SEALAND PORTS PRIVATE LIMITED

12/05/2017

To,

The Member Secretary,
Expert Appraisal Committee
Ministry of Environment, Forest and Climate Change (MoEF&CC),
Indira Paryavaran Bhawan,
3rd Floor, Vayu Wing,
Jor Bagh Road, Aliganj,
New Delhi-110003.

Kind Attention: Shri S.K. Srivastava, Scientist E

Sub: Environmental/CRZ Clearance for Development of Multi-Product SEZ/FTWZ and DTA at Layja Mota, Kutch District, Gujarat by M/s. Sea Land Ports Private Limited and M/s. Avash Logistic park Private Limited. [F.No.21-68/2011-IA-III] – Submission of additional information and Request for CRZ/Environmental Clearance– reg.

Reference:

1. Minutes of 163rd meeting of Expert Appraisal Committee for projects related to Infrastructure Development, Coastal Regulation Zone, Building/Construction, Industrial Estate and Miscellaneous projects held on 9th September, 2016 [item No: 3.2]
2. MoEF & CC issued ToR Letter dated March 5, 2013 and validity extension letter dated July 13, 2016

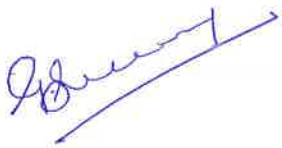
Respected Sir,

The EAC while considering the subject proposal in their 163rd meeting held on September 09, 2016, has sought certain additional information on EIA study vide reference 1.

We are herewith enclosing the document containing point wise clarifications of the observations to MoEF&CC with a request to consider the project in upcoming expert appraisal committee meeting for the issue of Environmental/CRZ clearance for Development of Multi-Product SEZ/FTWZ and DTA at Layja Mota, Kutch District

Thanking you,

For M/s. Sealand Ports Private Limited and and M/s. Avash Logistic park Private Limited.



Authorized Signatory

Encl: As Above

Multiproduct SEZ/FTWZ and DTA

at Layja Mota, Kutch Dist., Gujarat

CLARIFICATIONS TO EAC, MOEF&CC OBSERVATIONS (Ref: 163rd MoM)

May, 2017

Submitted By

M/s Sealand Ports Private Limited (SPPL) and M/s. Avash Logistic Park Private Limited (ALPL).

EIA Consultant: L&T Infra Engineering

Clarifications

Clarifications to Observations on Development of Multiproduct SEZ and Free Trade Warehousing Zone (FTWZ) at Layja Mota in District Kutch Gujarat– For further consideration of Environmental and CRZ Clearance – [F.No.21-68/2011-IA-III].

(Reference: Minutes of 163rd meeting of Expert Appraisal Committee for projects related to Infrastructure Development, Coastal Regulation Zone, Building/Construction, Industrial Estate and Miscellaneous projects held on 9th September, 2016)

1 There are many legal entities who could be designated as project proponents, and are involved in developing the SEZ, Port, TPP, CCPP, and/or other identified industrial units. The different documents submitted reveal non-uniformity in this regard e.g. public notice issued by GPCB for conducting public hearing reflects M/s Sealand Ports Pvt Ltd as the project proponent, for CRZ mapping, the clients are named as M/s Sealand Ports Pvt Ltd, M/s Avash Logistic Park Pvt Ltd, M/s Nana Layja Power Company Ltd, whereas the ToR for the instant proposal has been issued in the name of M/s Sealand Ports Pvt Ltd, M/s Avash Logistic Park Pvt Ltd. This needs to be clarified appropriately.

Infrastructure Leasing & Financial Services Limited (IL&FS) Group is promoting the development of the Multi-Product Special Economic Zone (SEZ), a Free Trade and Warehousing Zone (FTWZ), a Domestic Tariff Area (DTA) ("**the Project**") at Layja Mota in Kutch District, Gujarat, through its subsidiaries - M/s. Sealand Ports Private Limited (SPPL) & M/s Avash Logistic Park Private Limited (ALPL)

The major units apart from other industries, within this SEZ / FTWZ/DTA are two power plants which are being developed by M/s. **Nana Layja Power Company Limited (subsidiary of IL&FS Group)**; viz

- A 4000 MW Thermal Power Plant (TPP) supplemented with a 60 MLD Desalination Plant
- A 2000 MW Gas Based Combined Cycle Power Plant (CCPP)

IL&FS Ltd. Group is also promoting the project Shipyard cum Captive Jetties including LNG Terminal at Nana Layja, Taluka Mandvi, Dist. Kutch, Gujarat through its subsidiaries M/s. **Gujarat Integrated Maritime Complex Pvt Ltd** (GIMCO) & M/s **Sealand Ports Private Ltd** (SPPL). Details regarding the project proponents / Special Purpose Vehicles (SPVs) and the TORs obtained from MOEF are as below;

Table 1-1: Details of Proponents / TORs obtained

S. No	Project	Project Proponents / SPV	MoEF ToR
1	**Multiproduct SEZ & Free Trade Warehousing Zone (FTWZ)**	M/s Sealand Ports Private Ltd (**SPPL**) & M/s Avash Logistic Park Ltd (**ALPL**)	F.No.21-68//2011-IA-III, vide letter dated March 05, 2013
	Major Units within SEZ		
	a) 4000 MW Coal based Thermal Power plant (TPP)& 60 MLD Desalination plant	M/s Nana Layja Power Company Limited (**NLPCL**)	J-13012/13/2011-IA.II (T) vide letter dated December 28, 2011
	b) 2000 MW Gas based Combined Cycle Power Plant	M/s Nana Layja Power Company Limited (**NLPCL**)	J-13012/10/2012-IA.II (T) letter dated September

S. No	Project	Project Proponents / SPV	MoEF ToR
	(CCPP)		24, 2012
2	**Shipyard cum Captive Jetties including LNG Terminal**	M/s Gujarat Integrated Maritime Complex Pvt Ltd (**GIMCO**) & M/s Sealand Ports Private Ltd (**SPPL**)	F.No.11-87/2011-IA.III vide letter dated November 14, 2013

As per EIA notification, 2006 and subsequent amendments, MoEF office memorandum dated 24th December, 2010 on consideration of Integrated and interlinked projects, the project proponents have prepared a common EIA report after obtaining TORs from each of the respective Expert Appraisal Committees of MoEF & CC as detailed above

Draft EIA report has been prepared by strictly adhering to EIA notification 2006 and subsequent amendments and as per TOR prescribed by MOEF.

As the project is integrated and interlinked, draft EIA report has been prepared in two Volumes and Submitted to GPCB.

Volume- I covers Multipurpose SEZ, FTWZ, DTA Project with details of units within SEZ i.e, 4000 MW Thermal power plant, 2000 MW Gas based power project and other proposed industries within the SEZ / DTA. This also covers anticipated cumulative impacts, Emissions/discharges from proposed industries of SEZ and mitigation measures, environmental monitoring programmes, EMP, Corporate Social Responsibility, etc.

Volume- II covers Shipyard cum Captive Jetties including LNG Terminal. Marine environment, impact assessment, mitigation measures, environmental monitoring programme, EMP, Corporate Social Responsibility / livelihood of fishermen, etc.

The Integrated/Common EIA report and other necessary documents required for the public hearing was submitted to Gujarat Pollution Control Board (GPCB).

GPCB has conducted the Public Hearing covering aforesaid Projects:

1. Development of Multi-Product SEZ/FTWZ & DTA including a dedicated Utility Corridor & Anchor units of SEZ i.e., 4000 MW TPP Super Critical Coal based Thermal Power Plant with 60 MLD desalination Plant as units & 2000 MW gas based combined Cycle Power Plant (CCPP), with in the proposed SEZ/FTWZ at Layja Mota, Taluka Mandvi, Dist. Kutch and

2. Shipyard Cum Captive Jetties including LNG Terminal at Nana Layja, Taluka Mandvi, Dist. Kutch

The CRZ map / facilities of SEZ project includes certain specific details of associated facilities of Power plant units like sea water intake & outfall pipelines, sea water intake pump house, coal conveyor, gas pipeline etc, hence NLPCL inputs were considered in CRZ mapping

Further, it is confirmed that the Minutes of 163rd meeting of Expert Appraisal Committee held on 9th September, 2016 was with respect to the proposal for EC/CRZ Clearance for the development of Multiproduct SEZ and Free Trade Warehousing Zone (FTWZ) and DTA including Utility Corridor at Layja Mota in District Kutch (Gujarat) by M/s Sealand Ports Private Limited (SPPL) and M/s. Avash Logistic Park Private Limited (ALPL).

2 Since the proposal involves discharge of effluents also, the project proponent was required to apply to the GCZMA along with the 'No Objection Certificate' from the concerned SPCB. The same was not done.

The requisite GCZMA recommendations were already submitted to MoEF& CC and the same is attached as **Annexure I.**

No Objection Certificate / Consent to Establish (CTE) issued by Gujarat Pollution Control Board (GPCB) is attached as **Annexure II.**

3 The public hearing was allowed to be conducted by Hon'ble High Court of Gujarat vide order dated 11th December, 2014. The project proponent should provide the final outcome of the same.

The final outcome is attached as **Annexure III**

4 The CRZ mapping in respect utility corridor, especially around the creek, is not correct and needs to be reviewed and authenticated by the authorised agency.

The CRZ map in respect to utility corridor, especially around the creek was reviewed and revised by National Institute of Oceanography, (MoEF &CC authorised agency).

The corrected map by NIO is attached as **Annexure IV.**

5 Since the proposal involves combined intake and outfall facilities for all the constituent units of SEZ, cumulative impact on the marine eco-system is of prime concern and needs in-depth deliberations. That necessitates ascertaining the pollution loads from the individual units along with the characteristics, and also a relook at the conditions stipulated in the EC by the sectoral EACs.

The cumulative impact due to discharges from various individual units of SEZ/FTWZ & DTA and Shipyard cum Captive Jetties including LNG terminal projects have been assessed and proposed treatment systems, treated water characteristics, marine Outfall system with mathematical model studies have been studied in detail and the same is attached as **Annexure V.**

The above details are part of integrated EIA report which has been submitted to respective EACs including both the Power Plants for which the EC have been accorded.

Certain special and general conditions stipulated in the EC accorded for 4000 MW TPP and 2000 MW CCPP are re-produced below and the EC letters granted by MOEF are attached as **Annexure VI**.

5.1 Conditions stipulated with respect to intake/outfall in the Environmental Clearance Letter dated 26.06.2015 for Imported Coal based Thermal Power Plant at village Layja Motya, Mandvi Taluk, Kutch District, Gujarat

- **Specific Conditions A (i):** the activities attracting CRZ Clearance shall only be initiated after obtaining the prior CRZ Clearance from the competent authority. A copy of the same shall be submitted to the Ministry and its Regional office.
- **Specific Conditions A (x):** CoC of at least 1.3 Shall be adopted
- **Specific Conditions A (xx):** Sea water quality shall be continuously monitored for Salinity and temperature at selective sites across the impacted zone including estuarine waters. Mitigative measures shall be undertaken through institute such as Annamalai University for continuous preservation of mangroves and their ecology. The monitoring data shall be uploaded on the company's website and also submit to Regional Office of the Ministry every Six months.

- **Specific Conditions A (xxi):** To minimise the entrapment of even small marine Flora and fauna, state of the art low aperture intake screens with high effectiveness for impingement and entrainment and fishnet around the intake shall be installed.
- **Specific Conditions A (xxii):** Fish catch along the impacted zone of sea should be monitored periodically by the department of Fisheries, Government of Gujarat. The project proponent shall accordingly take up the matter with the Fishery Dept., Govt. og Gujarat from time to time.
- **Specific Conditions A (xxv):** A state of art environmental laboratory at the project site shall be established such that laboratory has the facilities for long term monitoring of Sea water Quality and Sediment in the impacted Zone over and above and ambient air, soil quality analysis of the area. The proponent shall undertake mitigative measures if there are any negative impacts.

5.2 Conditions stipulated in the Environmental Clearance Letter dated 29.09.2016 for 2000 MW gas based Combined Cycle Power Plant (CCPP) at village Godhra, Kutch District, Gujarat

- **Specific Conditions A (iv):** Ensure by periodic maintenance that there are no leakages of pipes transporting LNG and Seawater.
- **Specific Conditions A (viii):** CoC of at least 1.3 Shall be adopted
- **Specific Conditions A (xii):** Sea water quality shall be continuously monitored for Salinity and temperature at selective sites across the impacted zone including estuarine waters. Mitigative measures shall be undertaken through institute such as Annamalai University for continuous preservation of mangroves and their ecology. The monitoring data shall be uploaded on the company's website and also submit to Regional Office of the Ministry every Six months.
- **Specific Conditions A (xiii):** To minimise the entrapment of even small marine Flora and fauna, state of the art low aperture intake screens with high effectiveness for impingement and entrainment and fishnet around the intake shall be installed.
- **Specific Conditions A (xiv):** Fish catch along the impacted zone of sea should be monitored periodically by the department of Fisheries, Government of Gujarat. The project proponent shall accordingly take up the matter with the Fishery Dept., Govt. og Gujarat from time to time.
- **Specific Conditions A (xvii):** A state of art environmental laboratory at the project site shall be established such that laboratory has the facilities for long term monitoring of Sea water Quality and Sediment in the impacted Zone over and above and ambient air, soil quality analysis of the area. The proponent shall undertake mitigative measures if there are any negative impacts.

6 In view of the fact that intake and outfall facilities remain an integral part of the Super Critical Thermal Power Plant, and accordingly, as required under the provisions of the CRZ Notification, 2011 read with section 8(v) of the EIA Notification, 2006, the EAC desired that the Ministry may examine if the EC for the TPP was to be granted after appraising the proposal from CRZ perspective also.

It is pertinent to mention that while appraising the power plants, the respective EAC (T) have discussed in detail the intake/outfall facilities which is reflected clearly as special conditions in the EC Letter issued.

Also the Specific Conditions mentioned in Environmental Clearance Letter dated 26.06.2015 for Imported Coal based Thermal Power Plant (4000 MW) states clearly that **A (i): the activities attracting CRZ Clearance shall only be initiated after obtaining the prior CRZ Clearance from the competent authority. A copy of the same shall be submitted to the Ministry and its Regional office.**

In addition, Power Plants are units of the proposed Multi-Product SEZ/FTWZ & DTA including utility Corridor. Intake/Outfall System is not only the requirement of power plants but also the requirements of all other industrial sectors / constituents proposed in Multi-Product SEZ/FTWZ and DTA project.

Hence, SEZ developer has submitted the application for EC/CRZ clearance for the development of proposed Multi-Product SEZ/FTWZ and DTA including utility Corridor.

7 The CRZ area around the utility corridor is having significant sand dunes, which needs to be visited for contouring and geo-morphological characteristics of the area. The Committee felt the necessity for an expert opinion in this regard through a site visit.

During the project appraisal by Gujarat Coastal Zone Management Authority (GCZMA), site visit was conducted by Technical committee of GCZMA on July 04, 2015. As advised by GCZMA, a detailed study on existence of Sand dune was carried out Centre for Coastal Marine Research (CCMR), Tuticorin.

The Study team comprises of following experts.

- Dr.G.A.Thivakaran, Senior Principal Scientist, Gujarat Institute of Desert Ecology (GUIDE), Kachchh, Bhuj
- Dr.Nilesh P. Bhatt, Professor, Dept.of Geology, M.S.University of Baroda (MSU), Vadodara
- Dr.JayendraLakhmapurkar, Deputy Director, Gujarat Ecology Society (GES), Vadodara
- Dr.Vinoth Ravindran, Director & Project Coordinator, CCMR

The Sand Dune study report covering contouring and geo morphological characteristics of the area as submitted to GCZMA is attached as **Annexure VII.**

GCZMA deliberated the project in its 29th meeting held on 24-05-2016 and after detailed discussion recommended the project to MoEF&CC for the grant of CRZ Clearance for laying of intake pipeline, outfall pipeline with associated facilities and utility corridor as a part of proposed project for development of Multi-Product SEZ /FTWZ, DTA including Power and Desalination Plants at Village Layja Mota, Kutch District.

The key Specific conditions stipulated by GCZMA in its recommendation letter with respect to Sand dune are as follows.

1. The SLPPL shall have to ensure that the existing sand dunes are not disturbed due to the proposed project and shall remain intact
2. The trestle and approach road for lying pipeline shall be kept at 1.00 m highest height of sand dune.

With respect to specific condition (1) as above by GCZMA, the project proponent have already revised the project layout avoiding facilities in sand dune area except utility corridor which is permissible and SPPL hereby confirms that the specific condition (2) as above will be adhered. The revised facilities layout was submitted to MOEF&CC as part of Addendum 1 to EIA report dated July, 2016.

8 A substantial part of the SEZ area and the complete area of 124 acres for the very crucial utility corridor, are yet to be acquired by the project proponent. In terms of this Ministry's OM dated 7th October, 2014, the project proponent were asked to submit copies of the State Government Notification for acquiring the Government land and the letters of intent or purchase agreements from the private land owners

The project requires about 3606 acres of land from both Government and Private owners and the breakup details along with acquisition status are provided in **Table 8-1**.

Table 8-1: Project Land Requirement & Status

S. No.	Land Acquisition Status	Acres	Percentage (%)
A.	**SEZ Industrial Land Area (3473 Acres)**		
1.	Private Land acquired	2352	65.2
2.	Government Land in process of transfer	427	11.8
3.	Private Land to be acquired	320	8.9
4.	Other Government Land/Area to be acquired	374	10.4
B.	**Utility Corridor Area (133 Acres)**		
1.	Private Land to be acquired	102	2.8
2.	Government Land to be acquired	22	0.6
3.	Government Land with Proponent Possession	9	0.2
	Grand Total (A+B)	**3606**	**100**

From the above table, the land acquired /under process of transfer is 2788 acres (77.3%) out of 3606 acres.

To minimise balance land acquisition, proponent is considering to reduce the project land requirement by removing certain parcels of land. The SEZ industrial area would be planned in 3148 acres instead of 3473 acres and this will not have much implication on the master plan. Reducing land from project is expected to reduce the pollution load and the environmental impact predictions will be on conservative side.

The details of land acquisition status for total area of 3281 acres are given in **Table 8-2**.

Table 8-2: Revised Land Acquisition Status (SEZ including Utility Corridor)

S.No	Land Acquisition Status	Acres	Percentage %
A	**SEZ Industrial Area (3148 Acres)**		
1	Private Land Acquired	2335.5	71.2%
2	Government Land in process of transfer	424.4	12.9%
3	Private Land to be Acquired	268.7	8.2%
4	Other Government Land / Area to be acquired	119.4	3.6%
B	**Utility Corridor Area (133 Acres)**		
1	Private Land to be Acquired	102	3.1%
2	Government Land to be acquired	22	0.7%
3	Government Land with Proponent Possession	9	0.3%
	Grand Total (A+B)	**3281**	**100%**

From the **Table 8-3,** land acquired /under process of transfer is 2768.85 acres (84.4%) and the land to be acquired is 512.34 acres (15.6%) out of 3281acres. It may be noted that land to be acquired for Utility Corridor purpose is minimal, which is only 3.8 % of the total land requirement of project.

Therefore it is to mention that the major part of land requirement i.e, 84.4 % is under possession / transfer for the project and land to be acquired is only 15.6% out of which Government land is about 4.3%.

The land for development was certified as bonafide for industrial purpose by Industries Commissioner, Gujarat. It is submitted to EAC that balance land will be acquired before commencement of construction activity

Due to revision in SEZ industries land requirement from 3473 acres to 3148 acres, the change in land use breakup of SEZ is given in **Table 8-3**.

Table 8-3: Change in land use breakup of SEZ land

S.No	Particulars	Area Before revision in SEZ land in Acres	Area After revision in SEZ land Area in Acres
1	Thermal Power Plant	1298.00	1298.00
2	Gas Power Plant	88.0	88.0
3	Other SEZ Units including FTWZ	1291.5	1019.0
4	Non Processing Area	150.5	148.9
5	DTA-1	544.0	532.6
6	DTA-2	101.0	61.5
	Sub-Total	**3473**	**3147.7**

Change in Processing and Non-processing Area of SEZ

As per guidelines for power generation within SEZ dated April 06, 2015 issued by Ministry of Commerce and Industry, Department of Commerce (SEZ division), power plants shall be allowed only in non-processing area of SEZs.

Therefore area allocated for the proposed 4000 MW coal based thermal power plant and 2000 MW gas based power plant area are demarcated as non-processing area. The DTA-1 proposed towards Eastern portion of SEZ is taken into processing area without changing the industrial mix and DTA-2 proposed towards western portion of SEZ shall only remain as DTA.

Master Plan before and after revision in SEZ land, processing and non-processing areas is shown in **Figure 8-1** and **Figure 8-2.**

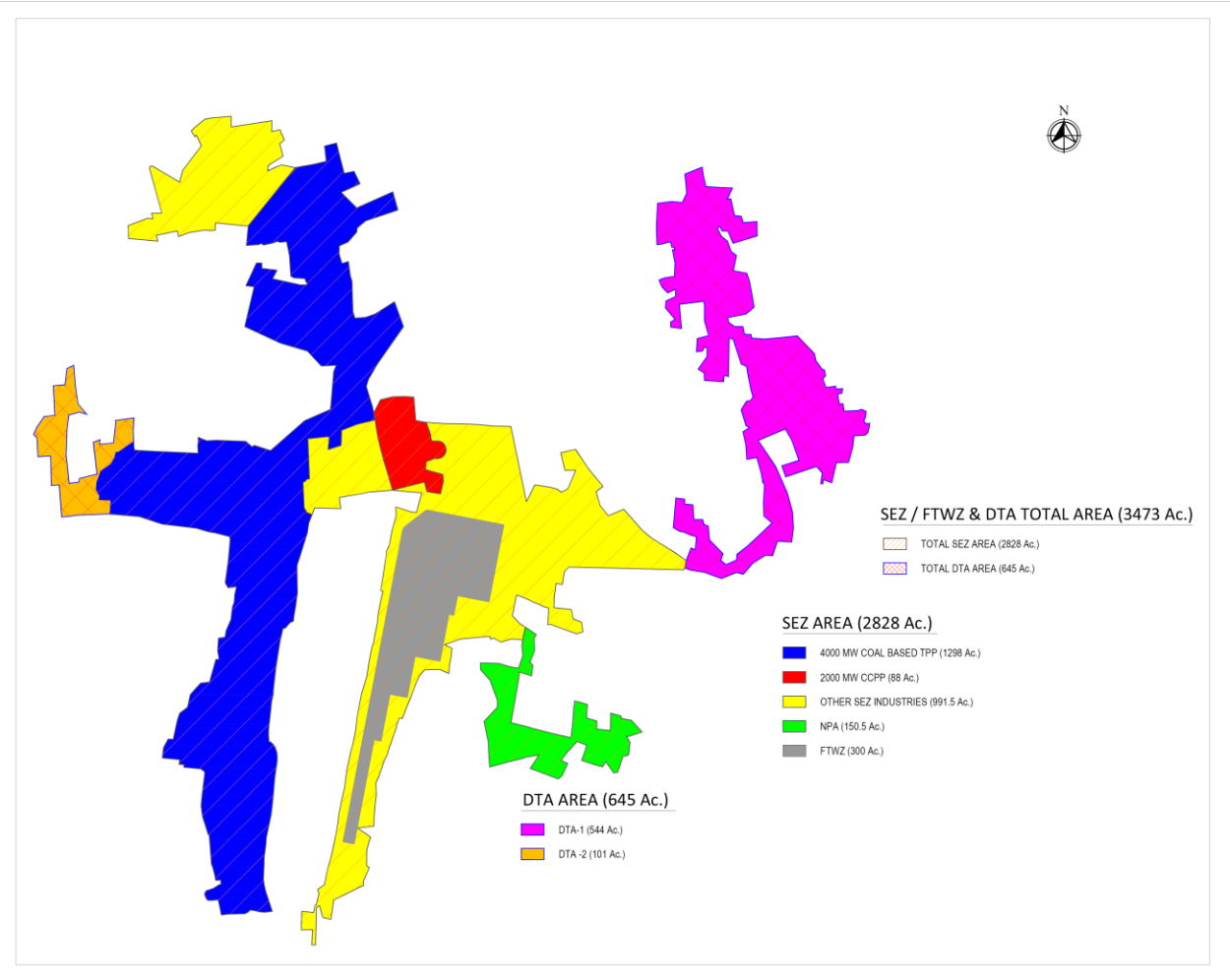


Figure 8-1: Master Plan of SEZ/FTWZ and DTA

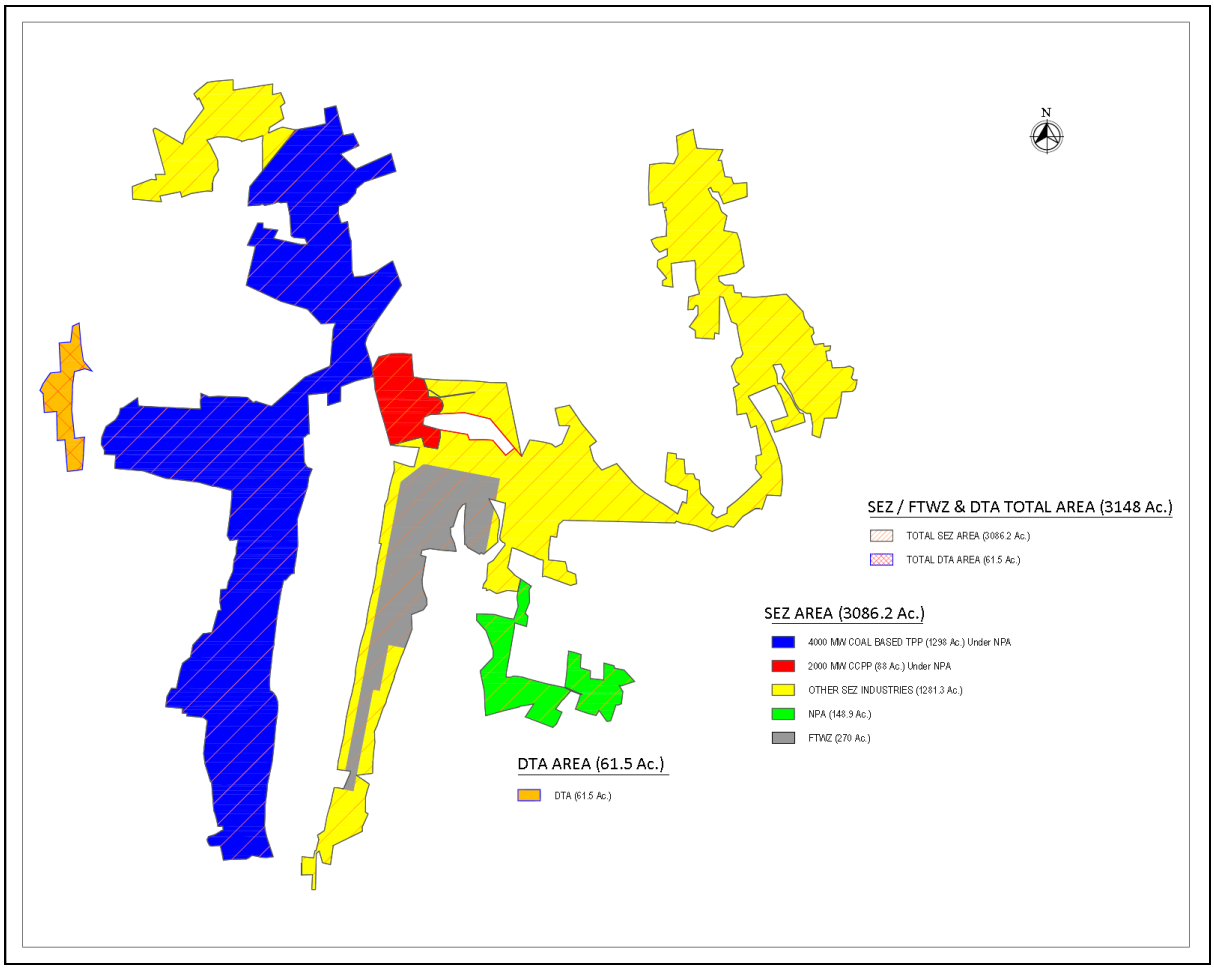


Figure 8-2: Revised Master Plan of SEZ/FTWZ and DTA

Annexures

Annexure I
GCZMA Recommendation Letter

GOVERNMENT OF GUJARAT
FORESTS & ENVIRONMENT DEPARTMENT
BLOCK NO. 14, 8TH FLOOR, SACHIVALAYA
GANDHINAGAR - 382 010.

HARDIK SHAH, IAS
DIRECTOR (ENVIRONMENT) &
ADDITIONAL SECRETRAY

Ph : (079) 23251062
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Ref. No.ENV-10-2015-155-E (T cell) ***June 29, 2016***

To,
Shri S.K. Srivastava
Additional Director(IA-III)
Ministry of Environment, Forests & Climate Change
Indira Paryavaran Bhavan, Jor Bugh,
Aliganj Road New Delhi - 110 003

Sub: CRZ clearance for proposed construction of intake and outfall facilities for the proposed development of Multiproduct SEZ/FTWZ, DTA including Power Plant and Desalination Plant at Layja Mota, Dist: Kutch by M/S Sealand Ports Private Limited t -regarding

Dear Sir,

M/S Sealand Ports Private Limited(SLPPL) has approached this Department seeking recommendations from the Gujarat Coastal Zone Management Authority for obtaining CRZ Clearance from the Ministry of Environment, Forests and Climate Change, Government of India for their proposed project for construction of Intake and outfall facilities for their proposed project for development of Multiproduct SEZ/FTWZ, DTA including Power Plant and Desalination Plant at Layja, Mota, Dist: Kutch, vide its letter dated 16th January, 2015

M/s Sealand Ports Private Limited (SLPPL) has submitted the following documents:

1. Various undertaking
2. Form 1 as per CRZ Notification 2011
3. A copy of the NOC dated 29-12-2012 issued by the Forests Department for proposed project for Power Plant and Desalination Plant
4. The CRZ map along with demarcation of High Tide Line, Low Tide Line, CRZ Boundary, and superimposition of the proposed route of pipeline on it, etc. prepared by the National Institute of Oceanography, Goa

5. Integrated /Common final Environment Impact Assessment report prepared by the L& T Infrastructure Engineering Limited(formerly known as L&T-RAMBOLL Consulting Engineers Limited)

The L& T Infrastructure Engineering Limited(formerly known as L&T-RAMBOLL Consulting Engineers Limited, in its EIA report has included Project Description (Chapter 2), Description of Environment(chapter 3), Anticipated Environmental Impacts and Mitigation Measures (chapter 4), Analysis of Alternatives(chapter 5), Environmental Monitoring Program(chapter 6) , Additional Studies(chapter 7), Project benefits(chapter 8), Environment Management Plan(chapter 9) The L& T Infrastructure Engineering Limited has also included one chapter as Summary and conclusions (Chapter 10).

The main findings of the Integrated /Common final Environment Impact Assessment report prepared by the L& T Infrastructure Engineering Limited(formerly known as L&T-RAMBOLL Consulting Engineers Limited) are summarized as follows:

I. The Multiproduct SEZ is proposed to be developed in an area of about 3,473 acres and utility corridor in an area of 124 acres. Among 3473 acres of SEZ land area, an area of 2318 acres of private land has already been acquired which is uninhabited. An area of 416 acres of government land is under transfer to SPPL & 720 acres of private land and 19 acres of other government land/area has to be acquired by SPPL. The utility corridor area of 124 acres contains private land (79 acres), government land (32 acres) and other government land/area (13 acres) has to be acquired by SPPL. The private land acquired has been purchased directly from the land owner through direct consent and negotiation. Wherever possible, government waste land was identified and it is under process of transfer for the project. The balance land will be acquired in compliance with the prevailing laws/acts. The land identified for the project is uninhabited and thus there will not be any resettlement of people due to land acquisition.

II. The project site mainly consists of scattered and sparse shrubs . The major grasses include several species of Cyperus and herbs like Indigofera. The land use of the existing area will be changed to industrial, commercial and residential areas which results in loss of existing vegetation and tanks. Also

it will have impact on the existing drainage pattern if the development was not properly planned. The bonafide certificate from Industries Commissionerate to use the land for industrial purpose is obtained. The change in land use pattern shall be as per requirement of the proposed project development plan which was certified for industrial use. The development shall be carried out in such a way to ensure proper drainage by providing surface drainage systems including storm water network etc. Also during site preparation care shall be taken to avoid any disturbance to the rivers located west of the project site (Vengdi Nadi) and Kharod River located towards East of project site. The planning shall be in accordance with landscape planning concepts with green areas.

III. The project site is relatively flat with minimum undulations and gradually sloping from north to south with the ground levels varying from 53 MSL to 21 MSL over a distance of approximately 7 km. The project site is with minimum undulations and most of the area within the SEZ/FTWZ and DTA is classified as "land without scrub". The soil composition mainly covered with sandy clay to silty clay. During the construction phase site levelling would be required which involves site preparation work, the soil and rock debris etc., achieved as cut material from the higher gradient shall be utilized to elevate the low level areas within project premises. The land disposal of solid wastes such as construction rubble, camp site garbage and discarded topsoil may impact soil quality. There might be a temporary phase of dumping the construction materials and wastes in the SEZ marring the aesthetics of the site. Apart from the localized construction impacts confined to the site, however, the impact is likely to be insignificant and no long term adverse impacts on topography are envisaged.

IV. The shoreline/coastline changes such as erosion/accretion is usually expected due to the development of marine structures such as breakwaters, groynes, Jetties, wharf etc. In proposed SEZ development, there is no proposal for construction of marine structures other than seawater intake and marine outfall. The captive jetties for power plants are proposed to be constructed as a part of Shipyard cum Captive Jetties including LNG terminal development. Hence, Impact assessment due to changes in

sediment transport pattern and shoreline changes are included in the shipyard cum captive jetties EIA report.

V. Seawater intake will be constructed within breakwaters at (-)9 m CD and marine outfall system shall be constructed at (-)10.3 m CD towards west of western breakwater of Shipyard cum captive jetties. The seawater intake pump house shall be located at onshore and sea water will be drawn from the intake which will be carried through pipelines upto power plants and desalination plant.

VI. Also a common marine outfall system is proposed for return cooling water discharge from 4000 MW coal based thermal power plant & 2000 MW Gas based thermal power plant, reject brine from 60 MLD Captive Desalination plant, CETPs treated discharge and discharge from Shipyard cum captive jetties including LNG terminal.

VII. In all submarine constructions, there are two principal zones of construction activity each requiring a different technique, namely, in-shore/surf zone and the offshore zone. The construction of submarine pipelines through the surf zone will cause temporary disturbance to the seabed along the alignment. Actually, the exposed portions of the pipelines can become a new habitat for marine organisms.

VIII. Construction within the surf zone requires that the pipe be placed in a trench excavated to a depth sufficient to provide protection of the completed pipeline during periods of heavy seas. Construction of intake/outfall structures will be carried out in such a manner, which will have minimum impact on existing marine and terrestrial ecology. It shall be ensured that there will be minimum ecological disturbance. Mangroves are not reported along the enroute of utility corridor which carries the seawater intake and marine outfall pipelines. Adoption of good construction management practices such as construction activity will be confined within the project site, selection of trenching equipment etc., to minimize the impacts on surrounding ecology to the bare minimal level.

IX. Marine water quality will be impacted due to trenching of seabed for construction of sub seabed pipelines. Direct impact of these activities on marine water quality would be increased turbidity due to suspended

sediment and will be predominant during trenching. The accidental spillage of construction material may also affect the marine water quality. Turbidity due to trenching operation varies with depth and lateral distance from the trenching location. During trenching, transport of sediment depends on velocity and fine material concentration. Very fine cohesive material will remain in suspension for a long time and is independent of hydrodynamic conditions. Due to above factors, there will be an increase in turbidity due to suspended sediment in water column. Thus, it can be inferred that trenching can cause a short-term and localised impact on marine water quality. Apart from turbidity, the marine water quality may be affected due to aqueous discharge (oily wastes, sanitary wastes, etc.) from the trenching equipments, barges and workboats involved in the construction activities.

X. Generally construction of marine structures may alter the seabed profile. In the proposed development, marine structures such as seawater intake/marine outfall and sub seabed pipeline which requires trenching in seabed, lowering of pipeline and backfilling are likely to change the seabed in terms of disturbance to the strata and localised sediment dispersion. The dispersed sediment tends to increase the turbidity of the seawater resulting in an impact on the food chain of the marine biota. However, by adopting measures as suggested, the probable impacts would be reduced to minimal level.

XI. The impact associated with the seawater intake is due to Impingement, entrapment and entrainment of marine organisms. The intake well has to be designed in order to avoid vortex formation. The intake well (structure) shall be designed in cylindrical form to avoid interference of currents. It should not cause any danger to the boats and fishermen moving in the vicinity. The intake should have appropriate screens and trash bars with small openings to minimize the entry of small marine organisms, fish larvae and fishes.

XII. Impingement occurs when organisms sufficiently large to avoid going through the screens are trapped against them by the force of the flowing source water – i.e., algae, plankton and bacteria are not exposed to

impingement. On the other hand entrainment occurs when marine organisms enter the seawater intake, are drawn into the intake system, and pass through. Impingement typically involves adult aquatic organisms (fish, crabs, etc.) that are large enough to actually be retained by the intake screens, while entrainment mainly affects aquatic species small enough to pass through the particular size and shape of intake screen mesh. Organisms that enter the intake and cannot swim back out of it are often referred to as entrapped. Such marine organisms could either be impinged on the intake screens or entrained if they pass through the screens and enter the downstream facilities of the desalination plant/other cooling water system. Considering the quantum of sea water to be drawn, cost of structure involved, constructability and maintainability, the VELOCITY CAP type with vacuum break arrangement is proposed for the sea water intake system. Intake water pipeline will be buried/ semi-buried GRP pipeline

XIII. A common marine outfall system is proposed for return cooling water discharge from 4000 MW coal based thermal power plant & 2000 MW Gas based thermal power plant, reject brine from 60 MLD Captive Desalination plant, CETPs treated discharge and discharge from Shipyard cum captive jetties including LNG terminal. The total marine outfall discharge quantity is around 921.4 MLD.

XIV. The proposed shipyard cum captive jetties is located to the eastern bank of the river Kharod. The proposed shipyard cum captive jetties will have two breakwaters designated as east and west breakwater with a dredged navigation channel. The presence of breakwater and dredged navigational channel can alter the current speeds and direction thereby influencing the dispersion of the effluents. Hence it is important to carry out the studies for scenarios with and without the marine facilities for the identification of most suitable and optimum location for locating the outfall.

XV. Water requirement for the cooling system and the desalination plant is proposed to be met from the sea. The combined requirement of sea water for this purpose is 1206.4 MLD and this will be drawn from the sea by means of velocity cap intake and onshore pump house. The intake location is 1.34 km away from shoreline and will be located inside the Shipyard

cum Captive Jetties basin enclosed within the breakwaters. The landfall point for routing the outfall pipelines are considered on both side of Shipyard cum Captive Jetties area i.e. on the western and eastern breakwater. The location of intake is at 69°13'58.6"E; 22°49'15.9"N .Suitability of outfall locations at different water depth was studied and optimum locations for effluent disposal is selected based on the simulated results.

XVI. Mathematical model was setup to simulate the hydrodynamic flow conditions in the region of interest and to achieve a calibrated model. The calibration was carried out for both tidal elevations and current speed. The observed data was compared with that of the simulated. The simulated results show close correlation between the observed and the simulated values. The calibrated model was then used for the study on advection-dispersion, to know the fate of the discharged effluents in the sea. Advection-dispersion study was carried out for various prospective outfall locations.

XVII. The model studies were carried out for combined discharge (Power plants, desalination plants and CETP) and CETP discharge alone. The results were analysed and plotted in terms of the Temporal-Maxima that would arise from each of the simulations. It was found that the maximum excess salinity was 0.54 ppt and the maximum excess temperature was only 0.3°C. These variations are comparable with the seasonal variations of temperature and salinity of coastal waters for which aquatic life is adapted.

XVIII. Based on the analysis of all the simulated results, all the prospective outfall locations show good dispersion characteristics of discharged effluent with and without proposed shipyard cum captive jetties layout. However, a comparative analysis was done to find the suitable outfall location which shows less chance of recirculation, which avoids hindrance to navigation of fishing boats and shorter distance from land fall point to avoid the impact on environment due to dredging of trench. It was found that outfall location at TL3**(Latitude 22° 48' 52.63"N and Longitude 69° 13' 49.13"E)** is more suitable and the same is recommended.

XIX. The excess salinity and temperature are extracted at 100 m and 500 m radius from outfall location (TL3). The excess salinity and temperature are found to be stabilising over the time. The excess salinity higher than 0.25 ppt was never found beyond 500m of the outfall and similarly the temperature do not exceed 0.15oC. Analysis was also carried out to know the movement of excess salinity and temperature towards river. The excess salinity and temperature near the River Kharod does not exceed 0.12 ppt and 0.06°C respectively. The maximum acceptable increase in the weekly average temperature resulting from artificial sources is 1oC during all seasons of the year, providing the summer maxima are not exceeded as per USEPA guidelines. The excess temperature falls well within the acceptable limits as specified in USEPA guidelines.

XX. The conceptual design of outfall for TL3 location is provided. Four numbers of pipes are recommended with diffuser at the discharge end. The diffuser length is kept as 25 m aligned at 900 to shoreline, each of the diffuser will have five risers with two openings on each riser.

XXI. Baseline status of vegetation clearly suggests that there are no endangered, endemic, rare plant species present within the project area. However, two important species i.e. Commiphora wightii and Tribulus terrestris in the buffer/study area with low abundance and less frequency of occurrence were found. The project sites support a few plant species of higher conservation significance (e.g. Commiphora wightii). However, their population is quite small and isolated in the buffer area. Also they are found in quite stunted stage. The proposed project construction activities may involve removal or thinning of some vegetation. Therefore, there are chances of some of these plants removed. Since patches of forest plantation are located in buffer area, it will be taken utmost precautions not to further degrade these areas by constructing temporary roads, dumping materials, solid wastes, garbage or any other form of material in to the surrounding grasslands. Rest of the project activities may not have any significant impacts on the vegetation of project area and surrounding area, in general, and on the plant species of higher conservation significance, in particular. It

is suggested that company should take up plantation of Commiphora wightii by involving local forest department or community.

XXII. Based on observations, literature review and consultation with forest department and local NGOs suggest the presence of sporadic nesting activities of two (2) species of Sea turtles on the sandy coast of Nana Layja village. The activities related to port/jetty for power plant and other infrastructure could hamper Sea turtles nesting. Gujarat has 1650 km long coastline, however, only 520 km of coastal tract is suitable for Sea turtle nesting (Sunderraj et al., 2002). The Nana Layja coast known for sporadic sea turtle nesting activities is a miniscule to the entire coast. Although nesting is of lower intensity, construction and operation phases of seawater intake and marine outfall system may cause impact on sporadic nesting of turtles with artificial lighting.

XXIII. The artificial beachfront lighting problem may be the most manageable of the human-caused sea turtle disturbances. Although some lighting is necessary for safety and security, light management measures can help prevent interference with sea turtle nesting habitat while still addressing human safety concerns. The mitigation measures like ,using lamps with a narrow area of focus i.e. lamps with a narrow field of scattering light,turning off unnecessary lights during the nesting season, using a smaller number or lower wattage of lights; repositioning, shielding, redirecting, lowering, or recessing fixtures so light does not reach the beach; Moreover, sea turtles are less affected by red, yellow, and low-pressure sodium-vapor lights, which can be substituted for ordinary lights. Construction activities shall be avoided in peak breeding/nesting season of sea turtles Intake and outfall system shall be designed keeping in view of avoiding the entanglement issues of turtles.

XXIV. An application was made to Principal Chief Conservator of Forests, Wildlife and Chief Wildlife Warden (CWLW), Gujarat for authentication of project site and study area is devoid of any National Park, Wildlife Sanctuary, Tiger Reserve or any other ecological sensitive areas. A copy of the NOC/clearance letter obtained from CWLW for SEZ units such as 4000

MW coal based power plant and 60 MLD desalination plant and 2000 MW gas based power plant

XXV. During construction the transport of construction material will cause dust emission, emission of exhaust gases from vehicles such as CO2, CO and NOx. The fugitive dust may coat the leaves of plants and trees. Fauna that occur in the study area may get disturbed with the sound of vehicles, construction and construction equipment. Spraying of water during handling of construction materials like sand and gravel will minimise dust emission. Properly maintained vehicles will produce reduced noxious emission. Temporary labour camps shall have proper sanitation facilities. The impacts caused by construction to fauna are temporary and not long term and most (if not all) the observed and documented flora and fauna of the project area will adapt to these impacts. Proper navigational aids must be installed to aid fishermen during construction activities of seawater intake and marine outfall.

XXVI. Coal to be transported from the captive jetties via the utility corridor and conveyors must be covered and preferably sprayed with water at intermittent transfer towers. It is proposed that all the vehicles for proposed cargo handling will conform to Pollution Under Control (PUC) norms and vehicles will be driven on paved surface throughout the access road/utility corridor.

The proposal of M/S Sea Land Ports Pvt Ltd was scrutinized by the Technical Committee in its15th meeting, which was held on 27-02-105 , wherein the representative of Sea land Ports Private Limited made a presentation about various activities to be carried out in the CRZ area, EIA report prepared by the L&T Infrastructure Engineering Limited (formerly known as L&T-RAMBOL Consulting Engineers Limited), and CRZ map prepared by the National Institute of Oceanography (NIO), Visakhapatnam.

During the presentation and discussion, it was observed by the Technical Committee that there may be existence of Sea turtle grounds and sand dunes as ESA. The committee also felt that activities within CRZ area should be given alongwith dimensions of all activities, which fall within ambit of CRZ Notification

2011. It was also felt necessary to obtained necessary clarification from the PCCF(WL) for existence of sea turtle at the project area. After detailed discussion, it was decided to ask various details from SLPPL

Accordingly details were called for from SLPPL on 12-03-2015. The SLPPL has submitted details vide its letter dated 01-04-2015.

The representative of the SLPPL made a presentation before the GCZMA during 25th meeting, which was held on 10-04-2015 and submitted that the SEZ area is away from CRZ area and only utilities corridor consists of Intake /Outfall pipeline , Coal conveyor etc would pass through CRZ area. Total land requirement would be 3,473 Acres + 124 Acres (utility corridor) and there are no rehabilitation and resettlement issues. There is no existence of ecologically Sensitive Areas such as wildlife, Sanctuary/National Parks etc, within 50 km from project site. It was submitted that they have obtained necessary certificate from the PCCF(WL)

The representative of the SLPPL submitted that none of the plant and faunal species recorded from the core area belongs to the rare/endangered/ endemic/ threatened category. However, in study area , plants having medicinal values Commipjora wightii and Tribulus terrestris were observed. Also , the species such as Oliv Ridly Seaturte, Green Seaturtle, long billed vulture etc .were reported No mangroves were reported in 10 km radius.

The representative of SLPPL submitted that there would be power requirement of @ 5MVA and 692.5MW for construction phase and operation phase respectively. During construction phase, the power requirement would be met through 66 kv substation at Bayali Village and partly from DG set. The power requirement for operation phase would be met through proposed power plant within SEZ. It was further submitted that @ 1.0 MLD water would be required for construction phase, which would be obtained from GWSSB. Approximately 1206.4 MLD sea water would be required for operation phase, and 2 54.63 MLD fresh water would be required for operation phase. There would be generation of @780.9 MLD return cooling water from power plant, @111MLD would be generated as reject brine from Desalination Plant and 19.4 MLD treated waste water would be generated from CETPs. The treated waste water would be discharged through marine outfall.

It was submitted by the representative of the SLPPL that seawater intake would be within breakwaters at (-) 9 m CD and 1.34 Km away from shoreline with velocity

cap arrangement. Marine Outfall system would be at (-) 10.3m CD towards the west of western breakwater of Shipyard cum captive jetties, which would be at 2.3 km away from the Land Fall Point(LFP). Excess salinity @100m distance would be 0.5 ppt and @500m , it would be 0.25 ppt. Excess temperature @100m would be 0.250 C and @500m, it would be 0.150 C. The maximum excess salinity was 0.54 ppt and maximum excess temperature was .030 C. These variations are comparable with the seasonal variations of temperature and salinity of coastal waters. Other CETP discharge pollutants would attain about 21 times dilution.

