o/c

adani

APSEZL/EnvCell/2015-16/040 Date: 26.05.2016

To
The Director (S),
Ministry of Environment & Forests,
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 of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat by M/s. Adani Ports & SEZ Limited."

Ref. : Environment clearance under CRZ notification granted to /s. Adani Ports & SEZ Limited vide letter dated 20th September, 2000 bearing no. J-16011/40/99-IA.III

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 / CRZ Clearance for the period of October'15 to March'16 is enclosed here for your records. The stated information is also provided in form of a CD (soft copy).

Thanking you,
Yours Faithfully,
For **Adani Ports and Special Economic Zone Limited**

Ennarasu Karunesan
Chief Executive Officer, APSEZL

30/5/16
OFFICE
कार्यालय
पर्यावरण एवं वन मंत्रालय (केन्द्रीय)
Ministry of Environment & Forests (C)
क्षेत्रीय कार्यालय (पश्चिम क्षेत्र)
Regional Office (Western Region)
भोपाल (म.प्र.)–462016

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, Gujarat – 390 023
3. Member Secretary, GPCB – Head Office, Paryavaran Bhavan, Sector 10 A, Gandhi Nagar, Gujarat– 382 010
4. Deputy Secretary, Forests & Environment Department, Block – 14, 8th floor, Sachivalaya, Gandhi Nagar, Gujarat – 382 010
5. Regional Officer, Regional Office, GPCB - Katira Complex-1, Mangalam Char Rasta, Sanskar Nagar, Bhuj (Kutch), Gujarat - 370 001

Adani Ports and Special Economic Zone Ltd
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Mundra, Kutch 370 421
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Environmental Clearance Compliance Report

of

Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities

at

Mundra Port,

Dist. Kutch, Gujarat

of

Adani Ports and SEZ Limited

for

Period:

October-2015 to March-2016

Index

Compliance Report

adani	**Adani Ports and SEZ Limited**	**From : October,15** **To : March,16**
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
A. Specific Condition		
i	All the conditions stipulated by the Gujarat Pollution Control Board vide their NOC No. PC/NOC/Kutch/391/18424 dated 10.6.99 and No. PC/NOC/Kutch/222(2)16880 dated 1.5.99 shall be strictly implemented.	Complied. The project is in operation phase and has been granted Consent to operate (CC&A) vide letter no. AWH 60840 valid till 17th November, 2016 by GPCB.
ii	The conditions stipulated in the letter No ENV-1098-6477-PI dated October 28, 1999 and No. ENV-1099-2702-PI dated 27.12.99 of shall be strictly implemented.	Point wise compliance report of CRZ recommendations issued vide letter No ENV-1098-6477-PI dated October 28, 1999 and No. ENV-1099-2702-PI dated 27.12.99 is enclosed as **Annexure- A**.
iii	The turning circle should be increased from 550 m to 600 m.	Complied. Details submitted on 15.12.2008 & there is no further change.
iv	A girdle canal with settlement tanks shall be provided around the coal storage area.	Trap drains are provided around the coal storage yard.
v	All efforts shall be made for water conservation and rain water harvesting. Arrangements shall be made for roof top rain water harvesting from various structures.	Details of the same is submitted to the Ministry of Environment, Forest & Climate Change along with half yearly compliance dated 02.12.2013.
vi	To obviate the problem of coastal erosion due to dredging, the setback distance of at least 50 m from the Chart Datum line of Bocha island would be maintained.	During Maintenance dredging in this area it is ensured that at least 50 m distance is maintained.
vii	The dredged material shall be disposed of only in the identified locations outside the CRZ area. While dumping the dredged material, sufficient distance should be ensured from the existing mangroves so that there is no damage to the ecology. During dumping of dredged material the mitigative measures as suggested by NIO shall be implemented. It shall be ensured that there is no dumping of dredged material in the CRZ.	The dredged material was utilized in the level rising in line with the EIA study done by NIO.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
viii	The mangrove afforestation shall be undertaken at the identified sites and the progress report in this regard shall be submitted to this Ministry regularly. All the recommendations suggested in the NIO report for restoration of the coastal habitat by mangrove afforestation at Navinal island shall be strictly implemented.	Complied. Details of mangrove plantation along the west of Navinal creek and green belt are submitted to the Ministry of Environment, Forest & Climate Change along with half yearly compliance dated 02.12.2013. Details on mangroves afforestation carried out by APSEZL till date is annexed as **Annexure – 1.**
ix	No ground water shall be withdrawn for this project.	Complied. Entire water requirement is sourced from Narmada water and desalination plant of APSEZL.
x	The project proponent shall ensure that the construction workers do not cut the Mangroves for fuel wood etc.	Complied. Project in operation phase.
xi	The project proponent shall ensure that no creeks are blocked and the natural drainage of the area is not affected due to project activities.	Complied. Construction activity is already completed. Details of culverts provided and creek system is submitted to the Ministry of Environment, Forest & Climate Change along with half yearly compliance dated 02.12.2013.
xii	The project proponent shall ensure that there will be no disposal of sullage and sewage generated from construction camps, surface run-off from construction sites, and oil and grease spillage from the construction equipment's in the creeks.	Complied. Project in operation phase.
xiii	The project proponent shall stick to the time bound program submitted to the Department of Environment, Government of Gujarat for the proposed activities including installation of desalination plant for meeting the entire water requirement. They shall coordinate their construction/operations schedule with the installation schedule of desalination plant.	Complied. Entire water requirement is sourced from Narmada water and desalination plant of APSEZL.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
xiv	The project proponent shall ensure that the commercial fisheries are not hampered due to presence of barges, vessels and other activities in the region. Necessary plan in this regard shall be prepared in consultation with the NIO and submitted within 3 months.	Complied.
xv	The project proponent shall bear the cost of the external agency that may be appointed by the Department of Environment, Government of Gujarat for carrying out the supervision and/or the monitoring of the construction activities.	Point noted.
xvi	The project proponent shall carry out the post-project monitoring of various environmental parameters in consultation with the Department of Environment, Government of Gujarat and Gujarat Pollution Control Board.	Being complied. • Monitoring is being carried out by NABL and MoEF&CC accredited agency. • Monitoring reports for the period from October'15 to March'16 are enclosed as **Annexure-2**.
xvii	The project proponent shall prepare the detailed traffic control management plan for the port and shall participate in the VTMS to be developed for the Gulf of Kachchh.	Complied. • Well defined traffic management procedures are in place. • M/s APSEZL has participated in VTMS program. Details submitted on 02.12.2013.
xviii	Action plan shall be prepared by the project proponents to prevent damage to marine life and also to the coastline in case of any oil spillage and the same shall be strictly implemented. Regular mock drills shall be carried out to ensure fitness of the equipment in place.	Complied. Oil spill contingency plan is in place and implemented. Updated Oil spill contingency plan is attached as **Annexure - 3.** Mock drills are conducted regularly. Detail on typical drill conducted is attached as **Annexure – 4**.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
xix	The project proponents shall work out the maximum quantity of spilled material, which can find its way into the coastal waters, under different accident scenarios, and their impact on aquatic life shall be studied after clearly demarcating the impact zones. On the basis of such studies, the necessary action plan to mitigate the likely impacts shall be prepared before commencement of the operations. Action taken report in this regard shall be submitted to the Ministry.	Complied. Oil spill contingency plan is in place and implemented. The same has been submitted to the Ministry of Environment, Forest & Climate Change along with Half yearly compliance report dated 29.05.2014. Updated Oil spill contingency plan is attached as **Annexure – 3.**
B. General Condition		
i	Construction of the proposed structures should be undertaken meticulously conforming to the existing Central / local rules and regulations. All the construction designs / drawings relating to the proposed construction activities must have approvals of the concerned State Government Departments / Agencies.	Complied. Construction activities are completed in accordance with the prevailing laws.
ii	The proponent shall ensure that as a result of the proposed constructions ingress of the saline water into the ground water does not take place. Piezometers shall be installed for regular monitoring for this purpose at appropriate locations on the project site.	Complied. Detail submitted on 02.12.2013. Regular monitoring are being carried out.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
iii	A comprehensive contingency plan in collaboration with the concerned authorities must be formulated to contain in case of any oil spills. Appropriate devices such as oil skimmer, oil monitor, oil water separator must be acquired for strengthening the contingency plan. All the service vessels that required for oil spill operations must be equipped with booms and dispersants. The personal onboard of these vessels must be properly trained in operation of these booms and dispersants.	Complied. Oil spill contingency plan is in place and implemented. The same has been submitted to the Ministry of Environment, Forest & Climate Change along with Half yearly compliance report dated 29.05.2014. Updated Oil spill contingency plan is attached as **Annexure – 3.**
iv	The operation plan for responding to an oil spill must include clear procedures for notification of a spill, response decision, clean up operations, communications, and termination of cleanup operations, cleanup cost, oil pollution, damage control and disaster management plan.	Complied. Oil spill contingency plan with defined procedure and responsibilities is in place and implemented. The same has been submitted to the Ministry of Environment, Forest & Climate Change along with Half yearly compliance report dated 29.05.2014. Updated Oil spill contingency plan is attached as **Annexure – 3.**

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
v	A well-equipped laboratory with suitable instruments to monitor the quality of air and water shall be set up so as to ensure that the quality of ambient air and water conforms to the prescribed standards. The laboratory will also be equipped with qualified manpower including a marine biologist so that the marine water quality is regularly monitored in order to ensure that the marine life is not adversely affected as a result of implementation of the said project. The quality of ambient air and water shall be monitored periodically in all the seasons and the results should be properly maintained for inspection of the concerned pollution Control agencies. The periodic monitoring reports at least once in 6 months must be sent to this Ministry as well as its Regional Office at Bhopal.	Being complied. • Monitoring is being carried out by NABL and MoEF&CC accredited agency. • Monitoring reports for the period from October,15 to March,16 are enclosed as **Annexure – 2**. • Half yearly compliance reports containing monitoring report is regularly submitted to MoEF&CC, Bhopal. Last compliance report was submitted on 24.11.2015.
vi	Adequate provision for infrastructure facilities such as water supply, fuel for cooking, sanitation etc. must be provided for the laborers during the construction period in order to avoid damage to the environment. Colonies for the laborers should not be located in the CRZ area. It should also be ensured that the construction workers do not cut trees including mangroves for fuel wood purpose.	Complied. Construction activities are completed.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
vii	To prevent discharge of sewage and other liquid wastes in to the water bodies, adequate system for collection and treatment of the wastes must be provided. No sewage and other liquid wastes without treatment should be allowed to enter into the water bodies. The quality of treated effluents, emissions, solid wastes and noise levels must confirm to the standards laid down by the competent authority including the Central/State Pollution Control Board.	Complied. All the liquid effluent and sewage is being treated in the treatment plant. • Monitoring of treated water is being carried out by NABL and MoEF&CC accredited agency. • Monitoring reports for the period from October,15 to March,16 are enclosed as **Annexure – 2**.
viii	Appropriate facility should be created for the collection of solid and liquid wastes generated by the barges/vessels and their safe treatment and disposal should be ensured to avoid possible contamination of the water bodies.	Being complied. • Ships berthing at Mundra Port comply with MARPOL regulations. • Solid waste (i.e. Garbage) received at port is being sorted out & sent for recycling. • No discharge is allowed into marine environment inside port limits and APSEZL does not receive sewage/liquid waste from ship. • Oily sludge (a mixture of oil, water and dirt) is disposed through authorized recycler / re-processor. • Oily slop is being received at port and separated at Oil Water separation facility provided by APSEZL. Separated oil is being sold to authorized recycler, whereas waste water is being treated at effluent treatment plant.
ix	Necessary navigational aids such as channel markers should be provided to prevent accidents. Internationally recognized safety standards shall be applied in case of barge /vessel movements.	Complied. Navigational aids such as buoys and leading lights have been provided.

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Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
x	During operation phase proper precautions should be taken to avoid any oil spills and no oily wastes shall be discharged into the water bodies.	Complied. • Oil spill contingency plan is in place and implemented. The same has been submitted to the Ministry of Environment, Forest & Climate Change along with half yearly compliance report dated 29.05.2014. • Updated Oil spill contingency plan is attached as **Annexure – 3.** • Oily sludge is being disposed through authorized recycler / re-processor
xi	The project authorities should take appropriate community development and welfare measures for the villagers in the vicinity of the project site, including drinking water facilities. A separate fund should be allocated for this purpose.	Complied. The CSR Activities are planned out at group level by Adani Foundation. Details of the CSR activity and expenditure from October,15 to March,16 is enclosed as **Annexure -5**.
xii	The quarrying material required for the construction purpose shall be obtained only from the approved quarries / borrow areas. Adequate safeguard measures shall be taken to ensure that the overburden and rocks at the quarry site does not find their way into water bodies.	Complied. Construction activities are completed.
xiii	The dredging operations, if any, to be undertaken with the prior approval of this Ministry, shall be executed with appropriate safeguard measures to prevent turbidity conditions in consultation with the expert agencies such as CWPRS / NIO.	Capital dredging is completed and project is in operation phase.
xiv	For employing unskilled, semi-skilled and skilled workers for the project, preference shall be given to local people.	Preference is given to local people for employment based on their qualification and experience.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
xv	To meet any emergency situation, appropriate firefighting system and water pipelines should be installed. Appropriate arrangements for uninterrupted power supply to the environment protection equipment and continuous water supply for the firefighting system should be made.	Complied. Details of the firefighting facility has been submitted along with the half yearly compliance report dated 02.12.2013.
xvi	Regular drills should be conducted to check the effectiveness of the on-site Disaster Management Plan.	Being Complied. Regular drills are being conducted for effectiveness of the system. Typical drill conducted is attached as **Annexure - 6**.
xvii	The recommendations made in the Environmental Plan and Disaster Management Plan, as contained in the EIA and Risk Analysis Reports of the project, shall be effectively implemented.	All the recommendations are being implemented.
xviii	A separate Environment Management Cell with suitably qualified staff to carry out various environment related functions should be set up under the charge of a Senior Executive who will report directly to the Chief Executive of the company.	Complied. M/s APSEZL 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. Executive who directly reports to the top management.
xix	The project affected people, if any, should be properly compensated and rehabilitated.	Not applicable.
xx	The funds earmarked for environment protection measures should be maintained in a separate account and there should be no diversion of these funds for any other purpose. A year wise expenditure on environmental safeguards should be reported to this Ministry.	Complied. Separate budget for the Environment Protection measures is earmarked every year. All environmental and horticulture activities are considered at group level and budget allocation is also done accordingly. Detail break up of budget spent during FY 2015-16 for Environment Protection measure attached as **Annexure - 7**

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000

Sr. No.	Conditions	Compliance Status as on 31-03-2016
xxi	Full support should 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.	Complied. M/s APSEZL is always extending full support to the regulatory authorities.
xxii	In case of deviation or alteration in the project including the implementing agency, afresh reference should be made to this Ministry for modification in the clearance conditions or imposition of new ones for ensuring environmental protection. The project proponents should be responsible for implementing the suggested safeguard measures.	Point Noted.
xxiii	This 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.
xxiv	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.	Point Noted.
xxv	A copy of the clearance letter will be marked to concerned Panchayat / local NGO. If any, from whom any suggestion / representation has been received while processing the proposal.	Complied.
xxvi	State Pollution Control Board should display a copy of the clearance letter at the Regional Office, District Industries centre and Collector's Office/Tehsildar's Office for 30 days	This condition does not belong to project proponent.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated in Environment Clearance under CRZ notification		

Half yearly Compliance report of Environment Clearance under CRZ notification for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide letter no. J-16011/40/99-IA.III dated 20th September, 2000		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
xxvii	The project proponent should advertise at least in two local newspapers widely circulated in the region around the project, 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 Website of the Ministry of Environment and Forests at http://www.envfor.nic.in/.	Complied.
xxviii	The Project Proponents should inform the Regional Office as well as the Ministry the date of financial closure and final approval of the project by the concerned authorities and the date of start of Land Development Work.	Complied.
xxix	The Project Proponent should make specific arrangements for rainwater harvesting in the project design and the rainwater so harvested should be optimally utilized.	Details of the same is submitted to the Ministry of Environment, Forest & Climate Change along with half yearly compliance dated 02.06.2015.

Annexure – A

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated under CRZ Recommendation		

Half yearly Compliance report of CRZ recommendation for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide DoEF, GOG letter no. ENV-1098-6477-p1 dated 28th October 1999		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
A. Specific Condition		
1	The company shall submit comprehensive Environmental Impact Assessment Report and Risk Assessment Report containing worst case scenario and detailed oil spill control management plan before carrying out the construction activities and shall implement all the mitigative measures/suggestions/recommendations given in the report of NIO and Tata AIG Risk Management Services.	Complied. Details submitted on 29.05.2014.
2	The company in no case tap ground water.	Complied. Entire water requirement is sourced from Narmada water and desalination plant of APSEZL.
3	The company shall not cut mangroves for the project activities except for stray mangrove seeding required for the railway line only after detailed assessment through NIO and 25 acre of land shall be planted with mangroves in consultation with NIO.	Complied. Details submitted on 02.12.2013. Details on mangroves afforestation carried out by APSEZL till date is annexed as **Annexure – 1.**
4	The company shall carry out the mangroves plantation programme in addition to 25-acre mangrove plantation to be done with the help of the NIO, in consultation with the forest department.	
5	The company shall ensure that the construction labors do not cut mangroves for fuel, etc.	Complied. Construction activity is already completed. Details submitted on 02.12.2013.
6	The company shall ensure that no creek are blocked due to the project activities,	Complied. Construction activity is already completed. Details submitted on 02.12.2013.
7	The company shall ensure that there will be no disposal of sullage and sewage generated from construction camps, surface run-off from construction sites, and oil and grease spillage from construction equipment in the creeks.	Complied. Construction activity is already completed.

adani	Adani Ports and SEZ Limited	From : October,15 To : March,16
Status of the conditions stipulated under CRZ Recommendation		

Half yearly Compliance report of CRZ recommendation for "Port expansion project including dry/break bulk cargo container terminal, railway link and related ancillary and back-up facilities at Mundra Port, Dist. Kutch in Gujarat vide DoEF, GOG letter no. ENV-1098-6477-p1 dated 28th October 1999		
Sr. No.	**Conditions**	**Compliance Status as on 31-03-2016**
8	The company shall stick to the time bound programme submitted to this department for the proposed activities including installation of desalination plant for meeting the entire water requirement.	Complied. Entire water requirement is sourced from Narmada water and desalination plant of APSEZL.
9	The company shall ensure that the commercial fisheries are not hampered due to the presence of barges, vessels and other activities in the region. Necessary plan in this regards shall be prepared in consultation with the NIO.	Complied. There are no commercial scale fishing present in Mundra. However, fishing boats are having unhindered access to Gulf of Kutch.
10	The company shall bear the cost of the external agency that may appointed by this department for carrying out the supervision and/or the monitoring of the construction activities.	Complied. Point noted. Construction activity is already completed.
11	The company shall carry out the post project monitoring of various environmental parameters in consultation with this department and Gujarat Pollution Control Board.	Being complied. Monitoring is being carried out by NABL and MoEF&CC accredited agency. Monitoring reports for the period from OCtober'15 to March'16 are enclosed as **Annexure-2**.
12	The company shall prepare the detailed traffic control management plan for the port and shall participate in the VTMS to be developed for the Gulf of Kachchh.	Complied. Details on the same were submitted on 2.12.2013.
13	In order the eliminate adverse impact on the mangroves of Bocha Island and coastal ecology of the region, the company shall carry out construction activities only after the construction design and methodology is approved by NIO.	Point noted. Construction activity is already completed.
14	Any other conditions may be stipulated by this department from time to time.	Point noted.

Annexure – 1

Mangrove Afforestation

S. NO.	Location	FY	Area (Hectare)	Clearance Reference	Plantation/Gap Filling	Species
A.1	Mundra Port Area (Mundra, Kutch)		24.00	Environment Clearace - Mundra (J-16011/13/95-IA.III dated 25 August 1995)	Plantation	Avicennia marina
Total Plantation			**24.00**			
B.1	Mundra Port Area (Mundra, Kutch)		25.00	Environment Clearace - Mundra (J-16011/30/2003-IA.III dated 21 July 2004)	Plantation	Avicennia marina
Total Plantation			**25.00**			
C.1	Luni/Hamiramora (Mundra, Kutch)	2007-08	40.00	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	Avicennia marina Rhizophora mucronata Ceriops tagal
C.2		2009-10	10.00		Gap Filling Work	
C.3		2010-11	10.00		Gap Filling Work	
C.4		2011-12	95.40		Plantation	
C.5		2012-13	25.40		Plantation	
C.6		2013-14-15	70.00		Gap Filling Work	
Total Plantation (C.1+C.4+C.5)			**160.80**			
D.1	Kukadsar (Mundra, Kutch)	2012-13	66.50	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	Avicennia marina
D.2		2013-14	10.00		Gap Filling Work	Avicennia marina
Total Plantation (D.1)			**66.50**			
E.1	Forest Area (Mundra)	2011-12	50.00	Forest Clearance - Mundra (F.No. 8-2/1999-FC (pt) dated 27 February 2009)	Plantation	Avicennia marina
E.2		2012-13	248.00		Plantation	Avicennia marina
Total Plantation (E.1+E.2)			**298.00**			

S. NO.	Location	FY	Area (Hectare)	Clearance Reference	Plantation/Gap Filling	Species
F.1	Jangi village (Bhachau, Kutch)	2012-13	50.00	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	Avicennia marina
F.2		2013-14	20.00		Gap Filling Work	Avicennia marina
Total Plantation (F.1)			**50.00**			
G.1	Jakhau Village (Abdasa, Kutch)	2007-08	40.10	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	Avicennia marina Rhizophora mucronata Ceriops tagal
G.2		2008-09	10.00		Gap Filling Work	
G.3		2009-10	10.00		Gap Filling Work	
G.4		2011-12	50.00	Environment Clearance - Dahej (11-37/2007-IA-III dtd 11 November, 2008)	Plantation	
G.5		2013-14	20.00		Gap Filling Work	
G.6		2012-13	30.00		Gap Filling Work	
G.7		2012-13	20.50	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	
G.8		2012-13	200.00	Environment Clearance - Mundra (10-47/2008-IA.III dtd. 12th Jan,2009)	Plantation	
G.9		2013-14-15	50.00		Gap Filling Work	
Total Plantation (G.1 + G.4 + G.7 + G.8)			**310.60**			
H.1	Sat Saida Bet (Kutch)	2014-15	250.00	Commitment with KPT for 250 Ha. - Tuna (By undertaking dated 3 June, 2013)	Plantation	Avicennia marina
Total Plantation			**250.00**			

S. NO.	Location	FY	Area (Hectare)	Clearance Reference	Plantation/Gap Filling	Species
I.1	Village Dandi (Navsari)	2006-07	200.00	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	Avicennia marina Rhizophora mucronata Ceriops tagal
I.2		2007-08	100.00		Plantation	
I.3		2007-08	100.00	Environment Clearance - Dahej (11-37/2007-IA-III dtd 11 November, 2008)	Plantation	
I.4		2008-09	200.00	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	
I.5		2010-11	200.00		Plantation	
Total Plantation (I.1 + I.2 + I.3 + I.4 + I.5)			**800.00**			
J.1	Village Talaza (Bhavnagar)	2011-12	50.00	Environment Clearance - Dahej (11-37/2007-IA-III dtd 11 November, 2008)	Plantation	Avicennia marina
J.2	Village Narmada (Bhavnagar)	2014-2015	250.00	CRZ Recommendation - Mundra (Env-10-2005-222-P dated 12 October, 2006)	Plantation	Avicennia marina
Total Plantation (J.1 + J.2)			**300.00**			
K.1	Village Malpur (Bharuch)	2012-13-14	200.00	CRZ Recommendation - Dahej ENV-10-2006-71-P dtd 29th May, 2007	Plantation	Avicennia marina
K.2	Village Kantiyajal (Bharuch)	2014-15	50.00	CRZ Recommendation - Hazira ENV-10-2012-30-E dtd 11th May,2012	Plantation	Avicennia marina
K.3	Village Devla Bharuch	2014-15	50.00		Plantation	Avicennia marina
K.4	Village Devla Bharuch	2015-16	100.00		Plantation	Avicennia marina
Total Plantation (K.1 + K.2 + K.3 + K.4)			**400.00**			
L.1	Village Tada Talav (Khambat, Anand)	2015-16	100.00	Environment and CRZ clearance - Mundra SEZ (10-138/2008/IA.III dated 15 July 2014)	Plantation	Avicennia marina
L.2	Village Tada Talav (Khambat, Anand)	2015-16	100.00		Plantation	Avicennia marina
Total Plantation (L.1 + L.2)			**200.00**			
G. Total (Plantation+ Gapfilling)			**2884.90**			

Annexure – 2

"HALF YEARLY ENVIRONMENTAL MONITORING REPORT"

FOR

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

MONITORING PERIOD:
OCTOBER 2015 TO MARCH 2016

PREPARED BY:

POLLUCON LABORATORIES PVT.LTD.
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T 0820 - 821 **ISO 9001:2008** **ISO 14001:2004** **OHSAS 18001:2007**

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

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 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	8.08	8.19	8.14	8.18	7.96	8.04	8.02	8.08	8.13	8.17	8.07	8.0	IS3025(P11)83 Re.02
2	Temperature	°C	29	30	28	29	28	29	29	30	28	29	29	30	IS3025(P9)84Re.02
3	Total Suspended Solids	mg/L	24	18	16	22	18	20	18	24	18	20	14	20	IS3025(P17)84 Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03 Edition2.1
5	Dissolved Oxygen	mg/L	5.6	5.0	5.0	4.6	5.6	5.2	5.2	4.4	5.2	4.8	5.4	4.4	IS3025(P38)89 Re.99
6	Salinity	ppt	40.54	41.17	39.80	41.08	41.40	41.80	39.72	41.13	39.78	40.08	40.28	40.98	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)5 520D
8	Nitrate as NO_3	mg/L	0.67	0.73	0.63	0.72	0.50	0.73	0.64	0.7	0.64	0.70	0.32	0.51	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.06	0.071	0.058	0.069	0.022	0.035	0.052	0.067	0.057	0.072	0.026	0.041	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.72	0.88	0.80	0.99	0.98	1.13	0.76	0.97	0.81	0.98	1.21	1.35	IS3025(P34)88 Cla.2.3
11	Phosphates as PO_4	mg/L	0.63	0.78	0.75	0.83	0.04	0.1	0.02	0.04	0.73	0.81	0.81	0.96	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	1.45	1.69	1.47	1.77	1.6	1.91	1.463	1.73	1.51	1.75	1.56	1.91	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	49870	50560	47580	48670	46980	47860	47480	48720	46850	47770	47580	48220	IS3025(P16)84 Re.02
15	COD	mg/L	29	38	9	19	19	24	10	20	9	14	19	33	APHA(22nd Edi) 5520-D Open Reflux

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16	Oxidisable Particular Organic Carbon	%	0.68	0.48	0.44	0.38	0.53	0.47	0.46	0.4	0.45	0.39	0.56	0.50	SOP – PLPL - 07
A	**Flora and Fauna**														
17	Primary productivity	mgC/L /day	2.02	0.90	1.91	0.42	2.70	1.46	2.91	1.84	2.02	0.22	2.13	0.33	APHA (22nd Edi) 10200-J
B	**Phytoplankton**														
18.1	Chlorophyll	mg/m^3	1.81	0.42	2.18	0.53	2.67	0.90	2.30	0.70	2.69	0.45	2.70	0.45	APHA (22^{nd}Edi) 10200-H
18.2	Phaeophytin	mg/m^3	0.072	1.348	0.203	1.727	BDL*	1.030	0.091	1.868	0.948	2.121	0.95	2.125	APHA (22^{nd}Edi) 10200-H
18.3	Cell Count	Unit x 10^3/L	186	45	232	54	252	110	208	66	225	79	264	68	APHA (22^{nd} Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22^{nd} Edi) 10200-H
			Asterionella sp.	Fragillaria sp.	Biddulphia sp.	Fragillaria sp.	Coscinodiscus sp.	Coscinodiscus sp.	Pinnularia sp.	Cocconeis sp	Navicula sp.	Synedra sp.	Asterionella sp.	Fragillaria sp.	
			Navicula sp.	Asterionella sp.	Fragillaria sp.	Synedra sp.	Gomphonema sp.	Nitzschia sp.	Gyrosigma sp	Navicula sp.	Coscinodiscus sp.	Nitzschia sp.	Biddulphia sp.	Coscinodiscus sp.	
			Nitzschia sp.	Coscinodiscus sp.	Gomphonema sp.	Nitzschia sp.	Gyrosigma sp.	Gomphonema sp.	Biddulphia sp.	Fragillaria sp.	Thallasionema sp.	Coscinodiscus sp.	Navicula sp.	Rhizosolenia sp.	
			Coscinodiscus sp.	Cyanophyceae	Rhizosolenia sp.	Gomphonema sp.	Pleurosigma sp.	Skeletonema sp.	Pinnularia sp.	Cyanophyceae	Gomphonema sp.	Fragillaria sp.	Synedra sp.	Biddulphia sp.	
			Rhizosolenia sp.	Oscillatoria sp.	Cymbella sp.	Cyanophyceae	Navicula sp.	Thallasionema sp.	Cyanophyceae	Oscillatoria sp.	Pinnularia sp.	Tabellaria sp.	Nitzschia sp.	Navicula sp.	
			Pinnularia sp.	Spirulina sp.	Thallasiosira sp.	Spirulina sp.	Synedra sp.	Cyanophyceae	Spirulina sp.	Spirulina sp.	Tabellaria sp.	Cyanophyceae	Gomphonema sp.	Synedra sp.	
			Amphipora sp.	Green Algae	Cyanophyceae	Oscillatoria sp.	Pinnularia sp.	Microcystis sp.	Green Algae	--	Synedra sp.	Oscillatoria sp.	Pleurosigma sp.	Cyanophyceae	
			Cyanophyceae	Chlorella sp.	Anabaena sp.	Green Algae	Cyanophyceae	Oscillatoria sp.	Spirogyra sp.	--	Asterionella sp.	Green Algae	Rhizosolenia sp.	Oscillatoria sp.	
			Oscillatoria sp.	Spirogyra sp.	Oscillatoria sp.	Chlorella sp.	Oscillatoria sp.	Green Algae	--	--	Cyanophyceae	Chlorella sp.	Fragillaria sp.	Green Algae	
			Anabaena sp.	--	Nostoc sp.	Hydrodictyon sp.	Nostoc sp.	Chlorella sp.	--	--	Spirulina sp.	Pediastrum sp.	Skeletonema sp.	Chlorella sp.	
			Green Algae	--	Green Algae	--	Anabaena sp.	Pandorina sp.	--	--	Oscillatoria sp.	--	Cyanophyceae	Hydrodictyon sp.	
			Hydrodictyon sp.	--	Chlorella sp.	--	Green Algae	Pediastrum sp.	--	--	Green Algae	--	Oscillatoria sp.	Pediastrum sp.	

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			Chlorella sp.	--	Hydrodictyon sp.	--	Ankistrodesmus sp.	--	--	--	Hydrodictyon sp.	--	Green Algae	--	
			Volvox sp.	--	Pediastrum sp.	--	Chlorella sp.	--	--	--	Chlorella sp.	--	Chlorella sp.	--	
			--	--	--	--	Pandorina sp.	--	--	--	--	--	Pediastrum sp.	--	
					--	--	Ulothrix sp.	--			--	--	Scenedesmus sp.	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/m^2	275	100	240	80	425	150	170	40	275	100	167	33	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Copepods	Copepods	Polychaetes Worms	Copepods	Echinoderms	Isopods	Polychaetes Worms	mysids	Nematodes	Polychaate worms	Polychaate worms	APHA (22nd Edi) 10200-G
			Crustaceans	Platinelminths	Decapods	Crustaceans	Decapods	Rotifers	Gastropods	Crustaceans	Polychaete worms	Gastropods	Echinoderms	--	
			Cyclops	Crustaceans	Ostracods	Gastropods	Gastropods	Barnades	Decapods	Platinelminths	Gastropods	--	Decapods	--	
			Decapods	--	Crustaceans	--	Polychaete worms	--	Nauplius larvae	Rotifers	Nauplius larvae	--	Isopods	--	
			Gastropods	--	Krill	--	Cyclops	--	--	--	Decapods	--	Mysids	--	
			Rotifers	--	Barnades	--							--	--	
			--	--	--	--			--	--					
19.3	Total Biomass	ml/100 m^3	91	18	87.8	8.4	76.3	12.1	55	7	97	17	96.87	2.14	APHA (22nd Edi) 10200-G
D	**Microbiological Parameters**														
20.1	Total Bacterial Count	CFU/ml	1840	1580	1480	1020	1780	1520	1390	1120	1490	1030	1690	1510	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-5)

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

SR. NO.	TEST PARAMETERS	UNIT	October 2015	November 2015	December 2015	January 2016	February 2016	March 2016	Test Method
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1	Organic Matter	%	0.62	0.50	0.48	0.57	0.52	0.51	FCO:2007
2	Phosphorus as P	mg/kg	144	127	140	131	119	137	APHA(22nd Edi) 4500 C
3	Texture	--	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	--
4	Petroleum Hydrocarbon	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
5	**Heavy Metals**								
5.1	Aluminum as Al	%	5.59	4.85	5.05	4.90	4.85	5.23	AAS APHA 3111 B
5.2	Total Chromium as Cr^{+3}	mg/kg	188	200	189	193	209	177	AAS 3111B
5.3	Manganese as Mn	mg/kg	860	689	709	702	687	919	AAS APHA 3111 B
5.4	Iron as Fe	%	2.12	4.07	3.95	4.68	4.07	2.79	AAS APHA(22nd Edi)3111 B
5.5	Nickel as Ni	mg/kg	50	51.96	52.09	52.06	51.87	57.97	AAS APHA(22nd Edi)3111 B
5.6	Copper as Cu	mg/kg	32	37.96	39.13	39.73	37.45	36.01	AAS APHA(22nd Edi)3111 B
5.7	Zinc as Zn	mg/kg	139	143	137	140	144	155	AAS APHA(22nd Edi)3111 B
5.8	Lead as Pb	mg/kg	1.18	1.54	1.63	1.50	1.60	1.68	AAS APHA(22nd Edi)3111 B
5.9	Mercury as Hg	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA- 3112 B
6	**Benthic Organisms**								
6.1	Macrobenthos	--	Polychaete worms Isopods Decapods Mysids	Polychaete worms Mysids Decapods	Polychaete worms Echinoderms Mysids Isopods	Polychaete worms Echinoderms Decapods Mysids	Polychaete worms Mysids Isopods	Prawns Mysids Decapods Echinoderms	APHA (22nd Edi) 10500-C
6.2	MeioBenthos	--	Copepods Ostracodes	Foraminiferans Nematodes Ciliates	Nematodes Hydrozoans	Nematodes Ciliates	Nematodes	Nematodes Ciliates	APHA (22nd Edi) 10500-C
2	Population	no/m^2	440	357	440	396	314	385	APHA (22nd Edi) 10500-C

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
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 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	8.20	8.32	7.81	7.74	7.99	8.03	7.77	7.59	7.89	8.08	7.98	8.05	IS3025(P11)83 Re.02
2	Temperature	°C	29	30	28	29	28	29	29	30	29	30	29	30	IS3025(P9)84R e.02
3	Total Suspended Solids	mg/L	20	28	20	30	22	40	22	34	18	24	18	20	IS3025(P17)84 Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.0 3Edition2.1
5	Dissolved Oxygen	mg/L	5.6	4.8	5.2	4.8	5.4	5	5	4.6	5.6	4.6	5.4	4.8	IS3025(P38)89 Re.99
6	Salinity	ppt	40.81	41.62	41.5	42.8	42.6	43.5	42.36	43.12	39.5	40.72	41.82	42.26	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)5 520D
8	Nitrate as NO_3	mg/L	0.535	0.76	0.46	0.67	0.67	0.89	0.49	0.704	0.61	0.671	0.525	0.633	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.064	0.043	0.027	0.056	0.069	0.049	0.029	0.059	0.047	0.034	0.029	0.059	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.342	0.480	0.47	0.530	0.42	0.53	0.503	0.61	0.379	0.444	0.465	0.535	IS3025(P34)88 Cla.2.3
11	Phosphates as PO_4	mg/L	0.166	0.152	0.306	0.23	0.041	0.048	0.316	0.268	0.245	0.154	0.312	0.26	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	0.941	1.283	0.95	1.256	1.15	1.46	1.022	1.368	1.036	1.149	1.019	1.227	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	1.0	BDL*	1.2	BDL*	1.0	BDL*	0.8	BDL*	0.8	BDL*	0.17	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	49220	49630	36700	38100	43920	46750	37460	38380	46860	47280	48360	49250	IS3025(P16)84 Re.02
15	COD	mg/L	14	16	19	22	14	19	17	20	9	14	14	19	APHA(22nd Edi) 5520-D Open Reflux
16	Oxidisable Particular Organic	%	0.83	0.34	0.38	0.52	0.8	0.3	0.4	0.5	0.55	0.43	0.6	0.5	SOP – PLPL - 07

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	Carbon														
A	**Flora and Fauna**														
17	Primary productivity	mgC/L /day	1.80	0.76	2.25	0.45	3.15	0.90	2.76	0.245	2.70	0.67	1.688	0.585	APHA (22nd Edi) 10200-J
B	**Phytoplankton**														
18.1	Chlorophyll	mg/m^3	1.789	0.481	1.922	0.641	2.210	0.720	1.644	0.246	2.964	0.828	2.964	0.134	APHA (22^{nd}Edi) 10200-H
18.2	Phaeophytin	mg/m^3	0.547	1.314	0.134	1.300	0.045	1.350	0.096	1.282	BDL*	1.303	BDL*	1.493	APHA (22^{nd}Edi) 10200-H
18.3	Cell Count	Unit x $10^3/L$	163	40	152	38	190	44	174	52	236	68	214	45	APHA (22^{nd} Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22^{nd} Edi) 10200-H
			Navicula sp.	Tabellaria sp.	Asterionella sp.	Thallasiosira sp.	Asterionella sp.	Fragillaria sp.	Rhizosolenia sp.	Nitzschia sp.	Navicula sp.	Synedra sp.	Achnanthes sp.	Amphora sp.	
			Nitzschia sp.	Amphora sp.	Cheatoceros sp.	Pinnularia sp.	Cymbella sp.	Coscinodiscus sp.	Coscinodiscus sp.	Biddulphia sp.	Coscinodiscus sp.	Fragillaria sp.	Amphora sp.	Biddulphia sp.	
			Gyrosigma sp.	Melosira sp.	Cymbella sp.	Synedra sp.	Pleurosigma sp.	Cocconeis sp.	Gomphonema sp.	Navicula sp.	Pinnularia sp.	Thallasionema sp.	Biddulphia sp.	Cyclotella sp.	
			Cocconeis sp.	Diploneis sp.	Pinnularia sp.	Tabellaria sp.	Skeletonema sp.	Cymbella sp.	Cymbella sp.	Pleurosigma sp.	Fragillaria sp.	Coscinodiscus sp.	Cocconeis sp.	Nitzschia sp.	
			Surirella sp.	Cyanophyceae	Thallasiosira sp.	Cyanophyceae	Thallasionema sp.	Navicula sp.	Synedra sp.	Cyanophyceae	Tabellaria sp.	Green Algae	Melosira sp.	Pinnularia sp.	
			Pinnularia sp.	Anabaena sp.	Skeletonema sp.	Microcystis sp.	Tabellaria sp.	Cyanophyceae	Tabellaria sp.	Bacillariophyceae	Pleurosigma sp.	Pandorina sp.	Synedra sp.	Skeletonema sp.	
			Cheatoceros sp.	Microcystis sp.	Cyanophyceae	Oscillatoria sp.	Fragillaria sp.	Anabaena sp.	Cyanophyceae	Anabaena sp.	Achnanthes sp.	--	Nitzschia sp.	Green Algae	
			Mastagloica sp.	Green Algae	Microcystis sp.	Green Algae	Cyanophyceae	Oscillatoria sp.	Oscillatoria sp.	Microcystis sp.	Skeletonema sp.	--	Coscinodiscus sp.	Ankistrodesmus sp.	
			Cyanophyceae	Volvox sp.	Oscillatoria sp.	Ulothrix sp.	Microcystis sp.	Nostoc sp.	Microcystis sp.	Green Algae	Synedra sp.	--	Green Algae	Chlorella sp.	
			Microcystis sp.	Spirogyra sp.	Spirulina sp.	Chlorella sp.	Oscillatoria sp.	Green Algae	Green Algae	Spirogyra sp.	Cyanophyceae	--	Chlorella sp.	Pandorina sp.	
			Oscillatoria sp.	--	Green Algae	--	Green Algae	Chlorella sp.	Pandorina sp.	Scenedesmus sp.	Oscillatoria sp.	--	Ulothrix sp.	Cyanophyceae	
			Green Algae	--	Chlorella sp.	--	Ankistrodesmus sp.	Pandorina sp.	Ulothrix sp.	--	Microcystis sp.	--	Volvox sp.	Anabaena sp.	
			Ulothrix sp.	--	Hydrodictyon sp.	--	Chlorella sp.	Scenedesmus sp.	Volvox sp.	--	Green Algae	--	Cyanophyceae	Oscillatoria sp.	

