2 Results**

Chlorophyll *a* concentration was varied from lowest of 0.17 mg/l at ST-5 surface water and highest of 2.19 mg/l at ST-3 bottom water. The pheophytin content varies from lowest 0.51 mg/l at ST-2 surface water and highest 1.19 mg/l on ST-1 surface water. In general, the highest chlorophyll a and pheophytin content was recorded at ST-3.

**Table 15: Chlorophyll *a* and Pheophytin (mg/l)**

| Station | Chlorophyll *a* | | Pheophytin | |
|---|---|---|---|---|
| | Surface | Bottom | Surface | Bottom |
| ST-1 | 1.99 | 1.46 | 1.19 | 0.86 |
| ST-2 | 0.95 | 1.15 | 0.51 | 0.69 |
| ST-3 | 1.92 | 2.19 | 1.07 | 1.22 |
| ST-4 | 1.80 | 1.70 | 1.02 | 0.98 |
| ST-5 | 0.17 | 2.10 | 1.03 | 1.18 |

## 3.7 Conclusion

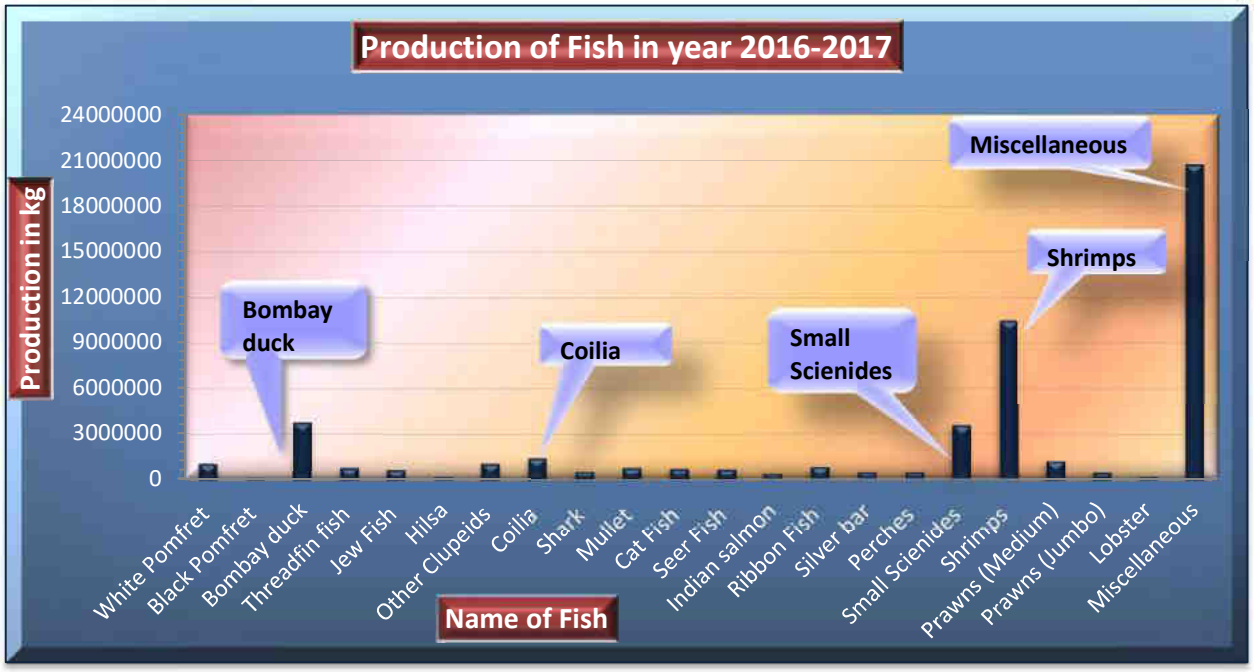
- The phytoplankton abundance in the study region was ranged from 4212 to 13674 cells $L^{-1}$. Highest phytoplankton abundance was observed at the ST-5 bottom water. However, lowest phytoplankton abundance was observed at the ST-1 surface water. A maximum 25 phytoplankton genera were identified at ST-4.
- In general, the highest chlorophyll a and pheophytin content was recorded at ST-3.
- Zooplankton abundance was ranged in between 324 to 1941 no.$m^{-3}$. ST-2 was characterized by lowest zooplankton abundance (324 no. $m^{-3}$) and biomass (0.094 ml $m^{-3}$), whereas highest were recorded at ST-5 abundance (1941 no. $m^{-3}$) and biomass (0.183 ml $m^{-3}$).
- In the sub-tidal region macro benthos abundance was higher at ST-1 (375 no. $m^{-2}$), whereas lowest abundance was recorded at ST-2 (275 no. $m^{-2}$). Highest macrobenthic biomass was recorded at ST-2 (6.293 mg. $m^{-2}$) as compared to other stations.
- In the inter-tidal regions, highest macro benthos abundance (375 no. $m^{-2}$) and biomass (6.302 mg. $m^{-2}$) were reported at IT-1 (LW). Lowest abundance and biomass recorded at IT-2 (HW)
- Overall assessment reveals that the physicochemical and marine biological parameters of the pre-monsoon sampling data were not deviated from the baseline monitoring data. However, the unsteady benthic sediment as the effect of natural tidal currents and exchange with sediment carriage activity affects the settlement of the benthic fauna, particularly in the west port area.

- **4.0 FISH PRODUCTION**

**Table 16: Fisheries Data of year 2016-17 at (Mundra)**

| Name of fish | Production in Kg |
|---|---|
| White Pomfret | 1049374 |
| Black Pomfret | 83622 |
| Bombay duck | 3776433 |
| Threadfin fish | 782294 |
| Jew Fish | 630119 |
| Hilsa | 149113 |
| Other Clupeids | 1048536 |
| Coilia | 1398373 |
| Shark | 520890 |
| Mullet | 756377 |
| Cat Fish | 695943 |
| Seer Fish | 658711 |
| Indian salmon | 338096 |
| Ribbon Fish | 792100 |
| Silver bar | 449295 |
| Perches | 446650 |
| Small Scienides | 3555958 |
| Shrimps | 10424501 |
| Prawns (Medium) | 1231639 |
| Prawns (Jumbo) | 489337 |
| Lobster | 146908 |
| Miscellaneous | 20684563 |

**Graph 1.9: Production of Fish (Spp.) During the Year 2016-17 in Kg**



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## Table 17: Center wise FISH Production (in Kg)

**District: Kutch** **Year :2016-17**

| Sr.No | Name of fish | Lakha pat | Nal sarovar | Jakhau | Nanalayja | Salaya | Modhava |
|---|---|---|---|---|---|---|---|
| I | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | White pomfret | 10257 | 0 | 746242 | 638 | 67625 | 53854 |
| 2 | Black pomfret | 0 | 0 | 81479 | 0 | 1145 | 0 |
| 3 | Bombay duck | 0 | 0 | 1704174 | 105808 | 20580 | 18247 |
| 4 | Thread fin | 155 | 171829 | 610310 | 0 | 0 | 0 |
| 5 | Jew fish | 22935 | 52585 | 521633 | 0 | 0 | 471 |
| 6 | Hilsa | 4205 | 0 | 133699 | 360 | 458 | 0 |
| 7 | Other clupeids | 21505 | 44267 | 587091 | 6674 | 6437 | 29568 |
| 8 | Coilia | 0 | 0 | 550627 | 13152 | 210 | 11216 |
| 9 | Shark | 7376 | 26840 | 437347 | 1092 | 0 | 1609 |
| 10 | Mullet | 40933 | 192790 | 468908 | 1423 | 481 | 8335 |
| 11 | Cat fish | 9248 | 110092 | 408418 | 4344 | 4745 | 13540 |
| 12 | Eel | 0 | 0 | 243195 | 0 | 0 | 0 |
| 13 | Leather jacket | 660 | 0 | 128493 | 0 | 0 | 0 |
| 14 | Seer Fish | 8604 | 118834 | 480147 | 3654 | 18050 | 542 |
| 15 | Indian Salmon | 3664 | 100190 | 188230 | 4228 | 0 | 0 |
| 16 | Ribbon Fish | 4674 | 0 | 497393 | 4719 | 55043 | 7118 |
| 17 | Silver bar | 13222 | 11215 | 300934 | 840 | 14635 | 2005 |
| 18 | Perches | 18774 | 21187 | 331093 | 0 | 0 | 2422 |
| 19 | Small scieniedes | 17428 | 30050 | 2759985 | 11935 | 2100 | 28108 |
| 20 | Shrimps | 2981 | 6708 | 9011696 | 16527 | 2730 | 87784 |
| 21 | Prawns(Medium ) | 0 | 0 | 929586 | 2471 | 420 | 3240 |
| 22 | prawns(Jambo) | 0 | 0 | 484722 | 0 | 0 | 0 |
| 23 | Lobster | 0 | 0 | 89126 | 2819 | 18021 | 11468 |
| 24 | Crabs | 0 | 0 | 283749 | 0 | 0 | 2645 |
| 25 | Levta | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | Sqid fish | 0 | 0 | 75408 | 0 | 0 | 0 |
| 27 | Tuna | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | Carangies/Macarel | 0 | 0 | 0 | 0 | 0 | 0 |
| 29 | Rani fish | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | Sole | 0 | 0 | 401179 | 0 | 0 | 0 |
| 31 | Miscellaneous | 69947 | 98112 | 19688961 | 17503 | 45607 | 25523 |
| | **TOTAL** | **256567** | **984699** | **42143825** | **198187** | **258287** | **307695** |

**Cont...**

| Sr.No. | Name of fish | Tragdi | Navinal | Zarpra | Mundra | Shekhadiya | Lunee | KukSar |
|---|---|---|---|---|---|---|---|---|
| I | 2 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 1 | White pomfret | 17333 | 2016 | 0 | 39831 | 0 | 25802 | 18928 |
| 2 | Black pomfret | 998 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | Bombay duck | 452429 | 43493 | 0 | 160401 | 0 | 417823 | 189979 |
| 4 | Thread fin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | Jew fish | 0 | 0 | 0 | 2160 | 0 | 0 | 0 |
| 6 | Hilsa | 0 | 0 | 0 | 0 | 0 | 134 | 0 |
| 7 | Other clupeids | 9031 | 6077 | 6432 | 55346 | 0 | 39972 | 58053 |
| 8 | Coilia | 67492 | 10695 | 0 | 102584 | 0 | 128017 | 128380 |
| 9 | Shark | 6497 | 372 | 0 | 3889 | 0 | 11273 | 3779 |
| 10 | Mullet | 273 | 78 | 0 | 2106 | 1116 | 3263 | 1491 |
| 11 | Cat fish | 5393 | 3410 | 5455 | 4617 | 0 | 27354 | 3454 |
| 12 | Eel | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | Leather jacket | 1425 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | Seer Fish | 2855 | 3582 | 0 | 1884 | 0 | 3462 | 171 |
| 15 | Indian Salmon | 7200 | 5430 | 0 | 0 | 0 | 744 | 85 |
| 16 | Ribbon Fish | 13780 | 4084 | 0 | 44278 | 0 | 25808 | 49390 |
| 17 | Silver bar | 2463 | 884 | 0 | 4524 | 0 | 7300 | 7519 |
| 18 | Perches | 0 | 832 | 0 | 1884 | 0 | 3642 | 645 |
| 19 | Small scieniedes | 60296 | 7948 | 8167 | 95376 | 0 | 98067 | 112066 |
| 20 | Shrimps | 77732 | 11060 | 53534 | 203974 | 0 | 161260 | 190815 |
| 21 | Prawns(Medium) | 12109 | 3464 | 0 | 34865 | 0 | 71739 | 34534 |
| 22 | prawns(Jambo) | 840 | 0 | 0 | 0 | 0 | 900 | 0 |
| 23 | Lobster | 0 | 2346 | 23128 | 0 | 0 | 0 | 0 |
| 24 | Crabs | 390 | 234 | 0 | 0 | 620 | 0 | 0 |
| 25 | Levta | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | Sqid fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27 | Tuna | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | Carangies/Macarel | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29 | Rani fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | Sole | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | Miscellaneous | 61757 | 14607 | 5612 | 100071 | 744 | 101292 | 55391 |
| | **TOTAL** | **800293** | **120612** | **102328** | **857790** | **2480** | **1127852** | **854675** |

**Cont...**

| Sr.No | Name of fish | Bhadre svar | Sangad | Takra | Kandla | Mithaport | Surajbari | TOTAL |
|---|---|---|---|---|---|---|---|---|
| I | 2 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 1 | White pomfret | 44889 | 878 | 0 | 14201 | 6880 | 0 | **1049374** |
| 2 | Black pomfret | 0 | 0 | 0 | 0 | 0 | 0 | **83622** |
| 3 | Bombay duck | 352051 | 109409 | 0 | 164672 | 37367 | 0 | **3776433** |
| 4 | Thread fin | 0 | 0 | 0 | 0 | 0 | 0 | **782294** |
| 5 | Jew fish | 0 | 0 | 0 | 25231 | 5104 | 0 | **630119** |
| 6 | Hilsa | 0 | 0 | 0 | 8184 | 2073 | 0 | **149113** |
| 7 | Other clupeids | 54041 | 5049 | 0 | 110559 | 7350 | 1084 | **1048536** |
| 8 | Coilia | 152233 | 82555 | 0 | 116545 | 34667 | 0 | **1398373** |
| 9 | Shark | 7180 | 161 | 0 | 12763 | 712 | 0 | **520890** |
| 10 | Mullet | 4992 | 433 | 0 | 25138 | 4617 | 0 | **756377** |
| 11 | Cat fish | 37118 | 2431 | 0 | 45379 | 5803 | 5142 | **695943** |
| 12 | Eel | 0 | 0 | 0 | 0 | 0 | 0 | **243195** |
| 13 | Leather jacket | 0 | 0 | 0 | 0 | 1600 | 0 | **132178** |
| 14 | Seer Fish | 1180 | 5382 | 0 | 6345 | 4019 | 0 | **658711** |
| 15 | Indian Salmon | 192 | 0 | 0 | 28133 | 0 | 0 | **338096** |
| 16 | Ribbon Fish | 33923 | 322 | 0 | 46308 | 5260 | 0 | **792100** |
| 17 | Silver bar | 11587 | 2232 | 0 | 64415 | 5520 | 0 | **449295** |
| 18 | Perches | 2699 | 0 | 0 | 57862 | 5610 | 0 | **446650** |
| 19 | Small scieniedes | 160636 | 7938 | 0 | 121479 | 19127 | 15252 | **3555958** |
| 20 | Shrimps | 217363 | 55730 | 0 | 262126 | 32095 | 30386 | **10424501** |
| 21 | Prawns(Medium) | 44469 | 42466 | 0 | 36121 | 16155 | 0 | **1231639** |
| 22 | prawns(Jambo) | 0 | 2875 | 0 | 0 | 0 | 0 | **489337** |
| 23 | Lobster | 0 | 0 | 0 | 0 | 0 | 0 | **146908** |
| 24 | Crabs | 0 | 950 | 0 | 62147 | 1860 | 0 | **352595** |
| 25 | Levta | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| 26 | Sqid fish | 0 | 0 | 0 | 0 | 0 | 0 | **75408** |
| 27 | Tuna | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| 28 | Carangies/Macarel | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| 29 | Rani fish | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| 30 | Sole | 0 | 0 | 0 | 0 | 0 | 0 | **401179** |
| 31 | Miscellaneous | 100413 | 83569 | 0 | 154131 | 56136 | 5187 | **20684563** |
| | **TOTAL** | **1224966** | **402380** | **0** | **1361739** | **251955** | **57051** | **51313387** |

***(Source: State Fisheries Department Kutch)***

**4.1 Observations of Fish Production**

- The highest annual fish production during the Year 2016-17in the Mundra is of Shrimps Fish (10424501 kg) and the lowest production is of Black Pomfret (83622 kg).
- The highest fish production during the year 2016-17was recorded in Jakhau Landing Centre whereas lowest at Sakhadiya Landing Centre.
  *(Source: State Fisheries Department of Kutch)*

**Table 18: Names of the Marine Monitoring Team Members**

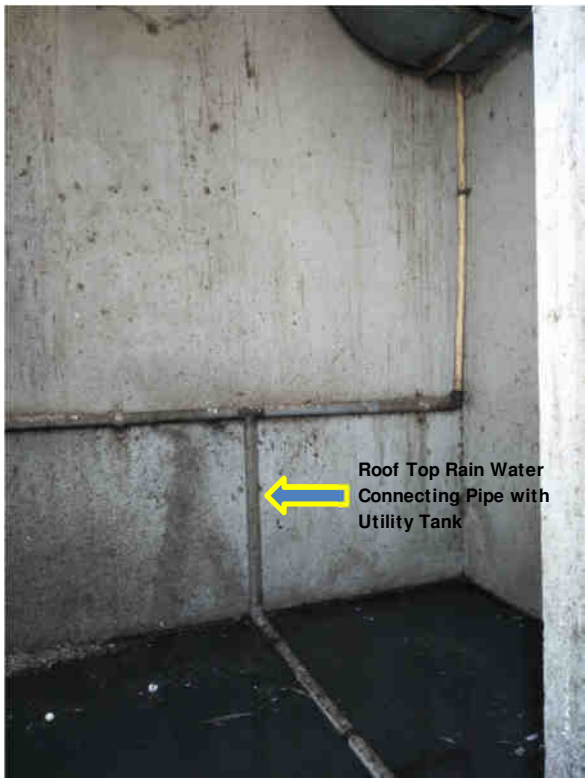
| Sr. No. | Name of Person |
|---|---|
| 1. | Dr. Dhiraj Narale (Marine Scientist) |
| 2. | Mr. Vijay Thanki (Env. Chemist) |
| 3. | Mr. Pravin Singh (Env. Chemist) |
| 4. | Miss. Shweta A. Rana (Env. Microbiologist) |
| 5. | Dr. Shivan Gouda (Marine Biologist) |

**DIFFERENT TYPES OF SAMPLING PHOTOGRAPHS**

**********

# ANNEXURE – 6

❖ **Roof Top Rain Water Harvesting System**


**Location: Tug Berth Building (Mundra Port Terminal)**

# ANNEXURE – 7

GPCB

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

**By R.P.A.D**

**Amendment to Consent to Establish (NOC)**
**CTE -96327**

**No. PC/CCA-KUTCH-1437/GPCB ID-53331/** **Date:**

**To,**
**Mundra Lpg Terminal Pvt. Limited,**
Near Plot No.:169/P,Navinal Island, Mundra,
Tal.:Mundra,
Dist.:Kutch

**Subject** : Amendment to Consent to Establish (CTE).

**Reference** :
1. CTE of the Board issued to your unit vide letter no PC/CCA-KUTCH-1437/GPCB ID-53331/424230, dated: 27/09/2017.
2. Your CTE Amendment Application Inward ID No. 141916, dated 03/08/2018.

Sir,

In exercise of the power conferred under section-27 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 6(2) of the Hazardous & Other Waste (Management & Transboundary Movement) Rules-2016 & as amended framed under the Environmental (Protection) Act-1986 and without reducing your responsibility under the said Acts/Rules in anyway; this Board is empowered to amend consent order conditions. Accordingly, the Consent to Establish issued vide letter no. PC/CCA-KUTCH-1437/GPCB ID-53331/424230, dated: 27/09/2017 under reference (1)stands amended in respect of the following conditions;

1. The validity period of the order shall be up to dated 03/10/2025
2. There shall be no increase in production capacity and Air details due to propose expansion.
3. **CONDITIONS UNDER WATER ACT 1974 AMENDED AS FOLLOWS:**
   - The condition 2.1 shall be read as;

     2.1(a) The domestic water consumption shall not exceed 80 KL/day and industrial water consumption shall not exceed 460.1 KL/day.

     2.1(b) The industrial waste water generation shall not exceed 217.6KL/day and generated effluent shall be send to neutralization tank for PH correction. The treated waste water shall be stored in 1500 KL/Day tank and it shall be utilized on land for Horticulture purpose in APSEZ premises. (GPCB ID 17739)

- The condition no. 2.5 shall be read as,
  2.5(a) The quantity of the domestic waste water (Sewage) shall not exceed 64 KL/day.

  2.5(b) The quality of sewage shall conform to following standards;

| Parameter | GPCB Norms |
|---|---|
| pH | 6.5 to 9.0 |
| BOD (3 days at $27^0$ C) | 30 mg/L |
| Total Suspended Solids (TSS) | 100 mg/L |
| Fecal Coliform (FC) | 1000 MPN/100 ml |

  2.5 (C) The treated sewage confirming to above standards shall be utilized for gardening and plantation purpose within APSEZ premises.

**4.** The other terms and conditions of CTE issued vide letter No.PC/CCA-KUTCH-1437/GPCB ID 53331/424230, Date:27/09/2017shall remain unchanged.

**For and on behalf of**
**Gujarat Pollution Control Board**

**(Sushil Vegda)**
**Senior Environment Engineer**

GPCB

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

By R.P.A.D.

**CORRECTION OF CONSOLIDATED CONSENT AND AUTHORIZATION (C C & A)**

**GPCB/CCA-Kutch -39 (5)/ ID-17739/** **Date 09.10.2018**

**To,**
**M/s. Adani Ports & Special Economic zone Limited,**
**Plot No: 169/P**
**At Navinal Island, Taluka: Mundra,**
**Dist: Kutch – 370 421**

Sub: - Correction of Consolidated Consent and Authorization (CC& A) of this Board.

Ref: -

1. Consent Renewal Order No: AWH-83561 dated 9.1.2017 validity up to 20.11.2021 issued vide letter No: GPCB/CCA-Kutch-39 (4)/ID-17739/403658 dated 9.2.2017
2. Your CCA- Amendment Application Inward no-124026 dated 12.7.2017
3. CCA Amendment vide No: GPCB/CCA-Kutch -39 (4)/ID-17739/424578 dated 03.10.2017
4. CCA Amendment vide No: GPCB/CCA-Kutch -582(3)/ID-35427/448701 dated 22.03.2018
5. CTE obtained vide letter No PC/CCA-Kutch-582 (3) / ID-35427/1700294 dated 4.1.2014
6. Your Letter dated 5.09.2018

2. The Products mentioned at Condition No: 2 of the above said CCA issued dated 03.10.2017 corrected as under: -

| No. | Name Of Product | Existing Quantity | Proposed Quantity | TOTAL Quantity |
|---|---|---|---|---|
| 1. | General Cargo | 4.0 Lac MT/Month | ------ | 4.0 Lac MT/Month |
| 2 | Liquid Cargo (Chemical/Poc Products | 2.65 Lac MT/Month | -------- | 2.65 Lac MT/Month |
| 3. | Storage And Distribution Of Bitumen | 26,400 MT/Month | ------ | 26,400 MT/Month |
| 4. | Dry Cargo Handling | 9 MMT/Month | ------ | 9 MMT/Month |
| 5. | Container Terminal Handling Operation | 4.5 Million TEUs/Annum | 1.2 Million TEUs/Annum | 5.7 Million TEUs/Annum |
| 6. | Waste destruction system for decomposition/destruction of municipal solid waste | 3.5 Cubic Meter (MSW Destruction Capacity @ 500 Kg/day) | ----- | 3.5 Cubic Meter (MSW Destruction Capacity @ 500 Kg/day) |
| 7. | Oil water separate (Flame Proof) to remove –Oil portion from slope oil received from Vessels/Ships | 25 $M^3$/Hr | --- | 25 $M^3$/Hr |
| 8. | Import, Storage And Distribution Of Edible Oil | 1.25 Lac MT/Month | 0.6 Lac MT/ Month | 1.85 Lac MT/Month |

3. Earlier, Board has granted CTE with reference to point No 5 of reference and accordingly, certain project activities to be further developed like cargo handling facilities for Adani port and SEZ limited for various commodities like Container, Coal, Iron ore, Steel & Scrap, Dry Bulk, Project and Heavy Engineering, Crude oil (SPM), POL, Chemicals and vegetables oils, automobiles etc.

   The Development for this balance cargo handling capacity will be done in future based on your business requirements and CCA amendment will be applied and issued in their respective PCB IDs as and when specific commodities will be commissioned only after completing the necessary formalities for obtaining of CCA amendment.

4. Remaining all other conditions of Consolidated Consent (CC&A) vides order No: AWH-83561 dated 9.1.2017 validity up to 20.11.2021 issued vide letter No: (1) GPCB/CCA-Kutch-39 (4)/ID-17739/403658 dated 9.2.2017. (2) No: GPCB/CCA-Kutch -39 (4)/ID-17739/424578 dated 03.10.2017 (3) No: GPCB/CCA-Kutch -39 (4)/ID-17739/424578 dated 03.10.2017 shall remains unchanged.

**For and on behalf of**
**Gujarat Pollution Control Board**

**(Sushil Vegda)**
**Senior Environmental Engineer**

GPCB

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

By R.P.A.D.

## AMENDMENT TO CONSOLIDATED CONSENT AND AUTHORIZATION (CC&A)

No. PC/CCA-KUTCH-39(4)/GPCB ID-17739/ 491900 Date: 21/01/19

To,
**Adani Ports & Special Economic zone Limited,**
**Plot No: 169/P**
**At Navinal Island, Taluka: Mundra,**
**Dist: Kutch – 370 421**

Subject : Amendment to Consolidated Consent and Authorisation (CC&A).

Reference :
1) CCA of the Board issued to your unit vide order No.AWH-83561 dated 09/01/201,No.PC/CCA-KUTCH-39(4)/GPCB ID17739/403658 date 09/02/201 .
2) Correction of CCA of the Board issued to your unit vide order No. PC/CCA-KUTCH-39(5)/GPCB ID17739/473575 date 24/10/2018.
3) Your CCA Amendment Application Inward ID No.146485, dated 24/10/2018.

Sir,

In exercise of the power conferred under section-27 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution)-1981 and Authorization under rule 6(2) of the Hazardous & Other Waste (Management & Transboundary Movement) Rules-2016 & as amended framed under the Environmental (Protection) Act-1986 and without reducing your responsibility under the said Acts/Rules in anyway; this Board is empowered to amend consent order conditions. Accordingly, the Consolidated Consent and Authorisation (CC&A) issued vide letter no. Consent order no. AWH-83561, dated 09/01/2018 no. PC/CCA-KUTCH-39(4)/GPCB ID17739/403658 date09/02/2017.which is valid up to 20/11/2021 under reference (1) and (2) stands amended in respect of the following conditions.

1. **Consent Order No.: H-98086 Date of Issue: 25/12/2018.**
2. The consent order shall be valid up to **20/11/2021**.
3. There shall be no change in any manufacturing activity and Air Details.
4. **CONDITIONS UNDER WATER ACT 1974 AMENDED AS FOLLOWS:**
   - The condition no. 3.1 shall be read as;

3.1 The quantity of the industrial effluent from manufacturing process and other ancillary operations shall not exceed 90.31KL/day. further generated waste water of 60 KL/day from washing of tank is treated in exiting ETP & treated waste water shall be used for Gardening and Plantation purpose.

**SUBJECT TO THE FOLLOWING SPECIFIC CONDITIONS:**

1. Unit shall strictly adhere to provisions of Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016 (H&OW (M&TBM) Rules-2016 and generated waste oil within ship shall be disposed as per the provisions of (H&OW (M&TBM) Rules-2016 only.

2. Unit shall not import of waste oil/ slope oil as per provisions of Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016.
3. Unit shall provide port reception facility to channelize the disposal of waste oil generated from ships/ vessels in environmentally sound manner.
4. Unit shall submit waste oil records and submit waste oil details with quantity to Board for every six months to this office and also to Regional office, Kutch (East) for its review and inspection.
5. Unit shall dispose of entire waste oil of ships/ vessels to the Registered Recyclers/ Re-processors as per the provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

**5. CONDITIONS OF AUTHORIZATION UNDER HAZARDOUS AND OTHER WASTE (M & TM) RULES – 2016 AMENDED AS FOLLOWS:**

- The conditions no **5.1** shall be read as:

**5.1** Adani Ports & Special Economic zone Limited, is hereby granted an authorization to operate facility for following hazardous wastes on the premises situated at Plot No: 169/P At Navinal Island, Taluka: Mundra, Dist: Kutch

| Sr. No. | Waste | Quantity per Year | | | Cat. | Facility |
|---|---|---|---|---|---|---|
| | | Existing | Proposed | Total | | |
| 1 | Used Spent Oil | 238 MT | -- | 238 MT | 5.1 | Collection, storage, Transportation, Disposal by selling out to registered recyclers |
| 2. | ETP Sludge | 1.095 MT | -- | 1.095 MT | 35.3 | Collection, storage, Transportation, Disposal at TSDF site of SEPPL/NECL |
| 3. | Contaminated cotton rags or other cleaning materials | 31 MT | -- | 31 MT | 33.2 | Collection, storage, Transportation, Disposal by Co-processing at cement plant of CHWIF |
| 4 | Asbestos Waste | Whatever quantity generated | -- | Whatever quantity generated | B-1 | Collection, storage, Transportation, Disposal at TSDF site |
| 5 | Glass Wool waste (Thermal insulation material) | Whatever quantity generated | -- | Whatever quantity generated | H-6.1 | Collection, storage, Transportation, Disposal at TSDF site |
| 6 | Down grade chemicals | Whatever quantity generated | -- | Whatever quantity generated | 20.2 | Collection, storage, Transportation, Disposal by sending to authorized Solvent |
| 7 | Discarded Container/ Barrel/ Contaminated Liners | 16 MT/year | -- | 26 MT/year | 33.3 | Collection, storage, Transportation, Disposal by selling out to registered decontamination facility |

GPCB

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

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | Bottom sludge | Whatever quantity generated | | Whatever quantity generated | 3.2 | Collection, storage, Transportation, Disposal by sending to common facility of SEPPL/NECL and /or sent for co-process at cement industries through recycling solution Pvt Ltd, Panoli |
| 9 | Waste Residue containing Oil | 100 MT | | 100 MT | 33.2 | Collection, storage, Transportation, Disposal by Co-processing at cement industries and / or incineration at CHWIF site. |
| 10 | Pig Waste | 24 MT | | 24 MT | 3.1 | Collection, storage, Transportation, Disposal by sending to common facility of SEPPL/NECL and /or sent for co-process at cement industries through recycling solution Pvt Ltd.Panoli |
| 11 | Waste Oil | -- | 0.18 MT | 0.18 MT/ye | 5.2 | Collection, storage, Transportation, Disposal by selling out to registered recyclers/ Re processors |

All other terms and conditions of Consolidated Consent (CC&A) order No.AWH-83561 dated 09/01/2017, No PC/CCA-KUTCH-39(4)/GPCB ID17739/403658 date 09/02/2017 shall remain unchanged.

**For and on behalf of**
**Gujarat Pollution Control Board**

**(Sushil Vegda)**
**Senior Environmental Engineer**

# ANNEXURE – 8

# Cost of Environmental Protection Measures

| Sr. No. | Activity | Cost incurred (INR in Lacs) | | | Budgeted Cost (INR in Lacs) |
|---|---|---|---|---|---|
| | | 2016 – 17 | 2017 – 18 | 2018 – 19 | 2018 – 19 |
| 1. | Environmental Study / Audit and Consultancy | 36.78 | 9.0 | 6.7 | 30.5 |
| 2. | Legal & Statutory Expenses | 4.76 | 5.07 | 4.42 | 5.7 |
| 3. | Environmental Monitoring Services | 27.95 | 27.02 | 20.36 | 36.0 |
| 4. | Hazardous / Non Hazardous Waste Management & Disposal | 12.52 | 65.62 | 95.72 | 84.8 |
| 5. | Environment Days Celebration | 6.71 | 2.85 | 0.28 | 10.0 |
| 6. | Treatment and Disposal of Bio-Medical Waste | 1.27 | 1.13 | 1.21 | 1.56 |
| 7. | Mangrove Plantation, Monitoring & Conservation | 72.38 | 60.0 | 47.0 | 50.0 |
| 8. | Other Horticulture Expenses | 555.00 | 547.0 | 579.32 | 579.32 |
| 9. | O&M of Sewage Treatment Plant and Effluent Treatment Plant (including STP, ETP of Port & SEZ & Common Effluent Treatment Plant) | 61.50 | 70.02 | 144.29 | 153.9 |
| 10. | Expenditure of Environment Dept. (Apart from above head) | 131.83 | 102.15 | 109.28 | 117.29 |
| | **Total** | **910.70** | **889.86** | **1008.58** | **1069.07** |

# ANNEXURE – 9

adani

# Compliance Report of EMP & Mitigation Measures

| Sr. No. | Suggested Measures | Compliance Status |
|---|---|---|
| ✍ **Construction Phase:** | | |
| 1 | Proper care is warranted while dredging which should be in a controlled manner. It should also be insured that reclamation, dredging, widening and slop stabilization measures do not significantly alter the stabilized erosional-accretional regime and prevailing rate of exchange of water between the outer area of the intricate creek system as well as the free flow of tidal water, to protect the mangroves. | All construction and operation activities as well as dredging and reclamation activities are being carried out as per the approvals.<br><br>Please refer condition no. 8 & 9 of the CRZ recommendation compliance report for further details. |
| 2 | Good sanitation, water and fuel should be made available to the work force. Labour colonies should be set-up landward of the HTL and away from mangrove. | Most of the construction labours resides in the nearby villages where all basic facilities are easily available. However, for those residing near the construction site, infrastructure facilities such as water supply, fuel, sanitation, first aid, ambulance etc. are provided by APSEZ. Details were submitted as a part of compliance report submission for the period Apr'17 to Sep'17.<br><br>Please refer general condition no. ii of the EC & CRZ clearance for further details. |
| ✍ **Operation Phase:** | | |
| 1 | Wastewater such as generated during cleaning of jetties, floor washing, domestic use etc. should be collected in a settling pond and released to marine environment only after ascertaining that it is free from oil and SS. The toilets on the jetties must have compact sewage treatment facilities. | Entire quantity of sewage generated from APSEZ premises is being treated in designated ETP / STP and treated sewage is used for Horticulture purposes.<br><br>Please refer specific condition no. xii of the EC & CRZ clearance or further details. |
| 2 | Dust should be routinely monitored at the vantage points and corrective measures such as water sprinkling should be practiced if it increases beyond permissible limits. | Ambient Air Quality (twice in a week) monitoring is being carried out by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratories Pvt. Ltd.<br><br>Adequate safeguard measures are being taken for abatement of dust emissions.<br>Please refer specific condition no. xi of the EC & CRZ clearance or further details. |
| 3 | It should be ensured that the effluent released into the Gulf meets | Entire quantity of effluent / sewage generated from APSEZ premises is being |

| Sr. No. | Suggested Measures | Compliance Status |
|---|---|---|
| | the prescribed GPCB criteria at all times. | treated in designated ETP / STP and treated water is being utilized on land for Horticulture purposes after compliance with GPCB standards.<br><br>Please refer specific condition no. xii of the EC & CRZ clearance or further details. |
| 4 | Appropriate spill response scheme (Tier-1 to Tier-3) should be in place to minimize impacts on marine environment, should a spill occur. | Oil spill contingency plan is in place to handle Tier 1 level oil spills considering different accident scenarios, and the vulnerable areas are identified and mitigation plan is prepared. A copy of the plan updated & approved by coast guard was submitted during half yearly compliance report submission for the period Apr'17 to Sep'17. |
| 5 | MPSEZL should commit mangrove restoration programme through afforestation in a defined time frame over larger and promising areas and should monitored periodically and protect from anthropogenic pressures. | APSEZ has carried out mangrove afforestation in more than 2850 ha. area across the coast of Gujarat.<br><br>Please refer specific condition no. i & vii of the EC & CRZ clearance or further details. |
| 6 | A comprehensive marine quality monitoring programme with periodic investigations at predetermined locations should be undertaken by a specialized agency. | Marine monitoring is being carried out once in a month by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratories Pvt. Ltd.<br><br>Please refer specific condition no. ix of the EC & CRZ clearance or further details. |
| 7 | The dust and noise levels at pre-decided locations including the jetty sites should be periodically monitored and remedial action taken if the levels exceed the prescribed norms. | Ambient Air Quality (twice in a week) and Noise (once in a month) monitoring are being carried out by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratories Pvt. Ltd.<br><br>Please refer specific condition no. xi of the EC & CRZ clearance or further details. |
| 8 | MPSEZL should establish an Environment Management Cell (EMC) directly under the control of the Chief Executive. | M/s APSEZ has a well structured Environment Management Cell, staffed with qualified manpower for implementation of the Environment Management Plan. The Environment Management Cell is headed by Sr. Manager who directly reports to the top management. Environment Cell Organogram is attached as **Annexure – 12**. |

# ANNEXURE – 10

adani

Date: 01.10.2018

APSEZ/MARINE/CG/04

The Commander
(For Regional Pollution Response Officer)
Headquarter Coast Guard Region (NW)
Gandhinagar

Sub: **Annual Updating of Oil Spill Contingency Response Plan (Tier 1) – APSEZ, Mundra**

Dear Sir,

The Oil Spill Contingency Plan was approved vide your letter no 7563 dated 07th November 2016.