The representative of SLPPL submitted that SEZ site is located about 8 Km from the HTL of open sea and about 6 km away from tidal influenced (CRZ)area of river Kharod. The project development area does not fall or contain any environmentally sensitive areas It was further submitted that the proposed SEZ/FTWZ and DTA associated facilities i.e Intake/outfall/coal conveyer/gas pipeline etc., are permissible activities as per CRZ Notification 2011.

The Authority deliberated the proposal of Sea land Port Pvt Ltd and observations made by the Technical Committee, and after detailed discussion, the GCZMA decided to carry out site visit by the Technical Committee alongwith representative of Fisheries Department for verification about the existence of Eco Sensitive Zones like Sand dunes, Sea turtle nesting, fishing activities in the area , erosion and accretion due to proposed project etc. It was decided to consider the proposal on receipt of the report from the Technical Committee in next GCZMA meeting

Again the proposal was discussed in the 27th meeting of the GCZMA, wherein the Authority was apprised that as per the decision taken in the 25th meeting of GCZMA, Technical Committee alongwith officials from the fisheries Department visited the site on 22nd April, 2015.However, due to back water and Creek, it was not possible for the Committee member to reach at the location of the site due to high water level in backwater and creek, there was no arrangement were made by the project proponent to reach at the site. However as per details received from Fisheries Department and Forests Department, it shows there is existence of Sea turtle nesting as well this site is also potential fish catch areas. It was decided by the Technical Committee to carry out site visit again where there is low tide and site is easily approachable. Accordingly, the site visit was carried out by the Technical Committee on 04-07-2015 and submitted its report with certain observations and

with a conclusion that The committee unanimously came to the conclusion that proposed site is located at very good beach and there is presence of good sand dunes as well as based on the Gujarat Ecology Commission's report and Forest Department data, it can be concluded that the Nana Layja coast is a sea turtle nesting ground and therefore the proposed project site fall within CRZ-IA as per the CRZ notification 2011

The SPPL has also submitted its reply vide its letter dated 08-07-2015 with reference to some queries raised by the Committee during visit

The Gujarat Coastal Zone Management Authority deliberated the proposal of Sea land Port Pvt Ltd observations made by the Technical Committee, and after detailed discussion, the GCZMA decided to defer the project at present and decided to ask the project proponent to carry out comprehensive study for existence of Sand dunes and sea turtle nesting ground at proposed location alongwith Conservation Plan thereof and also decided to obtain a comprehensive report from the PCCF(WL) about sea turtles.

Accordingly, the SLPPL submitted its letter dated 11-03-2016 along with two reports as: 1) Study on Sand Dune and its Ecological and Geological Features prepared by Centre for Coastal and Marine Research (CCMR), Tuticorin and 2) Study on Sea Turtle Nesting at the proposed project location prepared by Zoological Survey of India, Kolkata.

As decided in the last GCZMA meeting, the reports submitted by the project proponent were sent to PCCF(WL) and detailed report was sought for. The PCCF(WL) has submitted comments/suggestions on the report submitted by the SLPPL vide letter dated 28-04-2016

The PCCF(WL) vide its letter dated 28-04-2016 has given his opinion as that the proposed project may be considered for approval with following conditions:

- ***The Agency will take the responsibility of collecting field data during the entire nesting period of sea turtles. i.e. June to January months and the agency will prepare a conservation plan for providing protection to the natural nesting of sea turtle within the zone of influence and adjoining areas and shall incorporate it as part of the EMP and/or CSR. The agency will formulate a plan for creating an awareness among the local people about the sea turtle during the period of nesting. The agency will adhere to***

the recommendations and conservation plans suggested by Zoological survey of India.

- ***The agency shall prepare a plan for creating green shelter belt of suitable plant species.***

The Authority deliberated the proposal of M/S Sealand Ports Private Limited in its 29th meeting , which was held on 24-05-2016 and after detailed discussion, and considering the recommendations of PCCF(WL), it is decided to recommend to the Ministry of Environment, Forests and Climate Change, Government of India to grant CRZ clearance for their proposed project for laying of Intake pipeline , outfall pipeline with associated facilities and utilities corridor as a part of the proposed project for development Multi product SEZ/FTWZ, DTA including Power Plant and Desalination Plant Village: Layja Mota, Dist: Kutch by M/S Sealand Ports Pvt Limited with some specific conditions alongwith the conditions laid down by the PCCF(WL)

In view of the above, the State Government hereby recommends to the Ministry of Environment, Forests and Climate Change, Government of India to grant environmental clearance under the CRZ notification their proposed project for laying of Intake pipeline , outfall pipeline with associated facilities and utilities corridor as a part of the proposed project for development Multi product SEZ/FTWZ, DTA including Power Plant and Desalination Plant Village: Layja Mota, Dist: Kutch by M/S Sealand Ports Pvt Limited with strict compliance of the following conditions:

Specific Conditions:

1. The provisions of the CRZ Notification of 2011 shall be strictly adhered to by M/s SLPPL No activity in contradiction to the provisions of the CRZ Notification shall be carried out by M/s SLPPL
2. ***The SPPL shall have to obtain necessary approvals from all other authorities/agencies under various Acts/Rules /Regulations before commencing any activity.***
3. ***The SLPPL shall have to ensure that the existing sand dunes are not disturbed due to proposed project and it shall remain intact.***
4. ***The trestle and approach road for lying of pipeline shall be kept at 1.00m highest height of sand dunes.***

5. ***The treated effluent meeting with the Gujarat Pollution Control Board (GPCB) norms at the point recommended shall only be discharged through the said pipeline.***
6. ***The SLPPL shall have to provide continues monitoring system for effluent quality specifically in respect of Salinity and Temperature since these two are vital parameters looking to the nature of effluent***
7. ***All the recommendations and suggestions given by the consultant in its Marine Environment Impact Assessment reports shall be implemented strictly by M/s SLPPL***
8. ***The effluent not meeting with the GPCB norms shall not be discharged and shall be stored in the Guard Ponds and recycled back into the Effluent Treatment Plant for further treatment to achieve the GPCB norms. The SLPPL shall install necessary facilities for this purpose and shall strictly ensure the compliance with the GPCB norms, round the clock.***
9. ***The SLPPL shall prepare an emergency plan to protect existing environment in case of any eventuality/accidental rupture of the pipeline. It shall be ensured by the SSPL that in such cases, the treated effluent discharge is immediately stopped till the adequate measures are taken.***
10. ***The SLPPL shall have to abide by the all the terms and conditions stipulated by the PCCF(WL) as mentioned hereinabove.***
11. All the recommendations and suggestions given by L&T Infrastructure Engineering Limited and in their Environment Impact Assessment reports for conservation / protection and betterment of environment shall be implemented strictly by M/s SLPPL.
12. The construction and operational activities shall be carried out in such a way that there is no negative impact on mangroves, if any, and other important coastal / marine habitats. The construction activities shall be carried out only under the guidance / supervision of the reputed institute / organization.
13. M/s SLPPL. shall strictly ensure that no creeks or rivers are blocked due to any activity at Shipyard
14. The construction debris and /or any other type of waste shall not be disposed of into the sea, creek or in the CRZ areas. The debris shall be removed from the construction site immediately after the construction is over.

15. The construction camps shall be located outside the CRZ area and the construction labour shall be provided with the necessary amenities, including sanitation, water supply and fuel and it shall be ensured that the environmental conditions are not deteriorated by the construction labours.
16. M/s SLPPL shall bear the cost of the external agency that may be appointed by this Department for supervision / monitoring of proposed activities and the environmental impacts of the proposed activities.
17. The groundwater shall not be tapped within the CRZ areas by the SLPPL to meet with the water requirements in any case.
18. M/s SLPPL shall take up massive greenbelt development activities in consultation with Forest Department / GEER Foundation / Gujarat Ecology Commission. A comprehensive plan for this purpose has to be submitted to the Forests and Environment Department.
19. The SLPPL shall have to take up bio-shielding development programme as part of CSR in consultation with the Forests Department/PCCF and an action plan in this regard shall have to be submitted to the MoEF-GOI and this Department.
20. M/s SLPPL shall have to contribute financially for taking up the socio-economic upliftment activities in this region in consultation with the Forests and Environment Department and the District Collector / District Development Officer.
21. A separate budget shall be earmarked for environmental management and socio-economic activities including the greenbelt / mangrove plantation and details thereof shall be furnished to this Department as well as the MoEF, GOI. The details with respect to the expenditure from this budget head shall also be furnished alongwith the compliance report.
22. A separate Environmental Management Cell with qualified personnel shall be created for environmental monitoring and management during construction and operational phases of the project.
23. Environmental Audit report indicating the changes, if any, with respect to the baseline environmental quality in the coastal and marine environment shall be submitted every year by M/s SLPPL to this Department as well as to the MoEF&CC, GOI.

24. A six monthly report on compliance of the conditions mentioned in this letter shall have to be furnished by M/s SLPPL .on a regular basis to this Department as well as to the Ministry of Environment and Forests, Government of India

28. Any other condition that may be stipulated by this Department/ Ministry of Environment and Forests, Government of India from time to time for environmental protection / management purpose shall also have to be complied with by M/s SLPPL .

Thanking you

Yours sincerely,

(Hardik Shah)

Encl: As above

Copy to:

Ms. Sumathy Iyer
Director,
M/s Sealand Ports Private Limited
The IL&FS Financial Centre,
Plot No. C-22, G-Block
Bandra Kurla Complex, Bandra(E)
Mumbai-400 051--- For information please

Annexure II
SEZ/FTWZ and DTA CTE (NOC) Order

GPCB

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector 10-A, **Gandhinagar** 382010
Phone : (079) 23226295
Fax : (079) 23232156
website : www.gpcb.gov.in

BY R.P.A.D

CONSENT TO ESTABLISH
CTE-83683

PC/CCA-KUTCH-1276/GPCB ID 46075/ 406893 **Date:** 6.3.2017

To,
M/s. Sealand Ports Pvt. Ltd. (SPPL) &
M/s. Avash Logistic Park P. Ltd. (ALPL)
Survey No (as mentioned below),
Village: Layja Mota, Tal. Mandvi,
Dist. Kutch – 370 475

Subject : **Consent to Establish (NOC)** under Section 25 of Water (Prevention and Control of Pollution) Act 1974 and Section 21 of Air (Prevention and Control of Pollution) Act 1981.

Reference:

1. Your CTE application vide Inward No 89899 dated 4.2.2015
2. ToR of MOEF & CC, New Delhi vide No: F. No. 21-68/2011-IA.III dated 5.3.2013
3. MoEF & CC letter vide No F. No 21-68/2011-IA-III (P) dated 13.7.2016 extending ToR
4. Letter of Ministry of Commerce and Industry, Department of Commerce (SEZ section) vide letter No-F-1/16/2010-SEZ dated 13/05/2014 and 17.5.2016
5. Ministry of Commerce & Industry letter vide No F1/15/2010-SEZ dated 13.5.2014 and F1/15/2010-SEZ dated 17.5.2016 extending of validity for setting up of SEZ.
6. Your letter dated 11.02.2015, 30.11.2016, 1.12.2016 and 2.1.2017

Sir,

Without prejudice to the powers of the Board under the Water (Prevention and Control of Pollution) Act-1974, the Air (Prevention and Control of Pollution) Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that the Board grants Consent to Establish (NOC) for setting up (1) Multi-Product SEZ (Special Economic Zone) /FTWZ (Free Trade and War housing Zone), DTA (Domestic Tariff Area) including Power plant (4000 MW Coal based & 2000 MW Gas based) of industrial activity at Survey No 694 P197, 208, 527, 516, 520, 523/1 to 523/5, 478-487, 251-258, 254, 264-268, 385, 359/1, 388/1, 232, 413, 332, 259/1 to 259/2, 196, 379, 347, 376, 392, 694/45 etc of various villages like Undoth, Layja mota, Bayatha, Godhra, Ratadia Mota, Baytha, Nana layja etc of Tal. Mandvi, Dist. Kutch-370475.

The Industrial sector included in the Multiproduct SEZ / FTWZ and DTA houses are

(1) Engineering Goods
(2) Textiles and Handcrafts
(3) Shipping ancillary industry

(4) Power plant (2000 MW Gas Based and 4000 MW Coal Based) and Desalination Plants & Logistics

Further, sectors under DTA (Domestic Tariff Area) includes are (1) Plastic Industry (2) Non Metallic mineral products (3) Basic, allied, specialty chemicals and polymer products (4) Pharmaceuticals and medicinal products and (5) Textiles and handicrafts

1. The validity period of this CTE order shall be up to **03/02/2022**.
2. The list of the proposed different type of industrial sectors to be set up in SEZ are as below:

No.	Product Name	Quantity per Month
1.	Chemicals	47,834 MT
2.	Desalinated Water	18,25,000 KL
3.	Energy Production	37,23,000 MWH
4.	Focus Engineering Goods	52,334 MT
5.	Non Metallic Minerals	37,250 MT
6.	Plastic Industries	13,334 MT
7.	Shipping Ancillary and Naval Offsets	26,417 MT
8.	Textile Manufacturing	8,167 MT

3. The total area for Multi Product SEZ shall be 3606 acre out of which SEZ / FTWZ and DTA area shall be 3473 acre (including processing zone, non-processing zone and Domestic tariff area). The remaining area would be for utility corridor.

SUBJECT TO THE FOLLOWING SPECIFIC CONDITIONS:

1. The Consent to establish (CTE) is granted conditionally that M/s. Sealand Ports Pvt. Ltd. (SPPL) & M/s. Avash Logistic Park P. Ltd. (ALPL) shall not install & commission including any construction activity of entire SEZ of above mentioned activities without obtaining Environmental Clearance from MoEF&CC, New Delhi.
2. The Consent to establish (CTE) is granted conditionally that M/s. Sealand Ports Pvt. Ltd. (SPPL) & M/s. Avash Logistic Park P. Ltd. (ALPL) shall not install & commission including any construction activity in entire SEZ of above mentioned activities without obtaining NA permission from competent authorities.
3. M/s. Sealand Ports Pvt. Ltd. (SPPL) & M/s. Avash Logistic Park P Ltd. (ALPL) shall also obtain NA permission for the private land to be acquired (2776 Acres) and Government land (832 Acres) as per the details submitted by you.
4. This CTE is granted based on Terms of Reference (ToR) issued by MoEF & CC, New Delhi subject to condition that applicant shall obtain EC from MoEF&CC, New Delhi.

5. The M/s. Sealand Ports Pvt. Ltd (SPPL) shall prepare an emergency plan to protect existing environment in case of any eventuality/accidental rupture of the pipeline. It shall be ensured by the SSPL that in such cases, the treated effluent discharge is immediately stopped till the adequate measures are taken.

6. You shall comply all EC conditions issued by Ministry of Environment & Forests & Climate Change (MoEF & CC), New Delhi vide order No J-13012/13/2011.I.A.I (T) dated 26.6.2015 for 3960 MW (6 x 660 MW) Coal based Combined cycle power plant (CCPP) established with in SEZ area.

7. You shall comply all EC conditions issued by Ministry of Environment & Forests & Climate Change (MoEF & CC), New Delhi vide order No J-13012/10/2012.IA.II (T) dated 29.9.2016 for 2000 MW Gas based power plant established with in SEZ area.

8. Individual industries established with in SEZ shall have to obtain necessary permission from competent authority before establishment of Industry, including Environmental clearance from competent authority, if manufacturing activities attracts the provision of EIA Notification & its amendment with in M/s SPPL.

9. M/s SPPL shall take up massive greenbelt development activities in consultation with Forest Department/GEER Foundation/Gujarat Ecology Commission. A comprehensive plan for this purpose has to be submitted to the Forests and Environment Department.

10 M/s SPPL shall have to contribute financially for taking up the socio-economic upliftment activities in this region in consultation with the Forests and Environment Department and the District Collector/District Development Officer.

11 GPCB reserves the right to stipulate additional condition/ revoke any conditions, if found necessary. The Company will implement concerned conditions in a time bound manner.

12 Environmental cell shall be setup & shall be responsible for total environmental management of maintenance, conveyance and monitoring of all pipelines.

13 A separate budget shall be earmarked for environmental management and socio-economic activities including the greenbelt/mangrove plantation and details thereof shall be furnished to this Department as well as the MoEF & CC, GOI. The details with respect to the expenditure from this budget head shall also be furnished along with the compliance report.

14 No ground water shall be used without obtaining prior approval from the authority.

15 Applicant shall have to comply with all the Guidelines/Directive issued/ being issued by MoEF/CPCB/ GPCB from time to time.

16 Applicant shall have to comply with the Risk assessment and Disaster management plan.

17 Monitoring in respect to Air, Water, Noise level shall be carried out and results shall be submitted to this Board including online monitoring systems on quarterly basis.

18 Applicant shall have to comply with all the suggestions / Recommendation of the Environmental Public Hearing, enumerated in REIA report, enumerated in EIA.

19 Applicant shall have to comply with fly Ash Notification all Environmental Acts/ Rules/Notifications along with the amendments from time to time and other guidelines issued /being issued by MoEF/CPCB/DoEF from time to time.

20 You shall provide flow meter devices at each collection sump of each pipeline at Inlet/ outlet and necessary documentation of daily readings.

21 For maintaining and inspection of each pipeline carrying treated industrial effluent and domestic sewage, regular monitoring shall be carried out 24 x 7 hours.

22 For all conveyance pipelines, complaint redressal system shall be established at your level & designated officer shall be provided for remedial action

23 Any leakages overflow, damage to the pipeline, manhole for collection of effluent/ domestic effluent in pipelines, which shall be repaired & remedial action shall be taken immediately.

24 Action taken in this regard shall be communicated to Regional office Kutchh (West) and Head office, GPCB.

CONDITIONS UNDER WATER ACT 1974:

1. By Manufacturing of the above products, details of waste water generation and water consumption are as follows;

	Water Consumption	Waste Water Generation
Industrial	1206,400 KL/day (1206.4 MLD)	921,400 KL/day (921 MLD)
Domestic	4,000 KL/ day	5,970 KL/ day

2. The source of water shall be from sea and the intake system shall be at 69° 13' 58.6"E, 22° 49' 15.9" N as mentioned in Recommendation letter of Forests & Environment department addressed to MoEF & CC, New Delhi vide condition No 15 of this order.
3. The total quantity of water consumption for SEZ / FTWZ and DTA shall not exceed **1206.4 MLD** out of which, for Desalination plant it shall not exceed **171 MLD** and for both CPP it shall not exceed **1035.4 MLD**.
4. The water requirement for industrial cooling (For thermal power plants) is around 830 MLD (Million Liters per Day) will be sourced from Arabian Sea

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5. The total industrial effluent generation from SEZ / FTWZ, DTA and Power Plant industries shall not exceed as mentioned below;

From SEZ and FTWZ	8.89 MLD (excluding power plant)
From Power Plant	1.48 MLD
From DTA industries	12.007 MLD

3.1 The industrial effluent generated shall be treated in proposed 5 nos. of CETP with in SEZ area. The capacity and disposal system of CETPs shall be as below;

CETP	Estimated Effluent (MLD)	Industrial Sectors to be serviced	Treated Water Disposal System
CETP 1	8.74	Pharmaceuticals and Chemicals (DTA)	Marine Discharge
CETP 2	2.42	Non – Metallic, Minerals, Textiles and Handicrafts (DTA)	Marine Discharge
CETP 3	1.39	DTA (Plastic Industry)	Zero Discharge
CETP 4	8.18	Engineering Goods, Shipping, Textiles and FTWZ	Marine Discharge
CETP 5	1.75	Engineering Goods proposed at NW of SEZ	Zero Discharge

6. The marine discharge quantity shall not exceed **921.4 MLD** through outfall pipes. This discharge shall include following;

   a. Discharge from the TPP and desalination plant - 891.9 MLD
   b. the CETPs treated discharges -19.4 MLD
   c. Treated sewage from SEZ NPA and both the power plants - 7.04 MLD
   d. Treated wastewater from shipyard cum captive jetties - 3 MLD

7. CETP-3 and CETP-5 shall strict to maintain Zero discharge by providing adequate capacity of MEEs (Multiple Effect Evaporators) followed by RO treatment and treated waste waters from CETP-3 and CETP-5 shall be reused and shall strict to Zero discharge by installation of various ZLD technologies.

8. The **Discharge point** shall be at 10.3 m of water depth at **latitude 22°48' 52.63" N; longitude 69° 13' 49.13 E", which is granted and recommended under CRZ clearance issued by F& ED department to MoEF & CC, New Delhi.**

PARAMETER	GPCB NORMS
pH	5.5 to 9.0
Temperature	Shall not exceed 5°C above the receiving water temperature
Colour (pt.co. scale units)	100 units
Suspended Solids	100 mg / l
Oil & Grease	20 mg / l
Phenolic Compound	5.0 mg / l
Ammonical Nitrogen	50 mg / l

BOD (3 Days at 27 °C)	100 mg / l
COD	250 mg / l
Sodium Absorption Ratio	26
Bio – assay test	90% Survival of fish after 96 hours in 100% effluent.
Fluoride	15 mg/l
Sulphide	5.0 mg/l
Total Residual chlorine	1.0 mg/l

9. Return cooling water from power plants and reject brine from desalination plant of about 522 MLD shall be disposed into the Sea through a marine outfall facility.

Sr No	Industry	Parameter	Standards
"5 A.	Thermal Power Plant (Water consumption limit)	Water consumption	I. All plants with Once through Cooling (OTC) shall install Cooling Tower (CT) and achieve specific water consumption up to maximum of $3.5m^3$ /MWh within a period of two years from the date of publication of this notification. II. All existing CT-based plants reduce specification water consumption up to maximum of $3.5m^3$ /MWh within a period of two years from the date of publication of this notification. III. New plants to be installed after 1st January, 2017 shall have to meet specific water consumption up to maximum of $2.5m^3$ /MWh and achieve Zero waste discharge".

10. The sewage generated from SEZ non-processing area is estimated to be 13.0 MLD and will be treated in the STP.

11. The applicant shall provide adequate Sewage treatment in order to achieve the quality of the treated effluent as per GPCB norms as mentioned below:

PARAMETERS	PERMISSIBLE LIMIT
pH	6.5 TO 9.5
Ammonical Nitrogen	Not more than 5 mg/l
BOD	Not more than 10 mg/l
COD	Not more than 50 mg/l
TSS	Not more than 20 mg/l
Fecal coli form (MPN/100 ml)	Less than 100
N-Total	Not more than 10 mg/ltr

CONDITIONS UNDER AIR ACT 1981:

1. Individual industries shall obtain necessary permission of Gujarat Pollution Control Board before installation of their project under Air act-1981 Environment Acts with relevant details before commencement of project.

2. This CTE is granted for SEZ, Coal based power plant and Gas based power plant, which are part of SEZ, Therefore, here separate Air standards are not specified.

3. Project proponent shall obtain separate CTE, with all required technical details.

4. Unit shall obtain necessary permission for using relevant fuel in Boiler / furnace / TFH / D.G. Sets before commencement commissioning of production.

5. The applicant shall install & operate air pollution control system in order to achieve process gas emission before commencement of production and obtain necessary permission from the component authority.

6. The concentration of the following parameters in the ambient air within the premises of the industry shall not exceed the limits specified hereunder as per national Ambient Air Quality Emission Standards issued by Ministry of Environment and Forest dated 16th November-2009

No.	Pollutant	Time Weighted Average	Concentration in Ambient air in µg/M^3
1.	Sulphur Dioxide (SO_2)	Annual 24 Hours	50 80
2.	Nitrogen Dioxide (NO_2)	Annual 24 Hours	40 80
3.	Particulate Matter (Size less than 10 µm) OR PM_{10}	Annual 24 Hours	60 100
4.	Particulate Matter (Size less than 2.5 µm) OR $PM_{2.5}$	Annual 24 Hours	40 60

7. The applicant shall provide portholes, ladder, platform etc at chimney(s) for monitoring the air emissions and the same shall be open for inspection to/and for use of Board's staff. The chimney(s) vents attached to various sources of emission shall be designed by numbers such as S-1, S-2, etc. and these shall be painted / displayed to facilitate identification.

8. The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standards in respect of noise to less than 75dB(a) during day time and70 dB (A) during night time. Daytime is reckoned in between 6a.m. and10 p.m. and nighttime is reckoned between 10 p.m. and 6 a.m.

CONDITIONS UNDER HAZARDOUS WASTE:

1. Individual industries shall provide temporary storage facilities and maintain the record for each type of Hazardous Waste as per Hazardous & other wastes (Management & Transboundary Movement) Rules, 2016 as amended from time to time.

2. The applicant shall be obtain membership of common TSDF site for disposal Hazardous Waste as categorized in Hazardous & other wastes (Management & Transboundary Movement) Rules, 2016 as amended from time to time.

GENERAL CONDITIONS

1. Any change in personnel, equipment or working conditions as mentioned in the consents form/order should immediately be intimated to this Board.
2. The waste generator shall be totally responsible for (i.e. Collection, storage, transportation and ultimate disposal) of the wastes generated.
3. Records of waste generation, its management and annual return shall be submitted to Gujarat Pollution Control Board in Form – 4 by 31st January of every year.
4. In case of any accident, details of the same shall be submitted in Form – 5 to Gujarat Pollution Control Board.
5. Applicant shall comply relevant provision of "Public Liability Insurance Act-91".
6. Unit shall take all concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within 03 months and also along with Form 4.
7. Industry shall have to display on-line data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant, including wastewater and air emissions and solid hazardous waste generated within the factory premises.
8. Unit shall develop green belt within premises as per the CPCB guidelines. However, if the adequate land is not available within premises, the unit shall tie up with local agencies like gram panchayat, school, social forestry office etc. for the plantation at suitable open land in nearby locality and submit an action plan of plantation for next three years to GPCB.
9. The applicant shall have to submit the returns in prescribed form regarding water consumption and shall have to make payment of water cess to the Board under the Water Cess Act- 1977.
10. In case of change of ownership/management the name and address of the new owners/partners/directors/proprietor should immediately be intimated to the Board.
11. The applicant shall however, not without the prior consent of the Board bring into use any new or altered outlet for the discharge of effluent or gaseous emission or sewage waste from the proposed industrial plant. The applicant is required to make applications to this Board for this purpose in the prescribed forms under the provisions of the Water Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986.

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12. If the products/process falls in SCHEDULE-I or II of the Environmental Audit Scheme, as specified in the order dated 13/3/97 of Hon. High Court in MCA NO.326/97 in SCA No.770/95, the applicant shall also abide by the said scheme.
13. The applicant shall have to obtain P.L.I. Policy as per P.L.I. Act, 1991 and submit the copy of the same to the G.P.C.B.
14. The overall noise level in and around the plant area shall be kept well within the standards by providing noise control measures including engineering control like acoustic insulation hoods, silencers, enclosures etc on all sources of noise generation. The ambient noise level shall conform to the standards prescribed under the Environment (Protection) Act, 1986 & Rules.
15. Applicant is required to comply with the manufacturing, Storage and Import of Hazardous Chemicals Rules-1989 framed under the Environment (Protection) Act-1986.
16. If it is established by any competent authority that the damage is caused due to their industrial activities to any person or his property .in that case they are obliged to pay the compensation as determined by the competent authority.
17. Applicant shall have to comply with all the guidelines/Directive issued/ being issued by MoEF/CPCB/DoEF from time to time.
18. Applicant shall not use/withdraw ground water either during construction and /or operation phase.
19. Environmental cell shall be setup and shall be responsible for the total Environmental management.
20. Monitoring in respect to Air, Water, Noise level shall be carried out and results shall be submitted to this Board on quarterly basis.
21. Adequate plantation shall be carried out all along the periphery of the industrial premises in such a way that the density of plantation is at least 1000 trees per acre of land and a green belt of 10 meters width shall be developed.
22. The applicant shall have to submit the returns in prescribed form regarding water consumption and shall have to make payment of water cess to the Board under the Water (Prevention and Control of Pollution) Cess Act- 1977.
23. In case of transport of hazardous waste to a facility for (i.e. Treatment, Storage and disposal) existing in a state other than the state where hazardous waste are generated, the occupier shall obtain "No Objection certificate" from the state pollution Control Board, the Committee of the concerned state or Union territory Administration where the facility exists.
24. Unit shall take all concrete measures to show tangible results in waste generation reduction, voidance, reuse and recycle. Action taken in this regards shall be submitted within 03 months and also along with Form 4.

25. The unit shall maintain the records of production and consumption of electricity and water for each day during the period of production. The unit shall maintain separate figures for consumption of electricity for running the Air pollution control measures / incineration system by having a separate meter/sub- meter for each Air Pollution Control measures. The number of units consumed by operating the diesel generating sets, if any, shall also be maintained. In case of plants involving 'Bio-mass' treatment, for each addition of bio-mass time and quantity, should be recorded. The uptake rate of Oxygen of the bio-mass in the aeration basin and other parameters of biological system should be recorded, every day.

26. When electricity supply or water supply is disconnected in future on account of non-compliance with the GPCB norms or on account of the closure order, which may be passed by the court or by the Govt., /GPCB under any statutory provisions relating to environmental protection and prevention and control of pollution.

27. The unit shall not use any diesel generating set or any other alternative source of energy or water tankers from outside for continuing the production activities.

28. "Flow Meters" should be installed at inlet and outlet of Effluent Treatment Plant (ETP thereafter).

29. All the chemicals and nutrients, which are required to be added/dosed anywhere in the ETP, should be so added by using "Metering Pumps" only.

30. The printed log-books shall be maintained and get them certified for:-

30.1 Energy/Fuel Consumption/Raw material consumption and quantity of products manufactured.

30.2 Waste water/gaseous/ hazardous waste flow at inlet & outlet of E.T.P. & air pollution control measures/ incinerator.

30.3 Quantity of sludge generated/ treated/ stored/ reused/ disposed off separately for each type of hazardous waste.

31. Laboratory analysis/reports for each of the specified parameters of liquid effluents, gaseous discharge and hazardous waste sample.

32. Low NOx burners may be provided to avoid excessive formulation of NOx. Only LSHS will be used as fuel during the critical months to ensure that SO2 levels in the ambient air is within the norm specified.

33. A copy of approved On-site Emergency Plan as required under the Rules 13 and 14 of the Handling, Manufacture, Storage and Import of the Hazardous Chemicals Rules, 1989 should be submitted to the Board.

34. The funds earmarked for the Environmental protection measures should not be diverted for any other purpose and year wise expenditure should be reported to this Board and to the Government.

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35. Storm water shall not be mixed with the industrial effluent. Disposal system for storm water shall be provided separately.
36. Good housekeeping shall be maintained within the factory and industrial premises. All pipes, vents, joints valves and drains shall be leak proof. They should be checked periodically and arrangements thereof shall be indicated in the On-site Emergency Plan. Floor washing shall be admitted in to the effluent collection system for subsequent treatment and disposal.
37. The directives issued by the Board from time to time in view of direction issued by the Honorable High Court of Gujarat in the matter of S.C.A.770/95 shall have to be complied with.
38. The applicant shall make an application for renewal of the consent at least 60 days before the date of expiry of the consent.
39. Industry shall have to display the relevant information with regard to hazardous waste as indicated in the Hon. Supreme Court's order in W.P. No.657 of 1995 dated 14th October 2003.
40. Industry shall have to display on-line data outside the main factory gate with regard to quantity and nature of hazardous chemicals being handled in the plant, including wastewater and air emissions and solid hazardous waste generated within the factory premises.

For and on behalf of
Gujarat Pollution Control Board

(Sushil Vegda)
Senior Environment Engineer

Annexure III
High Court ORDER

IN THE HIGH COURT OF GUJARAT AT AHMEDABAD

WRIT PETITION (PIL) NO. 325 of 2014

==========

DINESH SINH VIKRAM SINH JADEJA....Applicant
Versus
STATE OF GUJARAT & 3....Opponents

==========

Appearance :
MR I H SYED, ADVOCATE WITH MR NARENDRA L JAIN, ADVOCATE for the Petitioner.
GOVERNMENT PLEADER for the Opponent No.1 & 2.
MR MIHIR JOSHI, SENIOR COUNSEL ASSISTED BY MR TANVISH BHATT FOR M/S. WADIA & GHANDY & CO. for Respondent No.3.
MR BIREN A VAISHNAV, ADVOCATE for the Opponent No.4.
MR ND GOHIL, CENTRAL GOVERNMENT STANDING COUNSEL for Respondent No.5.

==========

CORAM: HONOURABLE THE ACTING CHIEF JUSTICE
MR. VIJAY MANOHAR SAHAI
and
HONOURABLE MR.JUSTICE R.P.DHOLARIA

Date : 11/12/2014
ORAL ORDER
(PER : HONOURABLE THE ACTING CHIEF JUSTICE
MR. VIJAY MANOHAR SAHAI)

Draft amendment filed by learned counsel Mr. I.H. Syed assisted by learned counsel Mr. Narendra Jain for the petitioner is allowed. Let Union of India, Ministry of Environment & Forest be impleaded as respondent No.5.

Additional affidavit has been filed by the petitioner which is taken on record.

Issue notice to the respondents returnable on 19.12.2014. Mr. Utkarsh Sharma, learned Assistant Government Pleader waives service of notice on behalf of respondent Nos.1 & 2, Mr. Tanvish Bhatt, learned counsel appearing for M/s. Wadia Ghandy & Company waives service of notice on behalf of

respondent No.3, Mr. Biren Vaishnav, learned counsel waives service of notice on behalf of respondent No.4 and Mr. N.D. Gohil, learned Central Government Standing Counsel states that he along with Mr. Devang Vyas, learned Assistant Solicitor General would be appearing for respondent No.5 and he waives service of notice for respondent No.5.

All the respondents may file their counter affidavits within one week.

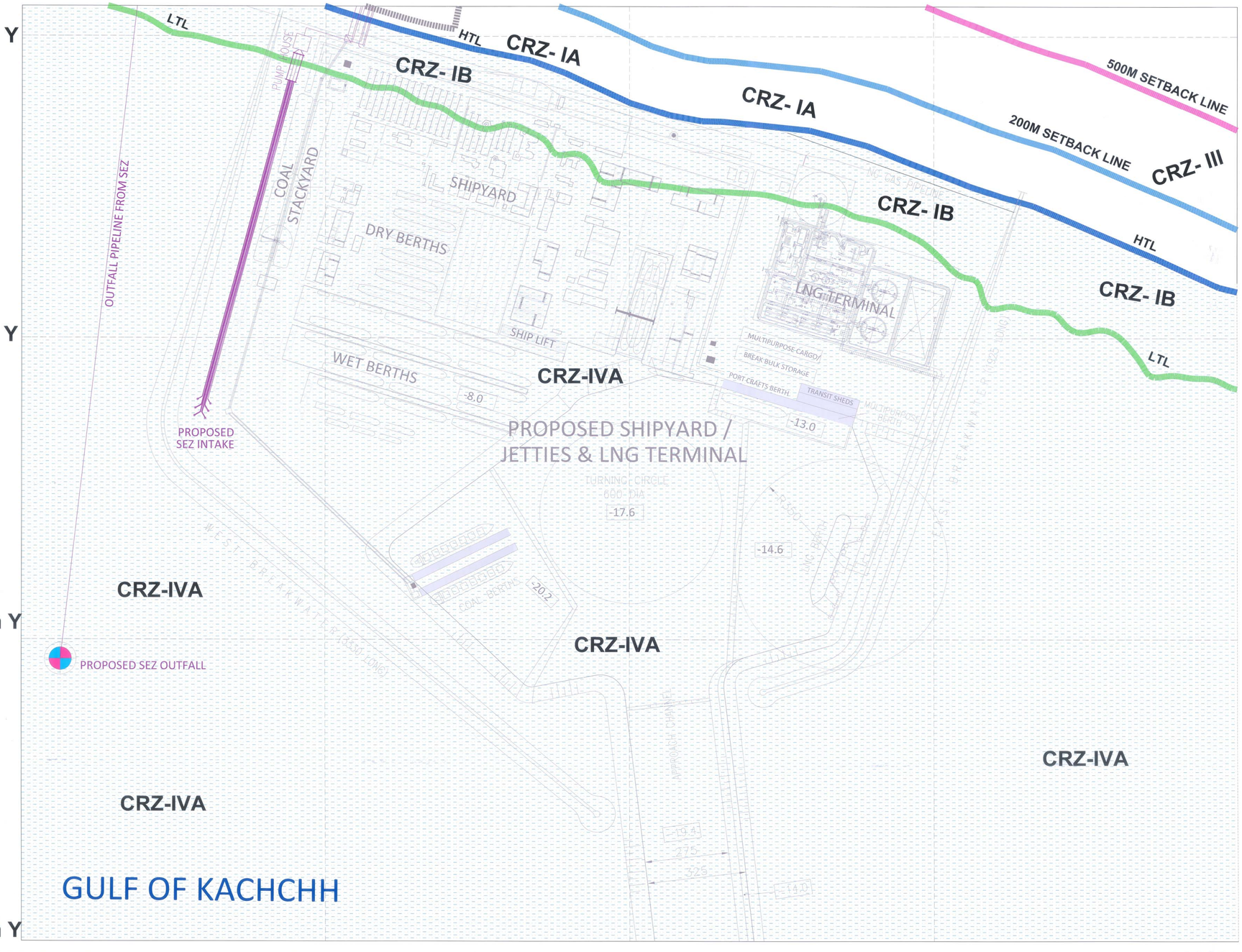
Meanwhile, the petitioner is permitted to participate and file his objections in the public hearing which is scheduled to be held on 12.12.2014 in pursuance of public notice published by Gujarat Pollution Control Board dated 10.11.2014 which is challenged in this writ petition.

(V.M.SAHAI, ACJ.)

(R.P.DHOLARIA,J.)

Savariya

Annexure IV
Corrected CRZ Map



LEGEND :

- : LTL
- : HTL
- : 200m Setback Line from HTL
- : 500m Setback Line from HTL
- : SEZ FACILITIES IN CRZ AREA
- : PROPONENT LAND BOUNDARY
- : Water Body

CRZ-IA : Stabilised Sand Dunes
CRZ-IB : Inter Tidal Zone
CRZ-III : Relatively Undisturbed (Rural Areas)
CRZ-IVA : LTL to 12NM Seaward side

GEODETIC DETAILS :

SPHEROID : WGS 1984

GRID : Universal Transverse Mercator

Mandvi	Lat: 22° 50' 00"N	Long: 69° 20' 00"E

Height above Chart Datum				MSL
MHHW	MLHW	MHLW	MLLW	2.6 m
4.1m	3.5m	1.7m	0.9m	

SURVEY ORGANIZATION :

NATIONAL INSTITUTE OF OCEANOGRAPHY
(COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH)
REGIONAL CENTRE
NO.176, LAWSONS BAY COLONY
VISAKHAPATNAM - 530017
PHONE : (0891) 2539180 e-mail : vsnmurty@nio.org
URL : http://www.nio.org

Survey period : 01.12.2010 to 05.12.2010 and
06.02.2013 to 10.02.2013, 27.02.2013 to 02.03.2013 & 01.07.2016

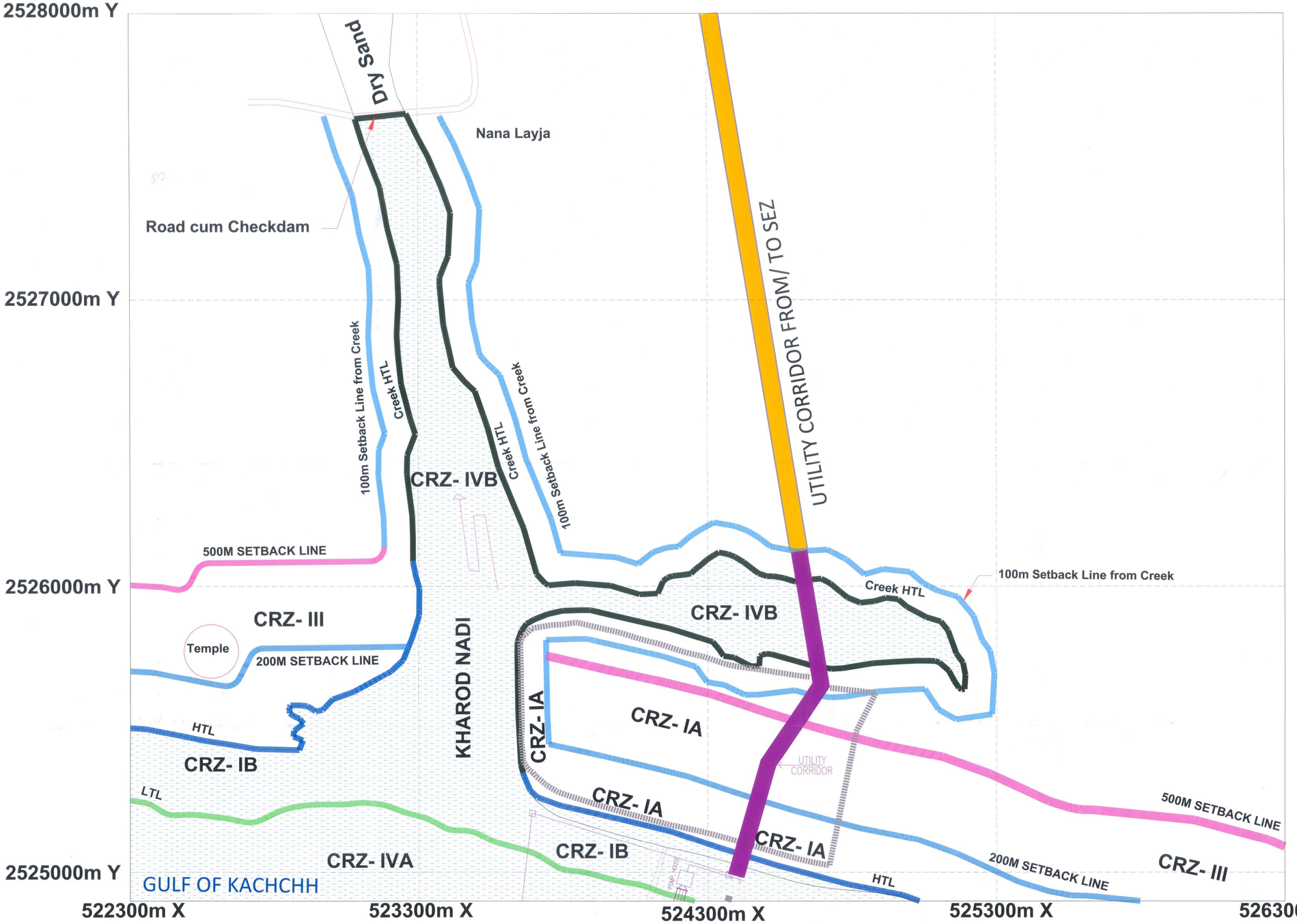
Scale - 1 : 4000

Client: M/s. Sealand Ports Private Limited,
M/s. Avash Logistic Park Private Limited
(Promoted by ILFS)

Fig : 3 (Part -1)

Demarcation of LTL, HTL and CRZ boundary for project area near Nana Layja,Mandvi Taluk, Kutch District,Gujarat.
(Revised on 09.02.2017)

Prepared By	Approved By	Forwarded By



LEGEND :

- : LTL
- : HTL
- : Creek HTL
- : 100m Setback Line from Creek HTL
- : 200m Setback Line from HTL
- : 500m Setback Line from HTL
- : SEZ FACILITIES IN CRZ AREA
- : PROPONENT LAND BOUNDARY
- : BREAK WATER
- : MAJOR ROAD
- : Water Body
- CRZ-IA : Stabilised Sand Dunes
- CRZ-IB : Inter Tidal Zone
- CRZ-III : Relatively Undisturbed (Rural Areas)
- CRZ-IVA : LTL to 12NM Seaward side
- CRZ-IVB : Tidal Influenced Waterbody

GEODETIC DETAILS :

SPHEROID : WGS 1984

GRID : Universal Transverse Mercator

Mandvi	Lat: 22° 50' 00"N	Long: 69° 20' 00"E

Height above Chart Datum				MSL
MHHW	MLHW	MHLW	MLLW	2.6 m
4.1m	3.5m	1.7m	0.9m	

SURVEY ORGANIZATION :

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06.02.2013 to 10.02.2013, 27.02.2013 to 02.03.2013 & 01.07.2016

Scale - 1 : 4000

Client: M/s. Sealand Ports Private Limited,
M/s. Avash Logistic Park Private Limited
(Promoted by ILFS)
(Revised on 09.02.2017)

Fig : 4(Part - 2)
Demarcation of LTL, HTL and CRZ area near Kharod nadi and open coast, Nana Layja, Mandvi Taluk, Kutch District, Gujarat.

Prepared By	Approved By	Forwarded By

Annexure V

Marine outfall - cumulative impact assessment model studies

Annexure V: Details of various possible discharges from the individual industrial sectors proposed in the SEZ/FTWZ & DTA , proposed treatment systems, treated water characteristics, marine Outfall system with mathematical model studies

1 Details of CETP proposed in SEZ/FTWZ & DTA

The wastewater in the SEZ/FTWZ and DTA will be generated from the industries such as Focus Engineering Goods, Textile/Handcrafts, Non Metallic minerals, Pharmaceuticals and medicinal products, Basic, allied, speciality chemicals and polymer products, Plastic Industries, thermal Power Plants, FTWZ and Shipping Ancillary sectors as well as from utilities/amenities. The wastewater generated is categorized broadly into two types namely:

- Industrial wastewater/effluent
- Domestic wastewater/sewage

Estimated effluent generation are as below;

i. From SEZ/ FTWZ excluding power plants around 8.89 MLD

ii. From power plants around 5.148 MLD

iii. From DTA industries about 12.007 MLD

Estimated sewage generation from SEZ/ FTWZ, DTA industries, Non Processing areas (NPA) and Power plants will be around 1.03 MLD, 0.549, 3.93 and 0.468 MLD respectively.

The Power plants which are the main industries of within the SEZ/FTWZ and DTA area will have their own ETP and STP to treat their effluents and sewage.

The Non Processing Area (NPA) will have a STP of 3.93 MLD Capacity to treat the sewage generated at NPA

The effluents generated at the industries proposed in the SEZ/FTWZ & DTA other than Power plants will be collected and treated in a common effluent treatment system, Hence it is termed as Common Effluent Treatment Plan (CETP). In order to achieve effective/efficient treatment in CETP, sewage generated in processing area is proposed to be mixed with industrial effluents at aeration tank in secondary treatment.

Considering the heterogeneous effluent characteristics, SEZ regulation for wastewater treatment at DTA, to achieve most effective treatment of wastewater from all industrial zones, and to avoid long-term O&M issues as suggested by MoEF, **five CETPs** are proposed. Among them, two CETPs are with zero discharge (i.e., one at DTA 2 and one at SEZ NW area for focus engineering goods) and other three CETPs (one for Pharmaceuticals and Chemicals, one for Non-Metallic Minerals, Textiles and Handicrafts, and one for Engineering goods, FTWZ, shipping and textiles industries) the treated wastewater are proposed to be discharged through marine outfall.

Details of proposed CETPs are given in **Table 1** below:

Table 1: Proposed CETPs

CETP	Estimated Industrial Effluent (MLD)	Industrial Sectors to be serviced	Treated Water Disposal System
CETP 1	8.74	Pharmaceuticals and Chemicals (DTA)	Marine discharge
CETP 2	2.42	Non-Metallic Minerals, Textiles and Handicrafts (DTA)	
CETP 3	1.39	DTA (Plastic Industry)	Zero

CETP	Estimated Industrial Effluent (MLD)	Industrial Sectors to be serviced	Treated Water Disposal System
			discharge
CETP 4	8.18	Engineering Goods, Shipping, Textiles and FTWZ	Marine discharge
CETP 5	1.75	Engineering Goods proposed at NW of SEZ	Zero discharge

Zero discharge units proposed at DTA (Plastic Industries) / CETP 3 and NW of SEZ for Focus engineering goods / CETP 5 will regenerate 3.14 MLD. Zero liquid discharge technologies help plants meet discharge and water reuse requirements. Reuse of this treated water is proposed and already taken in to consideration while estimating the total water requirement (Water balance)

The ZLD will be ensured by adopting the following

- Employing advanced wastewater treatment technologies to purify and recycle
- Monitoring at Individual CETP level is proposed
- No Discharge connection into Marine Outfall System during normal operations
- Imposing the responsibility on Member industries to adopt recycle/reuse methodologies to the extent possible.