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Dr. ArunBajpai
Lab Manager (Q)

			Oedogonium sp.	--	Pediastrum sp.	--	Pediastrum sp.	--	--	--	Volvox sp.	--	Microcystis sp.	--	
			Spirogyra sp.	--	--	--	Volvox sp.	--	--	--	Pandorina sp.	--	Nostoc sp.	--	
					--	--					Pediastrum sp.	--	Spirulina sp.	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/m^2	225	75	233	50	320	120	214	66	252	25	250	33	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Crustaceans	Copepods	Copepods	Copepods	Ostracods	Copepods	Crustaceans	Nematodes	Gastropods	Echinoderms	Copepods	APHA (22nd Edi) 10200-G
			Polychaetes	Siphonophores	Decapods	Polychaetes Worms	Krill	Crustaceans	Polychaetes	Siphonophores	Decapods	--	Rotifers	Nematodes	
			Ostracods	--	Polychaetes Worms	Decapods	Molluscans	--	Ostracods	--	Echinoderms	--	Decapods	--	
			Rotifers	--	Ostracods	--	Snails	--	Rotifers	--	Foraminiferans	--	Ostracods	--	
			Gastropods	--	Crustaceans	--	Rotifers	--	Gastropods	--	--	--	Crustaceans	--	
			Decapods	--	--	--			Decapods	--			Gastropods	--	
19.3	Total Biomass	ml/100 m^3	89	11	92.5	8.4	79.6	11	64	08	88	34	112	28.5	APHA (22nd Edi) 10200-G
D	**Microbiological Parameters**														
20.1	Total Bacterial Count	CFU/ml	1790	1410	1660	1140	1580	1370	1720	1350	1800	1470	2010	1780	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	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 [M2 MOUTH OF BOCHA & NAVINAL CREEK – N 22°44'239" E 069°43'757"]

SR. NO.	TEST PARAMETERS	UNIT	October 2015	November 2015	December 2015	January 2016	February 2016	March 2016	Test Method
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1	Organic Matter	%	0.682	0.46	0.67	0.503	0.476	0.545	FCO:2007
2	Phosphorus as P	mg/kg	169	156	157	150	155	161	APHA(22nd Edi) 4500 C
3	Texture	--	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	--
4	Petroleum Hydrocarbon	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
5	**Heavy Metals**								
5.1	Aluminum as Al	%	5.39	5.40	5.21	5.0	5.19	5.43	AAS APHA 3111 B
5.2	Total Chromium as Cr^{+3}	mg/kg	137	162	145	157	163	111	AAS 3111B
5.3	Manganese as Mn	mg/kg	705	599	807	545	597	758	AAS APHA 3111 B
5.4	Iron as Fe	%	2.21	1.98	2.07	2.21	1.98	2.19	AAS APHA(22nd Edi)3111 B
5.5	Nickel as Ni	mg/kg	38.77	24.4	36.64	28.15	24.28	53.97	AAS APHA(22nd Edi)3111 B
5.6	Copper as Cu	mg/kg	109	50.54	80.91	52.59	50.81	41.78	AAS APHA(22nd Edi)3111 B
5.7	Zinc as Zn	mg/kg	138	142	119	139	143	154	AAS APHA(22nd Edi)3111 B
5.8	Lead as Pb	mg/kg	1.32	1.38	1.11	1.33	1.38	2.28	AAS APHA(22nd Edi)3111 B
5.9	Mercury as Hg	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA- 3112 B
6	Benthic Organisms								
6.1	Macrobenthos	--	Polychaete worms Amphipods Decapods Krill	Echinoderms Polychaete worms Isopods	Echinoderms Isopods Decapods	Isopods Decapods Echinoderms	Mysids Echinoderms Isopods	Polychaete Worms Crabs Isopods Decapods	APHA (22nd Edi) 10500-C
6.2	MeioBenthos	--	Nematodes Foraminiferans Hydrozoa	Foraminiferans Copepods Nematodes Bryozoans	Foraminiferans Copepods Ciliates	Foraminiferans Hydrozoa	Foraminiferans Bryozoans	Nematodes Bryozoans	APHA (22nd Edi) 10500-C
2	Population	no/m^2	503	433	397	518	440	433	APHA (22nd Edi) 10500-C

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

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

SR. NO.	TEST PARAMETERS	UNIT	November 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	7.77	8.18	7.83	8.2	7.8	8.22	8.0	7.88	IS3025(P11)83Re.02
2	Temperature	°C	28	29	29	30	28	29	29	30	IS3025(P9)84Re.02
3	Total Suspended Solids	mg/L	20	24	22	26	20	23	24	28	IS3025(P17)84Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03Edition2.1
5	Dissolved Oxygen	mg/L	5.2	4.8	5.6	4.6	5.18	4.8	5.4	4.8	IS3025(P38)89Re.99
6	Salinity	ppt	41.1	42.7	41.6	42.5	41.0	42.6	42.84	43.06	APHA (22ndEdi) 2550 B
7	Oil & Grease	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	APHA(22ndEdi)5520D
8	Nitrate as NO_3	mg/L	0.32	0.43	0.37	0.45	0.305	0.442	0.355	0.432	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.016	0.025	0.013	0.023	0.015	0.025	0.02	0.025	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.6	0.69	0.58	0.67	0.592	0.69	0.819	0.93	IS3025(P34)88Cla.2.3
11	Phosphates as PO_4	mg/L	0.58	0.73	BDL*	BDL*	0.577	0.731	0.558	0.78	APHA(22ndEdi) 4500 C
12	Total Nitrogen	mg/L	0.92	1.14	0.913	1.143	0.912	1.151	1.194	1.388	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	50890	51360	51500	51110	50280	51480	51066	51580	IS3025(P16)84Re.02
15	COD	mg/L	14	28	16	30	9	28	24	28	APHA(22ndEdi) 5520-D Open Reflux
16	Oxidisable Particular Organic Carbon	%	0.3	0.2	0.27	0.19	0.3	0.2	0.32	0.22	SOP – PLPL - 07
A	**Flora and Fauna**										
17	Primary productivity	mgC/L/day	2.13	0.67	1.96	0.55	1.8	0.11	2.63	0.45	APHA (22nd Edi) 10200-J
B	**Phytoplankton**										
18.1	Chlorophyll	mg/m^3	2.296	0.507	1.560	0.118	3.02	0.401	2.77	0.401	APHA (22ndEdi) 10200-H

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18.2	Phaeophytin	mg/m^3	BDL*	1.549	0.524	2.48	BDL*	1.794	BDL*	2.141	APHA (22ndEdi) 10200-H
18.3	Cell Count	Unit x 10^3/L	241	58	182	22	284	63	199	35	APHA (22nd Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22nd Edi) 10200-H
			Biddulphia sp.	Cyclotella sp.	Coscinodiscus sp.	Fragillaria sp.	Navicula sp.	Fragillaria sp.	Nitzschia sp.	Nitzschia sp.	
			Cheatocerous sp.	Nitzschia sp.	Synedra sp.	Pinnularia sp.	Nitzschia sp.	Navicula sp.	Navicula sp.	Navicula sp.	
			Cyclotella sp.	Skeletonema sp.	Nitzchia sp.	Naviculla sp.	Synedra sp.	Coscinodiscus sp.	Coscinodiscus sp.	Fragillaria sp.	
			Fragillaria sp.	Melosira sp.	Thallasiosira sp.	Gyrosigma sp.	Coscinodiscus sp.	Gyrosigma sp.	Pinnularia sp.	Gyrosigma sp.	
			Rhizosolenia sp.	Gyrosigma sp.	Rhizosolenia sp.	Cyanophyceae	Skeletonema sp.	Synedra sp.	Thallasiosira sp.	Pinnularia sp.	
			Thallasiosira sp.	Cyanophyceae	Tabellaria sp.	Spirulina sp.	Asterionella sp.	Cyanophyceae	Cyclotella sp.	Synedra sp.	
			Tabellaria sp.	Oscillatoria sp.	Cyanophyceae	Oscillatoria sp.	Gomphonema sp.	Nostoc sp.	Gomphonema sp.	Green Algae	
			Cyanophyceae	Green Algae	Pediastrum sp.	Green Algae	Pinnularia sp.	Green Algae	Fragillaria sp.	pediastrum sp.	
			Microcystis sp.	Pandorina sp.	Hydrodictyon sp.	Chlorella sp.	Cyanophyceae	Pandorina sp.	Green Algae	Chlorella sp.	
			Nostoc sp.	Scenedesmus sp.	Green Algae	Desmids	Oscillatoria sp.	Volvox sp.	Ankistrodesmus sp.	Cyanophyceae	
			Spirulina sp.	--	Spirogyra sp.	--	Microcystis sp.	--	Chlorella sp.	Oscillatoria sp.	
			Green Algae	--	Chlorella sp.	--	Green Algae	--	Pandorina sp.	--	
			Chlorella sp.	--	Nostoc sp.	--	Ankistrodesmus sp.	--	Cyanophyceae	--	
			Hydrodictyon sp.	--	--	--	Hydrodictyon sp.	--	Oscillatoria sp.	--	
			Pediastrum sp.	--	--	--	--	--	Lyngbya sp.	--	
			--	--	--	--	--	--	--	--	
C	**Zooplanktons**										

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19.1	Abundance (Population)	no/m^2	233	67	216	28	217	68	125	25	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Copepods	Ctenophores	Nematodes	Polychaete worms	mysids	Decapods	Nematodes	APHA (22nd Edi) 10200-G
			Decapods	polychaete worms	Rotifers	polychaete worms	Decapods	Nematodes	Mysids	Echinoderms	
			Ostracods	--	Mysids	Copepods	Nematodes	Decapods	Bivalves	--	
			Chaetognathes	--	Bivalves	--	Echinoderms	--	Rotifers	--	
			Ctenophores	--	--	--	--	--	--	--	
			Krill	--	--	--	--	--	--	--	
			Cyclops	--	--	--	--	--	--		
19.3	Total Biomass	ml/100 m^3	96.5	8.9	84	7.6	86	21	42.54	3.04	APHA (22nd Edi) 10200-G
D											
20.1	Total Bacterial Count	CFU/ml	1640	1120	1590	1220	1630	1100	1720	1560	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-5)

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
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	November 2015	January 2016	February 2016	March 2016	Test Method
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1	Organic Matter	%	0.60	0.57	0.586	0.542	FCO:2007
2	Phosphorus as P	mg/kg	146	140	141	152	APHA(22nd Edi) 4500 C
3	Texture	--	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	--
4	Petroleum Hydrocarbon	mg/kg	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
5	**Heavy Metals**						
5.1	Aluminum as Al	%	5.20	5.40	5.39	5.45	AAS APHA 3111 B
5.2	Total Chromium as Cr^{+3}	mg/kg	160	168	165	141	AAS 3111B
5.3	Manganese as Mn	mg/kg	810	850	819	905	AAS APHA 3111 B
5.4	Iron as Fe	%	2.22	2.3	2.23	2.13	AAS APHA(22nd Edi)3111 B
5.5	Nickel as Ni	mg/kg	54	58	54.58	50.55	AAS APHA(22nd Edi)3111 B
5.6	Copper as Cu	mg/kg	34.0	32.0	34.2	35.8	AAS APHA(22nd Edi)3111 B
5.7	Zinc as Zn	mg/kg	136	130	133	135	AAS APHA(22nd Edi)3111 B
5.8	Lead as Pb	mg/kg	1.32	1.29	1.33	17.98	AAS APHA(22nd Edi)3111 B
5.9	Mercury as Hg	mg/kg	BDL*	BDL*	BDL*	BDL*	AAS APHA- 3112 B
6	Benthic Organisms						
6.1	Macrobenthos	--	Echinoderms Polychaete worms Isopods Decapods	Polychaete worms Bivalves Echinoderms Decapods	Polychaete worms Mysids	Crabs Amphipods Echinoderms	APHA (22nd Edi) 10500-C
6.2	MeioBenthos	--	Ostracods	Ctenophores	Nematodes Ostracods Foraminiferans	Ostracods Foraminiferans	APHA (22nd Edi) 10500-C
2	Population	no/m^2	377	368	317	337	APHA (22nd Edi) 10500-C

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POLLUCON LABORATORIES PVT. LTD. SURAT-3

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Lab Manager (Q)

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

SR. NO.	TEST PARAMETERS	UNIT	October 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	7.98	8.13	7.98	8.14	8.01	8.12	7.69	8.17	7.99	8.17	7.92	8.03	IS3025(P11)83Re.02
2	Temperature	°C	29	30	29	30	29	30	28	29	29	30	29	30	IS3025(P9)84Re.02
3	Total Suspended Solids	mg/L	24	30	19	22	16	20	20	24	20	22	26	28	IS3025(P17)84Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03 Edition2.1
5	Dissolved Oxygen	mg/L	5.8	4.8	5.2	4.4	5.4	4.8	5	4.6	5.2	4.4	5.66	5.24	IS3025(P38)89Re.99
6	Salinity	ppt	39.82	40.54	42.8	43.4	42.2	43.6	42.2	43	42.6	43.2	42.66	43.18	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	mg/L	0.36	0.39	0.46	0.55	0.33	0.2	0.49	0.6	0.47	0.56	0.32	0.18	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.051	0.065	0.054	0.07	0.059	0.077	0.052	0.067	0.054	0.07	0.056	0.084	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.702	0.776	0.74	0.82	0.91	1.15	0.72	0.8	0.74	0.879	0.95	1.117	IS3025(P34)88Cla.2.3
11	Phosphates as PO_4	mg/L	0.248	0.352	0.18	0.17	0.02	0.11	0.068	0.089	0.168	0.159	0.086	0.095	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	1.12	1.238	1.254	1.44	1.3	1.42	1.262	1.467	1.266	1.513	1.33	1.385	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	46890	48030	53670	54820	52990	54280	52910	54310	52990	53640	52670	53880	IS3025(P16)84Re.02
15	COD	mg/L	24	28	14	18	14	19	16	20	14	19	19	24	APHA(22nd Edi) 5520-D Open Reflux
16	Oxidisable Particular Organic Carbon	%	0.82	0.46	0.82	0.38	0.8	0.43	0.8	0.36	0.8	0.36	0.63	0.47	SOP – PLPL - 07
A	**Flora and Fauna**														
17	Primary productivity	mgC/L /day	1.688	0.788	2.36	0.563	3.03	1.46	2.852	0.844	2.13	0.563	2.138	0.428	APHA (22nd Edi) 10200-J
B	**Phytoplankton**														

H. T. Shah
Lab Manager

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Lab Manager (Q)

18.1	Chlorophyll	mg/m^3	1.789	0.587	1.816	0.721	2.48	0.69	1.692	0.505	3.204	0.721	3.2	0.721	APHA (22nd Edi) 10200-H
18.2	Phaeophytin	mg/m^3	0.23	1.207	0.24	1.03	BDL*	1.36	0.34	1.190	ND	1.615	BDL*	1.61	APHA (22nd Edi) 10200-H
18.3	Cell Count	Unit x 10^3/L	189	41	214	68	326	82	192	48	296	76	201	44	APHA (22nd Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22nd Edi) 10200-H
			Pleurosigma sp.	Navicula sp.	Asterionella sp.	Coscinodiscus sp.	Amphora sp.	Cymbella sp.	Pleurosigma sp.	Navicula sp.	Navicula sp.	Synedra sp.	Nitzschia sp.	Synedra sp.	
			Coscinodiscus sp.	Nitzschia sp.	Biddulphia sp.	Pleurosigma sp.	Asterionella sp.	Fragillaria sp.	Coscinodiscus sp.	Nitzschia sp.	Synedra sp.	Melosira sp.	Synedra sp.	Navicula sp.	
			Nitzschia sp.	Fragillaria sp.	Gomphonema sp.	Nitzschia sp.	Coscinodiscus sp.	Melosira sp.	Nitzschia sp.	Fragillaria sp.	Coscinodiscus sp.	Fragillaria sp.	Coscinodiscus sp.	Biddulphia sp.	
			Thallasionema sp.	Pinnularia sp.	Rhizosolenia sp.	Fragillaria sp.	Fragillaria sp.	Nitzschia sp.	Thallasionema sp.	Pinnularia sp.	Thallasiosira sp.	Navicula sp.	Navicula sp.	Gomphonema sp.	
			Pinnularia sp.	Cyanophyceae	Pinnularia sp.	Navicula sp.	Gomphonema sp.	Cyanophyceae	Pinnularia sp.	Cyanophyceae	Asterionella sp.	Coscinodiscus sp.	Thallasiosira sp.	Skeletonema sp.	
			Cyanophyceae	Anabaena sp.	Skeletonema sp.	Cyanophyceae	Skeletonema sp.	Oscillatoria sp.	Cyanophyceae	Anabaena sp.	Fragillaria sp.	Cyanophyceae	Surirella sp.	Pleurosigma sp.	
			Oscillatoria sp.	Oscillatoria sp.	Nitzschia sp.	Anabaena sp.	Cyclotella sp.	Microcystis sp.	Oscillatoria sp.	Oscillatoria sp.	Gomphonema sp.	Nostoc sp.	Cymbella sp.	Rhizosolenia sp.	
			Spirulina sp.	Green Algae	Navicula sp.	Oscillatoria sp.	Cyanophyceae	Nostoc sp.	Spirulina sp.	Green Algae	Melosira sp.	Green Algae	Biddulphia sp.	Green Algae	
			Green Algae	Ankistrodesmus sp.	Cocconeis sp.	Spirulina sp.	Microcystis sp.	Green Algae	Green Algae	Ankistrodesmus sp.	Skeletonema sp.	Chlorella sp.	Green Algae	Chlorella sp.	
			Chlorella sp.	Pandorina sp.	Cyanophyceae	Green Algae	Oscillatoria sp.	Chlorella sp.	Chlorella sp.	Pandorina sp.	Cyanophyceae	--	Ankistrodesmus sp.	Scenedesmus sp.	
			Volvox sp.	--	Oscillatoria sp.	Oedogoniu m sp.	Green Algae	Hydrodictyon sp.	Volvox sp.	--	Microcystis sp.	--	Hydrodictyon sp.	Ulothrix sp.	
			Ankistrodesmus sp.	--	Anabaena sp.	Pediastrum sp.	Ankistrodesmus sp.	Scenedesmus sp.	Ankistrodesmus sp.	--	Oscillatoria sp.	--	Pandorina sp.	--	
			Ulothrix sp.	--	Green Algae	--	Chlorella sp.	Volvox sp.	Ulothrix sp.	--	Green Algae	--	Cyanophyceae	--	
			--	--	Ankistrodesmus sp.	--	Pandorina sp.	--	--	--	Volvox sp.	--	Microcystis sp.	--	
			--	--	Oedogoniu	--	Scenedes	--	--	--	Pediastrum	--	Oscillatoria	--	

H. T. Shah
Lab Manager

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Lab Manager (Q)

					m sp.		mus sp.				sp.		sp.		
					Pediastrum sp.	--					--	--	Spirulina sp.	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/m^2	350	75	275	50	300	160	310	68	267	50	333	100	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Copepods	Ctenophores	Copepods	Copepods	Crustaceans	Cyclops	Decapods	Gastropods	Polychaete worms	Chaetognathes	Copepods	APHA (22nd Edi) 10200-G
			Krill	Decapods	Ostracods	Decapods	Polychaete worms	Gastropods	Copepods	Polychaete worms	Nematodes	Nematodes	Gastropods	Mysids	
			Decapods	--	Gastropods	--	Crustaceans	Nematodes	Nematodes	Ostracods	Echinoderms		Crustaceans	Crustaceans	
			Chaetognathes	--	Decapods	--	Nematodes	--	--	--	mysids		Copepods	Nematodes	
			Cyclops	--	Polychaete worms	--	Mysids	--	--	--			Nematodes	--	
			Rotifers	--	--	--	Rotifers	--	--				--	--	
			Ctenophores	--	--	--									
19.3	Total Biomass	ml/100 m^3	97	8.2	97.4	7.8	62.4	7.4	110	10.8	44	11	102	42.5	APHA (22nd Edi) 10200-G
D	**Microbiological Parameters**														
20.1	Total Bacterial Count	CFU/ml	2130	1870	1560	1220	1700	1580	1610	1280	1530	1210	1740	1620	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	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 [M4 JUNA BANDAR N 22°47'577" E 069°43'620"]

SR. NO.	TEST PARAMETERS	UNIT	October 2015	November 2015	December 2015	January 2016	February 2016	March 2016	Test Method
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1	Organic Matter	%	0.46	0.51	0.42	0.63	0.52	0.42	FCO:2007
2	Phosphorus as P	mg/kg	178	192	175	150	194	166	APHA(22nd Edi) 4500 C
3	Texture	--	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	--
4	Petroleum Hydrocarbon	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
5	**Heavy Metals**								
5.1	Aluminum as Al	%	5.19	5.08	5.41	5.62	5.09	5.28	AAS APHA 3111 B
5.2	Total Chromium as Cr^{+3}	mg/kg	165	146	119	129	147	144	AAS 3111B
5.3	Manganese as Mn	mg/kg	885	798	856	809	795	910	AAS APHA 3111 B
5.4	Iron as Fe	%	2.4	2.82	1.75	2.66	2.87	2.54	AAS APHA(22nd Edi)3111 B
5.5	Nickel as Ni	mg/kg	49.97	52	57.99	44.19	53.98	54	AAS APHA(22nd Edi)3111 B
5.6	Copper as Cu	mg/kg	43.97	48	43.98	40.22	48.97	60	AAS APHA(22nd Edi)3111 B
5.7	Zinc as Zn	mg/kg	166	190	160	189	190	170	AAS APHA(22nd Edi)3111 B
5.8	Lead as Pb	mg/kg	1.96	1.88	1.87	0.91	1.88	2.0	AAS APHA(22nd Edi)3111 B
5.9	Mercury as Hg	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA- 3112 B
6	Benthic Organisms								
6.1	Macrobenthos	--	Echinoderms Decapods Isopods	Polychaete worms Echinoderms Isopods	Echinoderms Mysids Isopods	Echinoderms Polychaete worms Mysids	Decapods Echinoderms Isopods	Polychaete Worms Crabs Anthozoans	APHA (22nd Edi) 10500-C
6.2	MeioBenthos	--	Nematodes Foraminiferans	Nematodes Foraminiferans	Nematodes Foraminiferans Hydrozoa	Nematodes Foraminiferans Ciliates	Hydrozoa Nematodes	Copepods Ciliates	APHA (22nd Edi) 10500-C
2	Population	no/m^2	314	314	433	481	385	440	APHA (22nd Edi) 10500-C

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Lab Manager

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Dr. ArunBajpai
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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 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	8.02	8.11	7.87	7.7	8.02	8.17	7.45	7.32	7.72	7.88	8.03	7.89	IS3025(P11)83Re.02
2	Temperature	°C	29	30	29	30	28	29	28	29	29	30	29	30	IS3025(P9)84Re.02
3	Total Suspended Solids	mg/L	24	32	18	24	12	16	20	26	19	25	18	22	IS3025(P17)84Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03 Edition2.1
5	Dissolved Oxygen	mg/L	5.8	4.6	5.6	4.6	5.2	4.8	5.4	4.4	5.6	4.4	5.8	5.2	IS3025(P38)89Re.99
6	Salinity	ppt	38.2	39.37	39.55	40.8	40.6	41.2	40.12	41.06	39.5	40.72	38.18	38.26	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	mg/L	0.627	0.704	0.616	0.677	0.64	0.69	0.582	0.628	0.625	0.686	0.587	0.633	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.047	0.039	0.047	0.035	0.047	0.031	0.044	0.03	0.461	0.034	0.032	0.022	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.277	0.397	0.378	0.443	0.3	0.4	0.396	0.465	0.386	0.444	0.447	0.558	IS3025(P34)88Cl a.2.3
11	Phosphates as PO_4	mg/L	0.158	0.171	0.247	0.157	0.026	0.096	0.158	0.048	0.259	0.154	0.304	0.136	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	0.951	1.14	1.041	1.155	1	1.12	1.022	1.123	1.474	1.164	1.066	1.213	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	2	BDL*	0.8	BDL*	0.6	BDL*	0.6	BDL*	BDL*	BDL*	3.8	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	47860	48320	36800	37300	44260	45590	37330	37530	46860	48220	47560	48110	IS3025(P16)84Re.02
15	COD	mg/L	14	19	9	14	9	19	10	16	9	14	10	19	APHA(22nd Edi) 5520-D Open Reflux
16	Oxidisable Particular Organic Carbon	%	0.58	0.46	0.56	0.42	0.58	0.46	0.6	0.4	0.53	0.43	0.64	0.5	SOP – PLPL - 07
A	**Flora and Fauna**														
17	Primary productivity	mgC/L /day	1.463	0.788	1.688	0.563	1.57	0.45	1.913	0.338	2.13	0.563	2.11	0.36	APHA (22nd Edi) 10200-J
B	**Phytoplankton**														

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18.1	Chlorophyll	mg/m^3	1.922	0.721	1.816	0.614	2.08	0.9	2.27	0.98	2.77	0.163	2.77	0.163	APHA (22nd Edi) 10200-H
18.2	Phaeophytin	mg/m^3	0.134	0.737	0.614	1.274	0.179	0.98	BDL*	0.84	BDL*	BDL*	BDL*	BDL*	APHA (22nd Edi) 10200-H
18.3	Cell Count	Unit x 10^3/L	196	52	145	32	222	58	159	62	195	35	245	38	APHA (22nd Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22nd Edi) 10200-H
			Gomphonema sp.	Asterionella sp.	Amphiprora sp.	Coscinodiscus sp.	Navicula sp.	Navicula sp.	Navicula sp.	Coscinodiscus sp.	Navicula sp.	Nitzschia sp.	Navicula sp.	Fragillaria sp.	
			Pleurosigma sp.	Cyclotella sp.	Biddulphia sp.	Nitzschia sp.	Synedra sp.	Fragillaria sp.	Nitzschia sp.	Nitzschia sp.	Nitzschia sp.	Navicula sp.	Synedra sp.	Asterionella sp.	
			Nitzschia sp.	Cymbella sp.	Pleurosigma sp.	Pleurosigma sp.	Nitzschia sp.	Gomphonema sp.	Fragillaria sp.	Fragillaria sp.	Synedra sp.	Fragillaria sp.	Asterionella sp.	Coscinodiscus sp.	
			Synedra sp.	Gyrosigma sp.	Skeletonema sp.	Navicula sp.	Coscinodiscus sp.	Pleurosigma sp.	Coscinodiscus sp.	Thallasionema sp.	Coscinodiscus sp.	Rhizosolenia sp.	Coscinodiscus sp.	Melosira sp.	
			Rhizosolenia sp.	Pinnularia sp.	Pinnularia sp.	Gomphonema sp.	Thallasionema sp.	Coscinodiscus sp.	Thallasionema sp.	Navicula sp.	Biddulphia sp.	Pleurosigma sp.	Fragillaria sp.	Pinnularia sp.	
			Surirella sp.	Cocconeis sp.	Cocconeis sp.	Cyanophyceae	Pleurosigma sp.	Cyanophyceae	Skeletonema sp.	Green Algae	Rhizosolenia sp.	Cyanophyceae	Pinnularia sp.	Skeletonema sp.	
			Tabellaria sp.	Green Algae	Cyclotella sp.	Oscillatoria sp.	Cyclotella sp.	Oscillatoria sp.	Green Algae	Ankistrodesmus sp.	Thallasiosira sp.	Oscillatoria sp.	Skeletonema sp.	Cyanophyceae	
			Biddulphia sp.	Oedogoniu m sp.	Cyanophyceae	Green Algae	Skeletonema sp.	Lyngbya sp.	Chlorella sp.	Chlorella sp.	Cheatocerous sp.	Microcystis sp.	Tabellaria sp.	Anabaena sp.	
			Cyanophyceae	Hydrodictyon sp.	Anabaena sp.	Pandorina sp.	Cyanophyceae	Green Algae	Pandorina sp.	Cyanophyceae	spirulines sp.	Green Algae	Cocconeis sp.	Spirulina sp.	
			Microcystis sp.	Scenedesmus sp.	Oscillatoria sp.	--	Anabaena sp.	Chlorella sp.	Cyanophyceae	Oscillatoria sp.	Cyanophyceae	Pandorina sp.	Gomphonema sp.	Oscillatoria sp.	
			Oscillatoria sp.	--	Spirulina sp.	--	Nostoc sp.	Pediastrum sp.	Microcystis sp.	--	Melosira sp.	--	Cyanophyceae	Green Algae	
			Green Algae	--	Green Algae	--	Oscillatoria sp.	Pandorina sp.	Oscillatoria sp.	--	Oscillatoria sp.	--	Microcystis sp.	Chlorella sp.	
			Chlorella sp.	--	Ankistrodesmus sp.	--	Green Algae	--	Nostoc sp.	--	Green Algae	--	Oscillatoria sp.	Pandorina sp.	
			Ulothrix sp.	--	Chlorella sp.	--	Ankistrodesmus sp.	--			Chlorella sp.	--	Spirulina sp.	Pediastrum sp.	
			Scenedesm	--	Pediastru	--	Pandorina	--			Scenedes	--	Green	--	

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			us sp.		m sp.		sp.				mus sp.		Algae		
				--	Volvox sp.	--	Scenedes mus sp.	--			Pandorina sp.	--	Ankistrode smus sp.	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/m^2	250	50	200	50	275	100	180	40	188	56	283	67	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Gastropods	Copepods	Polychaete worms	Nematodes	Decapods	Decapods	Copepods	Gastropods		Copepods	Gastropods	APHA (22nd Edi) 10200-G
			Krill	Polychaetes Worms	Decapods	Gastropods	Gastropods	Cyclops	Crustaceans	Decapods	Echinoderms	Gastropods	Polychaete worms	Polychaete worms	
			Polychaetes Worms	--	Ostracods	--	Crustaceans	Nematodes	Isopods	--	Krill	Decapods	Gastropods	--	
			Siphonophores	--	Gastropods	--	Mysids	--	Polychaete worms	--	Cyclops		Crustaceans	--	
			Rotifers	--	Crustaceans	--			Gastropods	--	Polychaete worms		Mysids	--	
			Cyclops	--	--	--			--	--			--	--	
			--	--	--	--			--	--					
19.3	Total Biomass	ml/100 m^3	75	15	85	0.7	45.2	7.4	89.5	2.4	48	3.5	116	63.5	APHA (22nd Edi) 10200-G
D	**Microbiological Parameters**														
20.1	Total Bacterial Count	CFU/ml	1650	1370	1740	1480	1620	1430	1680	1420	1700	1400	1890	1420	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-5)

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Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
Lab Manager (Q)

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 2015	November 2015	December 2015	January 2016	February 2016	March 2016	Test Method
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1	Organic Matter	%	0.701	0.64	0.629	0.73	0.65	0.619	FCO:2007
2	Phosphorus as P	mg/kg	189	180	162	189	181	163	APHA(22nd Edi) 4500 C
3	Texture	--	Sandy	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	--
4	Petroleum Hydrocarbon	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
5	**Heavy Metals**								
5.1	Aluminum as Al	%	5.6	5.79	5.61	5.17	5.77	5.66	AAS APHA 3111 B
5.2	Total Chromium as Cr^{+3}	mg/kg	120	119	121	89.98	117	112	AAS 3111B
5.3	Manganese as Mn	mg/kg	760	729	745	687	728	822	AAS APHA 3111 B
5.4	Iron as Fe	%	2.45	2.41	2.32	2.57	2.4	2.9	AAS APHA(22nd Edi)3111 B
5.5	Nickel as Ni	mg/kg	48.32	48.21	47.57	50.33	48.18	44.88	AAS APHA(22nd Edi)3111 B
5.6	Copper as Cu	mg/kg	52.52	54.52	49.82	56.37	54.48	32.76	AAS APHA(22nd Edi)3111 B
5.7	Zinc as Zn	mg/kg	166	179	167	183	178	173	AAS APHA(22nd Edi)3111 B
5.8	Lead as Pb	mg/kg	2.02	2.02	2.06	1.9	2.04	1.66	AAS APHA(22nd Edi)3111 B
5.9	Mercury as Hg	mg/kg	BDL*	BDL*	BDL*	BDL*	ND	BDL*	AAS APHA- 3112 B
6	Benthic Organisms								
6.1	Macrobenthos	--	Echinoderms Decapods Isopods Chaetognaths	Isopods Polychaete worms Echinoderms	Crabs Bivalves Echinoderms	Echinoderms Crustaceans Molluscans	Polychaete worms Mysids Decapods	Echinoderms Crabs Bivalves	APHA (22nd Edi) 10500-C
6.2	MeioBenthos	--	Gastrotriches Bryozoans Ostracodes	Bryozoans Copepods	Hydrozoa Nematodes	Copepods Foraminiferans	Ciliates Nematodes	Foraminiferans Copepods Hydrozoa	APHA (22nd Edi) 10500-C
2	Population	no/m^2	337	440	377	387	440	503	APHA (22nd Edi) 10500-C

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
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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 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	7.94	8.08	7.94	7.66	8.02	8.13	7.80	7.44	7.66	7.94	8.03	8.07	IS3025(P11)83Re.02
2	Temperature	°C	29	30	30	31	28	29	30	30	30	31	29	30	IS3025(P9)84Re.02
3	Total Suspended Solids	mg/L	14	16	16	22	17	23	14	20	16	24	16	20	IS3025(P17)84Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03 Edition2.1
5	Dissolved Oxygen	mg/L	5.8	4.6	5.4	4.8	5.2	4.6	5.2	4.6	5.4	4.6	5.4	4.8	IS3025(P38)89Re.99
6	Salinity	ppt	39.37	40.18	38.19	39.3	38.42	39.26	38.68	39.71	38.2	39.3	38.22	38.86	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	mg/L	0.616	0.857	0.46	0.75	0.52	0.78	0.413	0.674	0.457	0.747	0.355	0.479	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.067	0.053	0.026	0.021	0.037	0.49	0.029	0.024	0.028	0.021	0.015	0.028	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.203	0.342	0.22	0.38	0.15	0.31	0.232	0.4	0.213	0.388	0.335	0.577	IS3025(P34)88Cl a.2.3
11	Phosphates as PO_4	mg/L	0.545	0.446	0.17	0.162	0.19	0.17	0.267	0.082	0.168	0.159	0.263	0.285	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	0.886	1.252	0.707	1.15	0.71	1.59	0.674	1.098	0.696	1.156	0.705	1.084	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	1.4	BDL*	2.2	BDL*	1	BDL*	1.8	BDL*	2.2	BDL*	BDL*	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	44020	44680	46800	33500	46930	47460	46400	47020	44660	45120	43708	44260	IS3025(P16)84Re.02
15	COD	mg/L	24	14	28	24	24	19	22	18	28	24	24	28	APHA(22nd Edi) 5520-D Open Reflux
16	Oxidisable Particular Organic Carbon	%	0.48	0.8	0.76	0.58	0.82	0.52	0.64	0.4	0.76	0.58	0.638	0.472	SOP – PLPL - 07
A	**Flora and Fauna**														
17	Primary productivity	mgC/L /day	2.138	0.563	1.913	0.787	1.91	0.56	2.02	0.675	1.575	0.787	1.98	0.383	APHA (22nd Edi) 10200-J
B	**Phytoplankton**														