The annual updating of Oil Spill Contingency Plan was done on 01 Oct 2018. The details of changes incorporated are mentioned below:

| Sl No | Amendment | Page No |
|---|---|---|
| 1 | Shore line resources updated | 26 |
| 2 | Annex 3- Tug details updated | 75 |
| 3 | Annex 4- Contact details of APSEZ personnel updated | 78 |

The above is for your kind information and updating your records.

Thanking you,

Yours faithfully,

For Adani Ports and SEZ Ltd

Capt Anubhav Jain
Head– Marine Services
E Mail: ANUBHAV.JAIN@ADANI.COM
Mob: +91 8980015245

Capt. Anubhav Jain
AGM - Marine & PFSO
Adani Ports & SEZ Ltd.
Mundra - Kutch - Gujara

**CC:** The Commanding Officer, Indian Coast Guard Station, Mundra

# OIL SPILL CONTINGENCY RESPONSE PLAN TIER 1

(To be used in conjuction with OSRA Vol-1 and Vol-2)


**ADANI PORTS AND SPECIAL ECONOMIC ZONE LIMITED**
**POST BAG NO. 1**
**NAVINAL ISLAND**
**MUNDRA 370 421**
**PH. : (02838) 289221 / 289371**
**FAX : (02838) 289170 / 289270**

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This document is distributed as per Oil Spill Contingency Response plan. In addition, documents on a "need based" basis will be distributed.

All documents so distributed will be controlled documents & identified by a unique control number as per Oil Spill Contingency Response plan.

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| 2. | Management Representative | 02 | 01/01/2014 |
| 3. | Marine Control Room | 03 | 01/01/2014 |
| 4. | Sr. Manager (Fire Services) | 04 | 01/01/2014 |
| 5. | Auditor's Copy | 05 | 01/01/2014 |
| 6. | Systems Co-ordinator | Original Copy | 01/01/2014 |
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## Section 02: Amendment Records

| AMENDMENT RECORD SHEET | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Section** | **Sub-section** | **Page No.** | **Revision No.** | **Revision Date** | **Description of Revision** | **Approved** |
| 1. | Annex 3 | | 75 | | | Location of Oil Spill Equipment mentioned | Approved |
| 2. | Annex 15 | | 91 | | | List of recycler approved by state of Gujarat | Approved |
| 3. | | | 96 | | | Contingency Planning Compliance Checklist | Approved |
| 4 | Annex 16 | | 92 | | 29.08.2017 | List of agency for support & guidance for rescue & rehabilitation of oiled bird & mangroves management during oil spill | Approved |
| 5 | 03 | 3.6 | 45 | | 29.08.2017 | Additional information added | Approved |
| 6 | 02 | 2.6 | 26 | | 01.10.2018 | Shore line resources updated | Approved |
| 7 | Annex 3 | | 75 | | 01.10.2018 | Tug details updated | Approved |
| 8 | Annex 4 | | 78 | | 01.10.2018 | Contact details of APSEZ personnel updated | Approved |
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# Section 03: Strategy

**1 Introduction**

**1.1** Authorities and responsibilities
**1.2** Coordinating committee
**1.3** Statutory requirements
**1.4** Mutual aid agreements
**1.5** Geographical limits of plan
**1.6** Interfaces with ROSDCP and NOSDCP

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**2.2** Types of oil likely to be spilled
**2.3** Probable fate of spilled oil
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**2.6** Shoreline resources, priorities for protection
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**3.2** Limiting and adverse conditions
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**4 Equipment**

**4.1** Marine oil spill response equipment
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**5.1** Crisis manager and financial authorities
**5.2** Incident organization chart
**5.3** Manpower availability (on-site, on call)
**5.4** Availability of additional manpower
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**5.6** Training / safety schedules and drill / exercise programme

**6 Communications**

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# Action and operations

**7 Initial procedures**

- **7.1** Notification of oil spill to concerned authorities,
- **7.2** Preliminary estimate of response tier
- **7.3** Notifying key team members and authorities
- **7.4** Manning Control Room
- **7.5** Collecting information (oil type, sea / wind forecasts, aerial surveillance, beach reports)
- **7.6** Estimating fate of slick (24, 48, 72 hours)
- **7.7** Identifying resources immediately at risk, informing parties

**8 Operations planning**

- **8.1** Assembling full response team
- **8.2** Identifying immediate response priorities
- **8.3** Mobilizing immediate response
- **8.4** Media briefing
- **8.5** Planning medium-term operations (24, 48 and 72 hour)
- **8.6** Deciding to escalate response to higher tier
- **8.7** Mobilizing or placing on standby resources required
- **8.8** Establishing field command post communications

**9 Control of operations**

- **9.1** Establishing a Management team with experts and advisors
- **9.2** Updating information (sea, wind, weather forecasts, aerial surveillance, beach reports)
- **9.3** Reviewing and planning operations
- **9.4** Obtaining additional equipment, supplies, manpower
- **9.5** Preparing daily incident log and management reports
- **9.6** Preparing operations accounting and financial reports
- **9.7** Preparing releases for public and press conferences
- **9.8** Briefing local and government officials

**10 Termination of operations**

- **10.1** Deciding final and optimal levels of beach clean-up
- **10.2** Standing down equipment, cleaning, maintaining, replacing
- **10.3** Preparing formal detailed report
- **10.4** Reviewing plans and procedures from lessons learnt

# Data Directory

**Maps / Charts**

1. Coastal facilities, access roads, telephones, hotels etc.

2. Coastal charts, currents, tidal information (ranges and streams), prevailing winds
3. Risk locations and probable fate of oil
4. Shoreline resources for priority protection
5. Shoreline types
6. Sea zones and response strategies
7. Coastal zones and response strategies
8. Shoreline zones and clean up strategies
9. Oil and waste storage / disposal sites
10. Sensitivity Maps/ Atlas

**Lists**

1. **Primary Oil spill Equipment:** booms, skimmers, spray equipment, dispersant, absorbents, oil storage, Radio communications etc. (Manufacturer, type, size, location, transport, contact, delivery time, cost and conditions)
2. **Auxiliary Equipment:** Tugs and work boats, aircraft, vacuum trucks, tanks and barges, loaders and graders, plastic bags, tools, protective clothing, communication equipment etc. (Manufacturer, type, size, location, transport, contact, delivery time, cost and conditions)
3. **Support Equipment:** Aircraft, communications, catering, housing, transport, field sanitation and shelter etc. (Availability, contact, cost and conditions)
4. **Sources of Manpower:** Contractors, local authorities, caterers, security firms (Availability, numbers, skills, contact, cost and conditions)
5. **Experts and Advisors:** Environment, safety, auditing (Availability, contact, cost and conditions)
6. **Local and National Government contacts:** Name, rank and responsibility, address, telephone, fax, telex.

**Data**

1. Specifications of oils commonly traded
2. Wind and weather
3. Information sources

**Annexures**

# Strategy

## 1. Introduction

The movement of Petroleum/ Petroleum-products from the production centre in middle east to Adani Ports and SEZ Ltd and various other ports in Gulf of Kutch is handled through ships at sea and to refineries using pipe lines on ground. Like any other port, Adani Port is very much vulnerable to oil spill disaster arising due to collision, leakage or grounding of vessels in sea and damage to pipelines on ground.

This action plan prepared by Adani Ports and SEZ Ltd, Mundra is to combat the oil spill (LOS-DCP) is in accordance with the NOS-DCP, International Petroleum Industry Environmental Conservation Association (IPIECA).

### 1.1 Authorities and responsibilities

**Adani Ports and SEZ Limited**

APSEZL has responsibility for dealing with oil spillages which occur within port limit if the estimated quantity of product lost is 700 tons or less.

Should the spill migrate to other areas, the Coast Guard Monitor will assume the position of On Scene Commander and will direct the response effort. In both cases, APSEZL will act and deploy their resources as required by the relevant On Scene Commander.

This operational version of Oil Spill Contingency Response Plan for the Adani Ports and SEZ Ltd, Mundra is intended for use by all such personnel like Marine Personnel, Tug Masters and all others as indicated in the Spill Response Organization who may be involved in the response to oil spills which may occur within Adani Port Limits.

This plan has been prepared as per the stipulation of Ministry of Environment and Forest Clearance (MoEF) and Coast Guard Requirements.

**Gujarat Maritime Board**

While responsibility for oil spill contingency remains with conservator of the port – Gujarat Maritime Board Port Officer, this plan (Tier 1) demonstrates the readiness of Adani Port for mitigating oil spill incidents.

Port Conservator will monitor and provide the necessary assistance required for administering the oil spill operation within the port limit.

**Indian Coast Guard**

The Indian Coast Guard has a statutory duty to protect the maritime and other national interests of India in the Maritime Zones of India and to prevent and control marine pollution. Coast Guard is also the Central Co-coordinating Authority for marine pollution control in the country. The Indian Coast Guard is responsible for implementation and enforcement of the relevant marine pollution laws.

The National Oil Spill Disaster Contingency Plan stipulates the organizational and operational details to effectively combat a national oil spill contingency. The plan promotes the development of Regional and Local Contingency Plans in the three Coast Guard Regions.

The Coast Guard Monitor will assume the role of On Scene Commander in the event that any oil spill involving PLL operations exceeds 700 tons.

**Gujarat Pollution Control Board**

The Gujarat Pollution Control Board is responsible for, and control, waters up to 5 km from the shoreline. They require to be advised of all pollution incidents.

**Ministry of Environment, Gujarat**

The Ministry requires to be informed of all pollution incidents.

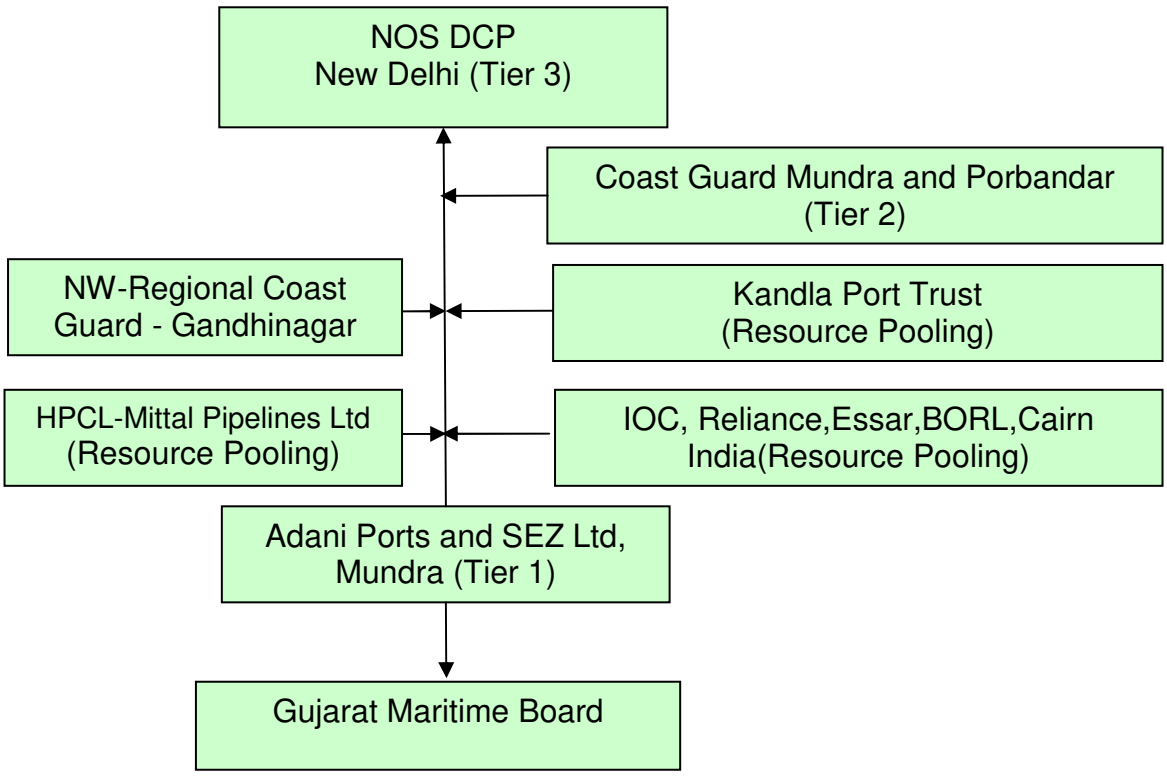
**Emergency Response Team**

Emergency Response Team (ERT) is the nomenclature used to describe the command and control team established for an oil spill incident at the jetty or in the jetty approaches, with representatives of organisations attending as described in section 2.4.

The ERT will convene at the Terminal Control Room, under the chairmanship of the Terminal Manager, and will consist of a Management Team and a Support Team as noted in section 2.3.

It is a strategic plan to quickly call on additional resources in a systematic manner firstly from Adani port and subsequently from other ports.

**1.2 Coordinating Committee**




**1.3 Statutory requirements**

The Indian Government is a signatory to the International Convention on Oil Pollution Preparedness, Response and Co-operation which came into force in May 94. Under the NOSDCP, it is obligatory for a port to have a Local Oil Spill Contingency Plan to combat oil spills within port limits.

This oil spill contingency response plan (Tier 1) is the response plan in accordance with the facilities available at Adani Port only.

This plan is prepared in accordance with:

a) Marine Environmental Impact Assessment of SPMs, COTs and connecting pipelines of APSEZL at Mundra dated February 2001, prepared by National Institute of Oceanography, Mumbai.

b) Report on Risk assessment study and On-site disaster management Plan for SPMs, COTs and connecting Pipelines of Adani Ports and Special Economic Zone Limited, by TATA AIG Risk Management Services Limited, dated February 2001.

c) HAZOP study report of SPM Terminal pipeline project by Intec Engineering, dated 26/02/2004.

d) IPIECA guide to Contingency planning for oil spills on water.

e) Oil spill risk assessment and contingency plan study done by M/s Environ Software Pvt. Ltd. (Copy enclosed)

### 1.4 Mutual aid agreements

APSEZL signed MOU with HPCL Mittal Pipelines Limited, Mundra operating in the region of Gulf of Kutch to have mutual aid agreement for the purpose of assisting each other within stipulated time frame with best combination of resources to combat and overcome any large and worst spill with the intent of maximizing the availability of the private, public and government sector response resources during oil spills where assistance is requested by another member.

As per agreement, the member agencies of the affected member state or province may directly request cascadable response resources located in oil handling agencies operating in the region of Gulf of Kutch.

### 1.5 Geographical limits of plan

Adani Ports and SEZ Ltd, Mundra is situated at the North head of Gulf of Kutch which is at the west coast of India. Ships calling Adani Port therefore have to traverse across the GOK. This oil spill contingency response plan (Tier 1) is applicable for the following:

1) Loading and Unloading of liquid cargo at the Multi-purpose terminal jetty at the Adani Port.

2) Unloading of the crude oil the vessels at the single point mooring (SPM) to offload 70,000 to 3,00,000 DWT.

3) Bunkering operations carried out within the port limits.

4) Any spill that occurs from any source within port limit (including West Basin, South Basin and LNG Terminal) whether at berths, anchorages or in the channel.

APSEZL falls within the area jurisdiction of The Commander, No.1 Coast Guard District (Gujarat), located at Porbandar. Mundra has a full-fledged Indian Coast Guard Station. The Port limit of APSEZL, Mundra is shown in enclosed chart in annexure 14.

### 1.6 Interface with ROSDCP and NOSDCP

For responding to oil spill, the Indian Coast Guard has developed the National Oil Spill Disaster Contingency Plan NOSDCP which has the approval of the Committee of Secretaries and has been in operation since 1996. The NOSDCP brings together the combined resources of the various organizations and departments, Coast Guard, Ports and Oil handling Agencies, and related industries, to provide a level of preparedness to the threat posed to the marine environment by oil spills.

The NOSDCP sets out a clear definition of the responsibilities of the major participants, such as the Coast Guard, various ministries and departments, ports and oil industry.

The national oil spill contingency plan hierarchy outlined in Figure 1 consists of NOSDCP at the apex level to coordinate significant or disaster type spills, the Regional Oil Spill Disaster Contingency plan (ROSDCP) to coordinate spill in the Gulf of Kutch, utilizing the resources available within the region.

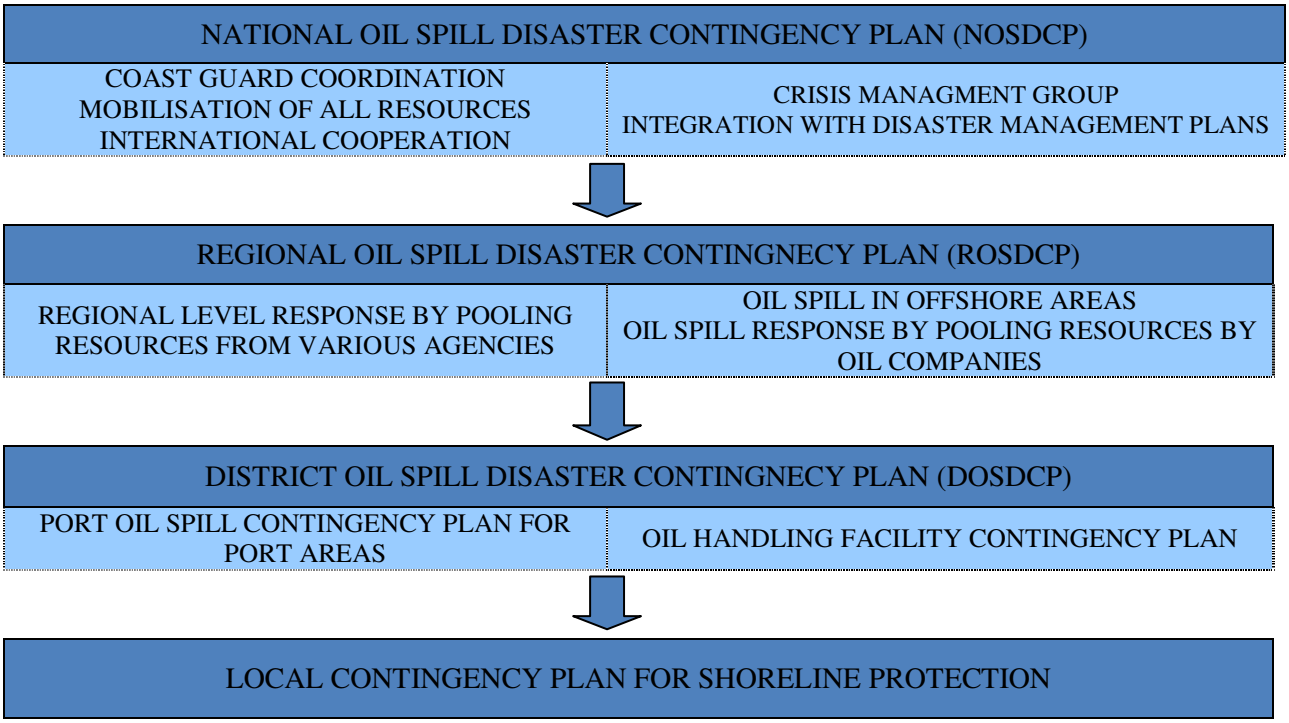



**Figure 1 - Contingency Plan hierarchy**

The aim of Local Contingency Plan - for the Mundra Port, is to outline arrangements for responding to oil spills in the coastal and shoreline areas, with the aim of protecting against environmental pollution as a result of oil spill or, where this is not possible, minimise the effect and respond the oil spill in an environment friendly manner and dispose the collected oil/debris in according to the existing laws/regulations/orders in force. CONTINGENCY PLAN FOR SHORELINE PROTECTION
ISTRICT OIL SPILL CONTINGN

## 2 Risk Assessment

The number of vessels calling annually at APSEZL is more than 3000 including Chemical and oil tankers. The threat of oil spill is much high in Gulf of Kutch and is very oil spill sensitive area. A marine national park is located in the Southern shore of GOK. There is a popular beach spot on the Northern shore namely Mandvi. Lastly, as GOK is a closed system, any oil spilled will arrive to the shores.

### 2.1 Identification of activities and risks

The scenario of the spill are classified under two categories :

- Oil Spill at Mundra Port Multi-Purpose Terminals
- Oil Spill at SPM

The oil spill could occur due to various reasons at any of the APSEZL's marine facilities (SPMs, Basins/ berths, anchorage or approach channel) within the new Mundra Port limit. The spills beyond these areas are not covered in this plan. Both the categories are discussed in detail

Accidental oil spill at Multipurpose terminals/ Basins/ berths, anchorage or approach channel is possible from overflow of slop tanks, bunker tanks, reception facility and road tankers (generally a low pressure operation).

Accidental oil spill at the SPM may be due to hose puncture while unloading, failure of swivel joint of SPM or Leakage of Crude Oil at PLEM or from the submarine pipeline.

Following risks are being addressed to mitigate incident of oil pollution:

- Connection of hoses with established work instructions for use of blank flanges, drip trays etc.
- Thorough understanding of use of OSD and limitations of vessel surging due to slack mooring ropes in given weather conditions.
- Monitoring of ships pump room atmosphere, display of fire notices and acknowledging accidental explosion through the use of IMO ship / shore check list.
- Spillage of F.O. during bunkering operations by using bunkering check list
- Ballast discharge contamination or malfunction of ship's sea side valves by prohibiting such operations without written permission of the port.
- Non use of reception facility of the port by ships on cost plus basis.

**Operational leakage**

**Spill due to floating hose failure at SPM: (183 t, at pumping rate of 10000 $m^3$/h of crude oil for 75 sec): (Spill points - S1 at HMEL SPM & S2 at Mundra SPM)**

Crude oil pumping rate from the tanker to the shore tanks will be varying between 5000 $m^3$/hr and 10000 $m^3$/hr. In the present study, the maximum pumping rate of 10000$m^3$/hr has been considered to assess the risk on a higher side. The Safety Break Away Coupling in the crude oil transfer hose will be activated within a few seconds in the event of hose rupture or hose failure. Again for the sake of assessing higher risk, a response time of 60 sec – 75 sec (worst case scenario) is considered to estimate the amount of oil that would spill at the SPM. Thus the quantity of crude oil spill has been estimated to be a maximum of 183 tons in the event of hose failure or rupture.

**Spill due to rupture of sub-sea crude oil pipeline from SPM to shore tanks: (384 tons of crude oil, at pumping rate of 10000 $m^3$/hr for 60 sec): Spill point S3 taken at midpoint of the pipeline from HMEL SPM to LFP)**

Crude oil pumping rate from the tanker will be in the range of 5000 $m^3$/hr to10000 $m^3$/hr. In the present study, to assess the maximum risk, pumping rate of 10000 $m^3$/hr has been considered. The minimum wall thickness of sub-sea crude oil pipeline is 15.6 mm and the maximum thickness is 24 mm. Moreover all along, 5 inches concrete cladding (weight coating) is provided on the surface of the pipeline. Crude oil pipelines designed, constructed and laid as per the international norms are safe and leakages are extremely rare during their designed life. However, a rupture of size 1 cm x 12.7 cm has been assumed for assessing the quantum of oil spill through sub-sea pipeline.

The maximum manifold pressure will be 12 kg/$cm^2$ and crude oil will be pumped to the shore tanks without any boosting device in-between. As the level in the tanker depletes, discharge pressure would also be reduced. Moreover, with the flow distance the crude oil pressure inside the pipe drops. For the sake of assessing the amount of oil spill in case of rupture of sub-sea pipeline, an average pressure of 10 kg/$cm^2$ and a water column height of 35 m have been considered.

Accordingly the quantity of Crude oil spill has been estimated using the formula given by

$Q = C_d A (2gH)^{1/2}$

Where,

Q = quantity of spill ($m^3$/s)

$C_d$ = coefficient of discharge (0.9)
A = Area of rupture ($m^2$) (1 cm x 12.7 cm)
H = Net head (m) (6.5 kg/$cm^2$ = 65 m)

This would give a value of 0.04 $m^3$ of crude oil per sec spilling out of the pipeline through the rupture as the pump will be in operation.

The availability of solenoid operated hydraulic shutoff valves in the sub-sea pipeline, which will get activated in less than 15 seconds time as soon as the pressure falls, will limit the amount of oil leaked in case of pipe rupture and consequent drop inside the pipeline. However 60 sec response time has been considered for quantification of oil spill. Accordingly the quantity of Crude oil spill has been estimated to be 2.4 $m^3$ before the pump discharge valve closes. However, there will be high pressure inside the pipeline initially and the oil inside the pipeline will start leaking into the waters through the hole as the pressure inside the pipe line is higher than the outside pressure, even after the valve is closed and pumping is stopped. Even after the pipeline inside pressure equalises the outside static pressure acting on the rupture, oil continues to start leaking as the density difference between the oil and water; oil being lighter and LFP is higher in elevation compared to the pipeline elevation. Two factors need to be considered here; the specific gravity of the crude oil inside the pipeline is less than 1 whereas the sea water specific gravity is more than 1. Also depending on the location of the hole/leak, there will always be a static head of sea water acting on the leak when the oil tries to flow out and sea water trying to flow in to occupy the place vacated by the leaked oil. Hence all the oil in the pipeline will not leak and there would be an equilibrium point reached when there would be no more oil leaking from the hole as the sea water pressures effectively blocks the oil leak. Also, the leak would be attended to within the stipulated time as per the standard maintenance procedures followed by the organisation. For the purpose of this study and as a worst case scenario before the leak is repaired by the established maintenance procedures, it is assumed that a maximum of 5% of the pipeline oil volume would leak and though it would be a continuous leak, this total quantity is taken to be instantaneous for the purpose of the study.

The pipeline length is approximately 10 km (from SPM to LFP) and the pipeline size is 42" NB. The pipeline volume works out to be approximately 8662 $m^3$ or 7622 t.
Hence the total oil leaked due to rupture in sub-sea pipeline will be 2.15 t + 5% of pipeline volume of oil in t (0.05 x 7622 =381 t) which works out to be a maximum of 383.45 t, say 384 t of crude oil.
For the purpose of simulation studies, this spill on the pipeline is assumed to have taken place at the midway point from HMEL SPM to LFP (designated as spill point **S3** in the report) and is taken on the sub-sea pipeline from HMEL SPM to LFP. As the pipeline from HMEL SPM to LFP and the Mundra SPM to LFP run very close only one leak point in the pipeline is studied as it gives a representative oil spill study for the pipeline leakage scenario.

**Spill due to collision at SPM: (Spill points S1 & S2)**

Crude Oil is received at SPM by ocean tankers having capacity between 90,000-360,000 metric tons. Crude Oil is pumped to shore tanks through pipeline/s from the SPM. In the present scenario, collision of the vessel at the SPM or tanker route with another vessel enroute to other terminals can cause partial damage to the vessels cargo tanks (not more than 3 nos. of cargo tanks) leading to a maximum oil spill of about 700 tons to 25,000 tons of crude oil. In the present study, the probable quantity of crude oil spill due collision at SPM is considered as 700 tons at the minimum and as 25,000 tons at the maximum.

**Spill due to collision or grounding in the tanker route: (Spill point S4)**

Tankers are expected to call at the SPMs frequently depending upon the demand for the refineries for the crude oil. These tankers may meet accidents like collision with other vessels or grounding in the vicinity of the SPM. In case of such accidents, the spillage may vary depending on the size of the tanker and the extent of damage and number of cargo tanks ruptured etc. In the present study the probable quantity of spill in the tanker route considered for modelling is 25000 tons at a point which lies on the tanker route to SPM not exactly within Mundra port limit; but a spill point is taken along the tanker route in the Gulf but close to the Mundra port limit.

**Spills at the berths (applicable to berths at West Basin, South Basin, East Basin, North Basin, LNG berth and existing cargo berths of Mundra port.)**

Oil spills can take place at the berths in the basins during the loading / unloading as well as berthing and traversing operations. The likely spill scenarios are discussed below:

a) **Spills during the navigation of the vessel along the approach channel: (Spill point S7 for West Basin)**
The spill location can be anywhere in the path. One location along the approach path has been selected for carrying out for model runs.

b) **Spills around the jetty (in the maneuvering basin / turning circle): (Spill point S6 for West Basin and Spill point S10 for South Basin)**
This can occur due to tug boat impacting the vessel and grounding of the vessel. One location around the jetty at the turning circle has been considered for the computational runs

c) **Spills at the berths: (Spill point S5 for West Basin, Spill point S9 for South Basin, Spill point S13 for East Basin, Spill point S14 for North Basin, Spill point S8 for LNG jetty, Spill point S11 for MMPT 1 and Spill point S12 for MICT / AMCT berth locations)**

During the loading/unloading operations spills may take place due to one or more of the following: –

Hose/ loading arm leakage (liquid products handled at the liquid berth), overflow on the vessel deck, vessel grounding at the jetty, vessel colliding with jetty, fire and explosion on the vessel or at the jetty, during bunkering operations etc.

**Spills along approach Channel / Route**

Vessels to the port berths follow the Deep Water route in Gulf of Kutch and Pilot boards at Pilot Boarding Ground “A” or “B”, subject to tide and the berth allotted to the tanker.

While the risk of grounding is low, it cannot be wholly eliminated; the most likely causes are steering or propulsion system failure or navigational error, any of which could result in grounding on the channel margins. Given that the bed of the Gulf is rocky at some places the likelihood of any significant hull damage cannot be ruled out. In a general case scenario, weld fractures in the forward bunker tanks could give rise to a release of approximately 10 Tons of diesel oil and in a worst case scenario extensive damage to the bunker tanks may occur which would cause a spill of 500 to 700 t of FO spill.

**Collision**

The risk of collision while transiting the channel is negligible given the reason that port authorities use sophisticated ship tracking and navigational systems as the Gulf traffic has increased. These systems would ensure that the chances of any collision are remote or non-existent when ships / marine craft traverses / transits through the channel. However, even if any collision occurs, it is beyond reasonable

doubt that such an incident would result in the fore part rather than the parallel mid-body of the vessel and the loss of integrity of hull plating of a cargo tank is most unlikely. A spill quantity of 700 t can be the maximum in such a scenario.

**Berthing Incident**

Oil and/ or liquid chemical spill can occur as a result of hull coming in contact with the corners of the jetty structure 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 on support tug in attendance or Master error or wrong judgment.

The potential spill quantities involved depend on the vessel type and the location and extent of the impact damage; hull damage to a 20000 DWT – 80000 DWT tanker / vessel in way of a forward or aft wing tank, for example, could give rise to a release of some 500 Tons of product. The potential spill quantity, should hull plating be ruptured in way of an aft wing diesel oil bunker tank can, historically, be up to 100 Tons.

**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 extent of the impact damage but can be over 20 tons for Diesel oil and 100 Tons for cargo (FO) oil. Spills from this cause are considered to be of low likelihood but the risk is acknowledged.

**Loading Arms / Flexible hoses**

The operation of loading arms / flexible hoses can lead to minor releases of oil. Common sources are vent valves, swivel joints and hydraulic lines. Such spillage seldom exceeds 0.1 Tons.

**Cargo Tank Overflow**

Cargo tank overflows can occur on board loading vessels; spills of this nature can be due to instrumentation failure, tank valve mismanagement or operator 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 and/or chemical will be retained on deck but, in a worst case scenario, up to 3 tons could escape overboard.

**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 tons; 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 tons must however is acknowledged.

**Fire and Explosion**

Fires and explosions on board ship represent a safety hazard with the risk of pollution as a secondary impact. Most tankers engaged for trading will be equipped with inert gas systems. Given the controls, which are imposed and enforced by APSEZL authorities 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, insofar as cargo transfer operations are concerned.

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, unauthorized hot work such as welding, and engine room fires can spread rapidly if not dealt with swiftly and can give rise to incidents of a very serious nature.

While the likelihood of fire or explosion occurring on board vessels berthed at the Mundra port berths is low, the risk is nevertheless acknowledged. Such an incident could give rise to a spillage of 700 tons or more.

**Bunkering – spillage of fuel oil**

Bunkering at the port may sometimes give rise to spills due to hose failure and / or bunker tank overflow etc. in spite of the strict regulatory supervision of the port operations. These spills could be as small as a few kgs to a maximum of 500 t of FO.

As can be seen from the spill scenarios mentioned above, the spills range from extremely negligible quantities to enormous quantities in rare catastrophic events. The simulation of oil spills does not vary significantly in various scenarios except for the magnitude of impact zone and the quantity involved in such impacts. Though the software is intended to be used for specific scenarios so as to get the trajectory and other weathering information; in this study, a few hypothetical scenarios have been simulated and computations carried out considering the worst-case scenarios of oil spills at the different likely locations in the domain.
Based on the above deliberations, the following scenarios for computations have been selected for carrying out modeling studies for the oil spill trajectory and weathering processes.

**Computational Scenarios:**

| **Spill Locations** | **Pre-monsoon (Jan)** | **Monsoon (July)** | **Post monsoon (Nov)** |
|---|---|---|---|
| **SPM** | | | |
| Crude oil spill of 183 t at the pumping rate of 10000 $m^3$/hr (for 75 sec release) at the SPMs (due to Hose failure)<br>Spill points: **S1** and **S2**<br>During spring and neap tide conditions (tide conditions : PF and PE) | ▪ | ▪ | • |
| Instantaneous crude oil spill of 700t at the SPMs<br>Spill points: **S1** and **S2** | ▪ | ▪ | • |
| Instantaneous crude oil spill of 25000t at the SPMs -- Spill points: **S1** and **S2** | ▪ | ▪ | • |
| Pipeline Leakage | | | |
| Crude oil spill of 384 t at the pumping rate of 10000 $m^3$/hr (for 60 sec release) along the pipeline corridor at a select (midway) point of subsea pipeline in the pipeline routes. -- Spill point: **S3** | ▪ | ▪ | • |
| Tanker route | | | |
| Instantaneous crude oil spill of 25000t along the tanker route at select location.<br>Spill point: **S4** | ▪ | ▪ | • |

| | | | |
|---|---|---|---|
| **West Basin (berths)** | | | |
| 100 tons (due to Berthing incident/ collision) at the West Basin berths (FO)<br>Spill point: **S5** | ▪ | ▪ | ● |
| 50 Tons (due to Berthing incident/ collision (diesel oil tanks) at the West Basin berths (HSD)<br>Spill point: **S5** | ▪ | ▪ | ● |
| 700 Tons due to Hull Failure / Fire / Explosion (FO) at the berths -- Spill point: **S5** | ▪ | ▪ | ● |
| In the maneuvering basin:<br>o 20 Tons of HSD oil due to Tug Impact (HSD)<br>o 100 Tons of FO due to Tug Impact<br>Spill point: **S6** | ▪ | ▪ | ● |
| Along the vessel route at one location: Instantaneous oil spill of 700t along the tanker route at a select location.(FO):<br>Spill point: **S7** | ▪ | ▪ | ● |
| **LNG Berth** | | | |
| 100 tons (due to Berthing incident/ collision) at the LNG berth (FO) --<br>Spill point: **S8** | ▪ | ▪ | ● |
| 50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the LNG berth (HSD) –<br>Spill point: **S8** | ▪ | ▪ | ● |
| 700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth-- Spill point: **S8** | ▪ | ▪ | ● |
| **South Basin (Berths)** | | | |
| 100 tons (due to Berthing incident/ collision) at the South Basin berths (FO) --<br>Spill point: **S9** | ▪ | ▪ | ● |
| 50 Tons (due to Berthing incident/ collision (diesel oil tanks) at the South Basin berths(HSD) – Spill point: **S9** | ▪ | ▪ | ● |
| 700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth -- Spill point: **S9** | ▪ | ▪ | ● |
| At the turning circle:<br>o 20 Tons of HSD oil due to Tug Impact<br>o 100 Tons of FO due to Tug Impact<br>Spill point: **S10** | ▪ | ▪ | ● |
| **At the existing MMPT 1 Berth:**<br>**: Spill Point S11** | | | |
| 100 tons (due to Berthing incident/ collision) at the berth(FO) --<br>Spill point: **S11** | ▪ | ▪ | ● |
| 50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the berth (HSD) –<br>Spill point: **S11** | ▪ | ▪ | ● |
| 700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth | ▪ | ▪ | ● |

| | | | |
|---|---|---|---|
| **At the existing MICT / AMCT Berths:**<br>**: Spill point S12** | | | |
| 100 tons (due to Berthing incident/ collision) at the (FO) - Spill point **S12** | ▪ | ▪ | • |
| 700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth - Spill point **S12** | ▪ | ▪ | • |
| **At the East Basin:**<br>**Spill point S13** | | | |
| 100 tons (due to Berthing incident/ collision) at the East Basin berth (FO) -<br>Spill point **S13** | ▪ | ▪ | • |
| **At the North Basin:**<br>**Spill point S14** | | | |
| 100 tons (due to Berthing incident/ collision) at the North Basin berth (FO) -<br>Spill point **S14** | ▪ | ▪ | • |

**2.2 Types of oil likely to be spilled**

Mundra Port mainly deals with Vegetable oils, Furnace oil, Naphtha, Methanol, High Speed Diesel, Super Kerosene Oil and other light oils at its Multi-Purpose terminal. The vessels calling at the port (or the designated anchorage areas) may spill fuel, diesel or a minimal quantity of lubricating oils. The SPM is being used to discharge crude oils from tankers.