1.1 Zero Discharge CETP 3 and CETP 5 Details

Following are the details of anticipated inlet characteristics of zero discharge CETP proposed for Plastic and Engineering industries.

Table 2: Zero discharge CETP Anticipated Inlet (Wastewater) Primary Characteristics

S. No.	Parameter	Unit	Designed Influent Characteristics
1.	pH	-	6-10
2.	Temperature	^{o}C	45.0
3.	Oil and grease	mg/l	20.0
4.	BOD	mg/l	1,470
5.	COD	mg/l	2,900
6.	Suspended Solids	mg/l	800
7.	Dissolved Solids	mg/l	2,000
8.	Cyanide (CN)	mg/l	2.0
9.	Chromium Total (Cr)	mg/l	2.0

The proposed treatment scheme for the Zero Discharge CETPs (3&5) is shown in **Figure -1.**

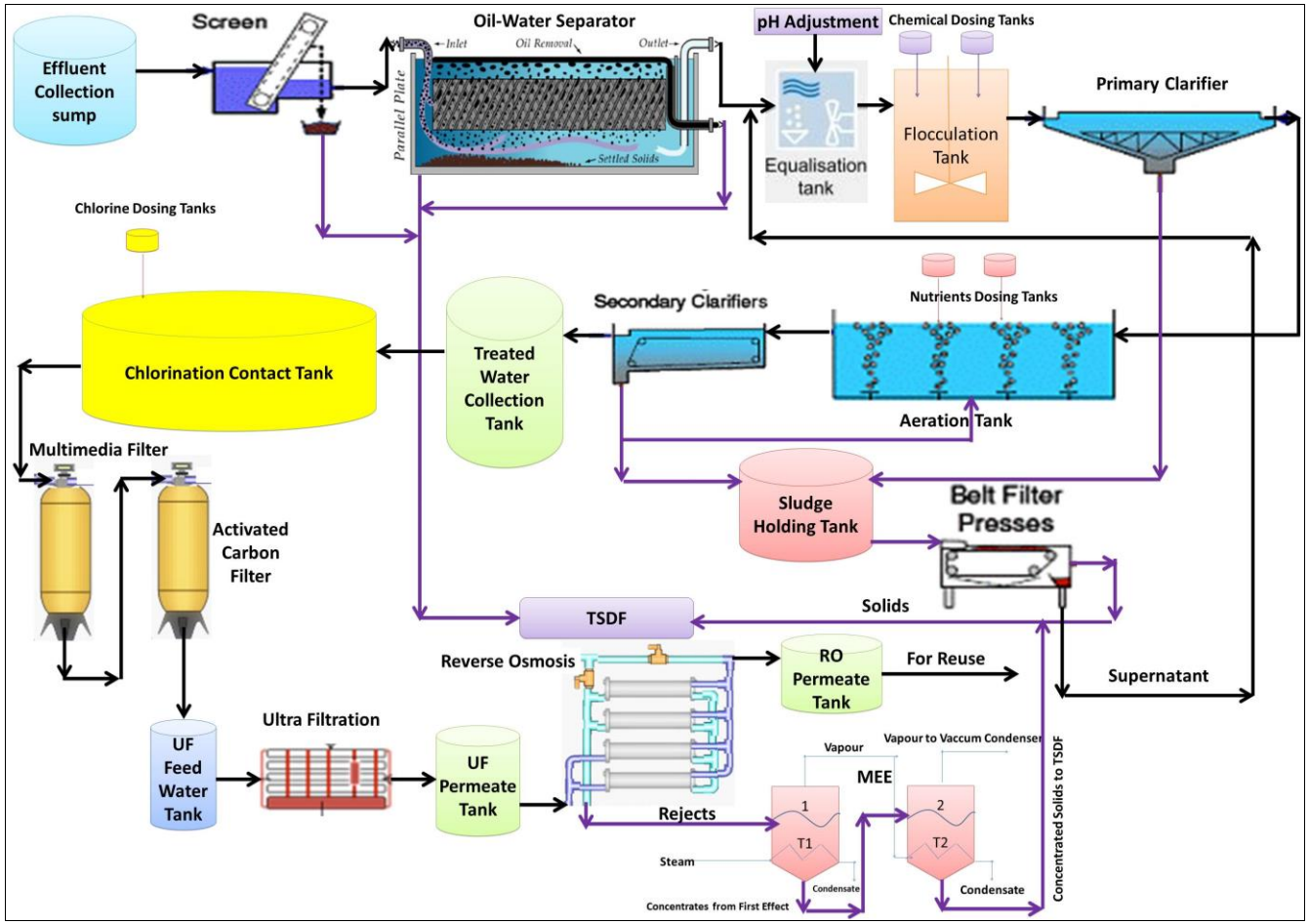


Figure 1: Proposed Treatment Scheme for Zero Discharge CETPs

The incoming wastewater will be treated initially in Bar Screen Chamber and Oil water separators to remove floatable materials and oil & Grease if any. Then it will be sent to Equalization tank to make a flow as homogeneous and PH adjustment will also be done. Thereafter depending on the quality of the wastewater to be treated including SS, the chemical to be used for treatment in the Flocculation tank/ Reactor will have to be changed. (For e.g.: For Cyanide: Na(OH) + NaOCl; For Chromium: Sulphuric Acid, $FeSO_4$, Lime etc.,). The Settled/ precipitated contents will be removed in the primary clarifier and then the WW will be sent to Aeration tank for the reduction of BOD/COD. Secondary Clarifier will be used to remove the solids/sludge present in the treated WW and then depending on the requirement/ use chlorine dosages will be added. Then this treated WW will be sent through multi grade filters and Activated Carbon Filters for further Polishing before feeding in to Ultra Filtration (UF) module. UF is essential to ensure the quality of feed to Reverse Osmosis (RO) to avoid frequent membrane replacements. RO system will ensure the required water quality for reuse and the reject will be treated with Multiple Effect Evaporator to make system as ZERO LIQUID DISCHSRGE (ZLD). All the recovered solids will be sent to TSDF.

Following are the details of anticipated treated water characteristics of zero discharge CETP proposed for Plastic and Engineering industries.

Table 3: Zero discharge CETPs Anticipated Treated Water Characteristics

S. No.	Parameter	Unit	Treated Water Characteristics
1.	pH	-	6.5-8.5
2.	Temperature	^{o}C	atm
3.	Oil and grease	mg/l	<0.5
4.	BOD	mg/l	<3
5.	COD	mg/l	<15
6.	Suspended Solids	mg/l	<0.5
7.	Dissolved Solids	mg/l	<100
8.	Cyanide (CN)	mg/l	<0.05
9.	Chromium Total (Cr)	mg/l	<0.05

Following are the water balance which shows the reuse of CETP 3 and CETP 5 treated water along with NPA STP treated water in various industrial sectors proposed in the Multi-Product SEZ/FTWZ and DTA.

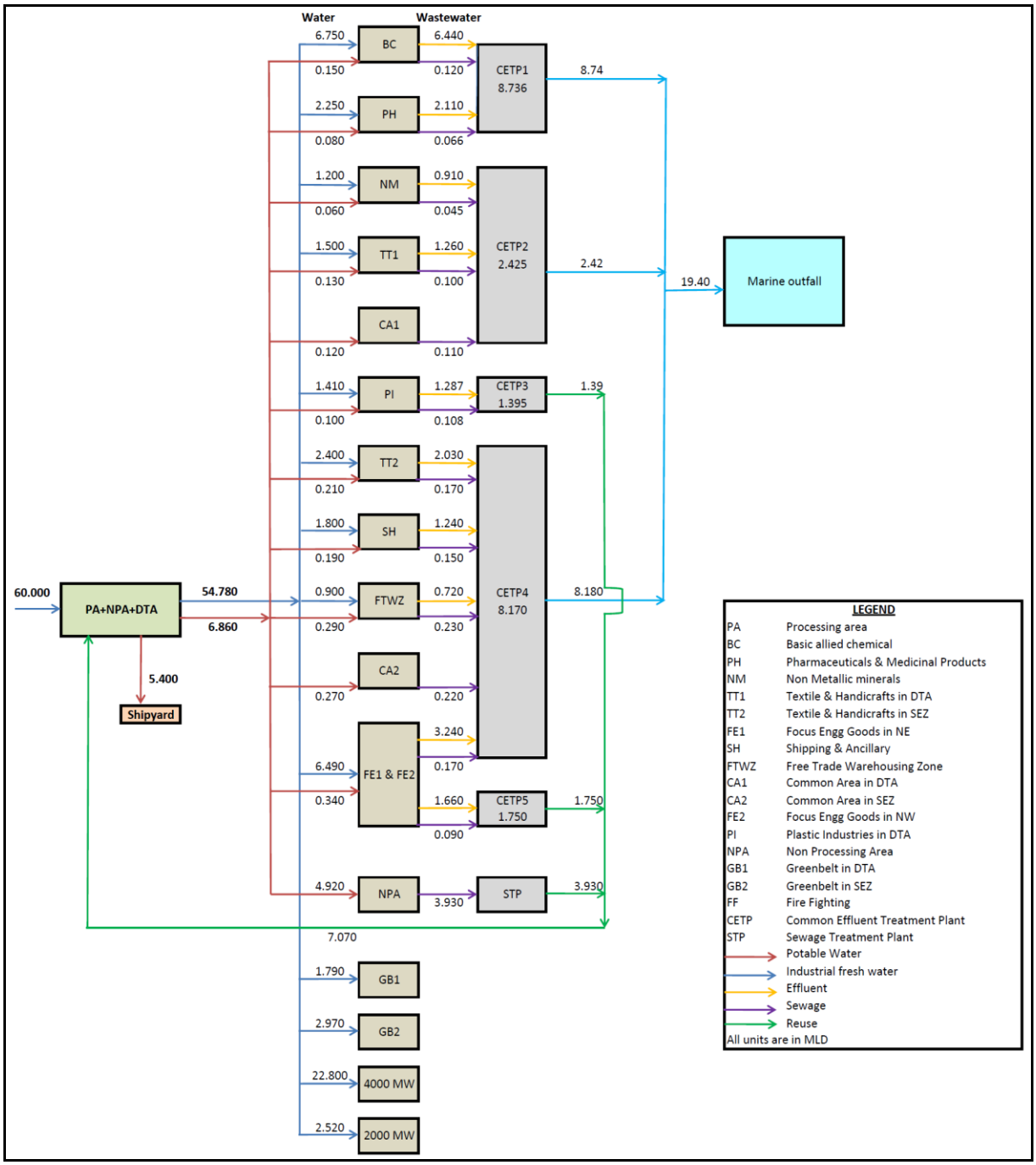


Figure 2: Raw Water Balance Diagram for SEZ/FTWZ and DTA

In addition, the cooling water requirements of both the Power plants proposed in the Multi-Product SEZ/FTWZ and DTA is estimated considering 1.3 CoC which ensure low water consumption as well as discharges with respect to Once Through System.

1.2 Other CETPs (CETP1, CETP 2 and CETP 4) Details

Following are the details of anticipated inlet characteristics of CETPs proposed for Chemicals & Pharmaceuticals (CETP1), Non Metallic Minerals & Textiles (CETP 2) and Engineering Goods, Textiles & Shipping (CETP 4).

Table 4: Anticipated Inlet Characteristics for Chemicals & Pharmaceuticals in CETP 1

S. No.	Parameter	Unit	Designed Influent Characteristics	CETP Influent Standard as per EP Act 1986 as amended
1.	pH	-	5.5-9.0	5.5-9.0
2.	Temperature	^{o}C	45.0	45.0
3.	Oil and grease	mg/l	20.0	20.0
4.	BOD	mg/l	1470	-
5.	COD	mg/l	2900	-
6.	Suspended Solids	mg/l	800	-
7.	Dissolved Solids	mg/l	2000	-
8.	Copper (Cu)	mg/l	3.0	3.0
9.	Zinc (Zn)	mg/l	15.0	15.0
10.	Chromium Hexavalent ($Cr^{(+6)}$)	mg/l	2.0	2.0
11.	Lead (Pb)	mg/l	1.0	1.0
12.	Cyanide (CN)	mg/l	2.0	2.0
13.	Iron (Fe)	mg/l	2.2	-
14.	Phenolic Compounds	mg/l	5.0	5.0
15.	Total Ammonical Nitrogen	mg/l	70	50
16.	Total Kjeldajl Nitrogen	mg/l	120	100
17.	Sulphides	mg/l	10	5.0
18.	Nitrates	mg/l	100	20.0

Table 5: Anticipated Inlet Characteristics for Non Metallic Minerals & Textiles in CETP 2

S. No.	Parameter	Unit	Designed Influent Characteristics	CETP Influent Standard as per EP Act 1986 as amended*
1.	pH	-	6-10	5.5-9.0
2.	Temperature	^{o}C	45.0	45.0
3.	Oil and grease	mg/l	20.0	20.0
4.	BOD	mg/l	1470	-
5.	COD	mg/l	2900	-
6.	Suspended Solids	mg/l	800	-
7.	Dissolved Solids	mg/l	2000	-
8.	Copper (Cu)	mg/l	3.0	3.0
9.	Zinc (Zn)	mg/l	15.0	15.0
10.	Chromium Hexavalent ($Cr^{(+6)}$)	mg/l	2.0	2.0
11.	Lead (Pb)	mg/l	1.0	1.0
12.	Cadmium (Cd)	mg/l	1.0	1.0
13.	Nickel (Ni)	mg/l	3.0	3.0
14.	Cyanide (CN)	mg/l	2.0	2.0
15.	Mercury (Hg)	mg/l	0.01	0.01
16.	Arsenic (As)	mg/l	0.2	0.2
17.	Chromium Total (Cr)	mg/l	2.0	2.0

Table 6: Anticipated inlet characteristics for Engineering Goods, Textiles & Shipping in CETP 4

S. No.	Parameter	Unit	Designed Influent Characteristics	CETP Influent Standard as per EP Act 1986 as amended*
1.	pH	-	6-10	5.5-9.0
2.	Temperature	^{o}C	45.0	45.0
3.	Oil and grease	mg/l	20.0	20.0
4.	BOD	mg/l	1,470	-
5.	COD	mg/l	2,900	-
6.	Suspended Solids	mg/l	800	
7.	Dissolved Solids	mg/l	2,000	-
8.	Copper (Cu)	mg/l	3.0	3.0
9.	Zinc (Zn)	mg/l	15.0	15.0

S. No.	Parameter	Unit	Designed Influent Characteristics	CETP Influent Standard as per EP Act 1986 as amended*
10.	Chromium Hexavalent ($Cr^{(+6)}$)	mg/l	2.0	2.0
11.	Lead (Pb)	mg/l	1.0	1.0
12.	Cadmium (Cd)	mg/l	1.0	1.0
13.	Nickel (Ni)	mg/l	3.0	3.0
14.	Cyanide (CN)	mg/l	2.0	2.0
15.	Mercury (Hg)	mg/l	0.01	0.01
16.	Arsenic (As)	mg/l	0.2	0.2
17.	Chromium Total (Cr)	mg/l	2.0	2.0

The proposed treatment scheme for the CETPs (1,2 &4) with marine Discharge is shown in **Figure 3**

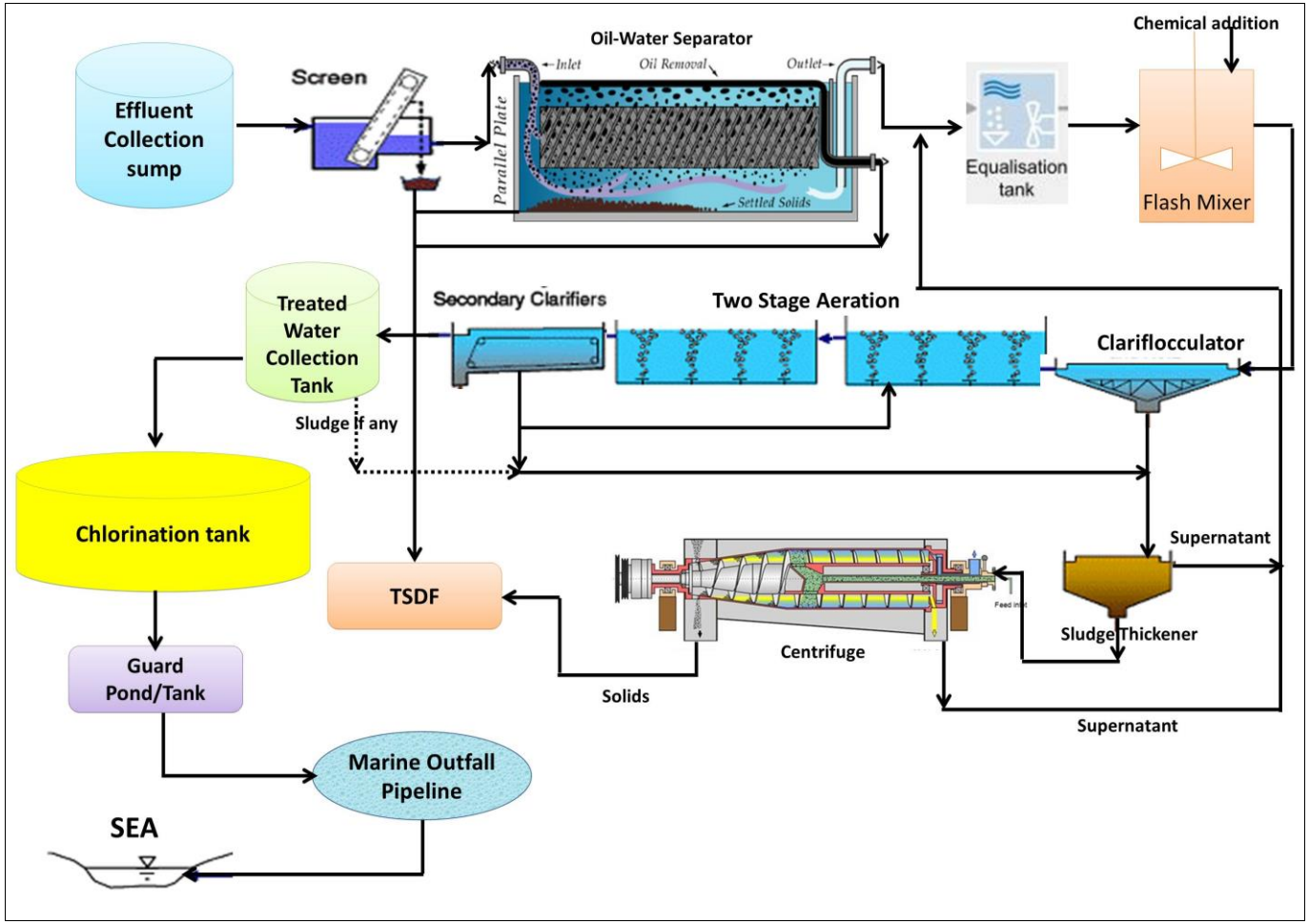


Figure 3: Proposed Treatment Scheme for CETPs 1, 2 and 4

The three (03) CETPs i.e. CETP 1, 2 and 4 will treat the wastewater to meet the marine discharge standards as prescribed in "General standards for discharge of Environmental Pollutants in marine coastal areas, G.S.R 422 (E) "The Environmental (Protection) Rules 1986".

The details of marine discharge along with other possible discharges are discussed below.

2 Details of Marine Discharge

A common marine discharge is proposed for SEZ / FTWZ & DTA Project and the discharge will include;

(i) the return cooling discharges from the TPPs (4000 MW & 2000 MW) and reject brine of desalination plant

(ii) the three CETPs 1,2 4 treated discharges

(iii) Treated sewage from SEZ NPA

(iv) Treated Sewage from both the power plants during rainy season

In addition, the proposed marine discharge will also accommodate treated wastewater from shipyard cum captive jetties.

2.1 Marine Discharge Quantities

The combined outfall quantity of ~921.4 MLD will be discharged into sea through outfall pipes. This discharges includes (i) the discharges from the TPP and desalination plant (891.9 MLD), (ii) the CETPs treated discharges (19.4 MLD), (iii) Treated sewage from SEZ NPA and both the power plants (7.04 MLD) and (iv) Treated wastewater from shipyard cum captive jetties (3 MLD)

2.2 Coordinates of marine discharge point

Based on the mathematical model study, the discharge point is proposed at 10.3 m of water depth at Latitude 69°13'49.13"E N; Longitude 22°48'52.63"N, which is at ~2.3 km from the shore.

A map showing the location of discharge point along with its coordinates is given in **Figure 4** below;

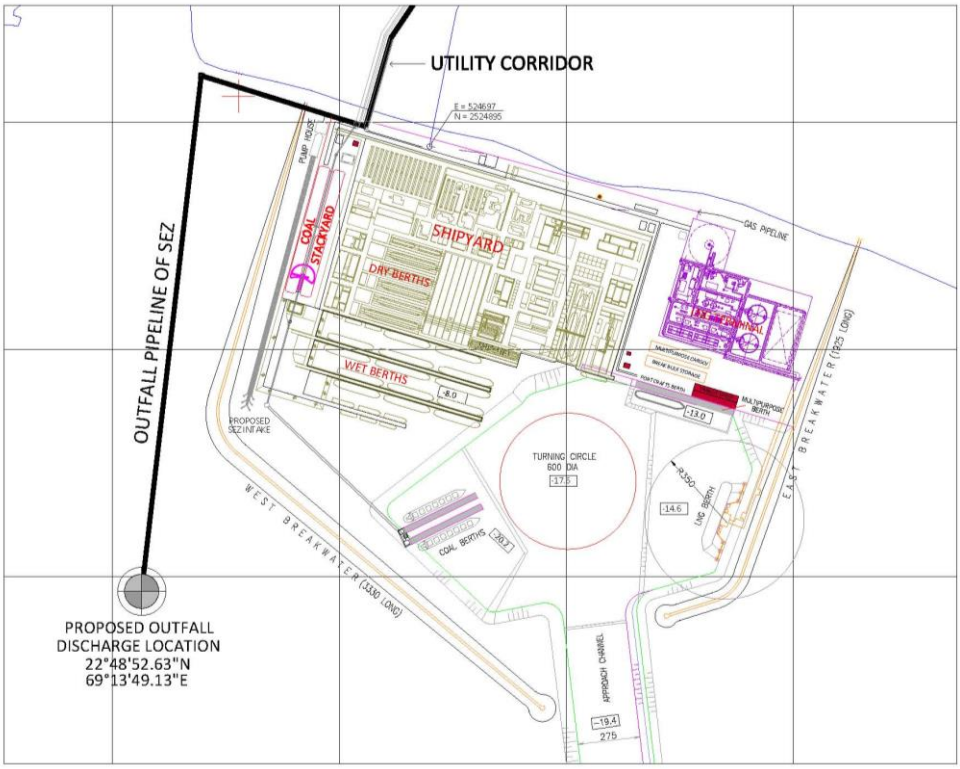


Figure 4: Discharge Point Location

2.3 Marine Outfall System

Considering the discharge quantity, it is prop0sed to have four pipelines to carry the effluent to the outfall location. Each pipe is proposed to have a 25 m long diffuser aligned 90^{o} to the coast. Each of the diffuser will have five risers with two ports of 0.3 m diameter on each riser. The centre to centre spacing between risers can be 5 m.

The general arrangement drawing for diffuser system is given in **Figure 5** below;

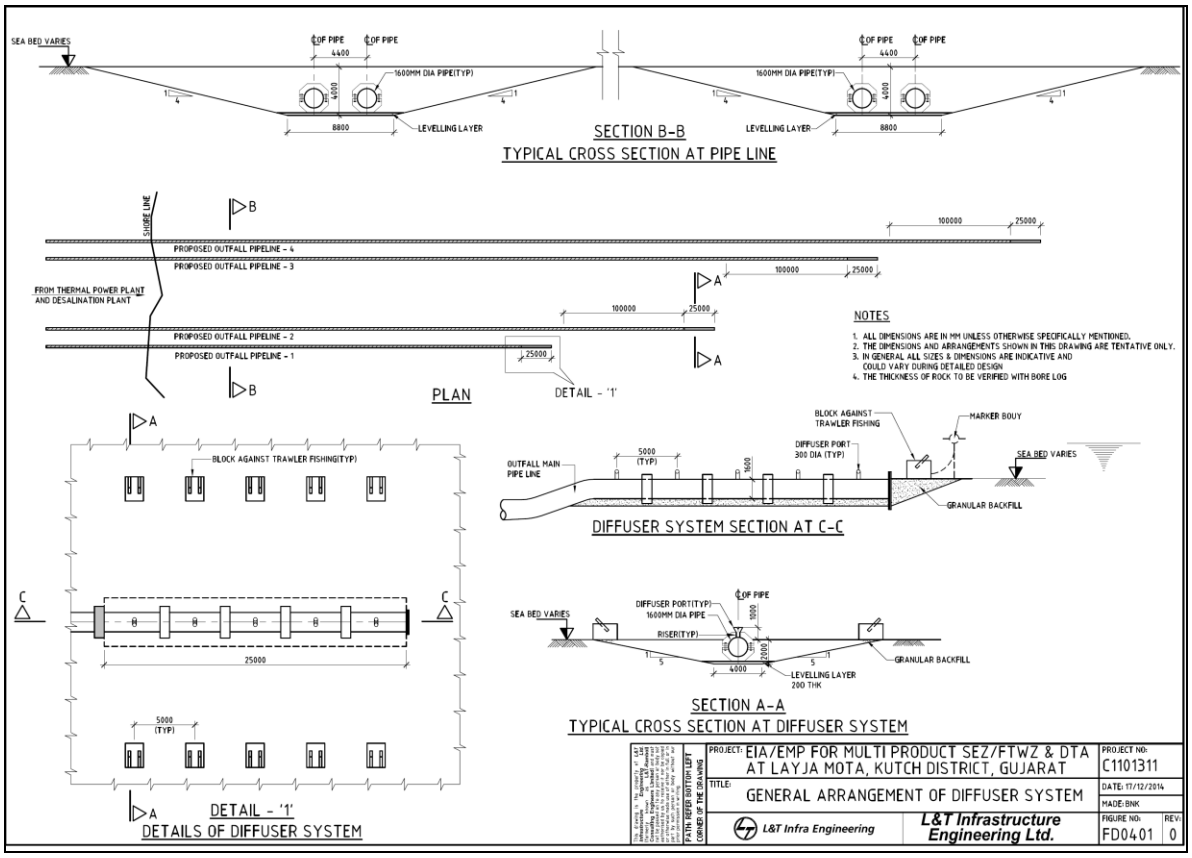


Figure 5: General Arrangement of Diffuser System

2.4 Summary of Mathematical Model Studies for Marine Discharge

Mathematical Model Study related to marine discharge point location and dispersion has been carried out by L&T Infra Engineering Ltd / LNTIEL (previously known as L&T Ramboll).

To understand the dispersion pattern of the Discharges wastewater plume, increase in ambient concentration of salinity, temperature and other parameters etc., to identify the suitable location for disposal of treated wastewater, this mathematical model study on advection and dispersion has been conducted. Mathematical model was setup to simulate the hydrodynamic flow conditions in the region of interest and to achieve a calibrated model. The calibration was carried out for both tidal elevations and current speed. The observed data was compared with that of the simulated. The simulated results show close correlation between the observed and the simulated values. The calibrated model was then used for the study on advection-dispersion, to know the fate of the discharged effluents in the sea. Advection-dispersion study was carried out for various prospective outfall locations.

The model studies were carried out for combined discharge (Power plants, desalination plants and CETP) and CETP discharge alone. The results were analysed and plotted in terms of the Temporal-Maxima that would arise from each of the simulations

Following are the various inputs considered for the Mathematical Model Study

- Meteorological Conditions such as seasons (Monsoon/ non-monsoon/post monsoon), wind etc.,
- Tide
- Bathymetry
- Current
- Other Proposed Feature near the Outfall location such as features of Shipyard Cum Captive Jetties
- Effluent Quantity and Characteristics

- Location of Intake, landfall and Outfall

These details are discussed in details in Section 4.4.3.3 of EIA Report.

Telemac-2D module of the Telemac Modelling System developed by the French Electricity Board is used. The model is calibrated by varying parameters like simulation time step, eddy viscosity, friction coefficient and numerical solvers. A good comparison between the observed data (tidal elevations and current speeds) and the simulated results is achieved after a number of trial simulations. The calibrated model parameters are further used for the simulation of the representative Environmental scenarios.

Simulations were carried to assess the dispersion characteristics of excess salinity, temperature and pollutants from the combined discharge and the pollutants discharge from CETP alone for the period of 30days covering the spring and neap tide phases for the following two scenarios.

- In the absence of proposed shipyard cum captive jetties
- With the presence of proposed shipyard cum captive jetties

Suitability of outfall locations at different water depth was studied and optimum locations for effluent disposal is selected based on the simulated results. The prospective outfall locations TL1, TL2, TL3 and TL4 are considered on the western side of the Shipyard cum Captive Jetties. Similarly, the prospective outfall location TL5 is considered on eastern side of Shipyard cum Captive Jetties.

2.4.1 Outfall Characteristics

The combined outfall quantity of ~921.4 MLD will be discharged into sea through outfall pipes. Since, there is a possibility of CETP being commissioned before the commissioning of TPP and desalination plant, effect of both combined discharge as well as that for CETP alone has been assessed and in this section combined discharge effect has been discussed. With the above background, the final effluent characteristic of combined discharge is used for model study and the details for the same are given in **Table 7** and **Table 8**. The model study for pH and suspended solids was not carried out as the excess concentration is zero.

Table 7: Outfall Characteristics

S. No.	Item	Units	TPP and desalination plants	CETP, Shipyard and rainy season discharge	Combined
1	Outfall quantity	MLD	891.90	29.44	921.4
2	Absolute Salinity	ppt	45.2	2.1	9.83 (excess)
3	Excess Temperature	Deg.C	5	0	5

Table 8: Expected Other Pollutant Characteristics

S. No.	Pollutants (1)	CETP discharge characteristics (2)	Return Cooling Water and Reject Brine characteris-tics (3)	Combined character-istics (4)	Sea Water Character-istics (5)	Combined excess characteristic (6) (4-5)	Excess characteristics from CETP alone (7) (2-5)	Units (8)
Conservative pollutants								
1	pH	7	8	7.9689	8	0	0	[-]
2	Oil & grease	10	0.0017355	0.3208	0.001335	0.319459	9.9	mg/l
3	Suspended solids	100	<100	<100.0000	298	0.0000	0	mg/l
4	Dissolved solids	2100	45201.08	43825.66	34000	9825.66	0	mg/l
5	Total	1	0.5	0.51596	-	0.51595	1	mg/l

S. No.	Pollutants (1)	CETP discharge characteristics (2)	Return Cooling Water and Reject Brine characteris-tics (3)	Combined character-istics (4)	Sea Water Character-istics (5)	Combined excess characteristic (6) (4-5)	Excess characteristics from CETP alone (7) (2-5)	Units (8)
	Residual Chlorine							
6	Mercury	0.01	0.0000728	0.00039	0.000056	0.000334	0.009944	mg/l
7	Lead	2	0.045487	0.107858	0.03499	0.072868	1.96501	mg/l
8	Cadmium	2	0.004433	0.068114	0.00341	0.064704	1.99659	mg/l
9	Copper	3	0.069706	0.163216	0.05362	0.10959	2.94638	mg/l
10	Zinc	15	0.082511	0.55855	0.06347	0.49507	14.93653	mg/l
11	Total Chromium	2	0.2	0.25744	-	0.2574	2	mg/l
12	Iron	3	0.08996	0.18282	0.0692	0.11362	2.9308	mg/l
Non Conservative pollutants								
1	COD	250	3.432	11.3003	2.64	8.660	247.36	mg/l
2	BOD	100	2.288	5.40613	1.76	3.6461	98.24	mg/l
3	Sulphides	5	0.338	0.486771	0.26	0.22677	4.74	mg/l
4	Nitrates	20	0.5564	1.17686	0.427	0.7488	19.57	mg/l

2.4.2 Alternative Outfall discharge locations Considered and Selection of Suitable Location

Advection-dispersion study has been carried for alternate outfall locations (TL1,TL2,TL3,TL4,TL5) to identify the best suitable location for outfall discharge point. The alternate outfall discharge locations are shown in **Figure 6** below;

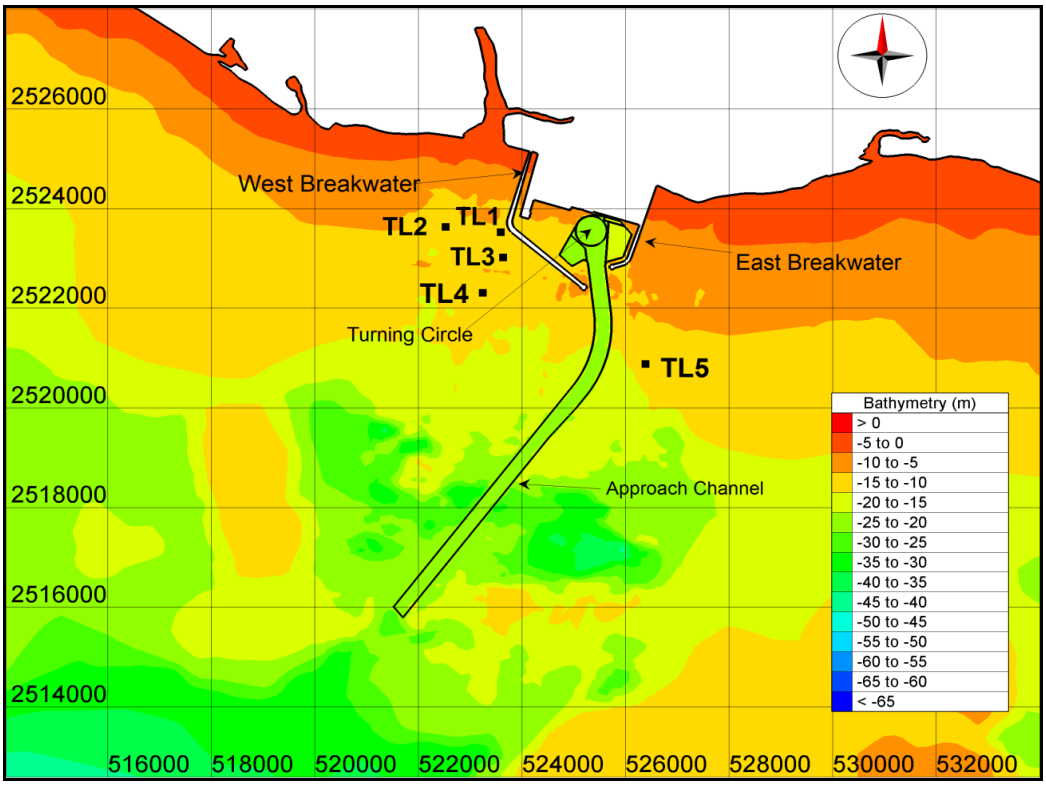


Figure 6: Alternate Outfall Locations (Bathymetry in MSL, WGS84)

2.4.2.1 Results and Discussion

The simulated model results are analysed as per relevant environmental criteria/guidelines for water quality to ensure protection to the characteristic marine community from adverse effects due to raised temperature and salinity above the ambient conditions.

The high tidal current in the study area aids in faster dispersion of the discharged effluents. It is observed that the excess salinity and temperature reaches to minimal levels within short distance from point of discharge. Temporal maximum of salinity and temperature were estimated for the simulated duration to understand the maximum spread and excess concentration of salinity and temperature. Similarly, to assess the average increase in the salinity and temperature, which is an important criteria in assessing the impact, weekly average of excess salinity and temperature were also estimated.

The temporal maximum excess salinity and temperature for each of the outfall locations is tabulated in **Table 9**. Similarly, weekly average excess salinity and temperature also tabulated in **Table 9**.

Table 9: Temporal Maximum and Weekly Average (for Salinity and Temperature)

Combination	Outfall Location	Temporal maximum		Weekly average	
		Excess salinity (ppt)	Excess temperature (Deg.C)	Excess salinity (ppt)	Excess temperature (Deg.C)
Without layout	TL1	0.48	0.24	0.16	0.08
	TL2	0.54	0.27	0.19	0.09
	TL3	0.45	0.23	0.14	0.07
	TL4	0.46	0.23	0.14	0.07
	TL5	0.44	0.22	0.11	0.05
With layout	TL1	0.48	0.24	0.21	0.10
	TL2	0.60	0.30	0.20	0.10
	TL3	0.48	0.24	0.19	0.09
	TL4	0.48	0.24	0.13	0.06
	TL5	0.40	0.20	0.10	0.05

The maximum acceptable increase in the weekly average temperature resulting from artificial sources is 1^{o}C during all seasons of the year, providing the summer maxima are not exceeded as per United States Environmental Protection Agency (USEPA) guidelines for water quality criteria in order to assure protection 0f the characteristic marine community from adverse thermal effects.

From the analysis of results, it is observed that the excess salinity does not exceed 0.5 ppt and 0.25 ppt at 100 m and 500 m respectively at any of the outfall location. Similarly, excess temperature does not exceed 0.25^{o}C and 0.15^{o}C at 100 m and 500 m respectively at any of the outfall location. These variations are comparable with the seasonal variations of temperature and salinity of coastal waters for which aquatic life is adapted.

It was observed that weekly average excess temperature is always lesser than 0.1°C anywhere in the model domain in any of the outfall location. This temperature falls well within the acceptable limits as specified in USEPA guidelines.

Based on comparative analysis of the outfall, following observations have been made:

1. TL1 is close to proposed breakwater and also very near to the intake point in the absence of Shipyard cum Captive Jetties breakwater and there is a chance of recirculation
2. The routing of pipeline for the outfall location TL2 falls in the approach to river mouth which may lead to hindrance for navigation of fishing boats, if any and possible damage to pipeline due to anchoring
3. TL4 and TL5 will have longer distance from the land fall point and the environmental impact due to dredging the trench for routing of pipeline will be more compared to other outfall locations

4. TL3 is more suitable in terms of all the above aspect compared to other outfall locations and hence was selected for locating the outfall

Based on the analysis of all the simulated results, all the prospective outfall locations show good dispersion characteristics of discharged effluent with and without proposed shipyard cum captive jetties layout. However, a comparative analysis was carried out to find the suitable outfall location which shows less chance of recirculation, which avoids hindrance to navigation of fishing boats and shorter distance from land fall point to avoid the impact on environment due to dredging of trench. It was found that outfall location at TL3 is more suitable and the same has been selected. The excess salinity and temperature at TL3 for combined discharge are found to be insignificant. The distance of outfall TL3 with respect intake is ~1.0 km.

TL3 fares marginally better in dispersion of excess salinity and temperature within 100 m and 500 m from the point of discharge. The excess salinity and temperature are extracted at 100 m and 500 m radius from outfall location (TL3). The excess salinity and temperature are found to be stabilising over the time. The excess salinity higher than 0.25 ppt was never found beyond 500m of the outfall and similarly the temperature do not exceed 0.15^{o}C. Analysis was also carried out to know the movement of excess salinity and temperature towards river. The excess salinity and temperature near the River Kharod does not exceed 0.12 ppt and 0.06°C respectively.

Also, studies were carried out for expected treated wastewater parameters at all the outfall discharge location and results indicates very small traces above the base values in both scenario of combined and individual discharge from CETP.

The analysis for temporal maximum excess of conservative and non-conservative pollutants from combined discharge and CETP alone is carried out and tabulated in **Table** 10 and **Table 11** for the selected outfall location TL3.

Table 10: Combined Excess Pollutant Characteristics for Outfall Location (TL3)

S. No.	Pollutants	Without Jetties Layout	With Jetties Layout
		Temporal Maximum (mg/l)	Temporal Maximum (mg/l)
Conservative pollutants			
1	pH	0	0
2	Oil & grease	0.01530	0.01443
3	Suspended solids	0	0
4	Dissolved solids	481.93	454.502
5	Total Residual Chlorine	0.02536	0.02392
6	Mercury	0.00002	0.00002
7	Lead	0.00350	0.00331
8	Cadmium	0.00310	0.00292
9	Copper	0.00527	0.00497
10	Zinc	0.02374	0.02239
11	Total Chromium	0.01259	0.01188
12	Iron	0.00547	0.00516
Non-Conservative pollutants			
1	COD	0.41591	0.39225
2	BOD	0.17536	0.16538
3	Sulphides	0.01096	0.01034
4	Nitrates	0.03604	0.03399

Table 11: Excess Pollutant Characteristics from CETP Alone for Outfall Location TL3

S. No.	Pollutants	Without layout	With proposed layout
		Excess temporal maximum (mg/l)	Excess temporal maximum (mg/l)
Conservative pollutants			

S. No.	Pollutants	Without layout	With proposed layout
		Excess temporal maximum (mg/l)	Excess temporal maximum (mg/l)
1	pH	0	0
2	Oil & grease	0.01644	0.01748
3	Suspended solids	0	0
4	Dissolved solids	0	0
5	Total Residual Chlorine	0.00164	0.00175
6	Mercury	0.00002	0.00002
7	Lead	0.00323	0.00344
8	Cadmium	0.00328	0.00349
9	Copper	0.00485	0.00515
10	Zinc	0.02456	0.02611
11	Total Chromium	0.00329	0.00350
12	Iron	0.00482	0.00512
Non-Conservative pollutants			
1	COD	0.40679	0.43244
2	BOD	0.16156	0.17174
3	Sulphides	0.00780	0.00829
4	Nitrates	0.03219	0.03422

2.4.3 Conceptual Design of Outfall

The conceptual design of outfall for selected TL3 location has been carried out. To prepare the conceptual design of outfall, the near field dispersion study has also been carried out using CORMIX software. The study was done with various combination of diffuser alignment, length of diffuser, port diameter and number of ports. From the analysis, the suitable conceptual design has been arrived. The alignment of diffusers will help to decide the near field limit and extent till which the dispersion takes place. The geometry of the outfall system is done based on the near field analysis. Considering the discharge quantity, it is recommended to have four pipelines to carry the effluent to the outfall location. Each pipe is proposed to have a 25 m long diffuser aligned 90^{o} to the coast. Each of the diffuser can have 5 risers with two ports of 0.3 m diameter on each riser. The centre to centre spacing between risers can be kept as 5 m. The results from CORMIX are tabulated in **Table 12**. The conceptual design parameter was prepared and is tabulated in **Table 13**

.

Table 12: Results from Cormix

Item Description	Details
Slot densimetric froude number	76.23
Port densimetric froude Number	23.40
Edge of near field from centre line of diffuser	**9.48 m**
Excess salinity at the edge of near field	0.46 ppt
Dilution at the edge of near field	**21.1**

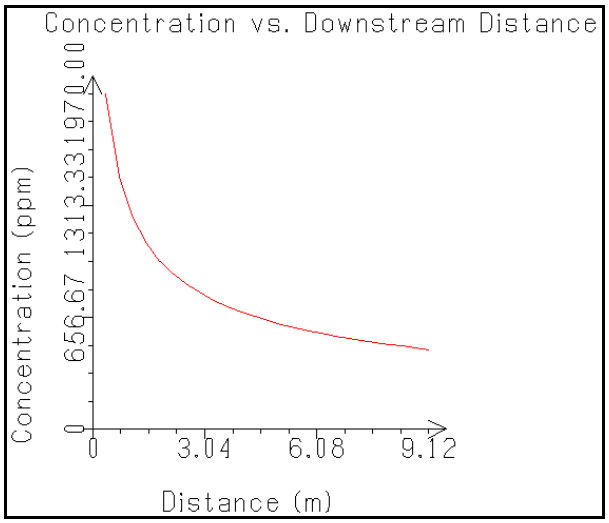


Figure 7:Concentration with Distance

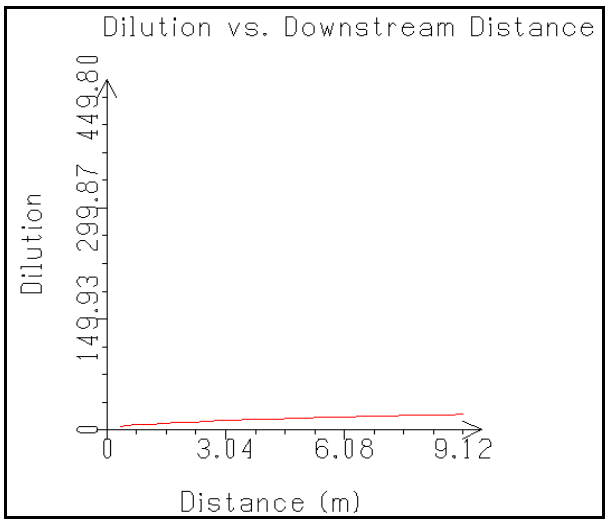


Figure 8:Dilution with Distance

It is observed that within in ~10 m at about 21 times dilution of discharge water quality parameters.

Table 13: Conceptual Design of Outfall

Item Description	Details
Outfall quantity	MLD
Water depth at outfall location	10.3 m (CD)
Pipe diameter for outfall	4 nos. of 1.6 m
Location of outfall (TL3)	523635E, 2523017N (WGS84) Latitude 22° 48' 52.63"N and Longitude 69° 13' 49.13"E,
Diameter of ports	0.3 m
Height of the diffuser ports from the sea bed level	1 m
No. of ports	10 ports in each pipe (2 no. of ports for each risers)
Velocity of flow in pipe	1.6 m/s
Discharge velocity	3.82 m/s
Port alignment	Fanned out
Angle of port centreline above the horizontal plane	60°
Angle of port centreline with diffuser main centreline	90°
Angle of port centreline with current direction	0°

Annexure VI

Environmental clearance letters of power plants

J-13012/13/2011-I.A.I (T)
Government of India
Ministry of Environment, Forest and Climate Change

Indira Paryavaran Bhawan, Jor Bagh Road
Aliganj, New Delhi-110003

To

Date: 26.06.2015

M/s. Nana Layja Power Company Ltd.
301-303, Kaivanna Complex,
Panchwati Ahmedabad,
Gujarat- 380006,

Tel. No. 0124-4716100; Fax: 0124-4716120

Subject: Imported coal based Supercritical Thermal Power Plant of 3960 (6x660) MW at Village Layja Mota, Mandvi Taluk, Kutch District, Gujarat by M/s. Nana Layja Power Co. Ltd.- Environmental Clearance.

Sir,

This has reference to your letters dated 24.12.2014, 15.01.2015, 29.01.2015 and 30.01.2015 on the above subject. The Ministry has examined the application. It is inter-alia noted that ToR for preparation of EIA/EMP report was accorded on 28.12.2011 and an extension of validity of ToR till 27.12.2014 was accorded on 21.01.2014. Public Hearing for the project was conducted by GPCB on 12.12.2014.

2. The proposed TPP including 60 MLD desalination plant will be located in Multiproduct SEZ being developed by IL&FS group companies. Total SEZ area is 3473 acres. Land identified for the project is un-inhabited and no R&R is involved due to Land Acquisition. Ecologically sensitive areas like Biosphere Reserves, National Parks, Wildlife Sanctuaries protected sites as per Ramsar convention and other protected areas (PA) are not present within 15 km radius of the project site. Wild life conservation plan has been prepared for the scheduled species in consultation with forest department and monitoring mechanism with implementation schedule is prepared. The proposed project cost is about Rs. 28,000 Crores and the cost towards capital cost towards environmental management is Rs. 1,374 Crores.

3. IL&FS Group is also developing Shipyard cum Captive Jetties including LNG terminal at Nana Layja coast, Kutch District, Gujarat and the Shipyard cum Captive jetties site is at 8 km south of SEZ site. These jetties will cater the requirements of SEZ including Power Plants. The land and sea water requirement (including Desalination Plant) based on imported coal are 1135 acres and 989 MLD respectively. Permission for sea water withdrawal was obtained from GMB. The imported coal requirement is 13.8 MTPA with GCV, sulphur and ash content of 4750 kcal/kg, 0.35 % and 12 % respectively. The fly ash and bottom ash generation would be 3628 TPD and 907 TPD respectively. Coal will be transported by ships to proposed Shipyard Cum Captive jetties facility near Nana Layja coast and will be transferred through covered conveyers upto power plant.