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18.1	Chlorophyll	mg/m^3	2.00	0.507	2.296	0.988	1.22	0.26	2.75	0.74	2.67	0.481	2.11	0.500	APHA (22ndEdi) 10200-H
18.2	Phaeophytin	mg/m^3	0.053	1.287	BDL*	0.9	0.75	1.39	BDL*	1.14	ND	1.83	BDL*	2.09	APHA (22ndEdi) 10200-H
18.3	Cell Count	Unit x 10^3/L	202	56	184	48	180	20	147	34	268	55	274	71	APHA (22nd Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22nd Edi) 10200-H
			Biddulphia sp.	Fragillaria sp.	Gyrosigma sp.	Achnanthes sp.	Asterionella sp.	Nitzschia sp.	Gomphonema sp.	Biddulphia sp.	Navicula sp.	Gyrosigma sp.	Biddulphia sp.	Fragillaria sp.	
			Navicula sp.	Biddulphia sp.	Cheatoceros sp.	Biddulphia sp.	Navicula sp.	Fragillaria sp.	Nitzschia sp.	Cocconeis sp.	Synedra sp.	Achnanthes sp.	Melosira sp.	Nitzschia sp.	
			Fragillaria sp.	Pleurosigma sp.	Fragillaria sp.	Cheatoceros sp.	Synedra sp.	Rhizosolenia sp.	Navicula sp.	Rhizosolenia sp.	Gomphonema sp.	Navicula sp.	Pinnularia sp.	Navicula sp.	
			Cymbella sp.	Thallasionema sp.	Pinnularia sp.	Cocconeis sp.	Rhizosolenia sp.	Coscinodiscus sp.	Fragillaria sp.	Coscinodiscus sp.	Skeletonema sp.	Synedra sp.	Tabellaria sp.	Tabellaria sp.	
			Rhizosolenia sp.	Pinnularia sp.	Nitzschia sp.	Rhizosolenia sp.	Melosira sp.	Cyclotella sp.	Coscinodiscus sp.	Navicula sp.	Thallasiosira sp.	Coscinodiscus sp.	Nitzschia sp.	Coscinodiscus sp.	
			Coscinodiscus sp.	Cyanophyceae	Pleurosigma sp.	Cyanophyceae	Skeletonema sp.	Rhizosolenia sp.	Asterionella sp.	Nitzschia sp.	Skeletonema sp.	Cyanophyceae	Navicula sp.	Asterionella sp.	
			Skeletonema sp.	Oscillatoria sp.	Cyanophyceae	Microcystis sp.	Coscinodiscus sp.	Cyanophyceae	Green Algae	Green Algae	Cyanophyceae	Oscillatoria sp.	Coscinodiscus sp.	Pinnularia sp.	
			Asterionella sp.	Spirulina sp.	Microcystis sp.	Oscillatoria sp.	Cyanophyceae	Oscillatoria sp.	Chlorella sp.	Chlorella sp.	Microcystis sp.	Green Algae	Skeletonema sp.	Cyanophyceae	
			Green Algae	Lyngbya sp.	Oscillatoria sp.	Nostoc sp.	Oscillatoria sp.	Nostoc sp.	Pandorina sp.	Ankistrodesmus sp.	Oscillatoria sp.	Volvox sp.	Fragillaria sp.	Oscillatoria sp.	
			Ankistrodesmus sp.	--	Spirulina sp.	Green Algae	Nostoc sp.	Green Algae	Cyanophyceae	Cyanophyceae	Green Algae	--	Cyanophyceae	Nostoc sp.	
			Chlorella sp.	--	Green Algae	Pandorina sp.	Green Algae	Chlorella sp.	Oscillatoria sp.	Microcystis sp.	Chlorella sp.	--	Microcystis sp.	Green Algae	
			Pandorina sp.	--	Ankistrodesmus sp.	Spirogyra sp.	Ankistrodesmus sp.	Hydrodictyon sp.	Spirulina sp.	--	--	--	Oscillatoria sp.	Chlorella sp.	
			Desmids	--	Pediastrum sp.	--	Chlorella sp.	Pediastrum sp.	--	--	--	--	Spirulina sp.	Pandorina sp.	
			Cosmarium sp.	--	--	--	Pandorina sp.	Pandorina sp.	--	--	--	--	Green Algae	--	
			Closterium	--	--	--	Scenedes	--	--	--	--	--	Chlorella	--	

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			sp.				mus sp.						sp.		
			--	--	--	--			--	--	--	--	Ankistrodesmus sp.	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/m^2	300	125	140	60	175	50	160	80	150	75	317	33	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Polychaetes Worms	Copepods	Polychaete worms	Echinoderms	Bivalves	Mysids	Polychaetes Worms	Polychaete worms	Nematodes	Copepods	Snails	APHA (22nd Edi) 10200-G
			Crustaceans	Chaetognathes	Decapods	Ostracods	Nematodes	Decapods	Isopods	Echinoderms	Nematodes	Polychaete worms	Decapods	Echinoderms	
			Decapods	--	Ostracods	Decapods	Isopods	*Nematodes*	Echinoderms	--	Hydrozoans		Gastropods	--	
			Polychaetes	--	Ctenophores	--	Decapods	--	Gastropods	--	Echinoderms		Echinoderms	--	
			Krill	--	Gastropods	--	Gastropods	--	--	--			Foraminiferans	--	
			Ostracods	--	--	--			--	--			--	--	
			Crustaceans	--	--	--			--	--					
			Rotifers	--					--	--					
19.3	Total Biomass	ml/100 m^3	101	46	82.5	7.4	48.52	8.72	99.6	3.9	91.2	3.5	139	4.68	APHA (22nd Edi) 10200-G
D	**Microbiological Parameters**														
20.1	Total Bacterial Count	CFU/ml	1970	1680	1680	1260	1890	1600	1520	1290	1670	1250	2050	1900	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-5)

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

SR. NO.	TEST PARAMETERS	UNIT	November 2015 SEDIMENT	Test Method
1	Organic Matter	%	0.6	FCO:2007
2	Phosphorus as P	mg/kg	143	APHA(22nd Edi) 4500 C
3	Texture	--	Sandy Loam	--
4	Petroleum Hydrocarbon	mg/kg	BDL*	PLPL-TPH
5	**Heavy Metals**			
5.1	Aluminum as Al	%	5.34	AAS APHA 3111 B
5.2	Total Chromium as Cr^{+3}	mg/kg	134	AAS 3111B
5.3	Manganese as Mn	mg/kg	790	AAS APHA 3111 B
5.4	Iron as Fe	%	2.48	AAS APHA(22nd Edi)3111 B
5.5	Nickel as Ni	mg/kg	43.1	AAS APHA(22nd Edi)3111 B
5.6	Copper as Cu	mg/kg	42	AAS APHA(22nd Edi)3111 B
5.7	Zinc as Zn	mg/kg	188	AAS APHA(22nd Edi)3111 B
5.8	Lead as Pb	mg/kg	1.08	AAS APHA(22nd Edi)3111 B
5.9	Mercury as Hg	mg/kg	BDL*	AAS APHA- 3112 B
6				
6.1	Macrobenthos	--	Polychaete worms Echinoderms Isopods	APHA (22nd Edi) 10500-C
6.2	MeioBenthos	--	Nematodes Foraminiferans Copepods	APHA (22nd Edi) 10500-C
2	Population	no/m^2	385	APHA (22nd Edi) 10500-C

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

SR. NO.	TEST PARAMETERS	UNIT	October 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	8.1	8.16	8.02	8.23	8.03	8.28	7.78	8.02	8.04	8.24	8.08	8.04	IS3025(P11)83Re.02
2	Temperature	°C	29	30	28	29	28	29	29	30	28	29	29	30	IS3025(P9)84Re.02
3	Total Suspended Solids	mg/L	18	22	20	28	22	26	22	30	22	30	18	22	IS3025(P17)84Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03 Edition2.1
5	Dissolved Oxygen	mg/L	5.6	4.8	5.6	4.8	5.4	4.6	5.4	4.6	5.6	4.8	5.8	4.4	IS3025(P38)89Re.99
6	Salinity	ppt	39.82	40.54	44.6	45.8	43.96	44.88	44.2	45.6	44.4	45.6	43.94	44.28	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	mg/L	0.443	0.52	0.54	0.66	0.33	0.58	0.52	0.64	0.564	0.655	0.556	0.602	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.497	0.638	0.02	0.029	0.032	0.022	0.019	0.025	0.021	0.03	0.037	0.051	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.684	0.748	0.62	0.7	0.59	0.52	0.6	0.65	0.062	0.703	0.819	0.95	IS3025(P34)88Cl a.2.3
11	Phosphates as PO_4	mg/L	0.447	0.479	0.19	0.15	0.027	0.041	0.048	0.089	0.19	0.15	0.844	0.903	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	1.624	1.906	1.18	1.389	0.96	1.13	1.1	1.272	1.205	1.388	1.412	1.603	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	0.4	BDL*	1	BDL*	0.88	BDL*	1.2	BDL*	1	BDL*	2	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	43460	45020	51990	53890	48830	49690	52090	54680	50890	52760	52540	53020	IS3025(P16)84Re.02
15	COD	mg/L	19	24	18	24	19	24	20	22	19	28	28	33	APHA(22nd Edi) 5520-D Open Reflux
16	Oxidisable Particular Organic Carbon	%	0.38	0.24	0.48	0.62	0.63	0.76	0.46	0.6	0.48	0.64	0.63	0.44	SOP – PLPL - 07
A	**Flora and Fauna**														
17	Primary productivity	1.19	0.45	1.35	0.338	1.12	0.33	1.236	0.348	1.688	0.45	2.813	0.495	1.193	APHA (22nd Edi) 10200-J

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		3													
B	**Phytoplankton**														
18.1	Chlorophyll	mg/m^3	1.842	0.614	1.762	0.614	1.73	0.61	2.016	0.598	1.602	0.214	1.549	0.506	APHA (22nd Edi) 10200-H
18.2	Phaeophytin	mg/m^3	0.12	1.199	0.294	1.33	0.97	1.64	0.14	2.06	1.03	1.78	0.844	2.366	APHA (22nd Edi) 10200-H
18.3	Cell Count	Unit x 10^3/ L	178	32	220	51	188	31	164	30	212	45	236	54	APHA (22nd Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22nd Edi) 10200-H
			Biddulphia sp.	*Nitzschia sp.*	*Asterionella sp.*	Fragillaria sp.	*Asterionella sp.*	*Fragillaria sp.*	Asterionella sp.	Biddulphia sp.	*Navicula sp.*	*Skeletonema sp.*	*Asterionella sp.*	*Navicula sp.*	
			Pinnularia sp.	*Pinnularia sp.*	*Gyrosigma sp.*	Gomphonema sp.	*Biddulphia sp.*	*Nitzschia sp.*	Nitzschia sp.	Navicula sp.	*Gyrosigma sp.*	*Synedra sp.*	*Biddulphia sp.*	*Nitzschia sp.*	
			Thallasiosira sp.	*Fragillaria sp.*	*Pinnularia sp.*	Navicula sp.	*Nitzschia sp.*	*Biddulphia sp.*	Navicula sp.	Thallasiosira sp.	*Skeletonema sp.*	*Navicula sp.*	*Navicula sp.*	*Biddulphia sp.*	
			Cheatoceros sp.	*Thallasiosira sp.*	*Synedra sp.*	Nitzschia sp.	*Rhizosolenia sp.*	*Navicula sp.*	Synedra sp.	Nitzschia sp.	*Coscinodiscus sp.*	*Coscinodiscus sp.*	*Nitzschia sp.*	*Melosira sp.*	
			Asterionella sp.	*Cyclotella sp.*	*Skeletonema sp.*	Skeletonema sp.	*Thallasionema sp.*	Cyanophyceae	Asterionella sp.	Cyclotella sp.	*Pinnularia sp.*	Cyanophyceae	*Rhizosolenia sp.*	Green Algae	
			Cyanophyceae	Green Algae	*Tabellaria sp.*	Cyanophyceae	*Skeletonema sp.*	*Oscillatoria sp.*	Green Algae	Green Algae	*Pleurosigma sp.*	*Nostoc sp*	*Skeletonema sp.*	*Chlorella sp.*	
			Anabaena sp.	*Pandorina sp.*	*Gomphonema sp.*	*Oscillatoria sp.*	*Cyclotella sp.*	*Microcystis sp.*	Pandorina sp.	Chlorella sp.	Cyanophyceae	*Oscillatoria sp.*	*Tabellaria sp.*	*Volvox sp.*	
			Microcystis sp.	*Chlorella sp.*	Cyanophyceae	*Spirulina sp.*	Cyanophyceae	*Nostoc sp.*	Cyanophyceae	Scenedesmus sp.	*Microcystis sp.*	--	*Synedra sp.*	Cyanophyceae	
			Spirulina sp.	*Ulothrix sp.*	*Oscillatoria sp.*	Green Algae	*Anabaena sp.*	Green Algae	Spirulina sp.	--	*Oscillatoria sp.*	--	Green Algae	*Oscillatoria sp.*	
			Green Algae	*Volvox sp.*	*Oedogoniu m sp.*	*Pandorina sp.*	*Oscillatoria sp.*	*Chlorella sp.*	Microcystis sp.	--	Green Algae	--	*Pandorina sp.*	*Lyngbya sp.*	
			Scenedesmus sp.	--	Green Algae	*Scenedesmus sp.*	*Nostoc sp.*	*Hydrodictyon sp.*	Anabaena sp.	--	*Chlorella sp.*	--	*Chlorella sp.*	--	
			--	--	*Hydrodictyon sp.*	--	Green Algae	*Pandorina sp.*	--	--	*Pediastrum sp.*	--	*Scenedesmus sp.*	--	
			--	--	*Pandorina*	--	*Ankistrode*	--	--	--	*Ankistrode*	--	Cyanophyc	--	

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					sp.		*smus sp.*				*smus sp.*		eae		
			--	--	*Pediastrum sp.*	--	*Pandorina sp.*	--	--	--	--	--	*Nostoc sp.*	--	
			--	--	--	--	*Pediastrum sp.*	--	--	--	--	--	*Spirulina sp.*	--	
			--	--	--	--	*Ulothrix sp.*	--	--	--	--	--	--	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/ m^2	375	50	280	100	200	80	398	67	240	80	300	67	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Ostracods	Copepods	Copepods	Decapods	Nematodes	Echinoderms	Molluscans	Gastropods	Polychaete worms	Copepods	Echinoderms	APHA (22nd Edi) 10200-G
			Krill	Decapods	Decapods	Decapods	Ostracods	Mysids	Decapods	Decapods	Nematodes	Nematodes	Gastropods	Gastropods	
			Isopods	--	Ostracods	Isopods	Krill	Barnades	Copepods	--	Decapods	Molluscans	Polychaete worms	--	
			Decapods	--	Rotifers	--	Crustaceans	--	Isopods	--	mysids	--	Foraminifera rans	--	
			Crustaceans	--	Ctenophores	--	Echinoderms	--	Gastropods	--	--	--	*Barnades*	--	
			Rotifers	--	Chaetognathes	--			--	--			--	--	
			Chaetognathes	--	--	--									
19.3	Total Biomass	ml/100 m^3	78	22	83.8	5.7	68.9	9	55	10	78	3.6	126	4.59	APHA (22nd Edi) 10200-G
D	**Microbiological Parameters**														
20.1	Total Bacterial Count	CFU /ml	1540	1220	1860	1340	1690	1500	1750	1280	1820	1350	1650	1750	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-5)

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Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
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 2015	November 2015	December 2015	January 2016	February 2016	March 2016	Test Method
			SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	
1	Organic Matter	%	0.569	0.53	0.51	0.52	0.579	0.462	FCO:2007
2	Phosphorus as P	mg/kg	170	200	170	198	202	165	APHA(22nd Edi) 4500 C
3	Texture	--	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	--
4	Petroleum Hydrocarbon	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	PLPL-TPH
5	**Heavy Metals**								
5.1	Aluminum as Al	%	5.33	5.00	5.09	5.6	5.01	5.25	AAS APHA 3111 B
5.2	Total Chromium as Cr^{+3}	mg/kg	87.99	98	101	102	98.57	93.99	AAS 3111B
5.3	Manganese as Mn	mg/kg	735	880	829	770	879	747	AAS APHA 3111 B
5.4	Iron as Fe	%	2.13	2.8	2.42	2.6	2.87	2.27	AAS APHA(22nd Edi)3111 B
5.5	Nickel as Ni	mg/kg	38.98	50	43.98	48	51.97	32.94	AAS APHA(22nd Edi)3111 B
5.6	Copper as Cu	mg/kg	43.97	54	47.98	52	54.58	46.41	AAS APHA(22nd Edi)3111 B
5.7	Zinc as Zn	mg/kg	162	160	48.57	174	162	154	AAS APHA(22nd Edi)3111 B
5.8	Lead as Pb	mg/kg	1.99	2.2	147	1.8	2.27	2.02	AAS APHA(22nd Edi)3111 B
5.9	Mercury as Hg	mg/kg	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA- 3112 B
6	**Benthic Organisms**								
6.1	Macrobenthos	--	Echinoderms Decapods Isopods	Mysids Isopods Echinoderms Polychaete worms	Polychaete worms Echinoderms Decapods Isopods	Crabs Ostracods Gastrotriches	Polychaete worms Mysids	Polychaete Worms Echinoderms Crabs	APHA (22nd Edi) 10500-C
6.2	MeioBenthos	--	Gastrotriches Copepods Ostracodes	Copepods Ostracods Ciliates	Nematodes Foraminiferans	Isopods Nematodes Decapods	Nematodes Ostracods Foraminiferans	Nematodes Hydrozoa	APHA (22nd Edi) 10500-C
2	Population	no/m^2	503	317	385	508	318	433	APHA (22nd Edi) 10500-C

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

SR. NO.	TEST PARAMETERS	UNIT	October 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	8.02	8.11	7.91	7.66	8.02	8.33	7.62	7.27	7.66	7.91	7.89	7.93	IS3025(P11)83Re.02
2	Temperature	°C	29	30	29	30	29	30	28	29	29	30	29	30	IS3025(P9)84Re.02
3	Total Suspended Solids	mg/L	14	20	18	22	19	25	20	24	19	23	14	22	IS3025(P17)84Re.02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03 Edition2.1
5	Dissolved Oxygen	mg/L	5.8	4.8	5.2	4.6	5.8	4.8	5.6	4.8	5	4.4	5.8	5	IS3025(P38)89Re.99
6	Salinity	ppt	40.3	41.6	41.7	42.53	39.88	40.98	42.1	42.93	41.6	42.54	42.38	42.88	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	mg/L	0.474	0.673	0.81	0.93	0.67	0.87	0.689	0.903	0.793	0.915	0.649	0.943	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.027	0.049	0.077	0.08	0.079	0.081	0.08	0.085	0.075	0.078	0.041	0.053	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.64	0.64	0.41	0.581	0.69	0.79	0.489	0.605	0.407	0.574	0.558	0.689	IS3025(P34)88Cla.2.3
11	Phosphates as PO_4	mg/L	0.279	0.361	0.78	0.88	0.075	0.089	0.083	0.144	0.777	0.868	0.095	0.108	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	1.141	1.369	1.29	1.59	1.45	1.74	1.258	1.593	1.275	1.567	1.248	1.685	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	0.2	BDL*	2.2	BDL*	1.8	BDL*	1.7	BDL*	2.1	BDL*	BDL*	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	47980	49710	33800	35000	40830	42620	34120	35330	48150	49630	51590	51620	IS3025(P16)84Re.02
15	COD	mg/L	14	18	22	24	24	28	18	20	20	24	14	19	APHA(22nd Edi) 5520-D Open Reflux
16	Oxidisable Particular Organic Carbon	%	0.44	0.62	0.94	0.44	0.78	0.49	0.88	0.4	0.9	0.4	0.696	0.472	SOP – PLPL - 07
A	**Flora and Fauna**														
17	Primary productivity	mgC/L /day	1.913	0.563	2.58	0.338	2.47	0.33	2.172	0.666	1.91	0.45	2.363	0.63	APHA (22nd Edi) 10200-J
B	**Phytoplankton**														

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18.1	Chlorophyll	mg/m^3	1.816	0.908	2.216	0.561	2.35	0.32	2.584	0.489	2.67	0.24	2.67	0.24	APHA (22ndEdi) 10200-H
18.2	Phaeophytin	mg/m^3	0.24	1.148	BDL*	1.103	BDL*	1.86	0.12	0.998	0.04	1.909	0.04	1.9	APHA (22ndEdi) 10200-H
18.3	Cell Count	Unit x 10^3/L	210	63	210	53	314	162	246	72	276	65	251	46	APHA (22nd Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22nd Edi) 10200-H
			Nitzschia sp.	Synedra sp.	Asterionella sp.	Biddulphia sp.	Navicula sp.	Fragillaria sp.	Skeletonema sp.	Biddulphia sp.	Asterionella sp.	Fragillaria sp.	Navicula sp.	Nitzschia sp.	
			Navicula sp.	Gyrosigma sp.	Coscinodiscus sp.	Cocconeis sp.	Nitzschia sp.	Gomphonema sp.	Synedra sp.	Pinnularia sp.	Navicula sp.	Nitzschia sp.	Asterionella sp.	Rhizosolenia sp.	
			Cymbella sp.	Thallasiosira sp.	Gomphonema sp.	Fragillaria sp.	Coscinodiscus sp.	Asterionella sp.	Navicula sp.	Pleurosigma sp.	Synedra sp.	Asterionella sp.	Skeletonema sp.	Pleurosigma sp.	
			Cymbella sp.	Pinnularia sp.	Pinnularia sp.	Synedra sp.	Fragillaria sp.	Rhizosolenia sp.	Rhizosolenia sp.	Green Algae	Coscinodiscus sp.	Navicula sp.	Rhizosolenia sp.	Skeletonema sp.	
			Gomphonema sp.	Navicula sp.	Thallasionema sp.	Cyanophyceae	Gomphonema sp.	Cyanophyceae	Coscinodiscus sp.	Pandorina sp.	Nitzschia sp.	Gyrosigma sp.	Cymbella sp.	Fragillaria sp.	
			Coscinodiscus sp.	Nitzschia sp.	Fragillaria sp.	Microcystis sp.	Skeletonema sp.	Microcystis sp.	Gomphonema sp.	Pediastrum sp.	Cymbella sp.	Cyanophyceae	Thallasiosira sp.	Cyanophyceae	
			Rhizosolenia sp.	Green Algae	Cyanophyceae	Oscillatoria sp.	Rhizosolenia sp.	Oscillatoria sp.	Green Algae	Cyanophyceae	Skeletonema sp.	Oscillatoria sp.	Cyclotella sp.	Oscillatoria sp.	
			Green Algae	Ulothrix sp.	Anabaena sp.	Green Algae	Cyanophyceae	Nostoc sp.	Spirogyra sp.	Lyngbya sp.	Cyanophyceae	Microcystis sp.	Cyanophyceae	Spirulina sp.	
			Scenedesmus sp.	Chlorella sp.	Oscillatoria sp.	Hydrodictyon sp.	Anabaena sp.	Green Algae	Hydrodictyon sp.	Microcystis sp.	Oscillatoria sp.	--	Anabaena sp.	Green Algae	
			Hydrodictyon sp.	--	Spirulina sp.	Pandorina sp.	Microcystis sp.	Chlorella sp.	Scenedesmus sp.	--	Microcystis sp.	--	Microcystis sp.	Ankistrodesmus sp.	
			Spirogyra sp.	--	Green Algae	Pediastrum sp.	Oscillatoria sp.	Pandorina sp.	Desmids	--	Nostoc sp.	--	Nostoc sp.	Scenedesmus sp.	
			Desmids	--	Ankistrodesmus sp.	--	Green Algae	Pediastrum sp.	Cosmarium sp.	--	Green Algae	--	Green Algae	--	
			Cosmarium sp.	--	Chlorella sp.	--	Ankistrodesmus sp.	--	--	--	Chlorella sp.	--	Chlorella sp.	--	
			--	--	Hydrodictyon sp.	--	Chlorella sp.	--	--	--	Pediastrum sp.	--	Pandorina sp.	--	
			--	--	--	--	Hydrodicty	--	--	--	Ulothrix	--	--	--	

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							on sp.				sp.				
			--	--	--	--	Volvox sp.	--	--	--	Scenedes mus sp.	--	--	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/m^2	250	100	250	75	367	100	208	80	250	75	183	50	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Chaetognathes	Gastropods	Copepods	Copepods	Polychaete worms	Nematodes	Copepods	Decapods	Polychaete worms	Gastropods	183	50	APHA (22nd Edi) 10200-G
			Krill	Decapods	Decapods	Polychaete worms	Echinoderms	Gastropods	Gastropods	Ostracods	Echinoderms	Echinoderms	Copepods	Copepods	
			Ostracods	Nematodes	Polychaete worms	Gastropods	Amphipods	--	Crustaceans	--	Molluscans		Ostracods	Decapods	
			Cyclops	--	Ctenophores	--	Krill	--	Cyclops	--	mysids	--	Echinoderms	Gastropods	
			Crustaceans	--	Krill	--			Polychaetes	--	--	--	Molluscans	--	
			Polychaetes	--	Crustaceans	--			--	--			Rotifers	--	
			--	--	--	--			--	--			--	--	
19.3	Total Biomass	ml/100 m^3	79.6	21	82.9	10.4	80.24	12.1	89	26	79	23	124	19.6	APHA (22nd Edi) 10200-G
D	**Microbiological Parameters**														
20.1	Total Bacterial Count	CFU/ml	1820	1690	1860	1440	1840	1680	1820	1580	1850	1430	2120	2440	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi.2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-5)

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Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
Lab Manager (Q)

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

SR. NO.	TEST PARAMETERS	UNIT	October 2015		November 2015		December 2015		January 2016		February 2016		March 2016		Test Method
			SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	SURFACE	BOTTOM	
1	pH	--	7.89	8.16	7.82	7.74	7.92	8.02	7.36	7.3	7.74	7.82	7.93	7.89	IS3025(P11)83Re .02
2	Temperature	°C	29	30	28	29	28	29	29	30	28	29	29	30	IS3025(P9)84Re. 02
3	Total Suspended Solids	mg/L	20	24	24	30	20	26	20	26	20	24	16	20	IS3025(P17)84Re .02
4	BOD (3 Days @ 27 °C)	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 3025 (P44)1993Re.03E dition2.1
5	Dissolved Oxygen	mg/L	5.8	4.8	5.2	4.8	5.2	4.8	5	4.6	5.2	4.8	5.6	4.4	IS3025(P38)89Re .99
6	Salinity	ppt	40.12	41.08	41.7	42.3	39.6	40.2	41.3	42.1	41.6	42.2	41.58	42.22	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	mg/L	0.474	0.581	0.508	0.61	0.56	0.7	0.612	0.689	0.503	0.625	0.355	0.51	IS3025(P34)88
9	Nitrite as NO_2	mg/L	0.044	0.068	0.075	0.097	0.084	0.09	0.07	0.089	0.072	0.097	0.069	0.092	IS3025(P34)88 NEDA
10	Ammonical Nitrogen as NH_3	mg/L	0.591	0.702	0.81	0.9	0.5	0.59	0.838	0.931	0.814	0.889	0.689	0.707	IS3025(P34)88Cl a.2.3
11	Phosphates as PO_4	mg/L	0.117	0.139	0.16	0.189	0.13	2.03	0.063	0.062	0.15	0.186	0.158	0.181	APHA(22nd Edi) 4500 C
12	Total Nitrogen	mg/L	1.1	1.351	1.39	1.607	1.15	1.39	1.52	1.709	1.389	1.61	1.113	1.309	IS3025(P34)88
13	Petroleum Hydrocarbon	mg/L	BDL*	BDL*	1.8	BDL*	1.2	BDL*	1.4	BDL*	1.7	BDL*	BDL*	BDL*	PLPL-TPH
14	Total Dissolved Solids	mg/L	47980	48710	38400	35500	47290	48260	38030	36380	45980	46720	48810	49690	IS3025(P16)84Re .02
15	COD	mg/L	24	28	19	24	14	24	18	22	19	24	24	28	APHA(22nd Edi) 5520-D Open Reflux
16	Oxidisable Particular Organic Carbon	%	0.74	0.4	0.7	0.38	0.63	0.41	0.63	0.37	0.71	0.39	0.48	0.32	SOP – PLPL - 07
A	**Flora and Fauna**														
17	Primary productivity	mgC/L/ day	2.138	0.338	2.25	0.788	2.25	0.22	1.762	5.8	2.47	0.9	2.31	0.54	APHA (22nd Edi) 10200-J
B	**Phytoplankton**														

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Lab Manager

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Lab Manager (Q)

18.1	Chlorophyll	mg/m^3	1.896	0.534	2.163	0.454	1.3	0.64	1.672	0.444	2.51	0.481	2.57	0.49	APHA (22ndEdi) 10200-H
18.2	Phaeophytin	mg/m^3	0.142	1.428	BDL*	1.602	0.74	1.11	0.236	1.182	0.22	1.83	0.219	1.83	APHA (22ndEdi) 10200-H
18.3	Cell Count	Unit x 10^3/L	208	60	223	62	178	70	218	54	286	38	228	51	APHA (22nd Edi) 10200-H
18.4	Name of Group Number and name of group species of each group	--	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	Bacillariophyceae	APHA (22nd Edi) 10200-H
			Amphiprora sp.	Navicula sp.	Asterionella sp.	Biddulphia sp.	Asterionella sp.	Fragillaria sp.	Nitzschia sp.	Navicula sp.	Navicula sp.	Synedra sp.	Asterionella sp.	Fragillaria sp.	
			Navicula sp.	Synedra sp.	Cocconeis sp.	Cocconeis sp.	Biddulphia sp.	Nitzschia sp.	Pinnularia sp.	Melosira sp.	Synedra sp.	Nitzschia sp.	Navicula sp.	Navicula sp.	
			Nitzschia sp.	Melosira sp.	Fragillaria sp.	Gyrosigma sp.	Coscinodiscus sp.	Skeletonema sp.	Synedra sp.	Coscinodiscus sp.	Cyclotella sp.	Coscinodiscus sp.	Nitzschia sp.	Thallasiosira sp.	
			Fragillaria sp.	Cheatoceros sp.	Pinnularia sp.	Pinnularia sp.	Gyrosigma sp.	Asterionella sp.	Gomphonema sp.	Fragillaria sp.	Pleurosigma sp.	Fragillaria sp.	Gomphonema sp.	Coscinodiscus sp.	
			Pinnularia sp.	Coscinodiscus sp.	Rhizosolenia sp.	Thallasiosira sp.	Nitzschia sp.	Cyanophyceae	Thallasiosira sp.	Skeletonema sp.	Skeletonema sp.	Tabellaria sp.	Gyrosigma sp.	Nitzschia sp.	
			Synedra sp.	Rhizosolenia sp.	Skeletonema sp.	Cyanophyceae	Rhizosolenia sp.	Oscillatoria sp.	Amphiprora sp.	Asterionella sp.	Fragillaria sp.	Cyanophyceae	Rhizosolenia sp.	Pleurosigma sp.	
			Skeletonema sp.	Green Algae	Thallasionema sp.	Microcystis sp.	Thallasiosira sp.	Nostoc sp.	Skeletonema sp.	Green Algae	Cheatoceros sp.	Oscillatoria sp.	Skeletonema sp.	Cyanophyceae	
			Biddulphia sp.	Pandorina sp.	Cyanophyceae	Green Algae	Cyanophyceae	Green Algae	Biddulphia sp.	Ankistrodesmus sp.	Biddulphia sp.	Green Algae	Fragillaria sp.	Oscillatoria sp.	
			Cyanophyceae	Ulothrix sp.	Oscillatoria sp.	Chlorella sp.	Microcystis sp.	Chlorella sp.	Cyanophyceae	Volvox sp.	Rhizosolenia sp.	Chlorella sp.	Cyanophyceae	--	
			Anabaena sp.	Volvox sp.	Nostoc sp.	Hydrodictyon sp.	Oscillatoria sp.	Pandorina sp.	Oscillatoria sp.	--	Cyanophyceae	Pediastrum sp.	Oscillatoria sp.	--	
			Oscillatoria sp.	--	Microcystis sp.	Pandorina sp.	Nostoc sp.	Ankistrodesmus sp.	Green Algae	--	Spirulina sp.	--	Microcystis sp.	--	
			Nostoc sp.	--	Green Algae	--	Green Algae	--	Volvox sp.	--	Oscillatoria sp.	--	Green Algae	--	
			Green Algae	--	Ankistrodesmus sp.	--	Ankistrodesmus sp.	--	Chlorella sp.	--	Green Algae	--	Chlorella sp.	--	
			Chlorella sp.	--	Chlorella sp.	--	Chlorella sp.	--	--	--	Hydrodictyon sp.	--	Pandorina sp.	--	
			Ulothrix	--	Hydrodicty	--	Pediastru	--			Chlorella	--	Scenedes	--	

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
Lab Manager (Q)

			sp.		on sp.		m sp.				sp.		mus sp.		
			Ankistrodesmus sp.	--	--	--	Scenedesmus sp.	--			--	--	--	--	
							Volvox sp.	--					--	--	
C	**Zooplanktons**														
19.1	Abundance (Population)	no/m^2	300	125	280	60	250	50	290	116	275	100	267	17	APHA (22nd Edi) 10200-G
19.2	Name of Group Number and name of group species of each group	--	Copepods	Polychaetes	Copepods	Ctenophores	Polychaete worms	Copepods	Muds skipper	Snails	mysids	Nematodes	Polechaete worms	Gastropods	APHA (22nd Edi) 10200-G
			Nematodes	Chaetognathes	Ctenophores	Copepods	Echinoderms	Molluscans	Bivalves	Copepods	Polychaete worms	Gastropods	Crustaceans	--	
			Decapods	Copepods	Krill	--	Amphipods	--	Nematodes	--	Gastropods	--	Molluscans	--	
			Hydrolod	--	Daphnia	--	Isopods	--	Hydrolod	--	Nauplius larvae	--	Decapods	--	
			Gastropods	--	Ostracods	--	Decapods	--	Ostracods	--	Decapods	--	Copepods	--	
			Ostracods	--	Gastropods	--			Gastropods	--			Gastropods	--	
			--	--	--	--			--	--					
19.3	Total Biomass	ml/100 m^3	86.9	6.2	91.2	10.8	10.24	30.1	80.6	8.4	97	17	132	3.24	APHA (22nd Edi) 10200-G
D	Microbiological Parameters														
20.1	Total Bacterial Count	CFU/ml	1550	1230	1720	1360	1500	1310	1840	1580	1490	1030	2780	1820	IS 5402:2002
20.2	Total Coliform	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	APHA(22ndEdi)9221-D
20.3	Ecoli	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS:1622:1981Edi. 2.4(2003-05)
20.4	Enterococcus	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 15186 :2002
20.5	Salmonella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-3)
20.6	Shigella	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 1887 (P-7)
20.7	Vibrio	/ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	IS : 5887 (P-5)

H. T. Shah
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POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
Lab Manager (Q)

RESULTS OF ETP WATER OUTLET

SR. NO.	PARAMETERS	UNIT	Liquid Terminal ETP Outlet						TEST METHOD
			Oct- 15	Nov-15	Dec-15	Jan-16	Feb-16	March-16	
1	Colour	Co-pt	30	40	50	30	30	20	IS3025(P4)83Re.02
2	pH	--	7.03	7.78	7.6	7.2	7.13	7.43	IS3025(P11)83Re.02
3	Temperature	°C	30	29	29	30	30	29	IS3025(P9)84Re.02
4	Total Suspended Solids	mg/L	42	22	22	34	48	20	IS3025(P17)84Re.02
5	Total Dissolved Solids	mg/L	1733	1057	1029	976	982	987	IS3025(P16)84Re.02
6	COD	mg/L	96	82	93	85	90	27	APHA(22nd Edi) 5520-D Open Reflux
7	BOD (3 Days @ 27 °C)	mg/L	16	26	24	22	32	BDL*	IS 3025 (P44)1993Re.03Edition2.1
8	Chloride as Cl	mg/L	559	336	337	385	523	335	IS3025(P32)88Re.99
9	Oil & Grease	mg/L	1.8	0.6	0.6	0.8	BDL*	BDL*	APHA(22nd Edi)5520D
10	Sulphate as SO_4	mg/L	46.63	102	57.77	302	298	96.31	APHA(22nd Edi)4500 SO_4 E
11	Ammonical Nitrogen as NH_3	mg/L	5.4	1.92	2.83	2.88	2.64	1.86	IS3025(P34)88Cla.2.3
12	% Sodium as Na	%	41.99	40.12	38.65	45.34	30.92	46.93	AAS APHA(22nd Edi) 3500 NA B/ Flame Photometer
13	Nickel as Ni	mg/L	0.022	0.016	0.012	0.02	0.022	0.012	AAS APHA(22nd Edi)3111 B
14	Phenolic Compound	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS3025(P43)92Re.03
15	SAR	--	BDL*	1.63	1.74	2.92	1.23	3.29	By Calculation
16	Total Chromium as Cr^{+3}	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS 3111B
17	Hexavalent Chromium as Cr^{+6}	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	APHA(22nd Edi)3500Cr B Colorimetric method
18	Copper as Cu	mg/L	0.018	0.013	0.013	0.014	0.015	0.014	AAS APHA(22nd Edi)3111 B
19	Lead as Pb	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA(22nd Edi)3111 B
20	Sulphide as S	mg/L	BDL*	BDL*	BDL*	BDL*	< 0.1	BDL*	APHA(22nd Edi) 4500-S
21	Mercury as Hg	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA- 3112 B
22	Zinc as Zn	mg/L	0.051	0.054	0.036	0.053	0.05	0.028	AAS APHA(22nd Edi)3111 B
23	Cadmium as Cd	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA(22nd Edi)3111 B
24	Cyanide as CN	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	APHA(22nd Edi)4500CN E
25	Arsenic as As	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	AAS APHA 3114 B
26	Fluoride as F	mg/L	0.44	0.58	BDL*	0.56	0.49	0.22	APHA(22nd Edi) 4500 F D SPANDS
27	Insecticides/Pesticides	mg/L	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	GC MS

*Below detection limit

H. T. Shah
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POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
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RESULT OF AMBIENT AIR QUALITY MONITORING

Location & Parameter	Unit	Oct- 15	Nov-15	Dec-15	Jan-16	Feb-16	March-16	Test Method
T1 TERMINAL								
Respirable Particulate Matter (PM_{10})	$\mu g/m^3$	79.74	81.90	85.41	82.31	82.20	77.24	IS:5182(P23):Gravimetric CPCB - Method (Vol.I,May-2011)
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	37.95	39.14	44.81	39.56	45.35	41.75	Gravimetric- CPCB - Method (Vol.I,May-2011)
Sulphur Dioxide as SO_2	$\mu g/m^3$	12.52	12.77	16.60	13.20	15.45	14.79	IS:5182(PII):Improved West and Gaeke
Oxides of Nitrogen as NO_2	$\mu g/m^3$	28.26	30.53	30.84	31.95	26.75	31.08	IS:5182(PVI): Jacob & Hochheiser modified (NaOH-NaAsO2) Method
Carbon Monoxide as CO	mg/m^3	0.46	0.39	0.51	0.50	0.55	0.67	NDIR Digital Gas Analyzer
Hydrocarbon as CH_4	mg/m^3	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	SOP: HC: GC/GCMS/Gas analyzer
Benzene as C_6H_6	$\mu g/m^3$	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 5182 (Part XI):2006/CPCB Method
NEAR FIRE STATION								
Respirable Particulate Matter (PM_{10})	$\mu g/m^3$	83.33	83.42	81.68	83.31	78.73	71.31	IS:5182(P23):Gravimetric CPCB - Method (Vol.I,May-2011)
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	41.91	40.77	42.02	40.98	39.57	34.11	Gravimetric- CPCB - Method (Vol.I,May-2011)
Sulphur Dioxide as SO_2	$\mu g/m^3$	14.53	15.57	16.53	16.89	19.25	15.46	IS:5182(PII):Improved West and Gaeke
Oxides of Nitrogen as NO_2	$\mu g/m^3$	30.95	33.18	31.73	33.57	29.11	31.84	IS:5182(PVI): Jacob & Hochheiser modified (NaOH-NaAsO2) Method
Carbon Monoxide as CO	mg/m^3	0.34	0.27	0.28	0.38	0.41	0.51	NDIR Digital Gas Analyzer
Hydrocarbon as CH_4	mg/m^3	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	SOP: HC: GC/GCMS/Gas analyzer
Benzene as C_6H_6	$\mu g/m^3$	BDL*	BDL*	BDL*	BDL*	BDL*	2.32	IS 5182 (Part XI):2006/CPCB Method
PUB /ADANI HOUSE								
Respirable Particulate Matter (PM_{10})	$\mu g/m^3$	71.81	72.95	80.57	67.28	70.98	68.38	IS:5182(P23):Gravimetric CPCB - Method (Vol.I,May-2011)
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	34.12	37.13	41.44	31.52	33.93	34.21	Gravimetric- CPCB - Method (Vol.I,May-2011)
Sulphur Dioxide as SO_2	$\mu g/m^3$	12.78	12.82	12.02	12.12	12.59	12.35	IS:5182(PII):Improved West and Gaeke
Oxides of Nitrogen as NO_2	$\mu g/m^3$	29.02	31.31	23.12	30.17	27.18	30.31	IS:5182(PVI): Jacob & Hochheiser modified (NaOH-NaAsO2) Method
Carbon Monoxide as CO	mg/m^3	0.35	0.39	0.41	0.64	0.60	0.77	NDIR Digital Gas Analyzer
Hydrocarbon as CH_4	mg/m^3	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	SOP: HC: GC/GCMS/Gas analyzer
Benzene as C_6H_6	$\mu g/m^3$	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 5182 (Part XI):2006/CPCB Method

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. ArunBajpai
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RESULT OF AMBIENT AIR QUALITY MONITORING

Location & Parameter	Unit	Oct- 15	Nov-15	Dec-15	Jan-16	Feb-16	March-16	Test Method
AIR STRIP								
Respirable Particulate Matter (PM_{10})	$\mu g/m^3$	67.92	77.19	75.31	67.92	72.08	72.15	IS:5182(P23):Gravimetric CPCB - Method (Vol.I,May-2011)
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	34.52	36.13	34.53	34.52	34.94	34.57	Gravimetric- CPCB - Method (Vol.I,May-2011)
Sulphur Dioxide as SO_2	$\mu g/m^3$	13.65	12.67	13.92	13.65	14.15	10.57	IS:5182(PII):Improved West and Gaeke
Oxides of Nitrogen as NO_2	$\mu g/m^3$	29.43	22.45	27.20	29.43	31.75	24.49	IS:5182(PVI): Jacob & Hochheiser modified (NaOH-NaAsO2) Method
Carbon Monoxide as CO	mg/m^3	0.36	0.21	0.29	0.36	0.31	0.34	NDIR Digital Gas Analyzer
Hydrocarbon as CH_4	mg/m^3	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	SOP: HC: GC/GCMS/Gas analyzer
Benzene as C_6H_6	$\mu g/m^3$	BDL*	BDL*	BDL*	BDL*	BDL*	BDL*	IS 5182 (Part XI):2006/CPCB Method
NEAR SHANTIVAN COLONY'S STP								
Respirable Particulate Matter (PM_{10})	$\mu g/m^3$	66.57	68.29	68.41	75.72	71.88	72.86	IS:5182(P23):Gravimetric CPCB - Method (Vol.I,May-2011)
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	34.04	31.99	32.98	36.20	34.10	35.07	Gravimetric- CPCB - Method (Vol.I,May-2011)
Sulphur Dioxide as SO_2	$\mu g/m^3$	13.80	13.15	15.02	13.53	14.93	15.46	IS:5182(PII):Improved West and Gaeke
Oxides of Nitrogen as NO_2	$\mu g/m^3$	26.47	28.38	31.06	29.78	31.00	28.93	IS:5182(PVI): Jacob & Hochheiser modified (NaOH-NaAsO2) Method

Note: Monthly average is calculated from result of 24 hourly &twice in a week monitoring.