At Berths:

- Vegetable oils,
- Furnace oil,
- Naphtha,
- Methanol,
- High Speed Diesel,
- Super Kerosene Oil,
- Carbon Black Feed Stock (CBFS),
- Motor Spirit,
- Other light oils

At SPM:

- Crude oil

At anchorages or within port limits:

- Fuel oil,
- Diesel oil,
- Minimal quantity of lubricating oil.

**2.3 Probable fate of spilled oil**

APSEZL is all weather, commercial port with geographical and hydrological advantages on the West Coast of India, in the Gulf of Kutch. Tidal range is between +0.37 m during Neaps and + 6.40 m during springs. Tidal streams flow $070^0 – 250^0$ at an average rate of 3 kts and 4-5 kts during spring tides.

It has been observed from the modeling study that during pre-monsoon season, the spills occurring at the APSEZL marine facilities move towards the southern / southwestern part of the Gulf of Kutch nearer to the facilities depending on tide phase.

The spills taking place at the APSEZL marine facilities move towards northern coast of Gulf of Kutch during monsoon season and affect the coast near Mundra, Kandla etc.
During post - monsoon season, the spills taking place at the APSEZL marine facilities move towards south / southwest and affect the islands /coast on southern side of the Gulf of Kutch.

The surface or subsurface oil spill consists of slick floating on the water surface, which partially dissolves in the water and partially evaporates into the atmosphere. There is a continuous exchange between the suspended and surface oil (floating oil). The assumption made in deriving the governing equations is that the thickness of the oil layer is negligible in comparison with the water depth.

In addition to the location, size and physico-chemical properties of the spill, other major factors affect the fate of the oil slick are governed by complex interrelated transport (turbulence) and weathering processes (evaporation, emulsification and dissolution). The spilled oil spreads and moves by the forces of winds and currents. A small portion of hydrocarbons begin to go into solution in the underlying water column, but most of the oil is lost through evaporation into the atmosphere. In the present model, all these processes are considered in the transport of Oil Slick.

Out of the above mentioned oils the vegetable or light oils do not pose any significant threat to the environment.

The spilled 'persistent' crude oil (or fuel oil) undergoes a number of physical and chemical changes known as "weathering". The major weathering processes are spreading, evaporation, dispersion, emulsification, dissolution, oxidation sedimentation and biodegradation.

> *The term persistent is used to describe those oils which, because of their chemical composition, are usually slow to dissipate naturally when spilled into the marine environment and are therefore likely to spread and require cleaning up. Non-persistent oils tend to evaporate quickly when spilled and do not require cleaning up. Neither persistence nor non-persistence is defined in the Conventions. However, under guidelines developed by the 1971 Fund, an oil is considered non-persistent if at the time of shipment at least 50% of the hydrocarbon fractions, by volume, distill at a temperature of 340ºC (645ºF), and at least 95% of the hydrocarbon fractions, by volume, distill at a temperature of 370ºC (700ºF) when tested in accordance with the American Society for Testing and Materials Method D86/78 or any subsequent revision thereof."*

a) **Spreading**: is one of the most significant processes during early stages of a spill is initially due to gravity. The oil spreads as a coherent slick and the rate is influenced by its activity. After a few hours, the slick begins to break-up and after this stage, spreading is primarily due to turbulence. Wind and wave actions also tend to fragment the slick, breaking it up into islands and windrows.

b) **Evaporation**: The rate and extent of evaporation depends primarily on the volatility of the oil. In general, oil components with a boiling point below 200 D C evaporate within 4 to 16 hours in tropical conditions. Spills of refined products such as kerosene and gasoline evaporate completely and light crude lose up to 40 % of its volume within a few hours. In contrast, heavy crude and fuel oils undergo little evaporation.

c) **Dispersion**: Waves and turbulence act on the slick to produce droplets of oil of different sizes. Small droplets remain in suspension while the larges ones rise to the surface. The rate of dispersion mainly depends on the nature of the oil and the sea state. Oils which remain fluid can spread unhindered by other weathering processes can disperse completely in moderate sea conditions within a few days. Viscous oils tend to form thick lenses on the water surface with slow tendency to disperse, which can persist for several weeks.

d) **Emulsification**: Several oils have tendency to absorb water to form water-in-oil emulsions thereby increasing the volumes of the emulsified mass by a factor of 3 to 4. The arte at which the oil is emulsified is largely a function of sea state though viscous oils absorb water slowly. In turbulent sea conditions, low viscosity oils can incorporate as high as 80 % water by volume within 2 to 3 hours.

e) **Dissolution**: The heavy components of crude oil are virtually insoluble in sea water while lighter compounds are slightly soluble. Hence levels of dissolved PHc rarely exceed 1 mg/l following a spill. Therefore, dissolution, does not make a significant contribution to the removal of oil from the sea surface.

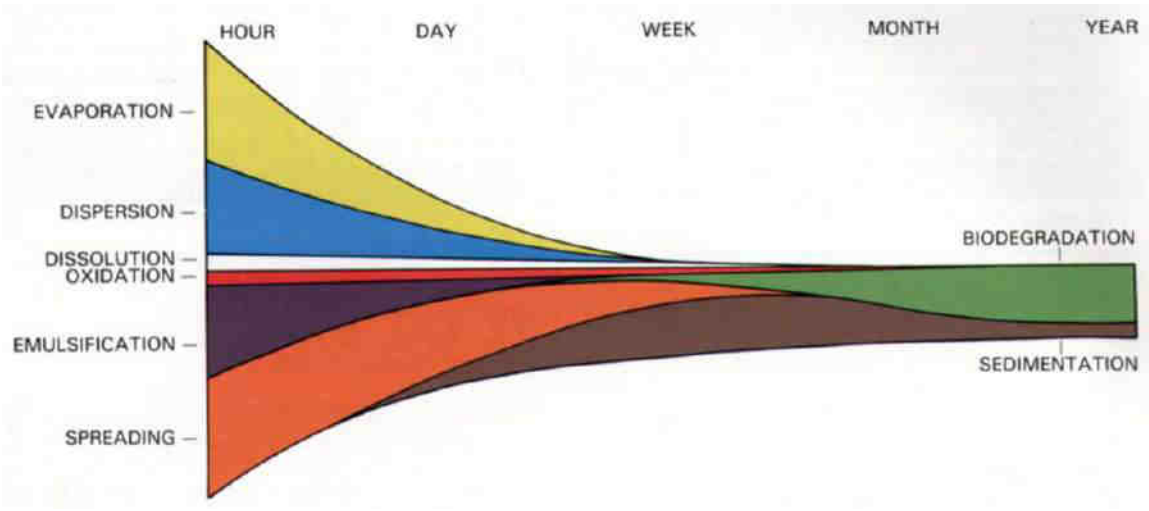
f) **Sedimentation**: Very few oils are sufficiently heavy to sink in sea water. However, the weathered residue gets mixed up with the suspended substances in water and may sink. This process becomes significant when water-in-oil emulsions attain specific gravity near to one and therefore need very little suspended substances to exceed the specific gravity of sea water (1.025).

g) **Oxidation:** Hydrocarbon molecules react with oxygen and either breaks down into soluble products or combine to form persistent tars. Many of these oxidation reactions are promoted by sunlight and their effect on overall dissipation is minor in relation to other weathering processes.

h) **Biodegradation** : Sea water contains a range of marine bacteria, moulds and yeasts which can use oil as source of carbon and energy. The main factors affecting the rate of biodegradation are temperature and the availability of oxygen and nutrient, principally compounds of nitrogen and phosphorous. Each type of micro-organism tends to degrade a specific group of hydrocarbons and whilst a range of bacteria exists between them which are capable of degrading most of the wide variety of compounds in crude oil, some components are resistant to attack.

Because the micro-organisms live in sea water, biodegradation can only take place at an oil/water interface. At sea, the creation of oil droplets, either through natural or chemical dispersion, increases the interfacial area available for biological activity and so enhances degradation.

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill whilst oxidation, sedimentation and biodegradation are long-term processes, which determine the ultimate fate of oil. Fig.3.1 shows schematic diagram of weathering processes with time.




**Schematic diagram of weathering processes with time**

It should be appreciated that throughout the lifetime of an oil slick, it continues to drift on the sea surface, independent of these processes. The actual mechanism governing movement is complex but experience shows that oil drift can be predicted by taking into account wind-induced effects and surface water currents. These can be calculated using mathematical modeling to determine the oil spill trajectory. The wind-induced effect is normally taken as 1-3% of the wind velocity, and the current effect as 110% of the current velocity. Reliable prediction of slick movement is clearly dependent upon the availability of good wind, tide and current data.

An understanding of the way in which weathering processes interact is important in forecasting their combined effect in changing the characteristics of different oils and the lifetime of slicks at sea. In order to predict such interactions, numerical models have been developed, based on theoretical and empirical considerations.

Accidental oil spills as indicated in 'Oil Spill Scenario' in section 2.1 of this plan might occur in the area of SPM. On the basis of the data modeled, the results indicate that

a) about 38 % of hydrocarbons are lost by evaporation, 2.8 % by emulsification and 0.75 % by dissolution within 5 hours;
b) the quantum of dissolved oil increases up to initial 5 hours and thereafter decreases as lighter (more soluble) hydrocarbons evaporate;
c) after 50 hour, no oil dissolves;
d) the trend of emulsified oil is similar to that of evaporated oil but emulsification occurs at a slow rate;
e) the radius of oil slicks increases to nearly 1400 m at the end of 148 hours; and
f) the maximum PHc concentration in water is about 39 μg/l.

The spill trajectories clearly reveal the dominance of wind in deciding the location of landfall of the weathered oil. Thus during June-August, the spill will be preferentially transported in the north east direction under the influence of south west winds while during October-November, and possible up-to February, the oil will be predominantly carried to the southern shore. It is also evident that under the influence of the southwest winds, the oil will be deposited on the northern shore within 60 hours, while it might take about 80 hours to reach the southern shore during north east winds.

**2.4 Development of oil spill scenarios including worst case discharge**

The scenario of the spill are classified under two categories:

1. Oil Spill at Mundra Port Multi-Purpose Terminals/ Basins
2. Oil Spill at SPM

Oil Spill at Mundra Port Multi-Purpose Terminals/ Basins

a) Leak during cargo transfer operations Minor (250 liters)

This can occur at the start of cargo operations, during operation due to leakage in pipes, expansion joints, and at the time of disconnection of hose at manifold. However, such instances are remote on implementation of International Safety Management by Ships and Quality Management systems by Port.

b) Slop tank / bunker tank overflow at, Jetty / Ship Minor (250 - 1000 ltrs.)

This source of pollution is purely of an accidental nature. The ship is expected to be ship shape with good trained crew and this has been emphasized to the Master of the vessel at the time of cargo transfer / bunkering. Based on a rate of 20 cbm/hr. and reaction time of 1 min, and hose content of 150 ltrs., likely spill is only 250 litres. A ship shore check list for cargo operations and bunkering is employed. A joint declaration is made by Marine Staff and Chief Officer / Master and enforced by Marine Manager. This results in good ship / shore co-ordination.

c) Spill during berthing (tug impact) Moderate (3000 liters)

Accidental contact with tugs or another marine structure is a possibility but quantum is not going to be significant because of Fendering system employed and training given to tug crews. Also with concept of double hull tanker the entire cargo compartments are protected by another hull, thus cargo spillage due to impact of tug is remote.

d) Grounding / Hull Damage :

APSEZL operates dry cargo & liquid cargo berths. Tankers mainly carry Furnace oil, Naphtha, Methanol, High Speed Diesel, Super Kerosene Oil and Vegetable oil. Oil transfer operations at the jetty are supervised by Liquid terminal staff. Manifold area has receptacle facilities to prevent accidental spills at connection / disconnection time. Berthing is done under controlled conditions and spill due to contact damage to underwater oil tanks is very remote. Radio officer controls movement of vessels in and around the berth and traffic presently is insignificant to pose any collision damage risk. Under water sea bed characteristic is soft sand. The berth area of about $500^2$ m is surveyed monthly for any changes and underwater obstructions; hence grounding resulting into oil spill is very remote.

Oil Spill at SPM

a) Hose Puncture while unloading:

In such an event, crude oil, about 10670 Kgs may spill onto water. On spillage the oil slick will be carried away at a distant location depending upon water current and wind direction. The trained crew of the maintenance vessel patrolling the area during unloading, would control the oil slick movement by using booms and subsequently, the oil will be collected by the skimmer.

b) Failure of Swivel joint of SPM:

In this event about 17780 Kgs of crude oil may spill onto water. In this case the leakage may be detected visually by the personnel monitoring the operation from the ship tanker or by the detectors provided on the SPM.

**c)** Leakage of Crude oil at PLEM or from the submarine pipeline:

This case will occur at least 20 m below the water surface, oil being lighter than water will travel upward and float on to water. By the time oil water reaches the sea water surface, the oil droplets may start undergoing “weathering process” and it may form emulsion along with water.

d) Ship Collision Frequency :

Based on the statistical data and its analysis carried out by National Institute of Oceanography, the probability of this type of accident is about one in every seven years for the traffic projection and hence, this case is ignored.

e) Ship Grounding Frequency :

Based on the statistical data and its analysis carried out by National Institute of Oceanography, the probability of this type of accident is about one in eleven years for the traffic projection and hence, his case is also ignored. Also with concept of double hull tanker the entire cargo compartments are protected by another hull, thus cargo spillage due to grounding is remote.

**2.5 Shoreline sensitivity mapping**

Gulf of Kutch is a typical semi-enclosed basin where the tidal forces interact with the open ocean waters of the sea, across its western open boundary at Okha. The currents of the region are tidal-driven and the water column is vertically well mixed. These features make the numerical modeling task easier, as a 2-D hydrodynamic model is sufficient to accurately reproduce the tides and currents for the study region in the Gulf of Kutch at Mundra.

The model domain of longitudes of 68° 50' 56.7" E and $70^0$ 27' 36.9'' E and the latitudes of 22°14' 58.8" N and 23° 01' 49.1'' N is selected for carrying out sensitivity analysis and predicting the fate and transport of oil spill that may take place at APSEZL's SPMs, Basins, berths and tanker route near Mundra coast in Gulf of Kutch.

The bottom roughness in the Gulf of Kutch varies due to the variation of bed sediment grain sizes. The bed consists of various sizes of clay, sand, silt and rocky soils. In the present study a uniform Manning's roughness coefficient has been used for numerical runs of hydrodynamic processes. The filled contours of Chezy's roughness coefficient are shown in Fig. A.1.4. The same roughness coefficient has been used to predict tides and tidal velocities in the Mundra area for prediction of oil spill trajectory.

The interpolated Chezy's coefficient calculated based on Manning's roughness and total water depth is shown in Fig.A1.4. The sensitivity analysis has been carried out with various Manning's value, which is the combined effect of $d_{50}$ sediment size and bed configuration, to calibrate the model with respect to the tide data of March and October 1994, at Sikka. The computational runs were continued with various sets of various bed roughness values till computed and measured tide levels are within the acceptable limit.

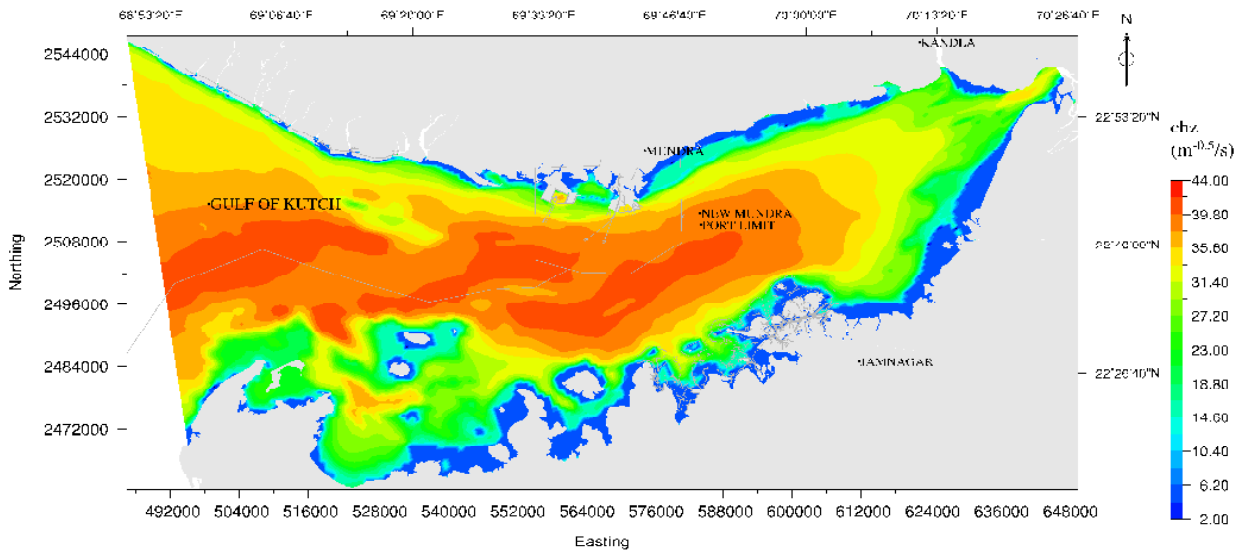



Fig.A1.4 Chezy's coefficient

For Shoreline sensitivity mapping refer Volume 2 (Annexure-V, VI and VII) of Oil Spill Risk Assessment.

**2.6 Shoreline resources, priorities for protection**

The SPMs and the Marine facilities (Existing Berths, South Basin, West Basin, North Basin, East Basin and LNG Berth etc.) are located in the Northern side of Gulf of Kutch at Mundra. VLCCs bring Crude oil and unload at the two SPMs which are connected to the Shore tanks by means of Submarine pipelines. The Crude unloaded at these SPMs is pumped through Submarine pipeline to Shore tank farm area.

Various Marine craft / solid cargo/ liquid cargo vessels traverse through the Gulf waters to berth at the various Terminals / Berths located in the new Mundra port limit. The general layout of the various facilities like SPMs, terminals etc. within the Mundra port limit area are shown in Fig.1.1 to Fig.1.4 in chapter 1. There is a probability of spillage at SPMs, along the sub-sea pipelines and tanker route during unloading operations and transportation. Apart from these operations at the SPMs, loading / unloading operations at the different berths of the Mundra port – South Basin, West Basin, North Basin, East Basin, LNG jetty and existing berths also may give raise to accidental spills at the berth locations. The spills at these locations may affect the shore and other facilities along the coast of Gulf of Kutch. The coast of Mundra has tidal flats, sand bars and not much in the way of mangroves. The mangroves, Marine Park / Marine Sanctuary etc. are on the Southern side of Gulf of Kutch. As it was observed that the spills occurring at the various locations of the APSEZL Marine facilities may reach the Coast on the Northern side as well as on the Southern side of the Gulf depending upon the season, there is a need to protect the environment in the event of an oil spill at any of the APSEZL Marine facilities.

**Shoreline Resources available with APSEZL, Mundra for deployment during shoreline cleanup/ emergent situation:**

| Item | Quantity |
|---|---|
| Oil Spill Dispersants | 15000 liters |
| Sorbent pads | 2000 nos. |
| Portable dispersant storage tank: 1000 ltr capacity | 1 no. |
| Portable pumps | 2 nos. |
| Oil discharge hose, 3”, 2 x 10 m | 1 set |
| Tanker Trucks | 04 nos. |
| Mini Vacuum Pump (30 m3 / hr) | 05 nos. |
| Sorbent Boom Pack( 12.5cm x 4 M) | 500 mtr |
| Slurry Pump (60 m3 / hr) | 01 no. |
| Start Tank with capacity 10000 liter(10 $m^3$) | 02 nos. |
| OSD Applicator- Oil Dispersant Spry Unit(20 ltr) for use on beach and inter tidal zones | 02 nos. |

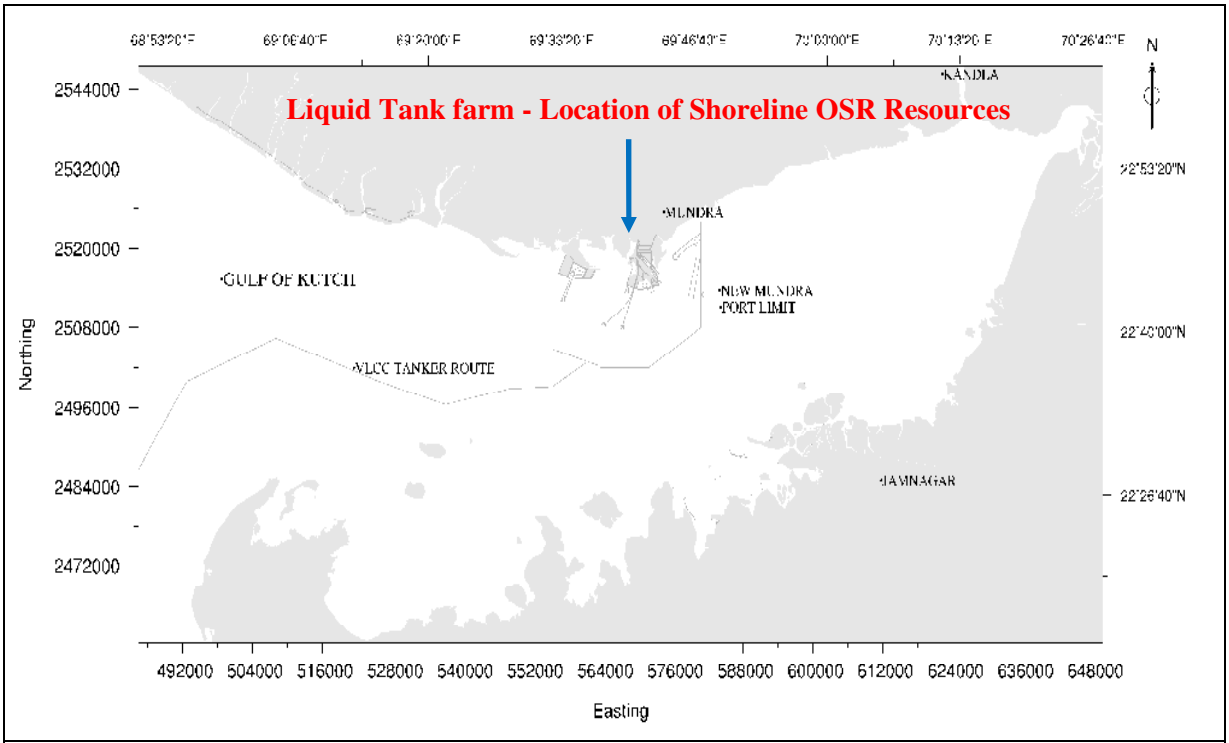



Fig.1.1 :General Arrangement of the marine facilities at Mundra port showing the VLCC route and facilities within the new Mundra port limit considered for carrying out the oil spill risk assessment studies.

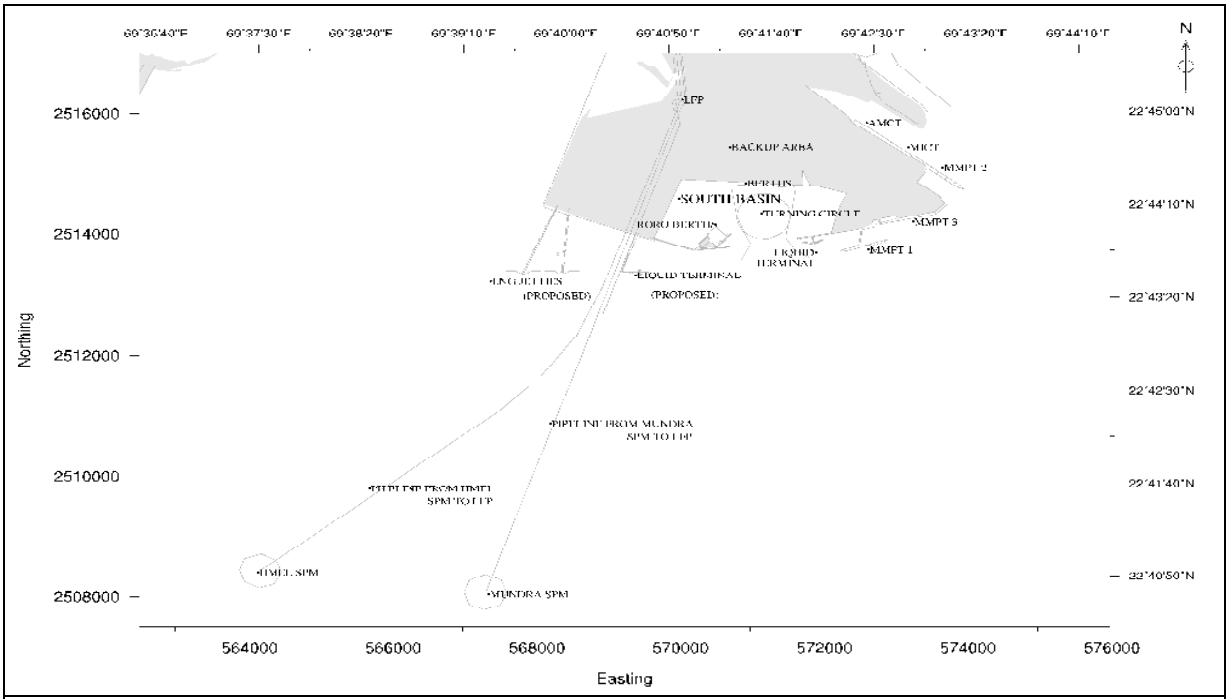



Fig1.2: Zoomed up portion of the South Basin showing the berths, turning circle, LNG jetty and existing berths as well as SPMs.


Fig.1.3 Zoomed up portion of the West Basin showing the berth locations and the approach channel for the vessels

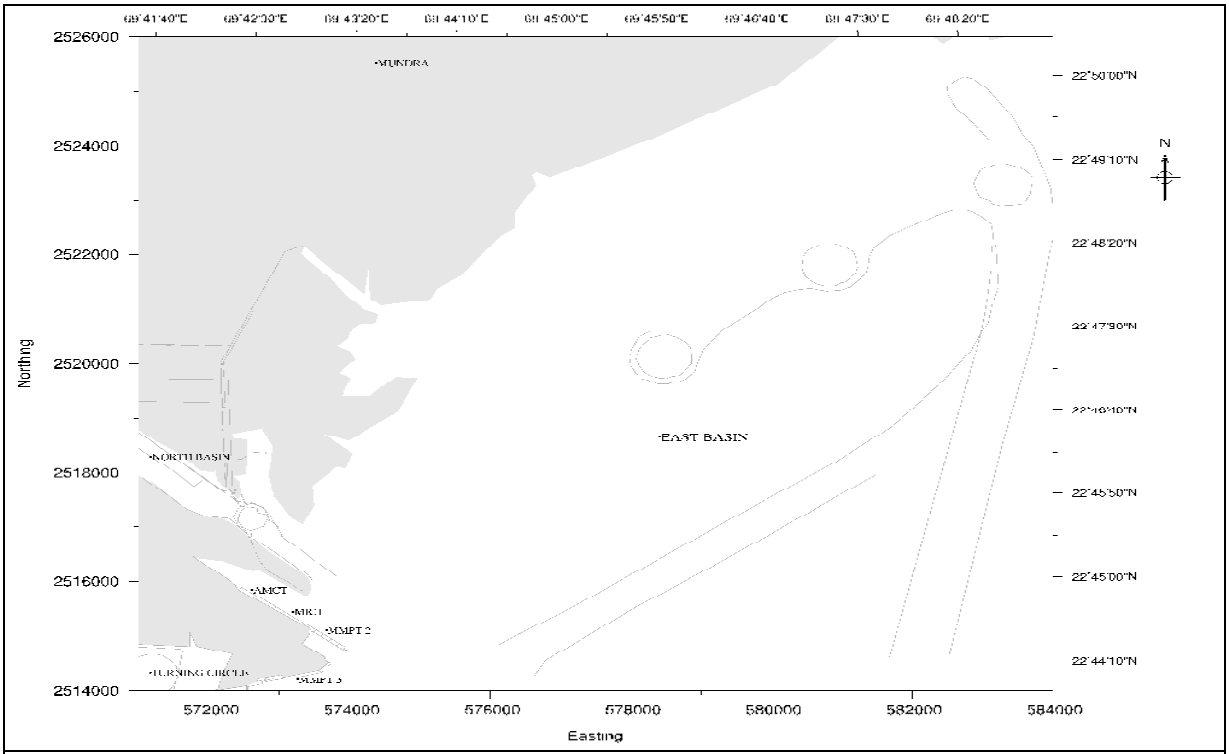



Fig.1.4 Zoomed up portion showing the East Basin & North Basin

**Marine resources in Gulf of Kutch**

**Phytoplankton**

Phytoplanktons are vast array of minute and microscopic plants passively drifting in natural waters and mostly confined to the illuminated zone. In an ecosystem these organisms constitute primary producers forming the first link in the food chain. Phytoplankton long has been used as indicators of water quality. Some species flourish in highly eutrophic waters while others are very sensitive to organic and/or chemical wastes. Some species develop noxious blooms, sometimes creating offensive tastes and odours or anoxic or toxic conditions resulting in animal death or human illness. Because of their short life cycles, plankton responds quickly to environmental changes. Hence their standing crop in terms of biomass, cell counts and species composition are more likely to indicate the quality of the water mass in which they are found. Generally, phytoplankton standing crop is studied in terms of biomass by estimating chlorophyll and primary productivity, while in terms of population by counting total number of cells and their generic composition. When under stress or at the end of their life cycle, chlorophyll in phytoplankton decomposes to phaeophytin as one of the major products.

**Phytopigments**

During April 2010, the phytoplankton pigments viz. chlorophyll a (1.7 – 2.4 mg/m3; av 1.9 mg/m3) and phaeophytin (0.3 – 1.2 mg/m3; av 0.7 mg/m3) varied considerably. In October 2010, chlorophyll a ranged from 2.0 – 4.2 mg/m3 (av 3.1 mg/m3) and phaeophytin from 0.7 - 1.1 mg/m3 (av 0.7 mg/m3) (Tables 8.1 and 8.2). The average concentration (mg/m3) of chlorophyll a off Vadinar during different sampling events (2010) is listed in Table 8.1:

**Table 8.1: Average chlorophyll a (mg/m3) off Vadinar (April 2010 to October 2010)**

| Area | Pathfinder | Nearshore | ESSAR DP | IOC SPM | ESSAR SPM | Salaya Creek | Gulf |
|---|---|---|---|---|---|---|---|
| April 2010 | 2.4 | 2.1 | 1.9 | 1.4 | 2.0 | 2.0 | 1.7 |
| Oct 2010 | 2.1 | 4.2 | 2.8 | 4.1 | 2.0 | - | 3.7 |

The values of phaeophytin during the present monitoring period are given in Tables 8.2, while, the average concentrations (mg/m3) between different sampling events (April 2010 and October 2010) are listed in Table 8.2.

**Table 8.2: Average phaeophytin (mg/m$^3$) off Vadinar (April 2010 to October 2010)**

| Month | Pathfinder | Nearshore | ESSAR DP | IOC SPM | Essar SPM | Salaya Creek | Gulf |
|---|---|---|---|---|---|---|---|
| April 2010 | 1.2 | 0.6 | 0.8 | 0.3 | 0.6 | 0.8 | 0.6 |
| Oct 2010 | 1.1 | 0.9 | 1.1 | 0.9 | 0.7 | - | 0.8 |

**Phytoplankton population**

As is generally the case with Coastal waters, the phytoplankton population density (68-332 nox$10^3$/l; av 186 no x $10^3$/l) and generic diversity (11-30 no; av 18 no) varied over a wide range and in a random manner during April 2010 (Table 8.3). In October 2010 the phytoplankton population density ranged from 100-789.6 nox$10^3$/l (av 329.4 no x $10^3$/l) and generic diversity ranged from 12-25 no (av 19 no) (Table 8.4) off Vadinar.

**Table 8.3: Average phytoplankton population density (no x $10^3$/l) and total genera (no) off Vadinar (April 2010 to October 2010)**

| Month | Pathfinder | | Nearshore | | ESSAR DP | | IOC SPM | |
|---|---|---|---|---|---|---|---|---|
| | Cell count (nox$10^3$/l) | Total genera (no.) | Cell count (nox$10^3$/l) | Total genera (no.) | Cell count (nox$10^3$/l) | Total genera (no.) | Cell count (nox$10^3$/l) | Total genera (no.) |
| Apr-10 | 216.2 | 19 | 200.5 | 17 | 192.7 | 15 | 127.7 | 18 |
| Oct 2010 | 203.1 | 19 | 446.6 | 20 | 323.6 | 23 | 360.4 | 18 |

| Month | Essar SPM | | Salaya Creek | | Gulf | |
|---|---|---|---|---|---|---|
| | Cell count (nox$10^3$/l) | Total genera (no.) | Cell count (nox$10^3$/l) | Total genera (no.) | Cell count (nox$10^3$/l) | Total genera (no.) |
| Apr-10 | 124 | 16 | 198.5 | 18 | 211 | 15 |
| Oct 2010 | 260 | 16 | - | - | 487.6 | 14 |

The above results indicated wide temporal and spatial fluctuations in the standing stock of phytoplankton between April 2010 and October 2010 off Vadinar. In general, the coastal waters revealed high average cell counts during October 2010 as compared to previous data. The generic diversity of phytoplankton during April 2010 widely varied with the dominance of genera such as Nitzschia (17.7%), Guinardia (16.7%), Skeletonema (9.1%), Thalassiosira (7.4%), Hemiaulus (7.2%), Navicula (6.1%), Rhizosolenia (4.5%), Biddulphia (3.4%) and Leptocylindrus (3.4%). In October 2010, the dominant phytoplankton genera were Leptocylindrus (57.6%), Guinardia (13.9%), Nitzschia (8.1%) and Chaetoceros (7.2%)

**Mangroves**

According to one estimate the dense mangrove cover of Narara Bet is spread over an area of 5.5 $km^2$. The mangrove area has increased in recent years due to extensive plantations made by the Forest Department. Mangrove cover and mudflat areas ($km^2$) in Jamnagar, Lalpur, Khambalia and Kalyanpur Talukas estimated based on satellite data are given in Table 8.4 below:

**Table 8.4: Mangrove areas ($km^2$) along Jamnagar coast**

| Taluka | Mangroves (Dense) | Mangroves (Sparse) | Tidal mudflats |
|---|---|---|---|
| Jamnagar | 12.03 | 23.91 | 83.53 |
| Lalpur | 1.96 | 3.95 | 50.50 |
| Khambalia | 3.86 | 11.48 | 101.94 |
| Kalyanpur | 0.04 | 0.01 | 0.78 |

*Singh H.S., 2000. Mangrove in Gujarat, GEER foundation

**Mangroves at Vadinar**

The intertidal expanse in the vicinity of Dargah ranged in 1 – 1.2 km. Lower intertidal zone was muddy with dense algal growth. The mid and upper intertidal zone sustained mangrove vegetation of ~ 500 m width. The zone around HTL was dominated by a sandy beach with ~ 5 m width and a narrow beam at the backshore. The distribution of mangroves at Vadinar during the present monitoring (April 2010) is given in Table 8.5 below:

**Table 8.5: Distribution of mangroves at Vadinar (Dargah - North side)**

| | **Location** | **Species** | **% FQ** | **Density** | **Height (m)** | **DBH (cm)** | **Seedling (no/m$^2$)** |
|---|---|---|---|---|---|---|---|
| D1 | 22$^o$ 26'42.6''N<br>69$^o$ 42' 07.8''E | *A. marina* | 100 | Sep-67<br>-38 | 0.5 - 3.5 | <2.6 - 6 | 0 - 2 |
| D2 | 22$^o$ 26' 50.5''N<br>69$^o$ 41' 52.9''E | *A. marina* | 40 | 0 - 5<br>-2 | 0.5 - 1.5 | <2.5 - 4 | 0 - 1 |
| **Vadinar (Dargah - south side; afforested area)** | | | | | | | |
| D3 | 22$^o$ 26' 30.8''N<br>69$^o$ 42' 05.6''E | *A. marina* | 100 | (20 - 75)<br>-50 | 1.0 - 2.3 | <1.5 - 5 | 0 - 15 |

As evident from above data, the stand density of *A.marina* at two locations (D1 and D2) along North-east of Vadinar Dargah varied from nil to 67 plants/100 m$^2$ with higher density of plants noticed at location D1. Frequency of occurrence ranged from 40 - 100% in the mid and upper intertidal zones. The height varied from 0.5 to 3.5 m. Mostly the plants were dwarf (av 1 m) with occasional tall plants of 3.5 m. Diameter at Breadth Height (DBH) varied from <2.5 to 6 cm. The seedling density was poor and varied from 0 - 2 no/m$^2$. The mid intertidal segment was the popular feeding site for flocks of flamingos.