4. Based on the information submitted and presentations made by you and your consultant, M/s. L&T Infrastructure Engineering Ltd. (formerly known as L&T Ramboll) before the Expert Appraisal Committee (Thermal Power) in its 30th Meeting held during 29th -30th January, 2015, the Ministry hereby accords environmental

clearance to the above project **based on imported coal only** under the provisions of EIA Notification dated September 14, 2006 and amendments therein subject to the compliance of the following Specific and General conditions:

A. Specific Conditions:

i) The activities attracting CRZ clearance shall only be initiated after obtaining prior CRZ Clearance from the Competent Authority. A copy of the same shall be submitted to the Ministry and its Regional Office.

ii) Vision document specifying prospective plan for the site shall be formulated and submitted to the Regional Office of the Ministry within **six months**.

iii) Additional soil for leveling of the proposed site shall be generated within the sites (to the extent possible) so that natural drainage system of the area is protected and improved.

iv) Harnessing solar power within the premises of the plant particularly at available roof tops shall be carried out and status of implementation shall be submitted periodically.

v) A long term study of radio activity and heavy metals contents on coal to be used shall be carried out through a reputed institute and results thereof analyzed every two year and reported along with monitoring reports. Thereafter mechanism for an in-built continuous monitoring for radio activity and heavy metals in coal and fly ash (including bottom ash) shall be put in place.

vi) Three stacks (twin flue) of 275 m height shall be provided with continuous online monitoring equipments for SOx, NOx and $PM_{2.5}$ & PM_{10}. Exit velocity of flue gases shall not be less than 22 m/sec. Mercury emissions from stack shall also be monitored on periodic basis.

vii) The sulphur and ash content of coal shall not exceed 0.35 % and 12 % respectively. In case of variation of quality at any point of time, fresh reference shall be made to the Ministry for suitable amendments to the environmental clearance.

viii) The coal transportation from the captive jetty shall be through closed coal conveyor system only.

ix) High Efficiency Electrostatic Precipitators (ESPs) shall be installed to ensure that particulate emission does not exceed 50 mg/Nm^3. Adequate dust extraction system such as cyclones/ bag filters and water spray system in dusty areas such as in coal handling and ash handling points, transfer areas and other vulnerable dusty areas shall be provided along with an environment friendly sludge disposal system.

x) COC of atleast 1.3 shall be adopted.

xi) *Explore the commercial utilization of brine instead of discharging into sea.*

xii) Disposal of solid/liquid from Desalination plant shall comply with the prescribed standards and if need be, environmental safeguard measures by providing balancing/neutralizing tank may be set up and operated regularly & efficiently.

xiii) *Natural topography and surface drainage shall be maintained to the extent possible. The second order and third order drains passing through the Plant shall be diverted so as to maintain them free from dust and pollutants. Further, ponds and check dams shall be created in the nearby villages using the diverted streams in consultation with State Govt.*

xiv) Monitoring of surface water quantity and quality shall also be regularly conducted and records maintained. The monitored data shall be submitted to the Ministry regularly. Further, monitoring points shall be located between the plant and drainage in the direction of flow of ground water and records maintained. Monitoring for heavy metals in ground water shall be undertaken.

xv) No water bodies including natural drainage system in the area shall be disturbed due to activities associated with the setting up / operation of the power plant.

xvi) Hydrogeology of the area shall be reviewed annually from an institute/ organization of repute to assess impact of surface water and ground regime (especially around ash dyke). In case any deterioration is observed, specific mitigation measures shall be undertaken and reports/ data of water quality monitored regularly and maintained shall be submitted to the Regional Office of the Ministry.

xvii) Wastewater generated from the plant shall be treated before discharge to comply limits prescribed by the SPCB/CPCB.

xviii) A well designed rain water harvesting system shall be put in place within six months, which shall comprise of rain water collection from the built up and open area in the plant premises and detailed record kept of the quantity of water harvested every year and its use.

xix) The wild life conservation plan and the allocation of funds shall be for a period of minimum 30 years.

xx) Sea water quality shall be continuously monitored for salinity, turbidity and temperature at selective sites across the impacted zone including estuarine waters. Mitigative measures shall be undertaken through institutes such as Annamalai University for continuous preservation of mangroves and their ecology. The monitoring data shall be uploaded on the company's website and also submit to Regional Office of the Ministry every six months.

xxi) To minimize entrapment of even small marine flora and fauna, state of the art low aperture intake screens with high effectiveness for impingement and entrainment and fishnet around intake shall be installed.

xxii) Fish catch along the impacted zone of sea should be monitored periodically by the Department of Fisheries, Government of Gujarat. The project proponent shall accordingly take up the matter with the Fishery Dept., Govt. of Gujarat from time to time.

xxiii) The project proponent shall upload environmental quality monitored data on a regular basis on its website.

xxiv) Marginalized section of society particularly traditional fishermen communities shall be identified based on 2011 population census data and socio-economic study of the various strata of families such as those carrying out subsistence

fishing, commercial fishing etc. shall be carried out and impact on their livelihoods shall be assessed separately. Accordingly, sustainable welfare scheme/measures shall be undertaken and status of implementation shall be submitted to the Regional Office of the Ministry within six months.

xxv) A state-of-the-art environmental laboratory at the project site shall be established such that the laboratory has facilities for long term monitoring of sea water quality and sediment in the impacted zone over and above and ambient air, soil quality analysis of the area. The proponent shall undertake mitigative measures if there are any negative impacts.

xxvi) Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Unutilized fly ash shall be disposed off in the ash pond in the form of slurry. Mercury and other heavy metals (As, Hg, Cr, Pb etc.) will be monitored in the bottom ash as also in the effluents emanating from the existing ash pond. No ash shall be disposed off in low-lying area.

xxvii) Fugitive emission of fly ash (dry or wet) shall be controlled such that no agricultural or non-agricultural land is affected. Damage to any land shall be mitigated and suitable compensation provided in consultation with the local Panchayat.

xxviii) Ash pond shall be lined with HDPE/LDPE lining or any other suitable impermeable media such that no leachate takes place at any point of time. Adequate safety measures shall also be implemented to protect the ash dyke from getting breached.

xxix) Green Belt consisting of three tiers of plantations of native species around the plant and at least 50 m width shall be raised. Wherever 50 m width is not feasible green belt of 20 m width shall be raised and detailed justification shall be submitted to the Ministry. Tree density shall not be less than 2500 per ha with survival rate not less than 80 %. *The width of the green belt shall be the maximum possible towards the nearby Bhandaras.*

xxx) Green belt shall also be developed around the Ash Pond over and above the Green Belt around the plant boundary.

xxxi) CSR schemes identified based on Public Hearing issues and need based assessment shall be implemented in consultation with the village Panchayat and the District Administration starting from the development of project itself. As part of CSR prior identification of local employable youth and eventual employment in the project after imparting relevant training shall be also undertaken. Company shall provide separate budget for community development activities and income generating programmes.

xxxii) As committed, a minimum amount of Rs 112 Crores shall be earmarked as capital cost for CSR activities. For proper and periodic monitoring of CSR activities, a CSR committee or a Social Audit committee or a suitable credible external agency shall be appointed. CSR activities shall also be evaluated by an independent external agency. This evaluation shall be both concurrent and final.

xxxiii) An Environmental Cell comprising of at least one expert each in environmental science/ engineering, ecology, occupational health and social science, shall be created preferably at the project site itself and shall be headed by an officer of appropriate superiority and qualification. It shall be

ensured that the Head of the Cell shall directly report to the Head of the Unit who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.

B. General Conditions:

(i) Space for FGD shall be provided for future installation as may be required.

(ii) The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. Arrangements shall be made that effluents and storm water do not get mixed.

(iii) A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising greenbelt/plantation.

(iv) Adequate safety measures shall be provided in the plant area to check/minimize spontaneous fires in coal yard, especially during summer season. Copy of these measures with full details along with location plant layout shall be submitted to the Ministry as well as to the Regional Office of the Ministry.

(v) Storage facilities for auxiliary liquid fuel such as LDO/ HFO/LSHS shall be made in the plant area in consultation with Department of Explosives, Nagpur. Sulphur content in the liquid fuel will not exceed 0.5%. Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place due to storage of oil.

(vi) First Aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.

(vii) Noise levels emanating from turbines shall be so controlled such that the noise in the work zone shall be limited to 85 dB(A) from source. For people working in the high noise area, requisite personal protective equipment like earplugs/ear muffs etc. shall be provided. Workers engaged in noisy areas such as turbine area, air compressors etc shall be periodically examined to maintain audiometric record and for treatment for any hearing loss including shifting to non noisy/less noisy areas.

(viii) Regular monitoring of ambient air ground level concentration of SO_2, NOx, $PM_{2.5}$ & PM_{10} and Hg shall be carried out in the impact zone and records maintained. If at any stage these levels are found to exceed the prescribed limits, necessary control measures shall be provided immediately. The location of the monitoring stations and frequency of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry. The data shall also be put on the website of the company.

(ix) Utilization of 100% Fly Ash generated shall be made from **4th** year of operation. Status of implementation shall be reported to the Regional Office of the Ministry from time to time.

(x) Provision shall be made for the housing of construction labour (as applicable) within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.

(xi) The project proponent shall advertise in at least two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned within seven days from the date of this clearance letter, informing that the project has been accorded environmental clearance and copies of clearance letter are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry of Environment and Forests at http://envfor.nic.in.

(xii) A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parisad / Municipal Corporation, urban local Body and the Local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent.

(xiii) The proponent shall upload the status of compliance of the stipulated environmental clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MOEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM ($PM_{2.5}$ & PM_{10}), SO_2, NO_x (ambient levels as well as stack emissions) shall be displayed at a convenient location near the main gate of the company in the public domain.

(xiv) The environment statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental clearance conditions and shall also be sent to the respective Regional Offices of the Ministry by e-mail.

(xv) **The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment and Forests, its Regional Office, Central Pollution Control Board and State Pollution Control Board. The project proponent shall upload the status of compliance of the environmental clearance conditions on their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, Ministry of Environment and Forests.**

(xvi) Regional Office of the Ministry of Environment & Forests will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring. Project proponent will up-load the compliance status in their website and up-date the same from time to time at least six monthly basis. **Criteria pollutants levels including NO_x (from stack & ambient air) shall be displayed at the main gate of the power plant.**

(xvii) Separate funds shall be allocated for implementation of environmental protection measures along with item-wise break-up. These cost shall be included as part of the project cost. The funds earmarked for the environment protection measures shall not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.

(xviii) The project authorities shall inform the Regional Office as well as the Ministry regarding the date of financial closure and final approval of the project by the concerned authorities and the dates of start of land development work and commissioning of plant.

(xix) Full cooperation shall be extended to the Scientists/Officers from the Ministry / Regional Office of the Ministry / CPCB/ SPCB who would be monitoring the compliance of environmental status.

5. The Ministry of Environment and Forests reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction of the Ministry. The Ministry may also impose additional environmental conditions or modify the existing ones, if necessary.

6. The environmental clearance accorded **shall be valid for a period of 7 years** from the date of issue of this letter to start operations by the power plant.

7. Concealing factual data or submission of false/fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environment (Protection) Act, 1986.

8. In case of any deviation or alteration in the project proposed including coal transportation system from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the condition(s) imposed and to add additional environmental protection measures required, if any.

9. The above stipulations would be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and rules there under, Hazardous Wastes (Management, Handling & Transboundary Movement) Rules, 2008 and its amendments, the Public Liability Insurance Act, 1991 and its amendments.

10. Any appeal against this environmental clearance shall lie with the National Green Tribunal, if preferred, within 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

Yours faithfully,

(B.B. Barman)
Scientist 'F'

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi-110001.
2. The Secretary, Department of Environment, Govt. of Gujarat.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chairman, Gujarat Pollution Control Board, Sector-10-A, Gandhi Nagar, Gujarat-382043
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
6. The Addl. PCCF (Central), Ministry of Environment, Forest and Climate Change, Regional Office (WZ), E-5, Kendriya Paryavaran Bhawan, Arera Colony, Ravishankar Nagar, Bhopal - 462016.
7. The District Collector, Kutch District, Gujarat.

8. Guard file/Monitoring File.
9. Website of MoEF&CC.

(B.B. Barman)
Scientist 'F'

J-13012/10/2012-IA.II (T)
Government of India
Ministry of Environment, Forest and Climate Change

Indira Paryavaran Bhawan, Jor Bagh Road,
Aliganj, New Delhi-110003

Dated: 29.09.2016

To

M/s Nana Layja Power Co. Ltd.,
301-303, Kaivanna Complex,
Panchwati, Ahmedabad,
Gujarat- 380006.

Sub: 2,000 MW Gas Based Combined Cycle Power Plant (CCPP) at Village Godhra, Kutch Distt, Gujarat by M/s. Nana Layja Power Co. Ltd. - reg. Environmental Clearance.

Sir,

This has reference to your online application dated 06.01.2015 and subsequent letters dated 26.02.2015, 29.04.2015 & 04.08.2016 on the above subject. The Ministry has examined the application. It is noted that the ToR for preparation of EIA/EMP report was accorded by the Ministry on 24.09.2012 and its validity was extended till 23.09.2015 vide letter dated 13.02.2015. Public Hearing for the project was conducted by the GPCB on 12.12.2014.

2. The proposed TPP will be located in Multiproduct SEZ being developed by IL&FS group companies. Total SEZ area is 3,473 acres and the area designated for TPP is 88 acres, of which plant area is 66 acres and green belt area is 22 acres. MoU has been signed with the SEZ developers for transfer of required land on long term lease basis. 100% of required land for the TPP has been acquired by SEZ developers. The Utility corridor of 8.33 km long and 60 m wide involves 124 acres of land. Since the land identified for project is un-inhabited, no R&R issue arise due to Land Acquisition. Ecologically sensitive areas like Biosphere Reserves, National Parks, Wildlife Sanctuaries, protected sites as per Ramsar convention and other protected areas are not present within 15 km radius of the project site. Letter and map duly authenticated by CWLW was obtained. There are no litigations pending or otherwise with respect to the project in any Court, Tribunal etc.

3. IL&FS Group is also developing Shipyard cum Captive Jetties including LNG terminal at Nana Layja coast, Kutch District, Gujarat and the Shipyard cum Captive jetties site is at 8 km South of SEZ site. These Jetties will cater the requirements of SEZ including Power Plants. Quantity of fuel (natural gas) required will be 7.7 MMSCMD (~2.0 MTPA) and shall be sourced/imported in form of Liquefied Natural Gas (LNG) from USA in special vessels. LNG shall be unloaded at LNG Jetty and storage and re-gasification of LNG shall be carried out at dedicated LNG Terminal. LNG Terminal of 5.0 MTPA capacity is proposed to be set up near Shipyard cum Captive Jetty being developed by IL&FS Group, located at a distance of around 11.6 km South to the project site at Nana Layja's seafront. The re-gasified LNG will be transported through underground pipeline which will be routed through dedicated utility corridor proposed between TPP and LNG Terminal. The "Term Sheet" for LNG Sale and Purchase Agreement (LSPA) was signed with BARCA LNG LLC, USA for supply of LNG for 25 years at commercially viable price.

4. Water requirement is based on 1.3 CoC. Condenser cooling will be closed cycle cooling using cooling towers (NDCT). Sea water intake for cooling water make-up will be required as 217.68 MLD with a fresh water requirement of 2.52 MLD from desalination plant. The water requirement has been optimized as per prevailing practices. Re-use and re-circulation of effluents, DM plant rejects, Boiler Area floor wash, Wastewater from oil water separator will be treated in ETP and will be used for greenbelt. STP treated water will be used for greenbelt. Other areas like return seawater which cannot be reused will be sent to marine outfall.

5. Based on the information submitted and presentations made by you and your consultant viz. M/s Vimta Labs, Hyderabad before the Expert Appraisal Committee (Thermal Power) in its 32nd *and 60th Meetings held during 23rd- 24th February, 2015 (MoM amended in the 34th Meeting held during April 29th- 30th, 2015) and 27th July, 2016 respectively,* the Ministry hereby accords environmental clearance to the above project under the provisions of EIA Notification dated September 14, 2006 and amendments therein subject to the compliance of the following Specific and General conditions:

A. Specific Conditions:

i) *The adjacent 3,960 MW coal based power plant shall comply with the standards stipulated by the Ministry vide Notification dated 07.12.2015. The EC of the same stands amended to this extent.*

ii) *Since the project site falls under seismic zone V, all precautions shall be taken as per the recommendations of subject experts.*

iii) *Latest authenticated satellite imagery shall be submitted on an annual basis to monitor the alterations of the area.*

iv) *Ensure by periodic preventive maintenance that there are no leakages of pipes transporting LNG and seawater.*

v) *The regenerated water bodies shall be maintained and sufficient funds shall be earmarked in this regard.*

vi) *Stacks of 70 m each shall be provided with continuous online monitoring equipments. Exit velocity of flue gases shall not be less than 22 m/sec.*

vii) *Dry Low NOx burners shall be installed to control NOx emission. NOx emission from each Gas Turbine shall not exceed 50 ppm.*

viii) *COC of atleast 1.3 shall be adopted.*

ix) *Explore the commercial utilization of brine instead of discharging into sea.*

x) *Natural topography and surface drainage shall be maintained to the extent possible. The second order and third order drains passing through the Plant shall be diverted so as to maintain them free from dust and pollutants. Further, ponds and check dams shall be created in the nearby villages using the diverted streams in consultation with State Govt.*

xi) *The wild life conservation plan and the allocation of funds shall be for a period of minimum 30 years.*

xii) *Sea water quality shall be continuously monitored for salinity, turbidity and temperature at selective sites across the impacted zone including estuarine*

waters. Mitigative measures shall be undertaken through institutes such as Annamalai University for continuous preservation of mangroves and their ecology. The monitoring data shall be uploaded on the company's website and also submit to Regional Office of the Ministry every six months.

xiii) *To minimize entrapment of even small marine flora and fauna, state of the art low aperture intake screens with high effectiveness for impingement and entrainment and fishnet around intake shall be installed.*

xiv) *Fish catch along the impacted zone of sea should be monitored periodically by the Department of Fisheries, Government of Gujarat. The project proponent shall accordingly take up the matter with the Fishery Dept., Govt. of Gujarat from time to time.*

xv) *The project proponent shall upload environmental quality monitored data on a regular basis on its website.*

xvi) *Marginalized section of society particularly traditional fishermen communities shall be identified based on 2011 population census data and socio-economic study of the various strata of families such as those carrying out subsistence fishing, commercial fishing etc. shall be carried out and impact on their livelihoods shall be assessed separately. Accordingly, sustainable welfare scheme/measures shall be undertaken and status of implementation shall be submitted to the Regional Office of the Ministry within six months.*

xvii) *A state-of-the-art environmental laboratory at the project site shall be established such that the laboratory has facilities for long term monitoring of sea water quality and sediment in the impacted zone over and above and ambient air, soil quality analysis of the area. The proponent shall undertake mitigative measures if there are any negative impacts.*

xviii) *The width of the green belt shall be the maximum possible towards the nearby Bhandaras.*

xix) *As committed, a minimum amount of Rs 28.75 Crores shall be earmarked as capital cost for CSR activities.* The recurring cost shall be as per the CSR policy of GOI till the operation of the plant.

xx) Vision document specifying prospective plan for the site shall be formulated and submitted to the Regional Office of the Ministry within **six months**.

xxi) Harnessing solar power within the premises of the plant particularly at available roof tops shall be carried out and status of implementation including actual generation of solar power shall be submitted along with half yearly monitoring report.

xxii) In case fuel for running the power plant is proposed to be changed from natural gas to other fuel (liquid or solid) the project proponent shall apply for such a change in environmental clearance along with necessary documents as required under EIA notification, 2006 (and its amendments).

xxiii) Concentration for photochemical oxidants shall be monitored along with NO_x and permanent monitoring stations shall be installed.

xxiv) Regular monitoring of ground level concentration of NO_x shall be carried out in the impact zone and records maintained. If at any stage the levels are found to exceed the prescribed limits, necessary control measures shall be

provided immediately. The location of the monitoring stations and frequency of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry. The data shall also be put on the website of the company.

xxv) Monitoring of surface water quantity and quality shall also be regularly conducted and records maintained. The monitored data shall be submitted to the Ministry regularly. Further, monitoring points shall be located between the plant and drainage in the direction of flow of ground water and records maintained. Monitoring for heavy metals in ground water shall also be undertaken and results/findings submitted along with half yearly monitoring report.

xxvi) A well designed rain water harvesting system shall be put in place within six months, which shall comprise of rain water collection from the built up and open area in the plant premises and detailed record kept of the quantity of water harvested every year and its use.

xxvii) No water bodies including natural drainage system in the area shall be disturbed due to activities associated with the setting up / operation of the power plant.

xxviii) Wastewater generated from the plant shall be treated before discharge to comply limits prescribed by the SPCB/CPCB.

xxix) Additional soil for leveling of the proposed site shall be generated within the sites (to the extent possible) so that natural drainage system of the area is protected and improved.

xxx) Green Belt consisting of three tiers of plantations of native species around plant and at least 50 m width shall be raised. Wherever 50 m width is not feasible a 20 m width shall be raised and adequate justification shall be submitted to the Ministry. Tree density shall not be less than 2500 per ha with survival rate not less than 80 %.

xxxi) CSR schemes identified based on need based assessment shall be implemented in consultation with the village Panchayat and the District Administration starting from the development of project itself. As part of CSR prior identification of local employable youth and eventual employment in the project after imparting relevant training shall be also undertaken. Company shall provide separate budget for community development activities and income generating programmes.

xxxii) For proper and periodic monitoring of CSR activities, a CSR committee or a Social Audit committee or a suitable credible external agency shall be appointed. CSR activities shall also be evaluated by an independent external agency. This evaluation shall be both concurrent and final.

xxxiii) An Environmental Cell comprising of at least one expert in environmental science/ engineering, ecology, occupational health and social science, shall be created preferably at the project site itself and shall be headed by an officer of appropriate superiority and qualification. It shall be ensured that the Head of the Cell shall directly report to the Head of the Plant who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.

xxxiv) The PP shall submit the progress of the project to CEA on six monthly basis.

xxxv) The Corporate Environmental Policy shall be as per the Ministry's O.M. dated 26.04.2011 and amendments if any.

B. General Conditions:

(i) The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. Arrangements shall be made that effluents and storm water do not get mixed.

(ii) A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising greenbelt/plantation.

(iii) Storage facilities for auxiliary liquid fuel such as LDO/ HFO/LSHS shall be made in the plant area in consultation with Department of Explosives, Nagpur. Sulphur content in the liquid fuel will not exceed 0.5%. Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place due to storage of oil.

(iv) First Aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.

(v) Noise levels emanating from turbines shall be so controlled such that the noise in the work zone shall be limited to 85 dB(A) from source. For people working in the high noise area, requisite personal protective equipment like earplugs/ear muffs etc. shall be provided. Workers engaged in noisy areas such as turbine area, air compressors etc shall be periodically examined to maintain audiometric record and for treatment for any hearing loss including shifting to non noisy/less noisy areas.

(vi) Regular monitoring of ambient air ground level concentration of SO_2, NOx, $PM_{2.5}$ & PM_{10} and Hg shall be carried out in the impact zone and records maintained. If at any stage these levels are found to exceed the prescribed limits, necessary control measures shall be provided immediately. The location of the monitoring stations and frequency of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry. The data shall also be put on the website of the company.

(vii) Provision shall be made for the housing of construction labour (as applicable) within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.

(viii) The project proponent shall advertise in at least two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned within seven days from the date of this clearance letter, informing that the project has been accorded environmental clearance and copies of clearance letter are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry of Environment and Forests at http://envfor.nic.in.

(ix) A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parisad / Municipal Corporation, urban local Body and the Local NGO, if any, from whom suggestions/representations, if any, were

received while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent.

(x) The proponent shall upload the status of compliance of the stipulated environmental clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MOEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM ($PM_{2.5}$ & PM_{10}), SO_2, NO_x (ambient levels as well as stack emissions) shall be displayed at a convenient location near the main gate of the company in the public domain.

(xi) The environment statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental clearance conditions and shall also be sent to the respective Regional Offices of the Ministry by e-mail.

(xii) The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment and Forests, its Regional Office, Central Pollution Control Board and State Pollution Control Board. The project proponent shall upload the status of compliance of the environmental clearance conditions on their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, Ministry of Environment and Forests.

(xiii) Regional Office of the Ministry of Environment & Forests will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring. Project proponent will up-load the compliance status in their website and up-date the same from time to time at least six monthly basis. Criteria pollutants levels including NO_x (from stack & ambient air) shall be displayed at the main gate of the power plant.

(xiv) Separate funds shall be allocated for implementation of environmental protection measures along with item-wise break-up. These cost shall be included as part of the project cost. The funds earmarked for the environment protection measures shall not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.

(xv) The project authorities shall inform the Regional Office as well as the Ministry regarding the date of financial closure and final approval of the project by the concerned authorities and the dates of start of land development work and commissioning of plant.

(xvi) Full cooperation shall be extended to the Scientists/Officers from the Ministry / Regional Office of the Ministry / CPCB/ SPCB who would be monitoring the compliance of environmental status.

C) An as built or as completed report on EMP to be submitted stating the scope/extent of work envisaged in the EIA along with estimated cost vis-à-vis the actual completed works and cost incurred. A certificate/completion certificate accordingly, shall have to be submitted before commissioning of the TPP.

6. The Ministry reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction. The Ministry may also impose additional environmental conditions or modify the existing ones, if necessary.

7. The environmental clearance accorded **shall be valid for a period of 7 years** from the date of issue of this letter for the start of production operations by the TPP.

8. Concealing factual data or submission of false/fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environment (Protection) Act, 1986.

9. In case of any deviation or alteration in the project proposed including fuel transportation system from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the condition(s) imposed and to add additional environmental protection measures required, if any.

10. The above stipulations would be enforced among others under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and rules there under, Hazardous Wastes (Management, Handling & Transboundary Movement) Rules, 2008 and its amendments, the Public Liability Insurance Act, 1991 and its amendments.

11. Any appeal against this environmental clearance shall lie with the National Green Tribunal, if preferred, within 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

Yours faithfully,

(Dr. S. Kerketta)
Director

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Secretary, Department of Environment, Govt. of Gujarat.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chairman, Gujarat Pollution Control Board, Sector-10-A, Gandhi Nagar-382043
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
6. The Chief Conservator of Forests, Regional Office (WZ), E-5, Kendriya Paryavaran Bhawan, Arera Colony, Ravishankar Nagar, Bhopal - 462016.
7. The District Collector, Kutch District, Gujarat.
8. Guard file/Monitoring file.
9. Website of MoEF&CC.

(Dr. S. Kerketta)
Director

J-13012/10/2012-IA.II (T)
Government of India
Ministry of Environment, Forest and Climate Change

Indira Paryavaran Bhawan, Jor Bagh Road,
Aliganj, New Delhi-110003

Dated: 07.03.2017.

To

M/s Nana Layja Power Co. Ltd.,
301-303, Kaivanna Complex,
Panchwati, Ahmedabad,
Gujarat- 380006.

Corrigendum

Sub: 2,000 MW Gas Based Combined Cycle Power Plant (CCPP) at Village Godhra, Kutch Distt, Gujarat by M/s. Nana Layja Power Co. Ltd. - reg. Environmental Clearance.

Sir,

This has reference to your online application dated 06.10.2017 on the above subject.

2. The Ministry has examined the application. It is noted that the Environmental Clearance (EC) for the above mentioned project was accorded by the Ministry on 29.09.2016. It is also noted that the integrated final EIA/EMP report for Multiproduct SEZ/FTWZ, DTA including Power & Desalination Plants has been prepared by environment consultant M/s L&T Infrastructure Engineering Limited (formerly known as L&T-RAMBOLL Consulting Engineers Limited), Hyderabad. Ministry hereby issues the corrigendum in regard to the environment consultant mentioned at the para 5 of the EC dated 29.09.2016. The environmental consultant mentioned as "*M/s Vimta Labs, Hyderabad*" is substituted with "*M/s L&T Infrastructure Engineering Limited, Hyderabad*".

3. All other conditions mentioned in the EC letter dated 29.09.2016 shall remain the same, as applicable.

4. This issues with the approval of the Competent Authority.

Yours faithfully,

(Dr. S. Kerketta)
Director

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Secretary, Department of Environment, Govt. of Gujarat, Block 14, 8th floor, Sachivalaya, Gandhinagar - 382 010, Gujarat.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chairman, Gujarat Pollution Control Board, Sector-10-A, Gandhi Nagar-382043

5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
6. The Additional Principal Chief Conservator of Forests (APCCF), Regional Office (WZ), E-5, Kendriya Paryavaran Bhawan, Arera Colony, Ravishankar Nagar, Bhopal - 462016.
7. The District Collector, Kutch District, Gujarat.
8. Guard file/Monitoring file.
9. Website of MoEF&CC.

(Dr. S. Kerketta)
Director

Annexure VII
SAND DUNE Study Report

DEVELOPMENT OF SHIPYARD CUM CAPTIVE JETTIES AND LNG TERMINAL AT NANA LAYJA AND MULTIPRODUCT SEZ/FTWZ & DTA AT MOTA LAYJA, KUTCH DISTRICT, GUJARAT

STUDY ON SAND DUNE AND ITS ECOLOGICAL & GEOLOGICAL FEATURES

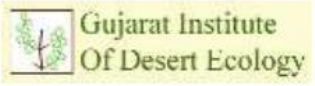
Consultant

Centre for Coastal and Marine Research (CCMR), Tuticorin

Sub Consultants

Gujarat Institute of Desert Ecology (GUIDE), Kachch, Bhuj

Gujarat Ecology Society (GES), Vadodara



FEBRUARY, 2016

Expert Project Personnel

Dr. Vinoth Ravindran, *M.Sc (Mar. Biol & Ocngr.)., M.Phil., Ph.D (Mar. Biol.)., M.B.A.*
Director & Project Coordinator, Centre for Coastal and Marine Research (CCMR), Tuticorin

Dr. G.A.Thivakaran, *M.Sc (Mar. Biol & Ocngr.)., M.Phil., Ph.D (Mar. Biol.).*
Senior Principal Scientist, Gujarat Institute of Desert Ecology (GUIDE), Kachchh, Bhuj

Dr. Nilesh P. Bhatt, *M.Sc., M.Phil., Ph.D (Geology).*
Professor, Dept.of Geology, The M.S.University of Baroda (MSU), Vadodara

Dr. Jayendra Lakhmapurkar, *M.Sc (Geology)., M.Sc (Hydro Geology)., Ph.D (Geology)*
Deputy Director, Gujarat Ecology Society (GES), Vadodara

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1. Introduction

1.1 General

A shipyard cum captive jetty including LNG terminal is being developed by Sealand Ports Private Ltd., (SPPL) and Gujarat Integrated Maritime Complex Pvt. Ltd., (GIMCO) at the coastal belt of Nana Layja village, Kutch district. The project coast spans over about 3 km from Nana Layja coast. The captive jetties are proposed to service the SEZ/FTWZ/DTA proposed by SPPL about 8.3 km from the marine facilities location.

A detailed and integrated EIA report for the projects has been earlier prepared and submitted by SPPL and GIMCO to Gujarat Coastal Zone Management Authority (GCZMA) for CRZ clearance.

GCZMA during the appraisal of the project have asked the SPPL and GIMCO to carry out a study on the sand dunes (Assignment) falling within the project onshore area which is about 79 ha.

1.2 Consultants Appointed by Proponents

Centre for Coastal and Marine Research (CCMR), Tuticorin was engaged by the project proponent to carry out sand dune study. Scope of Assignment is to cover physical parameters & description, ecological importance including species composition, diversity of flora and fauna, food webs and tropic relations, if any, geological aspects based on morphological & geophysical assessments, impact of project development on the sand dune ecosystem and suggest mitigation measures / recommendations.

1.2.1 Study Team

Well qualified study team comprising following key experts were employed for carrying out the study.

- **Dr.VinothRavindran,** M.Sc (Mar. Biol&Ocngr.)., M.Phil., Ph.D (Mar. Biol.)., M.B.A

  Director & Project Coordinator, Centre for Coastal and Marine Research (CCMR), Tuticorin

- **Dr.G.A.Thivakaran, M.Sc (Mar. Biol&Ocngr.). M.Phil., Ph.D (Mar. Biol.)**

  Senior Principal Scientist, Gujarat Institute of Desert Ecology (GUIDE), Kachchh, Bhuj

- **Dr.Nilesh P. Bhatt, M.Sc., M.Phil., Ph.D (Geology).**

  Professor, Dept.of Geology, M.S.University of Baroda (MSU), Vadodara

- **Dr.JayendraLakhmapurkar, M.Sc (Geology)., M.Sc (Hydro Geology)., Ph.D (Geology)**

  Deputy Director, Gujarat Ecology Society (GES), Vadodara

1.3 Approach & Methodology

1.3.1 General

The objective of the Assignment is to study the sand dune area in detail to comprehend the ecology of the area and to assess the impact of project development, suggest mitigation measures and recommendations

To achieve the objectives, a well - designed methodology was developed. Data were collected from primary & secondary sources, for baseline / primary survey, apart from observations during site visit,

- The area was divided into 6 transects and total 66 locations were identified for GPS positions of the filed survey / sampling locations. Sampling location coordinates were collected with the help of Garmin etrex 30 GPS instrument. Sampling location map was prepared using ARCGIS software
- Total of 30 sediment / soil samples were collected and were analysed to assess the geomorphology, composition, etc and laboratory analyses of samples
- Physical measurements were taken to deduce the topography / levels at various spots of the area. Topographic profile was created using GEOCONTEXT – GIS software and Digital Elevation Model (DEM) profile was created using Zonmus tool
- Field data based on earlier site investigations / surveys by the project proponents were also referred
- Remote sensing data (1998-2011) was used. Land cover maps of the study area was prepared using satellite image LISS IV November 2014, using supervised classification method
- Google satellite imageries were used for comparison
- Vegetation structure study was carried out by quadrate method by laying plots of 10 m x 10 m. In each plot, the total number of trees was recorded. The simple modified transect method was used for the density assessment. The identification of plants was

made from flora of Gujarat State, the flora of Indian desert ad flora of Presidency of Bombay

- Intertidal biota was recorded by using random quadrates of 1 m x 1 m size and density was calculated. The inter tidal biota were identified in the field itself and those which could not be identified were collected and taken to laboratory for further identification
- Other instruments like pH meter (Hanna make) Refractomer (Fisher scientific) were used as and when required to measure pH and salinity
- Secondary information were collected from literature and various published information

1.3.2 Sampling locations of field study

The transects and the sampling locations selected for the field study are shown in **Figure 1** and the GPS co-ordinates of the same are given in **Table 1**.

Figure 1: GPS marks showing the sampling / survey points in onshore area

Transect 1 (TR I)

Along the Eastern boundary (North to South and back), near the fence of the demarcated area. Data and samples were collected from 19 locations (St. 1-19).

Transect 2 (TR II)

East to West along the North side of the demarcated area. Data /samples were collected from 11 locations (St. 20-30).

Transect 3 (TR III)

Along the western margin from North to South along RiverKharod. Data /samples were collected from 5 locations (St. 31-35)

Transect 4 (TR IV)

From South East margin to the centre of the Northern border. Data/samples were collected from 9 locations (St 36-44)

Transect 5 (TR V)

Northern margin to the Southern margin and back in the central part of the dune. Data/samples were collected from 12 locations (St 45-56)

Transect 6 (TR VI)

Data/samples were collected from 11 locations, on the Western side of the dune, covering area between transect 2 and 3 (St. 57-66).

Table 1: GPS Positions of the field survey / sampling locations

St.	N Latitude	E Longitude	St.	N Latitude	E Longitude
1	22°50'17.22"N	69°14'33.30"E	34	22°50'8.69"N	69°13'49.06"E
2	22°50'15.06"N	69°14'32.88"E	35	22°50'6.12"N	69°13'52.13"E
3	22°50'14.58"N	69°14'31.08"E	36	22°50'5.59"N	69°14'1.94"E
4	22°50'10.98"N	69°14'31.56"E	37	22°50'8.59"N	69°14'0.40"E
5	22°50'4.20"N	69°14'29.34"E	38	22°50'9.28"N	69°14'4.05"E
6	22°50'1.38"N	69°14'28.62"E	39	22°50'11.77"N	69°14'7.32"E
7	22°49'59.82"N	69°14'28.14"E	40	22°50'15.79"N	69°14'8.61"E
8	22°49'57.06"N	69°14'26.46"E	41	22°50'17.44"N	69°14'9.38"E
9	22°49'59.46"N	69°14'25.14"E	42	22°50'19.41"N	69°14'10.12"E
10	22°50'1.17"N	69°14'20.60"E	43	22°50'20.31"N	69°14'10.67"E
11	22°50'1.44"N	69°14'16.06"E	44	22°50'21.82"N	69°14'13.61"E
12	22°50'4.34"N	69°14'20.36"E	45	22°50'17.90"N	69°14'28.66"E
13	22°50'6.96"N	69°14'23.94"E	46	22°50'17.32"N	69°14'24.89"E
14	22°50'7.62"N	69°14'24.18"E	47	22°50'13.67"N	69°14'23.27"E

St.	N Latitude	E Longitude	St.	N Latitude	E Longitude
15	22°50'11.34"N	69°14'28.14"E	48	22°50'11.69"N	69°14'23.56"E
16	22°50'16.02"N	69°14'32.58"E	49	22°50'9.97"N	69°14'22.24"E
17	22°50'18.30"N	69°14'34.08"E	50	22°50'7.19"N	69°14'20.13"E
18	22°50'21.42"N	69°14'35.40"	51	22°50'6.32"N	69°14'17.51"E
19	22°50'24.72"N	69°14'36.54"E	52	22°50'5.27"N	69°14'12.95"E
20	22°50'24.28"N	69°14'35.69"E	53	22°50'3.08"N	69°14'10.38"E
21	22°50'21.84"N	69°14'35.39"E	54	22°50'8.36"N	69°14'12.11"E
22	22°50'19.92"N	69°14'27.18"E	55	22°50'10.36"N	69°14'14.97"E
23	22°50'20.40"N	69°14'24.90"E	56	22°50'14.00"N	69°14'18.69"E
24	22°50'21.71"N	69°14'18.77"E	57	22°50'18.45"N	69°14'20.59"E
25	22°50'22.55"N	69°14'9.02"E	58	22°50'17.22"N	69°14'16.46"E
26	22°50'23.84"N	69°14'4.63"E	59	22°50'15.87"N	69°14'13.54"E
27	22°50'23.49"N	69°14'3.78"E	60	22°50'19.35"N	69°14'8.21"E
28	22°50'25.94"N	69°13'59.08"E	61	22°50'13.49"N	69°14'2.48"E
29	22°50'26.19"N	69°13'55.46"E	62	22°50'13.95"N	69°13'58.87"E
30	22°50'25.58"N	69°13'50.70"E	63	22°50'10.05"N	69°13'53.34"E
31	22°50'24.86"N	69°13'50.15"E	64	22°50'16.45"N	69°13'53.86"E
32	22°50'23.26"N	69°13'52.10"E	65	22°50'18.78"N	69°13'56.92"E
33	22°50'12.50"N	69°13'50.98"E	66	22°50'18.93"N	69°14'1.94"E

1.4 Structure of the Report

The information collected, inference of the data, and the suggestions & recommendations are documented as part of this report structured below;

1 - Introduction

2 - Project Description

3 - Onshore Area Environment

4 - Summary of Findings

5 - Conclusions and Recommendations

2. Project Description

2.1 General

M/s. Sealand Ports Private Limited (SPPL) &Avash Logistic Park Private Limited (ALPL) propose to develop a Multi-Product Special Economic Zone (SEZ), a Free Trade and Warehousing Zone (FTWZ) and a Domestic Tariff Area (DTA) at LayjaMota in Kutch District, Gujarat. Infrastructure Leasing & Financial Services Limited (IL&FS) is promoter of this project. A 4000 MW Thermal Power Plant (TPP) supplemented with a 60 MLD Desalination Plant and a 2000 MW Gas Based Combined Cycle Power Plant (CCPP) are planned to be developed within the proposed SEZ/FTWZ and DTA. In addition, other potential sectors identified for investment in the proposed SEZ and FTWZ include Logistics, Focus Engineering Goods, Textiles & Handicrafts, Shipping Ancillary and Naval Offsets. Plastic industry, Pharmaceuticals & Medicinal Products, Basic Chemicals, Polymer Products, Allied and Speciality Chemicals, Textiles and Handicrafts and Non Metallic Minerals are the industrial sectors proposed in the DTA. This project shall also have Non-Processing Area (NPA) and associated infrastructure facilities to cater the requirements of industries proposed within SEZ/FTWZ and DTA.

The SEZ project site is located at a distance of 1.5 km North of LayjaMota village and 18 km NW of Mandvi town (Taluk headquarters). The other major towns near the project site are Mundra, Bhuj and Kandla at a distance of 52 km (SE), 55 km (NE) and 100 km (East) respectively. Geographical co-ordinates of the site are 22^{o} 56′ 11″ NorthLatitude and 69^{o} 14′ 20″ East Longitude.

A Shipyard cum Captive Jetties including LNG Terminal, is being developed by **Gujarat Integrated Maritime Complex Private Limited** (GIMCO) and SPPL. This proposed Shipyard cum Captive Jetties including LNG Terminal is located at Nana Layja coast about 8.3 km south of proposed Multiproduct SEZ/FTWZ. The requirements of SEZ/FTWZ such as Coal for 4000 MW TPP, Gas for the 2000 MW CCPP and other import/exports of SEZ industries are proposed to be met from the Captive Jetties and LNG Terminal proposed at Nana Layja.

A dedicated Utility Corridor (UC) is proposed to connect the Captive Jetties and SEZ/FTWZ project site.

The project location is shown in **Figure 2** below:

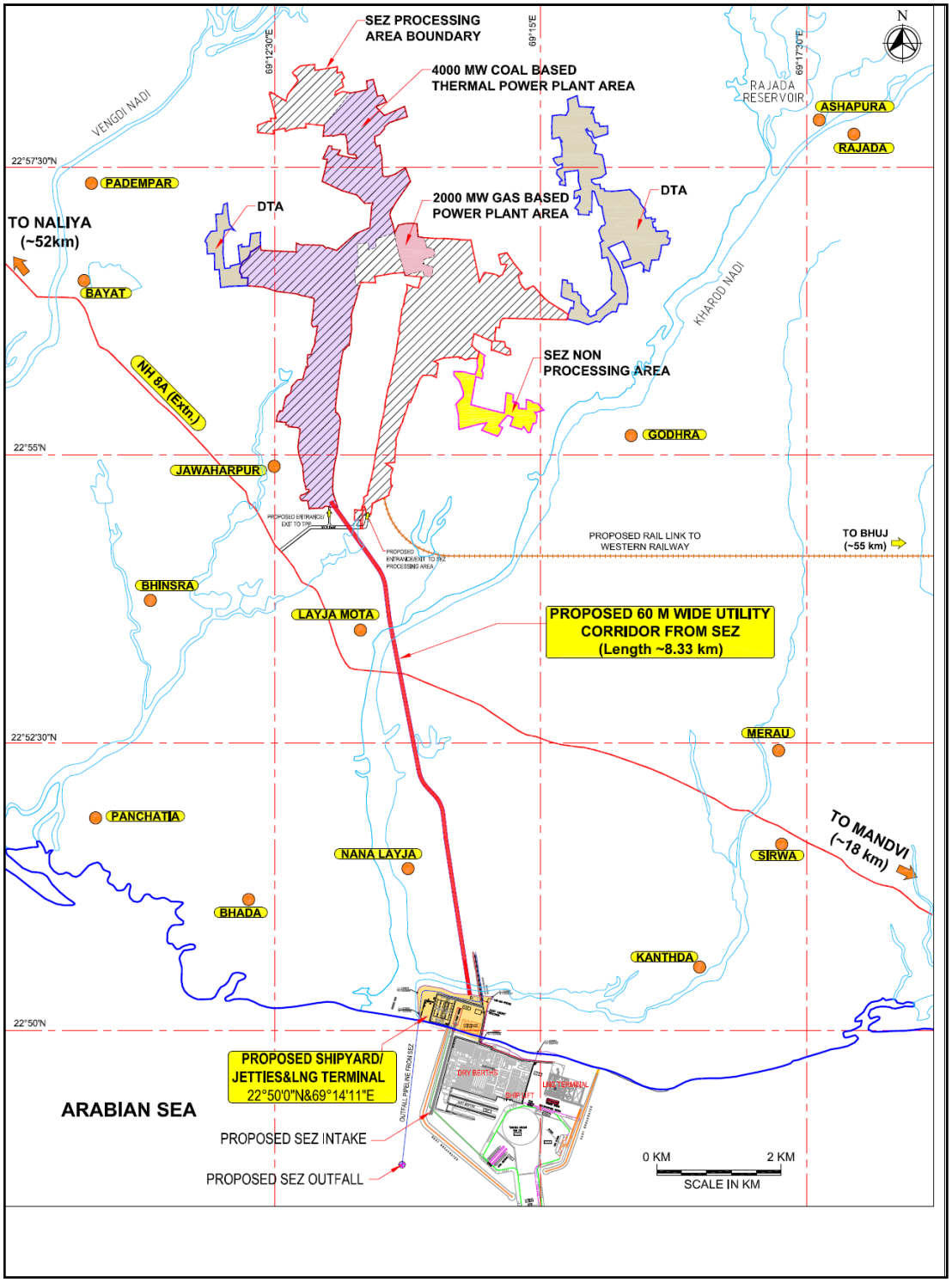


Figure 2: Project location

2.2 Marine Facilities Layout

The facilities layout is shown in **Figure 3.**

The key project facilities include;

1. Reclamation – Extending up to approximately 800 m from HTL covering about 181 HA of land
2. Dredging – Capital dredging of about 22 million cum to create depths up to -19.4 m CD
3. Breakwaters – West BW 3330 m long and East BW 1925 m long
4. Captive jetties – 4 captive jetties (1 LNG Jetty, 2 coal jetties and 1 multipurpose berth to service SEZ industries)
5. LNG regasification terminal
6. Ship building & ship repair yard

Onshore facilities consisting of storage area for coal & general cargoes, common user building, Intake & outfall pipeline, Natural gas pipeline, Intake pump house, a small part of utility corridor consisting of coal conveyor, natural gas pipeline, transmission tower, road, intake pipeline, outfall pipeline. It is proposed to level the onshore area to +7.0 m CD as part of project implementation

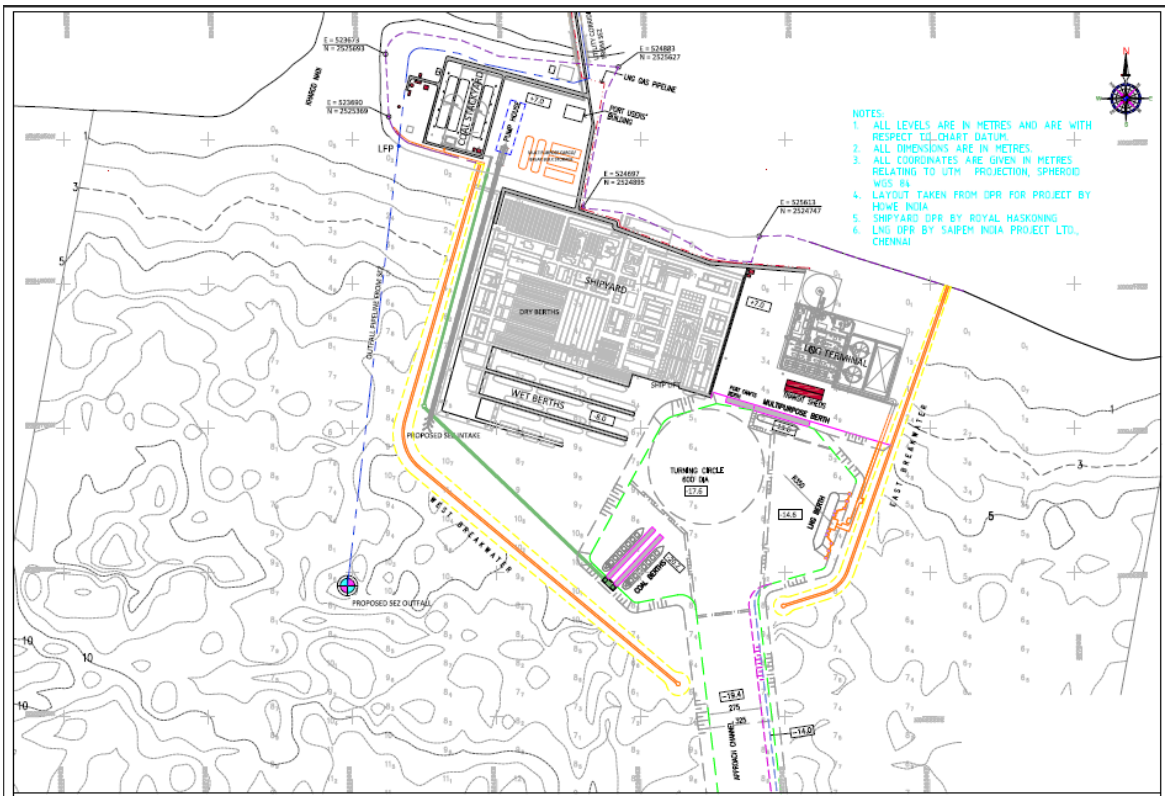


Figure 3: Facilities Layout

2.3 Project Facilities in Onshore Area

The onshore area is located south of the Nana Layja Village on the eastern bank of the Kharod River. The rectangular shaped area is confined by a beach facing the sea coast on the south and a creek on the north. A google image showing the onshore area is shown in **Figure 4.**

Figure 4: Google image showing the onshore area

The major facilities that are proposed in onshore area as part of SEZ project are shown in **Figure 5 and they include;**

1. Intake & pipeline
2. Outfall Pipeline
3. Intake pump house
4. Utility corridor consisting of coal conveyor, natural gas pipeline, transmission tower, road, intake pipeline, outfall pipeline

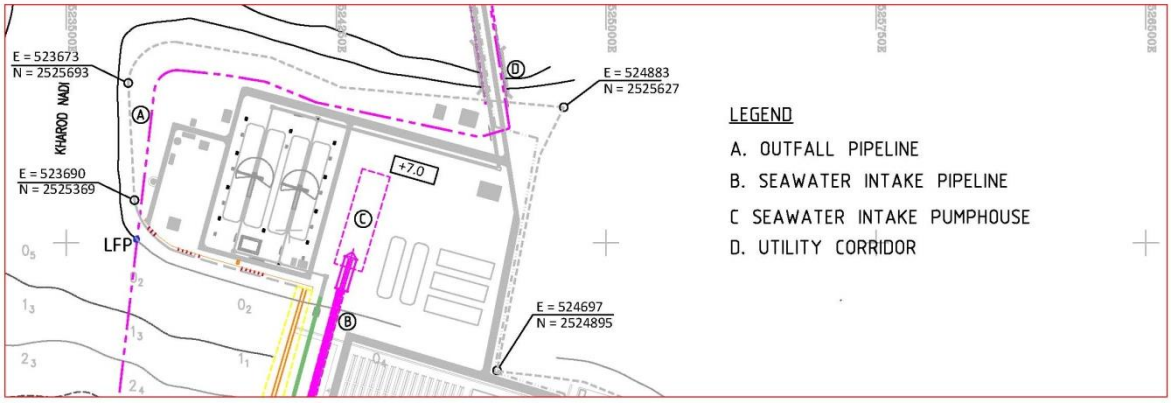


Figure 5: SEZ Facilities in onshore area

The major facilities that are proposed in onshore area as part of Shipyard cum captive jetties project are shown in **Figure 6 and they include;**

1. Coal stockyard and associated conveyor gallery up to utility corridor
2. Storage area for general cargoes / break bulk cargoes
3. Common user building and associated facilities
4. Natural gas pipeline

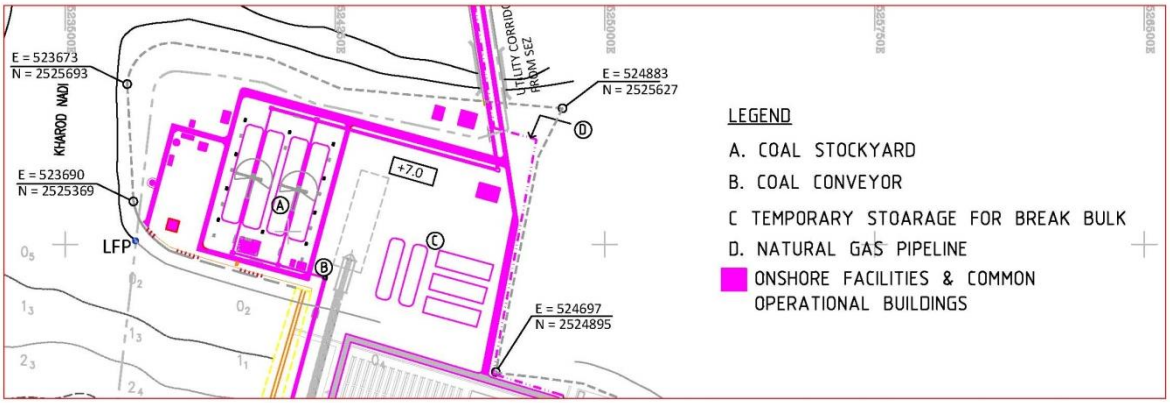


Figure 6: Shipyard cum Captive Jetties Facilities in Onshore Area

3. Onshore Area Environment

3.1 General description of Kutch coast

The total coastline of the Gulf of Kutch is 550 km out of which 250 m belongs to northern part of Gulf of Kutch. There are 14 coastal talukas surrounding the Gulf of Kachchh, out of which Kutch district has 7 Talukas namely Abdasa-Naliya, Anjar, Bhachau, Gandhidham, Lakhpat, Mandvi, Mundra.