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POLLUCON LABORATORIES PVT. LTD. SURAT-3

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RESULTS OF NOISE LEVEL MONITORING

RESULTS OF NOISE LEVEL MONITORING [DAY TIME]

Noise level in dB (A) Leq - Average								Limits in dB (A) Leq
Sr. No.	Location Name	Oct- 15	Nov-15	Dec-15	Jan-16	Feb-16	March-16	
1	T1 Terminal	55.4	67.6	67.3	67.5	65.6	64.6	
2	Near Fire Station	63.9	59.3	69.1	61.9	61.2	66.8	
3	PUB/Adani House	63.7	61.0	65.9	62.1	62.7	64.9	**75 dB (A) Leq**
4	Airstrip	54.5	49.6	61.5	46.4	46.3	44.4	
5	Near Shantivan STP	60.4	62.5	62.4	59.6	59.4	63.5	

RESULTS OF NOISE LEVEL MONITORING [NIGHT TIME]

Noise level in dB (A) Leq - Average								Limits in dB (A) Leq
Sr. No.	Location Name	Oct- 15	Nov-15	Dec-15	Jan-16	Feb-16	March-16	
1	T1 Terminal	51.7	61.1	56.1	62.5	60.7	62.2	
2	Near Fire Station	59.1	57.7	56.3	57.7	55.6	64.7	
3	PUB/Adani House	59.0	55.3	54.5	53.8	54.2	58.8	**70 dB (A) Leq**
4	Airstrip	51.4	44.3	48.1	45.4	45.7	37.0	
5	Near Shantivan STP	58.2	59.0	55.3	53.9	54.8	55.9	

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RESULT OF STACK MONITORING

SR. NO.	TEST PARAMETERS	Unit	Std. Limit	Thermic Fluid Heater (Bitumen)	Hot Water System-1 (Liquid Terminal)	#Hot Water System-2 (Liquid Terminal)	Test Method
Oct- 2015							
1	Particulate Matter	mg/Nm^3	**150**	#	23.52	32.39	IS:11255 (Part-I):1985
2	Sulfur dioxide	ppm	**100**	#	7.68	3.73	IS:11255 (Part-II):1985
3	Oxides of Nitrogen	ppm	**50**	#	31.36	36.03	IS:11255 (Part-VII):2005
Nov-2015							
1	Particulate Matter	mg/Nm^3	**150**	30.22	36.80	25.46	IS:11255 (Part-I):1985
2	Sulfur dioxide	ppm	**100**	4.35	5.77	6.41	IS:11255 (Part-II):1985
3	Oxides of Nitrogen	ppm	**50**	33.07	35.42	31.61	IS:11255 (Part-VII):2005
Dec-2015							
1	Particulate Matter	mg/Nm^3	**150**	18.24	29.53	24.51	IS:11255 (Part-I):1985
2	Sulfur dioxide	ppm	**100**	3.27	8.58	7.93	IS:11255 (Part-II):1985
3	Oxides of Nitrogen	ppm	**50**	32.34	39.07	35.57	IS:11255 (Part-VII):2005
Jan-2016							
1	Particulate Matter	mg/Nm^3	**150**	23.53	18.48	19.49	IS:11255 (Part-I):1985
2	Sulfur dioxide	ppm	**100**	4.55	6.82	9.62	IS:11255 (Part-II):1985
3	Oxides of Nitrogen	ppm	**50**	28.90	33.97	39.17	IS:11255 (Part-VII):2005
Feb-2016							
1	Particulate Matter	mg/Nm^3	**150**	19.52	15.55	26.83	IS:11255 (Part-I):1985
2	Sulfur dioxide	ppm	**100**	5.69	8.37	7.30	IS:11255 (Part-II):1985
3	Oxides of Nitrogen	ppm	**50**	34.50	30.64	25.66	IS:11255 (Part-VII):2005
March-2016							
1	Particulate Matter	mg/Nm^3	**150**	15.75	12.82	20.76	IS:11255 (Part-I):1985
2	Sulfur dioxide	ppm	**100**	3.49	6.82	4.73	IS:11255 (Part-II):1985
3	Oxides of Nitrogen	ppm	**50**	29.32	38.65	33.23	IS:11255 (Part-VII):2005

Monitoring was not done. Stack was under maintenance.
*Below detection limit
Results on 11 % O2 Correction when Oxygen is greater than 11 %.

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POLLUCON LABORATORIES PVT. LTD. SURAT-3

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RESULT OF DG STACK MONITORING

October- 2015								
		D.G. Set-1 (500 KVA)	D.G. Set-2 (500 KVA)	D.G. Set-3 (500 KVA)	D.G. Set-4 (500 KVA)	D.G. Set-5(500 KVA)	D.G. Set-6, 7 & 8 (1250 KVA, each)	
TEST PARAMETER	**UNIT**	**09/10/2015**	**09/10/2015**	**09/10/2015**	**09/10/2015**	**10/10/2015**	**06/10/2015**	**METHOD OF MEASUREMENT**
Particulate Matter	mg/Nm3	22.81	27.50	39.50	19.53	17.62	42.41	IS:11255 (Part-I):1985
Sulphur Dioxide	ppm	7.59	4.51	5.60	7.46	8.67	4.38	IS:11255 (Part-II):1985
Oxide of Nitrogen	ppm	34.53	37.60	30.41	39.38	33.55	36.49	IS:11255 (Part-VII):2005
January- 2016								
		D.G. Set-1 (500 KVA)	D.G. Set-2 (500 KVA)	D.G. Set-3 (500 KVA)	D.G. Set-4 (500 KVA)	D.G. Set-5(500 KVA)	D.G. Set-6, 7 & 8 (1250 KVA, each)	
TEST PARAMETER	**UNIT**	**16/01/2016**	**16/01/2016**	**16/01/2016**	**16/01/2016**	**16/01/2016**	**15/01/2016**	**METHOD OF MEASUREMENT**
Particulate Matter	mg/Nm3	13.55	22.51	32.53	26.84	24.24	30.62	IS:11255 (Part-I):1985
Sulphur Dioxide	ppm	5.73	6.63	8.47	4.47	6.46	9.52	IS:11255 (Part-II):1985
Oxide of Nitrogen	ppm	39.23	31.36	35.21	33.46	39.77	29.45	IS:11255 (Part-VII):2005

*DG sets are used as standby ,so stack monitoring is done on quarterly basis.Results on 11 % O_2 Correction when Oxygen is greater than 11 %,
BDL* : Below Detection Limit

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

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Lab Manager (Q)

MINIMUM DETECTION LIMIT [MDL]

Water parameter(mg/L)		
Sr. No.	**Test parameter**	**MDL**
1	Total Suspended Solids	1
2	Oil & Grease	1
3	BOD	10
4	COD	5
5	Total Dissolved Solids	3
6	Sulphate	0.3
7	Ammonical Nitrogen	0.05
8	Nickel	0.01
9	Phenolic Compound	0.001
10	Fluoride	0.01
11	Copper	0.013
12	Sulphide	0.01
13	Cyanide	0.0001
14	Residual Chlorine	0.1
15	Boron	0.02
16	Insecticides/Pesticides	0.01
17	Nitrate Nitrogen	0.15
18	Phosphorous	0.15
19	Petroleum Hydrocarbon	0.01
20	Lead	0.005
21	Mercury	0.0005
22	Zinc	0.022
23	Cadmium	0.001
24	Arsenic	0.00015
Sediment parameter(mg/kg)		
1	Petroleum Hydrocarbon	0.2

Ambient Air Parameter		
Sr. No.	**Test parameter**	**MDL**
1	Particulate Matter (PM10)	10
2	Particulate Matter (PM 2.5)	10
3	Sulphur Dioxide (SO_2) (µg/m^3)	5
4	Oxides of Nitrogen (µg/m^3)	5
5	Carbon Monoxide as CO (mg/m^3)	0.1
6	Benzene as C_6H_6 (µg/m^3)	2
7	Hydrocarbon (mg/m^3)	0.15

Stack parameter		
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

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

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Lab Manager (Q)

Annexure – 3

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
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Sr. No.	**Section**	**Sub-section**	**Page No.**	**Revision No.**	**Revision Date**	**Description of Revision**	**Approved**

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

2 Risk assessment

2.1 Identification of activities and risks
2.2 Types of oil likely to be spilled
2.3 Probable fate of spilled oil
2.4 Development of oil spill scenarios including worst case discharge
2.5 Shoreline sensitivity mapping
2.6 Shoreline resources, priorities for protection
2.7 Special local considerations

3 Response strategy

3.1 Philosophy and objectives
3.2 Limiting and adverse conditions
3.3 Oil spill response in offshore zones
3.4 Oil spill response in coastal zones
3.5 Shoreline oil spill response
3.6 Storage and disposal of oil and oily waste

4 Equipment

4.1 Marine oil spill response equipment
4.2 Inspection, maintenance and testing
4.3 Shoreline equipment, supplies and services

5 Management

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
5.5 Advisors and experts – spill response, wildlife and marine environment
5.6 Training / safety schedules and drill / exercise programme

6 Communications

6.1 Incident control room and facilities
6.2 Field communications equipment
6.3 Reports, manuals, maps, charts and incident logs

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.

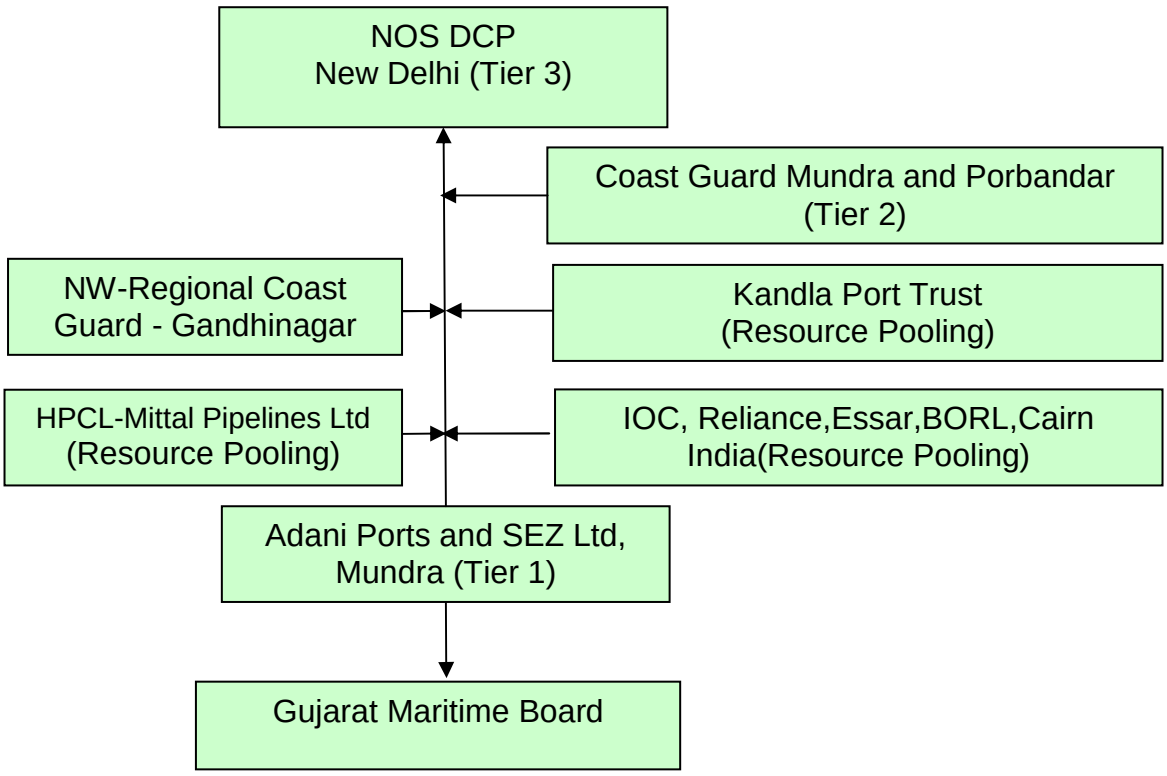
Emergency Response Team

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.

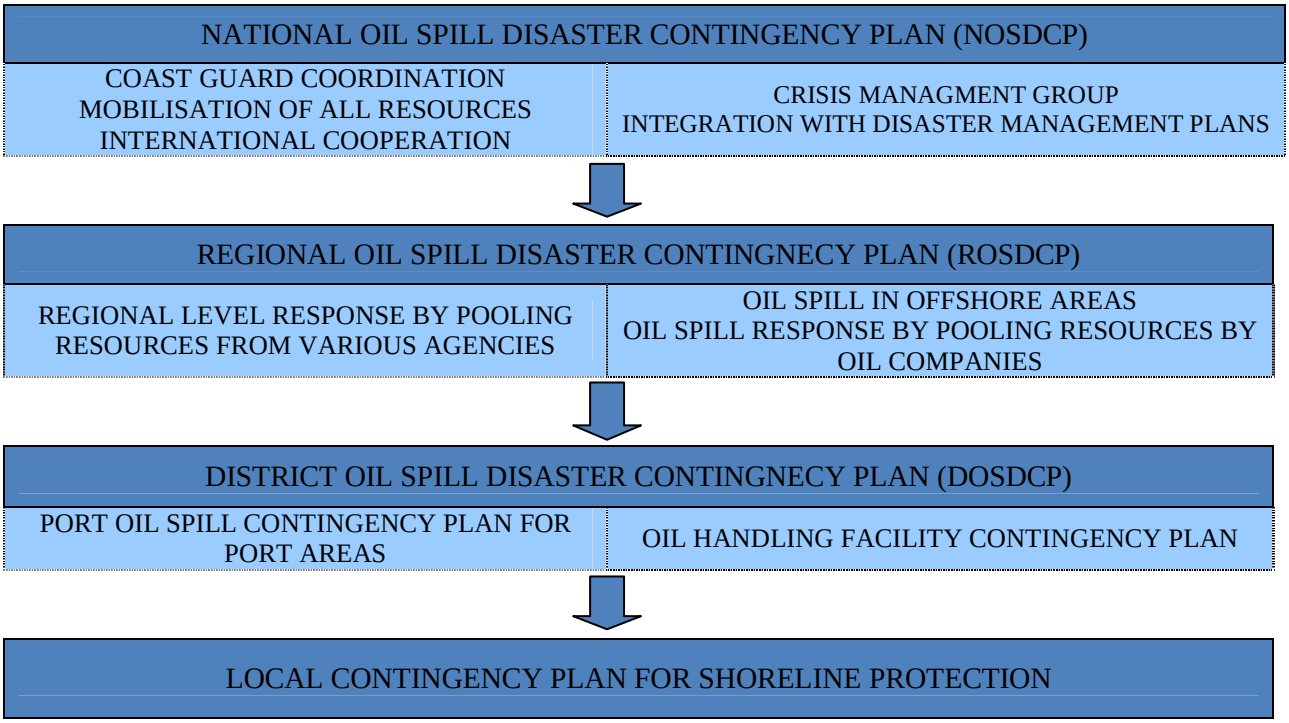


Figure 1 - Contingency Plan hierarchy

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 10000m^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) Spill points: **S1** and **S2** During spring and neap tide conditions (tide conditions : PF and PE)	▪	▪	•
Instantaneous crude oil spill of 700t at the SPMs 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. Spill point: **S4**	▪	▪	•

West Basin (berths)			
100 tons (due to Berthing incident/ collision) at the West Basin berths (FO) Spill point: **S5**	▪	▪	•
50 Tons (due to Berthing incident/ collision (diesel oil tanks) at the West Basin berths (HSD) Spill point: **S5**	▪	▪	•
700 Tons due to Hull Failure / Fire / Explosion (FO) at the berths -- Spill point: **S5**	▪	▪	•
In the maneuvering basin: o 20 Tons of HSD oil due to Tug Impact (HSD) o 100 Tons of FO due to Tug Impact Spill point: **S6**	▪	▪	•
Along the vessel route at one location: Instantaneous oil spill of 700t along the tanker route at a select location.(FO): Spill point: **S7**	▪	▪	•
LNG Berth			
100 tons (due to Berthing incident/ collision) at the LNG berth (FO) -- Spill point: **S8**	▪	▪	•
50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the LNG berth (HSD) – 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) -- 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: o 20 Tons of HSD oil due to Tug Impact o 100 Tons of FO due to Tug Impact Spill point: **S10**	▪	▪	•
At the existing MMPT 1 Berth: **: Spill Point S11**			
100 tons (due to Berthing incident/ collision) at the berth(FO) -- Spill point: **S11**	▪	▪	•
50 Tons (due to Berthing incident/ collision (diesel oil tanks)) at the berth (HSD) – Spill point: **S11**	▪	▪	•
700 Tons due to Hull Failure / Fire / Explosion (FO) at the berth	▪	▪	•

At the existing MICT / AMCT Berths: **: 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: **Spill point S13**			
100 tons (due to Berthing incident/ collision) at the East Basin berth (FO) - Spill point **S13**	▪	▪	•
At the North Basin: **Spill point S14**			
100 tons (due to Berthing incident/ collision) at the North Basin berth (FO) - 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.

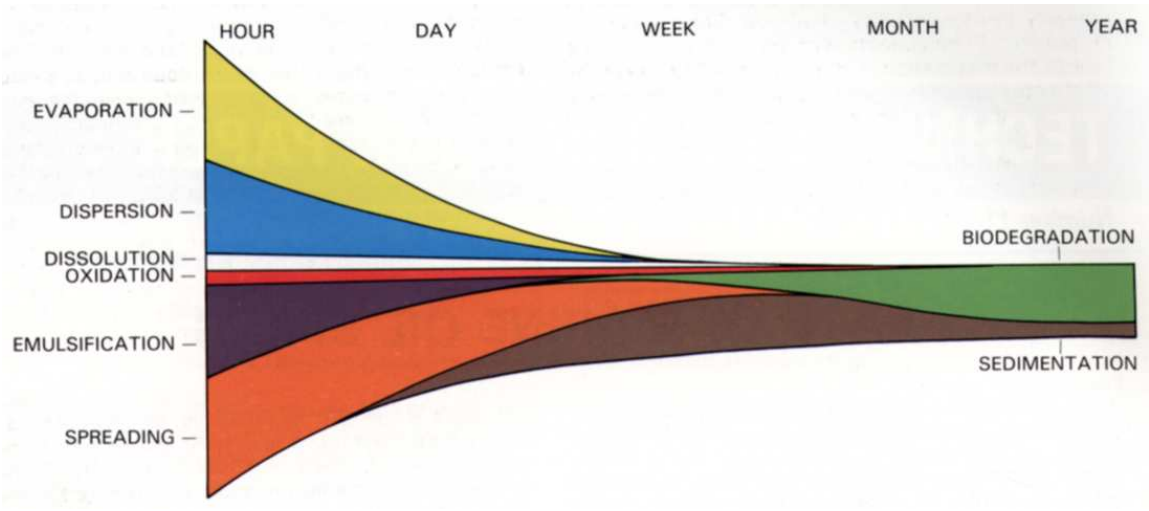
f) **Sedimentation**: Very few oils are sufficiently heavy to sink in sea water. However, the weathered residue gets mixed up with the suspended substances in water and may sink. This process becomes significant when water-in-oil emulsions attain specific gravity near to one and therefore need very little 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.

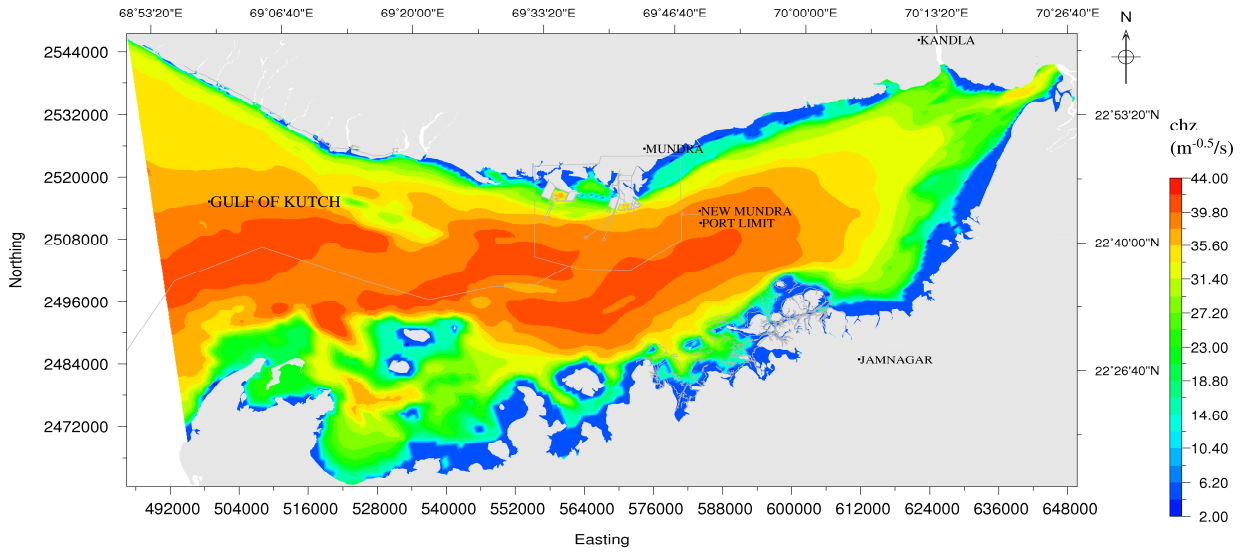


Fig.A1.4 Chezy’s coefficient

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	40250 liters
Absorbent pads	1000
Portable dispersant storage tank: 1000 ltr capacity	1 no.
Portable pumps	2 nos.
Oil discharge hose, 3”, 2 x 10 m	1 set
Rachet belt (Eco make)	10 nos.
Tool box (Eco)	6 nos.
Tanker Trucks	04 nos.
Mini Vacuum Pump (30 m3 / hr)	02 nos.
Slurry Pump (60 m3 / hr)	01 no.

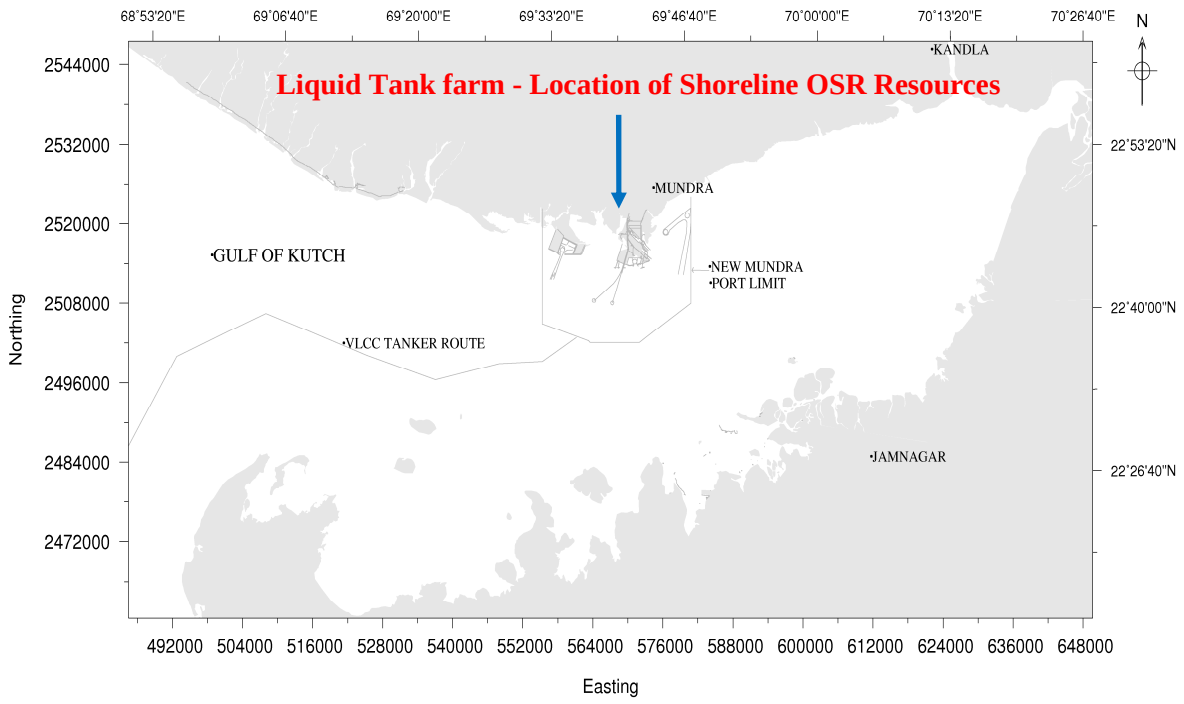


Fig.1.1 :General Arrangement of the marine facilities at Mundra port showing the VLCC route and facilities within the new Mundra port limit considered for carrying out the oil spill risk assessment studies.

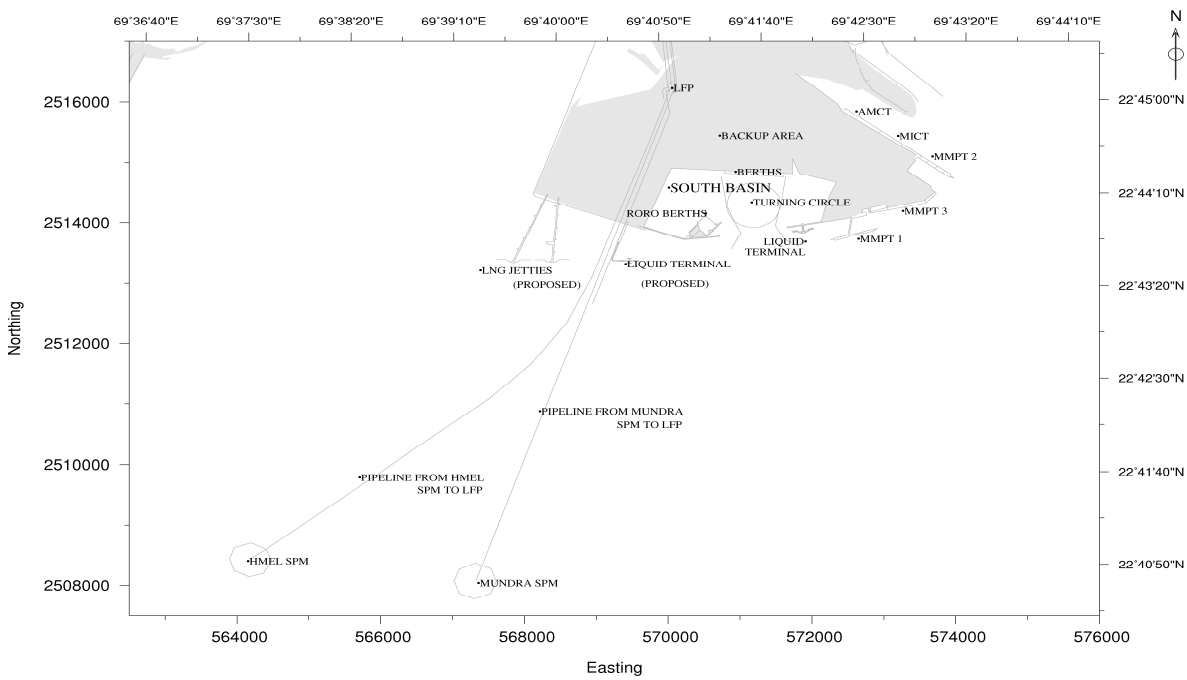


Fig1.2: Zoomed up portion of the South Basin showing the berths, turning circle, LNG jetty and existing berths as well as SPMs.

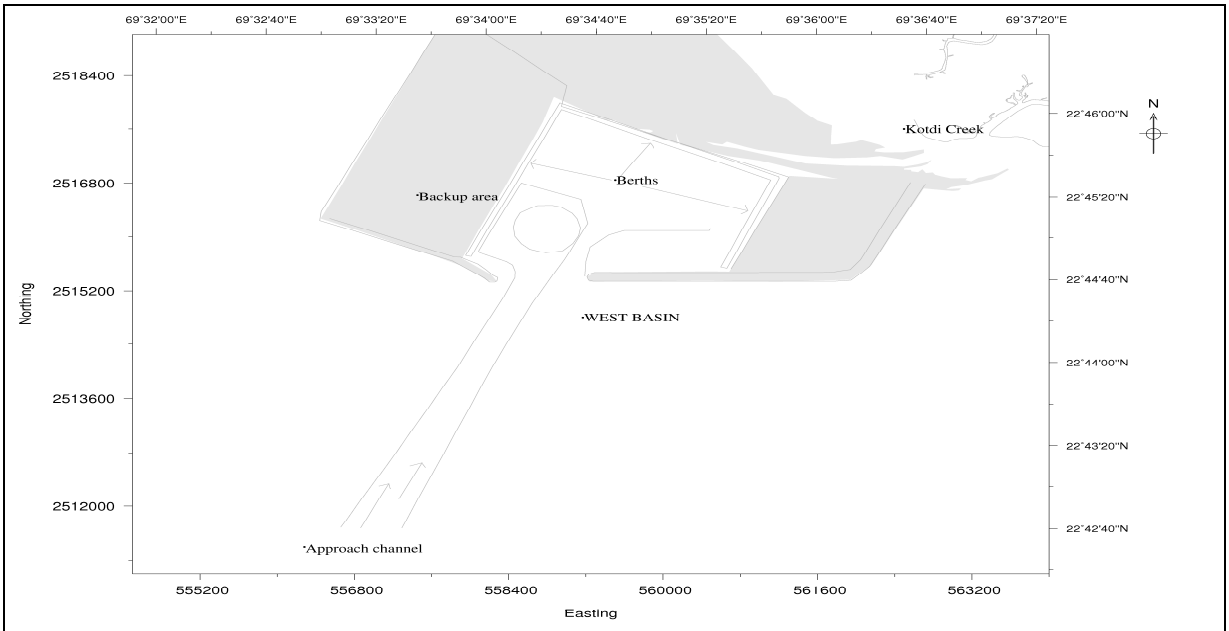


Fig.1.3 Zoomed up portion of the West Basin showing the berth locations and the approach channel for the vessels

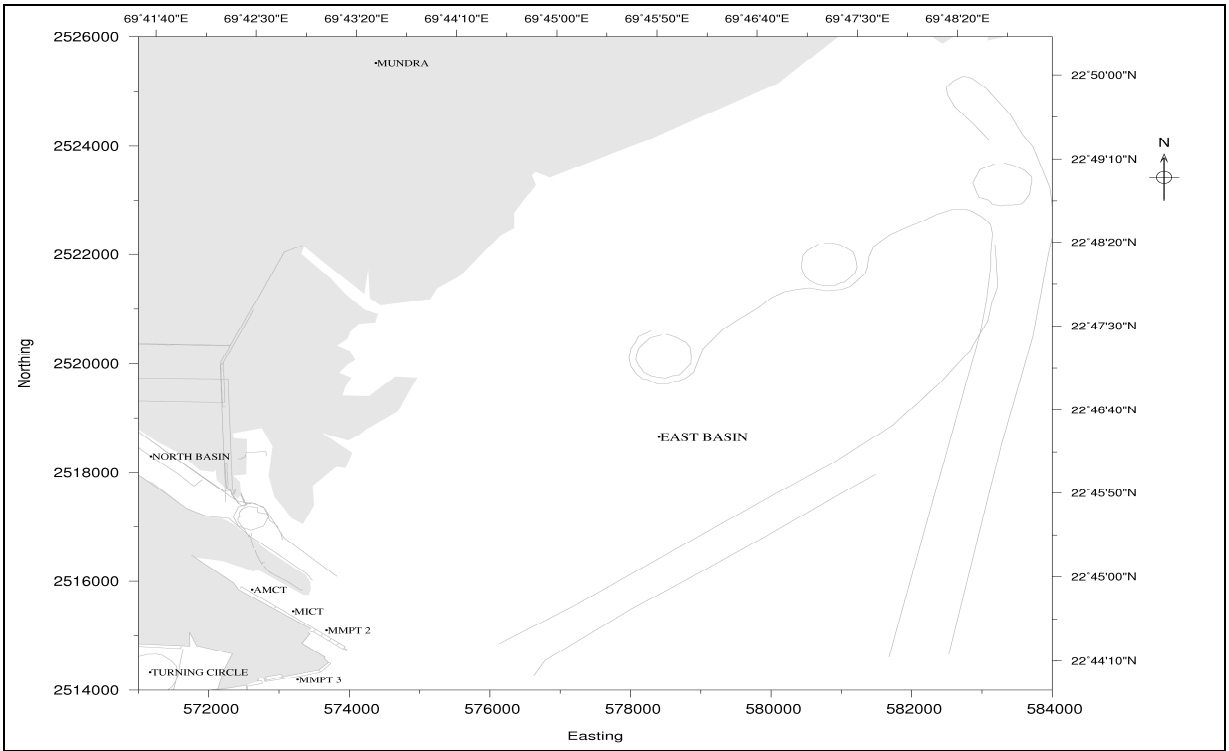


Fig.1.4 Zoomed up portion showing the East Basin & North Basin

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 nox10^3/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 nox10^3/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 (nox10^3/l)	Total genera (no.)	Cell count (nox10^3/l)	Total genera (no.)	Cell count (nox10^3/l)	Total genera (no.)	Cell count (nox10^3/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 (nox10^3/l)	Total genera (no.)	Cell count (nox10^3/l)	Total genera (no.)	Cell count (nox10^3/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 69^o 42' 07.8''E	*A. marina*	100	Sep-67 -38	0.5 - 3.5	<2.6 - 6	0 - 2
D2	22^o 26' 50.5''N 69^o 41' 52.9''E	*A. marina*	40	0 - 5 -2	0.5 - 1.5	<2.5 - 4	0 - 1
Vadinar (Dargah - south side; afforested area)							
D3	22^o 26' 30.8''N 69^o 42' 05.6''E	*A. marina*	100	(20 - 75) -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 69^o 43' 43.2''E	*A.marina* *C.tagal* *R.mucronata*	100 10 5	20-45 (38) 0.7* 0.2*	2-3 - -	3-8 - -	0-85 - -
N2	22^o 27' 59.1''N 69^o 43' 21.3''E	*A.marina*	100	60-90 (85)	2-4	25-12	0-7
N3	22^o 28' 03.5''N 69^o 43' 27.4''E	*A.marina* *R mucronata*	100 3	28-85 (50)	0.5-2.5 -	<15-7 -	0-55 -
N4	22^o 28' 07.2''N 69^o 43' 24.6''E	*A.marina*	100	30-130 (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/100m^3 (av 3.3 ml/100m^3) and 2.2-722.7 x 10^3/100m^3 (av 39 x 10^3/100m^3), respectively while during October 2010 the zooplankton biomass and abundance ranged from 0.2 to 12.0 ml/100m^3 (av 3.5 ml/100m^3) and 2.5-157.8 x 10^3/100m^3 (av 48.4 x 10^3/100m^3) respectively suggesting normal secondary production off Vadinar during the monitoring period.