The upper intertidal expanse along South-west of Vadinar Dargah (D3) showed good growth of afforested mangroves (Table 8.5). The density of mangroves ranged from 20 - 75 plants/100 m$^2$ with an average of 50 plants/100 m$^2$. The plant height varied from 1.0 to 2.3 m and the DBH ranged from <1.5 to 5 cm. The seedling density was low (0-15 no/m$^2$), however, better than that noticed along North-east of Vadinar - Dargah (D1 & D2). Present results are comparable with earlier monitoring studies (2007 - 2009).

**Mangroves at Narara**

The intertidal expanse along the IOCL pipeline corridor varied from 2000 - 2200 m. The mangroves vegetation from upper intertidal region was observed to be healthy, dominated by *A.marina* on both sides of the pipeline corridor. Four locations (N1 to N4) were selected for monitoring of mangroves at Narara as detailed in below given Table 7.6.

**Table 8.6: Distribution of mangroves at Narara**

| | Location | Species | % FQ | Density | Height (m) | DBH (cm) | Seedling (no/m$^2$) |
|---|---|---|---|---|---|---|---|
| N1 | 22$^o$ 27' 56.8''N<br>69$^o$ 43' 43.2''E | *A.marina*<br><br>*C.tagal*<br>*R.mucronata* | 100<br><br>10<br>5 | 20-45<br>(38)<br>0.7*<br>0.2* | 2-3<br><br>-<br>- | 3-8<br><br>-<br>- | 0-85<br><br>-<br>- |
| N2 | 22$^o$ 27' 59.1''N<br>69$^o$ 43' 21.3''E | *A.marina* | 100 | 60-90<br>(85) | 2-4 | 25-12 | 0-7 |
| N3 | 22$^o$ 28' 03.5''N<br>69$^o$ 43' 27.4''E | *A.marina*<br>*R mucronata* | 100<br>3 | 28-85<br>(50) | 0.5-2.5<br>- | <15-7<br>- | 0-55<br>- |
| N4 | 22$^o$ 28' 07.2''N<br>69$^o$ 43' 24.6''E | *A.marina* | 100 | 30-130<br>(80) | 0.5-3.5 | <2.0-3.5 | 0-10 |

* no/500 m$^2$

As can be noticed in the above table, the plant density of *A.marina* varied from 20 - 130 plants/100 m$^2$ with a frequency of occurrence of 100% at Narara. The species like *Ceriops tagal* (7 plants/500 m$^2$) and *Rhizophora mucronata* (2 plants/500 m$^2$ - 3 plants/100 m$^2$) were rarely noticed. The locations N2 (85 plants/100 m$^2$) and N4 (80 plants/100 m$^2$) revealed better average density of *A.marina* as compared to the rest. The height of *A.marina* varied from 0.5 to 4 m with N2 and N4 locations indicating better plant height than the rest. The DBH varied from <1.5 to 12 cm at the monitoring locations. The seedling density ranged from 0 - 85 no/m$^2$ with N1 and N3 locations sustained better seedling density than the rest. Few new plants (30 - 45 cm in height) of *C.tagal* and *R.mucronata* were noticed at the EOL pipeline corridor during the present monitoring.

**Sand dune vegetation**

The narrow beach of ~ 5 m width around HTL along Narara Bet is marked with berm of ~ 1.5-2 m width, followed by back shore sandy zone. Occasional shrubs of *Salicornia brachiata* and *Suaeda maritima* are observed on the backshore sandy zone. The sand dune flora is more predominant on berm and immediate back shore zone of ~5 m width. Sand dune flora is represented by seven species viz; *Crassa sp, Cyperus arenarius, Launea sp, Suaeda maritima, Salicornia brachiata,* unidentified *Poaceae* member and unidentified *Fabaceae* member.

**Seaweeds and Seagrasses**

Seaweeds, which are known as a source of food, fodder and manure, are mostly found attached to various substrata like sandy, muddy and coralline sediments as well as rocky areas and play a significant role in enriching the sea by adding dissolved organic matter, nutrients and detritus besides serving as nursery areas for the larvae and juveniles of innumerable marine organisms. Some green Seaweeds are edible, red algae are the important source of agar and some of the brown algae are used for manufacturing algin and alginic acid. Seaweeds are also used to produce some bioactive compounds.

The algal zone of Narara Bet is confined to 1.2-2.5 km width. A total of 62 species of algae and 3 species of sea grasses are recorded from this region. Among them *Lyngbya*, *Caulerpa*, *Cladophora*, *Ulva*, *Cystoceira*, *Dictyota*, *Hydroclathrus*, *Padina*, *Sargassum*, *Acanthopora*, *Amphiroa*, *Champia*, *Centraceros*, *Gracilaria*, *Hypnea* and *Polysiphonia* were common with the dominance of *Padina* and *Gracilaria* at the lower reef flat. The open mudflats of Narara Bet are dominated by algae like *Enteromorpha*, *Ulva*, *Lyngbya* and *Polysiphonia*, while, the upper sandy shore and mangrove areas are associated with *Enteromorpha* and *Ulva*. Seagrasses such as *Halophila ovata* and *Halodule uninervis* are common in patches on sandy regions of the reef, while, *Halophila beccarii* occasionally occurred on mudflats along the tidal channels.

*Open mudflats near Dargah and Narara pipeline corridor supported growth of twelve marine algae dominated by Enteromorpha spp (Table 8.7). The biomass of Enteromorpha estimated at ~ 4 kg/m2.*

**Table 8.7: Marine algal flora along Narara/Vadinar**

| Sr. No. | Species | % FO* | ES* |
|---|---|---|---|
| 1 | *Enteromorpha clathrata* | 100 | D |
| 2 | *Enteromorpha intestinalis* | 100 | D |
| 3 | *Caulerpa racemosa* | 50 | C |
| 4 | *Ulva fasciata* | 100 | D |
| 5 | *Ulva lactuta* | 100 | D |
| 6 | *Ulva reticulate* | 90 | D |
| 7 | *Codium elongatum* | 30 | O |
| 8 | *Sargassum ilicifolium* | 45 | C |
| 9 | *Sargassum tenerimmum* | 60 | CD |
| 10 | *Gracilaria corticata* | 55 | C |
| 11 | *Gracillaria verrucosa* | 85 | C |
| 12 | *Polysiphonia platycarpa* | 20 | O |

*%FO: Percentage Frequency Occurrence, ES: Ecological Status, D: Dominant (% FO = 80-100), CD: Co-dominant (% FO = 60-79), C: Common (% FO = 40-59), O: Occasional (% FO = 20-39).

The intertidal zone of Kalubhar Tapu harbours 47 species of marine algae and three species of seagrasses. The reef areas of this island are dominated by *Dictyota*, *Gracilaria*, *Padina*, *Hydroclathrus*, *Ulva* and *Hypnea*. The open mudflats and sandy areas at the upper intertidal are preferred by *Enteromorpha*, *Ulva*, *Lyngbya* and *Polysiphonia*. The sandy region of the reef flat supported seagrasses like *Halophila* and *Halodule*.

**Zooplankton**

The zooplankton standing stock in terms of biomass and population density during April 2010 (Table 8.8) varied from 0.2 to 121.2 ml/100$m^3$ (av 3.3 ml/100$m^3$) and 2.2-722.7 x $10^3$/100$m^3$ (av 39 x $10^3$/100$m^3$), respectively while during October 2010 the zooplankton biomass and abundance ranged from 0.2 to 12.0 ml/100$m^3$ (av 3.5 ml/100$m^3$) and 2.5-157.8 x $10^3$/100$m^3$ (av 48.4 x $10^3$/100$m^3$) respectively suggesting normal secondary production off Vadinar during the monitoring period.

The average zooplankton biomass (ml/100$m^3$), population density (nox$10^3$/100$m^3$) and total groups (no) off Vadinar during the monitoring period varied in accordance with the data presented in Table 8.8.

**Table 8.8: Average values of zooplankton (A) biomass (ml/100$m^{3)}$ (B) Population density (nox$10^3$/100$m^3$) and (c) total groups (no) off Vadinar (April 2010 – October 2010)**

| Area | | Pathfinder | Nearshore | ESSAR DP | IOC SPM | Essar SPM | Salaya Creek | Gulf |
|---|---|---|---|---|---|---|---|---|
| April 2010 | A | 8.3 | 1.1 | 1.1 | 0.9 | 1.4 | 2.5 | 3.5 |
| | B | 89.9 | 24.6 | 14.4 | 22.7 | 12.7 | 20.4 | 37.4 |
| | C | 17 | 15 | 12 | 16 | 13 | 16 | 17 |
| Oct 2010 | A | 4 | 3.9 | 1.5 | 3 | 5.7 | - | 2.1 |
| | B | 57.4 | 55.9 | 23.5 | 30.5 | 83.1 | - | 32.8 |
| | C | 13 | 11 | 10 | 10 | 9 | - | 7 |

The overall zooplankton standing stock was low and highly variable off Vadinar which could be due to high patchiness and seasonal variability in their distribution apart from high grazing pressure at higher trophic levels.

During April 2010, 24 faunal groups were identified in the coastal waters off Vadinar during the monitoring period while 17 faunal groups were present in the samples of October 2010. The most common faunal groups were copepods (40.5%), decapod larvae (19%), gastropods (22.5%), lamellibranchs (10.7%), and foraminiferans (2.1%) in April 2010. In addition to the above, groups like chaetognaths, siphonophores, *Lucifer* sp, polychaetes, ctenophores, medusae, amphipods, ostracods, mysids, heteropods, isopods, stomatopod larvae, appendicularians and fish larvae were also frequently noticed but in less numbers during April 2010. During October 2010, the dominant groups were copepods (93.6%) and decapod larvae (4.8%). In general, the coastal waters off Vadinar revealed a moderate production of zooplankton associated with random fluctuations and seasonal changes.

**Macro benthos**

The organisms inhabiting the sediment are referred as benthos. Depending upon their size, benthic animals are divided into three categories, macrofauna, microfauna and meiofauna and macrofauna. Benthic community responses to environmental perturbations are useful in assessing the impact of anthropogenic perturbations on environmental quality. Macrobenthic organisms which are considered for the present study are animals with body size larger than 0.5 mm. The presence of benthic species in a given assemblage and its population density depend on numerous factors, both biotic and abiotic.

**Intertidal macrofauna**

During April 2010, Intertidal macrofauna was studied along 5 transects viz. 1 transect (Transect I) at Kalubhar Island and 4 transects at Narara Bet. Several locations were sampled along each transect between the HTL and the LTL viz; High Water (HW), Mid Water (MW) and Low Water (LW). The intertidal macrofaunal standing stock in terms of population density (50-7800 no/$m^2$, av 2292 no/$m^2$) and biomass (0.1-37.2 g/$m^2$; wet wt, av. 9.2 g/$m^2$; wet wt) varied widely During the post monsoon, only the first three transects were sampled. In October 2010, the intertidal macrofaunal standing stock in terms of population density ranged from 0-3625 no/$m^2$ (av 1185 no/$m^2$) and biomass from 0-67.8 g/$m^2$; wet wt (av. 14.6 g/$m^2$; wet wt). These results are compared with historical data in Table 8.9.

**Table 8.9 Average of intertidal macro benthos off Vadinar during April 2010 to October 2010, (A) Biomass (g/$m^2$) (B) Population density (no/$m^2$) and (C) Total groups**

| Transect | | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| April 2010 | A | 11.2 | 4.2 | 13.7 | 10.7 | 6.1 |
| | B | 3983 | 1172 | 1292 | 2401 | 2614 |
| | C | 5 | 3 | 6 | 6 | 3 |
| Oct 2010 | A | 11.9 | 16.8 | 15.1 | - | - |
| | B | 1495 | 904 | 1156 | - | - |
| | C | 5 | 7 | 5 | - | - |

Overall, the intertidal region sustained good faunal standing stock and diversity and the contribution of major faunal components are comparable over the past many years at Narara Bet/Kalubhar.

**Subtidal macrofauna**

Subtidal macrofauna was studied at 13 stations in the coastal system off Vadinar during April 2010 and at 10 stations during October 2010. The distribution of subtidal faunal standing stock in terms of biomass (0.3 - 41.0 g/$m^2$; av 8.0 g/$m^2$ wet wt) and population density (150-8925 no/$m^2$; av 1902 no/$m^2$) during April 2010. In October 2010 the biomass ranged from 0.3 – 23.9 g/$m^2$ (av 7.1 g/$m^2$; wet wt) and population density ranged from 125-14975 no/$m^2$ (av 2282 no/$m^2$) The current data is listed (April 2010 – Oct 2010) in Table 8.10.

**Table 8.10 Average of subtidal macrobenthos off Vadinar during April 2010 to October 2010, (A) Biomass (g/m$^2$) (B) Population density (no/m$^2$) and (C) Total groups**

| Area | | Pathfinder | Nearshore | ESSAR DP | IOC SPM | ESSAR SPM | Salaya Creek | Gulf |
|---|---|---|---|---|---|---|---|---|
| April 2010 | A | 11.2 | 2.9 | 2.0 | 6.1 | 1.3 | 15.5 | 6.4 |
| | B | 3833 | 338 | 388 | 694 | 2375 | 1553 | 1865.5 |
| | C | 7 | 3 | 4 | 6 | 5 | 6 | 4 |
| Oct 2010 | A | 12.1 | 7.7 | 1.9 | 4.9 | 1.8 | - | 10.6 |
| | B | 5019 | 2967 | 400 | 1169 | 181 | - | 1652 |
| | C | 8 | 5 | 4 | 4 | 2 | - | 7 |

The macrobenthic population was dominated by polychaetes (50.1%), amphipods (18.5%), pelecypods (8.2%), decapod larvae (7.4%), tanaids (3.6%) and foraminiferans (3.2%) during April and by polychaetes (76.3%), amphipods (12.3%) and pelecypods (5%) during October 2010.

**Corals and associated biota**

Live corals at the Narara and Kalubhar reefs are mainly confined to the lower littoral (reef flat) and shallow subtidal zones (< 8 m). They are absent at the upper reef flat probably because of high rate of sedimentation and long exposure during low tide.

**Narara Bet**

The eastern segment of Narara Bet represents a formation of vast mud flat, which resulted in significant negative influence on the live coral population. Many regions along the reef flat on the western side are exposed during low tide for prolonged periods because of which the distribution of live corals was poor. In all 30 and 22 Scleractinian species have been identified in the intertidal and subtidal zones respectively of Narara Bet with *Montipora, Goniopora*, *Porites*, *Favia*, *Favites*, *Goniastrea*, *Platygyra, Cyphastrea, Pseudosiderastrea, Turbinaria, Leptastrea* and *Symphyllia* as the dominant genera.

In general, the live coral density decreased with depth. The live corals were absent beyond 8 m (CD). However, the subtidal area at Narara sustained good coral populations within 5 m (CD). Distance-wise corals were rich within 250 m towards the sea from the LTL. The corals of the genera *Montipora, Porites*, *Favites*, *Goniastrea, Goniopora, Cyphastrea*, *Leptastrea*, *Favia* and *Turbinaria* dominated the subtidal area.

**Kalubhar**

In general, Kalubhar reef sustained relatively healthy live corals at the lower intertidal and subtidal (<7 m depth) zones as compared to the population at the Narara reef. The north and north-west regions of Kalubhar had better coral density and diversity as compared to the east and south-east regions because of high sedimentation of the reef flat and the subtidal zones. Overall, 30 and 7 species of Scleractinians in the intertidal and subtidal zones respectively at Kalubhar have been identified. The corals at Kalubhar were mainly represented by genera *Montipora, Favia*, *Favites*, *Porites*, *Goniastrea*, *Goniopora*, *Cyphastrea, Platygyra,* and *Symphyllia* and *Turbinaria.* The live corals were absent at the reef edge of 50 m width due to total exposure for longer period whereas their coverage increased (90 to 100%) at the reef slope below 1 m depth.

A rich reef associated flora and fauna was noticed at Kalubhar. The common and dominant seaweed genera were *Sargassum*, *Gelidiella*, *Acanthophora*, *Ulva*, *Caulerpa*, *Codium*, *Dictyota*, *Padina*, *Halymenia*, *Enteromorpha*, and *Gracillaria*. Varieties of sponges were associated with coral boulders. The fauna consisted of coelenterates (*Zoanthus* sp., *Discosoma* sp., *Stoichactis*, *giganteum*, *Cerianthus* sp. and variety of corals), annelids (various polychaetes), echiuroid (*Ikedella misakiensis*), crustaceans (amphipods, isopods, *Acetes* sp., shrimps and crabs), molluscs (*Octopus* sp., *Sepia* sp., *Loligo* sp., gastropods, bivalves, nudibranchs etc.) echinoderms and variety of reef fishes.

**Fishery**

Gujarat ranks number one position in marine fish production in India. The Gulf contributes about 22% to the fish production of the state. The share of the Jamnagar District is between 5 and 14% (av 10%) to the State's total marine fish landings. The important fish landing centres in the vicinity of IOCL SPM area which falls under Khambalia zone are Vadinar, Bharana, Nana Amla and Salaya which together contributed about 6823 t, 8253 t and 5330 t of fish landings in 2006-07, 2007-08 and 2008-09 respectively to the total landings of the Jamnagar District. Similarly, the important fish landing centres in the vicinity of Sikka which falls under Jamnagar zone are Sachana, Baid, Sarmat, Bedi and Sikka which together contributed about 4768 t, 5122 t and 5848 t of fish landings in 2006-07, 2007-08 and 2008-09 respectively. Within the Jamnagar zone, the major landings (98%) were from Sachana (32%), Baid (27%), Sikka (19.7%) and Bedi (18.9%) during the last 3 years. Within the Khambalia zone, the major landings (81-89%) were at Salaya during the period 2006-09. On an average the Khambalia zone (56.5%) contributed to about 13% higher fish landings than Jamnagar zone (43.5%) for the last 3 years. However, the landings at Sikka (1.3%) and Vadinar (0.5%) to the total landings of the district were negligible during the period 2006-2009.

**Reptiles and mammals**

The reptiles are mainly represented by marine turtles Chelonia mydas and Lepidochelys olivacea which breed and spawn on the sandy beach along the Sikka-Vadinar coast as well as on the islands.

Dolphin (*Dolphinus delphis*) and whale (*Balanoptera* sp) are common in the Gulf. Though occurrence of Dugong (*Dugong dugon*) in the Gulf particularly along the Jamnagar coast has been reported, there are no recent sightings.

The resources discussed above likely to be threatened are tidal flats, Phytoplankton, Phytopigments, Mangroves, seaweeds and seagrasses, Zooplankton, Macrobenthos, Corals and associated biota, salt works fishing activities and other vocational related to marine sensitive areas in the coast of Vadinar and Sikka.

It has been observed from the modeling study that during pre-monsoon season, the spills occurring at the APSEZL marine facilities move towards the southern / southwestern part of the Gulf of Kutch nearer to the facilities depending on tide phase.

The spills taking place at the APSEZL marine facilities move towards northern coast of Gulf of Kutch during monsoon season and affect the coast near Mundra, Kandla etc.

During post - monsoon season, the spills taking place at the APSEZL marine facilities move towards south / southwest and affect the islands /coast on southern side of the Gulf of Kutch.

**2.7 Special local considerations**

Considering the distant proximity of various other installations with the port of Mundra, in case of a tier 1 spill, no other special considerations are deemed to be required apart from an active spill response close to the port facility itself.

# 3 Response strategy

## 3.1 Philosophy and objectives

This plan is intended to assist APSEZL in dealing with an accidental release or discharge of oil. Its primary purpose is to set in motion the necessary actions to stop or minimize the discharge and to mitigate its effects. Effective planning ensures that the necessary actions are taken in a structured, logical and timely manner.

This plan guides the HOD– Marine and his Duty Staff through the decisions which will be required in an incident response. The tables, figures and checklists provide a visible form of information, thus reducing the chance of oversight or error during the early stages of dealing with an emergency situation.

For this plan to be effective, it must be:

- familiar to those APSEZL staff with key response functions;
- regularly exercised; and,
- Reviewed and updated on a regular basis.

This plan uses a tiered response to oil and chemical pollution incidents. The plan is designed to deal with Tier One spillage. The products handled are likely to pose a greater fire and safety, rather than an environmental risk; there may thus be additional factors involving the safety of personnel, which will take precedence over the pollution response. In this case, reference must be made to the APSEZL Emergency Procedures Manual. The salvage and casualty management of any vessel that poses a threat of pollution is priority considerations.

During oil spill response activities, account must be taken of the following:

- site hazard information
- adherence to permit procedures
- spill site pre-entry briefing
- boat safety
- APSEZL safety manual and material safety data sheets
- Personal protective equipment needs
- heat stress
- decontamination

## 3.2 Limiting and adverse conditions

APSEZL is situated in natural protected Gulf of Kutch and there are less incidences of heavy wind or any other factor affecting operation.

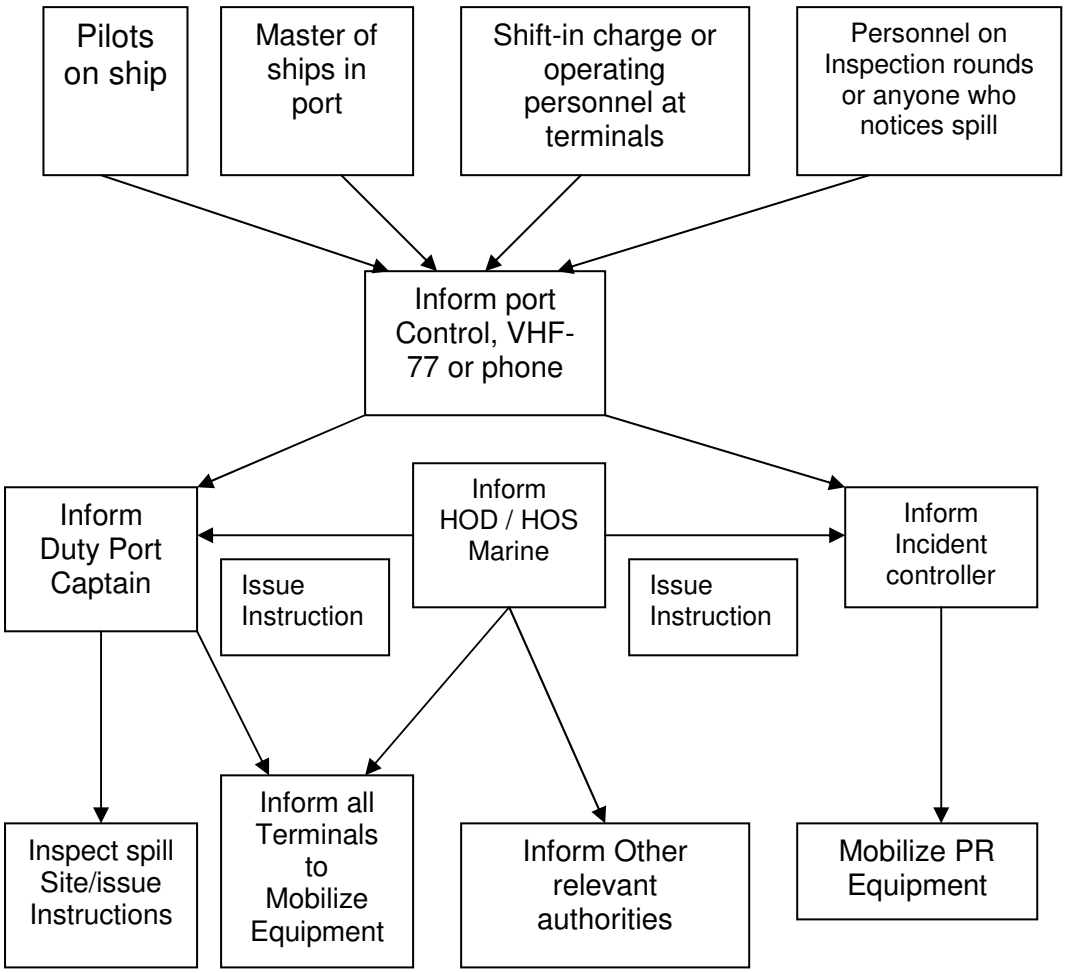
## 3.3 Oil spill response in offshore zones

SPM handles (unloading) crude oil and pumps it to shore tank farm area through sub-sea pipeline. The impact of such spills on marine environment is on the higher side. Hence, oil spill equipments are required for combating oil in case of such spills at the marine facilities at Mundra.

Based on the oil spill modeling study, it has been observed that crude oil spill of 700 tons (Tier-I) will spread over an area having radius of around 400 m within 4hr. APSEZL has already having facilities for combating a Tier-1 spill.

**3.4 Oil spill response in coastal zones**

***Contingency Chart to deal with Oil Spill***




**On-site Crisis Management Group – Action Group**

In an emergency, the personnel available at or near the incident site play vital role. This concept is made use of in nominating the Key Persons. It is necessary to nominate a functionary as the Incident Controller who is invariably a shift-in-charge of the facility. The Incident Controller tackling the emergency in real times requires the support from various other services i.e. Fire & Safety, Medical Services covering communication, transport and personal functions etc. A key person for each of these services therefore, is nominated.

Overall in charge of these activities is **Chief Operating Officer – Mundra Port.** The different functional coordinators, designated, will co-ordinate with Chief Controller in their respective functional areas. It is suggested that key personal chart be developed, giving the names, designation, telephone nos. of top level personnel who will act as coordinators in different disciplines/services. The duties and the responsibilities of various Key Persons and Coordinators need to be written down on a chart and should be made available across the organization at the site / location.

**Roles & Responsibilities**

**Incident Control Officer – (HOS – Marine / Duty Port Captain)**

- Directs and co-ordinates all field operations at the scene of the accident
- Assess incident/crisis at site, nature, location, severity, casualties, resource requirement
- Classifies incident - Advises Exe. Controller, Civil Defence, Dy. Conservator, Traffic Manager - regarding crisis severity status and emergency level, wind direction, temperature, casualties and resource requirements.
- **Conducts initial briefing to Chairman**
- Activates elements of the terminal emergency plan/ site response actions
- Protect port personnel and the public
- Directs security/fire fighting/oil spillage/gas leakage/vessel accidents/natural calamities, cargo operations shutdown
- Search for casualties and arrange first aid and hospitalization
- Brief or designate a person to brief, personnel at the incident scene
- Determine information needs and inform Crisis Management Group
- Coordinates all functional heads in field operations group to take action
- Manages incident operations to mitigate for re-entry and recovery
- Coordinate search and rescue operations
- Arrange evacuation of non-essential workers to assembly points –outside port
- Arranges tugs, mooring boats and pilot(s) for sailing vessel(s)
- Co-ordinates actions, requests for additional resources and periodic tactical and logistical briefings with Site Emergency Coordinator
- Coordinate incident termination and cleanup activities
- Instructs various emergency squads as necessary

**Site Emergency Coordinator – (Senior Pilot and Duty Radio Officer)**

- Direct operations from the emergency control center with assistance from Crisis Management Group
- Take over central responsibility from the Site incident controller (SIC)
- Decide level of crisis and whether to activate off site emergency plan
- Instruct SIC to sound appropriate alarm
- Direct the shutting down, evacuation and other operations at the port
- Monitor on site and off site personal protection, safety and accountability

- Monitor that causalities if any are given medical aid and relatives informed
- Exercise direct operational control of the works outside the affected works
- Monitor control of traffic movements within the port
- Coordinate with the senior operating staff of the fire, police and statutory authorities
- Issue authorized statements to the news media
- Review and assess possible developments to determine the most probable course of events
- Authorize the termination of the emergency situation by sounding the all clear siren-continuous long single tone siren for one minute
- Control rehabilitation of affected areas after emergency
- Arrange for a log of the emergency

**Fire Coordinator – (HOS - Fire / HOS -Safety)**
(Under the direction of the Incident Control Officer)

- Announces fire incident point over the public address system and evacuates workers to the assembly points
- Informs fire station immediately and leads fire fighting team to the incident location
- Informs SIC if external fire tender / fire-fighting equipment / materials/mutual aid is required
- If necessary, arranges and activates other fire-fighting equipment
- Arranges safety equipment e.g. fire suits, protective gloves and goggles, breathing apparatus
- In liaison with Civil Engineering Department, ensures that adequate water pressure is maintained in the fire hydrant system/at the area supply
- Maintains adequate records

**HOS - Security / Duty Security Officer**

- Directs, gate security and facilitates evacuation, transport, first aid, rescue
- Controls the entry of unauthorized persons and vehicles-disperses crowd
- Permits the entry of authorized personnel and outside agencies for rescues operations without delay. Liaises with State police
- Allows the entry of emergency vehicles such as ambulances without hindrances
- Ensures that residents within port area are notified about disaster and instructs to evacuate if necessary
- Ensure that all people are aware of the assembly points, where the transportation vehicles are available
- Ensure that the people are as per the head count available with the assembly point section of that area
- Liaise with the Chief Medical Officer to ensure first aid is available at the assembly points
- Carry out a reconnaissance of the evacuated area before declaring the same as evacuated and report to SIC.

**Medical Superintendent**

- Direct medical team
- Set up casualty collection centre arrange first aid posts
- Arrange for adequate medicine, antidotes, oxygen, stretchers etc
- Contact and cooperate with local hospitals and ensure that the most likely injuries can be adequately treated at these facilities e.g. burns
- Advise Chief Emergency Controller on industrial hygiene and make sure that the facility personnel are not exposed to unacceptable levels of toxic compounds

- Make arrangements for transporting and treating the injured
- Inform the hospitals of the situation in case of a toxic release and appraise them of the antidotes necessary for the treatment
- Maintain a list of blood groups of each employee with special reference to rare blood groups
- Liaise with Govt. Hospitals/Red Cross

**Marine Pollution Coordinator – Manager (Marine / pollution control)**

- Minimizes the impact of an accident on the environment for which it would develop methodologies to control hazardous spills
- Monitors cooperation with emergency response squads to conduct the actual cleanup work during and after the emergency.

- In case of fire and specially if the fire involves toxic/flammable materials, to ensure responsible actions for containing the run off fire water and other water from the damaged units
- Determines the level of contamination of the site as a result of the accident
- During cyclones/floods arranges sand bags and transfers important plans and documents to higher levels

**Traffic Coordinator – Duty Port Captain**

- Directs operation staff
- Prepares vessels to vacate from berth
- Arranges to protect cargo in vicinity from damage
- Arranges to segregate and shift cargo in sheds
- Submits consolidated list of dangerous goods in port including tankers in port and tank farms in port area
- Coordinates with ship owners / agents/C & F agents/stevedores

**Communications Officer – (Duty Port Captain / Marine Control In-charge)**

- Ensure telephone operator/signal room advises entire emergency team
- On receipt of instructions from the chief Incident controller, notifies the fire brigade/police/hospitals/district collector/mutual aid partners
- Keep the switchboard open for emergency calls and transmit the same to the concerned personnel effectively
- Refrain from exchanging any information with authorized persons unless authorized to do so by the Chief Incident Controller
- Maintains contact with other vessels through VTMS

**Chief Emergency Controller – (Head - HSE)**

- Inform district emergency authorities-District Collector, Medical officer-Coast Guard Pollution control -Inspector of factories-Inspector of Dock Safety & Health,
- Activate the off site plan if necessary
- Liaise with Jt. Secy./Director MOST (Ministry of Shipping) or relevant Govt. authority
- Inform the media

**Civil Coordinator – (HOS – Environment cell / HOS - Estate)**

- Inform Gujarat Pollution Control Board and other environmental agencies about the incident for getting necessary guidance
- Instruct the contractors to carry out urgent civil works if required
- Hire the barges for collecting the spilled oil, if required

**Marine Engineering Coordinator – (HOS – SPM / Diving Team in-charge)**

- Organise the tugs for combating the pollution
- Start the rigging of pollution combating equipment on tugs/launches
- Hire additional crafts if required

**HOD- Corporate affairs:**

- Collect detailed information periodically and liaise with press about the incident
- Arrange transport facilities, if required
- Inform local authorities/District Collector about the incident (as per EAP)

**HOS - Legal & HOD - Estate:**

- Issue notice under Major Port Trusts Act, Indian Ports Act(Prevention & Control of Pollution) Rules, etc; to the defaulting master/owner/agent
- Arrange for settlement of claims related to the pollution(as per EAP)

### 3.5 Shoreline oil spill response

Most oil spills reach the shorelines and cause visible oil pollution which is particularly sensitive to public opinion. The selection and correct application of clean up techniques are therefore essential. When an oil spill occurs on open water the optimal solution is to intercept and recover the oil before it reaches the shoreline. This is because:-

- The environmental damage is normally less critical in the open water environment
- The logistics of oil removal becomes more complex in the varied natural environment of coastlines compared with the open sea.
- The costs of oil recovery increases dramatically when oil reaches sensitive shorelines compared with open water operations.

Experience has shown that it is very difficult to avoid some oil reaching the shorelines. Mechanical equipment and chemical treatment at sea are often insufficient to recover all oil spilled at sea. When the oil reaches the shoreline, a number of different parameters specific for this particular situation have to be taken into consideration:-

- Quantity of oil
- Characteristics of the oil (for instance, toxicity and viscosity)
- Prevailing on-site conditions (weather, season, tides, temperature)
- Shoreline type or combination of types (cliffs, pebble, sand, marsh)
- Special Considerations

### The four main steps in a shoreline clean-up operation are:

**Step 1: Assessment**

- Determine the need to clean, setting priorities in line with this contingency plan
- Determine required degree of clean-up for each area in accordance with priorities
- Attain agreement between clean-up team, ecological experts, government authorities

**Step 2: Select Clean-up Method**

- Choose method appropriate to type of shoreline, access, degree of oiling
- Minimize damage caused by choice of clean-up technique, degree of clean-up
- Address conflicts of interest (e.g. needs of amenity use versus environment or response speed versus aggressiveness)

**Step 3: Clean-up Operations**

- Monitor clean-up, confirm choices made above, re-evaluate if necessary
- Minimize disturbance of shoreline features
- Minimize collection of un-oiled debris, sediments

**Step 4: Termination / Monitoring**

- Ongoing assessment of clean-up operations
- Determine when clean-up objectives have been met
- Post-spill monitoring to confirm recovery of shoreline features, biota

## The four main methods for shoreline clean-up are as follows:-

A. Pumping and Skimming Techniques

- Applicable to shorelines that are heavily oiled.
- Often the first step in cleaning a heavily contaminated shoreline.
- Preferred option because it results in fluid wastes that are relatively free of sediments and debris, which are more easily dealt with in disposal.
- Pumping and skimming techniques can also be used in conjunction with flushing techniques.