Figure 7: Kutch Coast

Due to its semi-arid nature, annual rainfall in Kutch coast is poor ranging from 250-350 mm which is often irregular. Mean rainfall (1932 to 2001) was highest at Mundra (407 mm) and Mandvirecorded a mean rainfall of 387 for this period. Rain during monsoon is confined to only 15-20 days and occurs as an instant downpour. Freshwater input into the near coastal waters is quite meager and appears to have least influence on the ambient coastal water quality except during the monsoon months when flash floods are discharged in the near coastal waters.

As a characteristic of arid zone, Winter and summer temperatures range from 4 - 48^{o}C with a yearly average humidity of 60% which increases to 80% during south-west monsoon and decreases to 50% during November-December. Average wind speed is 4.65 m/s with a maximum wind speed of 10.61 m/s in June. Phenomenon of drought is common with 2 drought years in a cycle of 5 years.

Tides in the Kutch coast are mixed, predominantly semidiurnal type with MHWS of 3.5 m (Okha) to 7.2 m (Navlakhi). The phase difference is not uniform for successive tides in the Gulf and it varies as per tidal condition ([1]ICMAM, 2002).

As per the IS: 1893 (Part 1) 2002 of Bureau of Indian Standards (BIS), the project site and study area fall in Earth Quake Zone V and is categorised as a very high risk zone.

Coastal environmental setting of the northern coast of GoK differs significantly from the southern coast in terms of climatological factors like aridity, coastal geomorphology and ecosystems.

The coastal area comprises of an interesting assemblage of palaeo and neo coastal landforms which include spits, beaches, bars, creeks, beach ridges, swales, raised mudflats, saline flats, non-saline flats, stabilized and active dunes, chennier ridge / chennier plain, mangrove swamps, tidal channels, tidal flats, etc.

Mudflats, mangroves, sand dunes and sandy beaches are the larger ecosystems in the Kutch coast along with other diverse habitats such as sandy shores and a network of creek systems. Coastal sandy stretches/ dunes are spread in the northern part of the Kutch coast from Jakhau to Rawalpir covering Pingleshwar, Khuada, Chhachhi, LayzaNana, MandviPalace, Mandvi (**Figure.8**)

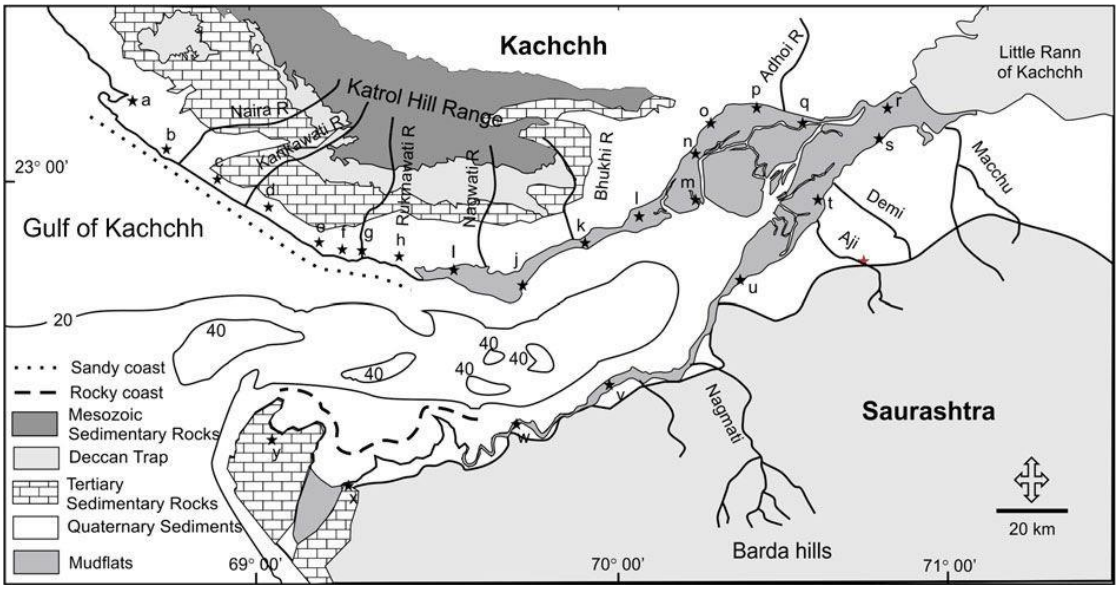


Figure 8. Map showing geological/geomorphic set up along the GoK coast

(a) Jakhau, (b) Pingleshwar,(c) Khuada,(d) Chhachhi,(e) LayzaNana, (f)MandviPalace,(g)Mandvi,(h)RawalPir,(i)Navinal,(j)Mundra,(k)Bhadreshwar,(l)JogniMata,(m)Kandla,(n)Gandhidham,(o)Chirai,(p)Bhachau,(q)Samakhyali,(r)SurajbariA,(s)SurajbariB,(t)Navlakhi,(u)Jodiya,(v)Bedi,(w)Vadinar,(x)Pindaraand(y)Okha)([2]Prizomwala*et al.*, 2014).

[1]ICMAM, 2002, Critical Habitat Information System for Gulf of Kachch, Gulf of Khambhat, Malvan, Karwar Is., Kadamat Is., Cochin Is., Gulf of Mannar, Pichavaram, Coringa, Gahirmatha.

[2]S P Prizomwala,NileshBhatt, and N Basavaiah (2014) Understanding the sediment routing system along the Gulf of Kachchhcoast, western India: Significance of small ephemeral rivers, *J.Earth Syst.Sci.*123,No.1, pp.121–133

3.2 Onshore Project Area

3.2.1 Description

3.2.1.1 General

The project onshore area is about 79 Ha (N Latitude 22° 50′ 27.61″ & 22°50′ 21.80″ and E Longitude 69°14′36.11″ & E69°14′29.40″) is located south of the Nana Layja Village on the eastern bank of the Kharod River. The rectangular shaped area is confined by a beach facing the sea coast on the south and a creek on the north. The area is easily accessible from the north almost throughout the day, except for 2-3 hours of peak high tide, when there is 2-3 ft water in the creek.

The eastern and northern sides are fenced by barbed wires. It is about 15 km west of the coastal town of Mandvi. Nana Layja is an open coast characterized by sandy beaches and sand dunes. Mudflats and mangroves, which are prominent habitats in other parts of Kutch coast are absent in the Nana Layja coastal stretch due to its open and sandy nature. Intertidal width at the coastal belt adjoining the onshore area is about 200 m and has few sandy coastal fauna. Sand dunes starts from HTL and extend almost up to creek with a belt of *Prosopis* thickets.

The google image showing the onshore area is given as **Figure 8**a.

Figure 8a: Google Image showing onshore area

The villages near by project onshore area are Nana Layja about 1.8 km and Kathada about 3 km away. Nana Layja village has a population of 960 with 197 households. Kathada has a population of 2848 with 572 households.

3.2.1.2 Land use / Land cover

As per revenue record, the onshore area belongs to survey no. 192/18 and the land use has been re-classified for Industrial use with effect from Dec 2010. The 7/ 12 revenue record is attached as **Annexure 1.**

The land cover map prepared in and around the project area, based on the supervised classification of LISS IV (November 2014) is given in **Figure 9** and the area analysis of land cover is given in **Table 2**

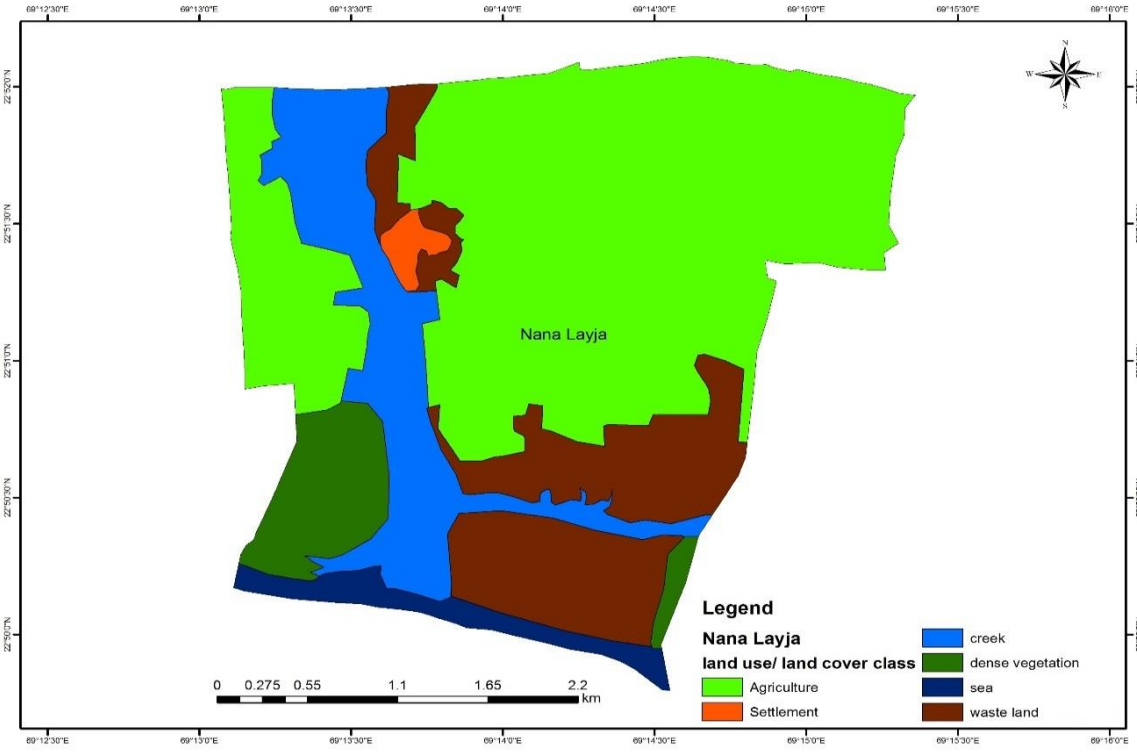


Figure 9: Land cover classification map in and around the project area

Table 2: Land Cover Statistics

Si. No.	Class	Area (ha)	Percentage %
1	Creek	165.58	14.6
2	Agriculture	642.80	56.8
3	Dense vegetation	72.88	6.4
4	Waste Land	202.74	17.9
5	Settlement	10.77	1.0
6	Sea	36.14	3.2

3.2.1.3 Onshore area pictures

Recent photographs of the onshore area are shown below from **Exhibit 1**to **Exhibit 6**:

Exhibit 1: Northern boundary adjacent to Nana Layja Creek

Exhibit 2: Eastern Boundary (Fence)

Exhibit 3: Southern side facing beach and the sea

Exhibit 4: View from East

Exhibit 5: Central part

Exhibit 6: Central part from South

3.2.2 Drainage and Floods

It may be noticed that no major drains are passing across the project area. Rivers that could drain the study area (within 15 km from Project site) are the KharodNadi and VengdiNadi along with other small streams. Most of these streams are ephemeral in nature and water flows for only about two months in them in a good rainfall year.

The flood in river Vengadi doesn't affect the project area as it is far away.

3.2.3 Storm Surges and Tsunami

3.2.3.1 Storm surge

Storm surge is caused primarily by the strong winds in a hurricane or tropical storm. In general, storm surge occurs where winds are blowing onshore. The highest surge tends to occur near the "radius of maximum winds," or where the strongest winds of the hurricane occur.

The proponent have carried out various mathematical model study for the Project by engaging COWI as part of which COWI have carried out a cyclone wave hind cast study to simulate the extreme waves off Nana Layja Coast, during the passage of the cyclonic storms that have occurred in Arabian Sea, using an in house Arabian Sea

wave model. COWI's Arabian Sea model has been used for several studies along the west Coast of India, Gulf of Oman and the Arabian Gulf.

Storm data were used to determine the extreme current conditions and surge heights near the Nana Layja coast. The storms for various return periods (1/10, 1/50 and 1/100 year) were selected based on the extreme value wind and wave analysis The wind speed and sea level pressure data along the storm track was obtained from various sources such as IMD, GTECCA and JTWC and provided to generate an artificial wind and pressure field using MIKE CYWIND tool of MIKE Zero. These wind and pressure fields of the three storm events corresponding to 1/10, 1/50 and 1/100 year return periods were used as an input to the model, to simulate the surge currents. It is seen that the maximum surge current speed for 1/10 year storm varies between 0.4 to 0.5 m/s, in the range of 0.5 to 0.7 m/s for the 1/50 year storm. Similarly, the maximum surge currents for the 1/100 year storm are in the range of 0.7 to 0.9m/s.

For the determination of surge height, in addition to the simulations with wind and barometric pressure forcing, simulations were also carried out with pure tidal and combined wind forcing and tidal forcing. The surge heights during these three storm events were determined from the difference in height between the tide generated height and combined effect of tide and wind generated height.

COWI used the results of these simulations were also used to assess the extreme surge levels along the two breakwaters of the proposed layout. COWI arrived at simulated surge values as 0.8, 1.6 and 2.2m for the 1 in 10, 1 in 50 and 1in 100 year storms respectively.

In reality, storm surge only makes up a part of what causes water levels to rise along the coast during a hurricane. The others are tides & waves. Considering Hs predicted inside the harbour by COWI, for the NL Project site, the extreme water level (w.r to CD) is calculated as;

Calculation of extreme water level;

MHWS	4.10 m
Wave crest height (0.7 x 2.7)	1.89 m
Storm surge	1.60 m
Total	**7. 59 m CD**

Thus the extreme water is calculated as +7.59 m CD and considering allowance for any other fresh water input / local rise in water level, reclamation fill level of + 8.0 m CD shall be preferred for the project

3.2.3.2 Tsunami

Tsunami struck Kutch district, five times in 700 years. According to the available historical records, the state witnessed first tsunami in 1333. Thereafter, the natural calamity struck in 1534 (where major part of the Kutch district was left as muddy wasteland) and again struck the Kutch's coastal region in 1819, 1893 and 1945.

3.3 Geomorphology

3.3.1 Status of Shoreline

The status of shoreline change due to erosion/accretion along Kutch district has been studied by Institute of Ocean Management, Anna University as part of National Assessment of Shoreline Changes of Gujarat coast. The shoreline status of the study area is shown in**Figure 10**. As shown in the figure, the project site is falling within the stable coast. The shoreline between the Kharod river confluence point and existing Mandvi port is stable. Low erosion is observed towards western side of Kharod river mouth.

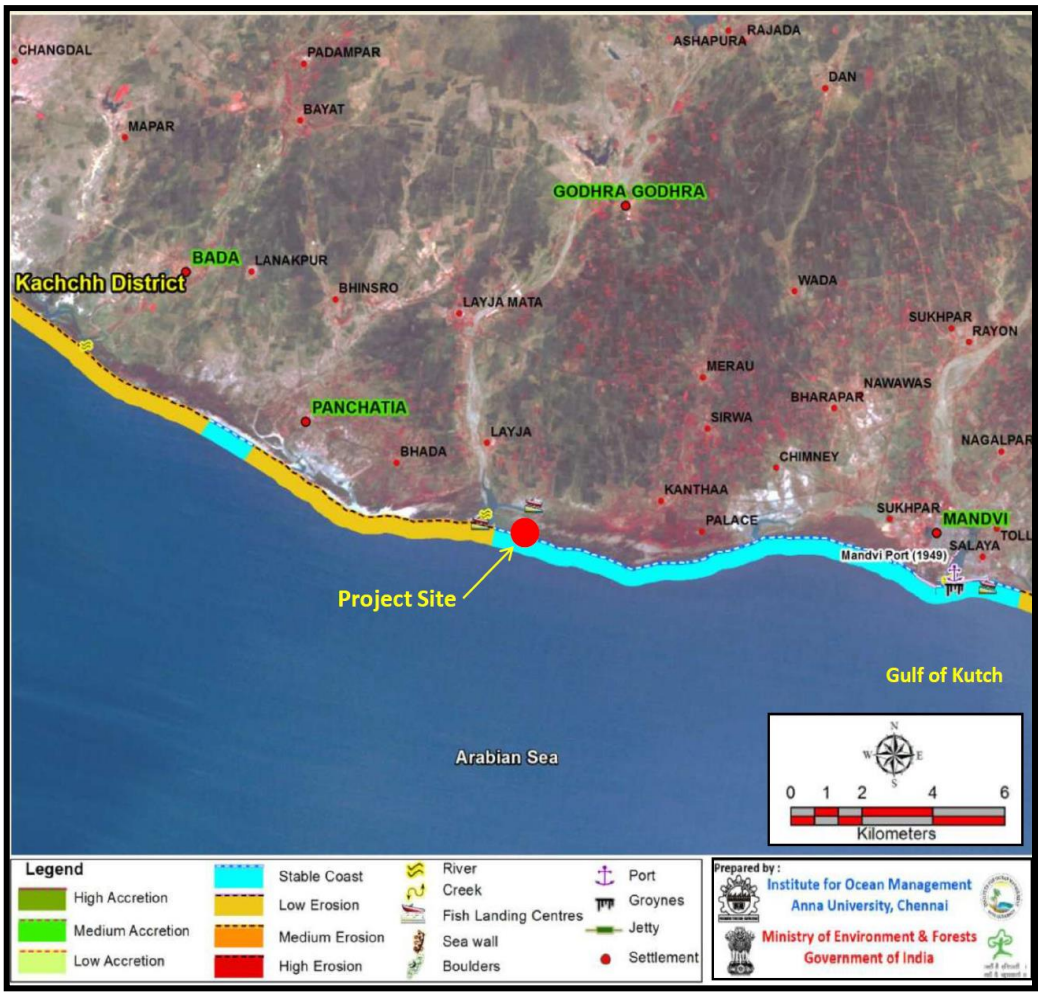


Figure 10: Status of Existing Shoreline in Study Area

3.3.2 Dune morphology and shoreline changes

In the proposed project development site, the coastline is straight, having sandy landforms like beaches, berm plain and mostly stabilized coastal dunes (Shukla et al .,2013[3]). The sediment is dominated by quartz, feldspars and magnetic minerals (Prizomwala*et al*.2013)[4].

Kharod River flows from north to south to confluence in the Gulf of Kutch on western part of the study area. Kharod is an ephemeral river originating from the central Kutch in the Katrol hill range. The river flows about 40 km to confluence in the Gulf of Kutch

[3] Shashi B. Shukla, Vikas M. Chowksey, Siddharth P. Prizomwala, Vishal M. Ukey, Nilesh P. Bhatt, and Deepak M. Maurya, 2013 Internal Sedimentary Architecture and Coastal Dynamics as Revealed by Ground Penetrating Radar, Kachchh coast, Western India, *ActaGeophysica*, vol. 61, no. 5, Oct. 2013, pp. 1196-1210.

[4]Prizomwala, S.P., S.B. Shukla, N. Basavaiah, and N. Bhatt (2013), Provenance discrimination studies on sediments of SW Kachchh coast, western India: In Insights from heavy mineral and mineral magnetic analysis, *J. Coastal Res*. **29**, 1, 52-60

west of Mandvi. The total catchment area of the river is around 356 sq km. The uplands of the river have sedimentary rock outcrops, mostly comprising of sandstone and shales of Mesozoic era. The middle reaches have Deccan Trap Formations of Cretaceous overlain by Tertiary sedimentary rocks.

The Kharodriver flows through pre- Quaternary rocks except in the vicinity of the coast where it flows through alluvial deposits for a few kilometres, forming a narrow estuarine mouth before confluence. **The coast of Mandvi region around Kharodriverhas mostly stabilized dunes.**

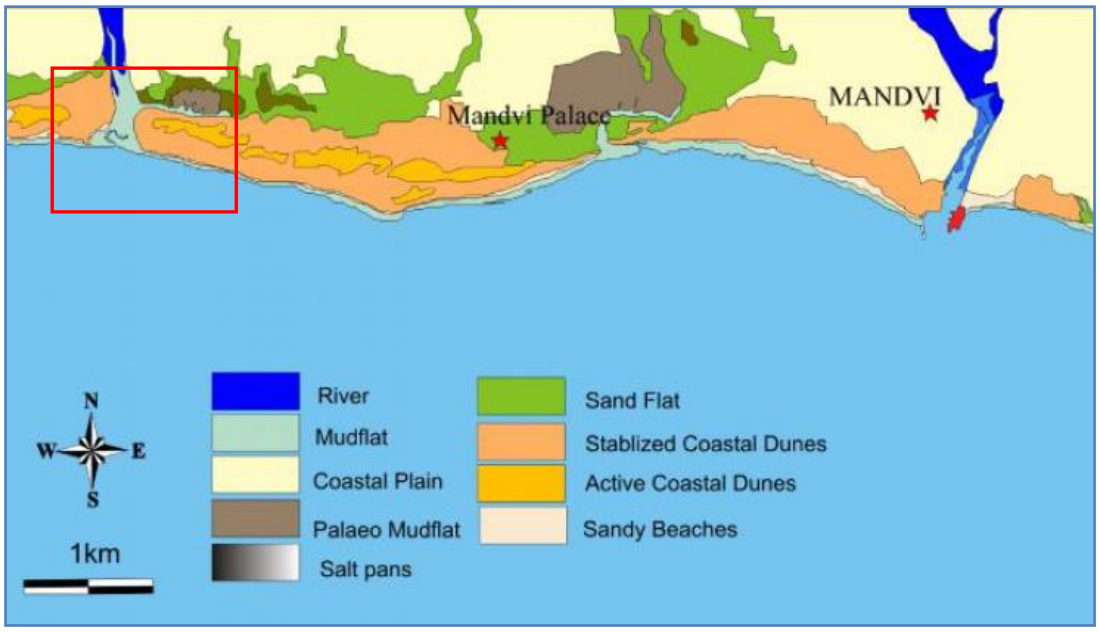


Figure 11: Geomorphic map showing coastal formations

The estuarine mouth of the river is about half a km wide, however long spits occupy almost 400 m of it, leaving only 100 m for the tidal inlets. During monsoon the river inflows erode the spits widening the mouth of the river. Growth and erosion of the spit are the annual - cyclic processes which depend on post monsoon accretion by long shore currents and erosion by monsoonal inflow. A creek on the northern side of the onshore project area meets the river at almost 90° angle.

The sheltered estuarine zone and the creek on the west &north of the dune are having mudflats / tidal influenced area and paleomud flats (**Figure 11**). The northern boundary of the coastal zone is having sand flats. (Shukla et.al. 2013)

The on shore area is categorized as mostly **stabilized with a smaller area of active zone in the central part** as per the DPR study of [8]Shukla et.al. (2013).

The present investigation also confirms the earlier studies on observation of the morphometrics of the dune. However, the superficial layer of the dune is loose and can be reworked by wind.

Satellite data for the period 1998-2011 (Figure 12) suggests no major change in the dune morphology, conforming stability though shore on the mouth of the river-sea complex shows minor seasonal changes like built up of spit, which starts in the post monsoon and continues up to the pre-monsoon and its erosion in the monsoon. This phenomenon suggests domination of sea process in the post monsoon to pre-monsoon period and revival of river-flow during the monsoon, leading to erosion of the spit.

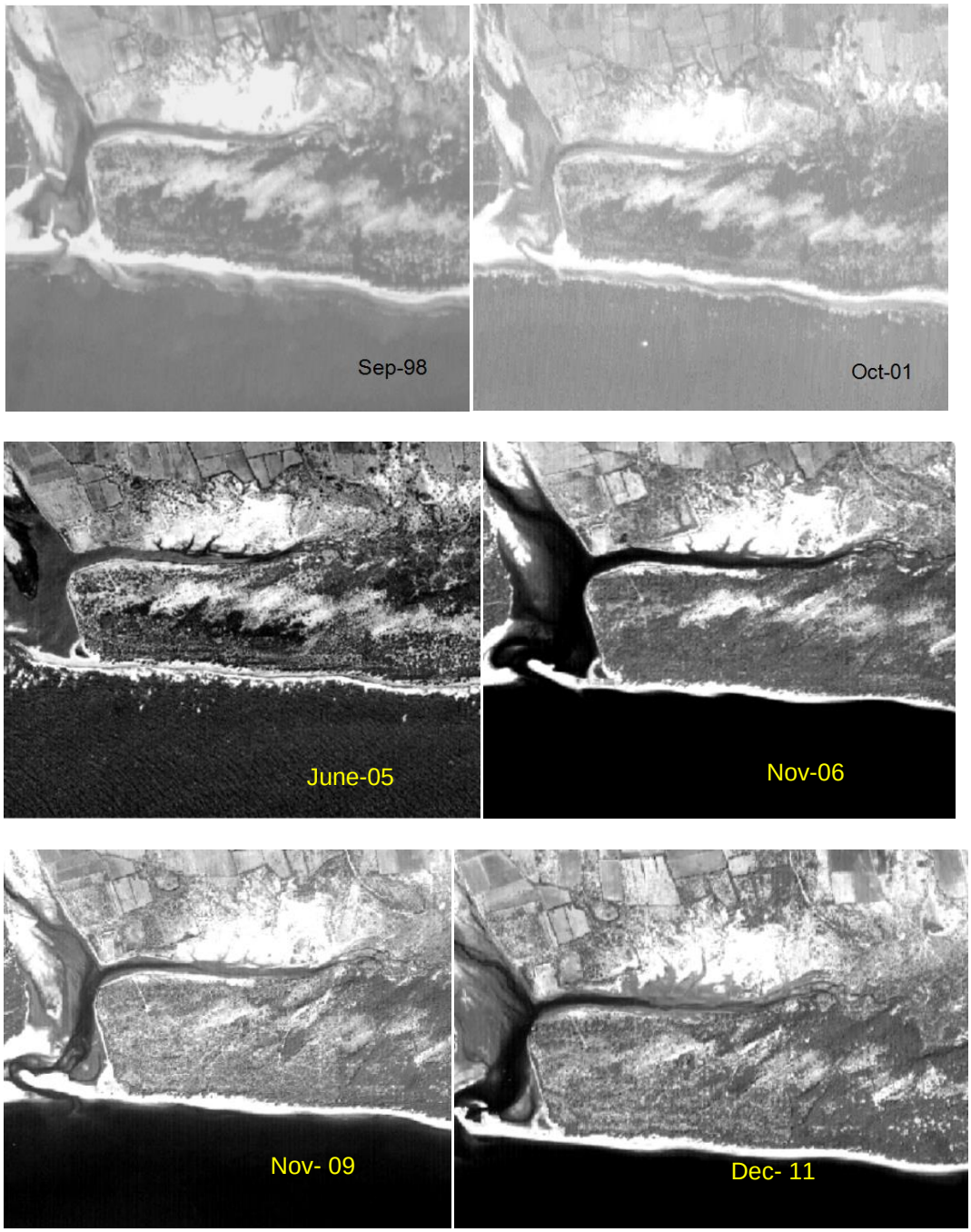
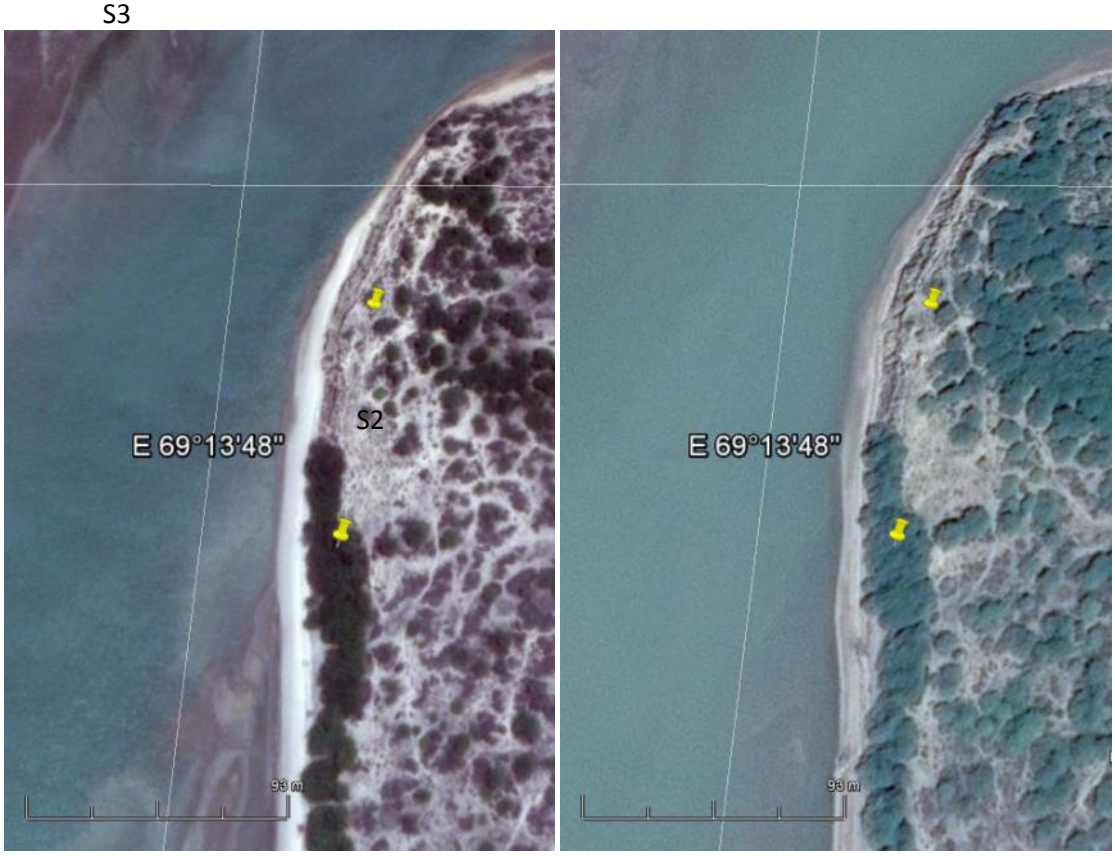


Figure 12: Satellite images of the project onshore area (1998-2011)

High resolution Google Earth images (2011 & 2013) were compared for the onshore area (west side) adjacent to Kharod river, and it is observed that no erosion has occured on cliff facing the Kharodriver(**Figure 13)**.



March 2011 **Sept 2013**

Figure 13: River side / Western side section of onshore area

The study area shows typical cliffing (scarping) of the seaward margins of the coastal dunes and the absence of new fore dunes (or the formation of new fore dunes lasting at most a few years). This is very widespread phenomenon around the world's coastline. Undercut by wave action, dune cliffs recede with sand collapsing on to the beach or into the sea, to be carried away offshore or alongshore.

Dune cliffs may stand vertical if the sand is moist and coherent, but as it dries, it falls to a basal apron that grows (if it is not swept away by waves or wind) as the cliff recedes, until it becomes a slope at the angle of rest of dry dune sand (about 32^0).

3.4 Topography

3.4.1 Survey (2011)

Topography survey of onshore area was carried out by DBM in Feb 2011, survey results is shown in **Figure 14**. Area is characterized by undulated sandy terrain with

ground levels varying from +2.4 m to +17.4 m. In the western side, ground levels are varying from +2.4 m to +10.4 m with average ground level of +6.4 m. Levels in the middle portion vary from +2.4 m to +10.4 m with average ground level of about +7.4 m. Eastern side has ground levels varying from +2.4 m to +17.4 m.

It may be noted that all above levels are with respect to MSL.

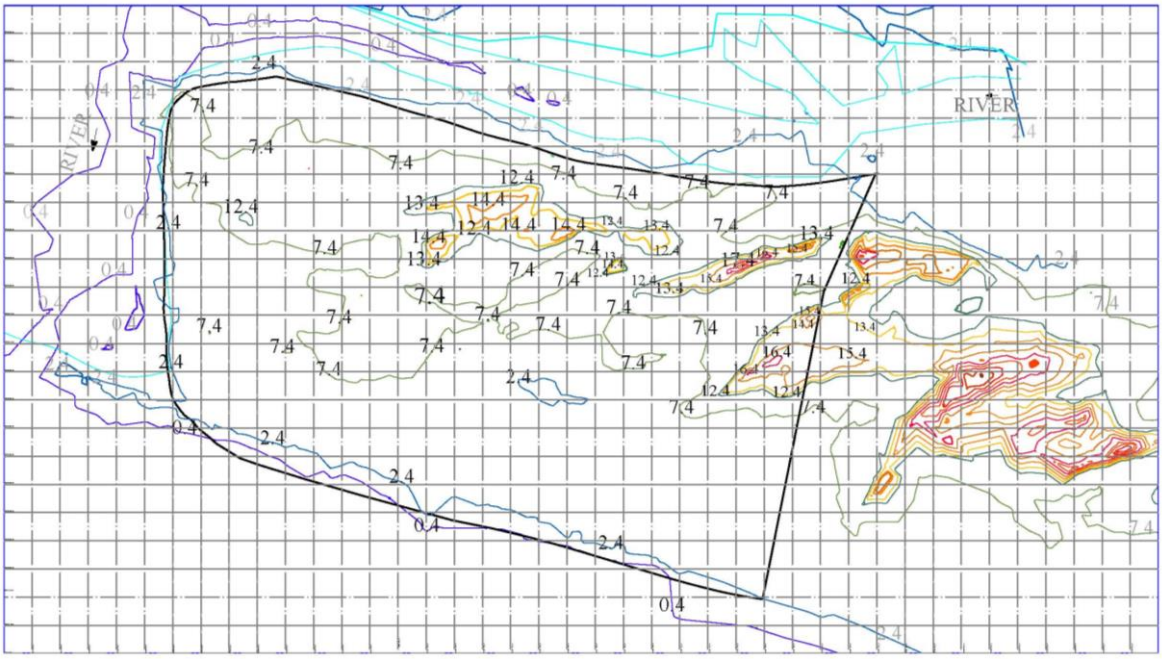


Figure 14: Site Topography

3.4.2 Topographic Observations (Present study)

Topographic levels were studied based on field observation supported by past literature, remote-sensing data, creating topographical profile (using GEOCONTEXT-GIS software) and creating DEM profile (using Zonmus tool).

Contour map was prepared for an area of 4 sq km area, covering the study area and surrounding region covering A, B, C and D boundaries (**Figure 15**). To get the altitudinal relation with the surrounding, a larger area was taken for the contour mapping.

Figure 15: Area (ABCD) selected to prepare the contour map and Data Elevation Model (DEM)

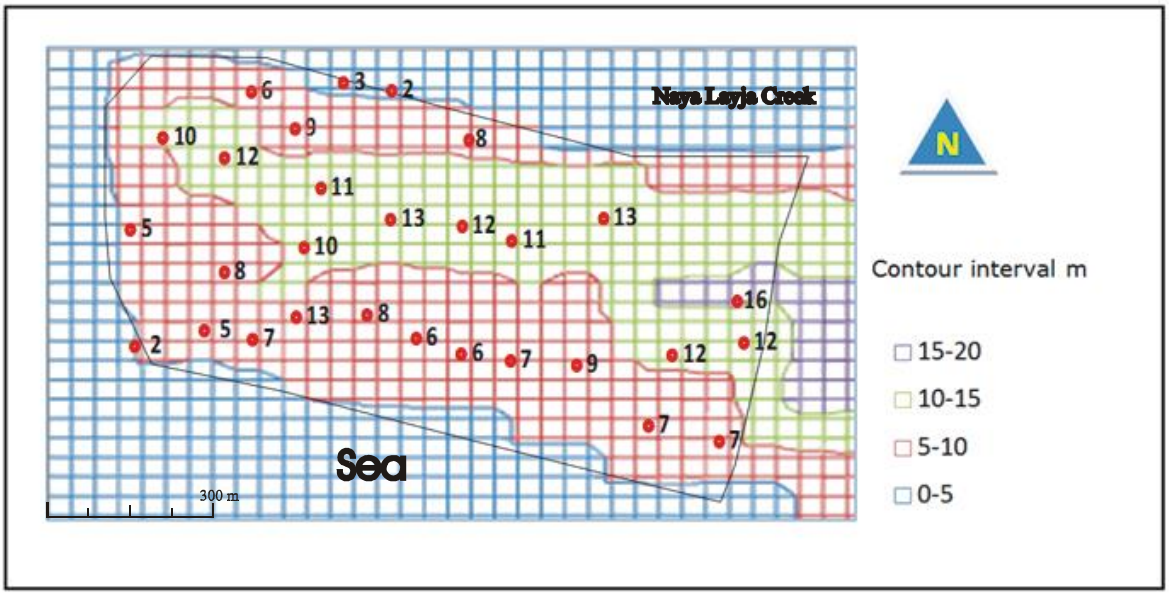


Figure 16: Contour map

This study indicates that the major part of the dune falls in 6-9 m above mean sea level (AMSL), (**Figure 16**). As major part of the dune falls in 6-9 m above sea level, higher undulation was seen between 10 to 13 m in the central part of the dune. The highest peak of the dune (falling in the study area) is on the eastern margin of the area, having a height of about 16 m.

3.4.3 Digital Elevation Model

Dune height was noted by physical measurements and with the help of GPS (GARMIN) wherever required. Digital elevation model prepared **(Figure 17)** from the satellite data indicates that the dune has relatively steeper cliffs on the southern and western sides.

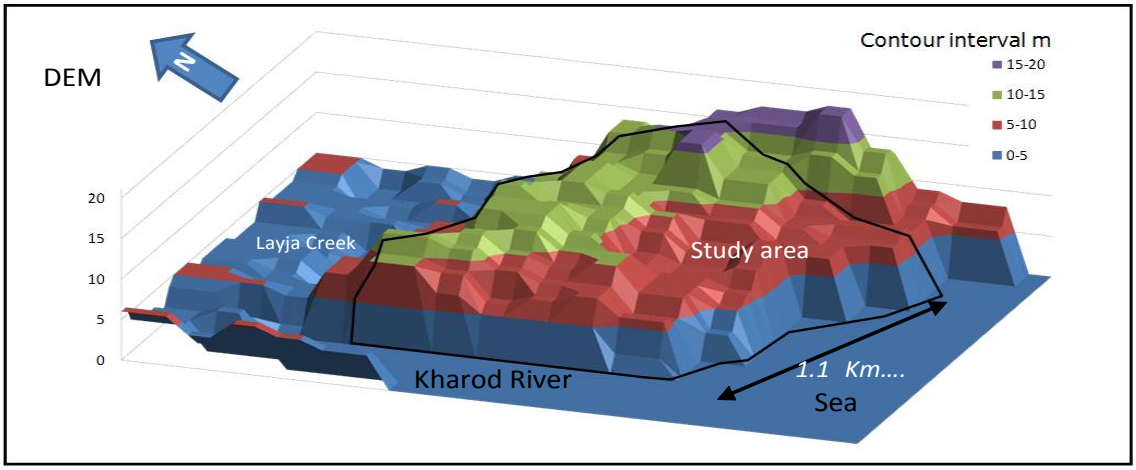


Figure 17: Digital Elevation Model (DEM)

Dune % by elevation

The onshore area levels and its extent of occurrence by percentage is:

0–10 m	= 66.0%
10 - 15 m	= 32.5%
Above 15 m	= 1.5%

Comparison of earlier onshore survey and the present study indicate that there is no change in elevation at various parts of the dune indicating stability.

3.4.4 Profiling

Six profile sections (three each North-South & West - East) were prepared to understand the slope factor of the area using Google earth software (**Figure** 18 to **Figure 21**). The elevations are with reference to AMSL.

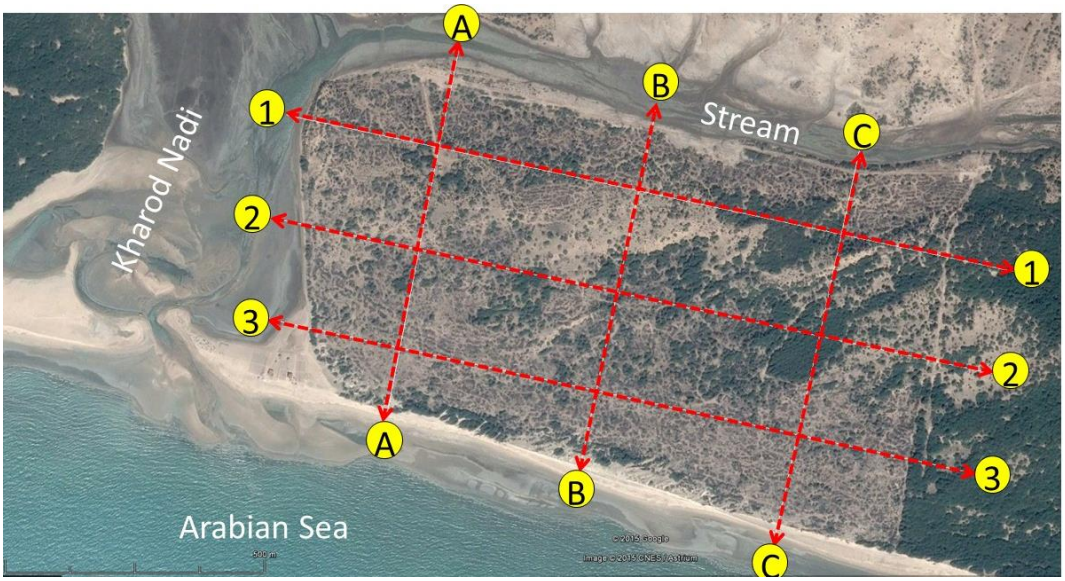


Figure 18: Delineation of onshore area profiles

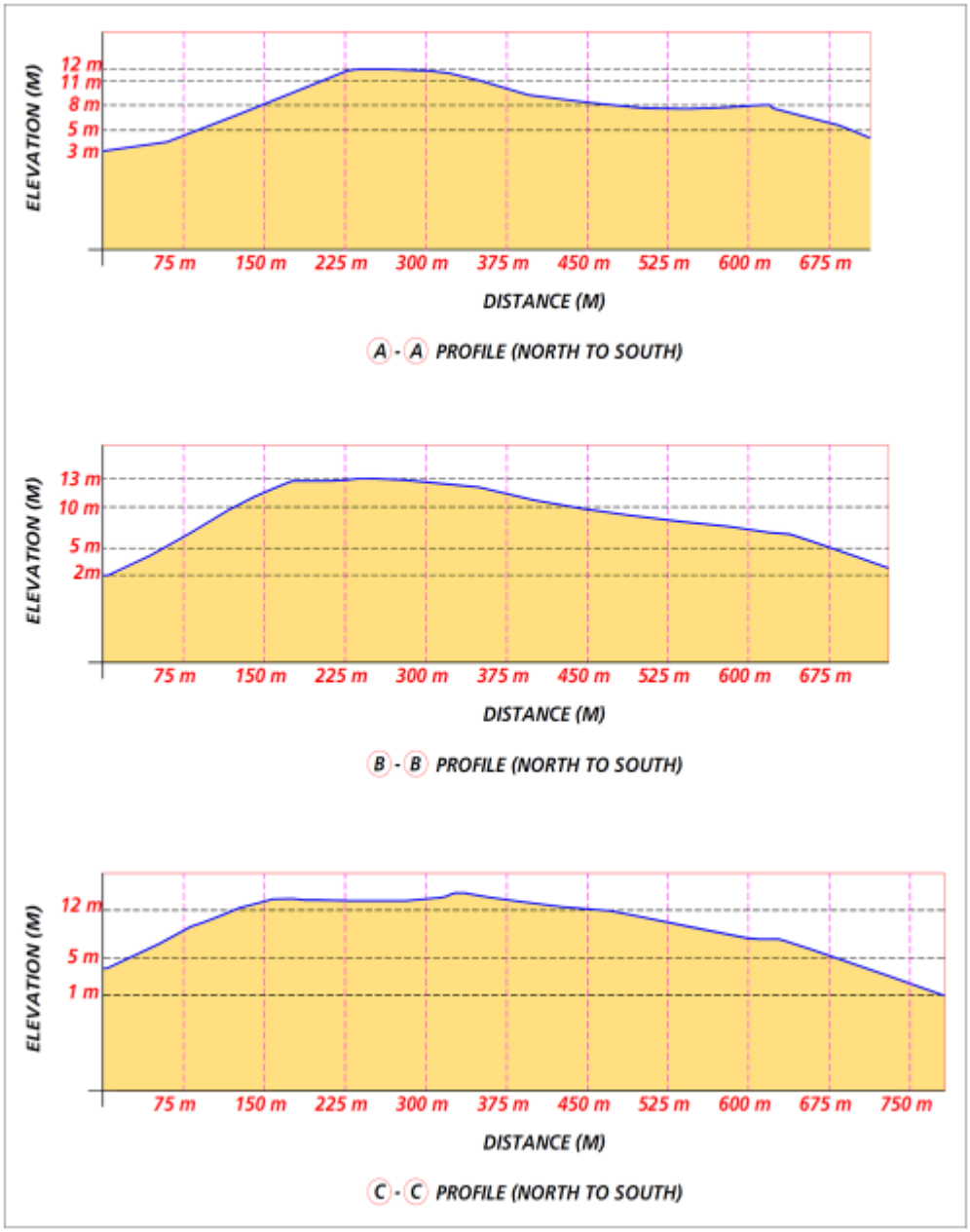


Figure 19: North South profiles

The north south profiles depict a steeper central part and the dune slope gets gentler on the west (near the mouth of the river).