The average zooplankton biomass (ml/100m^3), population density (nox10^3/100m^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 (nox10^3/100m^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.

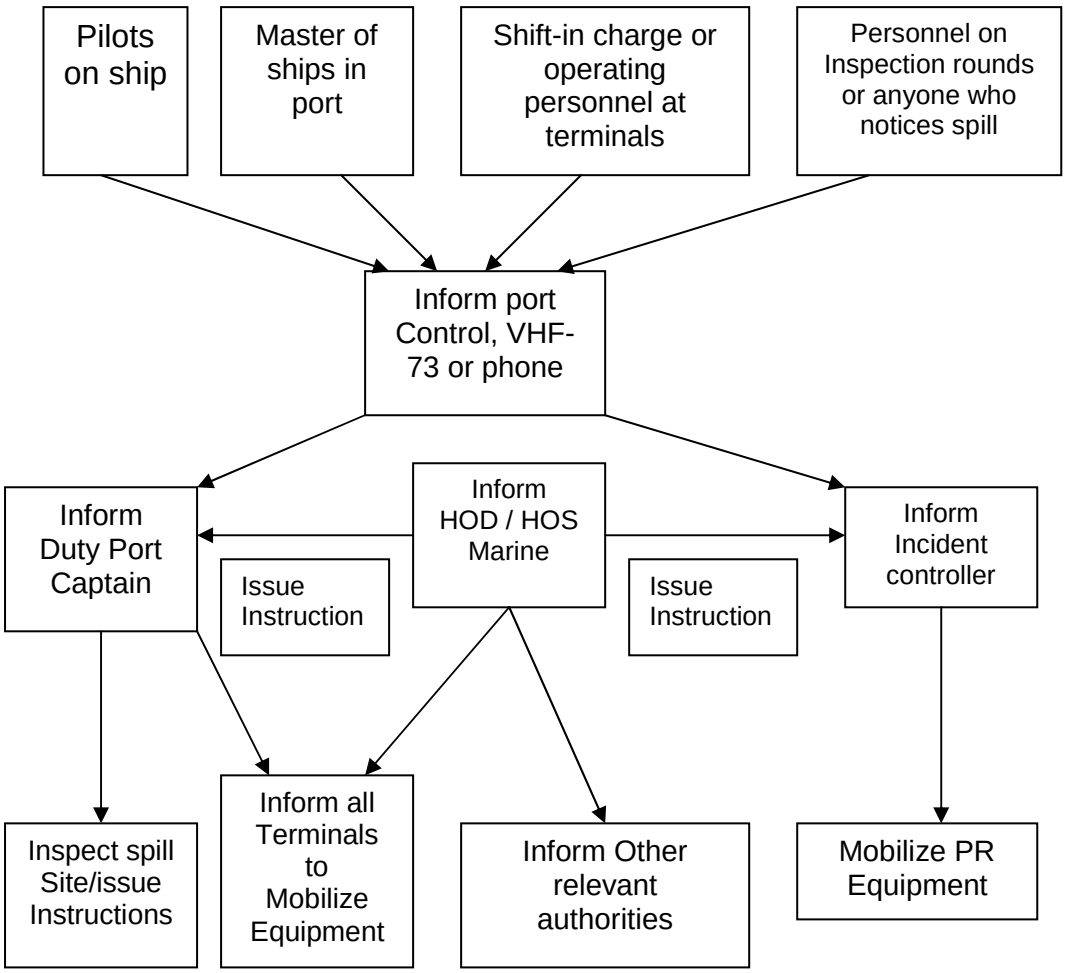
3.3 Oil spill response in offshore zones

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 ; - Heat treatment - Emulsion breaking chemicals - Mixing with sand	Use of recovered oil as fuel or refinery feedstock. Burning Return of separated sand to source.
SOLIDS	Oil mixed with sand	Collection of liquid oil leaching from sand during temporary storage Extraction of oil from sand by washing with water or solvent Removal of solid oil by sieving	Use of recovered oil as fuel or refinery feedstock. Direct disposal Stabilization with inorganic material. Degradation through land farming or composting. Burning
	Oil mixed with cobbles, pebbles or shingle	Collection of liquid oil leaching from beach material during temporary storage Extraction of oil from beach material by washing with water or solvents	Direct disposal. Burning
	Oil mixed with wood, plastics, sea weeds, sorbents	Collection of liquids leaching from debris during temporary storage Flushing of oil from debris with water	Direct disposal. Burning. Degradation through land farming or composting for oil mixed with sea weeds or natural sorbents.
	Tar balls	Separation from sand by sieving	Direct disposal Burning

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:-

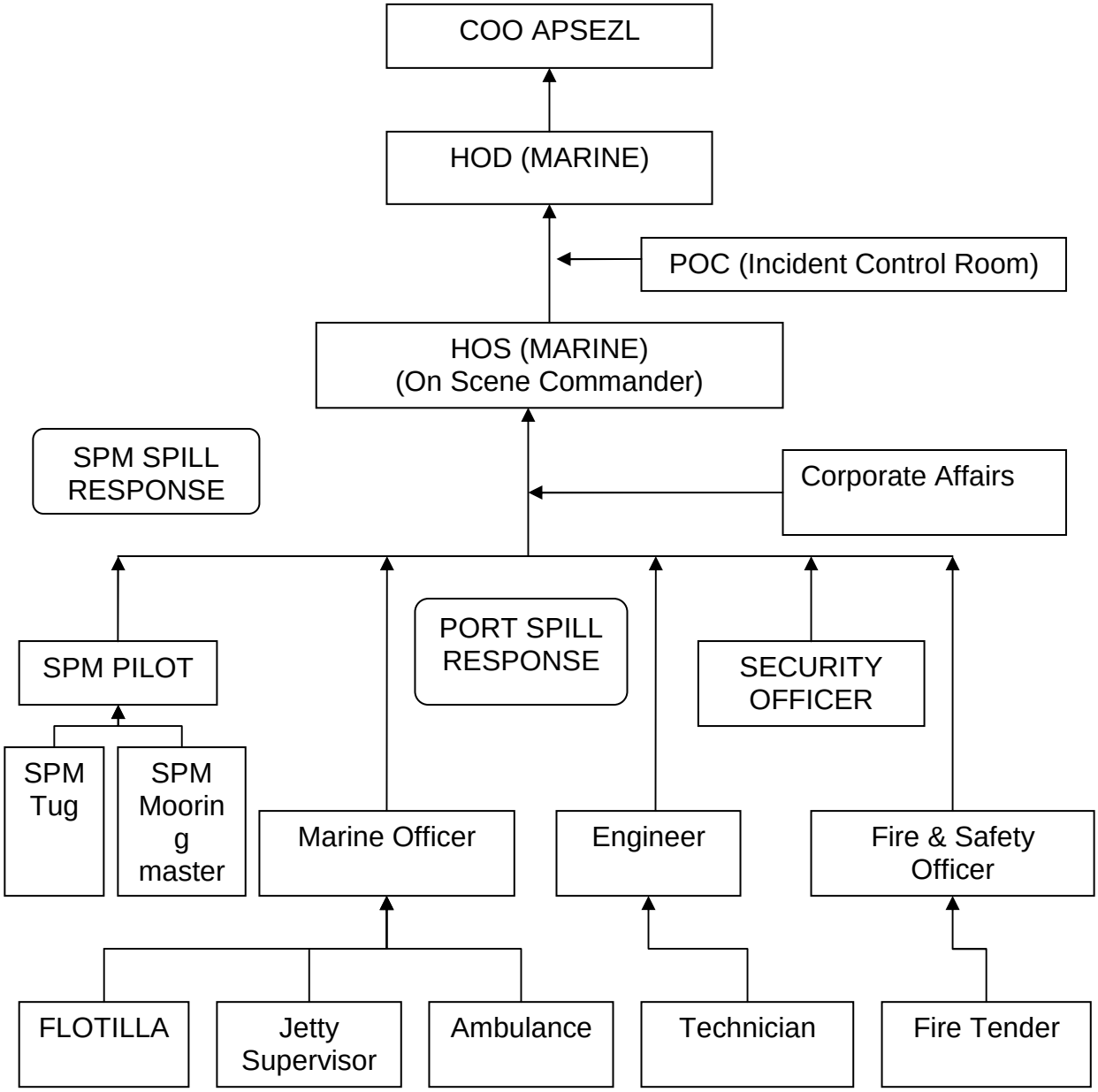
- Protective clothing for everybody (including boots and gloves), spare clothing.
- Cleaning material, rags, soap, detergents, and brushes.
- Equipment to clean clothes, machinery, etc., with jets of hot water.
- Plastic bags (heavy duty) for collecting oily debris.
- Heavy duty plastic sheets for storage 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 - 36
IMO Level-2 - 08

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

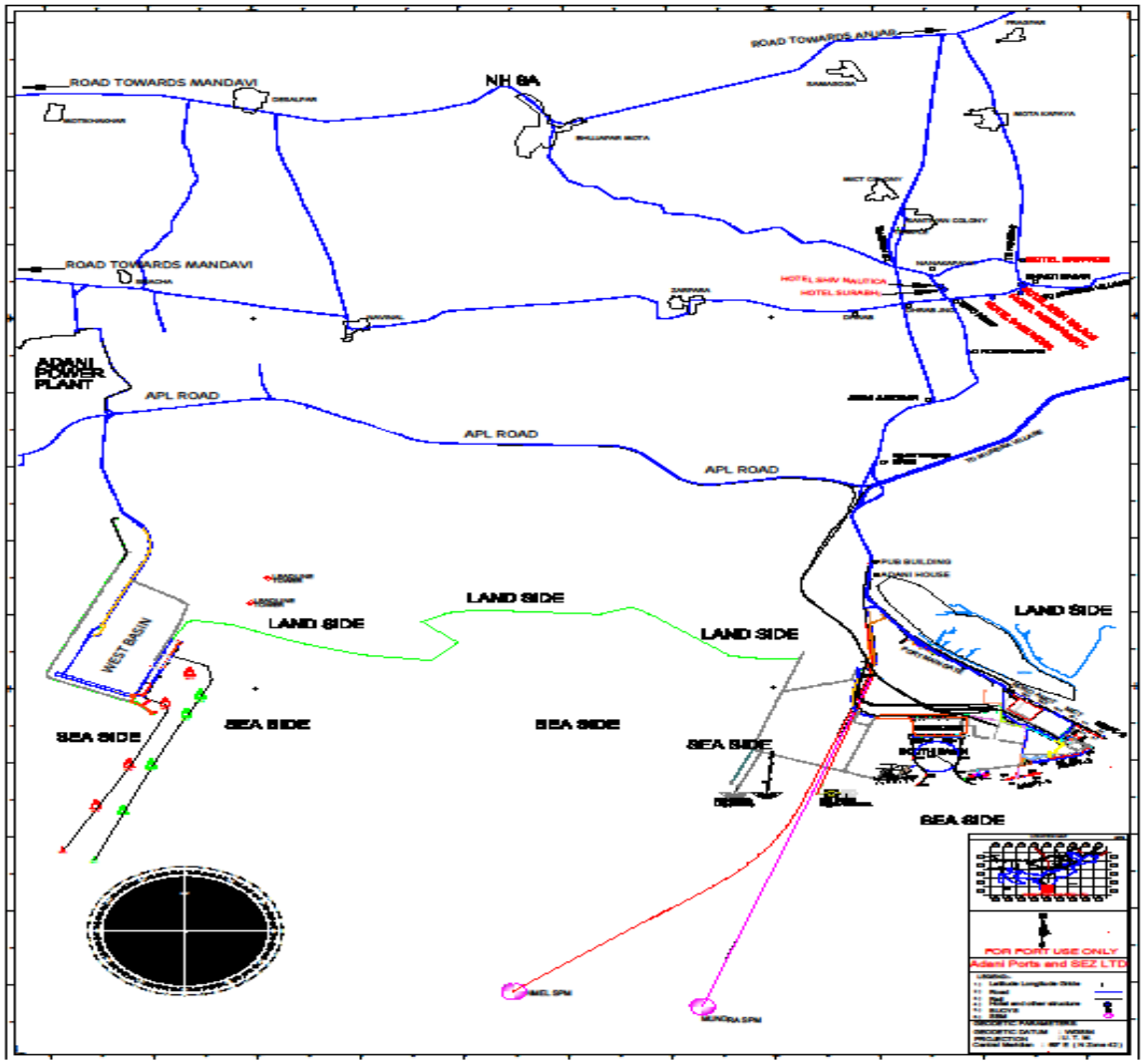
A complete spill response report will be produced by the Marine manager providing comprehensive and all-inclusive details of the circumstances leading to the spill, initial response and consequent affect of the same, subsequent follow up, effect of prevailing weather, adverse situations, safety issues, 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

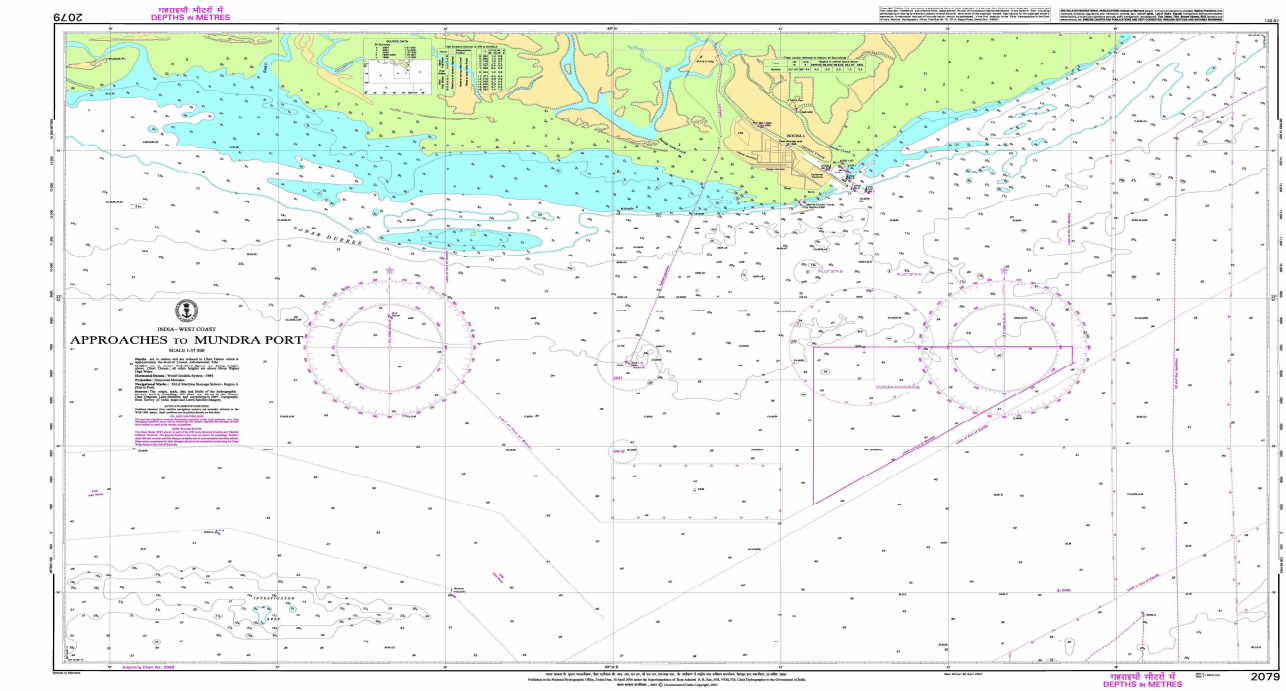
1. Coastal facilities, access roads, hotels etc.

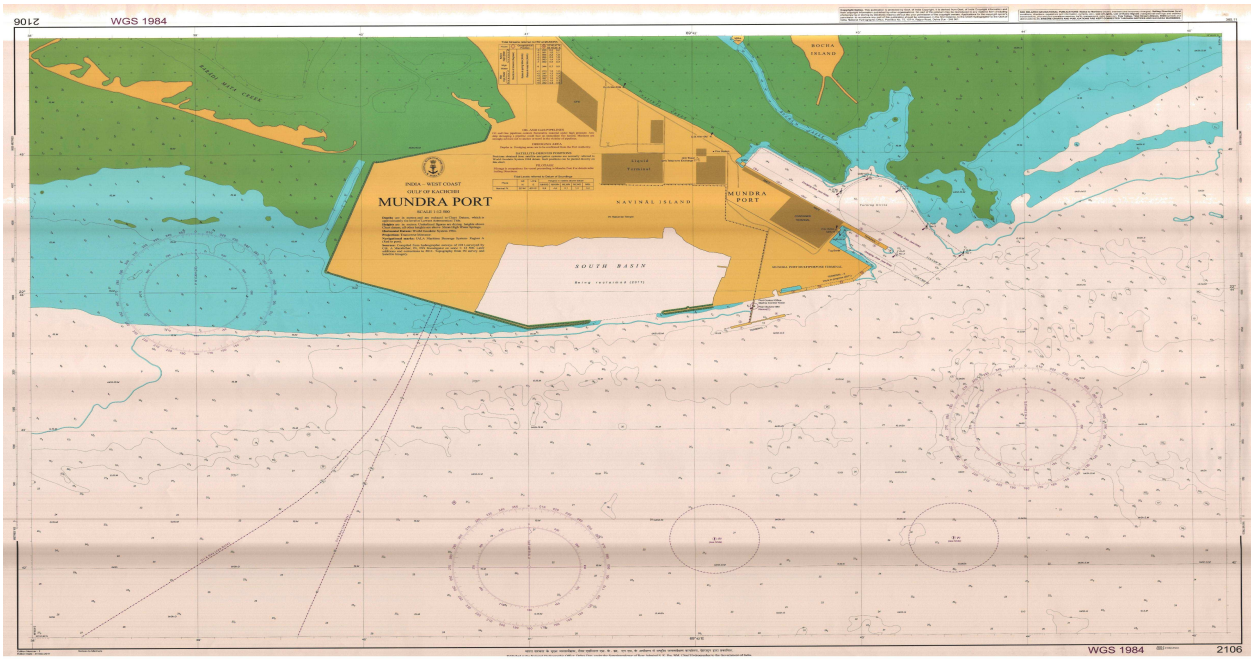


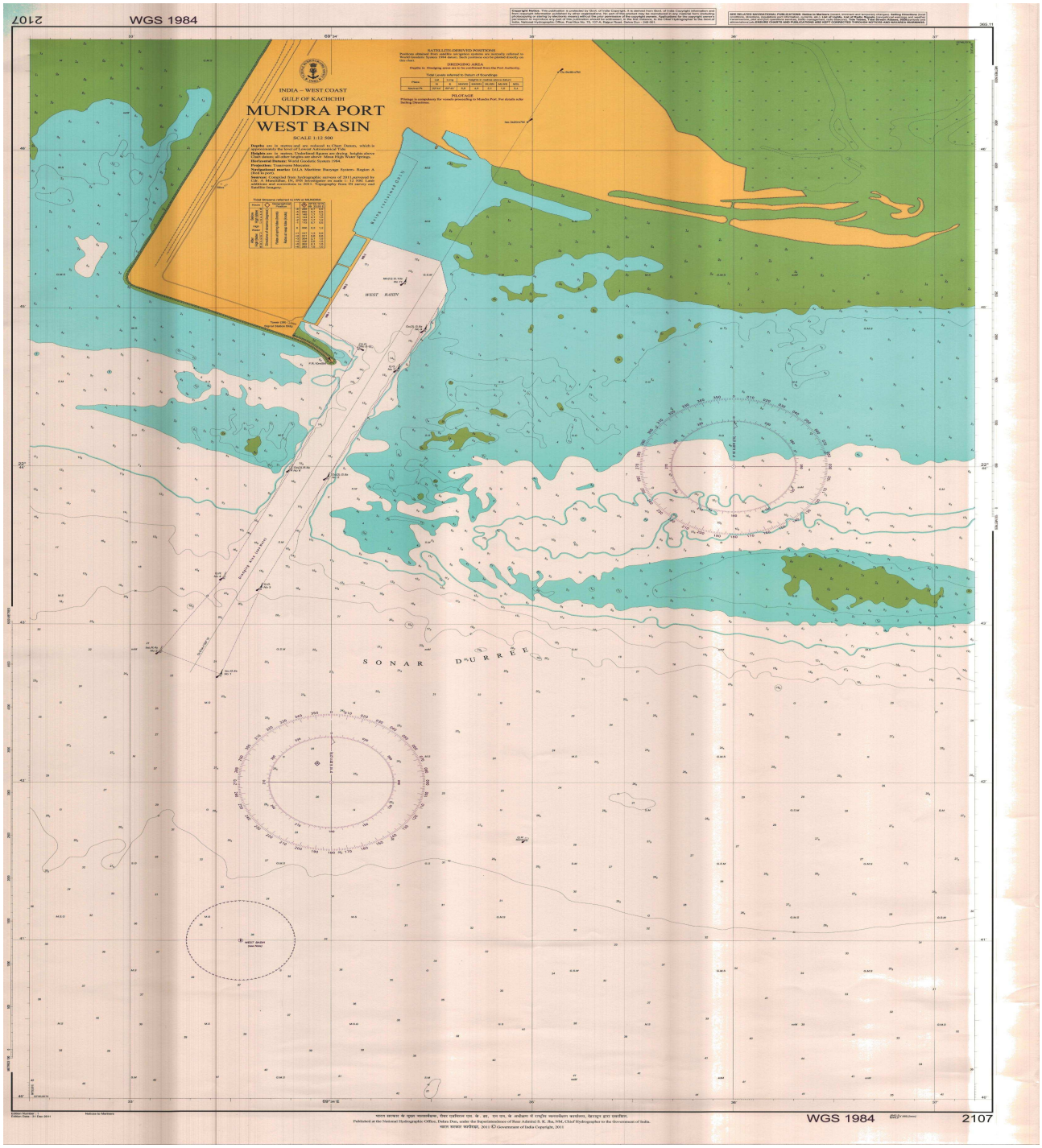
Telephones: Detailed in Annexure **4**

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
INDIA – WEST COAST
GULF OF KACHCHH
MUNDRA PORT
WEST BASIN
SCALE 1:12 500
SATELLITE-DERIVED POSITIONS
DREDGING AREA
PILOTAGE
WEST BASIN
SONAR DURREE
WGS 1984
2107

3. Risk locations and probable fate of oil

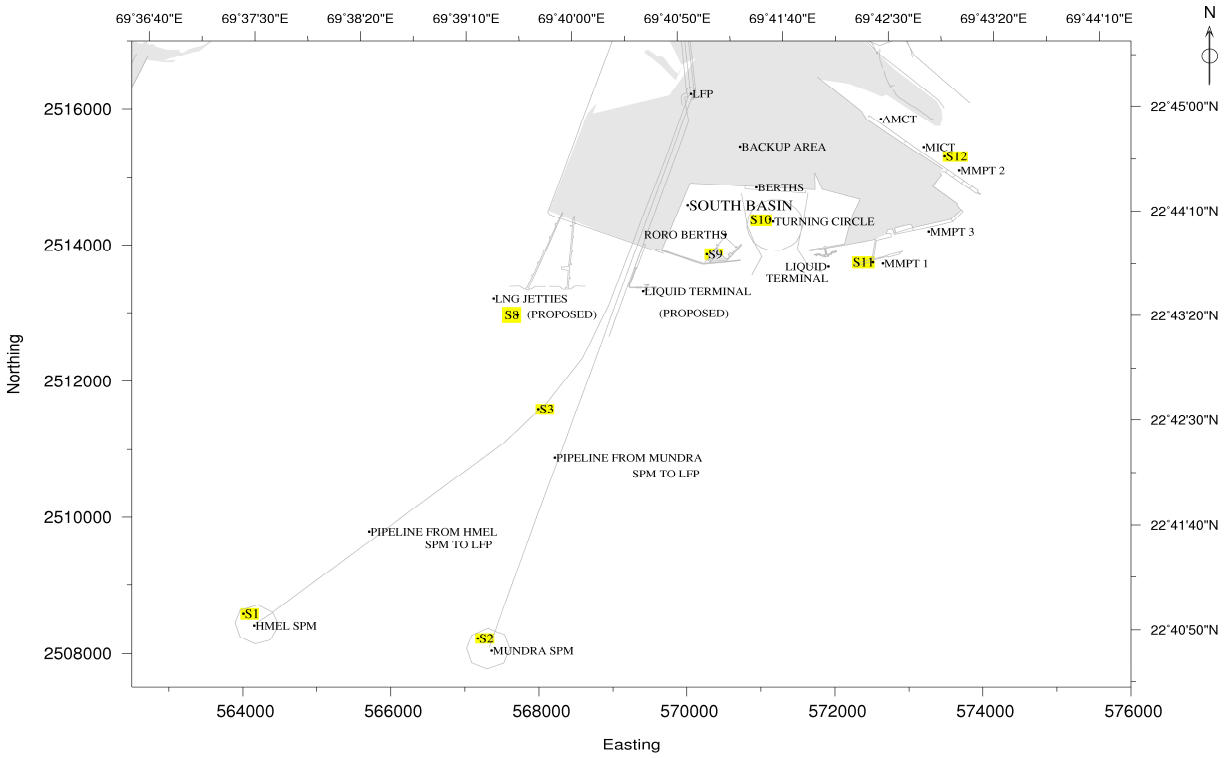


Fig.1: General layout of the Mundra port facilities of APSEZL showing the location of Spill Points for SPMs, South Basin berths, LNG jetty and existing berths

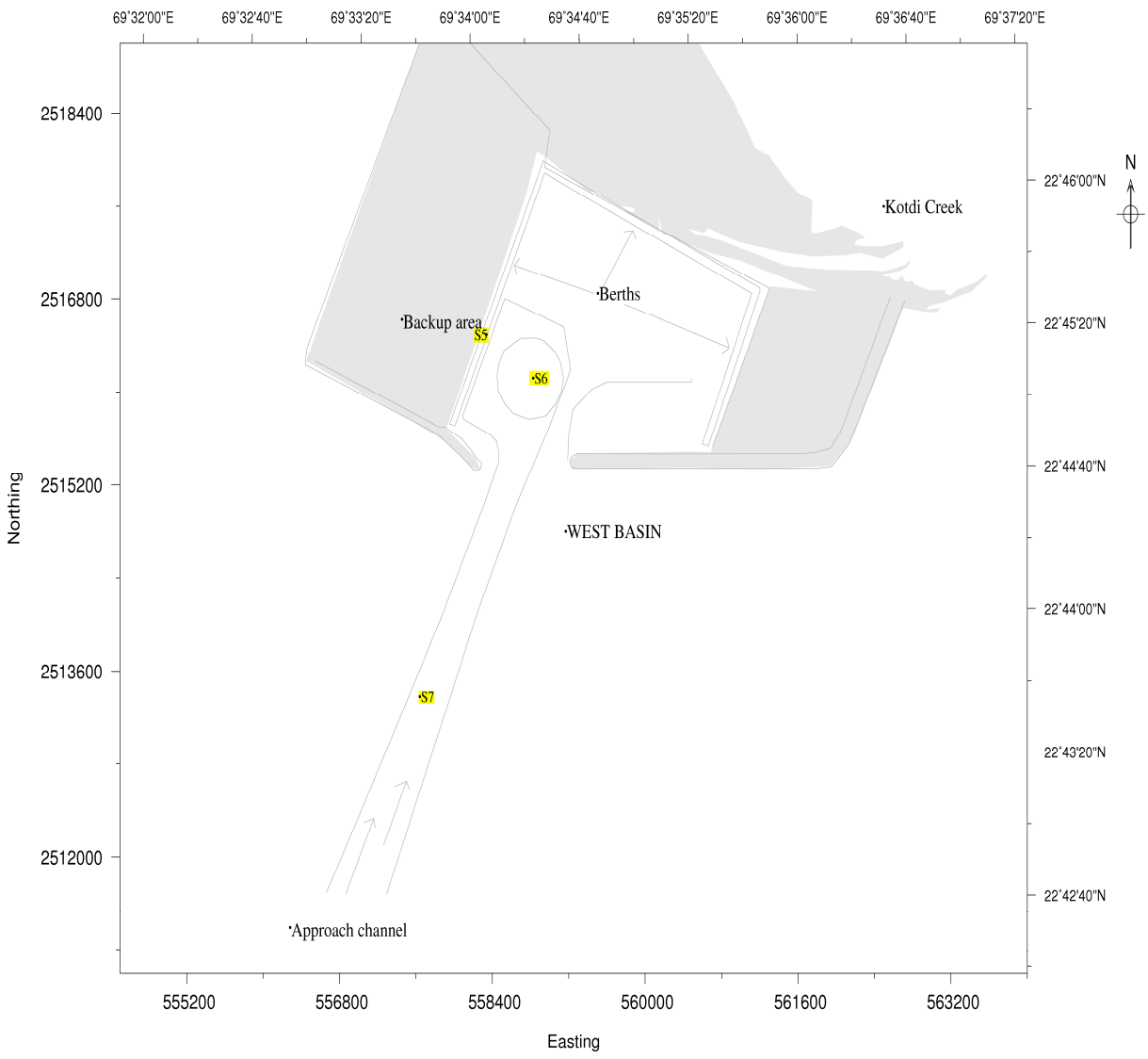


Fig.2: Zoomed up portion of Mundra port facilities of APSEZL showing the location of Spill Points for West Basin

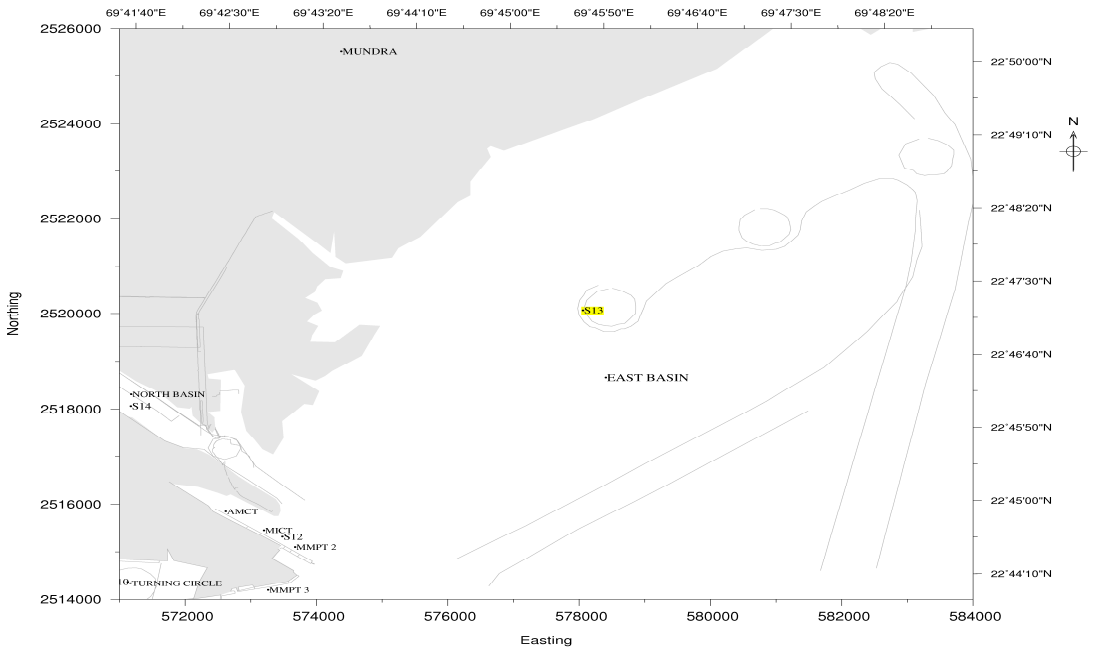
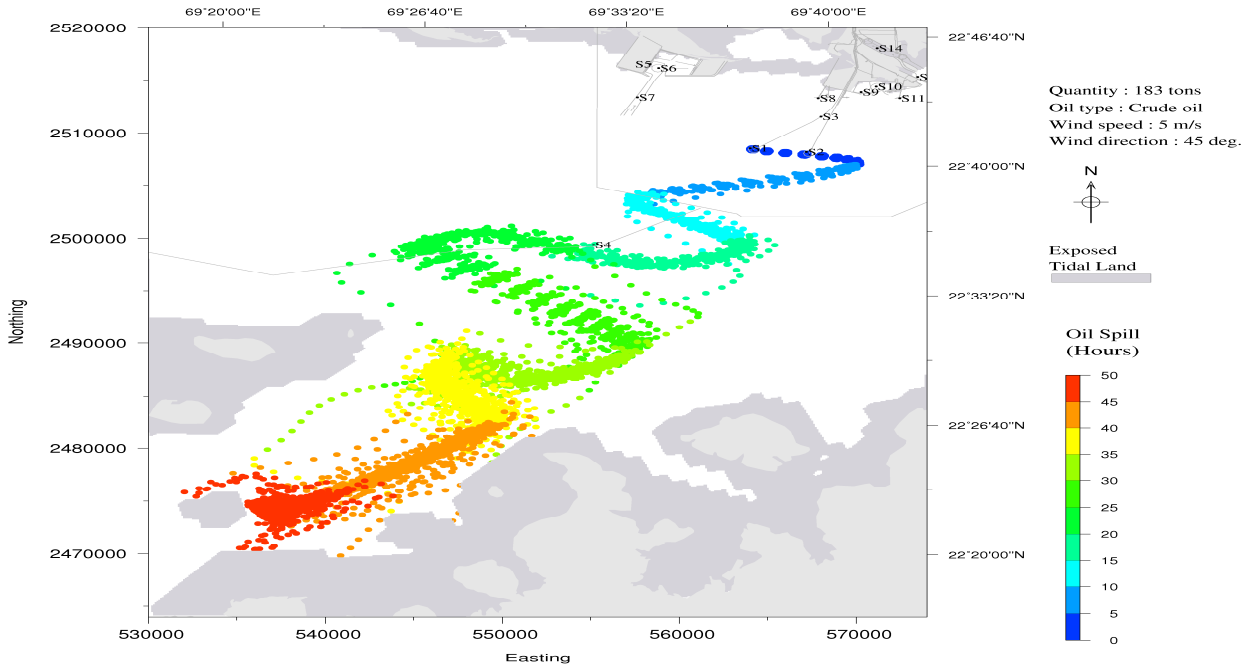
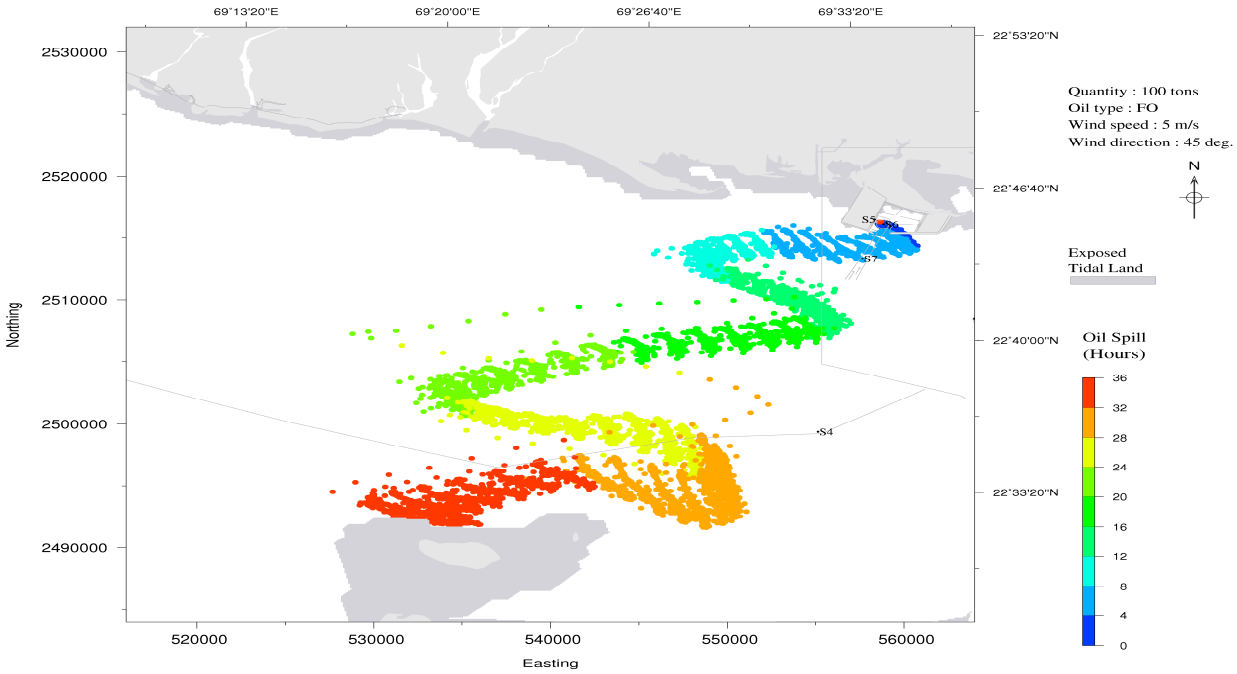