B. Flushing Techniques

- Use water or steam to flush oil from the beach, and direct it to a recovery location.
- Applicable to heavily contaminated beaches, and substrates that are relatively impermeable (e.g., mud and saturated beaches, boulders, and man-made structures) that will not allow the flushed oil to penetrate the beach surface.
- Typically carried out in conjunction with a skimming operation. The flushed oil is directed down-slope to skimmers positioned at the water's edge, with booms deployed around the skimmers to prevent any loss of the water.
- Options of using low or high pressure water, and of using ambient temperature water versus warm water or steam.
- Low pressure, cold water is generally the least effective, particularly with sticky oils and emulsions, but is least harmful on the environment.
- High pressure water and heated water and steam are more effective, but may remove and/or kill beach-dwelling organisms.

C. Sediment Removal Techniques

- Applicable to a variety of shoreline types, and in particular, when the shoreline is heavily contaminated, though likely to cause the greatest environmental impact
- The requirements are access for the heavy equipment required for transporting away oily debris and sediments for disposal and a surface which is able to support heavy equipment
- An important factor to consider is the depth of oil penetration
- Important to limit the depth of material removed in order to minimise disturbance to the beach, and to minimise disposal requirements
- The best option is to use manual labour to pick up the oily sediment and mechanical means to transport it away

D. Biodegradation Techniques

- Generally refers to "active" bioremediation, where nutrients and/or microorganisms are applied to enhance natural degradation
- Generally suitable for areas that are lightly oiled, especially lightly oiled salt marshes and tidal flats where the use of equipment could increase the environmental effects by forcing oil into the substrate
- It can also be used as a final clean-up step following more active efforts

The shoreline clean-up operation is normally not an emergency operation as is the case with an oil spill on open water. A clean-up project can last many weeks or months depending on the amount of oil spilled. Many wrong decisions can be made in planning and carrying out a shoreline clean-up operation. The contingency plan must be used in combination with consulting experts with experience of shoreline clean up. The agencies such as NIO, NEERI, Ports and Oil companies have experts with experience which is relevant for the specific oil spill situation and they should be consulted prior undertaking shoreline clean-up.

**3.6 Storage and disposal of oil and oily waste**

After the natural degradation by coagulation and evaporation of oil on water, residual oil and waste material collected during a Tier 1 response will be disposed off by in-situ or terrestrial burning.

| | **Type of material** | **Separation methods** | **Disposal methods** |
|---|---|---|---|
| LIQUIDS | Non-emulsified oils | Gravity separation of free water | Use of recovered oil as fuel or refinery feedstock |
| | Emulsified oils | Emulsion broken to release water by ;<br>- Heat treatment<br>- Emulsion breaking chemicals<br>- Mixing with sand | Use of recovered oil as fuel or refinery feedstock.<br>Burning<br>Return of separated sand to source. |
| SOLIDS | Oil mixed with sand | Collection of liquid oil leaching from sand during temporary storage<br>Extraction of oil from sand by washing with water or solvent<br>Removal of solid oil by sieving | Use of recovered oil as fuel or refinery feedstock.<br>Direct disposal<br>Stabilization with inorganic material.<br>Degradation through land farming or composting.<br>Burning |
| | Oil mixed with cobbles, pebbles or shingle | Collection of liquid oil leaching from beach material during temporary storage<br>Extraction of oil from beach material by washing with water or solvents | Direct disposal.<br>Burning |
| | Oil mixed with wood, plastics, sea weeds, sorbents | Collection of liquids leaching from debris during temporary storage<br>Flushing of oil from debris with water | Direct disposal.<br>Burning.<br>Degradation through land farming or composting for oil mixed with sea weeds or natural sorbents. |
| | Tar balls | Separation from sand by sieving | Direct disposal<br>Burning |

**Location for Dug Pond for temporary storage of oily water:**

To store the contaminated oily water, temporary dug pond will be excavated for storage of oily water. It is expected that 20 times volume of oil & water mixture will be generated if oil spill happen in the sea. Storage capacity of dug pond of volume 14000 m3 considering spill of level 1 (Tier-1) is required.

Location Identified for Dug Pond behind Maruti Yard (Lat. 22° 45.252'N , Long. 69° 41.093'E) is roposed.


- Size of Dug Pond to be provided : 100 mtr X 100mtr X 1.5mtr
- Total storage capacity (m3) : considering 20 times oily water @ 700 m3 = 14000 m3

Once the contaminated mixture of oil and water is stored, the same will be transferred via tanker to following location. Following are the steps require to be followed.

1. Oil Water Separator: Capacity 25 m3/hr.
2. Effluent Treatment Plant: Capacity 120 KLD
3. Parallely oil recyclers will be approached for the collection and transportation of the oily water.
4. Contaminated Soil / Sediments will be directly sent to the Treatment Storage and Disposal Facility (TSDF) site. List of Oil recyclers and TSDF sites are shown in Annexure – 15
5. Different types of equipment & manpower require for creating dug pond:

| **Name of Equipment** | **Quantity** | **Primary Responsibility of Equipment & Material** | **Secondary Responsibility** |
|---|---|---|---|
| Excavator | 10 Nos. | Marine Dept. | MHS section (Dry Cargo) / Asset Department / Procurement |
| JCB Machines | 10 Nos. | Marine Dept. | ES Civil / Asset Department / Procurement |
| **Material** | | | |
| HDPE Liners for dug pond | 10600 Sq. mtr. | Marine Dept. | Stores & Procurement |

In phase wise manner stored oily water will be treated at both the above facility to separate oil from water to the possible extent. Whereas, after recovery of oil from water, water confirming to the effluent discharge limit of oil (< 10 ppm) will be discharged in to sea.

Whereas in case oily water will not capable of treat at OWS & ETP will be dispose through sending it to registered recyclers, for which APSEZL have already done tie up with the registered recyclers as mentioned in **Annexure – 15**.

APSEZL have also done necessary tie up with various institutes/agency/NGO as mentioned in **Annexure – 16** for providing service for rescue & rehabilitation of oil socked birds as well as restoration of mangroves, when oil reaches to the sea shore and mangrove areas during oil spill. Mobile van / vehicle require for rescue of oil socked birds to transfer from affected area to treatment facility center.

# 4 Equipment

### 4.1 Marine oil spill response equipment

Detailed in Annexure 3

### 4.2 Inspection, maintenance and testing

The equipments are being kept in working condition. Routine inspection, maintenance and testing performed as per the stipulated requirements.

### 4.3 Shoreline equipment, supplies and services

The shoreline clean-up equipment which are essential for the oil removal operations at beaches are as follows:-

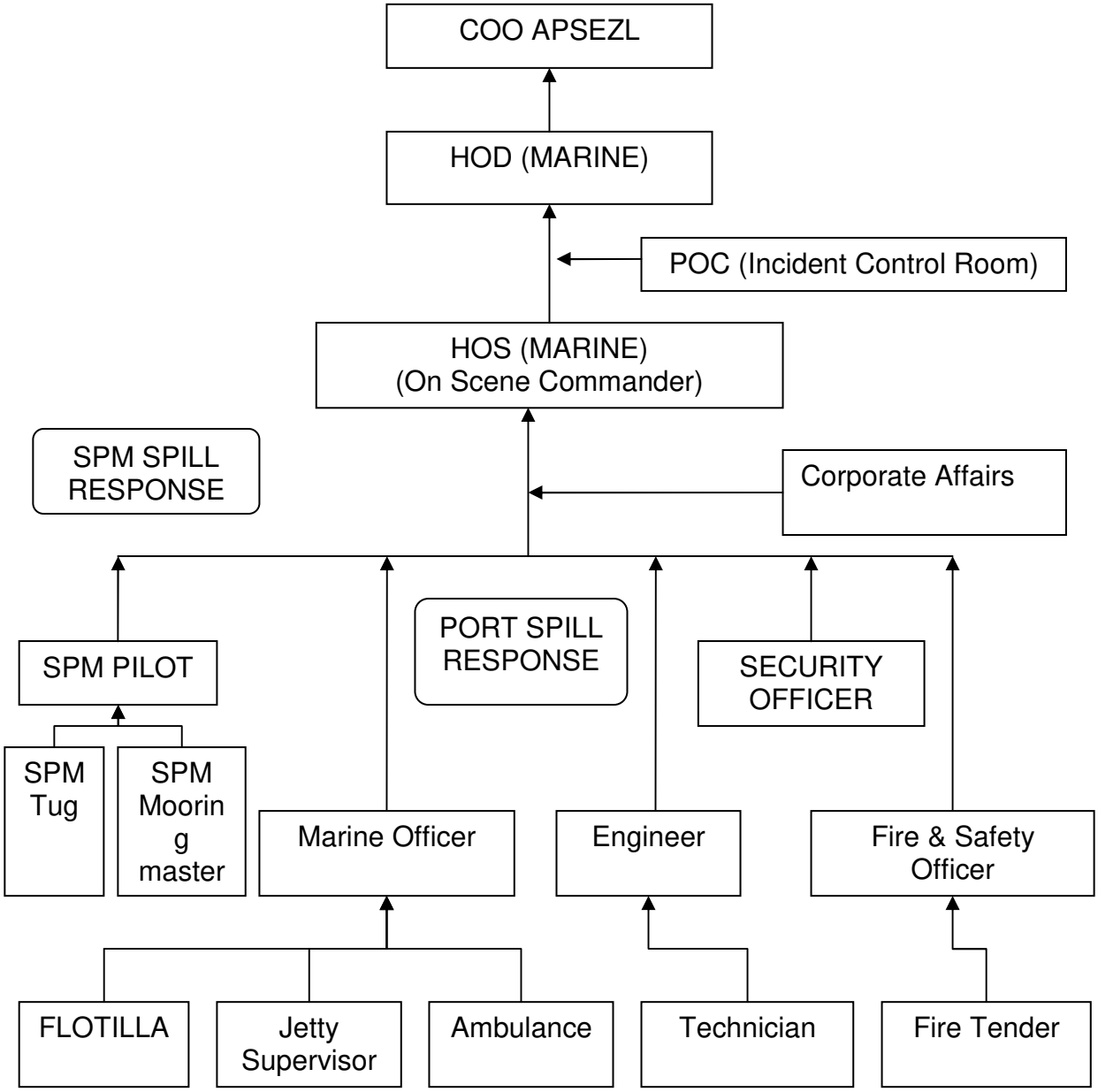
- Protective clothing for everybody (including boots and gloves), spare clothing.
- Cleaning material, rags, soap, detergents, and brushes.
- Equipment to clean clothes, machinery, etc., with jets of hot water.
- Plastic bags (heavy duty) for collecting oily debris.
- Heavy duty plastic sheets for storage areas especially for the lining of temporary storage pits.
- Spades, shovels, scrapers, buckets, rakes
- Ropes and lines
- Anchors, buoys
- Lamps and portable generators
- Whistles
- First Aid material.

# 5 Management

### 5.1 Crisis manager and financial authorities

The COO of APSEZL is the final authority of the oil spill response in case of a Tier 1 scenario. He is responsible for raising the level of the response if required and summoning additional help. The authority of all financial decisions rest with him.

### 5.2 Incident organization chart



**5.3 Manpower availability (on-site, on call)**

In an event of incident Kandla Port Trust, Gujarat Maritime Board, Gulf of Kutch Ports, District and Regional plans are deemed to have been implemented. Adani Ports and Special Economic Zone Limited (APSEZL) manpower and resources will be put at the disposal and will be deployed as required, provided APSEZL is the polluter and spill is within the Port Limits.

In the event of APSEZL not being the polluter and any event outside the port limit of Adani Port, APSEZL equipment will be subject to mutual assistance plan and it will be the responsibility of the above forum.

**5.4 Availability of additional manpower**

Similarly in the event of APSEZL being the polluter, additional manpower and supplies can be requested from the resources which are part of this forum.

A numbers of private parties have their labor force working round the clock in the port and on call these can be available.

**5.5 Advisors and experts – spill response, wildlife and marine environment**

APSEZL, being the nodal agency in this LOS-DCP, will function as the main agency. In the event of the emergency getting raised to higher tier, i.e. in case the incidence becomes a national disaster, the help and advice of Indian Coast Guard will be taken.

**5.6 Training / safety schedules and drill / exercise programme**

Training of all APSEZL staff who may get involved in implementing this plan is acknowledged. In house and external facilities (of ICG) are used periodically to impart training as per matrix below. Marine Manager has been appointed as training coordinator and custodian of oil pollution equipment. He shall organize training, drills and inspection of equipment as per the plan in force.

| Training Module | Duration | Frequency | Participants | Remarks |
|---|---|---|---|---|
| IMO Model Course | 2-5 days | Once | Key persons | By Maritime Training Institute |
| Oil Spill | 1-5 days | Once every 5 years | Key persons | Coast Guard |
| Oil spill equipment | 1-5 days | Once every Year | Managers | In house |
| Oil spillManagement course | 1 day | Once every year | Managers & junior staff | In house for in-depth knowledge |
| Notification exercise | 1-2 hours | 6 months | Operational staff | Check systems & communication |
| Table top | 2-6 hours | 12 months | Managers | Interactive discussions |
| Incident | 6-8 hours | 12 months with others | All | Mock drill |

**Number of IMO Level-1 and IMO Level-2 qualified staff available with Adani Ports and SEZ Ltd, Mundra:**
**IMO Level-1 -** 30
**IMO Level-2 -** 03

# 6 Communications

**6.1 Incident control room facilities**

Detailed in Annexure 3

**6.2 Field communication equipment**

Detailed in Annexure 3

**6.3 Reports, manuals, maps, charts and incident logs**

A copy of the relevant manual is kept with HOD – Marine. Maps/ Charts of APSEZL are kept in Marine Control Tower and attached in Annexures

# Action and operations

# 7 Initial procedures

**7.1 Notification of oil spill to concerned authorities**

The emergency (due to spill) should be initiated by the first person noticing it by activating the fire alarm from the nearest call-point or by contacting the fire control room immediately on the internal telephone or through mobile phone or through VHF Channel.

The SPM Pilot or On Scene Commander will report the spill to the Marine Control Room.

**7.2 Preliminary estimate of response tier**

The first few minutes after the incident / accident are invariably the most critical period in prevention of escalation. Therefore the person available at or near the incident site (and often responsible for carrying out that particular activity) on round the clock basis play a vital role in an emergency. The SPM Pilot or On Scene Commander will report the spill to the control room along with his estimate of the response tier.

**7.3 Notifying key team members and authorities**

Statutory First Information Report (FIR - given in annexure 1) is to be communicated by fastest means possible to President, GMB port and CG at Porbandar followed by full Pollution Report (POLREP – given in annexure 2). The report is to be updated, should the oil spill not be contained and likely to increase to Tier 2

**7.4 Manning Control Room**

Auxiliary control center is located at Port Operation Centre. Escalation of emergency if any is monitored here. Statutory reporting procedures of FIR and POLREP of developing situation and action taken are also sent from this center. The detail of the contacts to whom the information is to be given is placed at Annexure 4.

**7.5 Collecting information (oil type, sea / wind forecasts, aerial surveillance, beach reports)**

Marine Manager has the responsibility of arranging the collection of the relevant information which will help in mitigating the emergency

### 7.6 Estimating fate of slick (24, 48, 72 hours)

Considering the prevalent tidal stream, wind and weather conditions, section 8.3 is to be used in estimating the fate of the slick

### 7.7 Identifying resources immediately at risk, informing parties

Depending on the quantity of fluid spilled and the prevalent wind & weather conditions, the resources / facilities immediately at risk have to be identified by the On scene commander and the concerned parties informed.

## 8 Operations planning

### 8.1 Assembling full response team

On being appraised of the spill, the duty marine officer will inform the marine manager, who will, in turn initiate the assembly of the complete response team which essentially involves relaying information to all relevant personnel, parties and authorities and informing them of the initial response requirements.

### 8.2 Identifying immediate response priorities

Depending on the initial estimated response tier and the prevalent weather conditions, the marine manager, in consultation with the on scene SPM pilot / marine officer will identify the immediate resources at risk and the response priorities.

### 8.3 Mobilizing immediate response

The Manager - Marine will initiate the mobilization procedure of the spill equipment, resources and personnel depending on the scale of emergency at hand.

### 8.4 Media briefing

No other person is authorized to communicate with any external party by any means whatsoever unless expressly permitted by the HOD – Marine or COO, APSEZL.

### 8.5 Planning medium-term operations (24, 48 and 72 hour)

The HOD – Marine will plan the subsequent action to be taken in response to the tier 1 spill after the initial response is well under way and its consequences / effectiveness are duly evaluated.

### 8.6 Deciding to escalate response to higher tier

After carefully assessing the scenario and appraising the efficiency of the initial response in the prevalent conditions, the HOD – Marine will decide whether or not to escalate the response.

### 8.7 Mobilizing or placing on standby resources required

It is recommended that in case of a doubt (as the exact estimate of the quantity of oil spilled is quite difficult and the boundaries between the tiers will inevitably be blurred) it is important to be prepared to involve the next higher tier from the earliest moments. It is easier to stand down an alerted system than to try to escalate a response by calling up unprepared reserves at a late stage.

### 8.8 Establishing field command post communications

Communications between the Emergency Response Center/ Marine Control room and marine personnel during the response to any oil spillage will be primarily by VHF marine band radio on Channel 73 or 77

Communications between the Marine Control Room and other vessels will be established on VHF radio Channel 16 and will thereafter be conducted on Channel 73 / 77.

Use of cellular telephones will be minimized.

Communications between the Emergency Response Center/ Marine Control Room and external authorities and organizations will be undertaken by telephone and facsimile.

## 9 Control of operations

### 9.1 Establishing a Management team with experts and advisors

Detailed in Annexure **4**

### 9.2 Updating information (sea, wind, weather forecasts, aerial surveillance, beach reports)

The Marine Control Room is well equipped in assimilating data on weather and its forecasts. In case of a Tier 1 response, aerial surveillance and beach reports are not deemed to be essential

### 9.3 Reviewing and planning operations

Ongoing response and its influence in mitigating the situation will have to be constantly under review in order to contain the spill at the earliest.

### 9.4 Obtaining additional equipment, supplies, manpower

While deciding not to elevate the tier of the response the HOD- marine may still request additional resources from nearby port facilities which are essentially members of the common forum and are obliged to assist.

### 9.5 Preparing daily incident log and management reports

A complete report will be submitted by the Marine Manager to the HOD (Marine) every morning (in case the response extends to more than 1 day).
Format for the above report in Annexure 9

### 9.6 Preparing operations accounting and financial reports

The Port's accounting department will assess the expenditure incurred in the ongoing operation and submit a report to the President's office.

### 9.7 Preparing releases for public and press conferences

The COO's office, HOD – Marine and the Corporate communications cell will formulate the requisite press releases from time to time and hold press conferences.

### 9.8 Briefing local and government officials

The COO's office, HOD – Marine and the Corporate communications cell will formulate the requisite reports to brief local and government officials..

# 10 Termination of operations

### 10.1 Deciding final and optimal levels of beach clean-up

If at all a distant beach is affected, the COO APSEZL office will decide the optimal levels of cleanup in consultation with the conservator of the port – Gujarat Maritime Board Port Officer.

### 10.2 Standing down equipment, cleaning, maintaining, replacing

Considering the natural disintegration of the residual oil on water after the cleanup of the bulk amount, The HOD – Marine will decide when to stand down the response. The resources which have been used will have to be re-instated to the original condition by elaborate cleanup or replacement.

### 10.3 Preparing formal detailed report

The COO's office, HOD – Marine and the Corporate communications cell will formulate the requisite reports to brief local and government officials and media.

### 10.4 Reviewing plans and procedures from lessons learnt

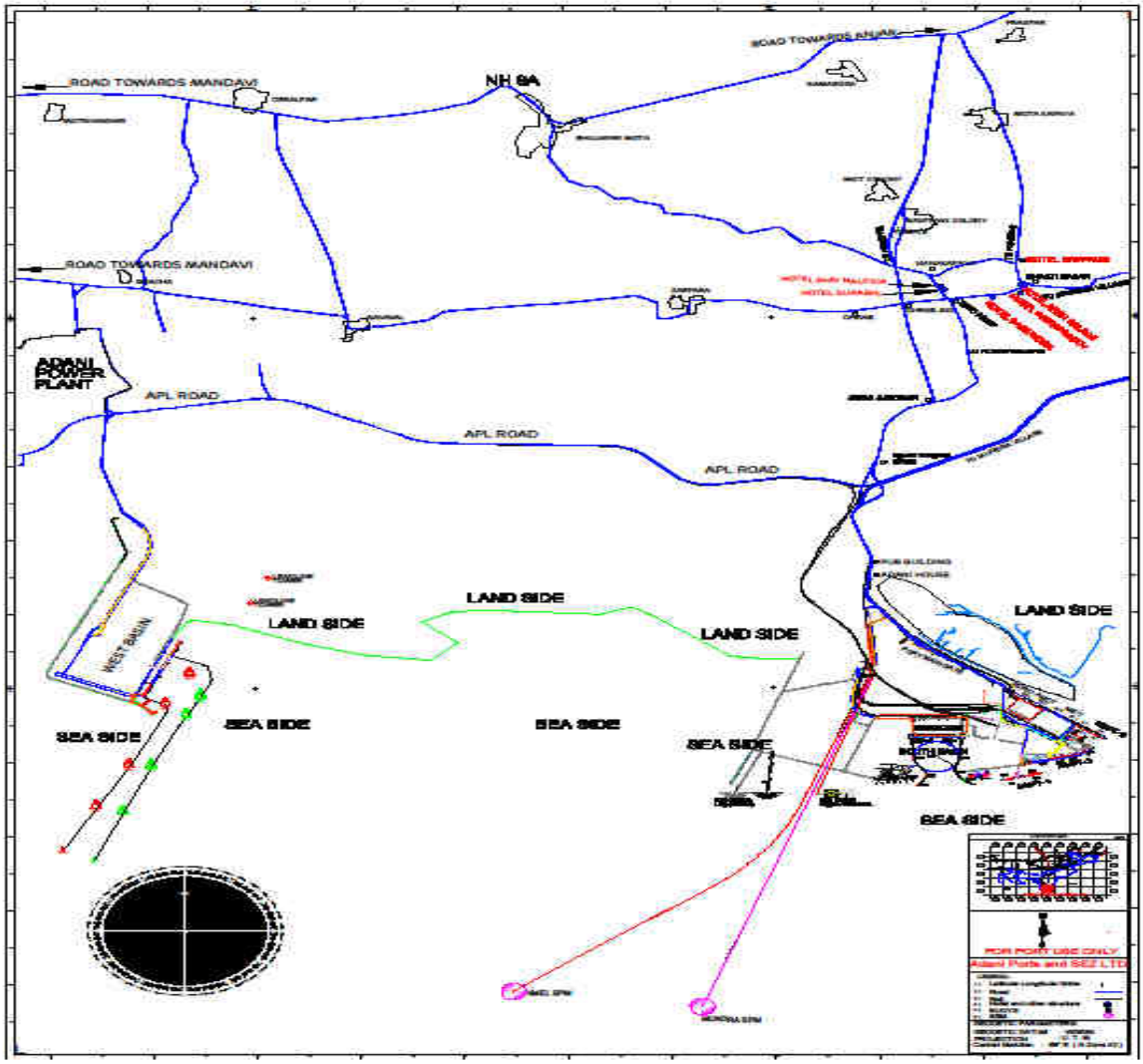
A complete spill response report will be produced by the Marine manager providing comprehensive and all-inclusive details of the circumstances leading to the spill, initial response and consequent affect of the same, subsequent follow up, effect of prevailing weather, adverse situations, safety issues, difficulties faced and lessons learnt.
Requisite changes will be affected to this plan on basis of such report.

Such a report will also be prepared by the marine manager after each drill or training session and requisite modification(s) incorporated to the plan in order to enhance the overall efficacy of the same.

## Data Directory

### Maps / Charts

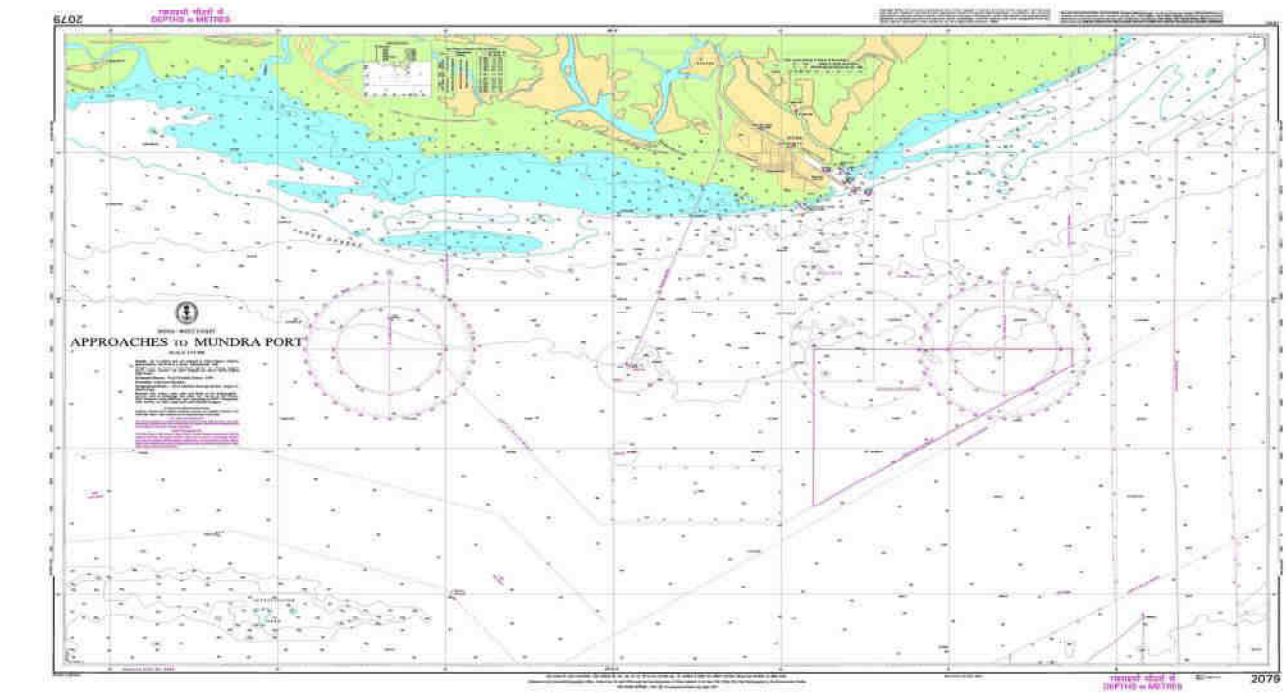
**1. Coastal facilities, access roads, hotels etc.**

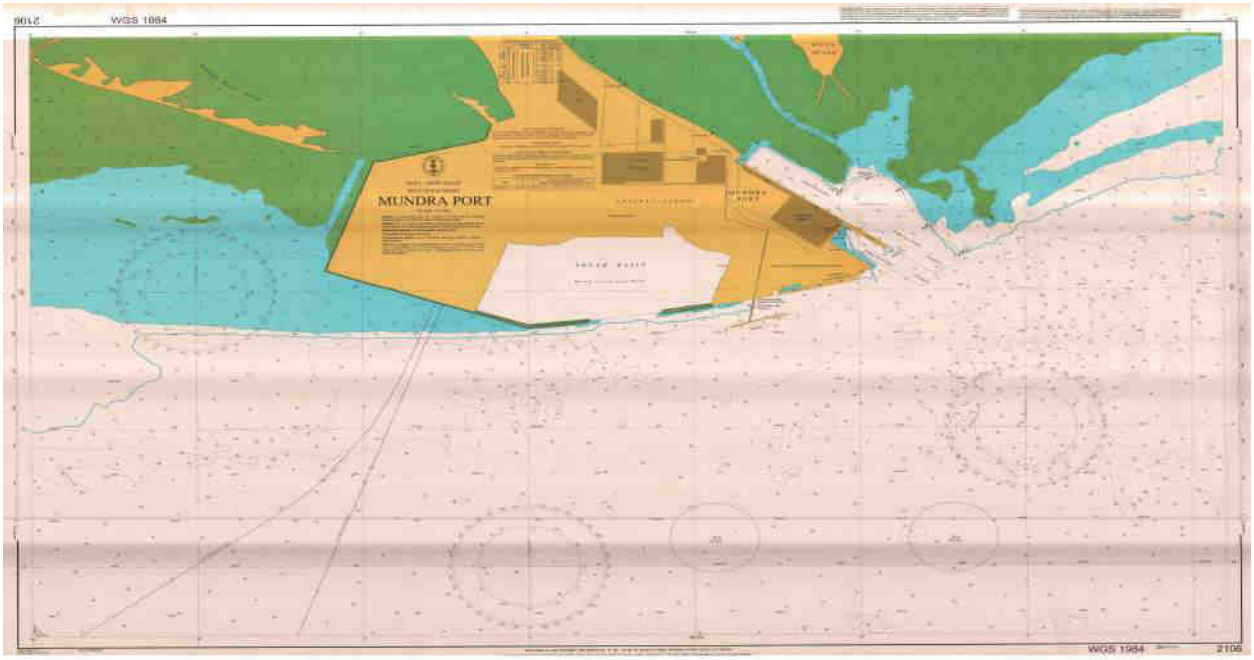


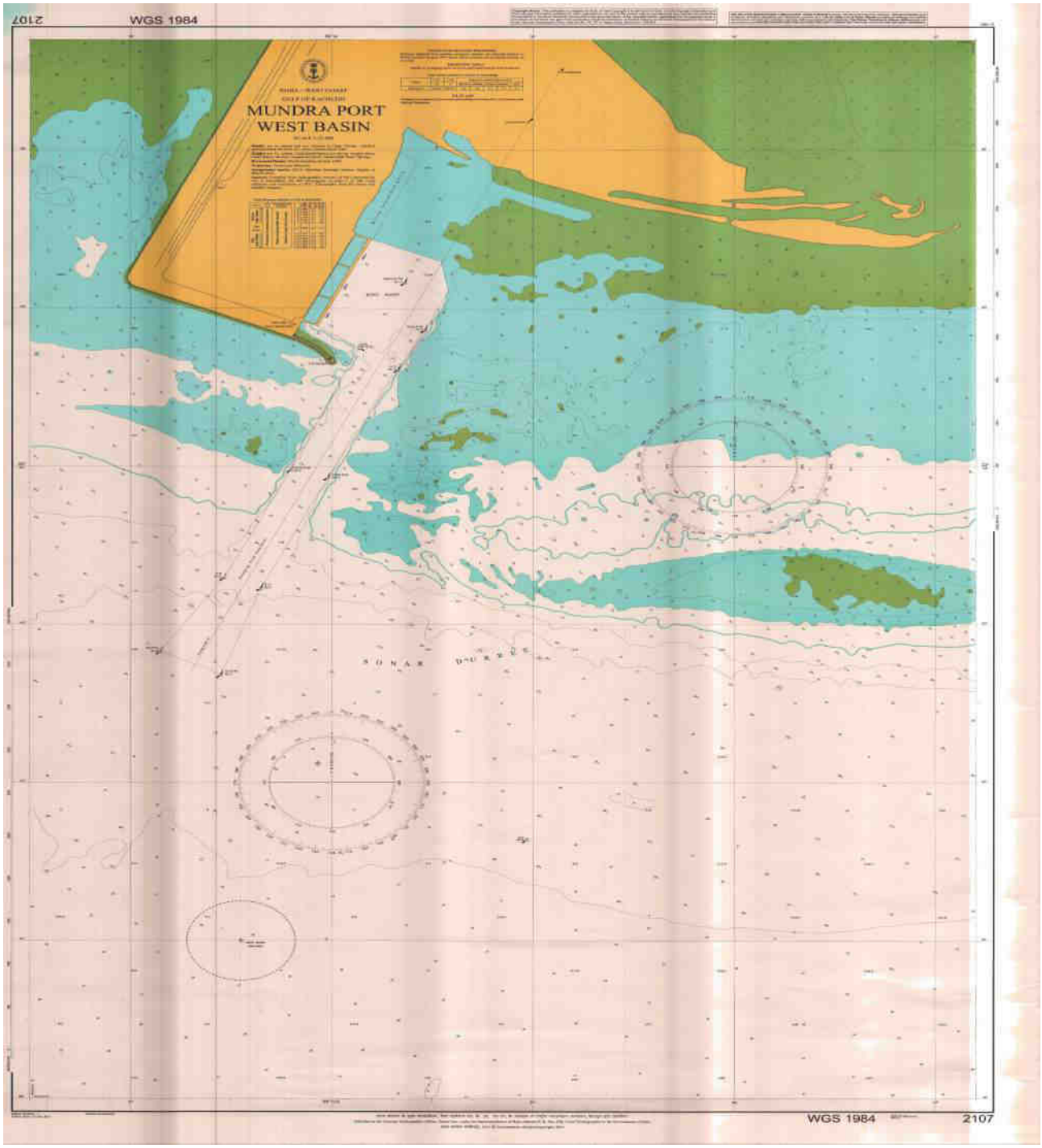

**Telephones:** Detailed in Annexure **4**

**2. Coastal charts, currents, tidal information (ranges and streams), prevailing winds**

Currents, tidal information (ranges and streams) : Detailed in Annexure- II, Annexure- III and Annexure- IV (Volume 2) of Oil Spill Risk Assessment




WGS 1984
MUNDRA PORT
WEST BASIN
WGS 1984
2107

### 3. Risk locations and probable fate of oil

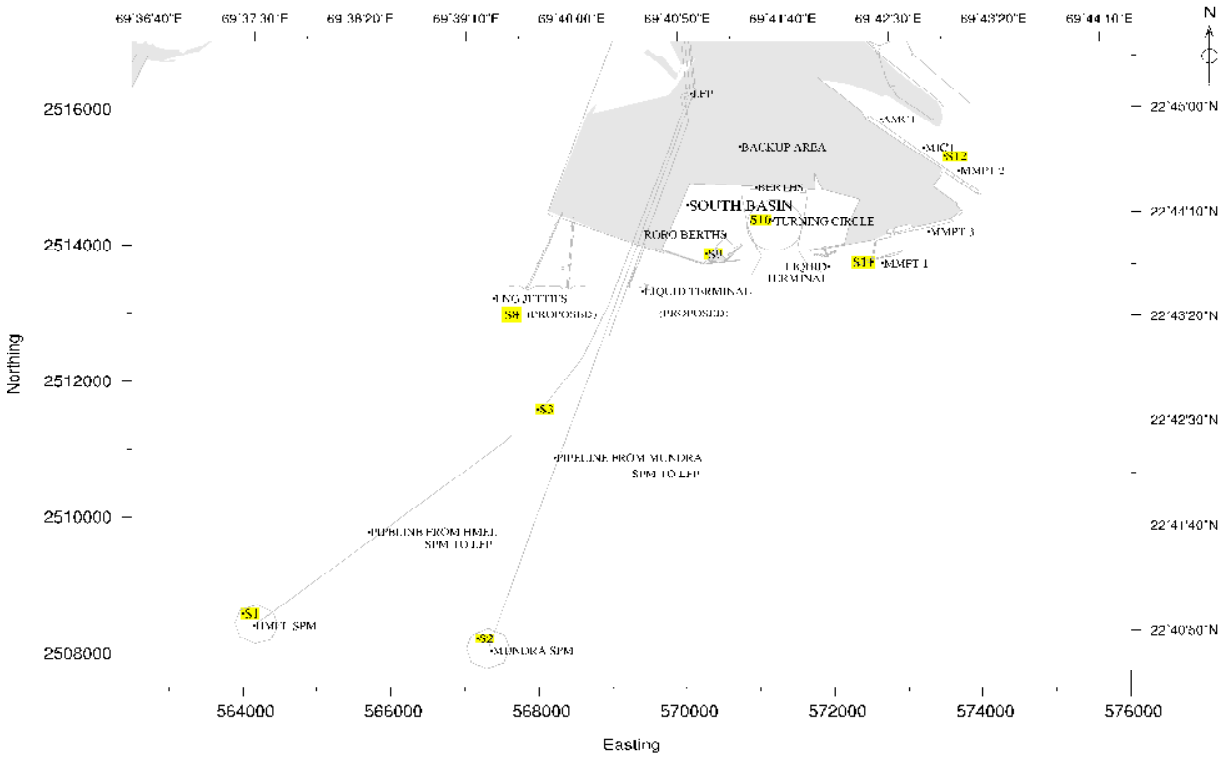



Fig.1: General layout of the Mundra port facilities of APSEZL showing the location of Spill Points for SPMs, South Basin berths, LNG jetty and existing berths