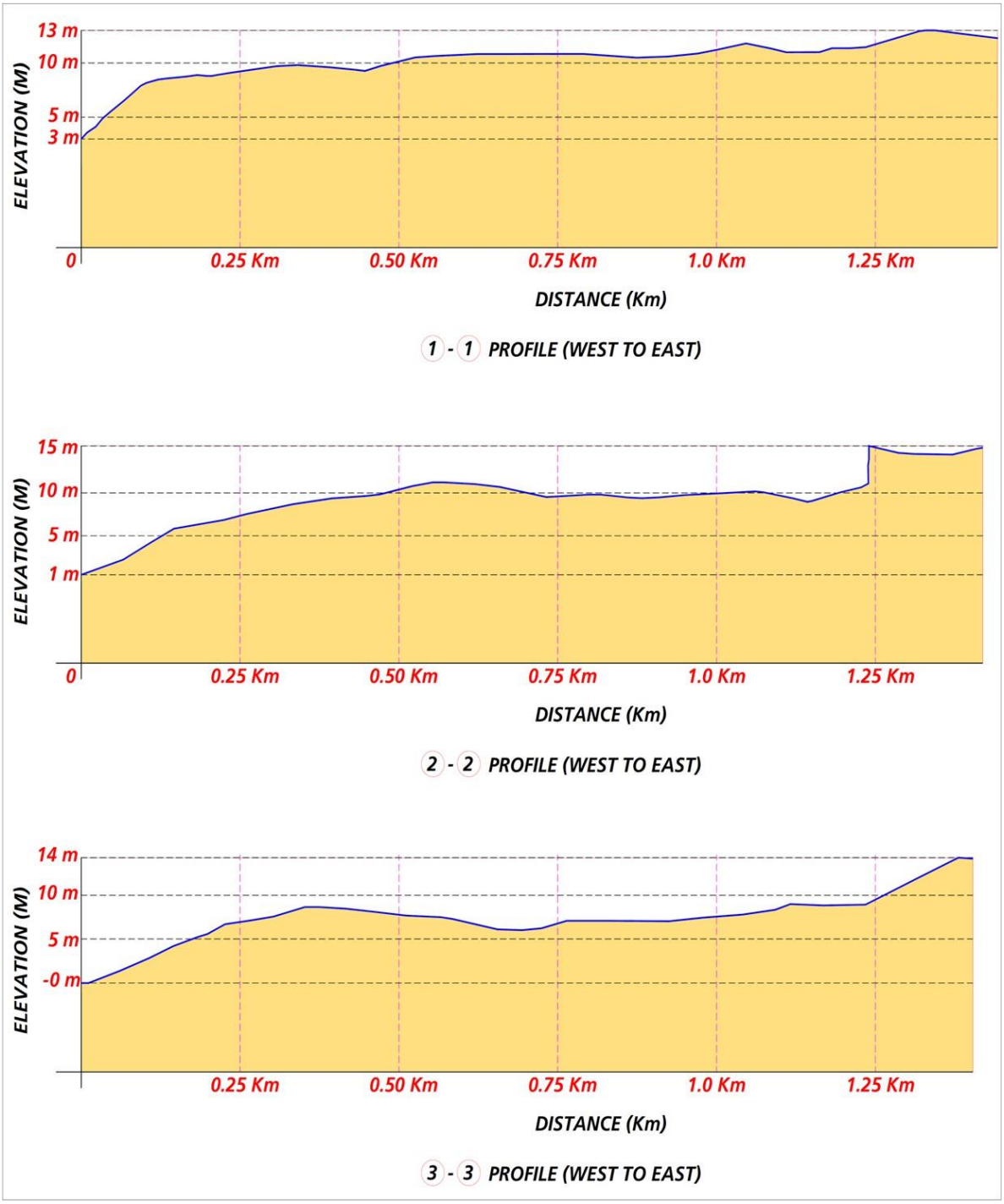


Figure 20: West East profiles

East- west profiles indicate that the northern part of the dune is a cliff facing the Khorad river (in west), and it becomes smaller towards south. The three northern sides, central and southern profiles indicate that higher portion is on the east, including the highest elevation point of the study area. In general, the west- east profiles reveal the presence of gentler slopes, as compared to the north- south profile of the dune.

West –East and North-South Profiles were created where the sand dune levels are high (**Figure 21).**

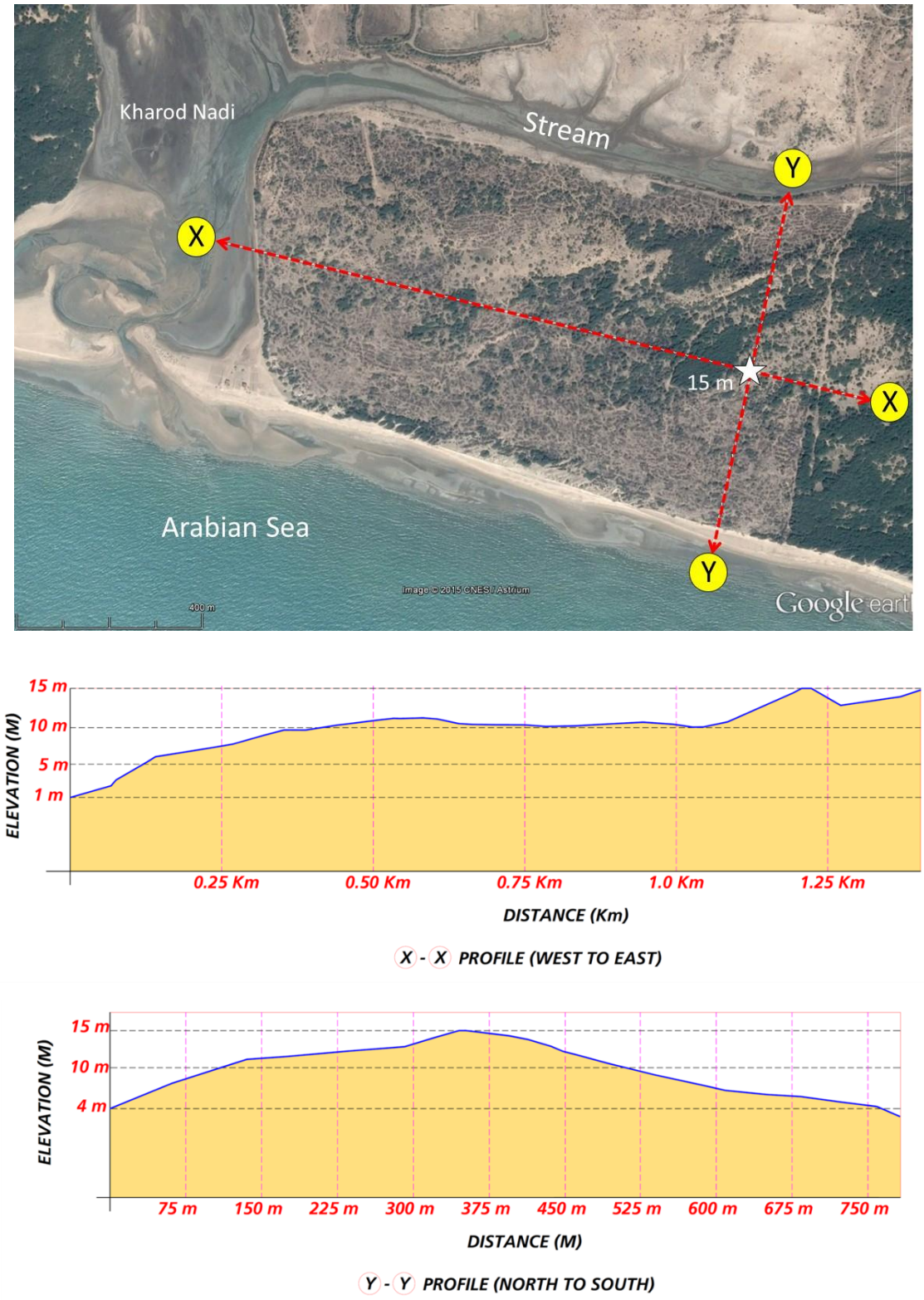


Figure 21: Profiles passing through high elevation area

It is inferred from the comparison of earlier Topographic survey (2011) and the recent profiles presented above, the site levels have not varied much. It indicates that the onshore sand dune area is not only stable in its extent but also with respect to its height / levels.

3.5 Geological aspects

3.5.1 Geological History of Study Area

GPR profile created (Shukla et.al. 2013[5]) **in the study area (Figure 22**and **Figure 23),** upto a depth of 6 meter, suggests presence of beach ridges, wash over, coastal dune and swale at various depths. Presence of the beach ridge system below 2-3 m depth is indicative of the low stand of sea just before the Middle Holocene. Wash over deposits show the high energy event in the past. **The presence of stabilized coastal dunes could be an imprint of high sea stand of the Middle Holocene time.**

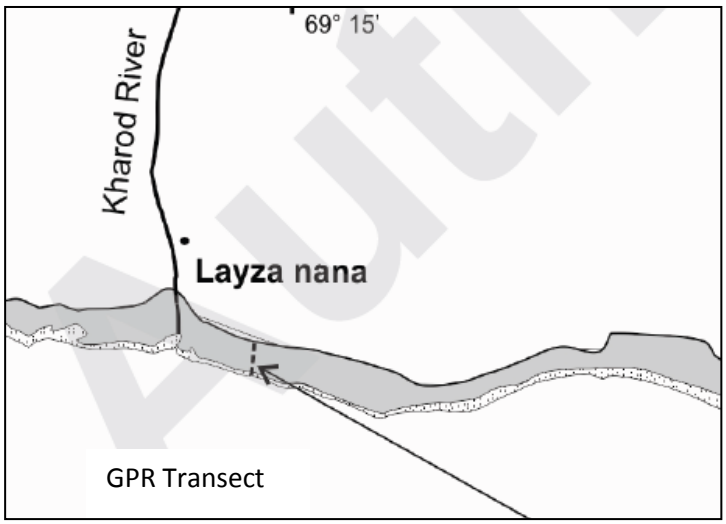


Figure 22: GPR Transect

[5]Shashi B. Shukla, Vikas M. Chowksey, Siddharth P. Prizomwala, Vishal M. Ukey, Nilesh P. Bhatt, and Deepak M. Maurya, 2013 Internal Sedimentary Architecture and Coastal Dynamics as Revealed by Ground Penetrating Radar, Kachchh coast, Western India, *ActaGeophysica*, vol. 61, no. 5, Oct. 2013, pp. 1196-1210.

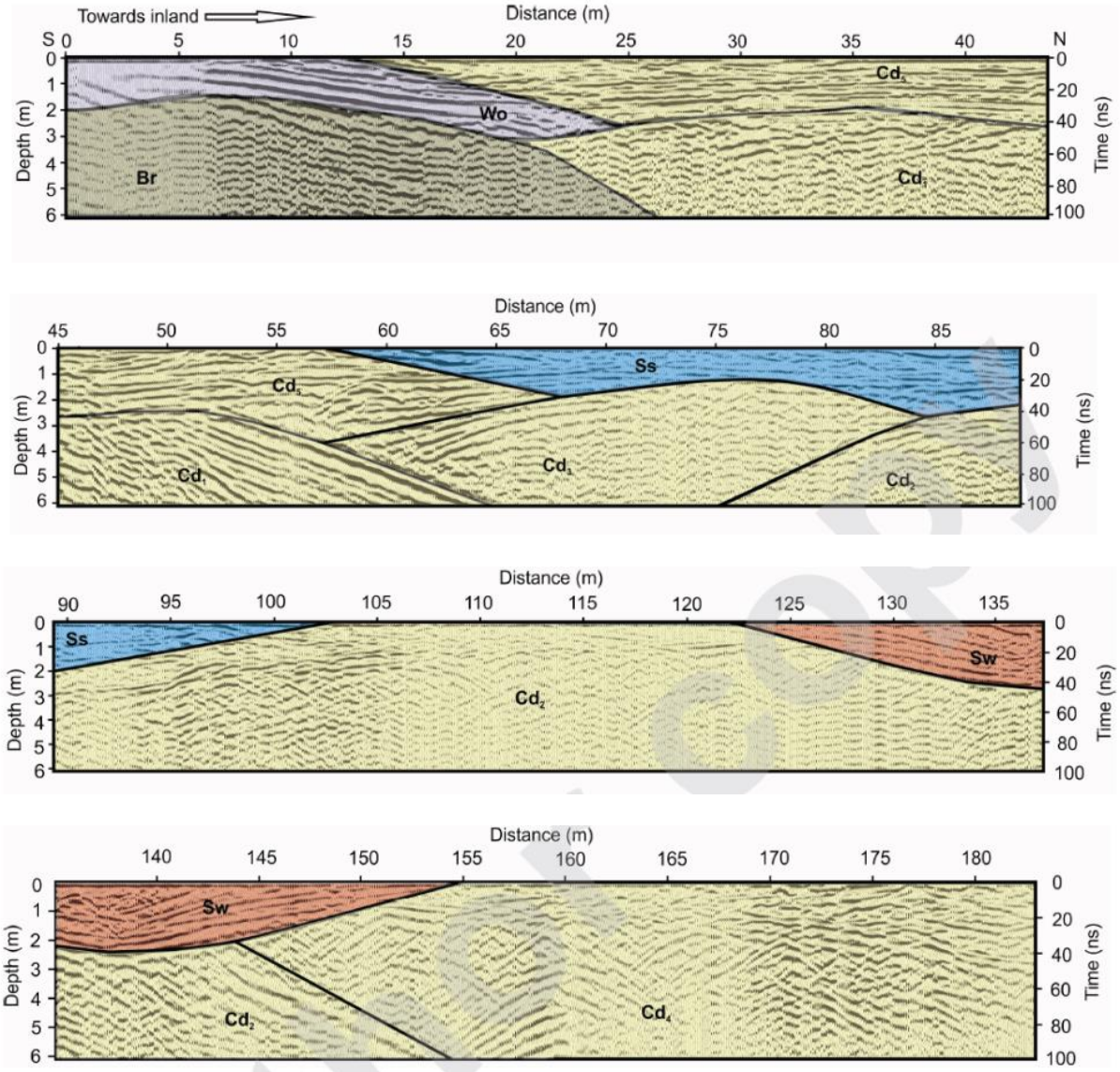


Figure 23: GPR profile of Beach-Dune Complex, Beach Ridge Facies (Br),wash over facies (Wo), coastal dune facies (Cd), sand sheet unit (Ss) and swale facies (Sw).

The data indicate rise in sea level after Middle Holocene (**Figure 24**) and it reached its peak in 4000 years before present (BP) with a high stand of 2-3 m above the present day mean sea level (Shukla et al 2013)[6]. High sea level led to intense inland dune building activity, which can be seen presently in the form of wide stabilized coastal dune field, about 1.25 km in width (in the project site dune Width is 0.5-0.6 km and length is about 1.1 km). The period also witnessed seasonal high energy events along the Kachchh coastline, documented in the form of wash over deposits and formation of

[6]Shashi B. Shukla, Vikas M. Chowksey, Siddharth P. Prizomwala, Vishal M. Ukey, Nilesh P. Bhatt, and Deepak M. Maurya, 2013 Internal Sedimentary Architecture and Coastal Dynamics as Revealed by Ground Penetrating Radar, Kachchh coast, Western India, *ActaGeophysica*, vol. 61, no. 5, Oct. 2013, pp. 1196-1210

swales in between the successive foreshore dunes. After reaching the peak in 4000 years, before present (BP), the relative sea level started to recede and since 2000 years BP, the present day coastal setup had been established.

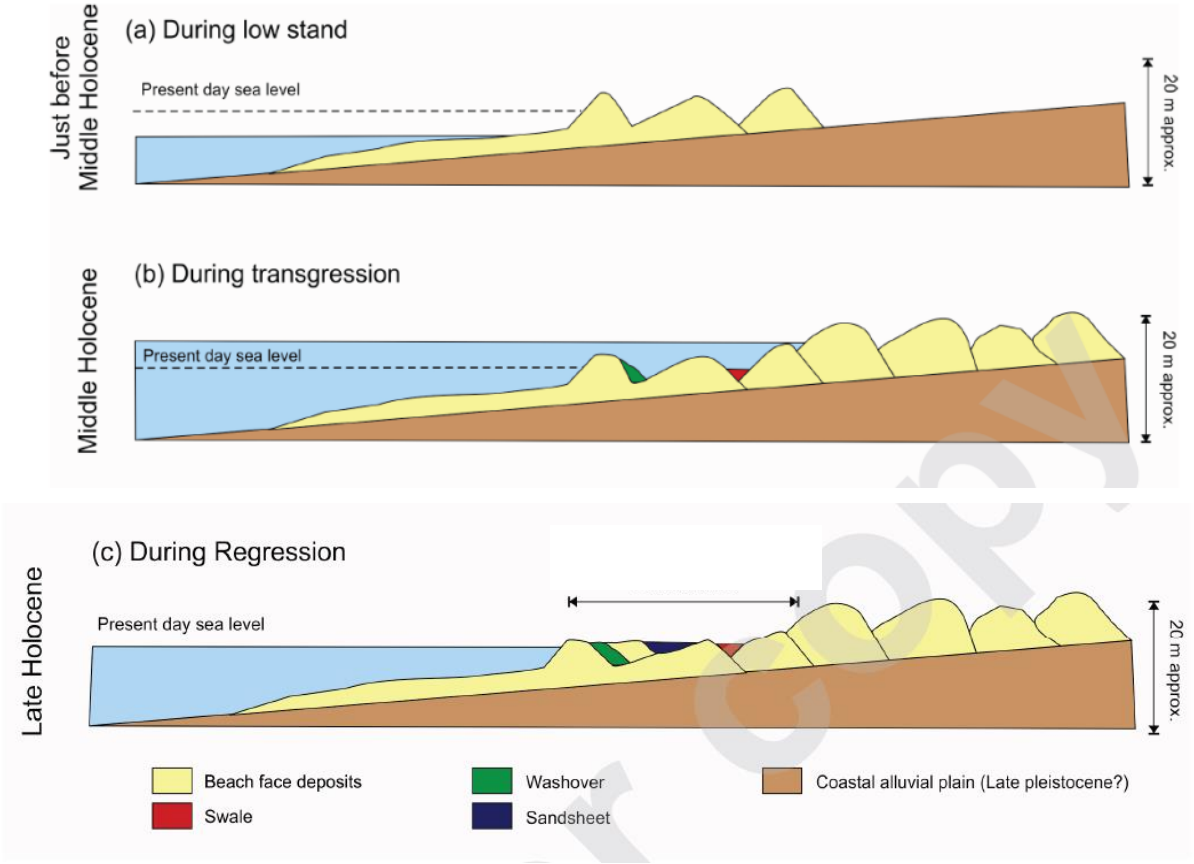


Figure 24: Schematic evolutionary model of the study area during the Holocene

3.5.2 Sediment /Soil

3.5.2.1 General

Sediments of the dunes consist of fine to very fine sand and silt and the sediment characters indicate windblown deposits. The sand shows poor compaction. Creek sediments consist of coarse sand, deposited by marine processes.

3.5.2.2 Sediment /Soil

A Total of 30 sediment/soil samples were taken for the analysis to assess the geomorphology, composition and stability of the dune (**Figure 25**).

Figure 25: Sampling locations for sediment/soil collection

3.5.2.2.1 Grain Size Analysis

Analysis was carried out following the method of Wentworth (1922)[7]; 11 sets of sieves (ASTM no. 10, 12, 18, 25, 35, 45, 60, 85, 120, 170, 230) and a pan was used to sieve the sediments for ½ phi grain size interval. The grain size classification is shown below in **Table 3**.

Table 3: Grain size classification

Category	Phi class	Size in mm/μm
Boulder	-12 to -8 phi	256 to 2048mm
Cobble	-8 to -6 phi	64 to 256 mm
Pebble	-6 to -2 phi	4 to 64 mm
Granular	-2 to -1 phi	2 to 4 mm
Very coarse grained sand	1 to 0.0 phi	1 to 2 mm
Coarse grained sand	0.0 to 1.0 phi	500 μm to 1 mm
Medium grained sand	1.0 to 2.0 phi	250 μm to 500 μm
Fine grained sand	2.0 to 3.0 phi	125 μm to 250 μm
Very fine grained sand	3.0 to 4.0 phi	63 μm to 125 μm
Coarse silt	4.0 to 5.0 phi	31 μm to 36 μm
Medium silt	5.0 to 6.0 phi	16 μm to 31 μm
Fine silt	6.0 to 7.0 phi	8 μm to 16 μm
Very fine silt	7.0 to 8.0 phi	4 μm to 8 μm
clay	8.0 phi and smaller	< 4 μm

Wentworth (1922)

[7] Wentworth CK. 1922. A scale of grade and class terms for clastic sediments.*Journal of Geology* **30**: 377–392.

Results were used to get the following for the statistical attributes.

- **Mean**: an arithmetic average of a series of values.
- **Median**: the value of the middle item in a set of data arranged in rank order. If the set of data has an even number of items, the median is the arithmetic mean of the middle two ranked items.
- **Mode**: the value or group of values that occurs with the greatest frequency in a set of data; the most typical observations.
- **Sorting**: based on inclusive graphic standard deviation
- **Skewness**: the quality, state, or condition of being distorted or lacking symmetry
- **Kurtosis**: the quality, state, of condition of peaks or flatness of the graphic representation of a statistical distribution.

The sediments of the upper layer of the study area were very loosely compacted, fine grained and sandy in nature. The sediments were finer near the root zone of trees, indicating some biogenic weathering of the material. Absence of calcite cement indicate that there is negligible or no cementation. Grain size of the samples analyzed are shown in **Table 4** and **Table 5**. Most of the samples are dominated by sand size particles ranging from coarse sand to very fine sand. Histograms of all the samples are given in **Annexure 2**.

The average/mean grain size of the sample is 2.2 phi (figure 26). The maximum mean is 2.7 (sample 5) whereas the lowest mean is 1.62 (sample 23). Average Mode class of the sediments is 2.158.The maximum Mode is 2.6 (sample 5) where lowest Mode is 1.5 (sample 23). The most dominating class is the fine sand because out of the 30 samples, 29 are dominated by fine grained category (having Median 2 and 2.5 phi) and only one sample is very fine grained (Median 3 phi).

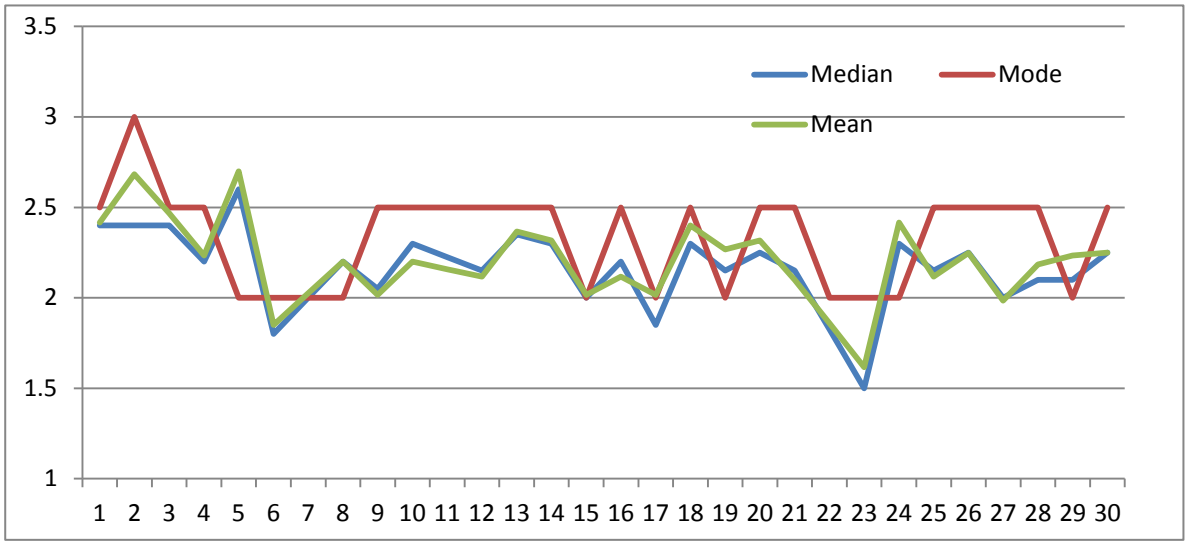


Figure 26: Mean, Mode and Median of the grain size analysis of the samples of the project onshore area

Table 4: Sample-wise grain size of the samples of the project onshore area

Phi interval	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
	% of weight retained														
-0.5	0.00	0.00	0.05	0.00	0.12	1.05	0.53	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
0	0.01	0.20	0.08	0.23	0.24	1.42	0.94	0.45	0.28	0.06	0.14	0.21	0.02	0.00	0.00
0.5	0.27	0.28	0.17	0.46	0.28	4.55	2.64	0.74	0.58	0.28	0.69	1.10	0.16	0.15	0.00
1	1.76	1.29	0.22	1.99	2.09	10.06	6.15	2.25	1.37	1.60	3.39	5.18	1.75	1.46	0.72
1.5	6.69	15.18	2.64	15.56	14.52	17.95	12.24	6.54	9.08	6.37	9.61	12.85	8.88	7.22	7.32
2	18.45	17.15	24.75	25.78	28.05	24.72	35.01	45.29	35.53	19.06	19.36	19.66	20.56	25.57	44.32
2.5	30.13	22.04	35.03	28.55	28.02	18.20	20.42	22.64	41.92	43.35	38.75	34.15	31.55	29.46	33.43
3	24.56	24.14	15.10	12.57	11.35	6.11	9.43	12.75	6.54	22.80	19.15	15.50	23.56	24.16	8.91
3.5	10.99	9.97	12.78	6.54	5.79	8.47	6.63	4.79	3.45	5.02	6.29	7.57	8.57	9.46	4.37
4	6.85	5.44	7.47	5.45	5.35	5.02	4.03	3.05	1.02	1.46	2.18	2.90	4.96	2.59	0.79
4.5	0.25	3.32	1.20	2.06	1.78	1.24	1.16	1.09	0.18	0.00	0.27	0.54	0.09	0.00	0.09
5	0.05	0.97	0.50	0.85	0.78	0.61	0.51	0.42	0.05	0.00	0.05	0.11	0.01	0.00	0.00
Mean	2.42	2.68	2.47	2.23	2.70	1.85	2.03	2.20	2.02	2.20	2.16	2.12	2.37	2.32	2.02
Median	2.4	2.4	2.4	2.2	2.6	1.8	2	2.2	2.05	2.3	2.225	2.15	2.35	2.3	2
Mode	2.5	3	2.5	2.5	2	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2
stddev	0.70	0.97	0.68	0.72	0.80	1.02	0.79	0.56	0.43	0.53	0.61	0.69	0.65	0.59	0.44
Skew	0.01	0.34	0.20	0.15	0.28	0.12	0.11	0.09	-0.05	-0.19	-0.11	-0.05	0.04	0.05	0.14
Class	near symmetrical	strongly fine	fine	fine	fine	fine	fine	near symmetrical	near symmetrical	coarse-skewed	coarse-skewed	near symmetrical	near symmetrical	near symmetrical	fine
Kurtosis	1.15	1.37	1.26	1.22	1.21	1.30	1.33	1.40	1.06	1.26	1.05	0.92	1.00	0.86	1.35
Class	leptokurtic	leptokurtic	leptokurtic	leptokurtic	leptokurtic	leptokurtic	leptokurtic	leptokurtic	mesokurtic	leptokurtic	mesokurtic	mesokurtic	mesokurtic	platykurtic	leptokurtic

Table 5: Sample-wise grain size of the samples of the project onshore area

Phi interval	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
	% of weight retained														
-0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	
0	0.19	0.00	0.01	0.00		0.11	0.06	0.00	0.00	0.16	0.01	0.60	0.07	0.00	0.03
0.5	1.27	0.00	0.13	0.00	0.16	1.05	0.52	0.00	0.06	1.45	0.56	0.83	0.67	0.06	0.62
1	4.52	2.67	1.53	1.66	1.75	5.84	3.31	0.78	1.79	6.87	1.77	1.84	1.85	1.79	1.52
1.5	13.83	13.14	7.69	12.46	8.88	12.98	9.65	6.32	5.45	13.95	8.99	9.25	9.23	5.45	7.20
2	20.49	34.57	18.17	30.46	20.56	20.66	31.99	43.32	38.76	21.66	22.55	36.53	22.55	38.76	23.55
2.5	34.10	22.78	32.58	25.49	31.55	32.15	31.77	31.39	27.32	30.10	33.35	40.05	32.34	27.32	33.00
3	14.28	15.73	24.86	17.46	23.56	15.40	12.66	9.91	15.27	14.30	21.56	6.54	22.45	15.27	24.25
3.5	7.91	7.55	9.74	8.79	8.57	7.07	5.90	4.74	6.24	7.14	7.57	2.46	7.35	6.24	7.04
4	2.82	2.58	5.08	2.69	4.96	3.90	3.24	2.59	3.71	3.96	3.65	1.15	3.55	3.71	3.01
4.5	0.50	0.57	0.20	0.79	0.09	0.57	0.75	0.93	1.20	0.55	0.03	0.75	0.01	1.20	0.01
5	0.11	0.42	0.01	0.40	0.01	0.19	0.10			0.15		0.01			
Mean	2.12	2.02	2.40	2.27	2.32	2.10	1.86	1.62	2.42	2.12	2.25	1.98	2.18	2.23	2.25
Median	2.2	1.85	2.3	2.15	2.25	2.15	1.825	1.5	2.3	2.15	2.25	2	2.1	2.1	2.25
Mode	2.5	2	2.5	2	2.5	2.5	2	2	2	2.5	2.5	2.5	2.5	2	2.5
standard deviation	0.76	0.68	0.72	0.66	0.72	0.69	0.65	0.62	0.73	0.80	0.63	0.48	0.66	0.62	0.64
Skewenes ss	-0.09	0.38	0.17	0.26	0.11	0.03	0.17	0.33	0.22	-0.06	0.02	0.04	0.19	0.31	0.02
Class	near	stron	fine	fine	fine	near	fine	strongl	fine	near	near	near	fine	stron	near

Phi interval	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
	symmetrical	gly fine				symmetrical		y fine		symmetrical	symmetrical	symmetrical		gly fine	symmetrical
Kurtosis	0.96	1.04	0.99	1.04	0.94	1.05	1.32	1.80	1.09	1.09	1.13	1.20	0.99	1.08	0.91
Class	mesokurtic	meso kurtic	mesokurtic	mesokurtic	mesokurtic	mesokurtic	leptokurtic	very leptokurtic	mesokurtic	mesokurtic	leptokurtic	leptokurtic	mesokurtic	meso kurtic	mesokurtic

3.5.2.2.2 Statistical analysis

A cumulative curve with a probability ordinate (Y-axis) was prepared for each sediment type using cumulative phi size for each of the following phi values: phi at 5% (φ5), phi at 16% (φ16), phi at 25% (φ25), 50%, 75%, 84%, and 95% (where % refers to the cumulative percent)

Graphic Median – 50% above and 50% below this category. The phi value at 50% is the Median of the sample or grain population. Half the population of grains (mass wise) was smaller than this and half was larger.

Graphic Mean – the average size category

$$M = \frac{\phi 16 + \phi 50 + \phi 84}{3}$$

Sorting by Inclusive Graphic Standard Deviation-

$$\sigma_I = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6{\cdot}6}$$

Folk (1968)[8] presented a verbal classification scale for sorting based on phi class.

<0.35	Very well sorted
0.35-0.500	Well sorted
0.5-0.710	Moderately well sorted
0.71-1.00	Moderately sorted
1.00-2.00	Poorly sorted
2.00-4.00	Very poorly sorted
4.00:	Extremely poorly sorted

Skewness- In probability theory and statistics, skewness is a measure of the asymmetry of the probability distribution of a real-valued random variable about its mean.

$$S = \frac{\phi 84 + \phi 16 - 2(\phi 50)}{2(\phi 84 - \phi 16)} + \frac{\phi 95 + \phi 5 - 2(\phi 50)}{2(\phi 95 - \phi 5)}$$

Skewness value can be positive or negative, or even undefined. For a unimodal distribution, negative skew indicates that the tail on the left side of the probability density function is longer or fatter than the right side – it does not distinguish these

[8] Folk, R. L., 1968, Petrology of Sedimentary Rocks: Austin, University of Texas Publication, 170 p.

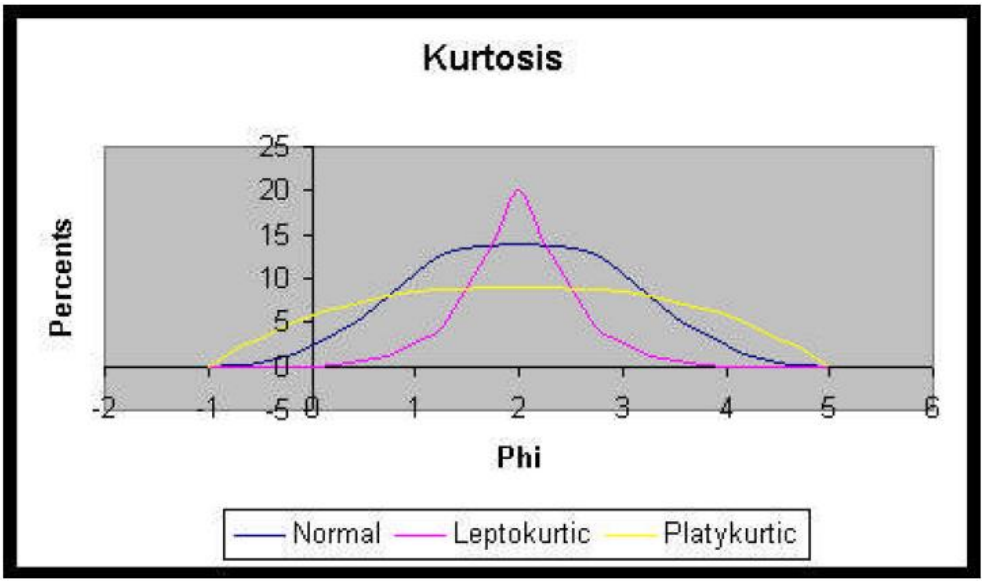
shapes. Conversely, positive skew indicates that the tail on the right side is longer or fatter than the left side. Understanding the skewness of the dataset indicates whether deviations from the mean are going to be positive or negative.

strongly fine	skewed +1.00 to +0.30
fine- skewed	+0.30 to +0.10
near symmetrical	+0.10 to -0.10
coarse-skewed	- 0.10 to -0.30
strongly coarse	-skewed -0.30 to -1.00

Kurtosis - In probability theory and statistics, kurtosis is a measure of the "tailedness" of the probability distribution of a real-valued random variable.

$$K = \frac{\phi 95 - \phi 5}{2.44(\phi 75 - \phi 25)}$$

In a similar way to the concept of skewness, kurtosis is a descriptor of the shape of a probability distribution and, just as for skewness, there are different ways of quantifying it for a theoretical distribution and corresponding ways of estimating it from a sample from a population.



Very Platykurtic	< 0.67
Platykurtic	0.67 to 0.90
Mesokurtic	0.90 to 1.11
leptokuRtic	1.11 to 1.50
Very Leptokurtic	1.50 to 3.00
Extremely Leptokurtic	> 3.00

For this measure, higher kurtosis means more of the variance is the result of infrequent extreme deviations, as opposed to frequent modestly sized deviations.

3.5.2.2.3 Sorting

Histograms of the samples give a general idea of sorting of the sediments (**Annexure-2**). For further statistical analysis, cumulative probability curves were prepared (**Annexure 3**). From which following results are obtained. Overall sediments of the dune are moderately well sorted, as 15 samples fall under this category; 9 samples are moderately sorted, 5 are well sorted and only one is poorly sorted (**Table 6** and **Figure 27**).

Table 6: Inclusive graphic standard deviation, indicating sorting class

Range	Class	Number of Samples
<0.35	Very Well Sorted	-
0.35-0.500	Well Sorted	5
0.5-0.710	Moderately Well Sorted	15
0.71-1.00	Moderately Sorted	9
1.00-2.00	Poorly Sorted	1
2.00-4.00	Very Poorly Sorted	-
4.00	Extremely Poorly Sorted	-

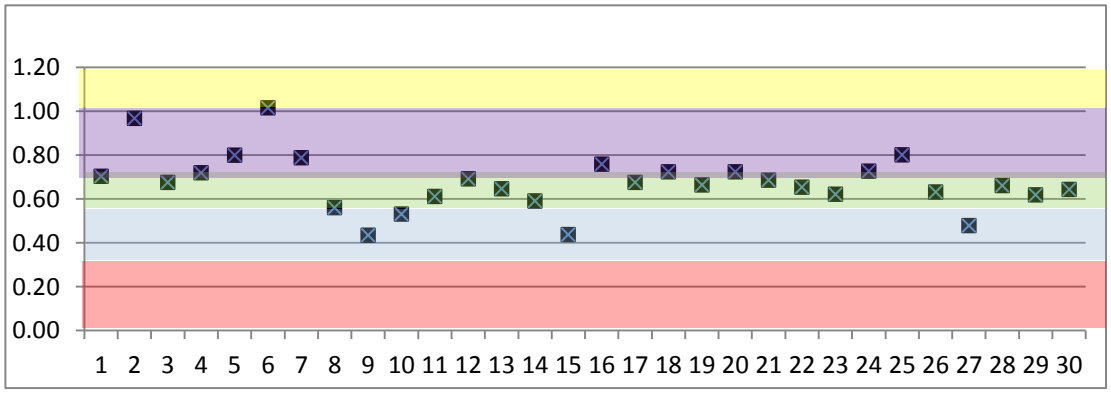


Figure 27: Inclusive graphic standard deviation

3.5.2.2.4 Skewness

Skewness of the sediments is shown in **Table 7** and **Figure 28**.

Table 7: Sediment skewness

Category	Range	Number of samples
Strongly fine- skewed	+1.00 to +0.30	4
Fine- skewed	+0.30 to +0.10	12
Near symmetrical	+0.10 to -0.10	12
Coarse-skewed	- 0.10 to -0.30	2
Strongly coarse-skewed	-0.30 to -1.00	-

Majority of the samples fall under in near symmetrical and fine skewed category, revealing uniformity in distribution and sorting of the sediments with some positive skewness, indicating fine grained sediments.

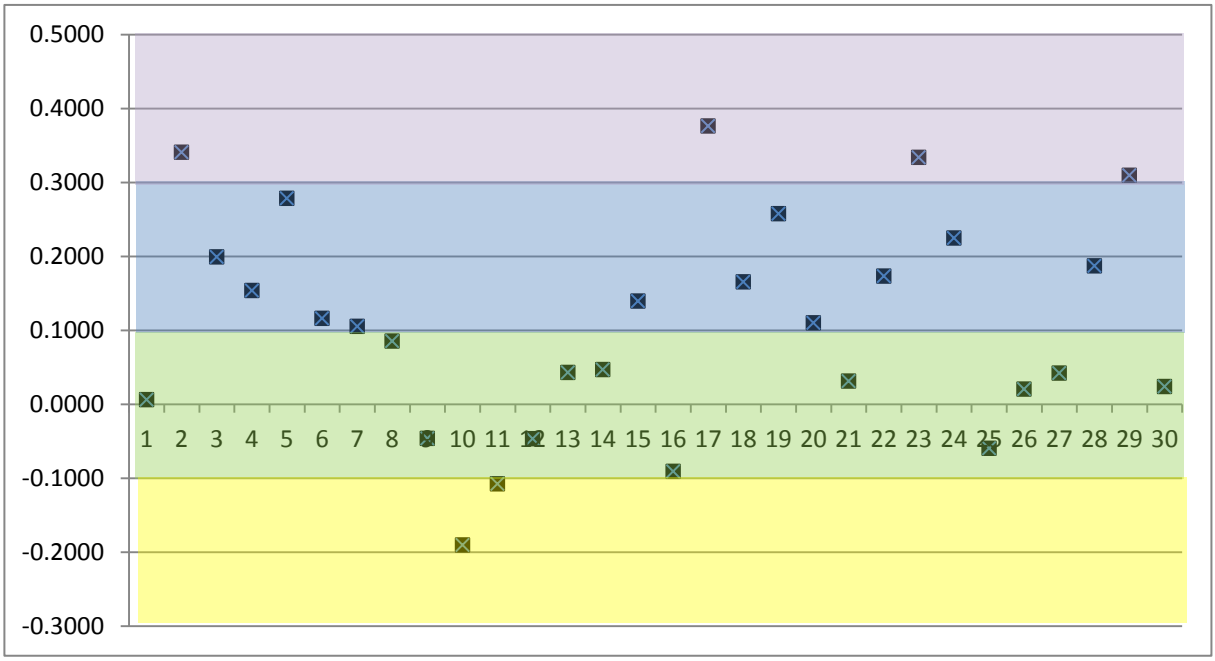


Figure 28: Sediment Skewness

It is generally accepted that the sand blown from a beach is typically fine grained (sand grains of diameter 0.1–0.3 mm, or just below 2ø to just above 3ø and are most readily moved by wind action), well sorted and well rounded. Grain size analyses show that the dune sands are often finer and better sorted than beach sands, with the positively skewed grain-size distributions.

3.5.2.2.5 Kurtosis

Kurtosis of the sediments is represented in **Table 8** and in **Figure 29**.

Table 8: Sediment Kurtosis

Category	Range	No of samples
Very Platykurtic	< 0.67	-
Platykurtic	0.67 to 0.90	1
Mesokurtic	0.90 to 1.11	15
Leptokurtic	1.11 to 1.50	12
Very Leptokurtic	1.50 to 3.00	1
Extremely Leptokurtic	> 3.00	-

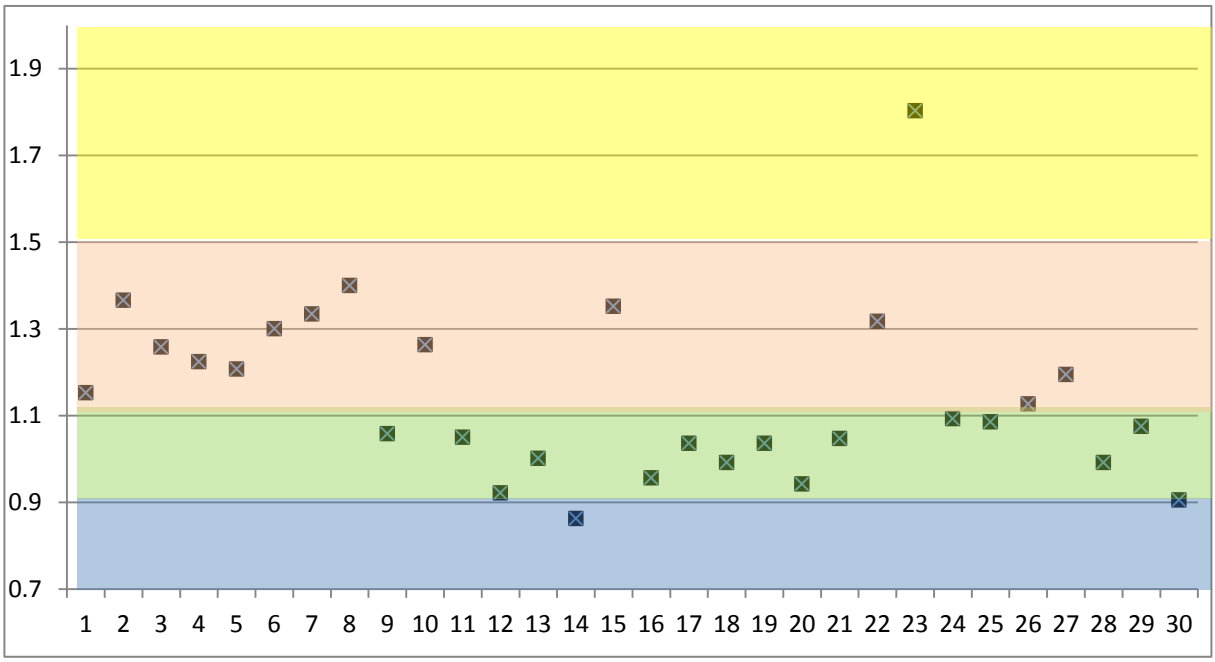


Figure 29: Sediment Kurtosis

Majority of the samples are mesokurtic and leptokurtic. The moderately uniform kurtoses of sediments indicate a dominance of a single process of transportation and deposition of these sediments.

The grain size analysis indicates that most of the samples are dominated by sand size particles ranging from coarse to very fine sand. The average/mean grain size of the sample is 2.2 phi (250 μm). The most dominating class is that of fine sand as out of 30 samples; 29 are dominated by fine grained category (having Median = 2 and 2.5 phi). One sample is very fine grained (Median= 3 phi). Overall sediments of the dune are moderately sorted. Skewness (nearly skewed and fine/positive skewed category) and Kurtosis (meso and leptokurtic) reveals fine grained sediments (windblown) and domination of a single process of transportation deposition.

3.5.2.3 Sediment Composition

Microscopic analysis of the sediments revealed the domination of quartz, feldspar, magnetic minerals and calcite grains (shells). Fresh looking grains in the southern eastern part of the dune could be seen at stations 9, 11, 53, 36, 35, 33 (sample nos. 15, 24, 23, 11, 10, 27) (**Figure 30**a,b). Whereas, roughness was observed in the samples collected from the inner side of the dune (**Figure 31** c, d). However there is minor variation in the composition of the sand, which is dominated by silica (around 80%).