Fig.3: Zoomed up portion of Mundra port facilities of APSEZL showing the location of Spill Points for North Basin & East Basin



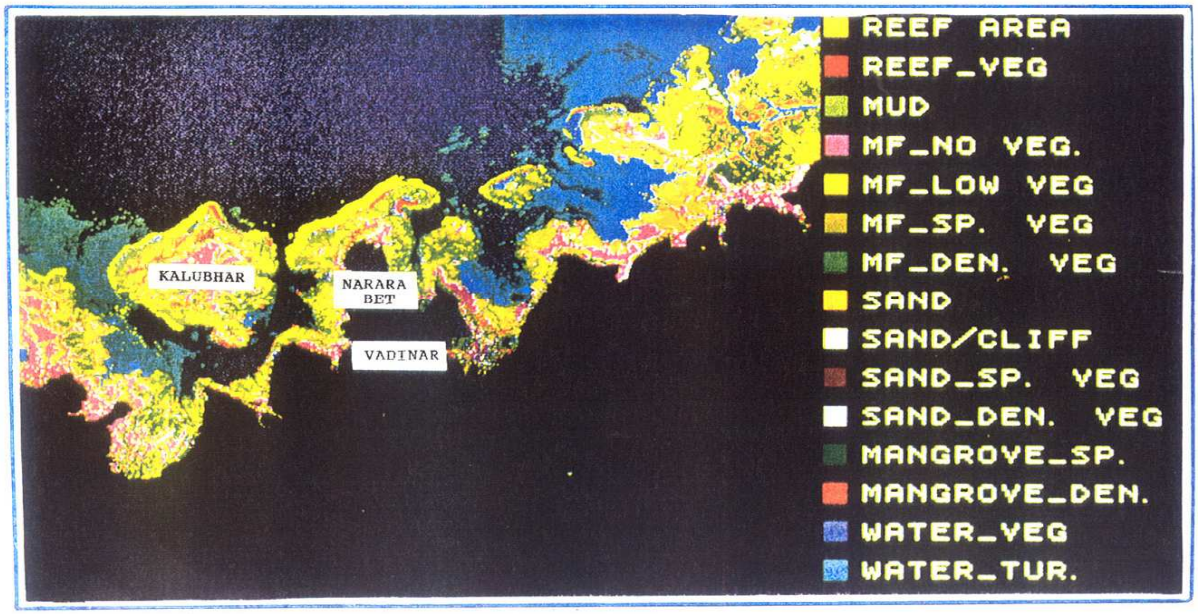
Oil Spill trajectory due to instantaneous crude oil leakage of 700 t (due to collision) at spill point S1 (HMEL SPM) after 50 hours during flood condition of the neap tide



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

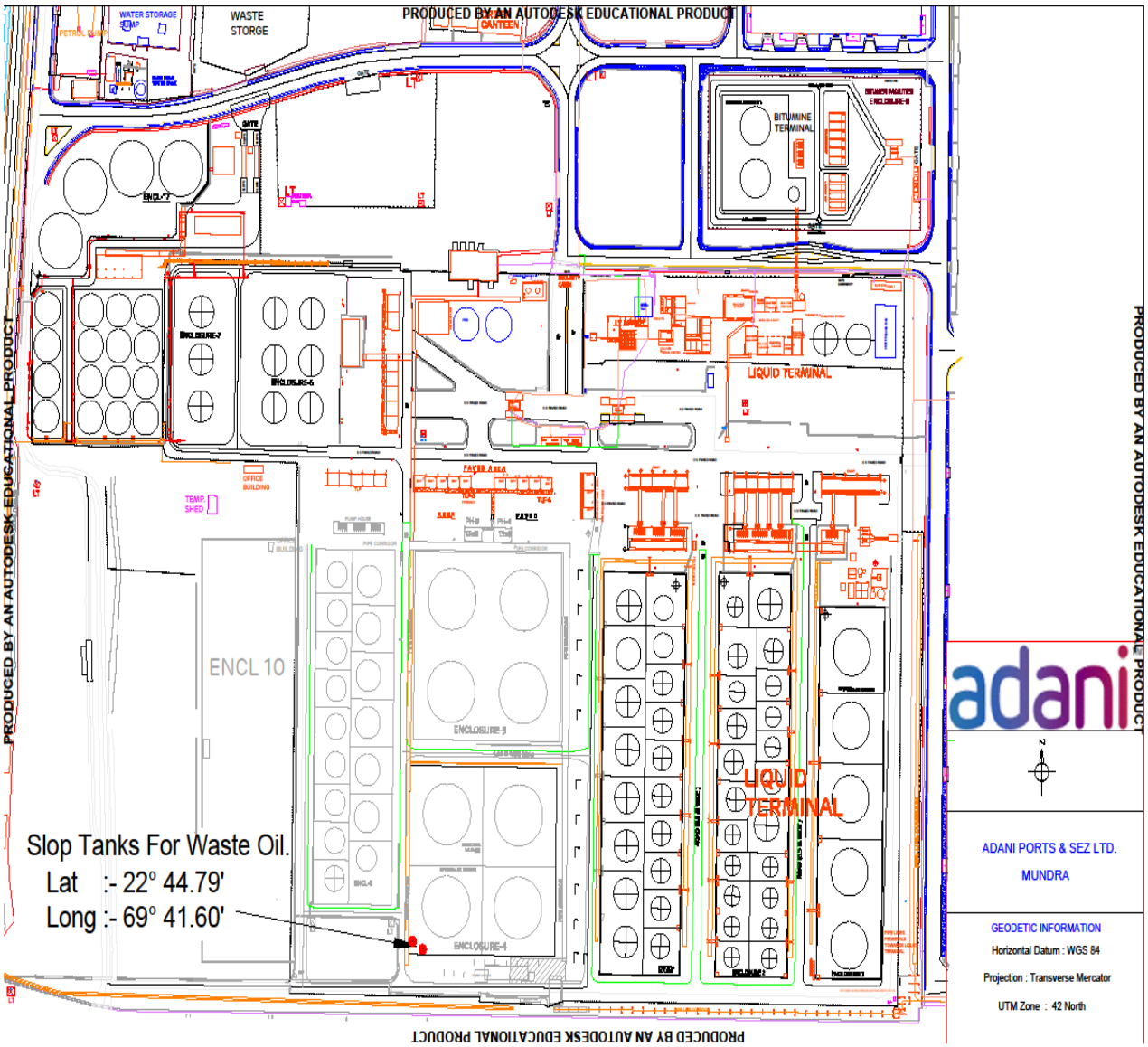
For Risk locations and probable fate of oil refer Annexure- V (Volume 2) of Oil Spill Risk Assessment.

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

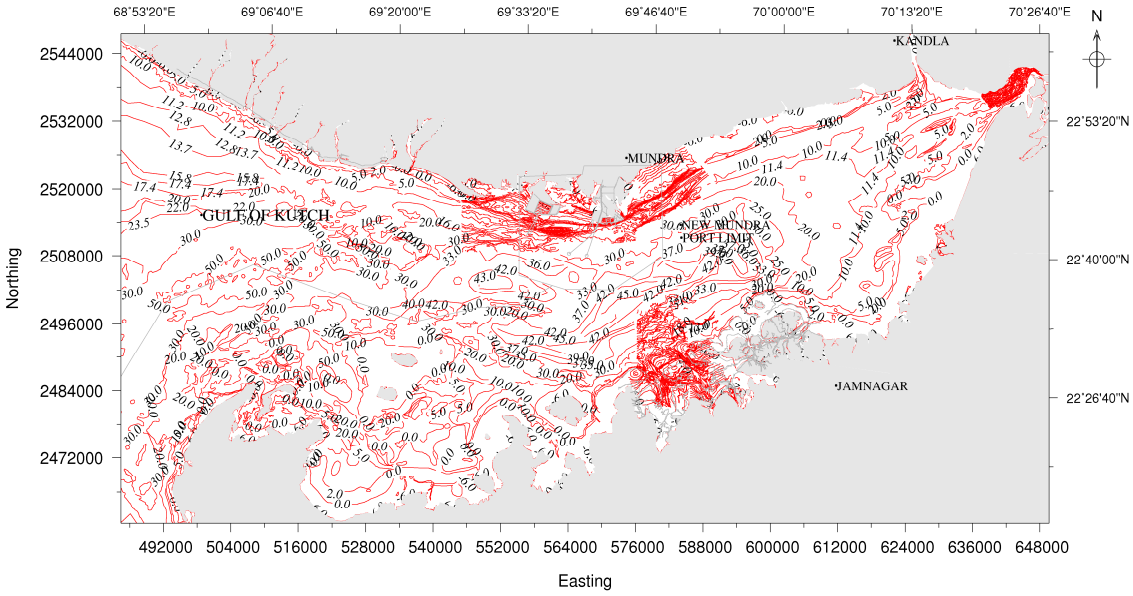


Fig.A1.1 Terrain features of study domain.

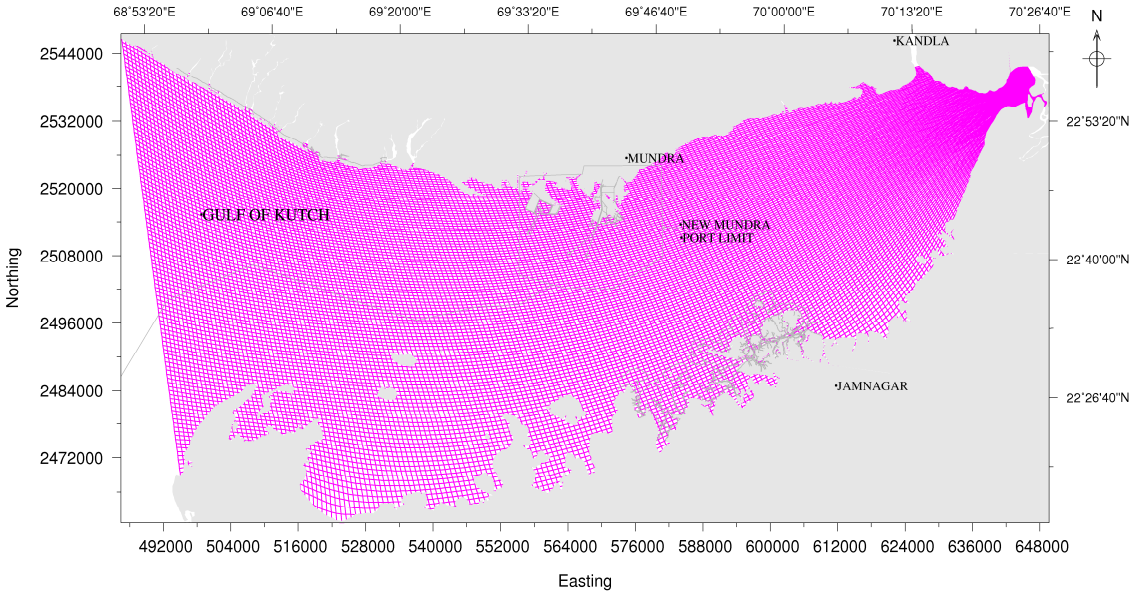


Fig.A1.2 Computational grid

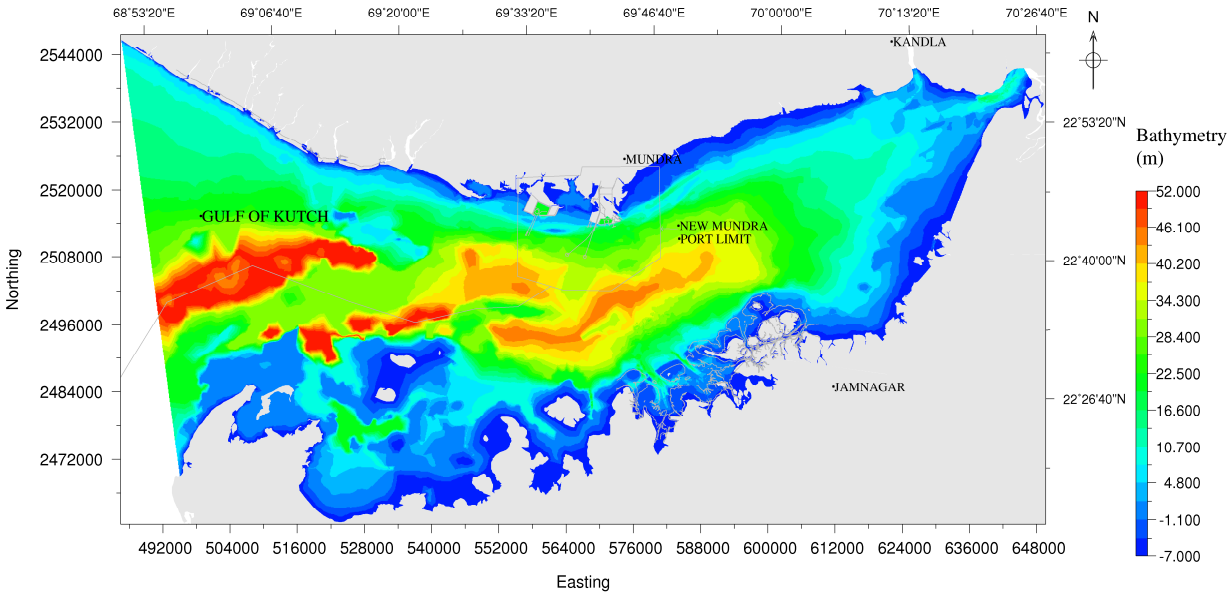


Fig.A1.3 Interpolated depth contours

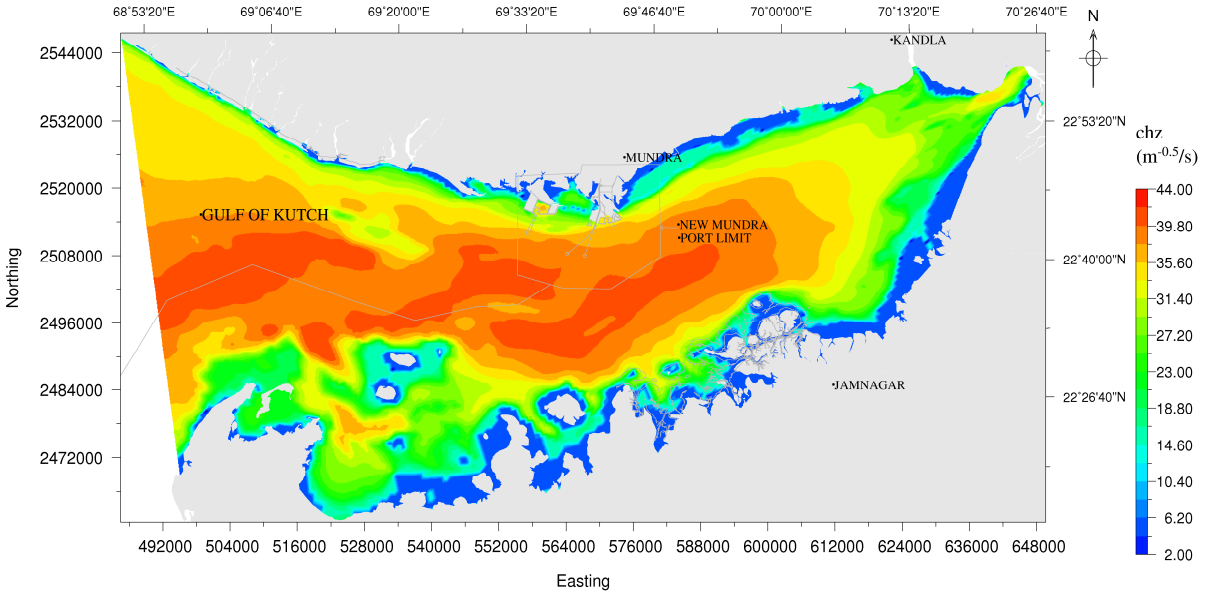


Fig.A1.4 Chezy's coefficient

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 (^{o}C)	Specific Heat of Liquid (J/Kg ^{o}K)	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^{o}C during 2005, it occasionally exceeds 40^{o}C. 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.

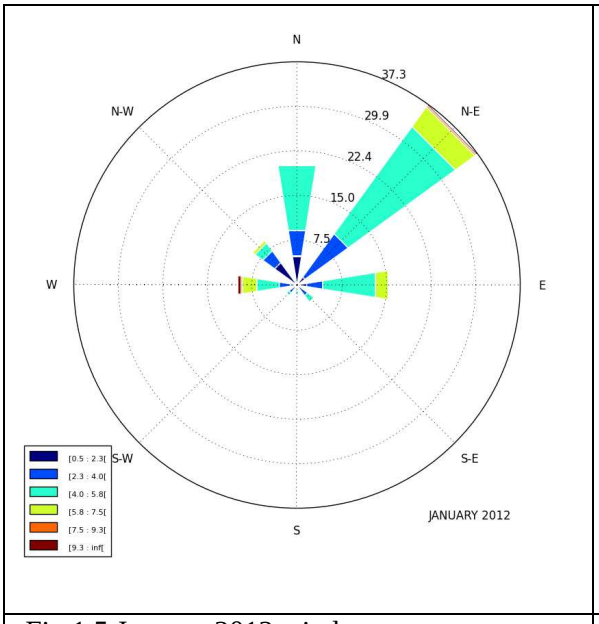


Fig.1.5 January 2012 winds

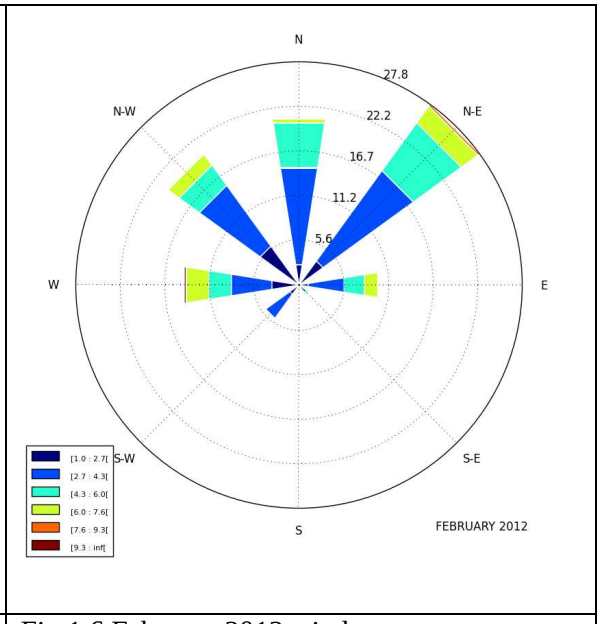


Fig.1.6 February 2012 winds

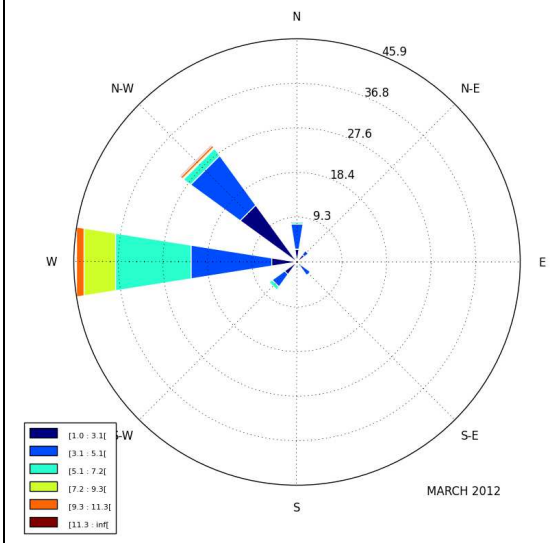


Fig.1.7 March 2012 winds

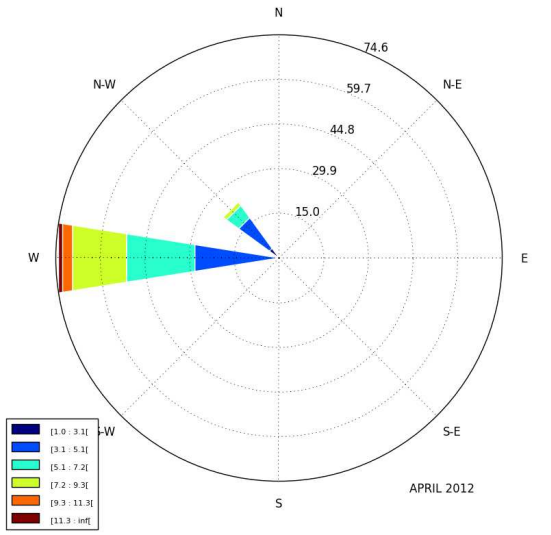


Fig.1.8 April 2012 winds

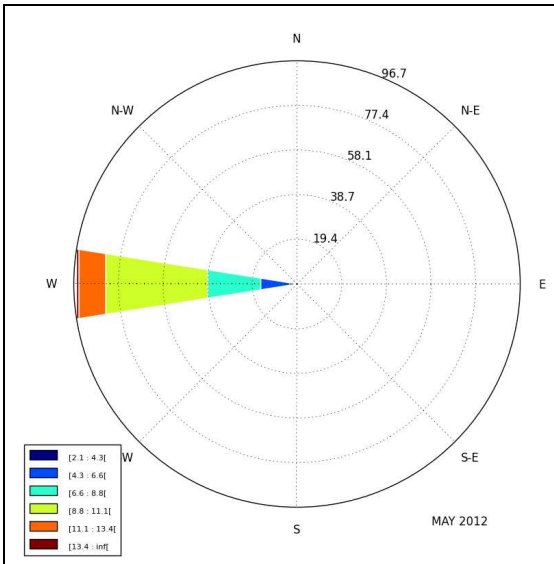


Fig.1.9 May 2012 winds

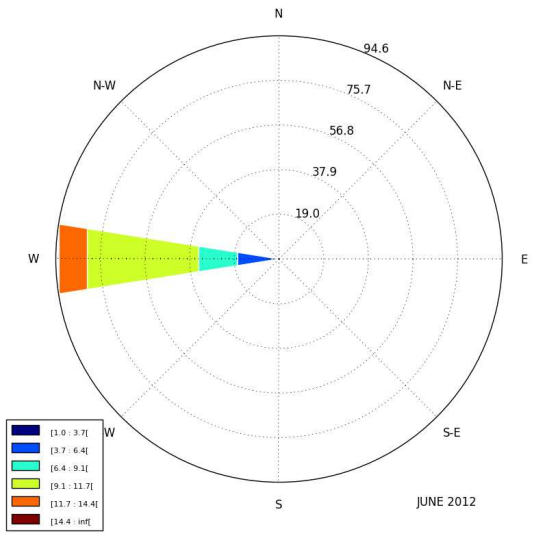


Fig.1.10 June 2012 winds

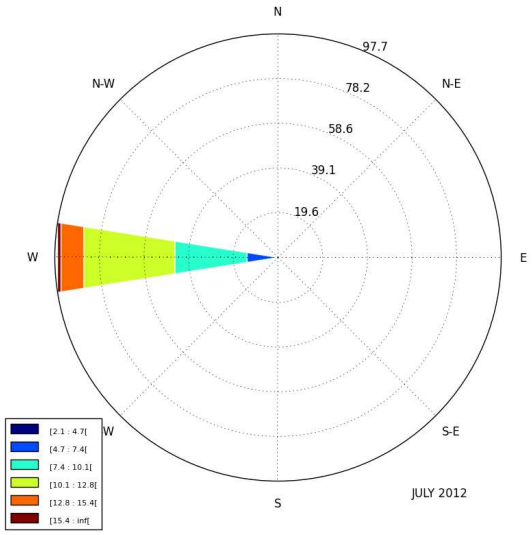


Fig.1.11 July 2012 winds

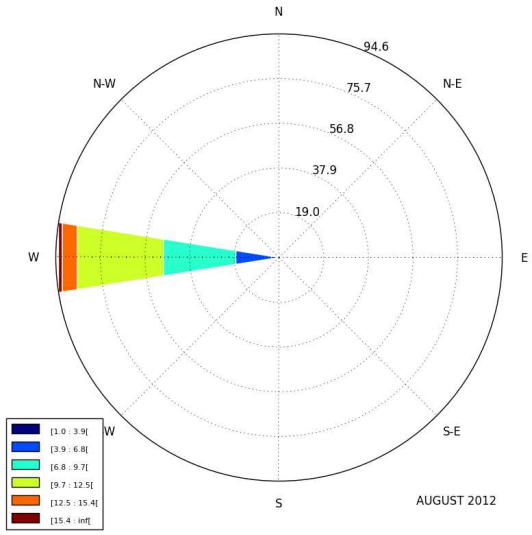


Fig.1.12 August 2012 winds

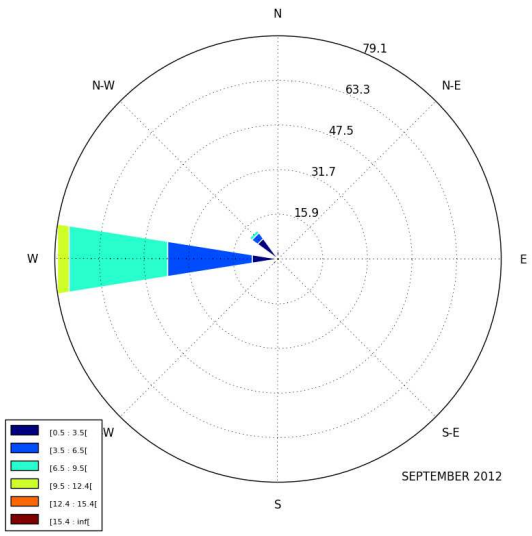


Fig.1.13 September 2012 winds

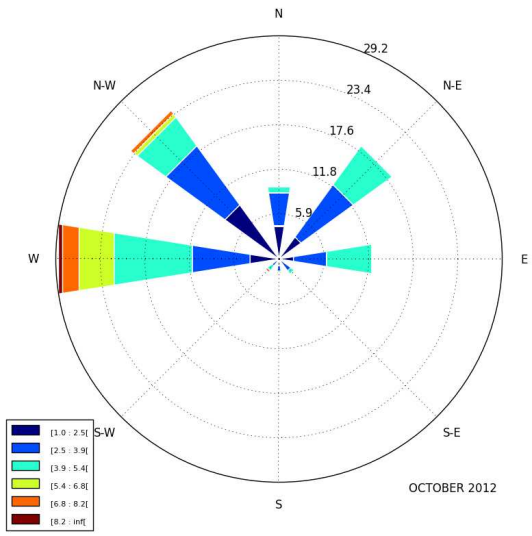


Fig.1.14 October 2012 winds

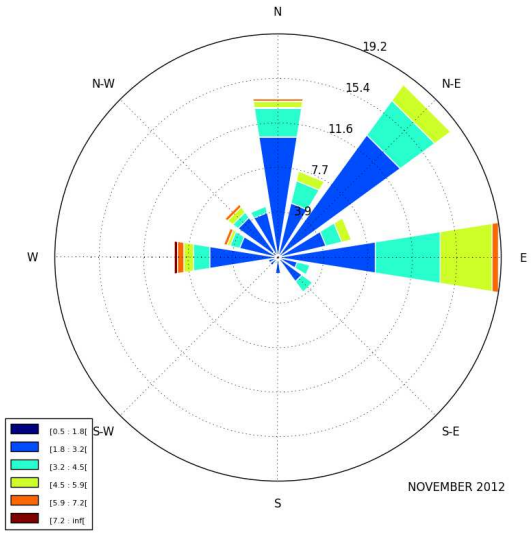


Fig.1.15 November 2012 winds

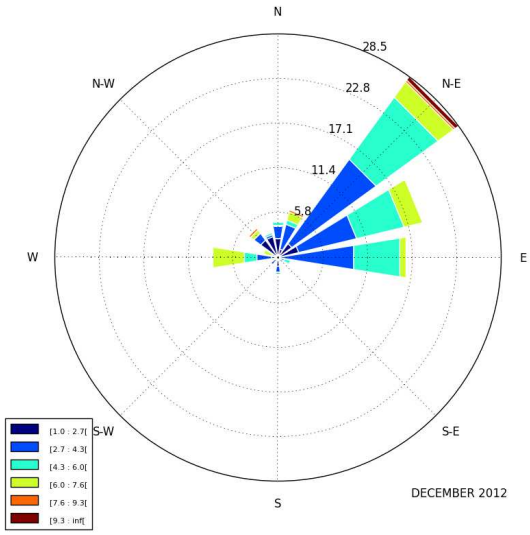


Fig.1.16 December 2012 winds

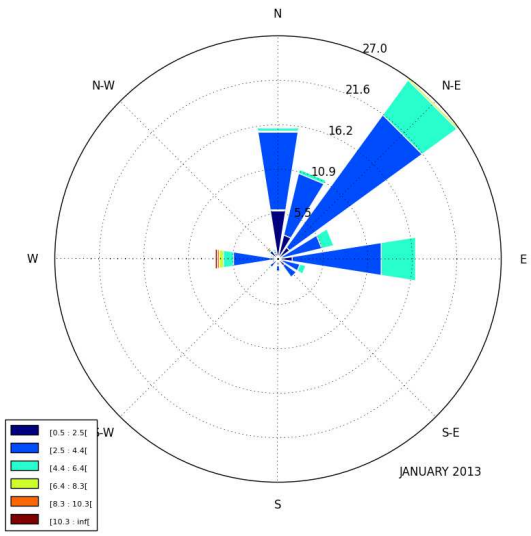


Fig.1.17 January 2013 winds

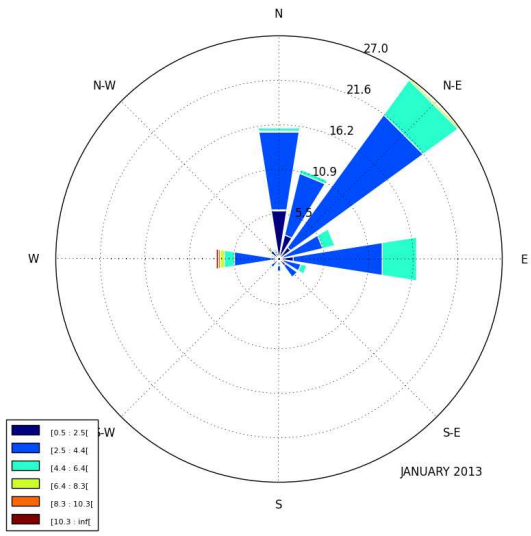


Fig.1.18 February 2013 winds

(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. 6	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. 8	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. 12	ASD	3000 X 2	3000 ltr	2000 ltr	1200	70
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. , 6, 7, 8, , 10, 11, 12, 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. 6, 7, 8, 11, 12, 14, 15, 16, 17 & 18 are fitted with a fire curtain and remote controlled fire monitors.

All above twelve 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.

Resources / Equipment Available with APSEZL, Mundra

Item	Quantity
Canadyne Fence Boom (Reel model 7296/8496 with Power Pack, Towing bridles and Tow lines - 255 Mtrs	1 no
Eco air boom with accessories - 300 m	1 no.
Fence boom with accessories – 250 m	1 no.
Markleen inflatable containment boom Z 1100 HD – 500m	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 m^3/ hr) (Side collector LSC-3C/2300(01CO2-P536). Oil transfer pump OT A 50 with oil transfer hose set	2 sets
Lamor Minimax 12 m^3 skimmer	2 sets
Multi-skimmer – 10 tph with pump	4 sets
Multi-skimmer – 30 tph with pump	1 set
Power pack for skimmers with hydraulic hoses	4 nos.
Power pack - 20 KV for skimmers with hydraulic hoses	1 no.
Floating tank (25 m^3)	2 nos.
Floating tank of 25 tonnes	2 nos.
Floating tank of 5 tonnes	5 nos.
Foot pumps for floating tank	6 nos
Oil Spill Dispersants	40250 liters
Absorbent pads	1000
Portable dispersant storage tank: 1000 ltr capacity	1 no.
Portable pumps	2 nos.
Hydraulic hoses for Markleen boom reel, 10 m	2 sets
Markleen diesel hydraulic power pack – 20 KW	3 nos.
Two – way hydraulic maneuvering panel	1 no
Backpack type boom inflator with petrol engine	3 nos.
Hydraulic hoses for maneuvering panel, 5 m	1 set
Oil discharge hose, 3”, 2 x 10 m	1 set
Air inflators – petrol engine (Markleen make)	2 nos.
Air inflators – petrol engine (Eco make)	1 no.
Two way hydraulic control panel with hydraulic hoses – 5 m (Markleen make)	1 set
Power pack trolley (Markleen make)	1 no.
Rachet belt (Eco make)	10 nos.
Tool box (Eco)	6 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 Executive Officer Head Marine Pollution Response Officer Port Control	02838-61115 02838-255727 02838-255730 02838-255761 / 289170 (Fax)
2.	Kandla Port Trust	Chairman Dy. Conservator Harbor Master Signal Station	02836-233001 / 234601 02836-223585 / 220235 02836-270201 02836-270194 / 549
3	Indian Oil Corporation, Mundra	CM (Ops) Manager (Ops) Control Room	02838- 222194 02838- 222197 02838- 224444
4	Indian Oil Corporation, Vadinar	DGM (Ops) Manager Tech Services Port Control	02833-256527 02833-256464 02833-256555
5	Reliance Petroleum Ltd Jamnagar	Marine Chief Senior Port Captain Port Control	0288-4013607 0288-4013750 0288-4012600 / 4012610
6	The Commanding Officer Indian Coast Guard Station, Mundra	ICGS, Mundra Station Ops Officer	02838 - 271402 & 03 (Tel) 02838 – 271404 (Fax)
7	The Commander Coast Guard Region (North West), Gandhinagar	COMCG (NW) Regional Ops & Plans Officer	079-23243241 (Tel) 079-23243283 (Fax)
8	The Commander No.1 Coast Guard District (Guj), Porbandar	COMDIS-1 District Ops & Plans Officer	0286-2214422 (Tel) 0286-2210559 (Fax)
9	The Commander Coast Guard Region (West) Mumbai	COMCG (W) Regional Ops & Plans Officer	022-24376133 (Tel) 022-24333727 (Fax)
10	The Officer-in-Charge Coast Guard Pollution Response Team (West), Mumbai	PRT (W) Officer-in-Charge	022-23722438 (Tel) 022-23728867 (Fax)
11	Gujarat Maritime Board	Vice Chairman & CEO Chief Nautical Officer	079-23238346 / 23238363 079-23234716

12	Ministry of Environment Govt. of Gujarat	Director (Environment)	079-23252154 / 23251062 079-23252156 (Fax)
13	Gujarat Pollution Control Board	Environmental Engineer	079-232 22756 079-232 22784 (Fax)

List Of Important Telephone Numbers Of Adani Group Personnel

S.No.	Description / contact person / designation	Telephone Nos.	
		Landline	Mobile
01	Capt. Sansar Chaube, Head – Marine & PFSO, APSEZL	02838 - 255727	91 9925223674
02	Capt. Rahul Agarwal, Dy PFSO, APSEZL	02838-255947	91 9687678479
03	Capt. Pankaj Kumar Sinha, Dy. PFSO, APSEZL	02838 –255730	91 7574894206
04	Mr.Cherian Abraham, Dy. PFSO - (AICTPL & CT-4)	91-2838 - 255733	9189800 48850
05	Capt. Kumar Paritosh, Dy. PFSO, AMCT	02838 – 255733	91 9879104839
06	Mr. Vilsan Kurian, Dy.PFSO, MICT	02838 – 252015	91 9879104805
07	Capt. Srinivas Kaki, Dy. PFSO, West Basin, APSEZL	02838 - 255963	91 9879203556
08	Marine control, APSEZL	02838 – 255333 / 255761	91 9825228673
09	Port Operation center, APSEZL	02838 –255762	91 9825000949
10	Port security Control, APSEZL	02838 – 289322	91 9825000933
11	Head - Security, APSEZL	02838 – 289947	91 9099005727
12	Head - Health, safety & Environment, APSEZL	02838 - 255777	91 7574894383
13	Head - Fire Dept. APSEZL	02838 – 255857	91 7069083035
14	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 • Initiate measures to prevent/ reduce further spillage • Maintain communication with other all vessels	
Step	**Actions**	**Additional Information**
Alert	(Marine Manager / On Scene Commander / SPM Pilot Tugs and other support/ response craft	*VHF Channel 73 / 77*
Initial Actions	Stop all cargo operations Ensure all safety precautions taken/observed Verify incident details Advise all relevant information to (Marine Manager / On Scene Commander / or SPM Pilot Initiate personal log 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 Mobilize response equipment/ personnel as directed by (Marine Manager / On Scene Commander / Maintain personal log of communications and events Act as instructed by (Marine Manager / On Scene Commander / SPM Pilot	
Final Actions	Submit personal log to HOD – Marine Attend debrief	

	MARINE MANAGER / On Scene Commander	**ANNEXURE 6**
Responsibilities	• Initially assess situation • Verify classification • Verify fate of spill • Verify resources immediately at risk, inform parties • Provide accurate situation reports to Radio Room/ HOD – Marine • Collect evidence and/ or statements • Liaise with HOD-Health, Safety, Environment & Fire • 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 Ensure all safety precautions have been taken Initiate response / Investigate cause/ source of spill Communicate all information to HOD – Marine Ensure samples of spilled oil taken Initiate personal log Take photographic evidence Collect evidence and take statements	*Stopped or ongoing*
Further Actions	Ensure resources are being deployed as required Provide co-ordination at-sea response Provide detailed situation reports to HOD- Marine Liaise with -Health, Safety Environment & Fire Department.	
Final Actions	Submit personal log to HOD – Marine Attend debrief	

	SPM Pilot	ANNEXURE 7
Responsibilities	• Initially assess situation • Verify classification • Provide accurate situation reports to Radio Room/ OSC • Collect evidence and/ or statements • Liaise with incident vessel regarding status of oil spill (if applicable)	
Step	**Actions**	**Additional Information**
Alert	□ Marine Control Room □ OSC □ Tugs and other support / response crafts	*VHF Channel 73 / 77*
Initial Actions	Assume role of On-Scene Coordinator Investigate cause/ source of spill Communicate all information to Marine Control Room Ensure samples of spilled oil taken Initiate personal log Take photographic evidence Collect evidence and take statements	*Stopped or ongoing*
Further Actions	Ensure resources are being deployed as required Provide co-ordination of the at-sea response Provide detailed situation reports to HOD – Marine	
Final Actions	Submit personal log to HOD – Marine Attend debrief	

	HOD – Marine	**ANNEXURE 8**
Responsibilities	• Confirm/ amend initial classification • Manage the APSEZL response • Authorize expenditure after consultation with COO APSEZL • Brief COO, APSEZL • Liaise with Coast Guard • Approve press statements for release	
Step	**Actions**	**Additional Information**
Alert	Coast Guard External organizations	
Initial Actions	Verify/ amend spill classification Ensure all safety precaution have been taken Confirm external organizations have been alerted Convene Emergency Response Team Predict slick movement Liaise with vessel Agents/ Owners as appropriate	
Further Actions	Chair the Emergency Response Team meetings Constantly review the strategy being employed and advise of changes where necessary Approve all expenditure commitments Brief President APSEZ Agree press statements with Corporate Relations Chief Confirm formal samples have been taken Advise Coast Guard if oil migrates outside of Local Area	
Final Actions **Final Actions**	Terminate the clean-up Collate personal logs. Prepare the incident report. Hold full de-brief involving all members. Amend contingency plan as required. General Report to President	

(contd.)		