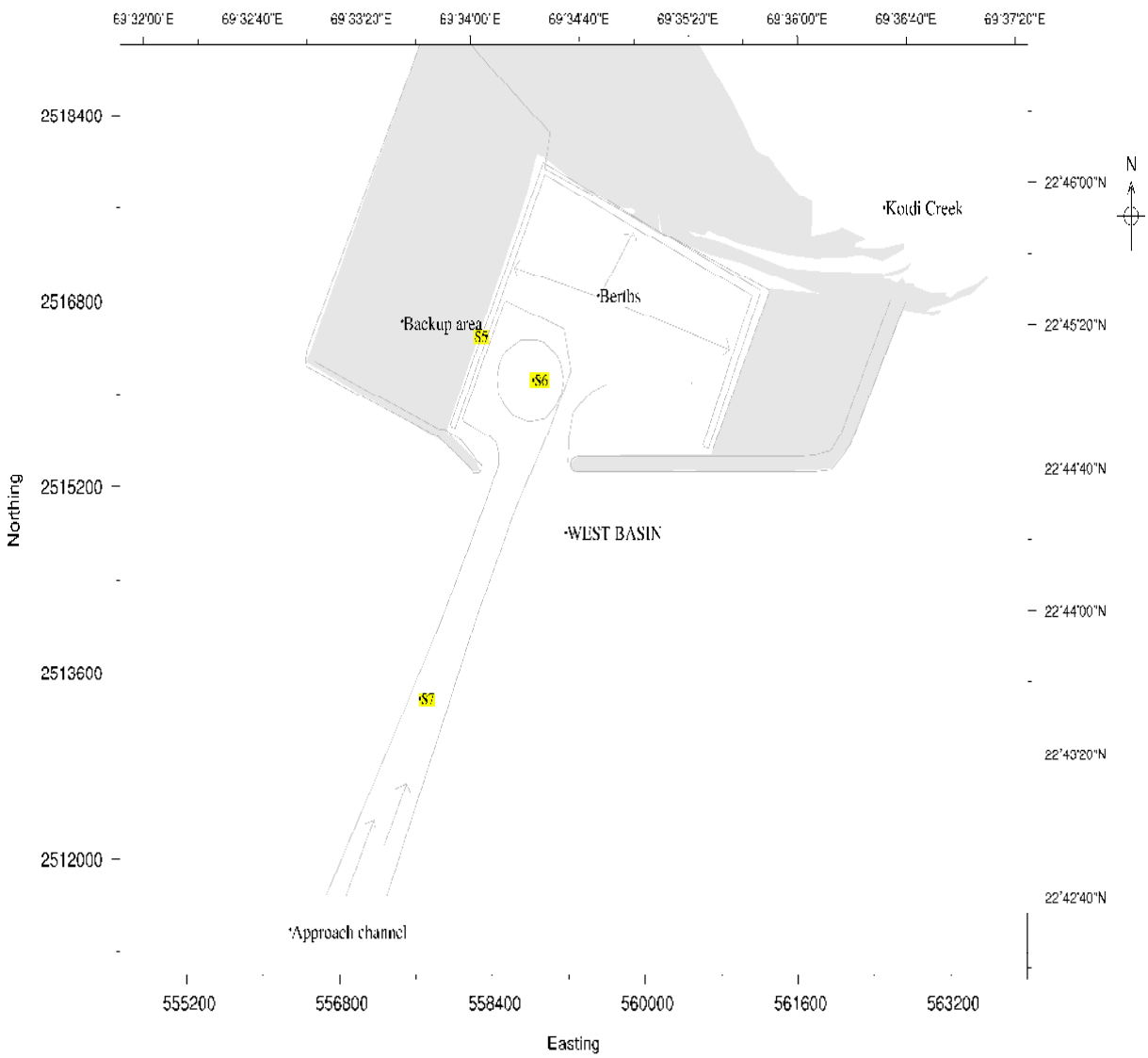



Fig.2: Zoomed up portion of Mundra port facilities of APSEZL showing the location of Spill Points for West Basin

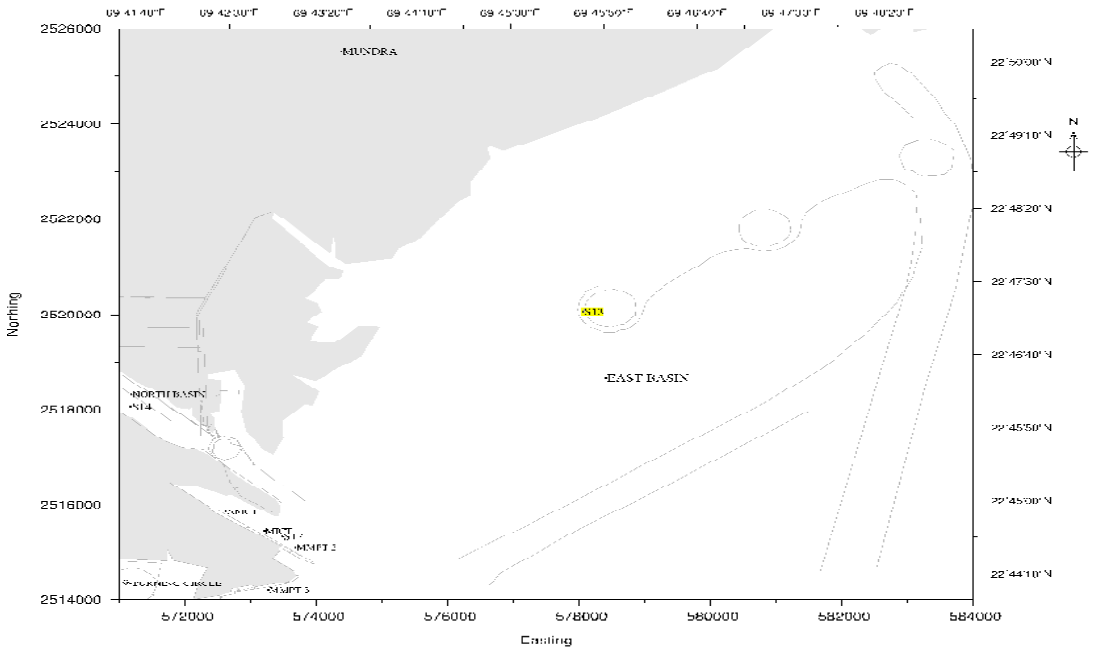
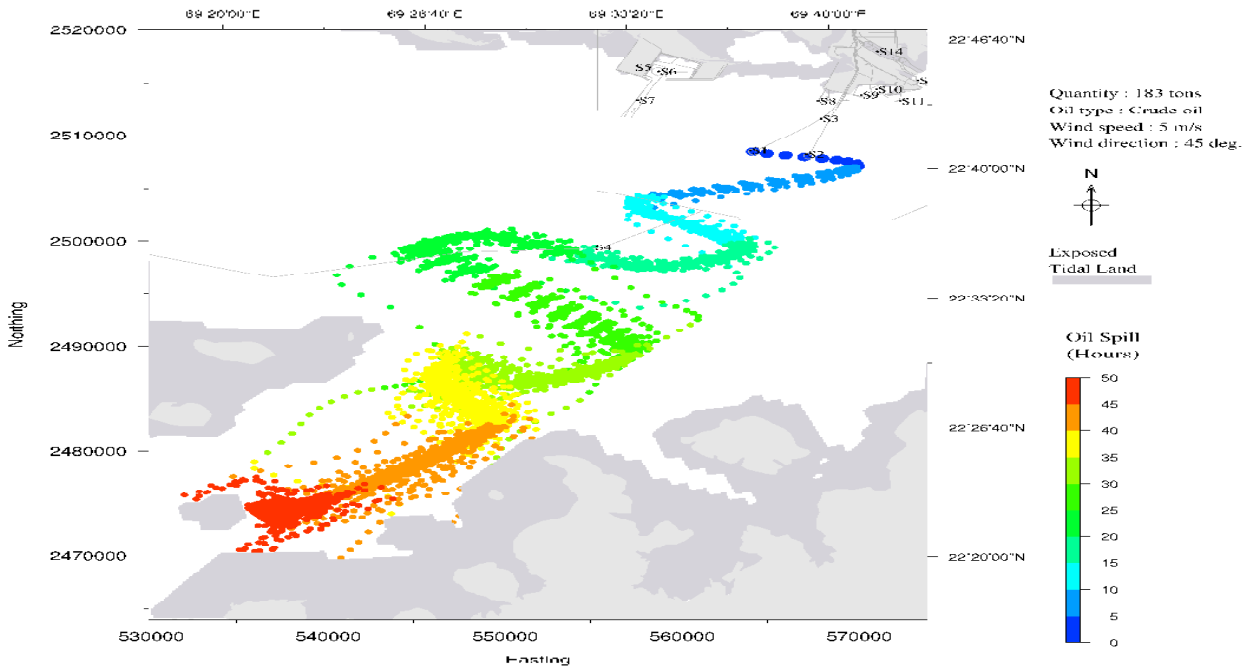
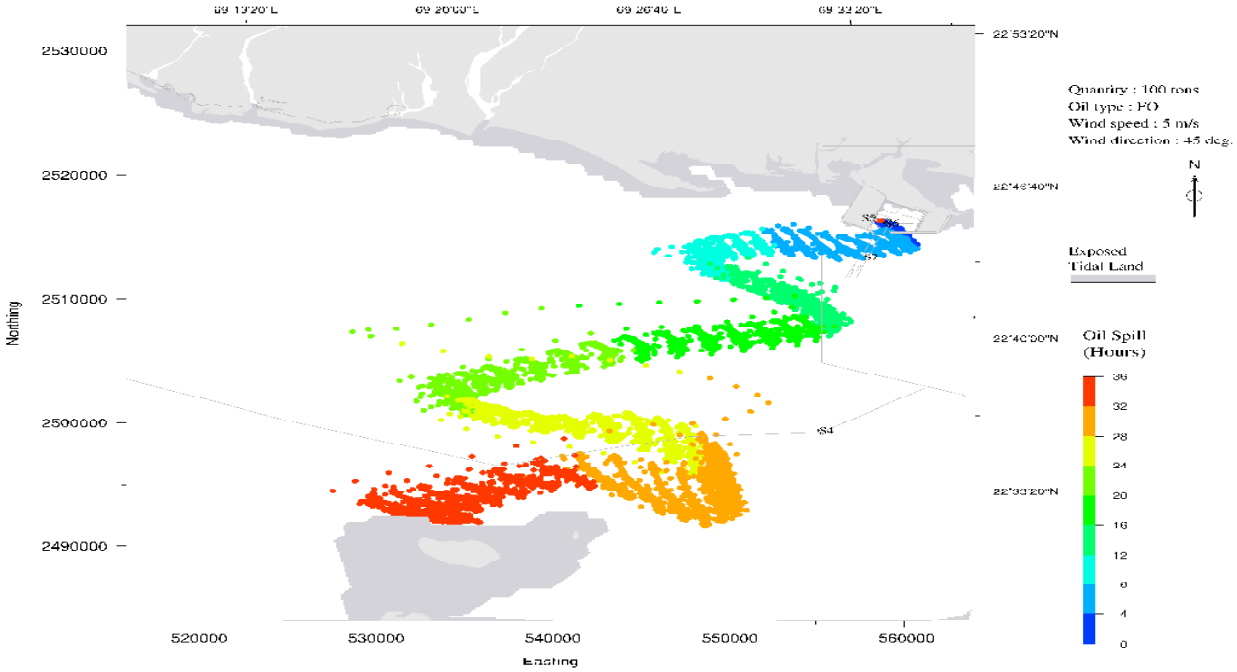



Fig.3: Zoomed up portion of Mundra port facilities of APSEZL showing the location of Spill Points for North Basin & East Basin




Oil Spill trajectory due to instantaneous crude oil leakage of 700 t (due to collision) at spill point S1 (HMEL SPM) after 50 hours during flood condition of the neap tide



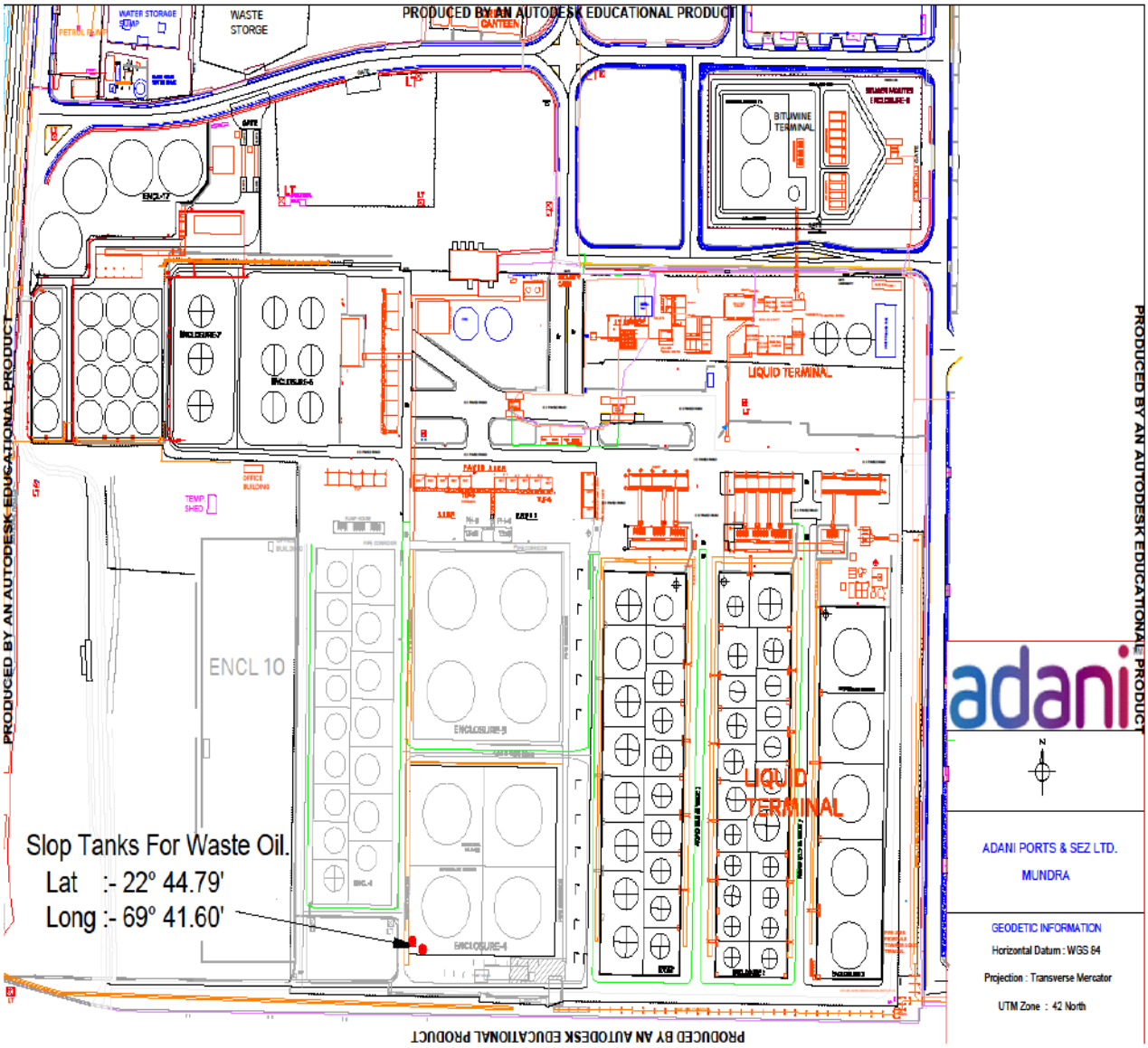

Oil Spill trajectory due to instantaneous FO leakage of 700 t (due to hull failure/ fire / explosion) at typical berth location in the West Basin

For Risk locations and probable fate of oil refer Annexure- V (Volume 2) of Oil Spill Risk Assessment.

**Shoreline resources for priority protection**

**Oil and Waste Storage / Disposal sites**

**Oil and Waste storage / Disposal tank No. 46, 109 and 110 are available within Liquid Tank farm.**



**Sensitivity Maps/ Atlas**

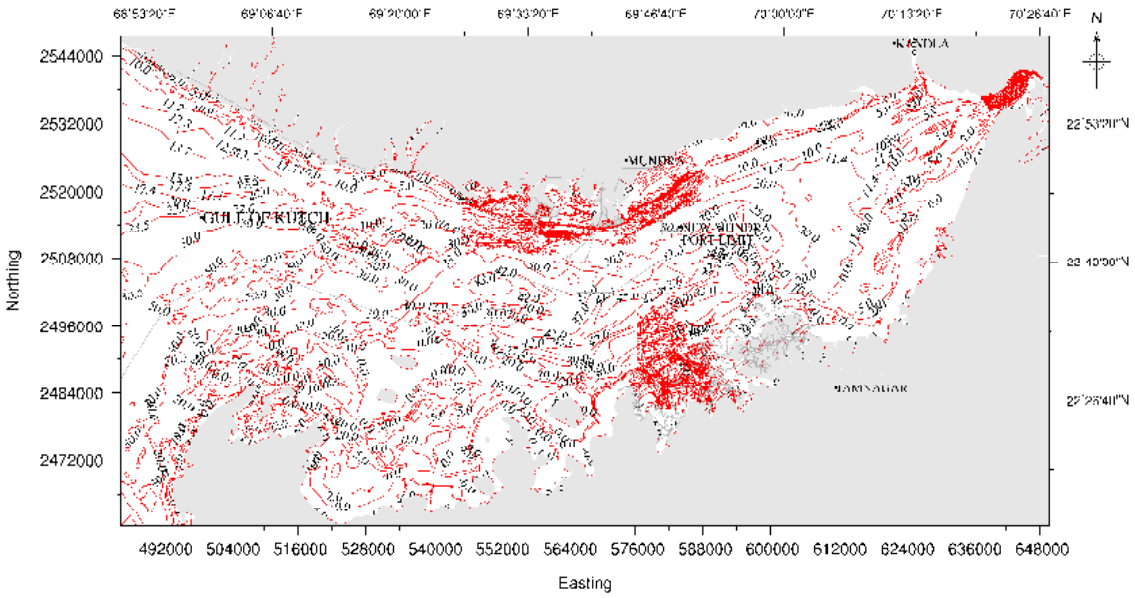



Fig.A1.1 Terrain features of study domain.

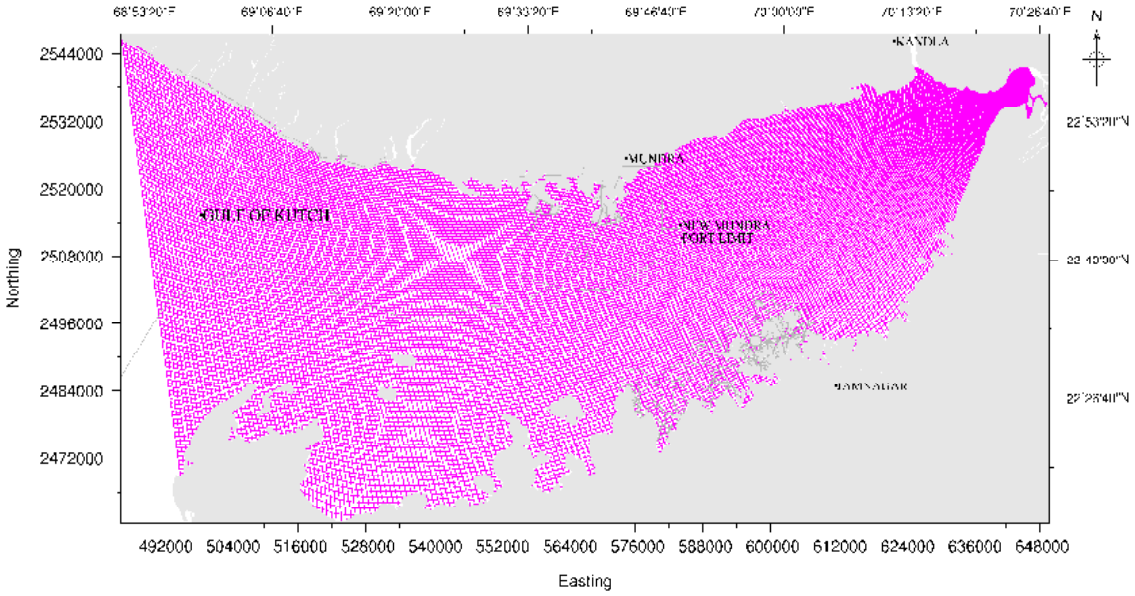



Fig.A1.2 Computational grid

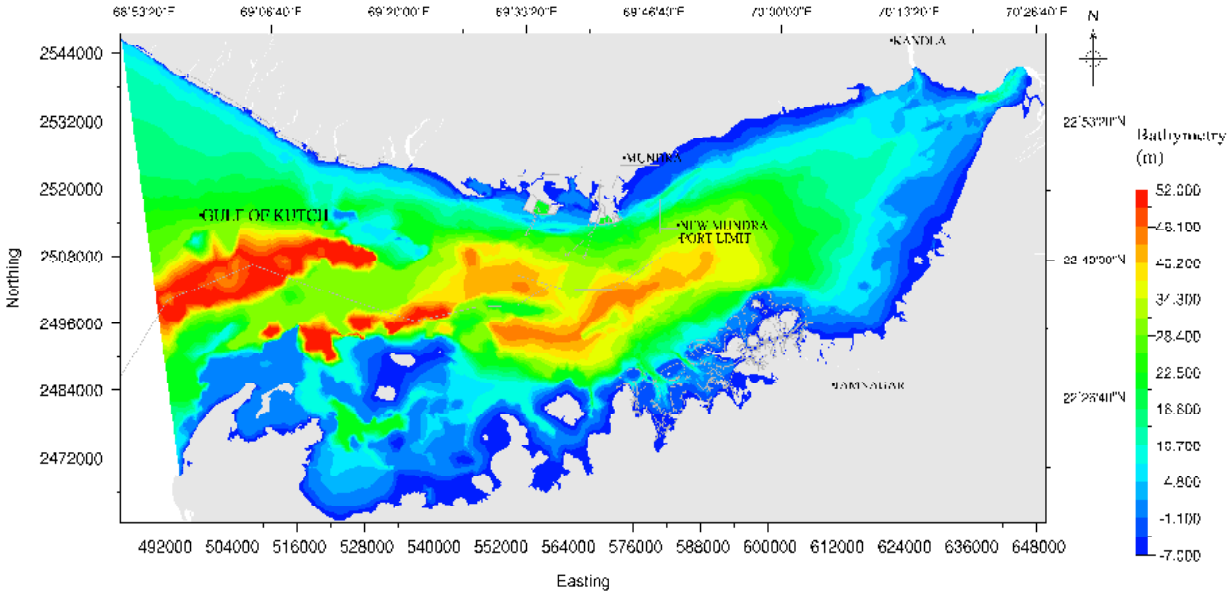



Fig.A1.3 Interpolated depth contours

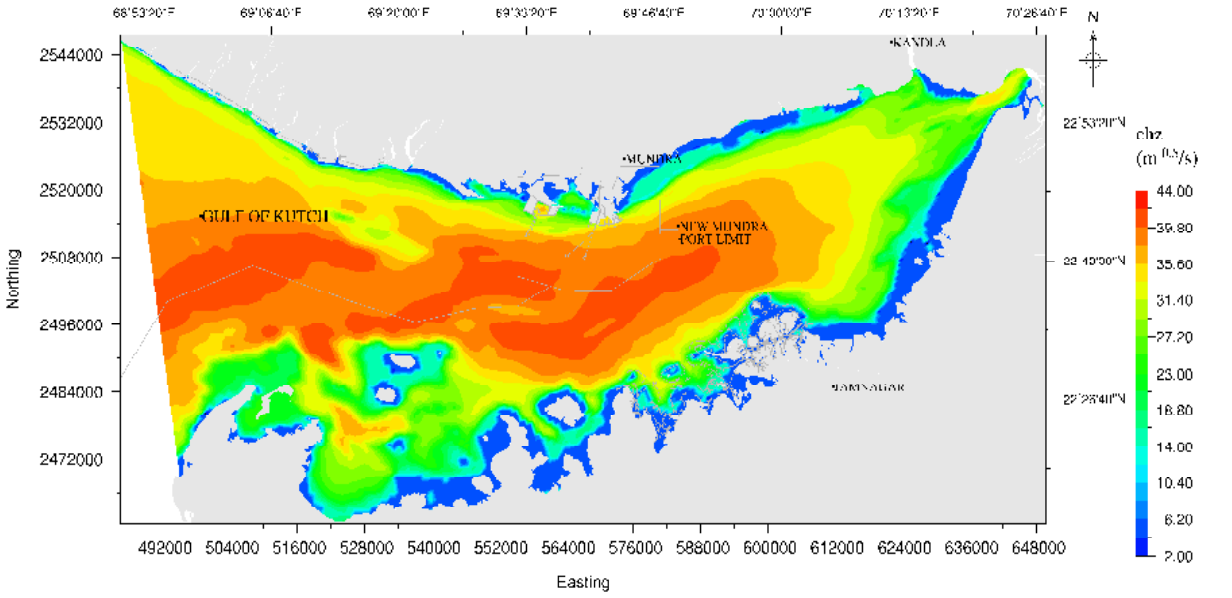



Fig.A1.4 Chezy's coefficient

## Lists

1. **Primary Oil spill Equipment:** booms, skimmers, spray equipment, dispersant, absorbents, oil storage, Radio communications etc.

   Detailed in Annexure **3**

2. **Auxiliary Equipment:** Tugs and work boats, aircraft, vacuum trucks, tanks and barges, loaders and graders, plastic bags, tools, protective clothing, communication equipment etc.

   Detailed in Annexure **3**

3. **Support Equipment:** Aircraft, communications, catering, housing, transport, field sanitation and shelter etc. (Availability, contact, cost and conditions)

   Not applicable

4. **Sources of Manpower:** Contractors, local authorities, caterers, security firms (Availability, numbers, skills, contact, cost and conditions)

   Refer Para 5.3

5. **Experts and Advisors:** Environment, safety, auditing (Availability, contact, cost and conditions)

   Detailed in Annexure **4**

6. **Local and National Government contacts:** Name, rank and responsibility, address, telephone, fax, telex.

   Detailed in Annexure **4**

## Data

1. **Specification of Oils commonly traded**

At the liquid berth, the representative products that would be handled are petroleum products like FO/ HSD / SKO / MS / CBFS / CPO / Naphtha etc. Vessels calling at the port will be having FO and HSD for their propulsion requirements.. The products like MS, Naphtha etc are oils of non – persistent nature; they tend to evaporate fast and will not stay long on the surface of the sea waters. Hence spill studies have been carried out for FO and HSD spills at the berths.

At the SPMs, Crude oil unloading takes place.

Physical and Chemical Properties of products handled at the SPMs, Berths and of the propulsion fuels of the ships / tankers

Data on the properties for the hydrocarbons / products handled at the jetty is required for quantitative hazard identification and consequence calculations. The properties of the FO and HSD, the petroleum hydrocarbons likely to be spilled due to the operations at the jetty are given in Table-3.1.

**Table-3.1: Properties of Crude Oil, FO and Diesel**

| Sl. No | Chemical | Boiling Range ($^oC$) | Specific Heat of Liquid (J/Kg $^oK$) | Heat of Evaporation (x $10^5$ J/Kg) | Heat of Combustion (x $10^5$ J/Kg) |
|---|---|---|---|---|---|
| 1 | Crude Oil | IBP - 700+ | 2385 | 3.4 | 425 |
| 2 | HSD | 200 - 350 | 2889 | 4.65 | 448 |
| 3 | Fuel Oil | 180 - 450 | 2500 | 3.4 | 452 |

The following characteristics of oil are used for modelling study:

**(a) Crude Oil**
Sp. Gr = 0.82 to 0.88
Surface Tension =3.0 e-03
Molar Volume =0.002
Viscosity: 275 CST at 37.8 deg C
Wax content: 12 – 19 %
Pour point of untreated crude: 30 deg C
Pour point of treated crude: 18 deg C

**(b) FO**
Sp. Gr = 0.92
Boiling point = > $260^0$ C
Vapor pressure = < 0.1 psia at $21^0$ C

**(c) HSD**
Sp. Gr = 0.86
Pour point = $6^0$ C - $18^0$ C
Vapor pressure = 2.12 to 26 mm Hg at $21^0$ C

## 2. Wind and weather

**Meteorological and Oceanographic Conditions**

The met-ocean conditions have been previously ascertained at several stages in the course of various studies conducted in past in respect of Mundra port projects. Flow modeling for the Mundra port location has been covered in the model developed by Environ, India, who have developed the model for whole of Gulf as relevant to Mundra region. It has been observed during model studies that flow regime does not have significant changes due to the proposed developments. The following are the main hydo-meteorological parameters for planning and designing of the marine facilities described below.

**Rainfall and Temperature**

The Kutch is a semi-arid region with weak and erratic rainfall confined largely to June-October period. With a few rainfall days, the climate is hot and humid from April till October and pleasant during brief winter from December to February. Although the monthly mean maximum temperature recorded is $37^oC$ during 2005, it occasionally exceeds $40^oC$. Rainfall alone forms the ultimate source of freshwater resource to the region. The average rainfall at Mundra is about 400 mm/year.

**Cyclones**

Cyclonic disturbances strike North-Gujarat, particularly the Kachchh and Saurashtra regions, periodically. These disturbances generally originate over the Arabian Sea and sometimes the Bay of Bengal. Generally during June, the storms are confined to the area North of 15°N and East of 65°E. In August, the initial stages, they move along the northwest course and show a large latitudinal scatter. West of 80°E, the tracks tend to curve towards North. During October the direction of movement of a storm is to the West in the Arabian Sea. However, East of 70E some of the storms move North-Northwest and later recurves North East to strike Gujarat-North Mekran coast.

**Wind**

There are strong winds at times at Mundra Port. The month wise wind rose diagrams for the year 2012 and for the months of January and February of the year 2013 are given below. In the period lasting over months March to May the wind direction is generally SWW (225˚ - 250˚) and velocity varies from 20 to 25 Knots. From June through August, the wind direction is predominantly SW and velocity varies from 25 to 30 Knots with short gusts going up to 35 to 40 Knots. Towards end of September and through October wind direction changes to NE with velocities ranging from 7 to 10 Knots. Direction remaining same the velocity varies 10 knots to 25 Knots in the period November to January. February is the calm period when wind direction is Southerly with velocity in the range of 7 Knots. Stormy weather may generate winds having velocity up to 100 Knots which should be taken as the worst case scenario for design of tall structures and heavy duty cranes.