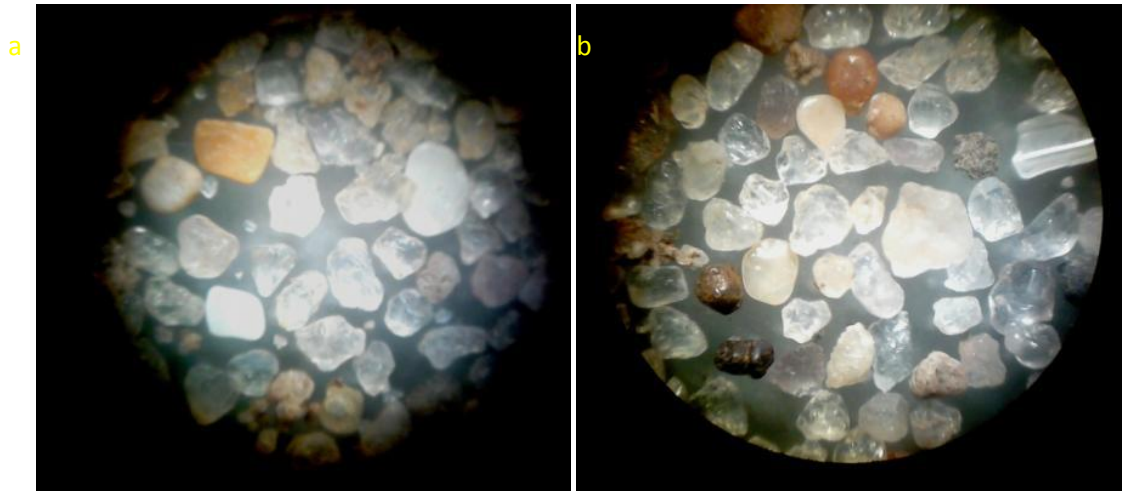


Figure 30: (a,b). Sediment/soil observed under the stereoscopic microscope

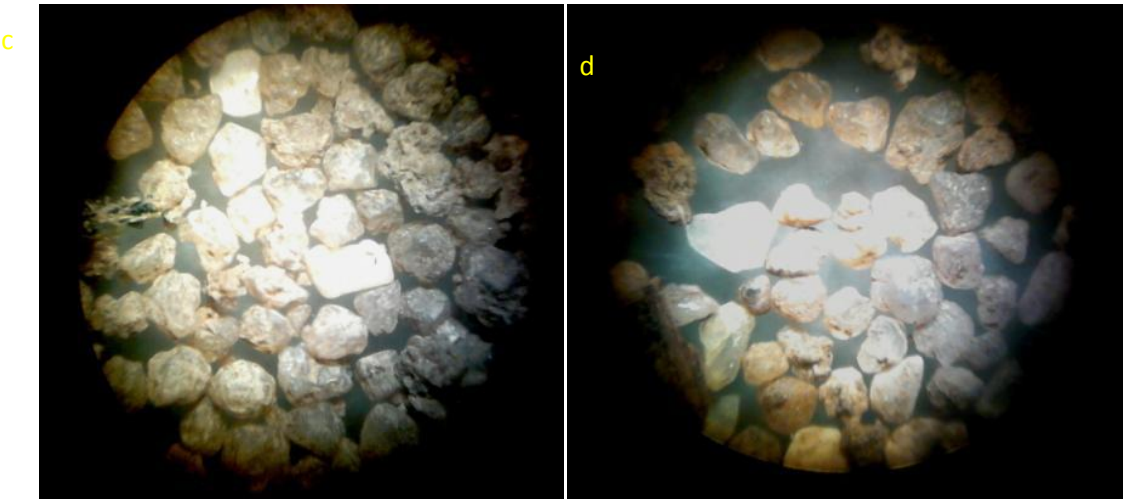


Figure 31: (c,d). Sediment/soil observed under the stereoscopic microscope

Indus is considered to be a major source of sediments in the region because it is the region's only perennial river, and the Kachchh falls within arid/ hyperarid climatic regime (Chauhan, 1994[9]; Chauhan et al., 2006[10]; Ramaswamy et al., 2007[11]). The coastal

[9]Chauhan, O.S., 1994. Influence of macrotidal environment on shelf sedimentation, Gulf of Kachchh, India. Continental Shelf Research, 14, 1477–1493.

[10]Chauhan, O.S.; Jayakumar, S.; Menezes, A.A.; Rajawat, A.S., and Nayak, S.R., 2006.Anomalous inland influx of River Indus, Gulf of Kachchh, India. Marine Geology, 229, 91–100.

depositional process including tidal flats, beaches and active dunes are having strong influence of Indus deltaic sediments and their redistribution by coastal process of the Gulf (Wells et al 1984[12], Ramswamy et al 2007). Presence of minerals like Kaolinite and mica in the sediments clearly indicate domination of Himalayan based sediments in the Gulf (Prizomwala*et al*., 2012).

Also such dry land with numerous rivers is highly susceptible to the erosive effects of flash floods because of limited resistance from the sandy bank material and the sparse vegetation (Reid and Frostick, 1997[13] Tooth, 2000[14],). Hence, though there are no perennial rivers in the Kachchh mainland, presence of Deccan trap derivatives (diopside–magnetite) upto 70% in the sediments of southwest Kachchh coast has also indicated that the sediment supply is primarily from the fluvial systems of Kachchh which debouch the west of the study area (i.e. Naira, Kankawati, Kharod and Rukmawati rivers) and their sediments are redistributed by the long shore currents and monsoonal winds (Prizomwala et al., 2013).

3.6 Flora and Fauna

Ecological study of the onshore sand dune area of the proposed project was conducted to assess the ecological sensitivity of the area.

3.6.1 General Methodology and Sampling Locations

3.6.1.1 Onshore area

Vegetation structure of the study area was studied at different representative sites of the project onshore area. Vegetation structure study was carried out by quadrate method by laying plots of 10m × 10m ([15]Mueller-Dombois and Ellenberg, 1967; [16]Kershaw and Wright, 1980). Random plots (10m × 10m) were laid in different sand dune patches. In each plot, total number of trees/vegetation were recorded. The simple

[11]Ramaswamy, V.; Nagender, N.B.; Vethamony, P., and Illangovan, D., 2007.Source and dispersal of suspended sediment in macro-tidal Gulf of Kachchh. Marine Pollution Bulletin, 54, 708–719.

[12]Wells, J. T., and Coleman, J. M., 1984.Deltaic morphology and sedimentology with special reference to the Indus River Delta, Marine Geology and Oceanography of the Arabian Sea and Coastal Pakistan. New York: Van Nostrand Reinhold, pp. 85-100.

[13]Reid, I. and Frostick, L.E., 1997. Channel form, flows and sediments in desserts. In: Thomas, D.S.G. (ed.). Arid Zone Geomorphology: Process, Form and Change in Drylands, 2nd edition. Chichester, U.K.: Wiley, pp. 205–229.

[14]Tooth, S., 2000. Process, form and change in dryland rivers: a review of recent research. Earth Science Reviews, 51, 67–107.

[15]Mueller-Dombois D and Ellenberg H. 1967.Aims and methods of vegetation ecology. John Wiley and Sons, New York, London. Pp.545.

[16]Kershaw A S and Wright C E. 1980.Sampling test of comparison and application of quadrate measure Pp: 21-39. In: Quantitative and Dynamic Plant Ecology. 2nd Ed. William Clowes and Sons Limited, London.

modified transect method was used for the density assessment. Density of trees/vegetation in each plot is expressed as number per hectare (No/ha). Identification of the plants was done using flora of Gujarat state ([17]Shah, 1978), The Flora of Indian Desert ([18]Bhandari, 1990) and Flora of the Presidency of Bombay ([19]Cooke, 1993-98).

GPS co-ordinates were taken in each sampling points and map was prepared using ARCGIS software. Sampling/survey sites for flora and fauna are given in (**Table 9, Figure 32**).

Table 9: GPS Coordinates of vegetation sampling locations

Point	Latitude	Longitude	Point	Latitude	Longitude
1	22° 50' 24.282"	69° 14' 35.693"	16	22° 50' 15.788"	69° 14' 08.064"
2	22° 50' 25.844"	69° 14' 35.391"	17	22° 50' 17.443"	69° 14' 09.380"
3	22° 50' 19.922"	69° 14' 27.178"	18	22° 50' 19.414"	69° 14' 10.117"
4	22° 50' 24.30"	69° 14' 24.899"	19	22° 50' 20.306"	69° 14' 10.671"
5	22° 50' 21.709"	69° 14' 18.774"	20	22° 50' 21.824"	69° 14' 13.610"
6	22° 50' 22.552"	69° 14' 09.023"	21	22° 50' 5.28"	69° 14' 11.04"
7	22° 50' 23.836"	69° 14' 04.629"	22	22° 50' 9.60"	69° 14' 23.28"
8	22° 50' 23.492"	69° 14' 07.777"	23	22° 50' 15.08"	69° 14' 18.6"
9	22° 50' 25.944"	69° 13' 59.026"	24	22° 50' 4.56"	69° 14' 18.6"
10	22° 50' 26.191"	69° 13' 55.455"	25	22° 50' 13.92"	69° 14' 28.32"
11	22° 50' 25.580"	69° 13' 50.696"	26	22° 50' 10.68"	69° 14' 11.76"
12	22° 50' 24.859"	69° 13' 50.153"	27	22° 50' 2.76"	69° 14' 25.44"
13	22° 50' 20.499"	69° 13' 50.778"	28	22° 50' 11.4"	69° 13' 56.64"
14	22° 50' 08.690"	69° 13' 52.172"	29	22° 50' 16.8"	69° 13' 59.16"
15	22° 50' 09.382"	69° 14' 04.849"			

[17]Shah G L. 1978. Flora of Gujarat State.Sardar Patel University, VallabhVidhaynagar, Gujarat.

[18]Bhandari M M. 1990. Flora of the Indian desert (Rev. Edi.). Scientific publishers, Jodhpur

[19]Cooke T. 1903-1908. The flora of the presidency of Bombay**.**Taylor and Francis, London.

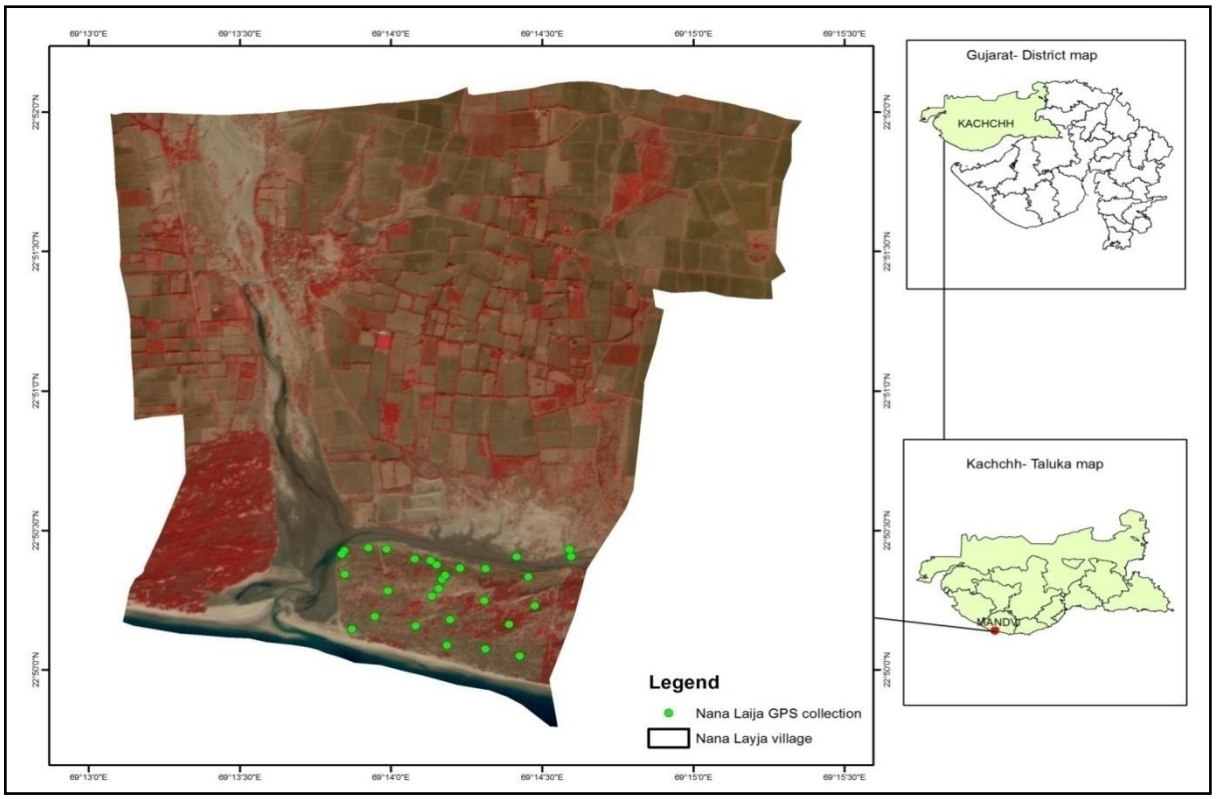


Figure 32: Vegetation sampling locations

3.6.1.2 Intertidal biota

Intertidal biota is a direct indicator of the ecosystem function. The adjoining creek area of the Sand dunes support organisms like crustaceans, gastropods and bivalves. In the present study, random quadrates of 1m×1m size were laid across the 10 random sampling locations and density of fauna was calculated. The intertidal biota were identified in the field itself and those which could not be identified were collected and taken to the laboratory for further identification. In the laboratory, flora/fauna belonging to different groups were identified based on the standard biological keys.

3.6.2 Floral and Faunal Density

In the coastal dune area, 46 different flora were recorded which include 11 tree species, 6 shrubs, 9 herbs, 10 grasses, 6 sedges, 2 creepers and 2 climbers(Table 10). Among the recorded floral richness in the study area, tree species were dominant (25%) followed by grasses (13.6%) herbs (18.1%) and climbers.

The tree species *Prosopis juliflora*, an invasive alien weed plant locally called *Kanda Baval* is the dominant vegetation in the study area (650 trees-shrubs/ha). Thickets of *Prosopis* were seen predominantly whose height ranged from 50 cm to 5 meter. The other tree species, *Acacia nilotica* and *Zizyphus nummularia* were also seen frequently.

Categorizing the recorded floral forms as per IUCN red data list showed that 39 plants fall under the category 'Not Evaluated', 6 plants under 'Least Concern' and 1 plant-' Critically Endangered'. However, this critically endangered plant is found in only few numbers in the project onshore area (**Table 10**).

Foreshore region of the dunes has species such as *Cenchrus biflora, C. Ciliaris* and *Urochondra setulosus* while species such as *Prosopis juliflora*, *P. Chilensi* sand *Commiphora wightii* occupy frontal and hind regions of the dunes, thus showing mixed vegetation types. Certain grass species such as *Dactylocteniums indicum*, *Cynodondactylon sp. and Aleurops lagopoides* were also recorded in supratidal belt, close to sand dunes.

Sand dunes are located close to the supratidal zone in most of the places. Sand dunes are inhabited by grasses such as *Aleurops lagopoides, Aristida spp., Cenchrus biflora, Cenchrus ciliaris and Urochondra setulosus* which form patches on the sandy substrate. Sedges such as *Fimbristylis cymosa* and *Cyperus arenarius* were recorded in very few instances. The climber *Coccinia grandis* is commonly seen in the sand dunes beyond the supra tidal zones. Similarly, the twiner, *Rhynchosia minima* was commonly seen in the adjacent sand substrates. One common shrub all along the supratidal and near coastal sandy substrate was *Salvadora persica* and the grass *Urochondras etulosus.*

Kutch district have herbaceous vegetation recorded in Abdasa, Lakhpat and Mandvi talukas. However, the major vegetation composition of Kutch district showed presence of thorny species like *Prosopis juliflora*, *Zizyphus nummularia*and *Capparis decidua* ([20]GES, 2014). The distribution of the critically endangered plant *Commiphora wightii* is found throughout Kutch district and in Rajasthan.

The earlier findings are similar to our present study which shows the dominance of the above species, mainly *Prosopis juliflora, which* has higher density than other floral forms.

The recommendations of the project on "Conservation and Development of Guggal (*Commiphora wightii)* in Gujarat" by the [21]Gujarat Forest Department (2007) has been adequately taken into account, wherever applicable, while framing the conservation

[20]GES, 2014. Ecological Profile of CoastalTaluka of Gulf of Kachchh. Sponsored by Gujarat Ecology Commission.Pages 1-135.

[21]Gujarat Forest Department (2007). A project on "Conservation and Development of Guggal (*Commiphorawightii)* in Gujarat" pp 1-39.

and management measures *for Commiphora wightii*, with respect to the present project development at Nana Layja.

It may be also noted that, though *C. wightii* has been reported to be present in the Kachchh District of Gujarat, the present proposed project development area/talukhas not been identified as a Medicinal Plant Conservation Area (MPCA) among the six hotspots in the Kachchh District (Tapkeshwari, Dhirnodhar, Chhapariya, Badargadh, Kurboi-Nabhoi) as identified by the Gujarat Forest Department (2007).

During the field visit, the following fauna were observed at the onshore area**;**

- Garden lizard (*Calotes versicolor*) - One
- Five-stripped palm squirrel *(Funambulus pennant)*- One
- Dragon flies (*Odonatasp.*) - Few
- Bandicoot Rat (*Nosoki asp*) - One

During discussion with the locals it is reported that Nilgai and Jackals are occasionally spotted, however nothing was observed during the field visit

No birds and no nests were observed during the field visit; this could be attributed to the presence of *Prosopis* and *Acacia* thickets which are not conducive for roosting and foraging.

Table 10: List of Flora with IUCN status& Density

S. No	List of Flora	IUCN Status	Indicative Density No/ha
Trees			
1	*Acacia nilotica*	Least Concern	87
2	*Acacia leucophloea*	Not Evaluated	34
3	*Acacia tortilis*	Not Evaluated	60
4	*Azadirachta indica*	Not Evaluated	3
5	*Prosopis cineraria*	Not Evaluated	124
6	*Prosopis juliflora*	Not Evaluated	650
7	*Salvadora persica*	Not Evaluated	145
8	*Commiphora wightii*	Critically Endangered	25 nos in total area (approx)

9	*Maerua oblongifolia*	Not Evaluated	7
10	*Maytenus emarginata*	Not Evaluated	5
11	*Prosopis chilensis*	Not Evaluated	80
Shrubs			
12	*Achyranthes aspera*	Not Evaluated	55
13	*Calotropis procera*	Not Evaluated	135
14	*Zizyphus nummularia*	Not Evaluated	30
15	*Euphorbia caducifolia*	Not Evaluated	65
16	*Euphorbia tirucalli*	Not Evaluated	25
17	*Grewia tenax*	Not Evaluated	21
Herbs			
18	*Boerhavia repens*	Not Evaluated	45
19	*Citrulus colocynthis*	Not Evaluated	30
20	*Heliotropium indicum*	Not Evaluated	68
21	*Launaea procumbens*	Not Evaluated	75
22	*Launaea sarmentosa*	Least Concern	18
23	*Sesuvium portulacastrum*	Not Evaluated	120
24	*Trianthema portulacastrum*	Not Evaluated	110
25	*Ziziphu s*spp	Not Evaluated	95
26	*Tribulus terrestris*	Not Evaluated	60
Grasses			
27	*Aeluropus lagopoides*	Not Evaluated	340
28	*Aristida* spp.,	Not Evaluated	375
29	*Cenchrus biflorus*	Not Evaluated	110
30	*Cenchrus ciliaris*	Not Evaluated	510
31	*Cynodondactylon*	Not Evaluated	145
32	*Dactyloctenium*s *indicum*	Not Evaluated	210
33	*Leptochloa fusca*	Least Concern	135
34	*Sporobolus sp.*	Not Evaluated	210
35	*Aerva persica*	Not Evaluated	85

36	*Urochondra setulosus*	Not Evaluated	105
Sedges			
37	*Cyperusconglomeritus*	Not Evaluated	220
38	*Cyperus arenarius*	Least Concern	140
39	*Fimbristylis cymosa*	Least Concern	120
40	*Fimbristylismiliacea*	Not Evaluated	77
41	*Pycreus* spp.,	Least Concern	305
42	*Scirpus tuberosus*	Not Evaluated	340
Creepers			
43	*Ipomoea pes-caprae*	Not Evaluated	75
44	*Rhynchosia minima*	Not Evaluated	120
Climbers			
45	*Mukia maderaspatana*	Not Evaluated	120
46	*Coccini agrandis*	Not Evaluated	105


Acacia nilotica


Acacia tortalis


Aeluropus lagopoides


Aerva persica


Azadirachta indica


Commiphora wightii


Euphorbia caducifolia


Euphorbia tirucalli

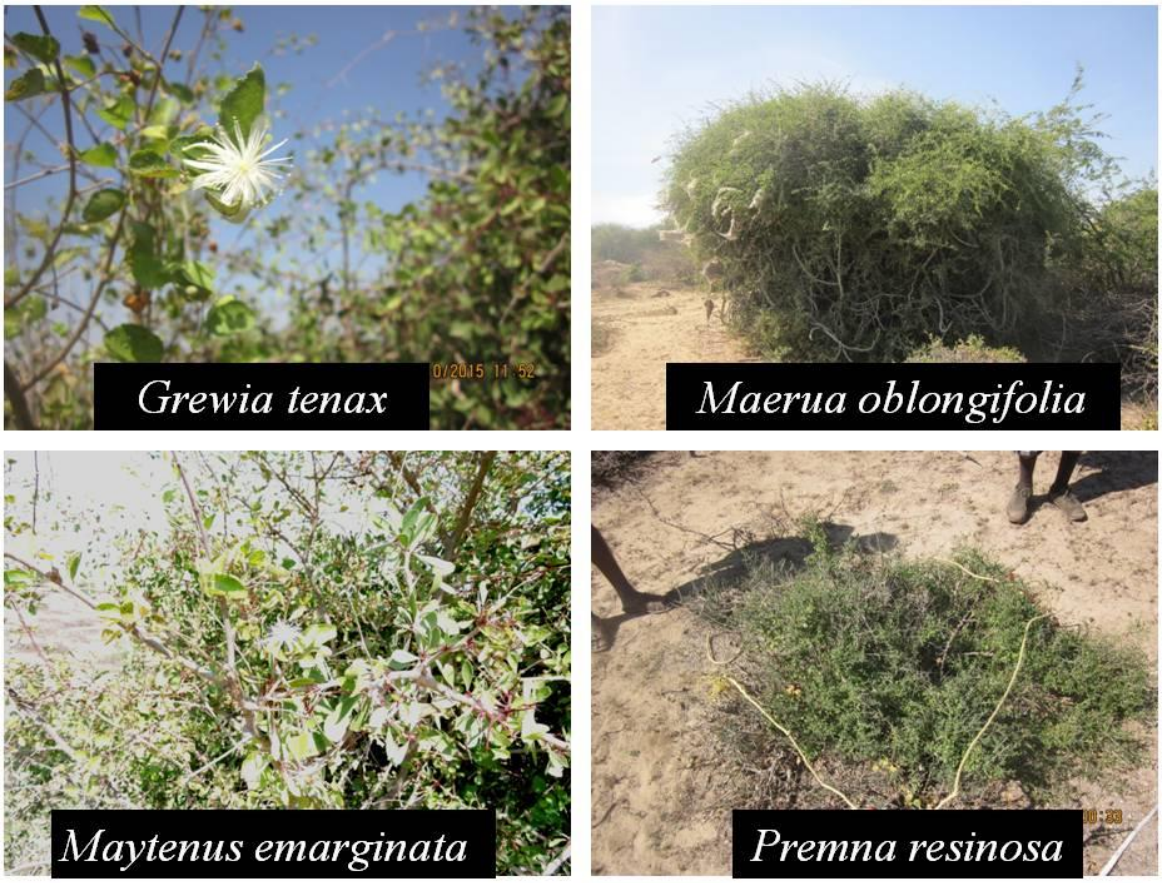


Figure 33: Flora Pictures

3.6.3 Intertidal Biota

Intertidal faunal assemblages were studied for their density and abundance and distribution during low tide at three different tidal levels (Low, mid and high tides). In each phase of the tidal level 1 m^2 quadrate (in triplicates) was placed randomly and all the visible macrofaunal organisms, encountered inside the quadrate, were identified, counted and recorded. Organisms, which could not be identified in the field were preserved in 5% formaldehyde and brought to the laboratory and identified using the standard identification keys (Abott, 1954; Chapgar, 1957; Apte, 1998).

In total three major groups (gastropods, bivalves, crustaceans) and other few minor groups were recorded in varying proportions; 14 gastropods, 4 bivalves, 11 crustaceans and 4 other forms such as anthozoans were recorded (**Table 11**). Gastropods were the dominant fauna both in terms of density and richness. Gastropod density varied from a minimum of 5 individuals/m2 to a maximum of 198 individuals/m2. Many gastropods species were recorded from the sandy inter tidal area. Forms such as *Umbonium vestiarium*, *Nodilittorina pyramidalis* and *Littorina scabra* registered maximum density while forms such as *Cantharus spiralis*, *Drupa singulata* were less in abundance.

Sandy shore forms mostly included gastropods such as *Naticapicta*, *Umbonium vestarium* and crustaceans such as *Ocypodasp*, *Matuta victor* and *Uca annulipes*. **None of the species belong to the Schedule-I category**.

Table 11: Biota collected from the intertidal area at the Nana Layja Coast and its vicinity and their density

Gastropods (in patches)	Density No/m²	Bivalves (in patches)	Density No/m²	Crustaceans	Density No/m²	Other Groups (in patches)	Density No/m²
Cantharusspiralis	5	*Pafia textile*	14	*Amphibalanus amphitrite*	24	*Armandia* sp.	8
Cellana eucosmia	7	*Anadora granosa*	5	*Semibalanus balanoidus*	15	Anthozoans	9
Cellana radiata	27	*Meretrix casta*	14	*Clibanarius* sp.	8	*Marphysa*s p.	65
Cerithideopsilla cingulata	16	*Saccostrea cucullata*	27	*Metopograpsus maculatus*	17	*Actiniaria*s p. (Sea anemone)	6
Diodora singaporensis	11			*Metopograpsus messor*	6		
Drupa sp.	17			*Matuta victor*	3		
Emarginula octariana	12			*Neoepisesarma sp.*	6		
Littoraria scabra	167			*Ocypodemacrosera*	9		
Littoraria undulata	156			*Scylla serrata*	7		
Natica picta	23			*Sesarma*sp.	9		
Nerit aalbicilla	9			*Uca annulipes*	11		
Nodilittorina pyramidalis	198						
Turbo brunneus	22						
Umbonium vestarium	149						

3.7 Physico-chemical parameters

In the adjoining creek, during the present study, air temperature and surface water temperature ranged from 30^{0}C to 33° C and 27.9°C to 29.2°C, respectively. pH ranged from 8.1 to 8.4 with an average value of 8.25. Salinity ranged from 40 to 44‰ with an average value of 42‰.

4. Summary of Findings

4.1 Summary

1. The project onshore area measuring about 79 Ha belongs to revenue Survey no 197/18 and is reclassified by revenue department "**for Industrial Purpose**" in 2010
2. As per land use / land cover details, the proposed project site does not have any designated forest (protected and reserved forests) areas.
3. The onshore area can be characterised as stabilised sand dune though a minor part seems to be reworked by wind. The coastal dune of the study area is categorized as stabilized as per the DPR study of Shukla et.al. (2013) and classified as a stable coast as per National Assessment of Shoreline Changes of Gujarat carried out by Institute of Ocean Management, Anna University.
4. Comparison of historical satellite imageries indicate that the onshore sand dune area has been stable, its extent has not changed and the elevations/height at various parts remain unchanged
5. The onshore area levels and its extent of occurrence by percentage is 0-10 m =66%, 10-15 m = 32.5%, 15 m above = 1.5%.
6. Digital elevation model prepared from satellite data indicate that the dune is having cliffs on the southern and western sides.

   Comparison of onshore area levels based on the earlier survey and the present study (2015) indicate that there is no major change in the elevation at various parts of the dune, indicating stability
7. From grain size analysis, it is observed that sand size particles range from coarse to very fine sand.
8. The satellite data suggests no major change in the dune morphology except in the confluence point of River Kharod to sea, which forms a river-sea complex, that shows minor seasonal changes like the built up of spit.
9. The ecosystem of the onshore area was found to support flora including trees, shrubs, herbs and grass species. In total, 46 different flora were recorded which include 11 tree species, 6 shrubs, 9 herbs, 10 grasses, 6 sedges, 2 creepers and 2 climbers. The dominant species observed are *Prosopis juliflora, prosopis sp.* and *Acacia sp.* contributing to about 80% of the biomass of vegetation in the area. The status of these species with respect to various countries is provided in **Annexure 4.** *Prosopis* is an alien invasive weed tree. The present project onshore area seems to be a *Prosopis*

invaded ecosystem. The other species are sparse & sporadic in the dune area. *Acacia sp.* is found in patches in portions of the dune, apart from sparse sporadic distribution in the dune. It is a thorny tree which does not offer to be a foraging species even for the feral cattle because of its prickly thorns.

10. *Commiphora wightii,* a critically endangered species as per IUCN classification could be recorded in the project onshore area. The distribution is very sporadic and is restricted to about 25 nos in the studied dune area of 79 Ha.
11. Few faunal species were observed like garden lizard (*Calotes versicolor*), Five-stripped palm squirrel *(Funambulus pennanti),* Dragon flies (*Odonata sp*.), Bandicoot Rat (*Nosokia sp*.). During discussion with the locals it is reported that Blue bull (*Boselaphus tragocamelus)* and Jackals are occasionally spotted, however nothing was observed during the field visit
12. No birds and no nests were observed during the field visit; this could be attributed to the dominant presence of *Prosopis* and *Acacia* thickets which are not conducive for roosting and foraging.
13. This project onshore area does not offer to be the nesting, breeding place of any avian species, as evidenced. Nor it is a foraging area. There are no endangered fauna in the area. There are no established food webs.
14. In total, four major groups of Inter tidal fauna such as gastropods, bivalves, crustaceans and other groups were recorded in varying proportions; 14 gastropods, 4 bivalves, 11 crustaceans and 4 other forms such as anthozoans were recorded. All of them are commonly seen in these inter tidal areas. None of the species belong to the Schedule-I category
15. Overall, all the species, faunal and floral have been reported with very few individuals in the proposed project site.

5. Conclusions / Recommendations

5.1 Conclusions

The present project development will require partial dressing of the coastal sand dune area to develop back up area facilities. It is proposed by the project proponent to level the area to + 7 m CD.

In this regard, the onshore area of the proposed development site was scientifically studied in detail and following conclusions are drawn.

1. The project onshore area measuring about 79 Ha belongs to revenue Survey no 197/18 and is reclassified by revenue department "**for Industrial Purpose**" in 2010
2. As per land use / land cover details, the proposed project site does not have any designated forest (protected and reserved forests) areas.
3. The onshore area can be characterised as stabilised sand dune though a minor part seems to be reworked by wind. The coastal dune of the study area is categorized as stabilized as per the DPR study of Shukla et.al. (2013) and classified as a stable coast as per National Assessment of Shoreline Changes of Gujarat carried out by Institute of Ocean Management, Anna University.
4. Comparison of historical satellite imageries indicate that the onshore sand dune area has been stable, its extent has not changed and the elevations/height at various parts remain unchanged
5. In total, 46 different flora were recorded which include 11 tree species, 6 shrubs, 9 herbs, 10 grasses, 6 sedges, 2 creepers and 2 climbers. Two species *Acacia*sp and *Prosopis juliflora* contribute to about 80% of the biomass of vegetation in the onshore area.
6. Few faunal species were observed like garden lizard (*Calotes versicolor*), *Funambulus pennanti* (Five-stripped palm squirrel) Dragon flies (*Odonata*sp), Bandicoot Rat (*Nosokia* sp). ***Hence, the proposed project onshore sand dune area does not have any significant flora and fauna***.

   This area does not offer to be the nesting, breeding place of any avian species, as evidenced. Nor it is a foraging area. There are no endangered fauna in the area. There are no established food webs. Hence, clearing these thickets will not cause any ecological impact, including displacement of faunal species and/or creation of

barriers for their movement. There will be no loss of native species or genetic diversity as there is continuous dune stretch all along Kutch district coast

7. However, *Commiphora wightii*, a critically endangered species as per IUCN classification was found in the project onshore area. The distribution is very sporadic and is restricted to about 25 nos in the project onshore sand dune area. Levelling/ dressing the dune could affect the distribution of this species in the proposed development site. Mitigation measures are recommended to replenish this plant and this shall have to be strictly adhered by the proponent.
8. Stable sand dunes play an important part in protecting the coastline for following reasons.

    a) They act as a buffer against wave damage during storms and protecting the land behind from salt water intrusion.

    b) This sand barrier allows the development of more complex plant communities in areas protected from salt water inundation.

    c) The dunes also act as a reservoir of sand to replenish and maintain the beach at times of erosion.

In this development, the proponent proposes to partially dress the sand dune area to maintain ground level +7 m CD. However considering the detailed study findings, the proposed project facilities which are essential for the Project, shall be permitted in the sand dune area by ensuring minimal onshore level of (+) 8 m CD . With this, the onshore area would still be stable and act as a buffer protecting the land behind. Due to the width and extent of the sand dune/onshore area, the land behind will not experience salt water inundation or sea spray.

Levelling to + 8 m CD would further benefit in combating the effects of storm surges tidal waves etc., (particularly in the very low south-western margin), if any would occur in the future because of the advantage of height increase in the seaward side, which is the combat zone during any surges.

Also, in this project, onshore sand dune area is not going to be flattened and as part of the EMP, the project proponent is going to monitor and maintain shoreline with respect to anticipated accretion/ erosion that may arise due to the project.

Levelling will not impact the biological structure of the area as there are no complex plant and animal communities in the sand dune area.

9. The project requires a utility corridor connecting onshore land to the proposed SEZ near MotaLayja village. It is noted that the utility corridor passes through the creek at the extreme East end of the creek & it is planned to go elevated. Natural tidal flushing in the minor creek system shall not be disturbed due to Project.

Considering the detailed study findings, since levelling will not impact the biological structure of the area as there are no complex flora and fauna and the dressed sand dune area will still act as a barrier, the proposed facilities in sand dune area which are essential for the Project, shall be permitted by ensuring minimal onshore level of (+) 8 m CD and strict adherence to the mitigation measures recommended for replenishing *Commiphora wightii.*

5.2 Recommendations

5.2.1 Mitigation measures for *Commiphora wightii*

The following mitigation measures are recommended to replenish the critically endangered plant *Commiphora wightii* that is found in the sand dune area though the density is less (about 25 numbers in an area of 79Ha).

1. The few trees / shrubs of *Commiphora wightii* present in the onshore area of the project development area should be uprooted and replanted in the adjoining sand dunes having the same ecological conditions rather than cutting and/or clearing the trees/shrubs.
2. During the green belt development *C. wightii* should be selected as the candidate species apart from other species for plantations. This effort will increase the density of *C wightii* in the area more than the present density.
3. Vegetative propagation of *C. wightii* should be done to facilitate nursery culture and re-plantation in the field, apart from utilizing the seed resources.
4. If sufficient number of seeds are not available, tissue culture of the germplasms of the plants shall be made and lab to field transplantation to adjoining areas be made.
5. Establishment of nursery practices for *C. wightii* shall be promoted preferably with community participation. A fund allocation of **about Rs. 50 lakhs** shall be earmarked by the project proponent over a period of five years for the conservation measures of *C. wightii* including relocation, tissue culture and nursery practices.

5.2.2 Other recommendations

1. The green belt shall also have sand dune medicinal plants cum sand binders such as *Spinifex littoreus*, *Citrullus colocynthis*, *Ipomea pes-carpae*, *Lippa nodiflora* etc. No alien species (trees, shrubs or grass) should be introduced during green belt development

2. The construction camps shall be located away from creek and adjoining dune areas.

3. Proper guidelines shall be issued to the contractors so as to ensure that all the construction materials are stored well within the area allotted for the purpose. This guideline should also include norms for the user groups not to dispose any construction waste materials (solid and liquid) in the nearby creek / sea.

4. Proper solid waste management is recommended

ANNEXURES

G. P. Bvc.-(V)-2055-20,00,000-2-2013-(3)
G. R. R. D., No. R.A.M. 102006-1223-L. I. dated : 3-8-2006.

ગામ નમુનો નંબર ૭ અને ૧૨ I 0807364

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બ્લોક/સરવે નંબર : ૧૯૧/ પૈકી ૧૮

સત્તાપ્રકાર નવી શરત (ન.શ)

ખેતરનું નામ :

અન્ય વિગતો :

પાનું :

મોજે : લાયજા નાના

તાલુકો : માંડવી

જિલ્લો : કચ્છ

લાયક જમીન	ક્ષેત્રફળ હે.આરે.ચો.મી.	ખાતા નંબર	ક્ષેત્રફળ હે.આરે.ચો.મી.	આકાર	નોંધ નંબરો અને કબ્જેદારોના નામ
જરાયત	૧૪૮-૮૭-૪૯			૯૪૩,૮૫૨,	
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કુલ ક્ષેત્રફળ	૧૪૮-૮૭-૪૯	૧૨૧	૧૪૮-૮૭-૪૯	0.00	માતાજી આશાપુરા પોટે(૯૪૩)
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જુડી તથા વિશેશધારો રૂ	0.00				
પાણીભાગ રૂ.	0.00				

ગણોતિયાની વિગતો

બીજા હકો અને બોજાની વિગતો

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નવી શરત ઔધોગીક હેતુસર<૮૫૨>

કોમ્પ્યુટરાઈઝડ ઉતારાની
નકલના ઉપયોગ માટે

નાયબ મામલતદાર (ઈ-ધરા)
માંડવી-કચ્છ

#-નામંજુર &-તકરારી *-૨૬

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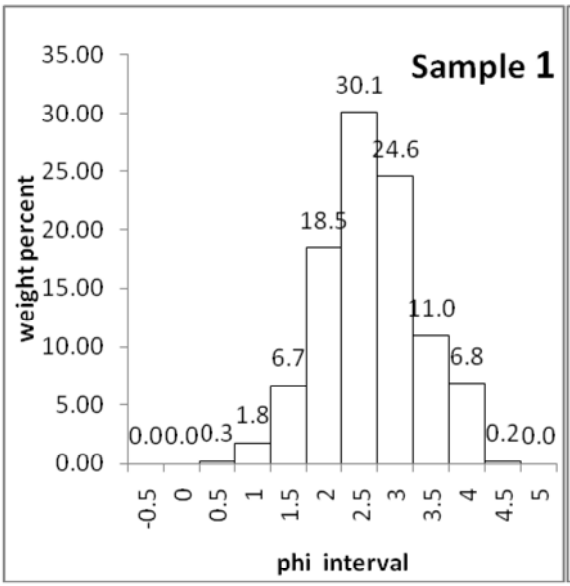
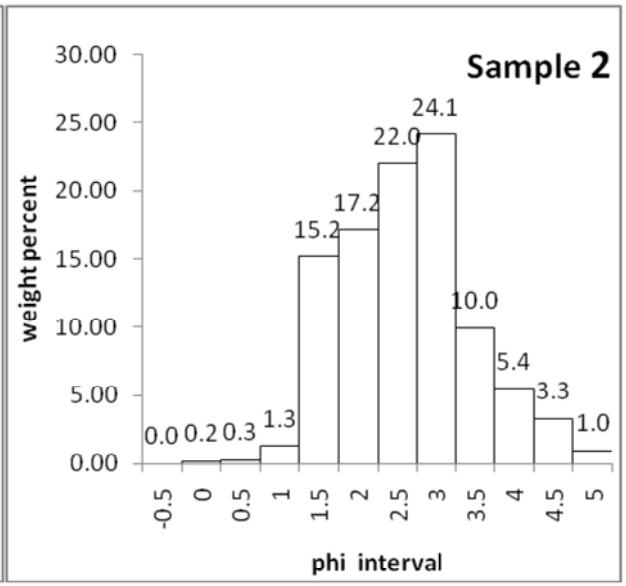
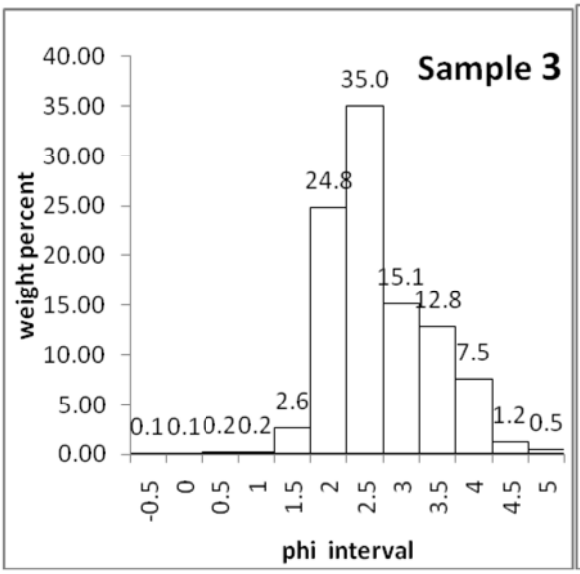
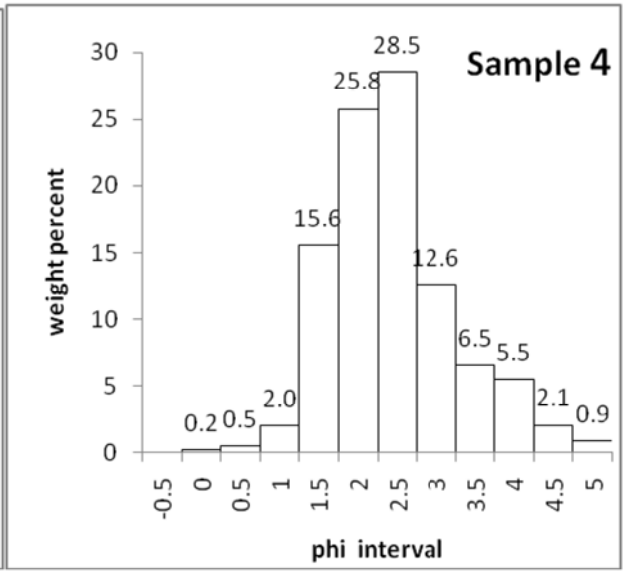
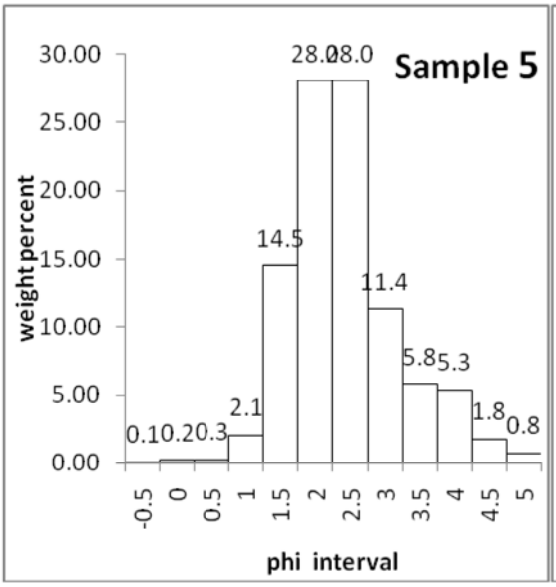
Annexure 2: Grain size analysis-Histograms







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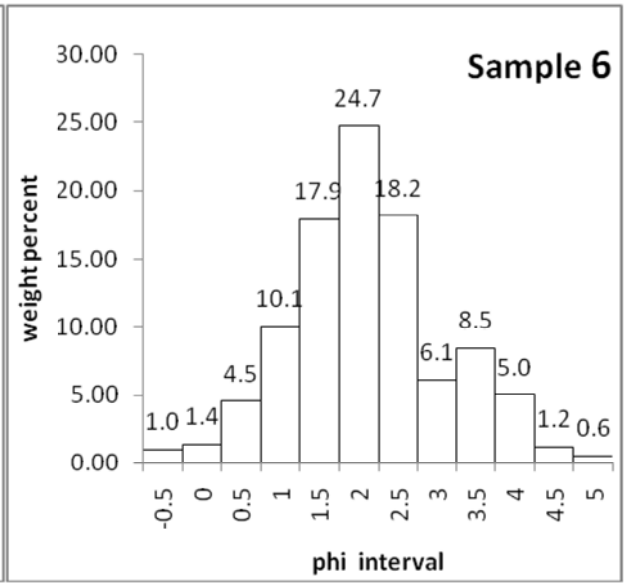
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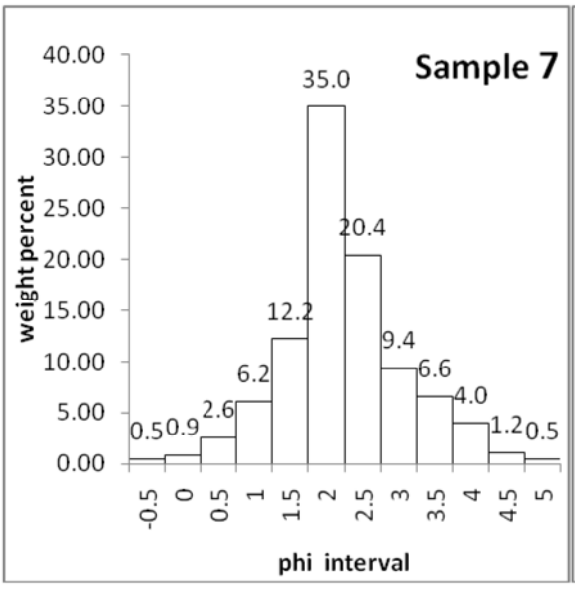
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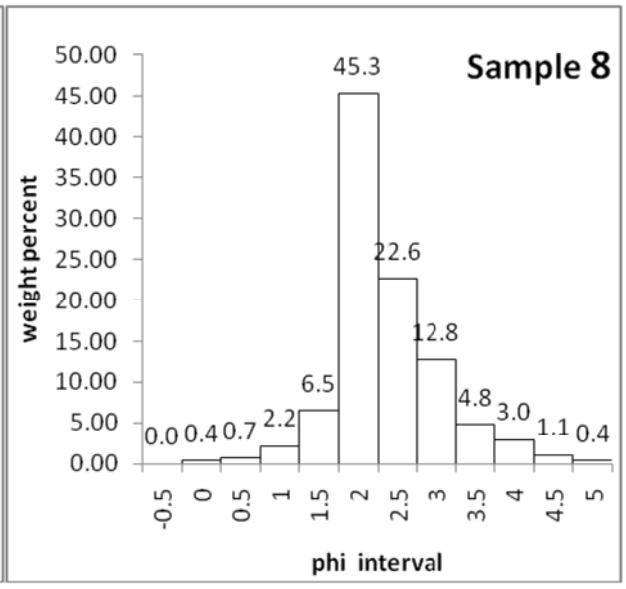
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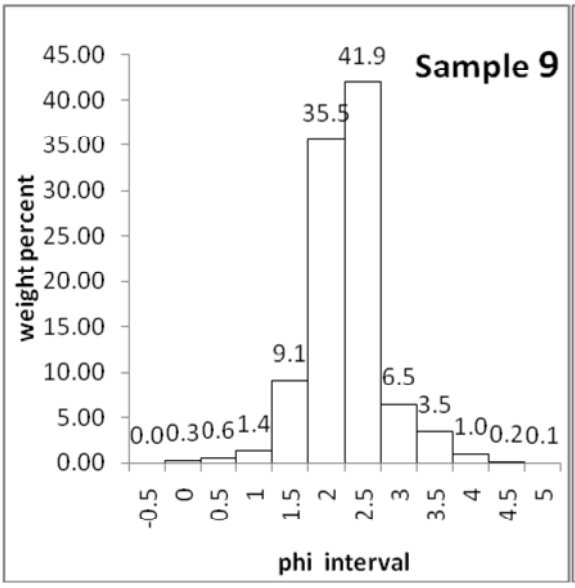
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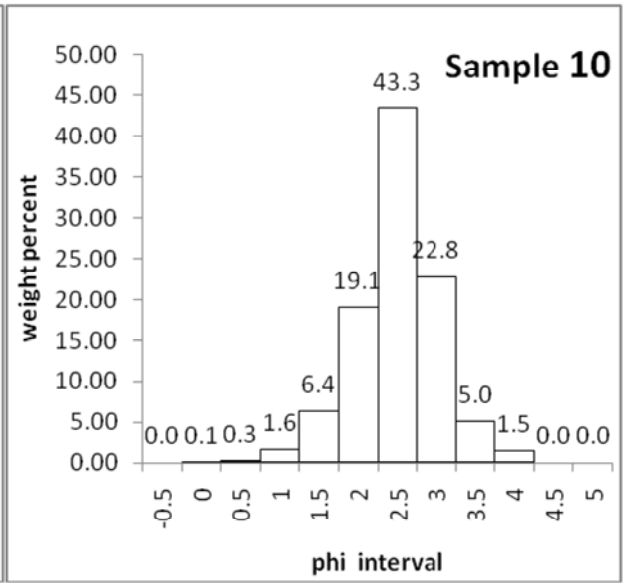
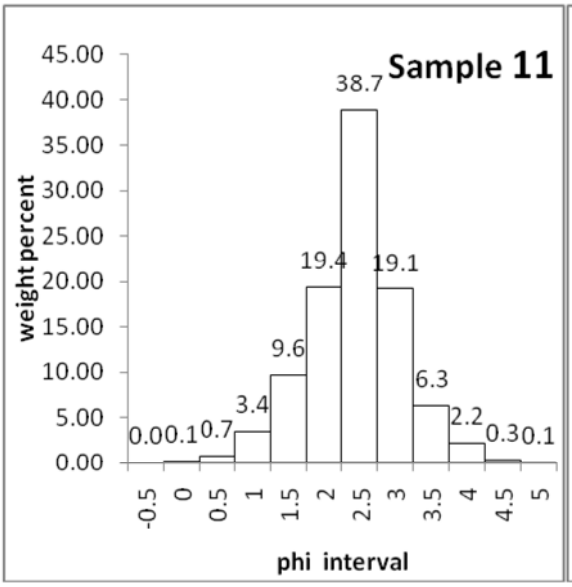
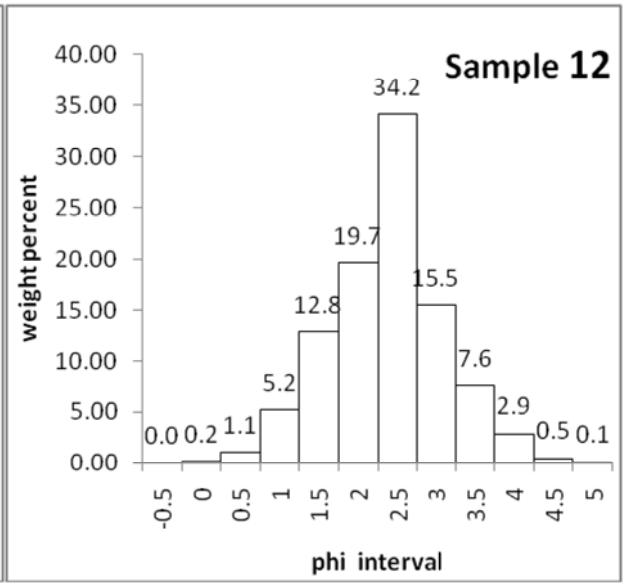
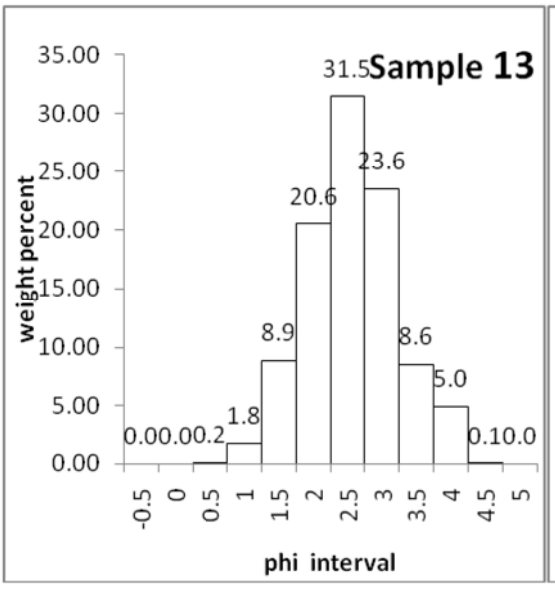
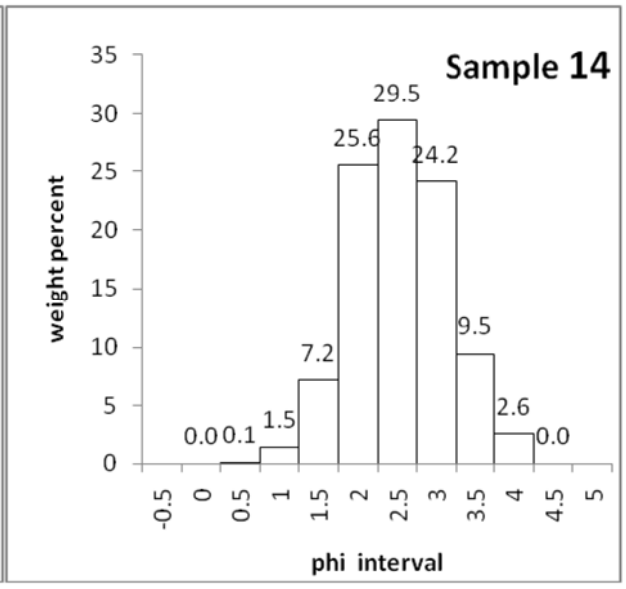
weight percent
phi interval
0.0 0.3 0.6 1.4 9.1 35.5 41.9 6.5 3.5 1.0 0.2 0.1