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:

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
Aasgard	49	-28	2 @ 10°C	58	14
Arabian Super Light	51	-39	2 @ 20°C		
Cossack	48	-18	2 @ 20°C	51	18
Curlew	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	-62	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	18	Semi-solid	15	58

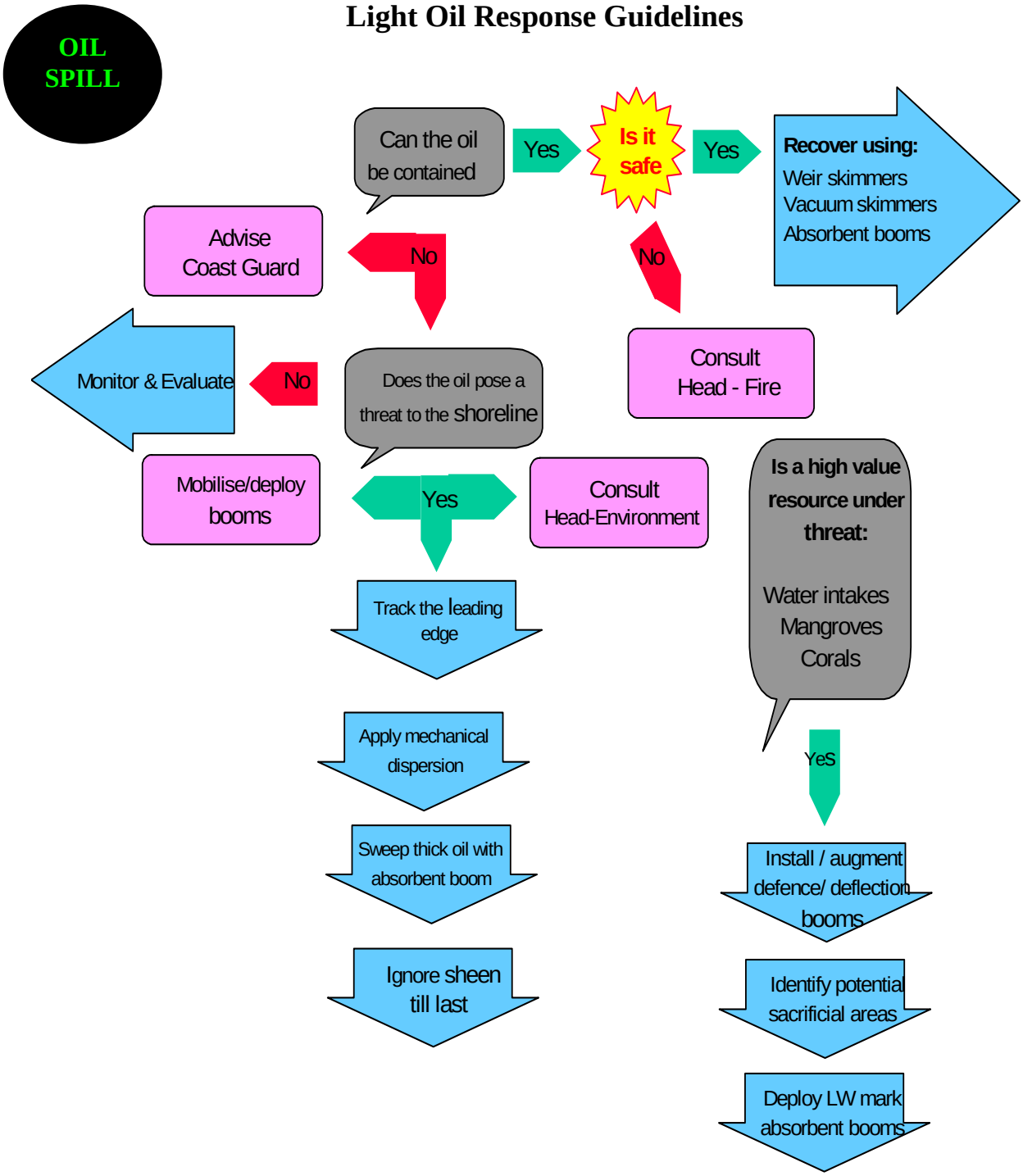
Group 4 oils

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%

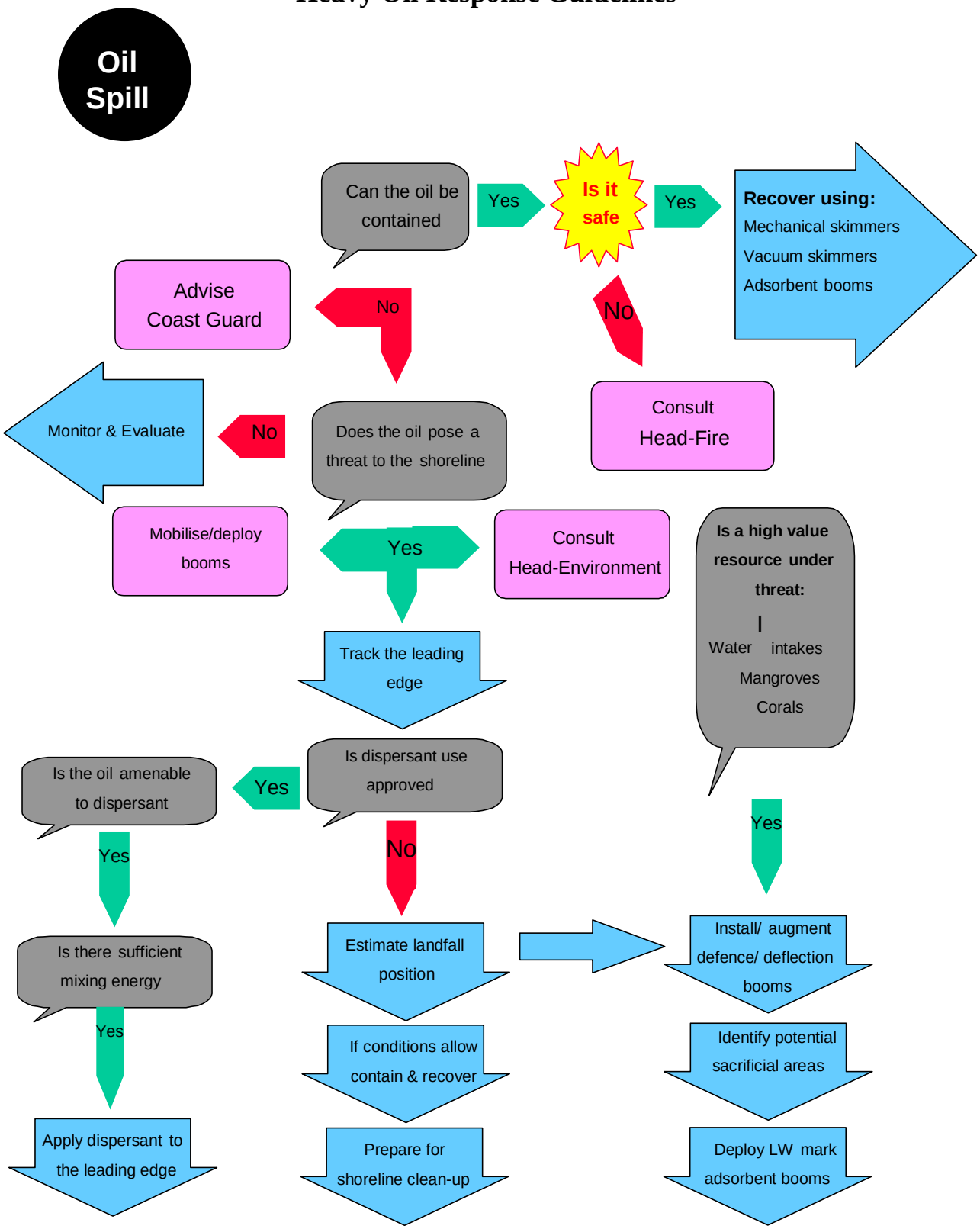
	A	B	C	D	E
Bachaquero 17	16	-29	5,000 @ 15°C	10	60
Boscan	10	15	Semi-solid	4	80
Cinta	33	43	Semi-solid	10	54
Handil	33	35	Semi-solid	23	33
Merey	17	-21	7,000 @ 15°C	7	70
Nile Blend	34	33	Semi-solid	13	59
Pilon	14	-3	Semi-solid	2	92
Shengli	24	21	Semi-solid	9	70
Taching	31	35	Semi-solid	12	49
Tia Juana 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		

Response Guidelines	ANNEXURE 12

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	

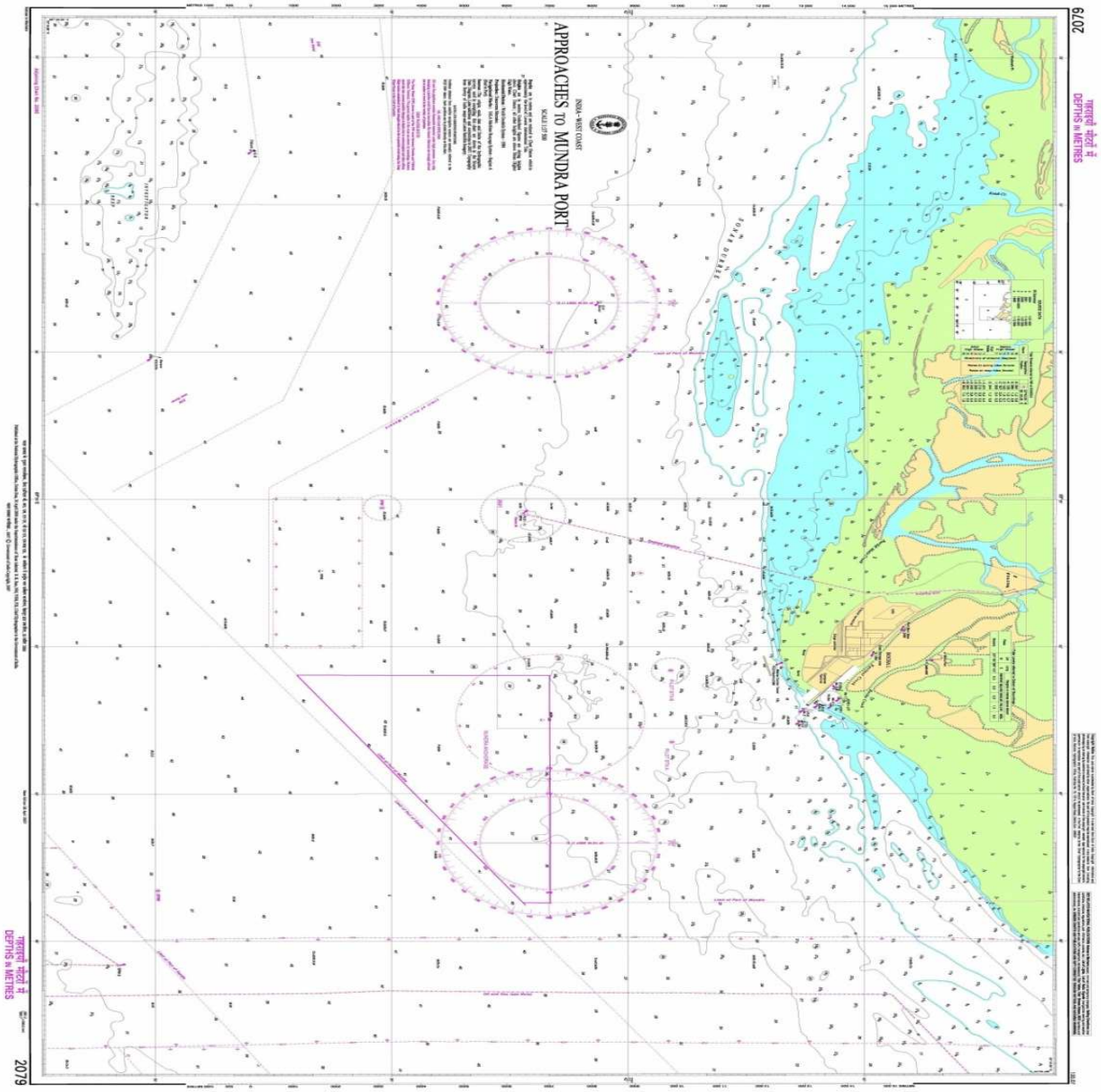
9. Personal Protective Equipment			
☐ Foot Protection		☐ Coveralls	
☐ Head Protection		☐ Impervious suits	
☐ Eye Protection		☐ Personal Floatation	
☐ Ear Protection		☐ Respirators	
☐ Hand Protection		☐ Other	

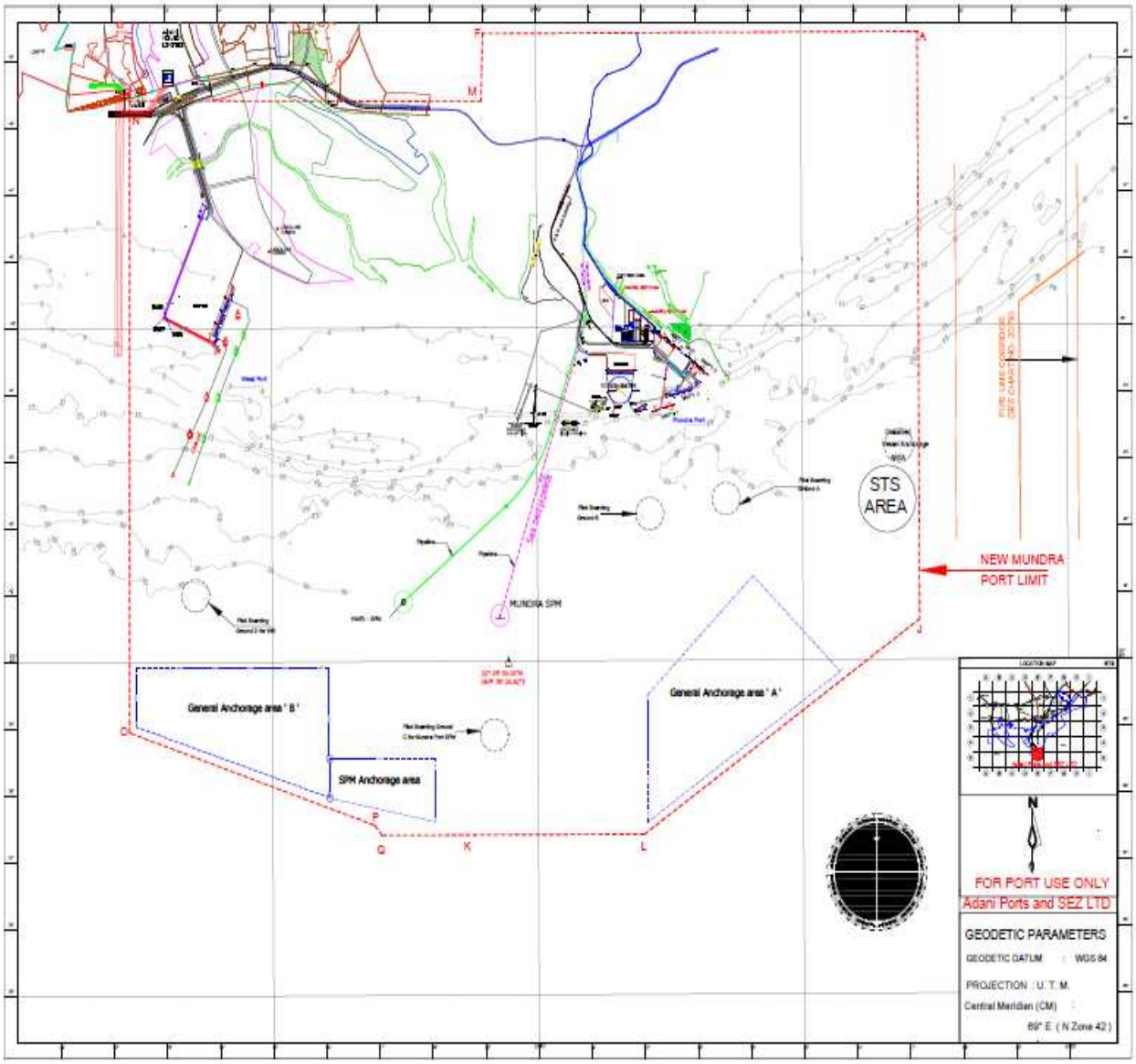
10. Site Facilities		
☐ Sanitation	☐ First Aid	☐ Decontamination

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
MUNDRA SPM
General Anchorage area ' B '
General Anchorage area ' A '
SPM Anchorage area
FOR PORT USE ONLY
Adani Ports and SEZ LTD
GEODETIC PARAMETERS
GEODETIC DATUM : WGS 84
PROJECTION : U. T. M.
Central Meridian (CM) :
69° E. (N Zone 42)

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: Adani Ports And Special Economic Zone Limited — HOD Marine

Signature:

Name: Capt. Sansar Chaube

Designation: Head - Marine

Organisation: Adani Ports and SEZ Ltd, Mundra

Place: Mundra

Date: 20 Apr 2016

Annexure – 4

OIL SPILL DRILL REPORT

INITIAL OIL SPILL REPORT		ANNEXURE 1
Particulars of person, office reporting	CAPT. SANSAR CHAUBE , HOD MARINE APSEZ MUNDRA	
Tel No.	9925223674	
Date & time of incident	17.02.2016	
Spill location	HMEL SPM	
Likely cause of spill	CARGO HOSE LEAKAGE	Witness –Tanker Seaman
Initial response action	Stopped pumping and valve closed	By- Crude Oil Tanker
Any other information	Spillage is stopped	

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	GM MARINE (APSEZ)
Time of FIR	17 / 1015 HRS
Source of spill	FLOATING CARGO HOSE
Cause of spill	Hose leak
Type of spill	Crude Oil
Colour code information (from CG)	Brown
Radius of slick	200 mtr
Tail	400 mtr
Volume	2.5 m3 approx
Quantity	2.3 Ton Appx
Weather	NW'ly x 14-16 knts
Tide / current	Flooding / 2 knt
Density	
Layer thickness	0.5 mm approx.
Air / Sea temp.	28 C / 25 C
Predicted slick movement	North Westerly towards IOCL SPM
Size of spill classification (Tier 1, 2 or 3)	Tier 1

OIL SPILL DRILL REPORT

POLREP		ANNEXURE 2
In case of an oil spill, MPSEZ will provide information to Commandant Coast Guard District 1 Porbandar COMDIS 1 and Coast Guard Station Vadinar CGS Vadinar in the following format:		
SN.	**Parameter**	**Data**
1.	Identity of the informant	Capt Sansar Chaube
2.	Time of information receipt	17/1005
3.	Source of Spill	FLOATING CARGO HOSE LEAK
4.	Cause of Spill	Hose Leak
5.	Type of oil	Crude Oil
6.	Colour code information	Brown
7.	Configuration	Circular
8.	Radius	200 mts
9.	Tail	400 mts
10.	Volume	2.5 m3
11.	Quantity	2.3 Ton Appx
12.	Weathered or Fresh	fresh
13.	Density	@15^0 C 0.9021
14.	Viscosity	
15.	Wind	NWly x 14-16 knts
16.	Wave Height	0.5 mtr
17.	Current	2 knt
18.	Layer Thickness	0.5 mm approx.
19.	Ambient air temperature	28 c
20.	Ambient sea temperature	25 c
21.	Predicted slick movement	North Westerly x 1.0 knts
22.	Confirm Classification of spill size	Tier 1

OIL SPILL DRILL REPORT

Page Number: 1 of 1	**Date: 17.02.2016**
Name: Capt. Pankaj Kumar Sinha	**Position: Marine Pilot**
Contact Number: 7574894206	**Signature:**

Time	**Activity Completed:**
1000	Oil Spill reported HMEL SPM
1002	Informed to HOD, HOS Marine
1003	SPM vessel informed to stop cargo operation and close all valves
1004	HMEL receiving terminal informed.
1015	Tug Ocean Citrine underway
1020	Dol 7 12 18 casted off from Tug Berth
1022	Dol 6 & 17 kept standby
1025	Tug Ocean Citrine arrives at site
1030	Ocean Citrine started lowering Candyine Fence Boom
1050	Canadyine Fence boom rigged and Skimmer lowered and commenced cleaning up operation.
1055	Ocean Citrine reported recovering oil through skimmer
1145	Ocean Citrine reported recovered 7.0 m3 of oil spill
1155	Oil spillage is under control all normal
1200	Drill Called off

Annexure – 5

Brief Summary on CSR activities by Adani Foundation, Mundra

Oct'15 to March'16

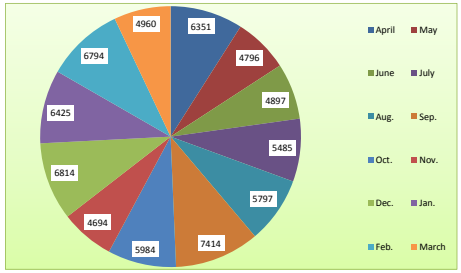
Contents

Adani Foundation has pioneered several innovations under its Health Programme in Mundra, Kutch. These innovations comprise of new methodologies to address the different aspects of health needs among the most marginalized communities, especially Malnourished Children, Women and Senior Citizens.

Committed to "Health for All" the Foundation runs Mobile Health Care Units, Rural Clinics, Special Innovative Projects i.e. Health Card to Senior Citizens, Fighting to Malnourishment in Mundra and Dialysis Project and Variety of Health Related Camps.

Community Health

MHCU Month wise Data- 2015/16		
1	Oct.	5984
2	Nov.	4694
3	Dec.	6814
4	Jan.	6425
5	Feb.	6794
6	March	4960
	Total	**35671**

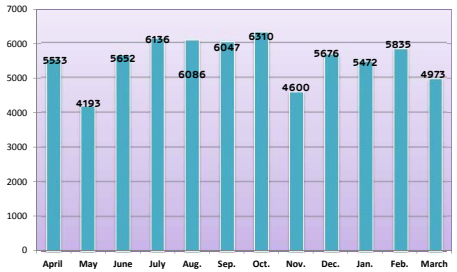


Mobile Dispensaries & Rural Clinics

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 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 113 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.

Village wise OPD Data-2015/16		
1	Tunda wandh	3571
2	Siracha	6207
3	Navinal	5181
4	Luni	12667
5	Vadala	5736
6	Bhadreshwar	5706
7	Nana kapaya	7728
8	Tunda	3114
9	Tuna anjar	3899
10	Vandi	4730
11	Rampar	4132
12	Tragadi Bandar	3842
	Total	**66513**



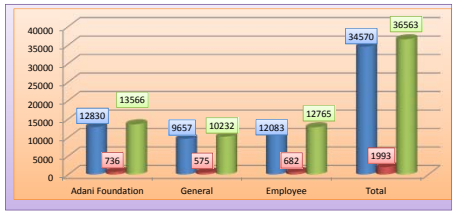
The Adani Foundation operates Rural Dispensaries in 08 villages of Mundra block, 03 villages of Anjar block and 01 village of Mandvi block. At these dispensaries, health services are provided free of charge for two hours daily by a doctor and a volunteer.

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 2015-16, total 12866 transactions were done by 7487 card holders of 66 villages of Mundra Taluka. They received cash less medical services under this project.
In Green Card category, 6665 aged people got treated for various illness & diseases at Adani hospitals, Mundra with an aid up to a limit of Rs. 50,000/- within the period of 3 years.
The 822 Blue Card Holders can avail diagnosis facility and treatment at a subsidized rate in the Adani hospitals, Mundra.

Details of Transaction		
1	Oct.	933
2	Nov.	558
3	Dec.	583
4	Jan.	615
5	Feb.	640
6	March	644
	Total	**6446**



Support to Reduce Malnourishment in Mundra

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.
The intervention by the Adani Foundation Mundra was initiated when it was realized that combatting malnutrition is one of the Millennium Development Goals (MDG).

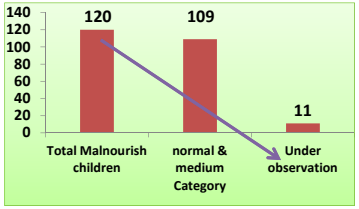
The objective of this Project is to improve the nutritional status of children in the block and give health & nutrition education to the community, especially to the mothers, to reduce the mortality rate among children below 5 years because of malnutrition and improve the physical & mental health of this age group.

Implementation Strategy

The Project mainly focused on improving nutritional status of all the malnourished children of aged 6 months to 5 years of age.
All the severely malnourished children as per ICDS data were screened by the Pediatrician of Adani hospital and underwent lab tests like hemoglobin examination, blood grouping, urine/stool test for detecting the presence of any other existing disease.
All the screened children were then provided supplementary nutrition in presence of the respective Anganwadi workers up to their proper recovery.
The supplementary nutrition was also given in the form of nutritious "Dry fruit Laddu".
De-worming & IFA tablet sand vitamin A were also given in the form of syrup.
Thereafter in the case of the child, suffering from a disease and some medical complications, is admitted and given medical treatment at Adani hospital.
Regular and periodic follow up and medical examinations were carried out which included Lab tests and weight measurement along with general health check up by the Pediatrician and the children were treated accordingly if required. Some serious cases are referred to a pre-defined Hospital at Ahmedabad.
Venue for the medical camp was Adani Hospital Mundra and travelling expenses were reimbursed to reach Adani Hospital along with breakfast and lunch.
Adani Foundation Health Team in coordination with Adani Hospital played the pivotal role in the effective implementation and organization of Medical Camp at Adani Hospital .

Role and Responsibility of Adani Foundation

- Health Checkup camp
- Awareness activity
- Home visit
- Health related equipment provided
- Financial support provide for better treatment
- Doctor services provided (Pediatric, Gynec, Dietitian)
- AF provides Nutritional Food Support



Outcome of the Project

Adani foundation works with the objective that every child improves their health status and lives with a good health. We follow all processes regularly every month, it resulted that 109 children health was improved till November 2015 among 120 children under severe malnourished category. Adani Foundation is supporting remaining 11 Children with regular monthly health check up at Adani hospital and has been providing free treatment.

Due to this initiative of AF, remaining 4 children out of 11 will come in normal category by the March 2016, remaining 7 children have the health problem since childhood (By birth) and there are least possibilities of improvement (i.e. Birth problem, Mental illness, Physically problem, Hereditary etc.) but still AF has been providing treatment for improvement.

Malnourish Child Health Camp		
Sr. No.	Month	Total Patient
1	Oct-15	7
2	Nov-15	8
3	Dec-15	9
4	Jan-16	7
5	Feb-16	11
6	Mar-16	6
	Total	**48**

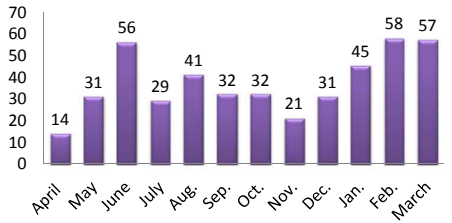
Conclusion

The vision behind the project was:

- To identify malnourished children (0-6 years), to improve their nutritional status
- To identify and treat their medical ailments.
- To provide health education and counsel the parents regarding importance of nutrition
- To increase the awareness in general population towards nutrition.

Adani Foundation has successfully achieved the goal to convert 109 children into normal category out of 120 remaining children in the year 2014-15.

To make these achievements sustainable, the parents of targeted children have been convinced that they would now continuously keep watch over the nutritional status of their children to prevent any future complications.



Medical Supports		
1	Oct.	32
2	Nov.	21
3	Dec.	31
4	Jan.	45
5	Feb.	58
6	March	57
	Total	**244**

Support for Medical Aid to Deprived

The scope of the organization extended up to providing best health care facilities to the needy, poor, challenged and not so well-to-do families for the treatment of illness and diseases. It is not always possible to predict the medical expenses. Moreover, those who are economically not so sound, become indebted for lifetime in case of certain illnesses. Therefore, Adani Foundation provides primary health care and financial assistance for ailments such as kidney related problems, paralysis, cancerous and tumor surgeries, neurological and heart problems, blood pressure, diabetes etc.

In current month we organized two medical examination camps in which Medical Support was given to 244 People from Mundra, Bhadreshwar, Zarpara, Shekhadia Nana Mota Kapaya, Bhujpur, Vadala, Wandi and other villages under our work area.

Camp-Year 2015-16			
Sr.no	Date	Festival Location	Total Patinets
1	15-Apr	Ganesh Mandir Mela	140
2	15-Apr	Samuh Sadi Mundra	319
3	15-May	Luni Samuha sadi	165
4	15-Jun	Ganesh Mandir Lokanpan	45
5	August-15	Sukhpar-Mundra	125
6	August-15	Bhadreshwar Fishemen Camp	86
7	**15-Nov**	**Luni Uras**	**52**
8	**15-Nov**	**Vishnu Maha yagya- Dharbhudi**	**1467**
9	**15-Dec**	**Shah Bukhari Uras-Mundra**	**234**
10	**16-Mar**	**Juna Bandar Camp**	**65**
Total			**2698**

Health Camps

Various health camps are organized at regular intervals to meet the specific requirements of the community. Screening camps are organized regularly as per the route map planned in coordination with Adani Hospitals. During the year 2015-16, 10 speciality camps were organized and 2698 Patients were benefitted.

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 11 Patients were being supported for regular dialysis (twice in a week) during this year.

CALMED PROJECT- Collaborative Actions in Lowering Maternity Encounters Death

Adani Foundation has been looking after the health requirements of Mundra block for a long time. It has got a rich experience to address the preventive and curative health measures at Mundra belt. Therefore it was assessed by the Adani Foundation team that the most burning problen of this region is to cure Maternal Health, therefore, The demand was raised from the AF staff to improve the maternal health.

Looking at the strengths of AF the following role has been identified.

The prime objective is to reduce maternal and new born mortality through a collaborative cascade of training, briefings, publicity and monitoring. An effective programme to reduce maternal mortality (MDG 5A) requires collective efforts by Government, Professionals and Communities to deal with medical and administrative issues in a top down and bottoms up approach as both the approaches are important and complimenting to one another.

Activities proposed for this project are Selection of CHC/PHC, Training of trainers, AF Involvement in Target Areas, Identification of Needs in Target Areas, Implementation-mechanism, Publicity, and Communication-A Preparing Training Materials in MCH- Funding - Reporting: The project consultant of this project will submit monthly planning to AF.

Capacity building inputs are given to the AF staff so that they can help in maternal and child health situations and reduce the maternal death.

Implementation Strategy of the project: Master trainers i.e. Doctors from Adani Foundation, Adani Hospitals Mundra and Gujarat Adani Institute of Medical Sciences will be identified. Co - trainers would also be selected. The Master trainers will further percolate the knowledge and skill to ANM/ ASHA for the next 3 years. Total 35 women were benefitted in the previous year.

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.

Mpw's Village Meeting

Sr. No	Month	C.M. Meeting	MPW Meeting
1	October	43	178
2	November	26	134
3	December	29	142
4	January	24	129
5	February	38	127
6	March	13	96
	Total	**173**	**806**

Death Body Van Data

Sr. No	Month	No.of Death Body
1	October	45
2	November	64
3	December	64
4	January	56
5	February	73
6	March	72
	Total	**394**

- Adani Foundation Team has initiated coordination with GKGH hospital since last year and established a reception area for the smooth patient coordination and preparation for the social networking programme.
- Adani Foundation organized General Health Camps and Speciality Camps in various interior villages of Kutch in coordination with GKGH which created magical impact and benefitted 3335 patients. Adani Foundation Bhuj Health team has also organized more than ten 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 394 dead bodies privileged till now to different locations in Kutch.

MHCU is really blessings for us !

Patient Tabassum baby was reported with the complaint of severe itching, scaling and bleeding from skin. Her parents approached our mobile dispensary and she has been treated successfully with utter care and proper treatment by our dedicated doctors and now she has overcome from the disease.

Children : future of nation!

A two year old girl – Sherbanu could not stand independently. She was underweight, very weak and malnourished. During the survey of malnourished children by the health team of Adani Foundation, we found that in spite of very good financial condition, Sherbanu was severely malnourished child. Her father, Kadar Bhai is associated with animal husbandry business and earns handsome. Ruksana banu – her mother did not want girl child therefore she did not even give her lactation. She did not take care of her and has been working in the cattle shed. Sherbanu did not get any food which is necessary for her growth. Adani Foundation team with ICDS visited frequently and took the small, helpless and malnourished daughter in medical camp and gave her proper treatment. She was given vitamin injections and medicines along with nutritious food. Gradually, her health shown inprovement and within 8 months she came out of the category of malnourished children. Her grand mother is happy with her growth and promised us to take care of her and committed to take our involvement as when required.

"Adani ji Bhalai Maniyu Elto Occho Aay"!

Firoza is a seven years old little angel living at Luni Bandar. Her father Ramzan bhai is taking care of his family of seven members. He is fisherman that's why his income is irregular and depends on season. Firoza had the complain of frequent nose bleeding. Ramzan bhai told this health problem to the Adani Foundation team members. Unfortunately, Firoza was diagnosed with blood cancer after series of reports at Adani Hospital. Firoza' s parents were in deep grief but the AF team members supported them and gave courage to face the situation with a commitment of financial support for the complete treatment. After taking proper treatment at Adani Hospital, Firoza is now completely alright. Our eyes fill with tears when we see her dancing and playing at Bandars. Her father says with great gratitude, "Adaniji bhalai maniyu etlo ochho aay".

"Adani foundation aje ghadpan ni lakadi bani ne ubhu rahyu"

Mariyam banu is a widow living alone at old station road at Bhuj. She has two sons, but they both live separately from her. One day a misfortune took place and during her routine work she slipped and her leg got fractured. Her neighbours took her to the G. K. General Hospital. Immediately a decision for the surgery was taken and successful operation was done by the team of expert doctors. She was hospitalized next for 30 days but none of her son came and asked about her well being and health. When Kishor – Adani foundation team member went and asked her with sympathy she started crying hard and expressed her emotion by saying "Mara saga dikrao kyarey mari puchha karva nathi aavya pan foundation aje maro dikro banine puchhe chhe k BAA, TAMANE KEM CHHE?"

"Women Health Awareness Seminar"

We organised a seminar on "Woman Health Awareness and World Population Day"' in collaboration with ICDS and Taluka Health Office.
We tried to create awareness regarding women health and importance of population control through this programme
More than 350 women participated and faclitated.

"Blood donation camp"

On the birthday of our Chairman Shri Gautam bhai Adani a remarkable blood donation drive was conducted.People actively participated and total 1388 units blood were collected from the Mundra.

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.
Under this programme, we associated ourself with Fisherman community, Farmers and Women groups.

Adani Ports and SEZ Limited started its business in 1996. When APSEZ started port operations, fishing community was found deprived and in a perpetual state of poverty. They were living a scattered life. Unavailability of roads, pure drinking water and unhygienic living conditions had made their lives tragic and miserable. We thought we could not achieve our goal of development unless and until we support them to uplift the living standard of the people of this community. After inception of CSR arm of the Adani Group – Adani Foundation in 1996, a strategy based on priorities and continuous and comprehensive socio-economic development and reforms for the fishing community was planned.

With the Foremost objective to improve living standards of Fisher-folk, Adani Foundation protracted support in Education, Health, Sustainable Livelihood and Rural Infrastructure Development Sectors.

SUSTAINABLE LIVELIHOOD DEVELOPMENT PROGRAM

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	47
2	Luni	32
3	Zapara-Chhacha	32
4	Bavadi bandar	33
	Total	144

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

The chief objective behind all the facilities provided to the fisher-folk is to promote education.

- Educational tours are organized for children.
- Special attention was given to girl child education.

We facilitate transport provision to students from standard 6th to 8th studying in nearby villages.
Bicycles are distributed for students who have got enrolled for higher education.
Scholarships are given to the students of ITI, Diploma Engineering or Degree Engineering Students.
280 male fishermen and 58 female were inspired by the exposure visits to Adani Ports SEZ, Adani Power Ltd. and Adani Wilmar Ltd. (Edible oil refinery).

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 7474 fishermen were benefitted by Mobile Dispensary every 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 413 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 280 senior citizens from fisher folk community are enrolled in the scheme. They are getting cash less medical services upto Rs. 50,000 for three years. Besides this, follow up with the card holders is a regular activity. It has been observed that card holders treat the card as an important document. Most of them keep these cards in their wallets with other important documents and cards.

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. Adani Foundation spent Rs. 32.60 Lacs till date for the same, including construction of training center at Vasahat. The uniqueness of the vocational trainings was that they included practical sessions and simulation activities.

Sr. No.	Course Name	No of Students
1	IT – Basic Computer	39
2	Tally ERP9	8
3	Checker	4
4	Checker Cum RTG Crane Operator	9
	Total	**60**

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 85000 Litres of water is supplied at different settlements.

Potable Water			
Sr.	Vasahat	Total liters/ day	Total HH
1	Juna Bandar	23000	141
2	Luni Bandar	15000	110
3	Zarpara*	5000	30
4	Bavadi Bandar	12000	88
5	Veera Bandar	10000	66
6	Ghavarvaro Bandar	5000	40
7	Kutdi Bandar	15000	121
	Total	85,000	596

Machhimar Awas Yojana

Fishermen stay at vasahat/settlement at sea shore in gunny bag shanties in hot sun, wild winds and harsh winters. Participatory and consultative process with residents helped in choosing a special design of foldable housing. At Bandar, a project titled 'Home Sweet Home' made it possible to provide appropriate shelters for the fishermen who reside near the coastline throughout the year except the rainy season. Shelters, equipped with basic facilities such as toilet and pure drinking water, have been constructed for staying during season of fishing and to provide a healthy and hygienic residence. Total 140 shelters have already been handed over to fishermen families at Juna Bandar and 110 shelters are being made at Luni Bandar with the facility of electricity as an added advantage.