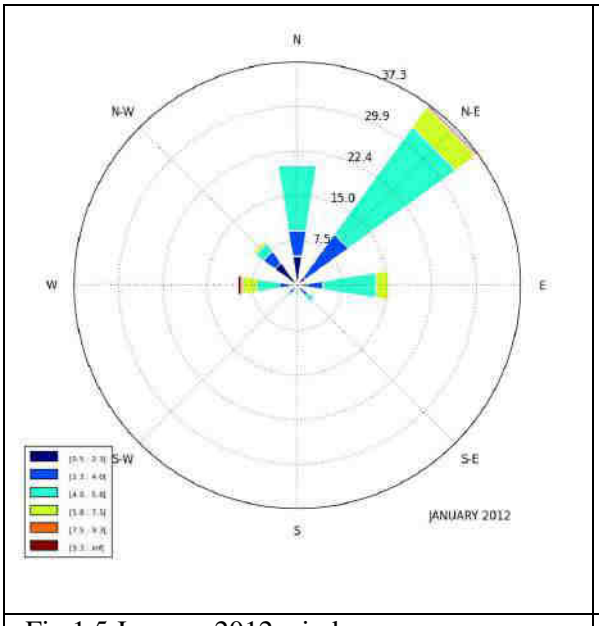



Fig.1.5 January 2012 winds

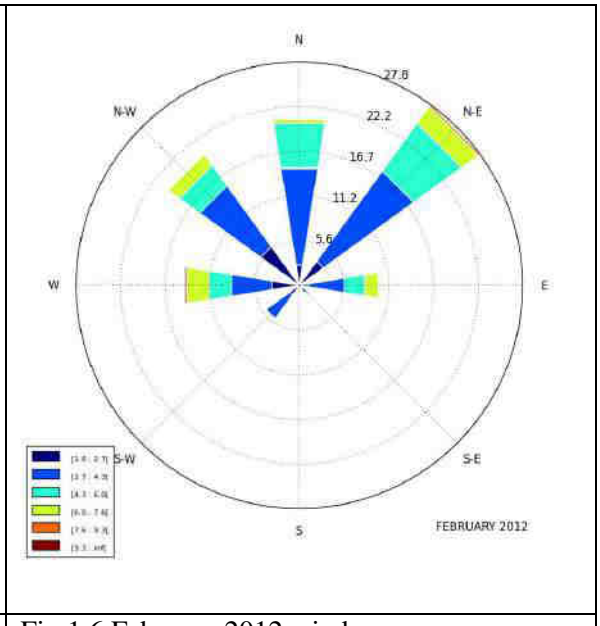



Fig.1.6 February 2012 winds

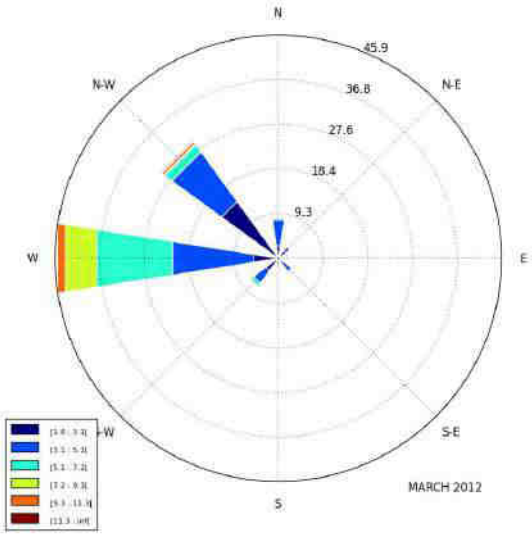



Fig.1.7 March 2012 winds

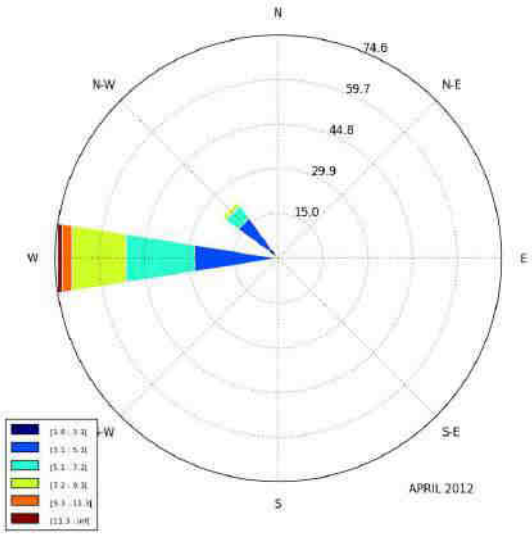



Fig.1.8 April 2012 winds

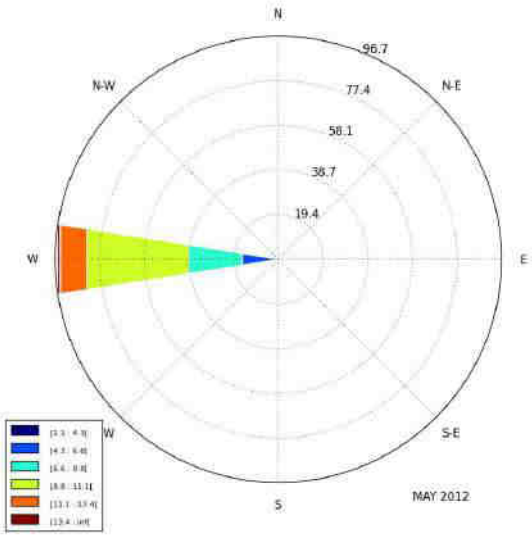



Fig.1.9 May 2012 winds

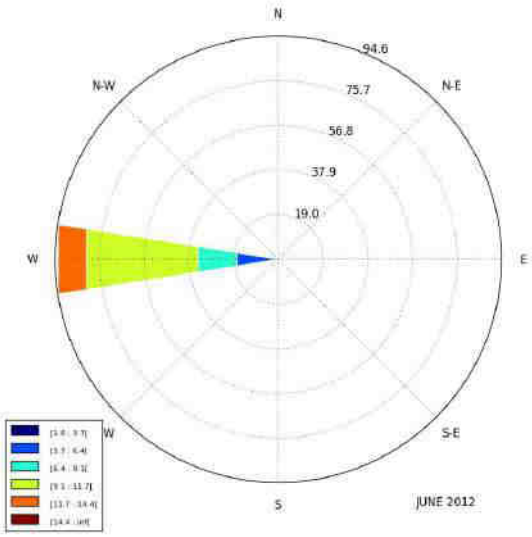



Fig.1.10 June 2012 winds

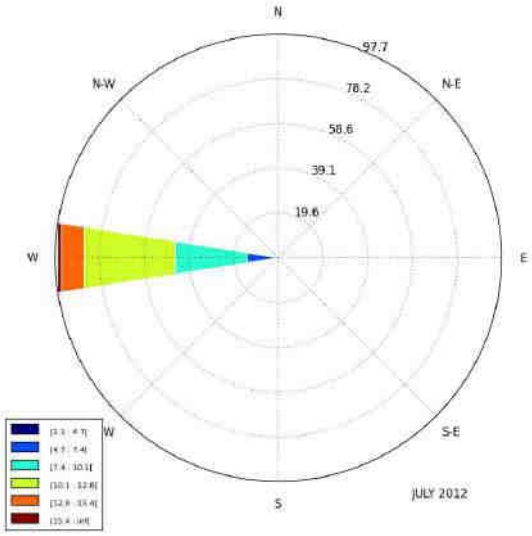



Fig.1.11 July 2012 winds

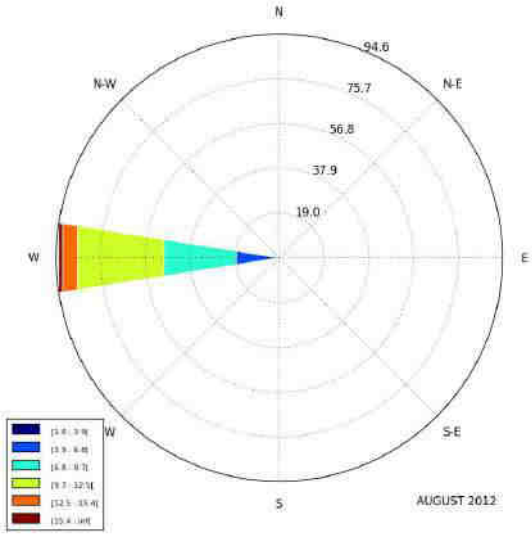



Fig.1.12 August 2012 winds

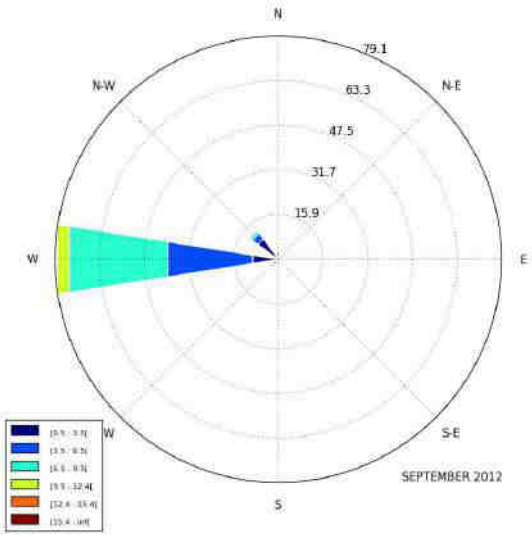



Fig.1.13 September 2012 winds

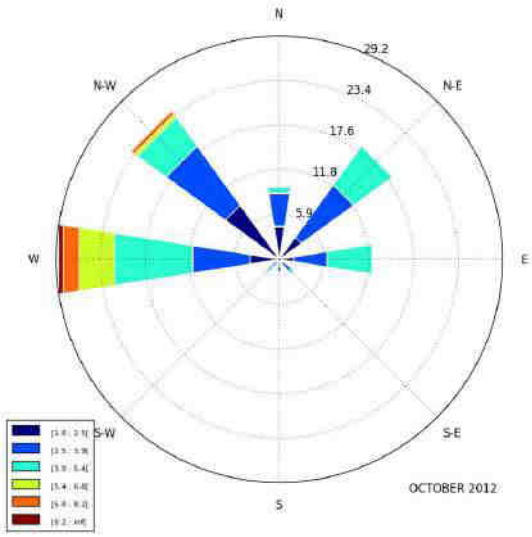



Fig.1.14 October 2012 winds

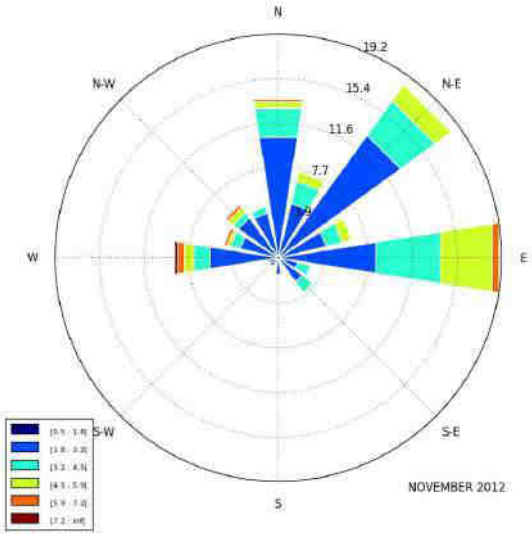



Fig.1.15 November 2012 winds

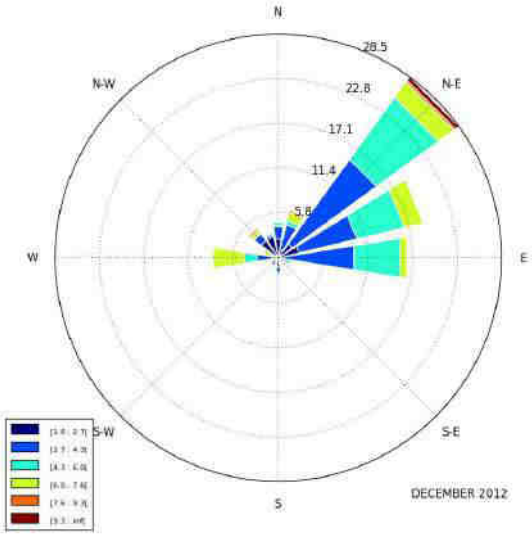



Fig.1.16 December 2012 winds

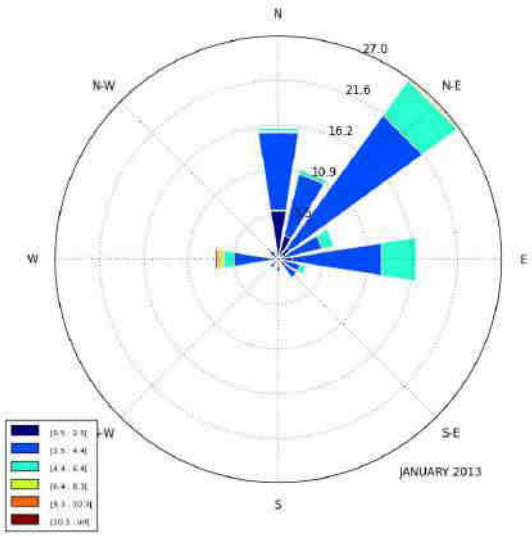



Fig.1.17 January 2013 winds

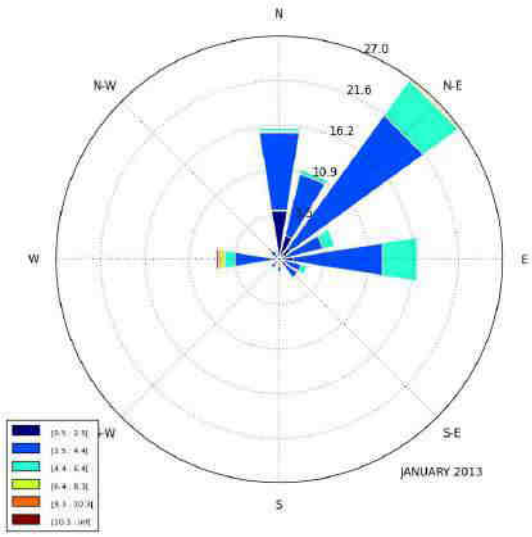



Fig.1.18 February 2013 winds
(Readings till Feb 18,2013)

**Tides**

The tidal planes were assessed in 1998 and are as shown in Table below.
The Highest Astronomical Tide (HAT) is estimated to be about +6.4 m above chart datum (CD), and the Lowest Astronomical Tide (LAT) to be at 0.0 m CD.

| Tide | Height (m) above CD |
|---|---|
| Mean High Water Springs | 5.8 |
| Mean High Water Neaps | 4.6 |
| Mean Low Water Neaps | 2.1 |
| Mean Low Water Springs | 1.0 |

**Currents**

Currents in the approaches to the port are dominated by the tidal flows, with predictable variations over diurnal, monthly and annual time scales. Currents in this part of the Gulf flow parallel to the natural sea-bed contours. Currents can be relatively strong, with speeds in excess of 3.0 Knots reported at sometimes of the year. The Admiralty Chart shows currents off Navinal point to be 3.0 Knots East & West bound. It is observed that the currents are usually aligned with the bed contours and are stronger in deeper waters off the coast. The impact of future development over the existing coast-line can be determined by the change in current speed resulting from the proposed developments.

**Waves**

In past HR Wallingford (HRW) has studied the wave climate considering wave energy from locally generated waves and swell propagating in to the Gulf of Kutch from the Arabian Sea. The results of the study carried out by HRW are presented in the Table below.

**Design Waves at Mundra**

| Direction Sector (ºN) | Return Period (years) | Inshore Direction (ºN) | Hs (m) | T2 (sec) |
|---|---|---|---|---|
| 210 | 1 | 222 | 1.2 | 5.0 |
| | 5 | 222 | 1.4 | 5.3 |
| | 20 | 221 | 1.6 | 5.8 |
| | 100 | 221 | 1.8 | 6.1 |
| 240 | 1 | 226 | 1.5 | 5.4 |
| | 5 | 226 | 1.7 | 5.8 |
| | 20 | 225 | 1.8 | 6.1 |
| | 100 | 225 | 2.0 | 6.5 |
| 270 | 1 | 239 | 1.4 | 5.5 |
| | 5 | 236 | 1.7 | 6.3 |
| | 20 | 236 | 1.8 | 6.7 |
| | 100 | 235 | 2.0 | 7.4 |
| 300 | 1 | 240 | 0.8 | 5.2 |
| | 5 | 240 | 0.9 | 5.6 |
| | 20 | 239 | 1.0 | 6.2 |
| | 100 | 238 | 1.2 | 6.7 |

Atmospheric stability is an important factor for predicting the dispersion characteristics of gases/vapours into the surrounding environment. Change in atmospheric stability is a direct consequence of the vertical

temperature structure. The stability effects are mathematically represented through Pasqual parameters. The following stability classification is employed:

| Stability Class | Atmospheric Condition |
|---|---|
| A | Very Unstable |
| B | Unstable |
| C | Slightly Unstable |
| D | Neutral |
| E | Stable |
| F | Very Stable |

Condition of atmospheric stability is estimated by a suitable method that uses dispersion parameters viz., vertical temperature gradient, profile of the winds and roughness factor. The roughness factor for the Mundra area is small since it mainly comprises of plain land.

The following meteorological information has been taken in the calculations for the Mundra area (GMB-2010):

Average ambient temperature : 30$^{o}$C
Average wind speed : Wind data for the whole year 2012 is available and is used
Stability condition : F (Very Stable)

## 3 Information sources

This plan is prepared in accordance with:

a) Marine Environmental Impact Assessment of SPMs, COTs and connecting pipelines of APSEZL at Mundra dated February 2001, prepared by National Institute of Oceanography, Mumbai.
b) Report on Risk assessment study and On-site disaster management Plan for SPMs, COTs and connecting Pipelines of Adani Ports and Special Economic Zone Limited, by TATA AIG Risk Management Services Limited, dated February 2001.
c) HAZOP study report of SPM Terminal pipeline project by Intec Engineering, dated 26/02/2004.
d) IPIECA guide to Contingency planning for oil spills on water.
e) Oil spill risk assessment and contingency plan study done by M/s Environ Software Pvt. Ltd. (Copy enclosed)

**ANNEXURES**

| **INITIAL OIL SPILL REPORT** | | **ANNEXURE 1** |
|---|---|---|
| Particulars of person, office reporting | | |
| Tel No. | | |
| Date & time of incident | | |
| Spill location | | |
| Likely cause of spill | | Witness |
| Initial response action | | By |
| Any other information | | |

This FIR is to be sent to Marine Manager by fastest means of communication possible. It is an offence not to report oil pollution incident.

This FIR is to be followed by company's incident report also.

Following POLREP report to the Government through nearest CG information will also be required:

| | |
|---|---|
| Identity of informant | |
| Time of FIR | |
| Source of spill | |
| Cause of spill | |
| Type of spill | |
| Colour code information (from CG) | |
| Radius of slick | |
| Tail | |
| Volume | |
| Quantity | |
| Weather | |
| Tide / current | |
| Density | |
| Layer thickness | |
| Air / Sea temp. | |
| Predicted slick movement | |
| Size of spill classification (Tier 1, 2 or 3) | |

**POLREP** **ANNEXURE 2**

In case of an oil spill, APSEZ will provide information to Commandant Coast Guard District 1 Porbandar COMDIS 1 and Coast Guard Station Mundra in the following format:

| SN. | Parameter | Data |
|---|---|---|
| 1. | Identity of the informant | |
| 2. | Time of information receipt | |
| 3. | Source of Spill | |
| 4. | Cause of Spill | |
| 5. | Type of oil | |
| 6. | Colour code information | |
| 7. | Configuration | |
| 8. | Radius | |
| 9. | Tail | |
| 10. | Volume | |
| 11. | Quantity | |
| 12. | Weathered or Fresh | |
| 13. | Density | |
| 14. | Viscosity | |
| 15. | Wind | |
| 16. | Wave Height | |
| 17. | Current | |
| 18. | Layer Thickness | |
| 19. | Ambient air temperature | |
| 20. | Ambient sea temperature | |
| 21. | Predicted slick movement | |
| 22. | Confirm Classification of spill size | |

**Additional Information :**

**LIST OF RESOURCES AVAILABLE** **ANNEXURE 3**

**Tugs Available for Oil Spill Containment**

| Name of Tug | Type | BHP | OSD | AFFF | Capacity (cubm/Hr) | BP |
|---|---|---|---|---|---|---|
| Dolphin No. 3 | ASD | 2200 X 2 | 3000 ltr | 2000 ltr | 1200 | 55 |
| Dolphin No. 4 | ASD | 2200 X 2 | 3000 ltr | 2000 ltr | 1200 | 55 |
| Dolphin No. 7 | ASD | 2200 X 2 | 3000 ltr | 2000 ltr | 1200 | 55 |
| Dolphin No. 10 | ASD | 3000 X 2 | 3000 ltr | - | - | 70 |
| Dolphin No. 11 | ASD (DSV) | 2200 X 2 | 3000 ltr | 2000 ltr | 1200 | 55 |
| Dolphin No. 14 | ASD | 3000 X 2 | 3000 ltr | 2000 ltr | 1200 | 70 |
| Dolphin No. 15 | ASD | 3000 X 2 | 3000 ltr | 2000 ltr | 1200 | 70 |
| Dolphin No. 16 | ASD | 3000 X 2 | 3000 ltr | 2000 ltr | 1200 | 70 |
| Dolphin No. 17 | ASD | 3000 X 2 | 3000 ltr | - | - | 70 |
| Dolphin No. 18 | ASD | 3000 X 2 | 3000 ltr | 2000 ltr | 1200 | 70 |
| Khushboo | Fixed screw | 401 X 2 | - | - | - | 10 |

Dolphin No. 3, 4, 7, 10, 11, 14, 15, 16, 17 & 18 are fitted with Oil Spill Dispersant boom and proportionate pump to mix OSD and Sea water as required. Dolphin No.3, 4, 7, 11, 14, 15, 16, 17 & 18 are fitted with a fire curtain and remote controlled fire monitors.

**All above eleven Tugs have class notation as Harbour Tugs and are certified to work within the Harbour limits only.**
Reception Facility : 12" pipe line, connected to a slop tank at chemical tank farm.

Dolphin 11 has fire fighting system of 1200 m3/hr along with 20 ton lifting "A" frame and diving support facility.

**Location of Oil Spill Equipment**: The Oil Spill Equipments are stored in SPM Store.

**Resources / Equipment Available with APSEZL, Mundra**

| Item | Quantity |
|---|---|
| **Canadyne Fence Boom (Reel model 7296/8496 with Power Pack, Towing bridles and Tow lines - 235 meter** | 1 no |
| Power pack with boom reel with hydraulic hoses | 2 nos. |
| Power pack - 20 KV with boom reel with hydraulic hoses | 2 nos. |
| **Lamor Side Collector system (Recovery Capacity 123 m³/ hr)**<br>(Side collector LSC-3C/2300(01C02-P536). Oil transfer pump OT A 50 with oil transfer hose set | 2 nos.<br>2 sets |
| **Lamor Minimax 12 m³ skimmer** | 2 sets |
| Power pack for skimmers with hydraulic hoses | 4 nos. |
| Power pack - 20 KV for skimmers with hydraulic hoses | 1 no. |
| **Floating tank (25 m³ )** | 1 nos. |
| Foot pumps for floating tank | 6 nos |
| Oil Spill Dispersants | 5000 ltr |
| Portable dispersant storage tank: 1000 ltr capacity | 1 no. |
| Portable pumps | 2 nos. |
| Two – way hydraulic maneuvering panel | 2 nos |
| **Oil Containment Boom**-Length 2000 metres, Height -1500 mm, Draft-900mm, Free Board-600mm | 2000 mtr |
| **Current Buster Boom**-Fasflo -75 (for response in fast current) | 2 Nos |
| **Skimmer**-KOMARA 15 Duplex Skimmer System with floating IMP 6 Pump. | 4 Nos |
| **12.5T Flexible Floating Storage Tank** (PUA). | 3 Nos |
| Diesel Driven Transfer Pump for Flex Barge | 2 Nos |
| Site Hose Kit for the transfer Pump for the Flex Barge | 2 Nos |
| 3" & 2"Hose Adaptor for Transfer Pump and Hose | 2 Nos |
| **Shoreline Cleanup Equipment** | |
| Mini Vac System | 5 Nos |
| **OSD Applicator**- Oil Dispersant Spry Unit(20 Ltr) for use on Beach and Inter Tidal Zones | 2 Nos |
| Startank with Capacity 10000 liter($10m^3$) | 2 Nos |
| Sorbent Boom Pack(12.5cm x4 M) | 500 mtr |
| Sorbent pad | 2000 Nos |

**Facilities in the Marine Control room:**

1. Tidal stream gauge: This can accurately read the prevalent rate of flow and direction of current.
2. Tide gauge: For accurately calculating the height of tide at any given time.
3. Wind gauge: For direction and speed of wind.
4. VHF sets (fixed and portable) with complete range of marine frequencies to be used for field operations.

**LIST OF TELEPHONE NUMBERS OF EXPERT ADVISORS ANNEXURE 4**

**List of Important Telephone Numbers of Govt. Officials and other neighboring Organisations (Expert and Advisors) related to Spill Combating Plan**

| SN. | Company | Name and Designation | Telephone Numbers |
|---|---|---|---|
| 1. | APSEZL, Mundra | Chief Operating Officer<br>Head Marine<br>Pollution Response Officer<br>Port Control | 02838-6272602838-255727<br>02838-255727<br>02838-255761 / 289170 (Fax)<br>02838-255739 |
| 2. | Kandla Port Trust | Chairman<br>Dy. Conservator<br>Harbor Master<br>Signal Station | 02836-233001 / 234601<br>02836-223585 / 220235<br>02836-270201<br>02836-270194 / 549 |
| 3 | Indian Oil Corporation, Mundra | CM (Ops)<br>Manager (Ops)<br>Control Room | 02838- 222194<br>02838- 222197<br>02838- 224444 |
| 4 | Indian Oil Corporation, Vadinar | DGM (Ops)<br>Manager Tech Services<br>Port Control | 02833-256527<br>02833-256464<br>02833-256555 |
| 5 | Reliance Petroleum Ltd Jamnagar | Marine Chief<br>Senior Port Captain<br>Port Control | 0288-4013607<br>0288-4013750<br>0288-4012600 / 4012610 |
| 6 | The Commanding Officer<br>Indian Coast Guard Station, Mundra | ICGS, Mundra<br>Station Ops Officer | 02838 - 271402 & 03 (Tel)<br>02838 – 271404 (Fax) |
| 7 | The Commander<br>Coast Guard Region (North West), Gandhinagar | COMCG (NW)<br>Regional Ops & Plans Officer | 079-23243241 (Tel)<br>079-23243283 (Fax) |
| 8 | The Commander<br>No.1 Coast Guard District (Guj), Porbandar | COMDIS-1<br>District Ops & Plans Officer | 0286-2214422 (Tel)<br>0286-2210559 (Fax) |
| 9 | The Commander<br>Coast Guard Region (West) Mumbai | COMCG (W)<br>Regional Ops & Plans Officer | 022-24376133 (Tel)<br>022-24333727 (Fax) |
| 10 | The Officer-in-Charge<br>Coast Guard Pollution Response Team (West), Mumbai | PRT (W)<br>Officer-in-Charge | 022-23722438 (Tel)<br>022-23728867 (Fax) |
| 11 | Gujarat Maritime Board | Vice Chairman & CEO<br>Chief Nautical Officer | 079-23238346 / 23238363<br>079-23234716 |

| | | | |
|---|---|---|---|
| 12 | Ministry of Environment<br>Govt. of Gujarat | Director (Environment) | 079-23252154 / 23251062<br>079-23252156 ( Fax ) |
| 13 | Gujarat Pollution Control Board | Environmental Engineer | 079-232 22756<br>079-232 22784 (Fax) |

**List Of Important Telephone Numbers Of Adani Group Personnel**

| S.No. | Description / contact person / designation | Telephone Nos. | |
|---|---|---|---|
| | | Landline | Mobile |
| 01 | Capt. Anubhav Jain, Head – Marine & PFSO, APSEZL | 02838 - 255727 | 91 9925223674 |
| 02 | Mr.Cherian Abraham, Dy. PFSO - (AICTPL) | 91-2838 - 255733 | 9189800 48850 |
| 03 | Capt. Kumar Paritosh, Dy. PFSO, ACMTPL | 02838 – 255733 | 91 9879104839 |
| 04 | Mr. Hari Govindan V , Dy.PFSO, MICT | 91-2838 - 285072 | 91 9879104805 |
| 05 | Marine control, APSEZL | 02838 – 255333 / 255761 | 91 9825228673 |
| 06 | Port Operation center, APSEZL | 02838 –255762 | 91 9825000949 |
| 07 | Port security Control, APSEZL | 02838 – 289322 | 91 9825000933 |
| 08 | Head - Security, APSEZL | 02838 – 289947 | 91 90999 99262 |
| 09 | Head - Health, safety & Environment, APSEZL | 02838 - 255777 | 91 7574894383 |
| 10 | Head - Fire Dept. APSEZL | 02838 – 255857 | 91 7069083035 |
| 11 | Occupational Health Centre | 02838 - 255710 | 91 8980015070 |
| | | | |
| | | | |
| | | | |

| | Marine Officer/ SPM Mooring master | ANNEXURE 5 |
|---|---|---|
| **Responsibilities** | • Observe or receive report of oil or chemical spill incident<br>• Initiate measures to prevent/ reduce further spillage<br>• Maintain communication with other all vessels | |

| Step | Actions | Additional Information |
|---|---|---|
| **Alert** | (Marine Manager / On Scene Commander / SPM Pilot<br>Tugs and other support/ response craft | *VHF Channel 73 / 77* |
| **Initial Actions** | Stop all cargo operations<br>Ensure all safety precautions taken/observed<br>Verify incident details<br>Advise all relevant information to (Marine Manager / On Scene Commander / or SPM Pilot<br>Initiate personal log<br>Place tugs/other response craft on stand-by | *Liaise with Terminal Shift Engineer* |
| **Further Actions** | Brief (Marine Manager / On Scene Commander / SPM Pilot as necessary<br>Mobilize response equipment/ personnel as directed by (Marine Manager / On Scene Commander /<br>Maintain personal log of communications and events<br>Act as instructed by (Marine Manager / On Scene Commander / SPM Pilot | |
| **Final Actions** | Submit personal log to HOD – Marine<br>Attend debrief | |

| | MARINE MANAGER / On Scene Commander ANNEXURE 6 | |
|---|---|---|
| **Responsibilities** | • Initially assess situation<br>• Verify classification<br>• Verify fate of spill<br>• Verify resources immediately at risk, inform parties<br>• Provide accurate situation reports to Radio Room/ HOD – Marine<br>• Collect evidence and/ or statements<br>• Liaise with HOD-Health, Safety, Environment & Fire<br>• Liaise with incident vessel regarding status of oil spill (if applicable) | |
| **Step** | **Actions** | **Additional Information** |
| **Alert** | HOD – Marine | |
| **Initial Actions** | Proceed to incident location, assume role of On-Scene Coordinator<br>Ensure all safety precautions have been taken<br>Initiate response /<br>Investigate cause/ source of spill<br>Communicate all information to HOD – Marine<br>Ensure samples of spilled oil taken<br>Initiate personal log<br>Take photographic evidence<br>Collect evidence and take statements | *Stopped or ongoing* |
| **Further Actions** | Ensure resources are being deployed as required<br>Provide co-ordination at-sea response<br>Provide detailed situation reports to HOD- Marine<br>Liaise with -Health, Safety Environment & Fire Department. | |
| **Final Actions** | Submit personal log to HOD – Marine<br>Attend debrief | |

| | SPM Pilot | ANNEXURE 7 |
|---|---|---|
| **Responsibilities** | • Initially assess situation<br>• Verify classification<br>• Provide accurate situation reports to Radio Room/ OSC<br>• Collect evidence and/ or statements<br>• Liaise with incident vessel regarding status of oil spill (if applicable) | |

| Step | Actions | Additional Information |
|---|---|---|
| **Alert** | Marine Control Room<br>OSC<br>Tugs and other support / response crafts | *VHF Channel 73 / 77* |
| **Initial Actions** | Assume role of On-Scene Coordinator<br>Investigate cause/ source of spill<br>Communicate all information to Marine Control Room<br>Ensure samples of spilled oil taken<br>Initiate personal log<br>Take photographic evidence<br>Collect evidence and take statements | *Stopped or ongoing* |
| **Further Actions** | Ensure resources are being deployed as required<br>Provide co-ordination of the at-sea response<br>Provide detailed situation reports to HOD – Marine | |
| **Final Actions** | Submit personal log to HOD – Marine<br>Attend debrief | |

| | HOD – Marine | ANNEXURE 8 |
|---|---|---|
| **Responsibilities** | • Confirm/ amend initial classification<br>• Manage the APSEZL response<br>• Authorize expenditure after consultation with COO APSEZL<br>• Brief COO, APSEZL<br>• Liaise with Coast Guard<br>• Approve press statements for release | |

| Step | Actions | Additional Information |
|---|---|---|
| **Alert** | Coast Guard<br>External organizations | |
| **Initial Actions** | Verify/ amend spill classification<br>Ensure all safety precaution have been taken<br>Confirm external organizations have been alerted<br>Convene Emergency Response Team<br>Predict slick movement<br>Liaise with vessel Agents/ Owners as appropriate | |
| **Further Actions** | Chair the Emergency Response Team meetings<br>Constantly review the strategy being employed and advise of changes where necessary<br>Approve all expenditure commitments<br>Brief President APSEZ<br>Agree press statements with Corporate Relations Chief<br>Confirm formal samples have been taken<br>Advise Coast Guard if oil migrates outside of Local Area | |
| **Final Actions**<br><br>**Final Actions (contd.)** | Terminate the clean-up<br>Collate personal logs.<br>Prepare the incident report.<br>Hold full de-brief involving all members.<br>Amend contingency plan as required.<br>General Report to President | |

| **OIL SPILL PROGRESS REPORT** | **ANNEXURE 9** |
|---|---|

| | |
|---|---|
| **Incident Name:** | |
| **Updated by:** | |
| **Date:** | **Time (local):** |
| **Summary of Incident Response Operations:** | |
| **Summary of Incident Response Resource Utilization:** | |

| | | | |
|---|---|---|---|
| Number of Aircraft: | | Number of Vessels: | |
| Dispersant Used: | Liters | Length of Booms in Use: | m |
| Number of Recovery Devices: | | Number of Storage Devices: | |
| Sorbent Used: | kg | Bio-remediation Used: | kg |
| Number of Personnel: | | Number of Vehicles: | |

Specialist Equipment:

| **Oil Spill Balance Sheet:** | |
|---|---|
| Total amount of oil spilled: | Tons |
| Total amount of oil recovered: | Tons |
| Outstanding amount of spilled oil: | Tons |
| **Mass balance:** | |
| Estimated Natural Weathering: | Tons |
| Mechanically agitated: | Tons |
| Chemically dispersed: | Tons |
| Skimmer recovered: | Tons |
| Sorbent recovered: | Tons |
| Manually recovered: | Tons |
| Bio-remediated: | Tons |
| Other: | Tons |

| **Emergency Response Log** | **ANNEXURE 10** |
|---|---|
| **Page Number:** | **Date:** |
| **Name:** | **Position:** |
| **Contact Number** | **Signature:** |

| Time | Activity Completed: |
|---|---|
| | |
| | |
| | |
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| | |
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| | |

**Control Room Officer** **HOD – Marine**

| Classification of Oil | ANNEXURE 11 |
|---|---|

## Group 1 oils

A: °API > 45 (Specific gravity < 0.8)
B: Pour point °C
C: Viscosity @ 10–20°C: less than 3 CSt
D: % boiling below 200°C: greater than 50%
E: % boiling above 370°C: between 20 and 0%

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Asgard | 49 | -28 | 2 @ 10°C | 58 | 14 |
| Arabian Super Light | 51 | -39 | 2 @ 20°C | | |
| Cossack | 48 | -18 | 2 @ 20°C | 51 | 18 |
| Cutlew | 47 | -13 | 2 @ 20°C | 57 | 17 |
| F3 Condensate | 54 | <-63 | 1 @ 10°C | 81 | 0 |
| Gippsland | 52 | -13 | 1.5 @ 20°C | 63 | 8 |
| Hidra | 52 | -42 | 2.5 @ 10°C | 60 | 11 |
| Terengganu condensate | 73 | -36 | 0.5 @ 20°C | >95 | 0 |
| Wollybutt | 49 | -53 | 2@ 20°C | 55 | 4 |
| Gasoline | 58 | | 0.5 @ 15°C | 100 | 0 |
| Kerosene | 45 | -55 | 2 @ 15°C | 50 | 0 |
| Naptha | 55 | | 0.5 @ 15°C | 100 | 0 |

## Group 2 oils

A: °API 35–45 (Specific gravity 0.8–0.85)
B: Pour point °C
C: Viscosity @ 10–20°C: between 4 Cst and semi-soli
D: % boiling below 200°C: between 20 and 50%
E: % boiling above 370°C: between 15 and 50%

| Low pour point <6°C | A | B | C | D |
|---|---|---|---|---|
| Arabian Extra Light | 38 | -30 | 3 @ 15°C | 26 |
| Azeri | 37 | -3 | 8 @ 20°C | 29 |
| Brent | 38 | -3 | 7 @ 10°C | 37 |
| Draugen | 40 | -15 | 4 @ 20°C | 37 |
| Dukhan | 41 | -49 | 9 @ 15°C | 36 |
| Liverpool Bay | 45 | -21 | 4 @ 20°C | 42 |
| Sokol (Sakhalin) | 37 | -27 | 4 @ 20°C | 45 |
| Rio Negro | 35 | -5 | 23 @ 10°C | 29 |
| Umm Shaif | 37 | -24 | 10 @ 10°C | 34 |
| Zakum | 40 | -24 | 6@ 10°C | 36 |
| Marine Gas oil (MGO) | 37 | -3 | 5 @ 15°C | |
| **High pour point >5°C** | | | | |
| Amna | 36 | 19 | Semi-solid | 25 |
| Beatrice | 38 | 18 | 32 @ 15°C | 25 |
| Bintulu | 37 | 19 | Semi-solid | 24 |
| Escravos | 34 | 10 | 9 @ 15°C | 35 |
| Sarir | 38 | 24 | Semi-solid | 24 |
| Statfjord | 40 | 6 | 7 @ 10°C | 38 |

## Group 3 oils

A: °API 17.5–35 (Specific gravity 0.85–0.95)
B: Pour point °C
C: Viscosity @ 10–20°C: between 8 CSt and semi solid
D: % boiling below 200°C: between 10 and 35%
E: % boiling above 370°C: between 30 and 65%

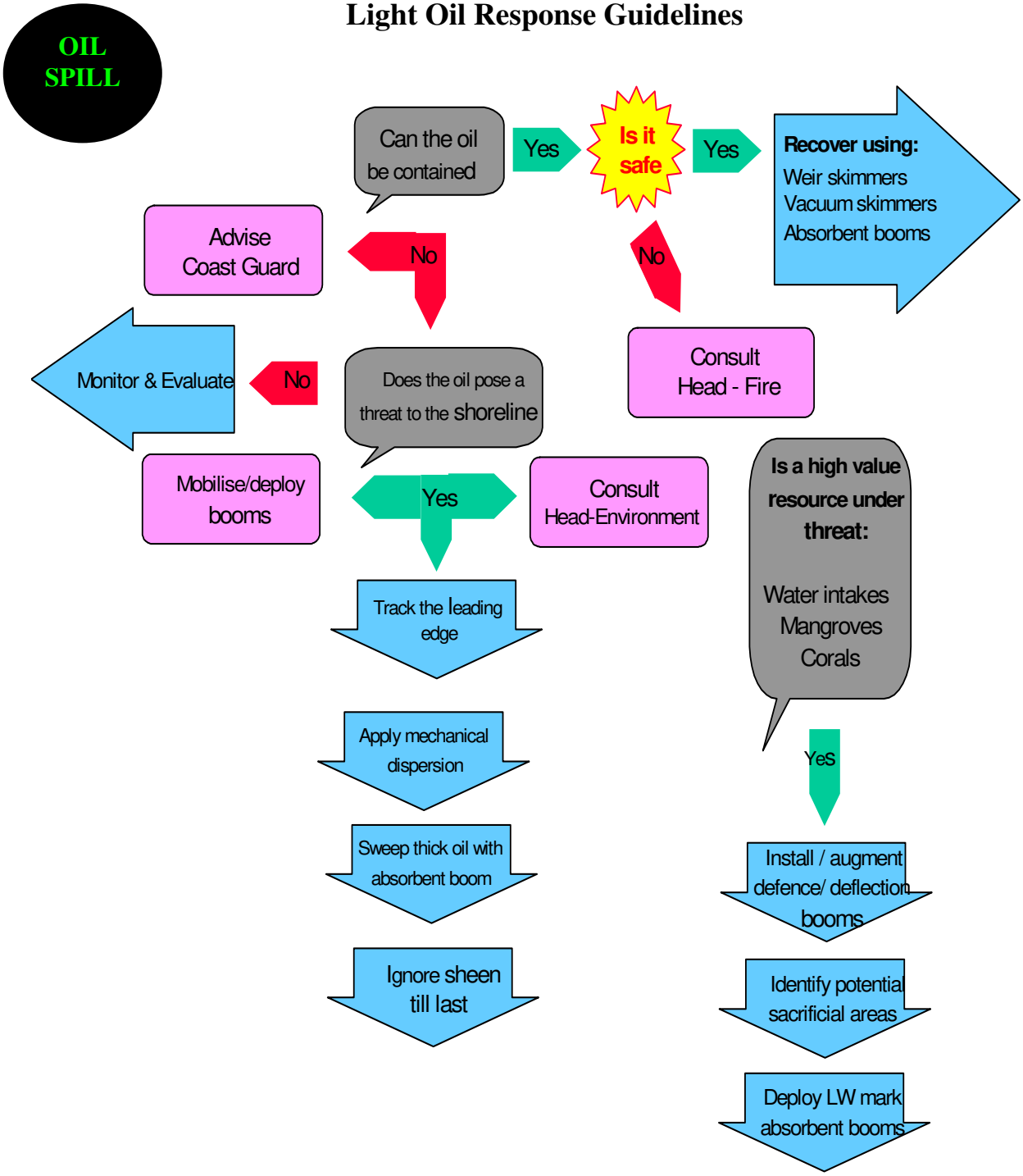
| Low pour point <6°C | A | B | C | D | E |
|---|---|---|---|---|---|
| Alaska North Slope | 28 | -18 | 32 @ 15°C | 32 | 41 |
| Arabian Heavy | 28 | -40 | 55 @ 15°C | 21 | 56 |
| Arabian Medium | 30 | -21 | 25 @ 15°C | 22 | 51 |
| Arabian Light | 33 | -40 | 14 @ 15°C | 25 | 45 |
| Bonny Light | 35 | -11 | 25 @ 15°C | 26 | 30 |
| Iranian Heavy | 31 | -36 | 25 @ 15°C | 24 | 48 |
| Iranian Light | 34 | -32 | 15 @ 15°C | 26 | 43 |
| Khafji | 28 | -57 | 80 @ 15°C | 21 | 55 |
| Sirri | 33 | -12 | 18 @ 10°C | 32 | 38 |
| Thunder Horse | 35 | -27 | 10 @ 10°C | 32 | 39 |
| Tia Juana Light | 32 | -42 | 500 @ 15°C | 24 | 45 |
| Troll | 33 | -9 | 14 @ 10°C | 24 | 35 |
| IFO 180 | 18–20 | 10–30 | 1,500–3,000 @ 15°C | | – |
| **High pour point >5°C** | | | | | |
| Cabinda | 33 | 12 | Semi-solid | 18 | 56 |
| Coco | 32 | 21 | Semi-solid | 21 | 46 |
| Gamba | 31 | 23 | Semi-solid | 11 | 54 |
| Mandji | 30 | 9 | 70 @ 15°C | 21 | 53 |
| Minas | 35 | 15 | Semi-solid | 15 | 58 |