Machhimar Sadhan Sahay Yojana

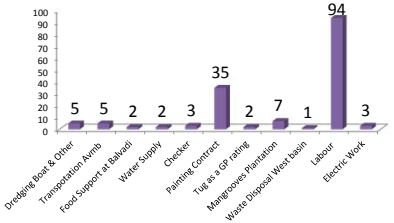
Fishing material was also provided by the Adani Foundation at Mundra as per the requests of Pagadiya fishermen. Fishing nets, ropes, buoys, ice boxes, crates, weighing scales, anchors, solar lights etc. were also provided according to their needs.

Sr	Village / Bandar	Year 2015-16
1	Shekhadia	6
2	Bavdi Bandar, Bhadreswar, Radh Bandar, Sanghad	43
3	Wandi	3
4	Kutadi	18
5	Tragadi	5
	Total	**75**

Toilet Block		
Sr.	Village & Bandar	Qty
2	Luni	38
4	Navinal	30
	Total	**68**

Sughad Yojana

Toilets for men and women are constructed at all three Vasahats. Infrastructure was accompanied with continuous awareness campaign on hygiene, sanitation and use of toilets in particular.



Machhimar Ajivika Uparjan Yojana

During the non-fishing months, the fishermen under unusual circumstances are required to be benefitted with some alternate economic activity to help them to sustain economically. Under such cases due to the paucity of their available funds and resources, it became extremely difficult for the majority of them to survive. Looking at the miseries of the fishing folk the Foundation introduced 'Mangrove Plantation' in the area as a means of alternate income generating activity for the fisher folk community during the non-fishing months. Both men and women from the communities received trainings on Cheriya Plantation, moss cleaning etc. required for Mangrove Plantation. The program again was developed holistically, where focus was not only given on income generation but this initiative was seen as an important means to ensure environment sustainability. From July 2015 to Dec 2015, 3861 man–days employment was provided by the Adani Foundation. In addition to the given employment, more than 25000 man-days employment has been provided till date. We have supported 42 Pagadiya Fishermen as painting labourers & 7020 man–days employment was provided to them.

Bandar Svachhata Yojana

A cleanliness drive was initiated by the Adani Foundation recently at Juna Bandar, Mundra, a port town in Kutch region of Gujarat. Juna Bandar is a temporary habitat of fisher folk community, where the families of fishermen live for around 8 months a year. Having a clean and hygienic living environment is the utmost important requirement for the health and profession of the fishing folk. To provide them with both - health and profession is quite challenging.

The cleanliness drive envisaged by the Adani Foundation was quite comprehensive, including all aspects pertaining to clean and hygienic living, Several activities were carried out during the day that marked the uniqueness of this drive.

The main essence of this drive was to promote clean and hygienic behavioral practices. This Drive will not be limited for one day, it will continue for a long time to develop habit.

The International Coastal Clean-up Day

The International Coastal Clean-up is one of the largest volunteer efforts in the world dedicated to the health of our oceans. Every year, 20th September is dedicated to this noble cause of cleaning our beaches / shorelines impounded with lots of waste material which is considered non-biodegradable in nature and considered hazardous to the ocean health. Indian Coast Guard had been associated with this international event in India and has been organizing clean-up drive for our beaches once in a year to represent its concern for the overall ocean health and generating awareness among public. Coast Guard Authority being in Mundra would be organizing a clean-up operation in coordination with Adani Foundation.

Adani Foundation gives momentum to "Swachchh Bharat" movement at Juna Bandar, Mundra with Fisher folk community.

Fisherman Cricket league

Every year Seven days cricket tournament 'Adani Premiere League' has been organized for fishermen community to promote healthy sports and build up good relations with youth. More than 16 Teams of Fishermen are participating mainly from villages like Zarpara, Navinal, Shekhadia, Luni and Bhadreshwar & Vandi (Tuna). Winners are awarded with a Trophy and Prize and all other participants are also awarded with consolation prizes.

Fisherman Cycle Marathon

With the foremost objective to improve living standards among fisher folk, Adani Foundation protracted support in Education, Health, Sustainable Livelihood and Rural Infrastructure Development Sectors, Adani Foundation organized Cycle Marathon for Fisherman.

The main objective of event is to bridge the Gap between Fisherman Community and Adani group. It is to generate Trust among Fishermen about the welfare activities of Adani Foundation to support and uplift the Fishermen community.

This year, we invited Mr. R. K. Singh (Indian Coast Guard) and Mr. K. B. Zala (P.S.I.- Marin Police) as our guests to create awareness among the Fishermen for Safety and Security of our nation. They also motivated the Participants and further congratulated the Winners who Secured First 3 Positions respectively. On this occasion Mr. Mukesh Saxena (Head, Adani Foundation) conveyed his regards to all fishermen and thanked them for their active support and participation in the activity conducted by the Adani foundation.

Pandhe Lodhiyo jo Medavo

With the objective to generate social awareness and social mobilization among Pagadiya fisherman community, to spread the message of importance of Education, to spread the message of importance of health and hygiene and to generate awareness of alternate livelihood training, skill development for youth and enhance their economic wellbeing, different schemes of Adani Foundation for each core area are being shared by team members.

"Halo Sapana na Vavetar Kariye!!!"

Adani Foundation believes that, "The children of today will shape the future of tomorrow" and "We should always give a chance and support to educate girl child".

One Girl Nazma Manjaliya residing in village Luni was very eager to study. She got very good result in high school but due to financially weak condition she could not go for higher studies. After that, her family member stopped her for further studies. AF Team Member convinced her father to allow her to study and informed him regarding scholarship scheme. Her Father was impressed by this scheme and he permitted Nazma to study. Today she is studying in college and simultaneously working in our Balvadi as a teacher. Thus, by this scheme this passionate girl can find pathways for bright future.

Nazma and her parents say, "Adani Foundation has brightened up our future."

"Balvadi at Bandar : Singing Sea Birds"

The Girl named Amina is 3 years old. She lives at Zarpara Bandar with her Family. She was living in unhygienic and unhealthy condition. Due to this condition she used to fall sick frequently. After joining Balvadi, she learned the importance of hygiene and started to remain clean. By nutritious food given in Adani Balvadi, she could keep herself healthy. Moreover, she learned to speak English Alphabets and now she sings poems and songs with full enthusiasm.

Her parents expressed their gratitude to foundation in the words "Adani e Amari dikri ni jindagi sudhari didhi".

Together we can and we will make a difference !

With support from the Adani Foundation the fisher folk got the painting work inside as well as outside the Adani Port and turned their off-season non-productive days into productive days. With the time their debts have decreased and hence quality of life has improved.

During informal meetings with the community leaders, the foundation team thought that these people could be given painting work inside the port. There is a contractor named Talab bhai who is also a fisherman. Talab bhai hired local fishermen cum labourers. The Foundation Team decided to discuss with the community give them the contract. Thus a fisherman became a contractor and generated income for himself and his community. He has purchased his own tempo to transfer labourers from one place to another. This is really an achievement for the Adani Foundation creating alternate livelihood opportunity.

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.

Drive for Technology to use in agriculture

• We have initiated Programme for Awareness of Farmers in collaboration with KVK. The outreach is approximate 30 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	21
2	Zarapara	15
3	Siracha-	12
4	Navinal	10
	Total	**58**

Agriculture & Animal Husbandry

Food for cattle

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 74,356 mann fodder worth Rs. 127.00 Lacs approximately.

Tree plantation programme

A Tree Plantation programme was run in Tunda, Baroi, Mundra and Pragapar.
Total 2600 Trees of Gulmohar, Neem, Pipal, Ashoka and other Flower plants were planted at various locations like temples, Anganwadi, Schools, Crematorium. These are the places where these newly planted trees can easily be taken care by students, teachers and other villagers.

Beti Vadhavo Abhiyan

Beti Vadhavo programme was organized in 24 Villages in the presence of Village Sarpanch and other leaders. We explained people about the various topics i.e. importance of girl child, Sex Ratio, Gender Equality and laws regarding Child abortion. This initiative was well accepted by community and we have observed a visible change in their mindset.
We have facilitated 260 daughters with Kit (Small Bed sheet, Mosquito net, Soap and Cream with nutritious food for mother)

The objective of this Project

- Encouraging corporate leadership capacity with the quality to ascertain gender equality
- Encouraging adequate respect and support for human rights and non-discrimination and in consequence treating men and women equally at workplaces
- Making sure that all men and women workers are provided with equal facilities in terms of their overall welfare and safety at workplaces
- Encouraging women to develop entrepreneurial skills, which in turn, would make them self-dependent
- Advocating the promotion of gender equality within in a community

Women's Empowerment Programme			
Sr. no	Village Name	Group Name	Presents Member
1	Kandagara	Jay Mekaran Saheli group	20
2	Siracha -1	Vandan Saheli SHG	11
3	Siracha-2	Shree matiya dev Saheli group	10
4	Sekhadiya	Jay Sonal Saheli Group	13
5	Baroi	Adhar Saheli group	18
6	Navinal	Vishavas Saheli Group	20
7	Sadau	Akta Saheli Group	15
		Total	**107**

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 programme with two major women's group of Villages near Adani Power and Adani Ports. Both the groups of women (60 women in total) successfully completed their training for preparing washing powder, phenyl, liquid for cleaning utensils and hand wash etc.

- We have selected 6 women groups having 10 members each, 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 after discussion with the Administrative Department of Ports and Power regarding the supply of the material, rate etc.

- Our pilot project is preparing Washing Powder and Phenyl. We are planning to start Home Made Products after discussion with HOD and Random groups of ladies in colonies and villages.

Implementation Strategy

We have received a proposal from VRTI for Women Empowerment Projects.
They are linked with more than 5000 women groups of Mandvi, Mundra, Naliya and Rapar. As per discussion they will work on Self Help groups in three phases in three years.

- First Phase : Planning, Skill Development, understanding Finance Management, Women Empowerment, Capacity Building which includes formation of strong base and groups, connection with targeted women and train them so that they can start their own Gruh Udyog. Skill Raising Training will be regarding handicrafts, food items and other house hold items.
- Second Phase: Implementation provision of rotating fund, setting up of business and continuous guidance and capacity building, solving teething trouble in startup business, providing training for branding and marketing.
- Third Phase: Monitoring, Fund Guidance and Management of Fund Rotation.

Coordination with Government for Widow and Senior Citizen Scheme

- We are 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 to two persons for the handicapped in coordination with Bhuj Samaj Suraksha Khata for regular visit and follow up.
- Last year, 47 widows and 38 Senior citizens and 121 handicapped - total 206 members got benefitted from the approval of pension certificate. The financial benefit of the senior citizen yojana is Rs. 400 per month and the widow scheme is of Rs. 900 per month.

ધુપસળી બનીને અદાણી ફાઉન્ડેશન મારા જીવન મા સુવાસ આણી !

કેમ છો ? મજામાં ! હુ ગુલાબસંગ , કાંડાગરા ગામનો વતની , મારી આંખો એ આજની તારીખે કુલ ૭૦ દિવાળી ઓ જોઇ ચુકી છે. કાંડાગરા ગામના સીમાડે આવેલા ઘેઘુર વડ ની છાયામા મારી યાની કેબીન છે. છેલ્લા ઘણા વર્ષો થી વેહેલો આવી અને મારા કામે લાગી જાઉ છું . આછી પાતળી આવક માં ગુજરાન ચાલ્યે જાય છે.

ઇશ્વરે કદાચ મને પોતાની વધુ નજીક રાખવા ધાર્યો હશે એટલે હું દિવ્યાંગ છું. હું મારા માટે અપંગ શબ્દ વાપરતો નથી. પંગુતાનાં કારણે મારાં લગ્ન ખુબ જ મોડા થયા અને કરૂણતા કહો તો બાળકો થયા માં પણ વિલંબ થયો . સંતાન મા આજે મારે ૧૫ વર્ષ નો પુત્ર અને ૮ વર્ષ ની દિકરી છે. મારી ઉમર ઘણી મોટી છે અને મારા બાળકો નાના છે એટલે મારે આ ઉમરે પણ કમાવવુ પડે છે. આજથી દોઢ વર્ષ પહેલા હુ રસ્તાપર લાકડી ના ટેકે ચાલતો અને ઘણી વાર તો ચાલતા ચાલતા પડી જતો હતો . વળી કયારેક કોઇ ભૌતા આદમી નો સહારો લઇ મુશકેલી વેઠી ને ઘરે થી નીકળી મારી યાની કેબીન સુધી જતો.

અને એક દિવસ સુર્યોદયની સાથે મારા જીવન મા પણ સુર્ય ઉગ્યો. અદાણી ફાઉન્ડેશનના ના કાર્યકર કરશનભાઇ વા પીપા રોકયા અને ખરા બપોરે છાંયડે બેસી વાતે વળગ્યા . મારી આપવીતી જાણ્યા પછી તેઓ એ સરકાર ની દિવ્યાંગ યોજના વિષે જણાવ્યુ અને મદદ કરવા વચન આપ્યુ. પણ કહે છે ને "દુરસ્ત દુઠે ત્યારે કાંઇ ન છુટે" સરકાર શ્રી ના નિયમ મુજબ ૫૦ વર્ષ ની આયુ બાદ ટ્રાઈસીકલ આપવામા આવતી નથી. અદાણીફાઉન્ડેશન દ્વારા એક શુભ દિવસે મને ત્રણપૈડા વાળી સાયકલ આપવામા આવી. ત્રણપૈડા વાળી સાયકલે મારા જીવનનો સંઘર્ષ ઘણો જ હળવો કરી નાખ્યો. આજે કોઇનો પણ આધાર રાખ્યા વગર દુધ ખરીદી ને સવાર નાં વહેલા હુ મારી કેબીન ચાલુ કરી દઉ છું.

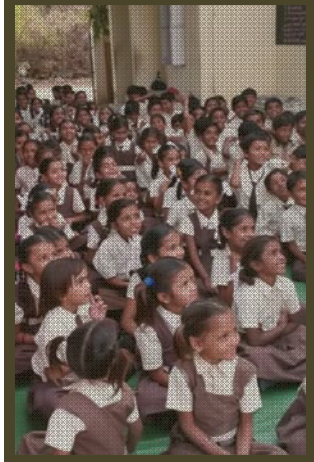
અરે ! હજુ મારી વિતક અહી જ પુરી નથી થતી. અદાણી ફાઉન્ડેશન ના કાર્યકર કરશનભાઇ એ જણાવ્યુ કે ૬૦ વર્ષ મોટી ઉમર ના અને જેના બાળકો ૨૧ વર્ષ થી નાના હોય એવા વડીલો માટે નિરાધાર પૂજ્ય પેન્શન યોજના નુ લાભ તમને મળી શકે અને આ યોજના નુ અમારા પતિ -પત્નિ નુ ભરી અને પાસ કરવી પણ આપ્યા . આજે દર મહિને સરકાર દ્વારા અમને ૮૦૦ રુપિયા પેન્શન મળી રહ્યુ છે.

ધુપસળી ની જેમ અદાણી ફાઉન્ડેશને પોતાના કાર્યો દ્વારા મારા જીવન માં મહેક ફેલાવી છે તે માટે આભાર નાં શબ્દો ઓછા પડશે પણ હું આશીર્વાદ જરુર આપીશ કે આવા સત્કાર્ય કરવા માટે અદાણી ફાઉન્ડેશન ને ઇશ્વર જોમ, જુસ્સો અને વિશ્વાસ અર્પણ કરે.

Education Initiative of Adani Foundation signed an MoU with Maa Foundation, Vapi and adopted four major projects from them. The list of the projects upto October 2014-15 was:

Under M-KEN project, the Adani Foundation worked in 27 schools in the year of 2015-16. During this year, the project received massive support from students, teachers and villagers. After the end of one year, students who were weak in reading and writing, started reading and writing. Meetings with Parents were arranged at specific intervals, because of which the ratio of students remaining absent went down. Role model activity helped to raise their moral values. Thus, during the year, 27 schools completed the project successfully and we got good results at the end of year.

The M-KEN Project has benefitted 7582 students in 27 Government Schools through its various activities throughout the year.



Education

Disha Project :

Disha as the name suggests is showing directions. With the help of psychometric test, Project Disha helps students to identify their inner strength, ability, skills and areas of their interest. Along with the career talk, it also suggests the suitable career for each one of the students. It also provides valuable information about different career options available under different streams of education and future opportunity available after pursuing the course.

The Disha Project has benefitted 2797 students in 21 Government schools through its various activities throughout the year

Science & Maths on Wheel

Science and Mathematics are complementary to each other. They seem tough but become easy with right approach and logical thinking. Learning of Mathematics and science can be a lot of fun if related to day - today activities. Science and Mathematics can be popularized among children through fun filled activities.

To fulfill the vision, Adani Foundation-Education initiative adopted a project called 'Science on Wheels and Maths Fair' from 'Maa' Foundation and got implemented in the month of November, previous year.

The objective of this project is to take Science and Maths in a fun and friendly manner to the primary schools. The van filled with science models goes to the primary school and stays there for a day.

This Project has benefitted 2524 students in 35 Government schools through its various activities throughout the year.

Parvarish Project

Parvarish Project equips students with essential soft and social skills required to succeed in the workplace and for cultivating interpersonal skills. It also provides them with good human qualities required to live a happy life.

This five day long residential camp's objective is to develop the personality of the students so that when they go in the outer world they can face the competition and sustain themselves.

This Project has benefitted 300 students in 16 Government schools through its various activities throughout the year.

Other Activities

Projects with MAA Foundation were implemented upto October 2015. After completion of these projects it was necessary to remain in touch with schools through various activities.

We organized various competitions and sessions of Mind Power.

Other activities organized throughout the year

No	School Name	Village	Activity- Competition	Participants
1	KGBV	Desalpar	Essay, Elocution, Drawing	80
2	Kumar Shala	Zarpara	Essay	78
3	Kumar Shala	Mota Kapaya	Drawing	67
4	Anand Wadi	Desalpar	Essay	57
5	Darbari	Bhujpur	Essay	63
6	Vagher Vas	Bhadreshwar	Essay, Handwriting	72
7	Bavadi Bandar	Bhadreshwar	Handwriting	22
8	Juna Bandar	Old Port	Handwriting	84
9	Govt School	Navinal	Essay	63
10	High school (4)	Desalpar, Gundala, Bhujpur	Goal setting and Min power workshop	270

Project UDAAN for Kutchh

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 Ahmedabad and Kutch Districts. From this year, we have started charging nominal fees to make the project sustainable.

Details of visits made by various institutes of Kutch is listed below along with the revenue generated.

Details of visitor institute under UDAAN Project			
Sr. No	School Name & Address	Visitors	fees
1	GMDC College Nakhtrana	107	16050
2	Veerayatan Institute, Haripar -Mandavi	215	32250
3	Industrial Training Institute, Anjar	150	free
4	Industrial Traning Institute, Bhuj	380	free
5	Industrial Traning Institute, Mandvi	210	free
6	Industrial Traning Institute, Gadhidham	364	free
7	T.D Valanin Girls High School, Nakhtrana	589	44175
8	M.A Jadeja High School, Manjal- Nakhtrana	57	4275
9	Jakhho Govt. High School – Abdasa	49	free
10	P.B.K Vidhalay, Kotda – Nakhtrana	307	23025
11	K. S. Patel High School , Ravapar - Nakhtrana	156	13875
12	Sant Khetabapa High School ,Vithon	160	12000
13	Devisar Govt. High School, Nakhtarana	47	Free
14	G.M.D.C . College, Nakhtrana	56	8400
15	K.V. Govt. High School, Nakhtrana	629	Free
16	Desalapr Govt. High School, Nakhtrana	44	free
17	Naredi Govt. High School - Abdasa	54	free
18	T.D. Valanin Girls High School, Nakhtrana	161	12075
19	Government School, Mathal	41	Free
20	Industrial Traning Institute, Mundra	250	free
21	Industrial Traning Institute, Nakhtrana	101	free
22	Government Engineering college Bhuj	160	free
23	Government Polytechnic college Bhuj	106	free
24	Dhanvantry College Surat	48	7200
25	S.R. Patel Engineeing college Uja	54	8100
26	Government School Dumara	53	free
	Total	**4548**	**166125**

Adani Vidya Mandir, Bhadreshwar

Adani Vidya Mandir, a unique Gujarati medium school was started in June 2012 at Bhadreshwar village of Mundra Taluka. The objective behind setting up this school is to provide free education to children of fishermen and economically challenged families. The foundation provides nutritious food to the pupils including breakfast, lunch and snacks every day. Special care is taken to provide high quality education and overall development of children. The children are groomed to go back to their families and communities and be the agents to change.

In the Year 2015-16, Adani Vidya Mandir became a school having classes from 1st to 9th with total strength of 379 students. Right now 111 students are coming from Fisher folk communities.

Additional Coaching for new enrolled students was structured upto 17th May, 2015. Main objective is to make the new students cope up with new syllabus. Remedial Teaching has been started for Mathematics and Science subject. In addition to quality education, we focus on overall health, co-curricular activities and sports related events.

The Annual Day Celebration was held on March 5, 2016. Shri Ramesh bhai Sanghavi was the special guest for the occasion. It was witnessed by around 750 parents, village leaders and teachers of other government schools.

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.

It is important to build new structures. It is equally important to maintain these with ease and regularity. Adani Foundation has designed, planned and built a strong infrastructure for the betterment of education, community health, agriculture and living standards, all initiatives were fulfilled according to the official requests and demands of people of the community and the Gram Panchayat.

Under this core area, the Projects undertaken including construction of various infrastructures in villages as per requirements.

- Water Conservation Projects: Being situated in the coastal region, Kutch District has issues of safe drinking water. In Kutch, there is scarcity of potable water. Moreover, the water contains high level of TDS. High TDS is the root cause of bone and kidney diseases. In almost all villages of Mundra Taluka, people use ground water for drinking purpose. To deal with this situation, Adani foundation has initiated to construct check dams and pond deepening works.

This year Adani foundation carried out pond deepening in Kandagra village and constructed earthen bund construction across the river at Tunda Wandh village.

- Drinking Water Related Projects: Potable drinking water is basic requirement of any village. For better health and hygiene of village drinking water should be clean and pure. So, this project will create positive and effective social impact. **Adani Foundation has installed RO Plant at primary school at Tunda Wandh. It has also constructed an overhead water tank at Modhava village.**

- Education Related Projects: Education is the most powerful weapon which you can use to change the world." To improve the quality of education and to improve school environment, the Adani Foundation supports for infrastructure development on request basis. Adani Foundation carries out the construction of assembly hall, classrooms, computer labs, space for midday meal, playground, school walls, washrooms etc. as per the needs and preferences of the school. It is aimed at providing facilities in education sector to the present generation.

We have constructed Community Hall and four classrooms at Adani DAV public school, Nana Kapaya. We have constructed toilets and security cabin at Adani Vidya Mandir at Bhadreshwar.

- Health Related Projects: The proposed work was related to our major core area – health. Adani Foundation has constructed medical center at Tragadi, and individual toilets at Dhrub, Luni Badar and Navinal village.

- Adani Foundation has also constructed platforms for drinking water, solar light, space for drying fish, etc. The construction of temporary residence of fishermen in order to provide them healthy lifestyle is being looked under the Fisherman Housing Programme by the Adani Foundation. In 2015-16, Adani Foundation constructed 1600 Mtr approach road for Pagadiya fisherman of Shekhadia. Sand filling was done at Old Bandar and Luni Bandar. We have constructed a Training Center at Luni bandar itself for various training programmes.

- Fisherman Related Projects: The primary objective of Adani Foundation is the development of the marginalized section of the region. The welfare of the Fisher Folk Community is of prime importance. In order to raise the standard of living of the fisherman community, Adani Foundation is active in providing good roads to reach ports and other remote corners of the Dist.. Kutch

- Other Projects: Some Projects we took up to fulfill the demands of communities. We have completed Atithi Bhavan construction at Tunda Wandh, Sai Suthar Samajwadi at Mundra, Construction of Madresa room at Luni etc.

Affordable Housing competition

In August 2014, We have organized Model Making Competition among students of technical branch of Kutch District. The three Winners of the Competition constructed replica of their model at Nana Kapaya, Baroi and Gundala Village, which will be used as medical centre at Gundala and Nana Kapaya and as a residence for the poorest of poor at Baroi Village.

"We are glad to share that the students have learnt the practical, economical and soft approach of civil engineering. This learning would play crucial role in building their knowledge and confidence as a professional. Use of local resources is the need of the hour; we must realize the importance of our future generation and give them immense support to grow."

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 centre 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.

Due to social and cultural traditions, various training programmes are organized at school or village level for youth and women so that they can gain the benefits in the future as well.

Adani Skill Development Centre provides opportunities to the young people to become self-reliant, responsible and active citizens.

ASDC is proud that along with generating employment, it has also been a source of inspiration for entrepreneurship.

Vision:

To systematize the skill development efforts in the Nation and create an environment where youth and women not only get some vocational training but also gets some gainful employment, entrepreneurship and self- respect.

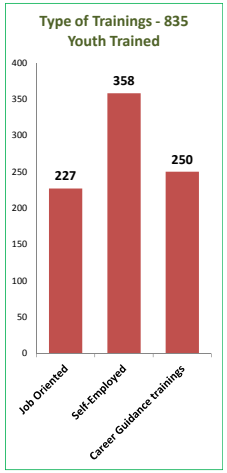
Objective:

- Bridge the wide gap in demand & supply of human power.
- Awareness regarding availability, needs and vision for career development and education.
- Facilitation, spreading awareness, creating new opportunity to upgrade skills through organizing various skill trainings in the region.
- To improve overall status of rural Youth and women in the society by enhancing confidence and entrepreneurship in them.
- Encouraging youth for participatory approach in social and economic activity and helping them to keep away from addictions, to become self-dependent, and empower them to live a dignified life.
- To build a feeling of harmony in the society by creating a rapport of goodwill, mutual trust and respect.

Skill development trainings administered by ASDC

Each training module of ASDC is well-designed to make the learning more effective. Hands on experiment is the key factor to enhance learning in all the courses offered by ASDC.

All the trainings are offered at either ASDC centre, Port, Power plant, or at specific villages depending on the need of the module and the students. Certificate for each course is given by ASDC or by partner institute.



- **IT- Basic Computer**
  Word, Excel, Power Point, Internet, Web Browser detail
- **Tally ERP 9**
  Basic Accounts, Voucher Entry, Ledgers, Group Creation, VAT, TDS, Service tax, Excise etc. is taught for 60 days to benefit students of class XII and above having commerce background.
- **Spoken English**
  Grammar, Tenses, Vowels, Articles, Prepositions, Phonetics, Tenses, Communication Skills etc. are offered especially for students and working people. The duration for this course is of 60 days.
- **Auto mobile Assistance**
  The training given here is regarding Units and Dimensions, Measuring & Marketing (Preparation of jobs for welding, Dismantling and assembly of components), Inspection, Preventive etc. and repair of bearing, gearbox, couplings, and TPM, Condition Monitoring, Kaizen.
- **O&M of Coal Handling System at Ports**
  This module includes Induction at Port + First Aid + Safety training, GSU (Grab Ship unloaded) Crane Theory training, GSU Crane Simulator training, Commercial Documentation O & M of coal handling Activities Stacker Reclaimer Theory training, Silo Theory Training, Conveyor Theory Training, On Job Training conveyor.
- **Checker cum RTG Crane Operator**
  In this programme students get training regarding Safe Operating Practices, RTG Controls and Functions, Pre-Operational and Operational Checks, Driving, Hoisting and Lowering Loads, Operations - Transferring Loads for three months.

- **Mechanical & Electrical work of Container Terminal**
  This programme includes training of Crane Operation & maintenance for two months and the minimum qualification for this is ITI Fitter & Electrical.

- **Stitching & Bagging Machine Operator**
  The training includes teaching of stitching and bagging operation in FCC 7 plant. It is for 1 Month and the min. qualification required is 10 Pass.

- **Checker**
  Students get basic induction on Safety, Fire, First Aid, Security, CT, Export Import Procedures, Identification of containers, Container construction, Hazardous classification & Symbols, Role of yard checker, Role of deck checker, Role of Wharf checker, Bay Plan, Awareness of RDT, Custom Seal.

- **Vocational training for 9th and 10th std students**
  1. Basics of Agriculture and Animal Husbandry, 2. Workshop and Engineering, 3. Energy and Environment, 4. Food Processing, Personal Health and Hygiene.

- **Light Motor Vehicle**
- **Mobile Repairing**

- **LED Bulb Assembly**
- **Courses for Females**
  Beauty Parlour, Tailoring, Mud work, Thread work, Glass Painting, Fabric work each Basic Embroidery work etc.

"Project Swaadheen"-

We gave this name as it proves to be helping the students to become "swa-adheen" - self motivated. Total 65 students from 9th & 10th Std. participated in this training.
This unique project was implemented in collaboration with an organization Lend – a - Hand India and Zarpara School. We provided vocational training and career guidance to young boys and girls from urban and rural communities in pre-identified trades as a part of secondary school curriculum.
This year we initiated this project at Zarpara High School and trained the students in various skills related to Electricity, Engineering, Agriculture and Animal Husbandry, home and health etc. Students gained a lot of practical knowledge, guidance of right vocation for them, self-dependence and confidence.

Training for MIS

A Training Programme was conductaed by the Head Office for All Coordinators and Project Officer for MIS Application. Adani foundation has planned to start AF Online Application for reporting, monitoring & evaluation. Taining for the same was organized from 8th June to 11th June 2015 at AMDC in coordination with Cyber Swift. The training was organized by Mr. Sanjiv Ranjan.

Adani foundation CSR Conclave 2016

"Adani foundation CSR Conclave 2016" was held on 8th and 9th January 2016 at AMDC, Ahmedabad.
The Conclave gave further momentum to our works by consolidating newer and passionate ideas which are more dynamic impactful, replicable and at the same time sustainable.

Adani Foundation, CSR Budget - Mundra Budget Utilization 2015-16 (Oct.15 to Mar.16)				
Sr. No.	Program	Expenditure Apr.15 to Sept.15	Expenditure Oct.15 to Mar.16	Total Expenditure 2015-16
A.	Admin Expense	52.49	94.21	146.7
B.	Education			
(i)	Education Initiative	37.96	18.97	56.93
(ii)	Adani Vidya Mandir-Bhadreshwar	44.56	75.2	119.76
(iii)	Shanti Vihar	147.89	180.18	328.07
	Sub Total	230.41	274.35	504.76
C.	Community Health	161.27	134.06	295.33
D.	Fisher Folk, SLD & Agriculture	98.04	87.23	185.27
E.	Rural Infrastructure Development	75.25	205.13	280.38
	Other Expenditure	88.9	0	88.9
	BUDGET 2015-16: GRAND TOTAL	**706.36**	**794.98**	**1501.34**

adani™

Resources Logistics Energy

Annexure – 6

MOCK DRILL REPORT

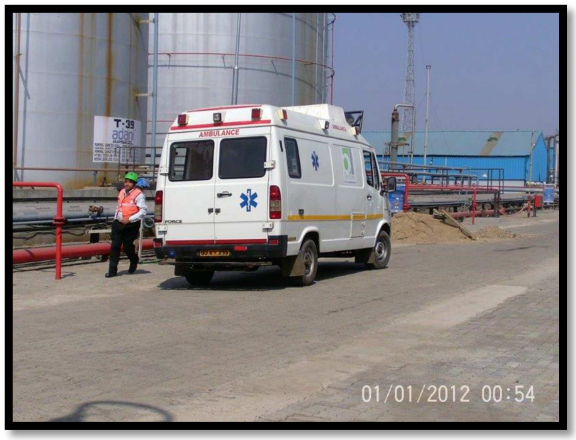
DATE : 07th November 2015
TIME : 11:30 AM
LOCATION : Liquid terminal (Tank no-36)
SCENARIO : Fire in Hexane Tank no. 36 with 02 nos. casualties.

INTRODUCTION:

Mr. Lakhuram (M/s Shri Ganesh travel) was informed to liquid control in charge Mr. Giri about the fire occurred at T-36 (Hexane) manhole side and two persons were observed burn injury. Immediately liquid in charge Informed to fire, POC, OHC, and Safety & Security. POC subsequently intimates the same through message/call to concern departments.

LOCATION (WITH PHOTOGRAPH): LIQUID TERMINAL

SEQUENCE OF EVENTS (WITH PHOTOGRAPHS AND TIME):




01/01/2012 00:53


01/01/2012 00:55


K.R.Ra
Liq


Liquid
01/01/2012 00:58


01/01/2012 00:55


VIJAY
01/01/2012 01:02


01/01/2012 01:10


01/01/2012 01:14

OBSERVATION:

Calling time of the drill:

Drill commenced	: 11:30 AM
Spot person Inform to LT Control	: 11:30 AM
LT Control Inform to fire department	: 11:30 AM
LT Control Called OHC Assistance	: 11:31 AM
LT Control Informed Port Control	: 11:32 AM
LT Control Inform to ERT assistance	: 11:32 AM
LT Control Inform to Safety	: 11:35 AM
LT Control Informed to LT Maintenance	: 11:35 AM

Responding:

Fireman rushed the spot	: 11:30 AM
Fire tender rushed the spot	: 11: 35 AM
Ambulance rushed the spot	: 11:36 AM
Security Personnel rushed the spot	: 11:37 AM
Shift Manager (IC) rushed the spot	: 11:41 AM
Electrical personnel rushed the spot	: 11:42 AM
Mechanical personnel rushed the spot	: 11:42 AM
QHS Department	: 11:42 AM
All clear	: 11:45 AM

GOOD OBSERVATIONS:

1) Good response by fire team.
2) Announcement by security for evacuation.
3) Good response by workers for evacuation.
4) Tanker's drivers rushed the assembly point.

AREA OF IMPROVEMENT/OBSERVATIONS:

1) Head Counting was not carried out by security at assembly point.
2) It was decided in the mock drill meeting, provide reflective jacket & helmet to shift manager with proper identification as site incident controller & he will be responsible as site incident controller.
3) While an emergency need to be open others liquid gate for easy evacuation.
4) Need to be improvement in communication through proper channel by LT control; it was observed communication missing to HOS/HOD, HR & Admin for an emergency.

VOTE OF THANKS:

Vote of the thanks by LT Head Mr. Sudip Das Gupta (LT), Mr. Dattatray Gore (HSE), Mr B B Kaushik (Fire) & Manan Bhatt (HSE) and him given to the special thanks to all team members of mock drill participants.

SUPPORTING STAFF:

Drill Organized By	:	Mr. Rana Bambhaniya / Mr. Bhushan Bhatt
Drill guided By	:	Mr. Rana Bambhaniya
Exercise Performance Assessor	:	Mr. Dattatray Gore / Mr. Manan Bhatt
Site incident controller	:	Mr. Sudip Das Gupta / Mr. Rajamanickam Vijayan
Report prepared By	:	Mr. Rana Bambhaniya

SUMMARY (OPTIONAL – BUT FOR INTERNAL REFERENCE):

Detailed Event	Expected Action	Remarks
Site Main Controller : - Shall ensure all possible assistance to personnel affected for medical attention and hospitalization as appropriate	Has been informed by site incident controller	He will late reach at site due to no communicate by site incident controller.
Site Incident Controller Shall immediately assess the scale of emergency and report to Site Main Controller for instructions/ directions and Shall liaise with other heads of department for their support and assistance and shall ensure continual reporting of situation to Site Main Controller and shall recommend calling for external resources as appropriate.	Had liaised with other heads for getting assistance to mitigate the situations.	Performed very well - Informed the concern for mitigation action.
HOS – Administration Shall	----	-----

report to Site Incident Controller immediately and assist him as directed.		
HOD – Human Resources Shall report immediately to Site Incident Controller and assist him as directed.	------	------
HOD – Corporate Affairs Shall report immediately to Site Incident Controller and assist him as directed.	-------	-------
HOD/ HOS – Engineering Services Shall report immediately to Site Incident Controller and assist him as directed.	Shall ensure and try to stop the leakage & Electrical supply.	Site in charge along with technician reached at site immediately for mitigation activity.
HOD/ HOS – Commercial shall ensure availability of materials required by the Site Incident Controller.	Arrange necessary material / equipments if require.	No person from commercial has been reached to the site nor confirms the attendance.
HOD/ HOS – Finance & Accounts shall report immediately to Site Incident Controller and assist him as directed.	Shall ensure availability of funds and cash for all emergent requirements.	No person from F&A has been reached to the site nor confirms the attendance.
HOD/ HOS – Security shall **i**nstruct the security personnel to occupy pre-determined post for controlling security of installation.	Shall close the gate and control the man & vehicle movement.	All the personnel working at the gate rushed to site and helped workers working in terminal, medical, fire and safety team. Security restricted entry of the gate for labors and vehicles movement inside Liquid Terminal. Also helped to workers to evacuate them told them to gather at assembly point near driver's canteen.
HOS – Fire Services will normally function as an advisor to the Site Incident Controller.	Fire staff shall reached to site for attending fire emergency	Done – reached immediately and attend the emergency.
HOD/ HOS – Safety shall report at Emergency Control Center	Shall assist Site Main Controller with necessary information, support and resources	Safety officer reached at site and guided the situation.
HOS – Occupational Health Center Contact Site Main Controller.	Report at Emergency Control Center or at Occupational Health Center as instructed by the Site Main Controller.	Medical staff immediately reached the spot for assistance in case of emergency Medical Ambulance proper place and also should be parked properly so that immediately the victim should be kept in Ambulance and it should go to OHC.

Annexure – 7

ENVIRONMENTAL PROTECTION EXPENDITURES

(April'15 to March'16)

Sr. No.	Activity/ Category	Expenditure (INR)
1	Environmental Study / Audit and Consultancy	45,45,300/-
2	Legal & Statutory Expenses	3,30,000/-
3	Environmental Monitoring Services	26,80,162/-
4	Hazardous Waste Management & Disposal	34,56,637/-
5	Environment Day Celebration	7,18,375/-
6	Treatment and Disposal of Bio-Medical Waste	1,22,860/-
7	Mangrove Plantation	53,28,386/-
8	Mangrove Monitoring & Conservation	20,36,220/-
9	Horticulture Expenses	4,34,72,000/-
10	O&M of Sewage Treatment Plant and Effluent Treatment Plant	18,18,272/-
11	Capital Cost of Development of STP Plant & Wind Screen at West Port	56,75,433/-
12	Expenditure of Environment Dept. (Apart from above head)	1,35,89,989/-
Total Environmental Expenditures in Rs. (INR)		8,37,73,634/-