## Group 4 oils

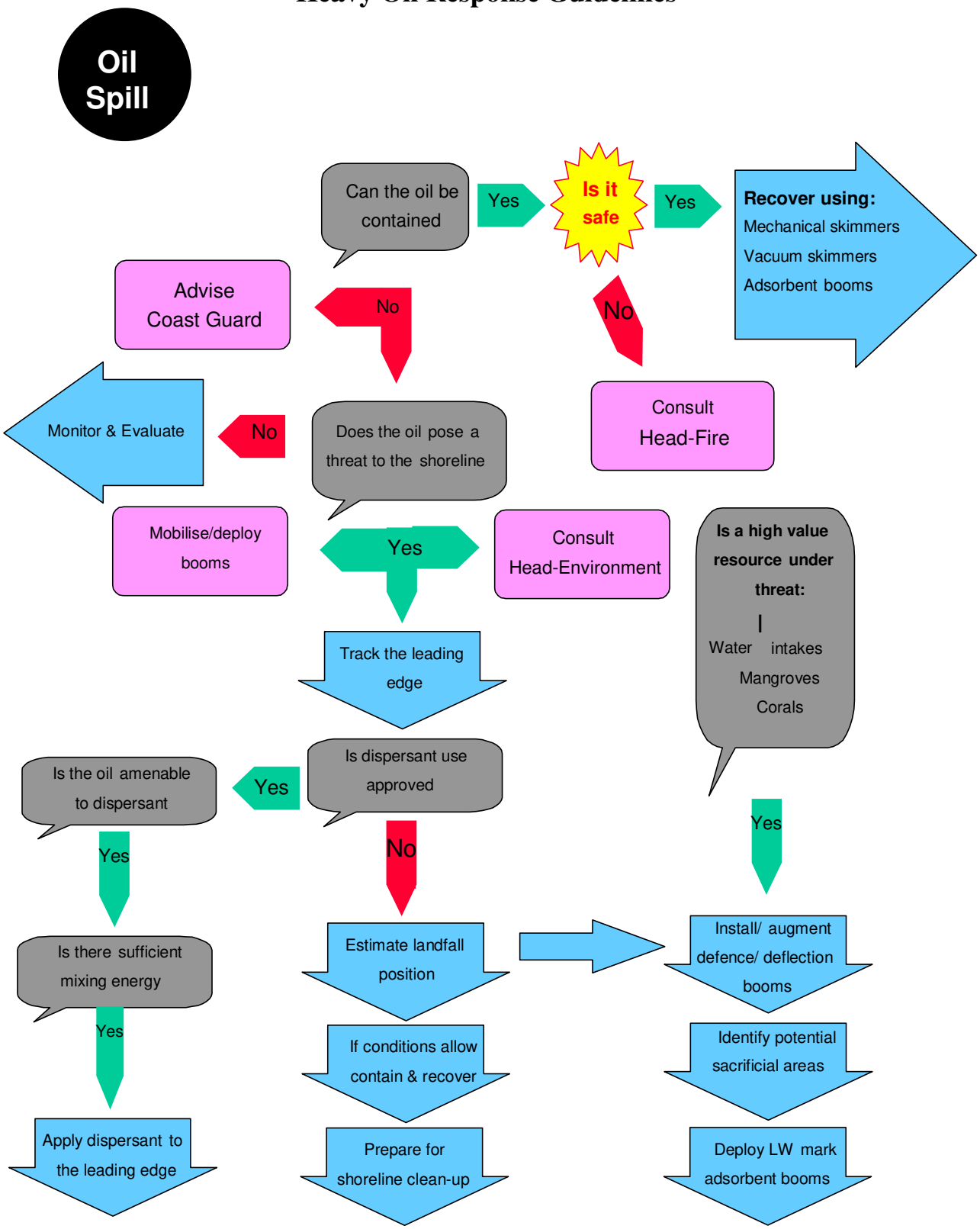
A: °API <17.5 (Specific gravity >0.95) or
B: Pour point >30°C
C: Viscosity @ 10–20°C: between 1500 CSt and semi-solid
D: % boiling below 200°C: less than 25%
E: % boiling above 370°C: greater than 30%

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Bachaquero 17 | 16 | -29 | 5,000 @ 15°C | 10 | 60 |
| Boscan | 10 | 15 | Semi-solid | 4 | 80 |
| Cinta | 33 | 43 | Semi-solid | 10 | 54 |
| Handil | 33 | 35 | Semi-solid | 23 | 33 |
| Merey | 17 | -21 | 7,000 @ 15°C | 7 | 70 |
| Nile Blend | 34 | 33 | Semi-solid | 13 | 59 |
| Pilon | 14 | -3 | Semi-solid | 2 | 92 |
| Shengli | 24 | 21 | Semi-solid | 9 | 70 |
| Taching | 31 | 35 | Semi-solid | 12 | 49 |
| Tia Juana Pesado | 12 | -1 | Semi-solid | 3 | 78 |
| Widuri | 33 | 46 | Semi-solid | 7 | 70 |
| IFO 380 | 11–15 | 10–30 | 5,000–30,000 @ 15°C | | |

## Light Oil Response Guidelines



## Heavy Oil Response Guidelines



| **Site Specific Health and Safety Plan** | | | | | **ANNEXURE 13** |
|---|---|---|---|---|---|
| ***Assessment Form*** | | | | | |
| **1. APPLIES TO SITE :** | | | | | |
| **2. DATE :** | | **3. TIME :** | | **4. INCIDENT :** | |
| **5. PRODUCT(S)** : | | | | (Attach MSDS) | |
| **6. Site Characterization** | | | | | |
| **6a. Area** | ☐ Open water | ☐ Inshore water | ☐ River / Creek | ☐ Salt marsh | ☐ Mudflats |
| | ☐ Shoreline | ☐ Sand | ☐ Shingle | ☐ Intake Channel | |
| 6b. Use | ☐ Commercial | ☐ Industrial | ☐ Public | ☐ Government | ☐ Recreational |
| | ☐ Residential | ☐ Other | | | |

| **7. Site Hazards** | | | |
|---|---|---|---|
| | ☐ Boat safety | ☐ Fire, explosion, in-situ burn | ☐ Slips, trips and falls |
| | ☐ Chemical hazards | ☐ Heat stress | ☐ Steam and hot water |
| | ☐ Drum handling | ☐ Helicopter operations | ☐ Tides |
| | ☐ Equipment operations | ☐ Lifting | ☐ Trenches, excavations |
| | ☐ Electrical hazards | ☐ Motor vehicles | ☐ Visibility |
| | ☐ Fatigue | ☐ Noise | ☐ Weather |
| | ☐ Others | ☐ Overhead/buried utilities | ☐ Work near water |
| | ☐ | ☐ Pumps and hoses | |

| **8. Air Monitoring** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ☐ $O_2$ | | ☐ LEL | | ☐ Benzene | | ☐ $H_2S$ | | ☐ Other | |

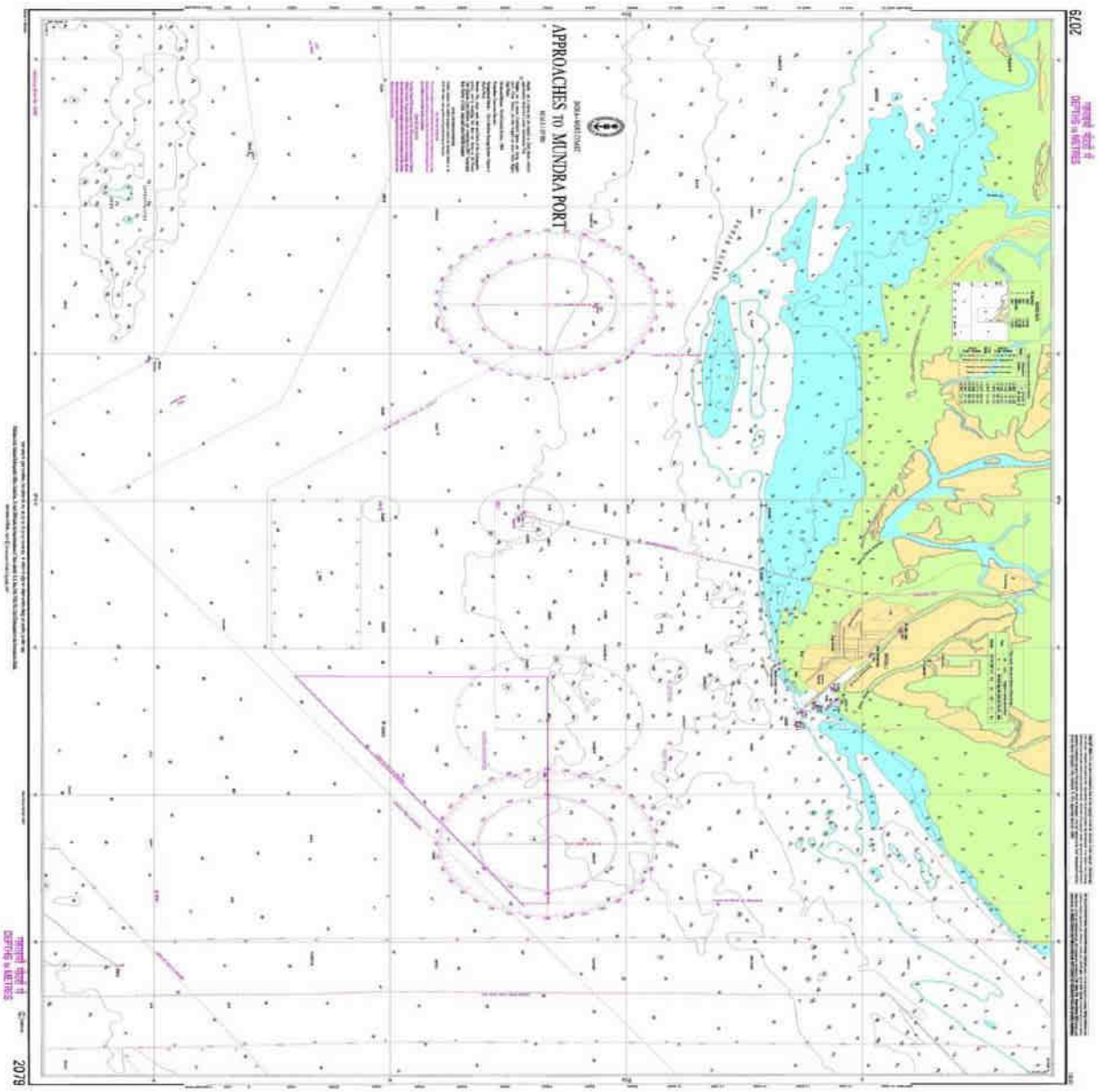
| **9. Personal Protective Equipment** | | | |
|---|---|---|---|
| ☐ Foot Protection | | ☐ Coveralls | |
| ☐ Head Protection | | ☐ Impervious suits | |
| ☐ Eye Protection | | ☐ Personal Floatation | |
| ☐ Ear Protection | | ☐ Respirators | |
| ☐ Hand Protection | | ☐ Other | |

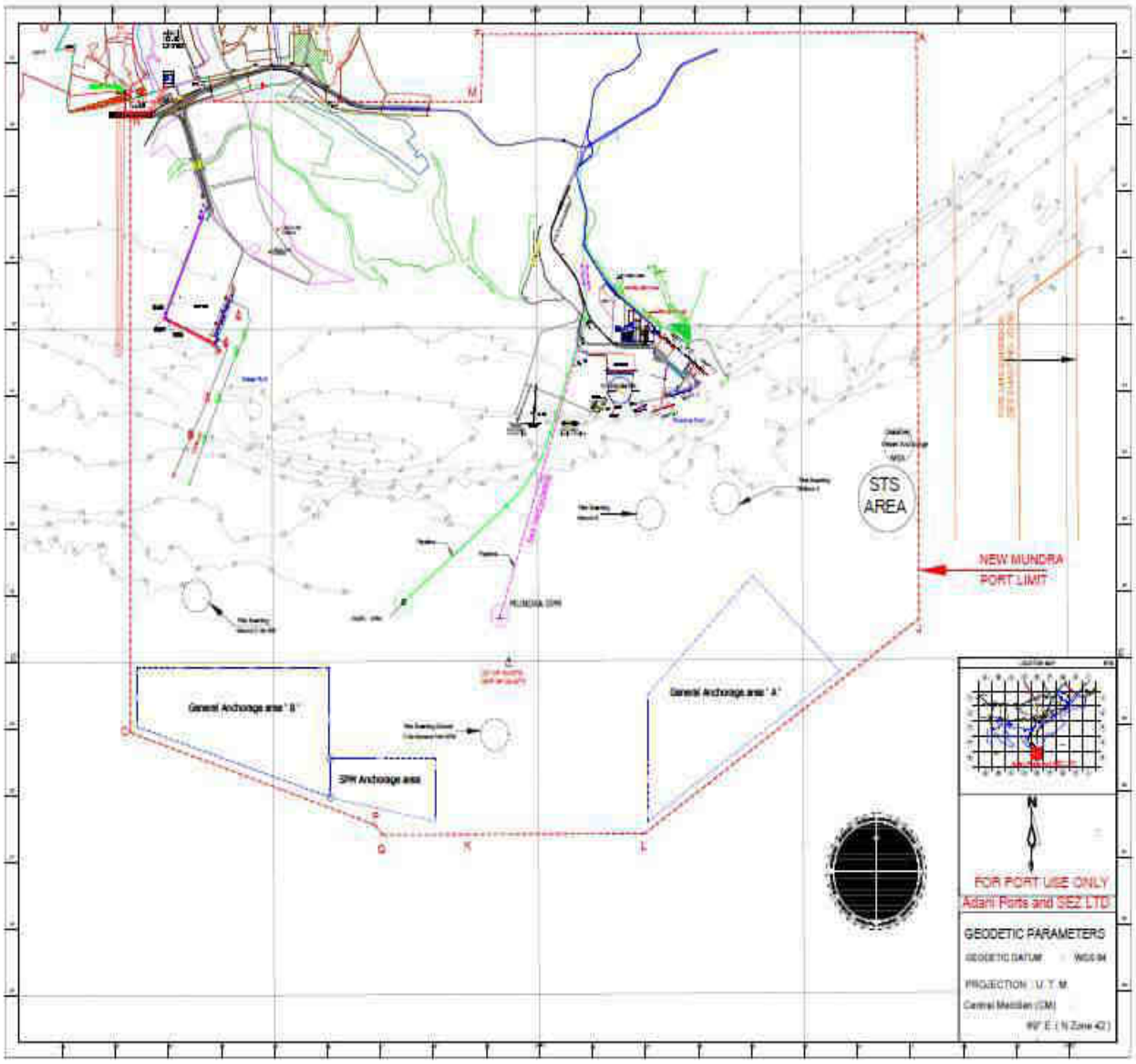
| **10. Site Facilities** | | |
|---|---|---|
| ☐ Sanitation | ☐ First Aid | ☐ Decontamination |

| **11. Contact details :** | | |
|---|---|---|
| ☐ Doctor | Phone | |
| ☐ Hospital | Phone | |
| ☐ Fire | Phone | |
| ☐ Police | Phone | |
| ☐ Other | Phone | |

| | |
|---|---|
| **12. Date Plan Completed** | |
| **13. Plan Completed by** | |

| Indian Chart 2079 | **ANNEXURE 14** |
|---|---|




STS
AREA
NEW MUNDRA
PORT LIMIT
General Anchorage area 'B'
SPM Anchorage area
General Anchorage area 'A'
FOR PORT USE ONLY
Adani Ports and SEZ LTD
GEODETIC PARAMETERS

| List of recycler approved by state of Gujarat | ANNEXURE 15 |
|---|---|

**LIST OF APPROVED VENDOR FOR COLLECTION & DISPOSAL OF OIL SPILL WASTE WATER AND OILY SOIL**

| Sr No. | Name of the party & Contact Detail | Date of Issue of Passbook alongwith validity | Capacity |
|---|---|---|---|
| 1 | M/s Jawrawala Petroleum, Plot No: 200/33, B/H Kashiram Textile Mill, Narol, Ahmedabad – 382405<br>Contact Detail - (079) - 25358099<br>(M) +91 9824045726 | 18/09/2012 to 17/09/2017 | 1. 4800 KLPA - Used Oil<br>2. 9000 KLPA – Waste Oil |
| 2 | M/s Reliance Barrel Supply co., 200/34, B/H-Kashiram Mill, Narol, Ahmedabad-382405<br>Contact Detail - (079) - 25356629<br>(M) +91 9824090021 | 03/09/2014 to 02/09/2019 | 1. 8280 KLA - Used Oil<br>2. 9000 KLA – Waste Oil |
| 3 | M/s Western India Petrochem Industry, Plot No-50, 51, GIDC Estate, Village Gozaria, Dist-Mehsana.<br>Contact Detail - Tel:+91- 278- 420941<br>Fax:+91- 278- 429503 | 25/07/2014 to 24/07/2019 | 1. 3660 KLPA – Used oil<br>2. 11100 KLPA – waste oil |
| 4 | M/s Saurashtra Enviro Projects Pvt. Ltd.(SEPPL)<br>3rd Floor,K.G.Chambers, Udhana Darwaja, Ring Road, Surat, Gujarat, India-395002<br>Contact Detail - +91 261 2351248 | TSDF Site | 3,95,000 MT (Landfilling) +<br>7.50 Million Kcal/Hr. (Incineration) |
| 5 | M/s Bharuch Enviro Infrastructure Ltd, Ankleshwar<br>Contact Detail -<br>Phone 91-2646-253135<br>Fax 91-2646-222849 | TSDF Site | 23,00,000 MT (Landfilling) +<br>120 MT/Day (Incineration) |
| 6 | M/s Nandesari Environment Control Ltd. Nandesari, Vadodara,<br>Contact Detail –<br>Phone 265 – 2840818<br>Fax 265 – 2841017 | TSDF Site | 3,00,000 MT (Landfilling) +<br>700 Kg/Hr. (Incineration) |

| **LIST OF AGENCY FOR SUPPORT & GUIDANCE FOR RESCUE & REHABILITATION OF OILED BIRD & MANGROVES MANAGEMENT DURING OIL SPILL** | **ANNEXURE 16** |
|---|---|

| Sr No. | Name of the party & Contact Detail | Contact Person | Contact Detail | Activity |
|---|---|---|---|---|
| 1 | Gujarat Institute of Desert Ecology P.O Box No. #83, Opp. Changleshwar Temple, Mundra Road Bhuj - 370001 Gujarat – India. | Dr. Thivakaran | EMAIL: desert_ecology@yahoo.com FAX: 02832-235027<br><br>02832-235025 | Restoration of Mangroves |
| 2 | Kalapoornasuri Karunadham Karunadham Hospital, At – Shedata, Bhuj, Kucth | | (M) 9925020776 | Rescue of oil socked birds / animals and medical treatment facility |
| 3 | Anchorwala Ahinshadham Bhagwan Mahavir Pashu Raksha Kendra, Pragpar, Mundra, Kutch. | | Phone (02838) 22352 | Rescue of oil socked birds / animals and medical treatment facility |
| 4 | **ASHA Foundation** C/182, Ashoknagar, Opposite ISRO Satellite, Ahmedabad – 380015, Gujrat, India. | Lalubhai | Phone: 09824037521 ,09879877281 Email: ashahmedabad@yahoo.co.in Website: www.ashafoundationindia.org | Rescue of oil socked birds / animals and medical treatment facility |

**Terms, definitions and abbreviations used in this plan**

| | |
|---|---|
| APSEZL | Adani Ports and Special Economic Zone Ltd. |
| COO | Chief Operating Officer |
| DGM | Deputy General Manager |
| DGS | Directorate General of Shipping |
| ENGR. | Engineer |
| ESD | Emergency Shut Down |
| FIR | First Information Report |
| FO | Furnace Oil |
| GMB | Gujarat Maritime Board |
| GPCB | Gujarat Pollution Control Board |
| HOD | Head Of Department |
| HQ | Head Quarters |
| HSD | High Speed Diesel |
| ICG | Indian Coast Guard |
| IMO | International Maritime Organization |
| IPMS | Integrated Port Management System |
| KPT | Kandla Port Trust |
| LWS | Low Water State |
| MCLS | Maximum Credible loss scenario |
| MMD | Mercantile Maritime Deptt. |
| MOEF | Ministry of Environment & Forest |
| MSDS | Material Safety Data Sheets |
| NOS DCP | National Oil Spill Disaster Contingency Plan |
| OSC | On Scene Commander |
| PLEM | Pipe line end manifold |
| POLREP | Pollution Report |
| PPE | Personal Protective Equipment |
| PR | Public Relations Officer |
| R/O | Radio Officer |
| SKO | Super Kerosene Oil |

## Certificate of Endorsement

(To be certified personally by an officer not below the post of Deputy Conservator of a port facility or the Installation Manager of an oil installation, or offshore installation, or equivalent legally responsible authority)

**I hereby certify that:**

1 The oil spill contingency plan for the facility under my charge has been prepared with due regard to the relevant international best practices, international conventions, and domestic legislation.

2. The nature and size of the possible threat including the worst case scenario, and the resources consequently at risk have been realistically assessed bearing in mind the probable movement of any oil spill and clearly stated.

3. The priorities for protection have been agreed, taking into account the viability of the various protection and clean-up options and clearly spelt out.

4. The strategy for protecting and cleaning the various areas have been agreed and clearly explained.

5. The necessary organization has been outlined, the responsibilities of all those involved have been clearly stated, and all those who have a task to perform are aware of what is expected of them.

6. The levels of equipment, materials and manpower are sufficient to deal with the anticipated size of spill. If not, back-up resources been identified and, where necessary, mechanisms for obtaining their release and entry to the country have been established.

7. Temporary storage sites and final disposal routes for collected oil and debris have been identified.

8. The alerting and initial evaluation procedures are fully explained as well as arrangement for continual review of the progress and effectiveness of the clean-up operation.

9. The arrangements for ensuring effective communication between shore, sea and air have been described.

10. All aspects of plan have been tested and nothing significant found lacking.

11. The plan is compatible with plans for adjacent areas and other activities.

12. The above is true to the best of my knowledge and belief.

13. I undertake to keep the plan updated at all times and keep the Indian Coast Guard informed of any changes through submission of a fresh certificate of endorsement.

Seal: Capt. Anubhav Jain
AGM - Marine & PFSO
Adani Ports & SEZ Ltd.
Mundra - Kutch - Gujarat

Signature:

Name: Capt. Anubhav Jain

Designation: Head - Marine

Organisation: Adani Ports and SEZ Ltd, Mundra

Place: Mundra

Date: 01 Oct 2018

## Contingency Planning Compliance Checklist

| Name of the Port/ Oil Handling Agency | Adani Ports and SEZ Limited, Mundra |
|---|---|

| | DESCRIPTION | Complied Yes/No | Remarks |
|---|---|---|---|
| **Risk Assessment** | | | |
| 1. | Whether the facility produces / handles / uses / imports / stores any type of petroleum product. | Yes | **(Ref. OSCRP 2.2)** |
| 2, | Whether risk assessment is done | Yes | **(Ref. OSCRP 2.0)** |
| 3. | Who did the risk assessment | Yes | Environ Software (P) Ltd. & APSEZ |
| 4. | Whether maximum volume of oil spill that can occur in the worst case scenario is considered. | Yes | **(Ref. OSCRP 2.4)** |
| 5. | Whether relative measures of the probability and consequences of various oil spills including worst case scenario are taken into account. | Yes | **(Ref. OSCRP 2.4)** |
| 6. | Whether all types of spills possible in the facility are considered including grounding, collision, fire, explosion, Rupture of hoses. | Yes | **(Ref. OSCRP 2.3 & 2.4)** |
| 7 | Please specify the list of oils considered for risk assessment | Yes | **(Ref. OSCRP 2.2)** |
| 8 | Whether the vulnerable areas are estimated by considering maximum loss scenario and weather condition | Yes | **(Ref OSCRP 2.1 Computational Scenarios)** |
| 9 | Whether impacts on the vulnerable areas are made after considering the marine protected areas ,population ,fishermen ,saltpans ,mangroves ,corals, and other resources within that area | Yes | **(Ref. OSCRP 2.6)** |
| 10 | Whether measures for reduction of identified high risk are included by reducing the consequences through spill mitigation measures | Yes | **(Ref. OSCRP 1.4, 2.3, 2.6. 3 & 5)** |
| 11 | Whether steps have been considered to reduce risks to the exposed population by increasing safe distances by acquiring property around the facility ,if possible | NA | All facilities developed within SEZ keeping safe distances from the exposed population. |
| 12 | Whether risk levels are established for each month after considering the probability with tide and current and consequences of each such spill | Yes | **(Ref. OSCRP 2.1 computational scenarios & 2.3)** |
| 13 | Whether prevention and mitigation measures are included in the plan | YES | **(Ref. OSCRP 4.0, 7.0, 8.0 & 9.0)** |
| 14 | Whether the spill may affect the shoreline.(length of the shoreline with coordinated) | Yes | **Ref. OSCRP 2.3 & 2.6)** |
| 15 | Whether time taken the oil spill to reach ashore in each quantity of spill in various month are mentioned in the plan | Yes | **(Ref. OSCRP 2.3)** |
| 16 | Whether sensitivity mapping has been carried out | Yes | **(Ref. OSCRP 2.5)** |
| 17 | Does the sensitivity mapping clearly identify the vulnerable areas along with MPAs, corals fishermen community, saltpans, mangroves and other socio-economic elements in the area | Yes | **(Ref. OSCRP 2.5 & 2.6)** |

| | | | |
|---|---|---|---|
| 18 | Do the sensitivity maps indicate area to be protected on priority | Yes | **(Ref. OSCRP 2.6)** |
| 19 | Does the maps indicate boom deployment locations | NA | Booms not deployed permanently |
| 20 | Whether any marine protected area will be affected | YES | **(Ref. OSCRP 2.5 & 2.6)** |
| 21 | Whether total number of fishermen likely to affected is mentioned in the plan | Yes | **(Ref. OSCRP 2.6)** |
| 22 | Whether any saltpan in the area is going to be affected | Yes | **(Ref. OSCRP 2.6)** |
| 23 | Whether any mangroves in the area will be affected by a spill | Yes | **(Ref. OSCRP 2.6)** |
| **Preparedness** | | | |
| 24 | whether any containment equipment is available | Yes | **(Ref. OSCRP Annex 3)** |
| 25 | Whether any recovery equipment is available | Yes | **(Ref. OSCRP Annex 3)** |
| 26 | Whether the facility is having any temporary storage capacity | Yes | **(Ref. OSCRP Annex 3)** |
| 27 | Whether location of the oil spill response equipment is mentioned in the plan | Yes | Has been included in Annex 3 |
| 28 | Whether suitable vessels available for deploying the boom skimmer etc. | Yes | **(Ref. OSCRP Annex 3)** |
| 29 | Whether OSD held with facility | Yes | **(Ref. OSCRP Annex 3)** |
| 30 | Whether the OSD held with the facility is approved for use in Indian waters | Yes | |
| 31 | Whether the facility has MoU with other operator for tier -1 preparedness | Yes | **(Ref. OSCRP 1.4)** |
| 32 | Whether the list of oil spill response equipment available with each agency in deliberation | Yes | MoU document |
| 33 | Whether the facility has any MoU with private OSRO | NA | Port itself is equipped to deal with oil spill emergencies |
| 34 | Whether the procedure for evoking the mutual aid is clearly described in the plan | Yes | **(Ref. OSCRP 1.4)** |
| 35 | Whether additional manpower is available | Yes | **(Ref. OSCRP 5.4)** |
| 36 | Whether list of approved recyclers is mentioned in the plan | Yes | List of recycler approved by state of Gujarat is included in Annexure 15. |
| 37 | Whether NEBA (net environmental Benefit Analysis) has been undertaken | Yes | Before commissioning of any new project, various environmental aspects with their positive or adverse impact is considered under EIA Environment Impact Assessment stage. |
| **38** | **Whether the areas from priority protection have identify in the plan** | YES | **(Ref. OSCRP 2.5 & 2.6)** |
| 39 | Whether relevant authorities and stakeholder were consulted for NEBA and during the areas for property protection | Yes | Before commissioning of any new project Environment Impact Assessment & Public consultation is carried out, in which relevant authorities & stakeholders |

| | | | |
|---|---|---|---|
| | | | were consulted. |
| 40 | Whether district administration has been appraised of the risk impact of oil spills? | Yes | District Level Disaster Management Plan is prepared and regularly updated at district level by District Collector of Kutchh. Under DMP Oil spillage contingency is identified as risk. During preparation & updating of disaster management plan, District Level Authority organises & compiles information from various industries of kutchh. APSEZL is regularly participating in the same & providing necessary information to district level administration. |
| **Action Plan** | | | |
| 41 | Whether the plan outlines procedure for reporting of oil spill to coast guard | Yes | **(Ref. OSCRP 7.3)** |
| 42 | Whether the oil spill response action is clearly mentioned | Yes | **(Ref .OSCRP 3.1 to 3.6)** |
| 43 | Whether the action plan include all duties to be attended in connection with an oil spill | Yes | **(Ref. OSCRP 3.4)** |
| 44 | Whether the action plan includes key personnel by their name and designation viz. C/C, S/C | Yes | **Ref. OSCRP Annexure-4** |
| 45 | Whether alternate coverage is planned to take care of the absence of a particular person [in cases where action plan is developed basic names] | Yes | **(Ref. OSCRP 5)** |
| 46 | Whether the plan includes assignment of all key coordinators viz.the communication controller ,safety coordinator ,Emergency management team, Administration and communication coordinator and safety coordinator | Yes | **(Ref. OSCRP 3.4)** |
| 47 | Whether contact directory containing numbers of key response and management personnel is intimated in the plan | Yes | Ref. OSCRP Annexture-4 |
| 48 | Whether approved recyclers are identified for processing recovered oil and oily debris | Yes | List of approved recycler of Gujarat state is included in annexure 15.<br><br>Membership of common disposal facility for disposal of oily debris is also attached annexure 16. |
| 49 | Whether the shoreline likely to be affected is identified | Yes | **(Ref. OSCRP 2.5 & 2.6)** |
| 50 | Whether final report on the incident is submitted to CGHQ as per NOS-DCP 2014 | NA | **No incident** |
| 51 | Whether the spill incident and its consequences | NA | **No incident** |

| | | | |
|---|---|---|---|
| | are informed to fishermen and other NGOs for environment protection through media | | |
| | **Training and exercises** | | |
| 52 | Whether mock fire /emergency response drills are specified in the plan | Yes | **(Ref. OSCRP 5.6)** |
| 53 | Whether the mock drills cover all types of probable oil spill | Yes | |
| 54 | Whether the plan mentions list of trained manpower | Yes | **(Ref. OSCRP 5.6)** |
| 55 | Whether record for periodic mock drill are maintained in a well-defined format | Yes | |
| 56 | Whether the plan updated according to the finding in mock-drills and exercises | Yes | |
| | DESCRIPTION | | |
| 57 | What is the frequency of updation /review of contingency plan? | Yes | As Per NOSDCP 2015 |
| 58 | Periodicity of joint exercises with mutual aid partner | Yes | |
| 59 | Frequency of mock-drills for practice | Yes | **(Ref. OSCRP 5.6)** |
| 60 | Whether the records for periodic mock drills are maintained in a well-defined format | Yes | **(Ref. OSCRP 5.6)** |
| 61 | Whether the plan is updated according to the finding of mock-drills and exercises | Yes | |
| 62 | Frequency of updation /review of contingency plan | Yes | As Per NOSDCP 2015 |

I, hereby ,declare that the all information appended above and true and correct to my knowledge of belier

Capt. Anubhav Jain
AGM - Marine & PFSO
Adani Ports & SEZ Ltd.
Mundra - Kutch - Guiarat

Date: 01 Oct 2018 Chief conservator /Installation manager

**VERIFIED**

Date: (District commander ICG )
or his representative

Date: (Regional commander ICG)
or his representative

# ANNEXURE – 11

## Expense Details for Fisherfolk Amenitites work in different core areas

| Sr. | Details | 2016-17 | 2017-18 | 2018-19 | Total | Total Amount in Lacs |
|---|---|---|---|---|---|---|
| | Expenditure Details (Amount in Rs.) | | | | | |
| 1 | Vidya Deep Yojana | 2069300 | 1930000 | 2087000 | 6086300 | **60.9** |
| 2 | Vidya Sahay Yojana | 552580 | 495000 | 691000 | 1738580 | **17.4** |
| 3 | Adani Vidya Mandir – Shaping Lives | 4200000 | 4030000 | 3472000 | 11702000 | **117.0** |
| 4 | SENIOR CITIZEN HEALTH CARD | 0 | 8430000 | 1750000 | 10180000 | **101.8** |
| 5 | FINANCIAL SUPPORT TO POOR PATIENTS | 4439507 | 1275000 | 813000 | 6527507 | **65.3** |
| 6 | Machhimar Kaushalya Vardhan Yojana | 188708 | 200000 | 397000 | 785708 | **7.9** |
| 7 | Machhimar Sadhan Sahay Yojana | 0 | 0 | 315000 | 315000 | **3.2** |
| 8 | Machhimar Awas Yojana | 4592106 | 1165000 | 0 | 5757106 | **57.6** |
| 9 | Machhimar Shudhh Jal Yojana | 2236050 | 2700000 | 2038000 | 6974050 | **69.7** |
| 10 | Sughad Yojana | 1367300 | 170000 | 0 | 1537300 | **15.4** |
| 11 | Machhimar Akshay kiran Yojana | 860850 | 100000 | 68000 | 1028850 | **10.3** |
| 12 | Machhimar Ajivika Uparjan Yojana | 1558800 | 500000 | 1382000 | 3440800 | **34.4** |
| 13 | Bandar Svachhata Yojana | 106400 | 50000 | 0 | 156400 | **1.6** |
| 14 | Cricket league and Cycle Marathon | 432000 | 657119 | 638000 | 1727119 | **17.3** |
| 15 | Sports Material For Children & Youth at Vasahats | 197797 | 0 | 0 | 197797 | **2.0** |
| 16 | New Pilot Initiative for Polyculture | 398240 | 160000 | 0 | 558240 | **5.6** |
| 17 | New Pilot Initiative for Cage farming Asian Seabass & Lobster | 8.64 | 660000 | 0 | 660008.64 | **6.6** |
| | **TOTAL** | **17975386** | **20227119** | **12441000** | **59372765.64** | **593.7** |

# ANNEXURE – 12

## Organogram of Environment Management Cell, APSEZ, Mundra