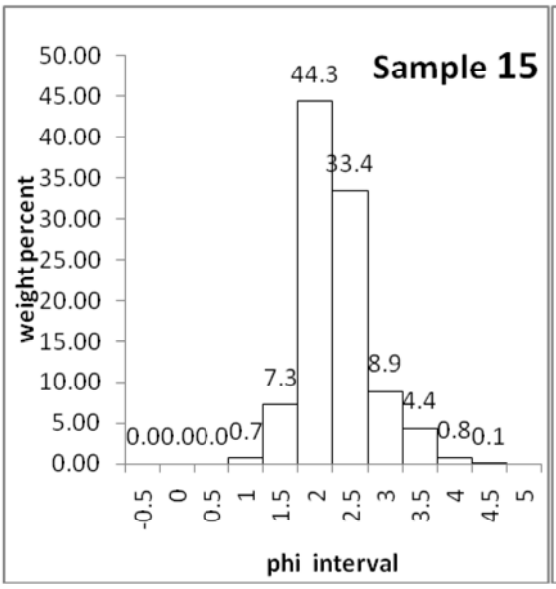

Sample 10
weight percent
phi interval
0.0 0.1 0.3 1.6 6.4 19.1 43.3 22.8 5.0 1.5 0.0 0.0

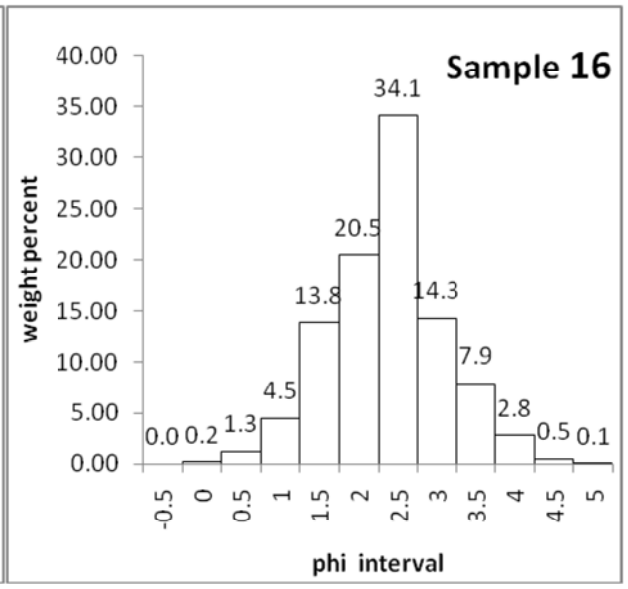

Sample 11
weight percent
phi interval
0.0 0.1 0.7 3.4 9.6 19.4 38.7 19.1 6.3 2.2 0.3 0.1

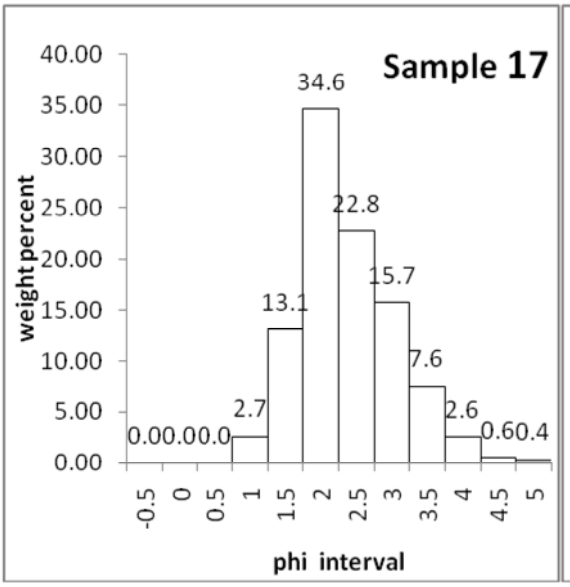

Sample 12
weight percent
phi interval
0.0 0.2 1.1 5.2 12.8 19.7 34.2 15.5 7.6 2.9 0.5 0.1

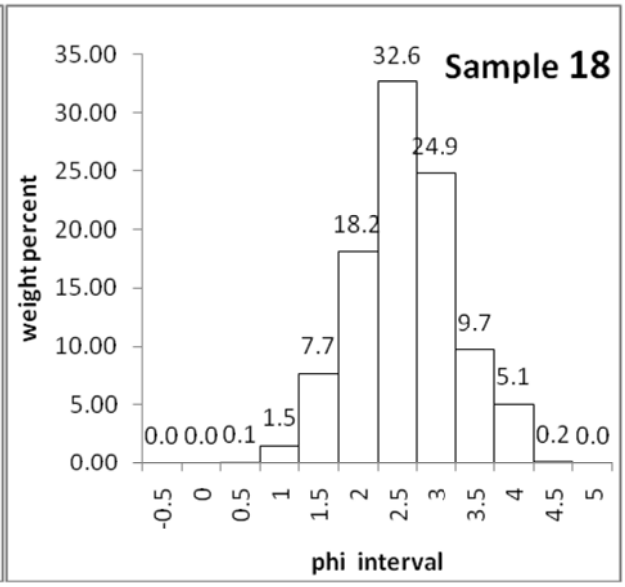

Sample 13
weight percent
phi interval
0.0 0.0 0.2 1.8 8.9 20.6 31.5 23.6 8.6 5.0 0.1 0.0

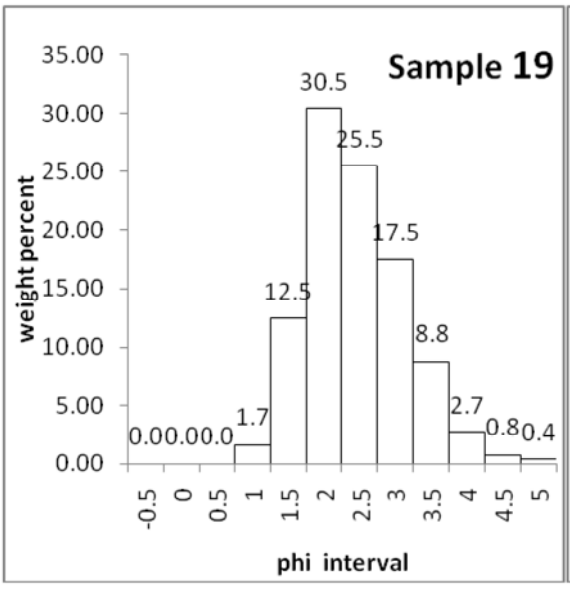

Sample 14
weight percent
phi interval
0.0 0.1 1.5 7.2 25.6 29.5 24.2 9.5 2.6 0.0

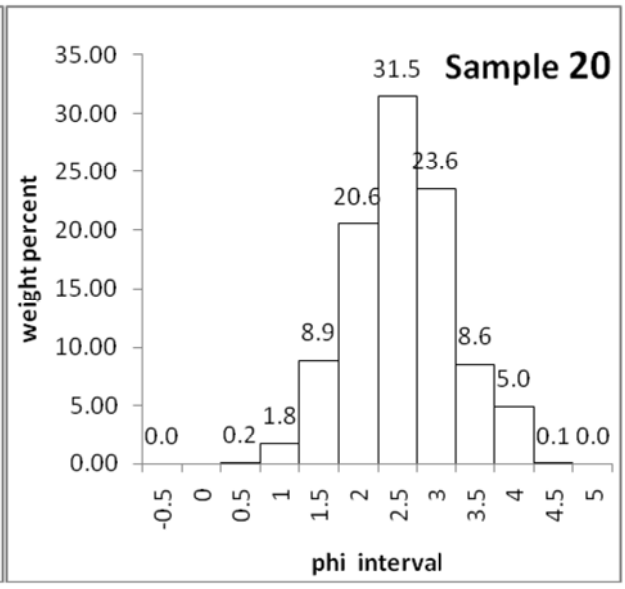

Sample 15
weight percent
phi interval
0.0 0.0 0.0 0.7 7.3 44.3 33.4 8.9 4.4 0.8 0.1

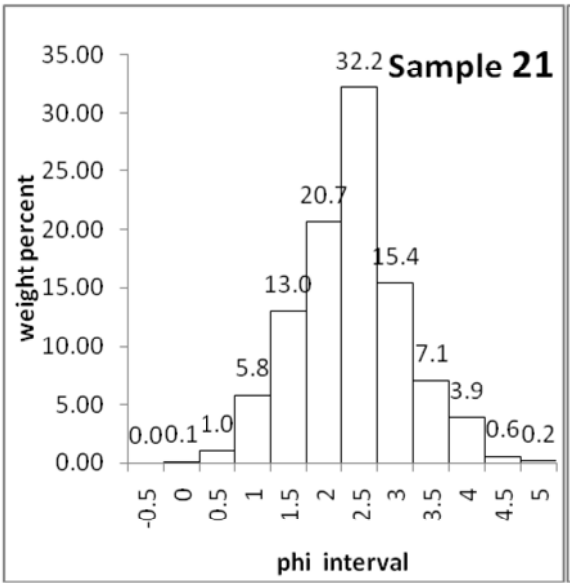

Sample 16
weight percent
phi interval
0.0 0.2 1.3 4.5 13.8 20.5 34.1 14.3 7.9 2.8 0.5 0.1


Sample 17
weight percent
phi interval
0.0 0.0 0.0 2.7 13.1 34.6 22.8 15.7 7.6 2.6 0.6 0.4


Sample 18
weight percent
phi interval
0.0 0.0 0.1 1.5 7.7 18.2 32.6 24.9 9.7 5.1 0.2 0.0


Sample 19
weight percent
phi interval
0.0 0.0 0.0 1.7 12.5 30.5 25.5 17.5 8.8 2.7 0.8 0.4


Sample 20
weight percent
phi interval
0.0 0.2 1.8 8.9 20.6 31.5 23.6 8.6 5.0 0.1 0.0


Sample 21
weight percent
phi interval
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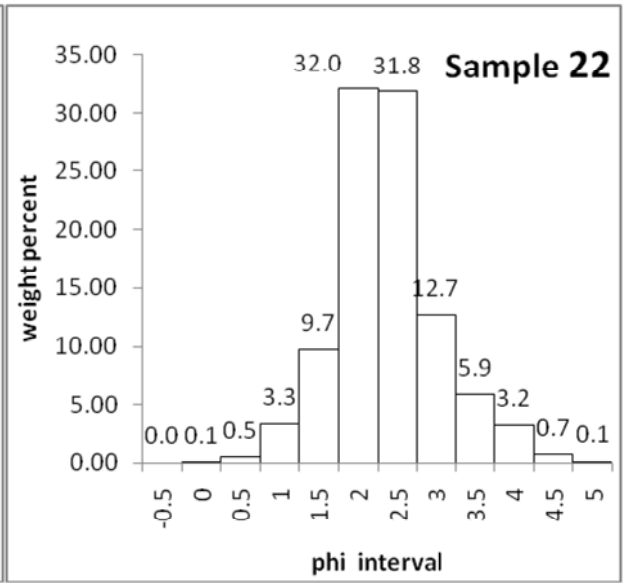
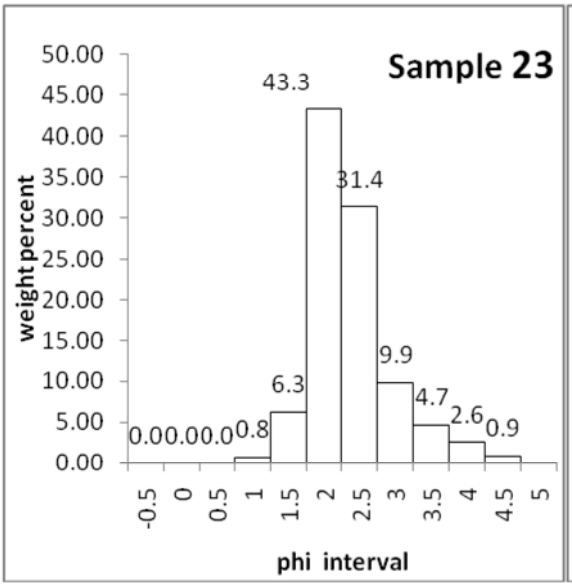
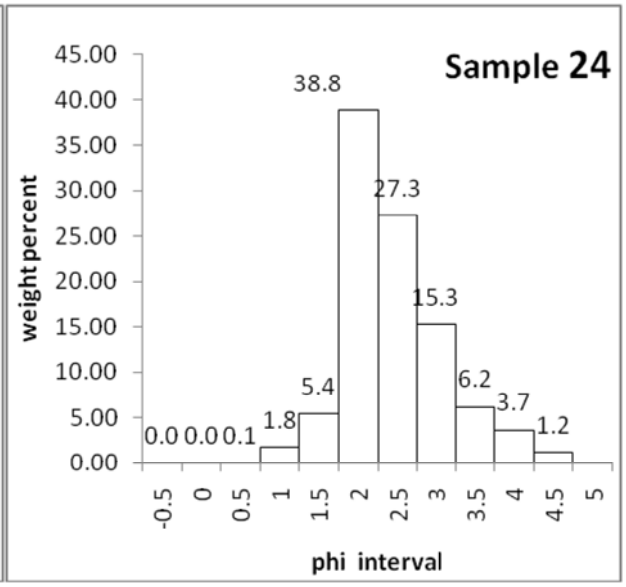
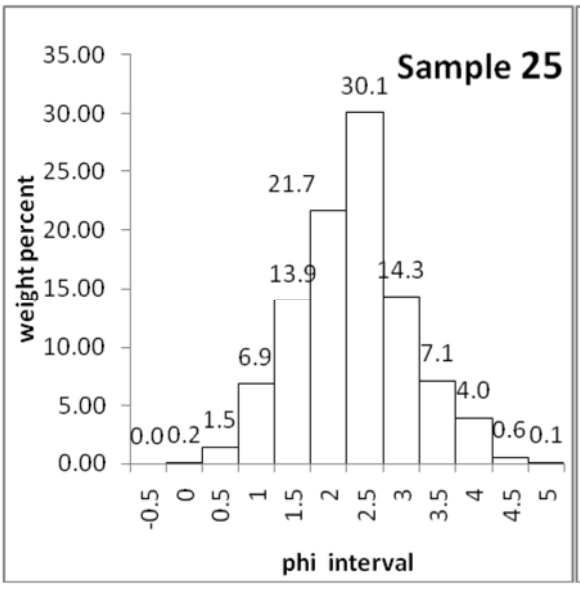

Sample 22
weight percent
phi interval
0.0 0.1 0.5 3.3 9.7 32.0 31.8 12.7 5.9 3.2 0.7 0.1


Sample 23
weight percent
phi interval
0.0 0.0 0.0 0.8 6.3 43.3 31.4 9.9 4.7 2.6 0.9


Sample 24
weight percent
phi interval
0.0 0.0 0.1 1.8 5.4 38.8 27.3 15.3 6.2 3.7 1.2


Sample 25
weight percent
phi interval
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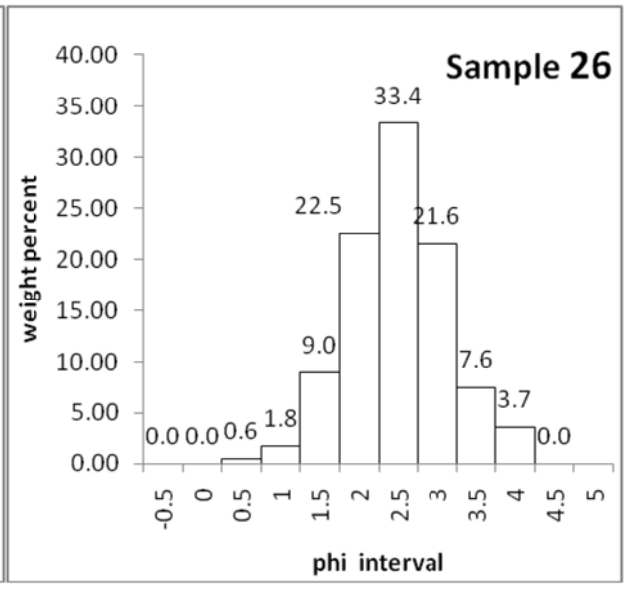
Sample 26
weight percent
phi interval
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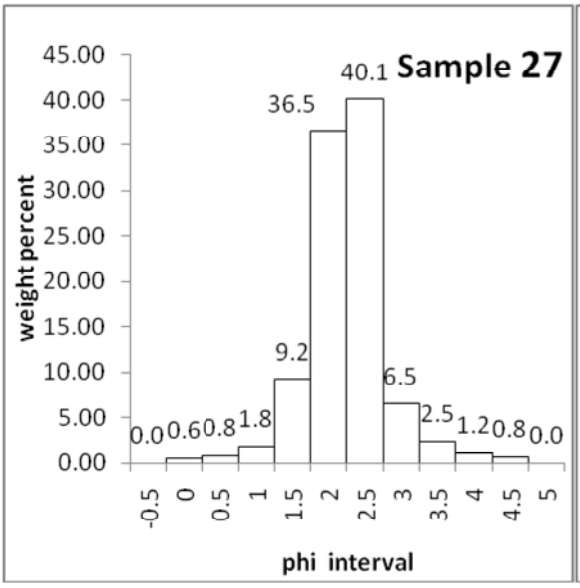
Sample 27
weight percent
phi interval
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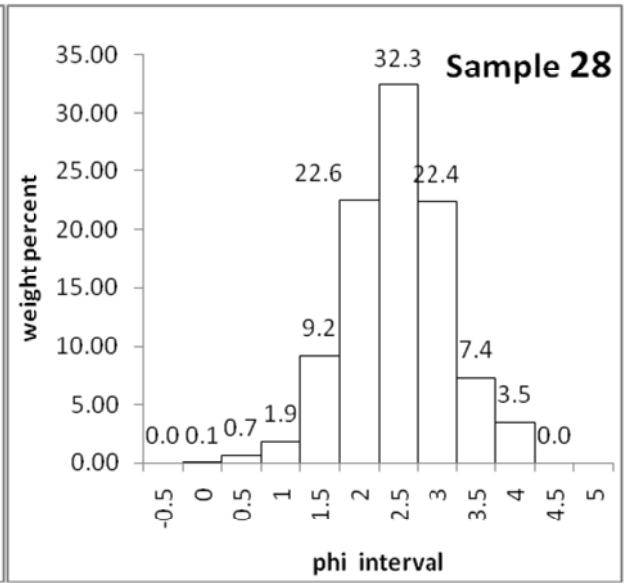
Sample 28
weight percent
phi interval
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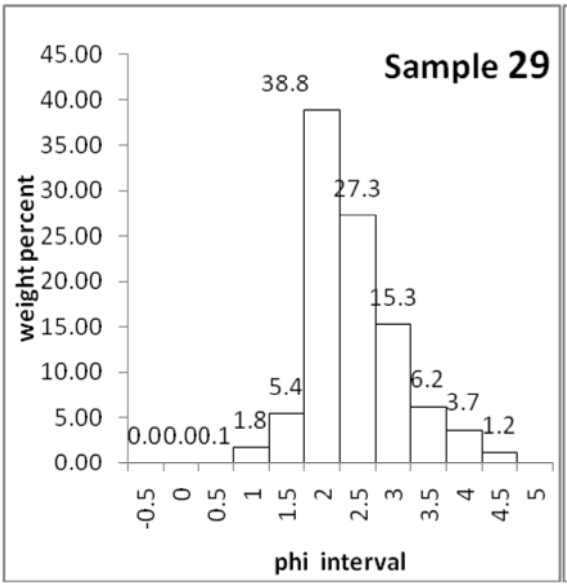
Sample 29
weight percent
phi interval
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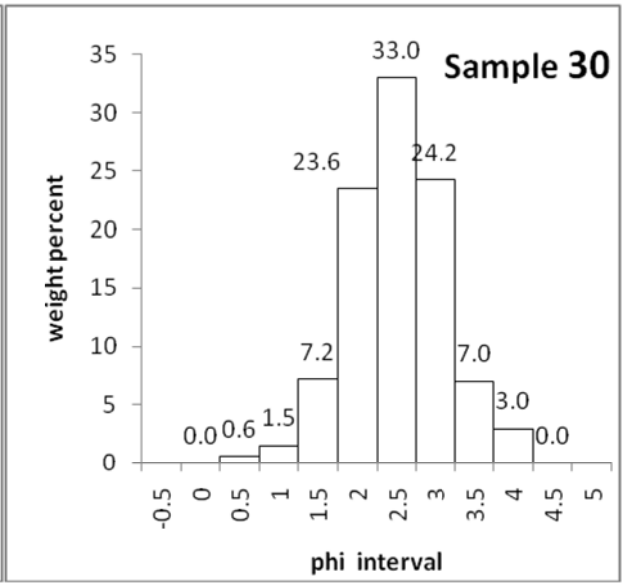
0.1
1.8
5.4
38.8
27.3
15.3
6.2
3.7
1.2


Sample 30
weight percent
phi interval
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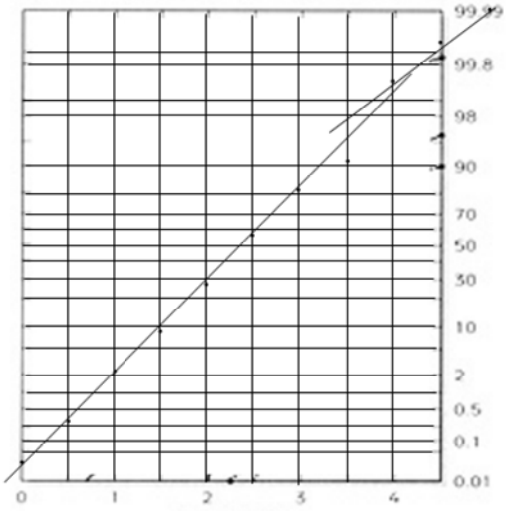
7.2
23.6
33.0
24.2
7.0
3.0
0.0

Annexure 3: Cumulative curves



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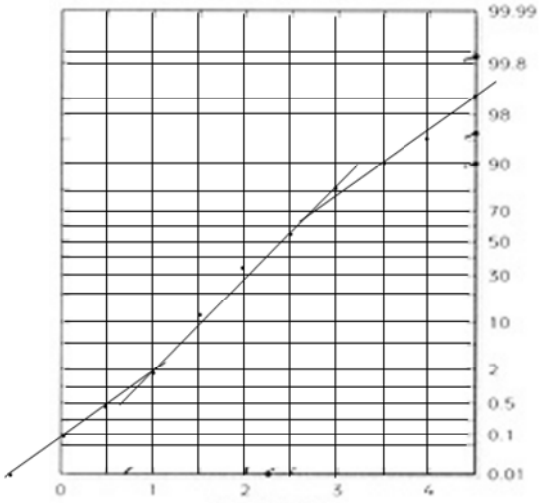

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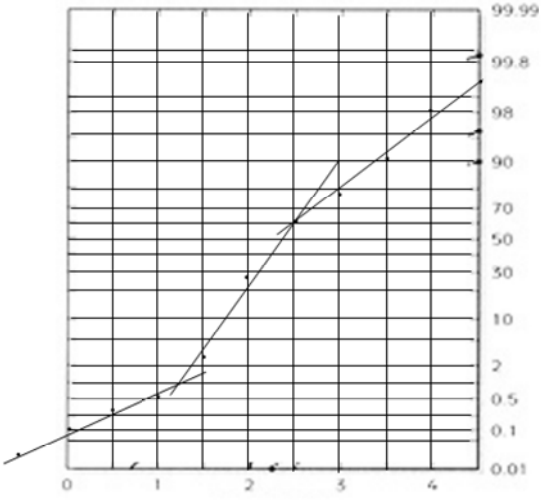

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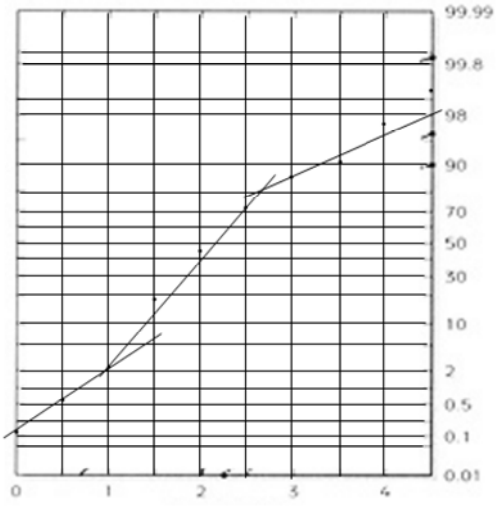

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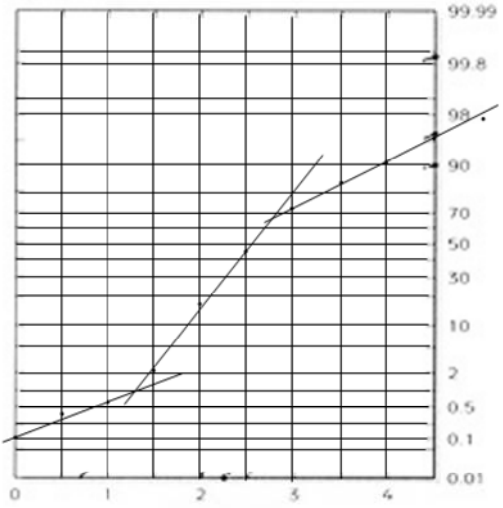

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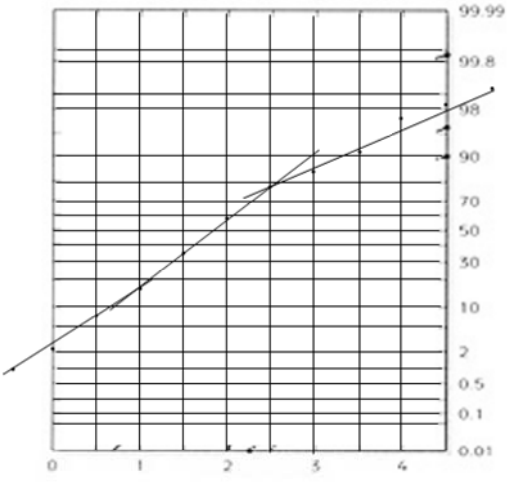

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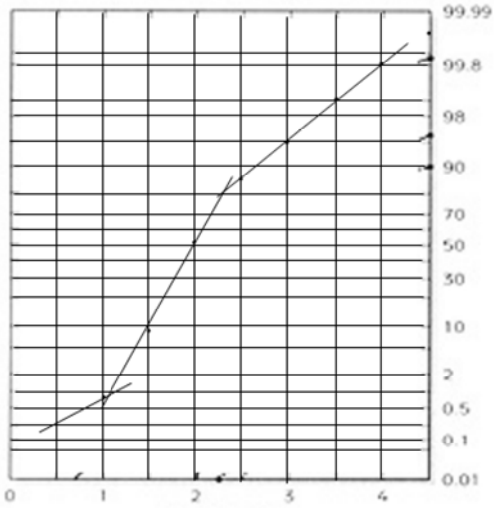
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2
0.5
0.1
0.01
0
1
2
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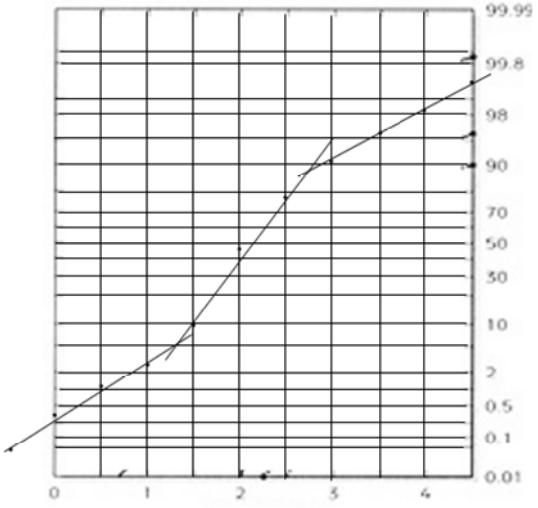
4

7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0.01
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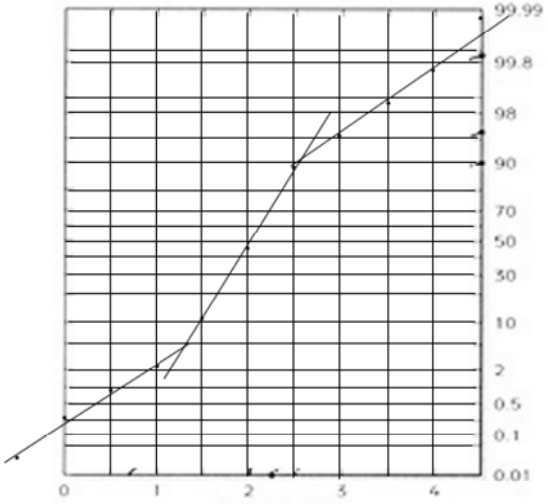
8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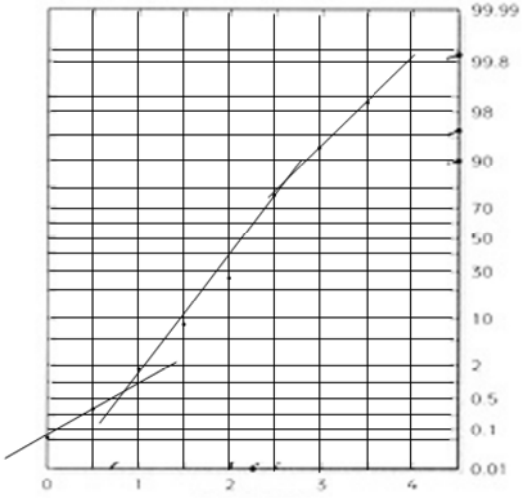
9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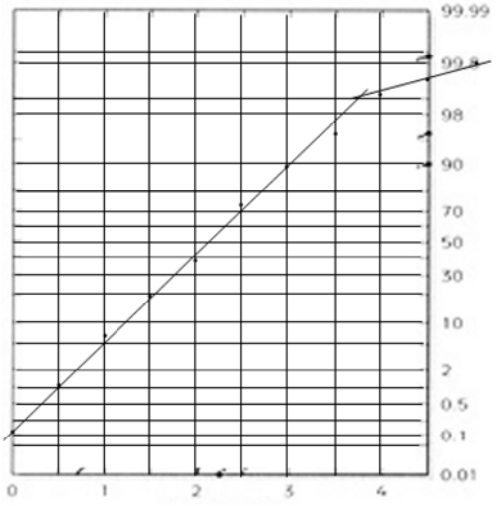
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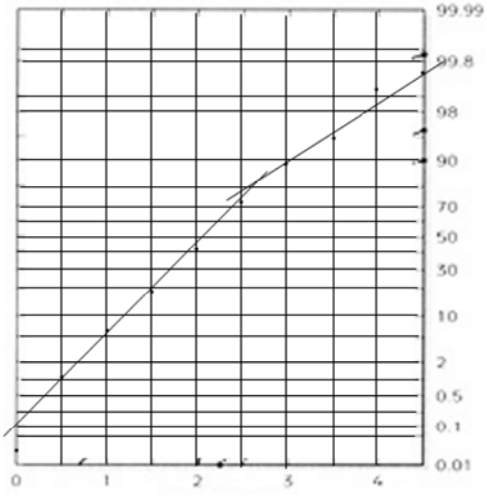
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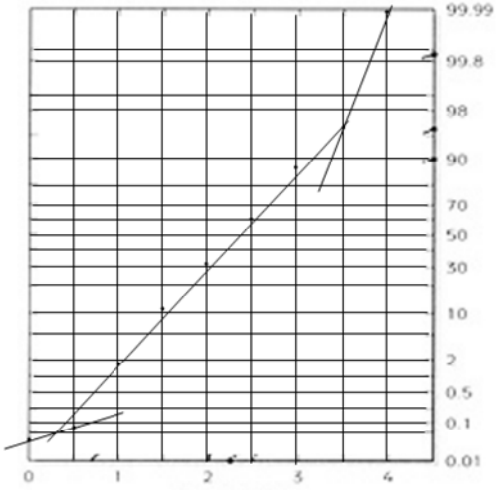
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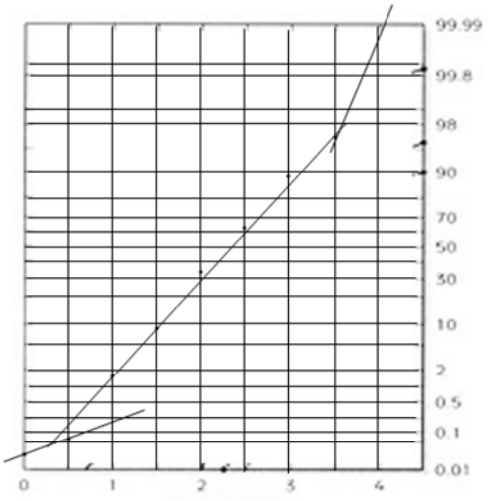
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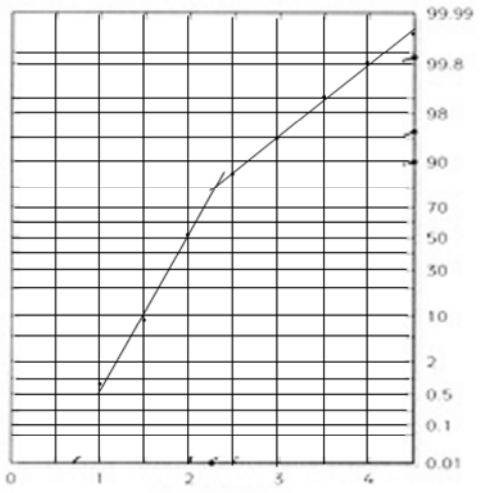
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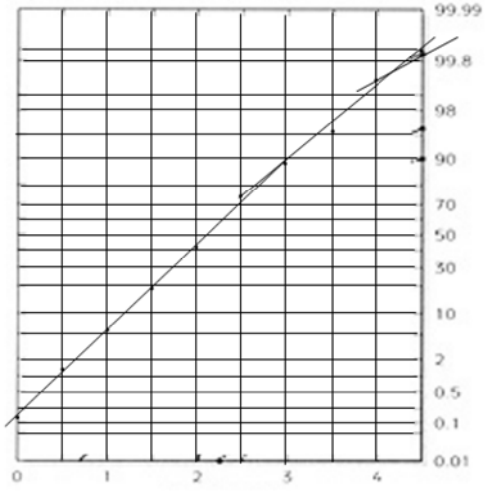
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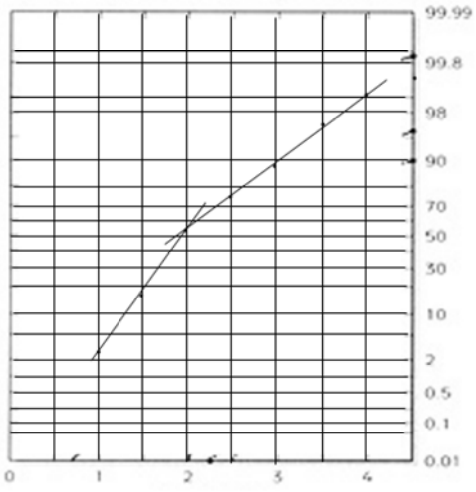
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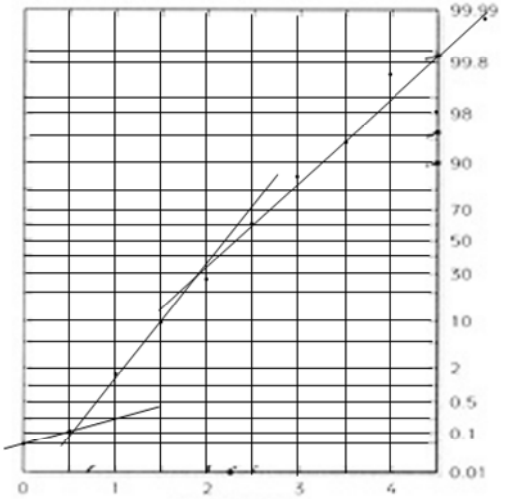
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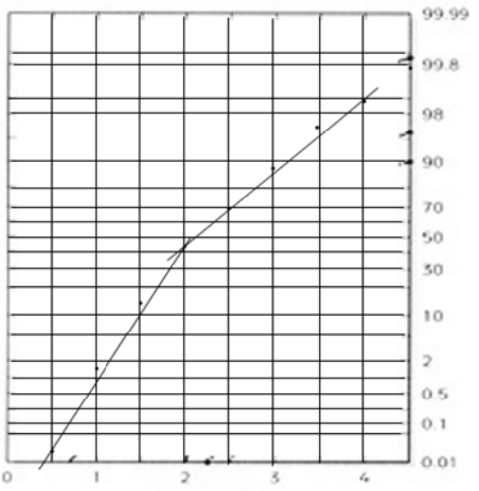

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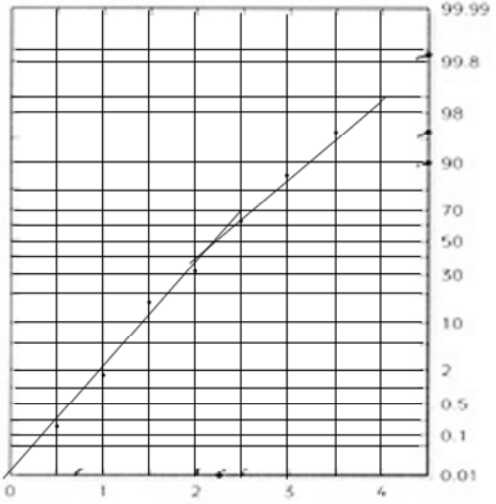

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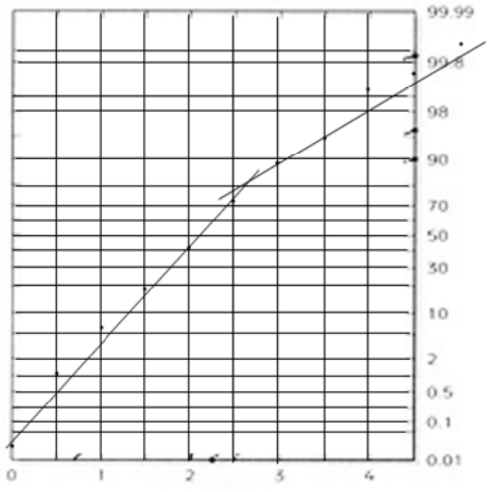

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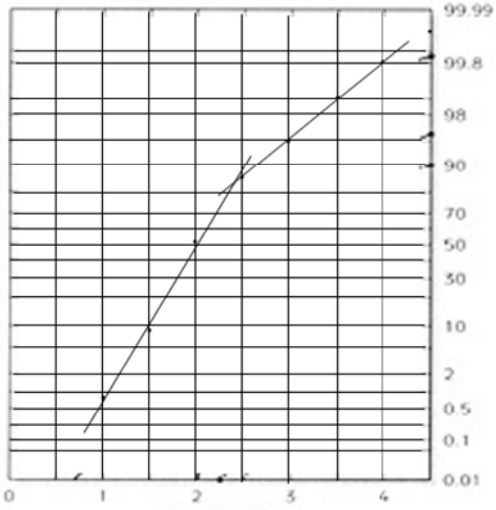

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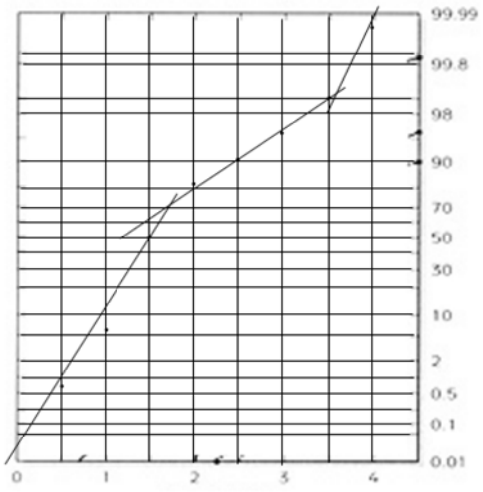
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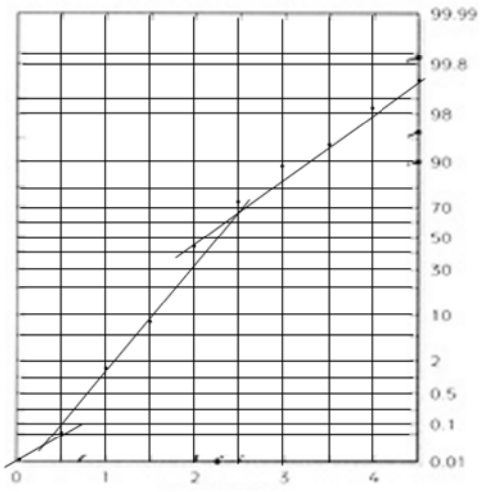
23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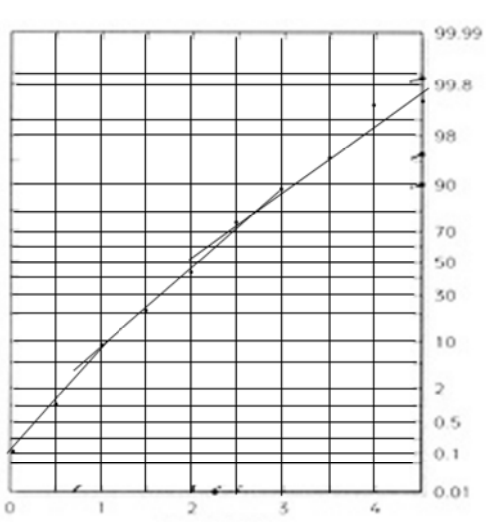
24



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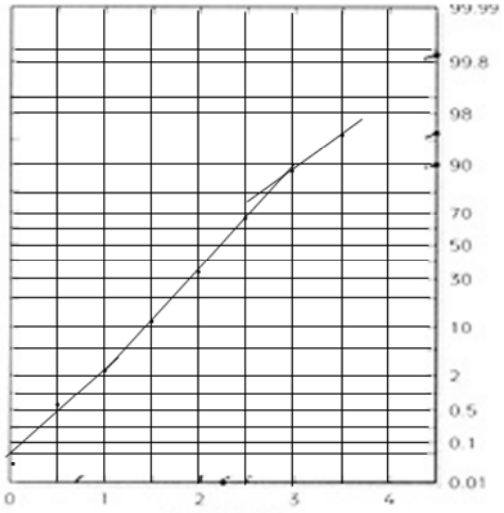

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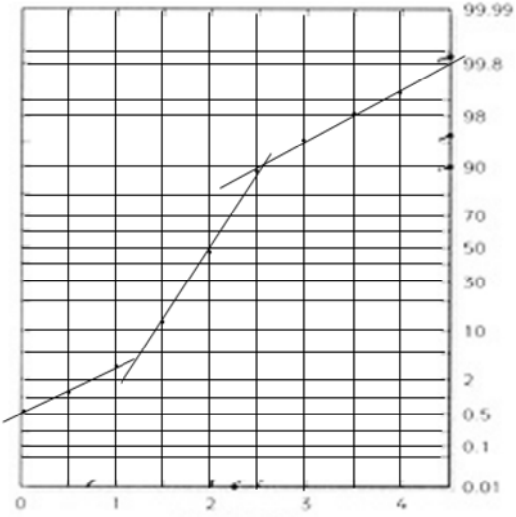

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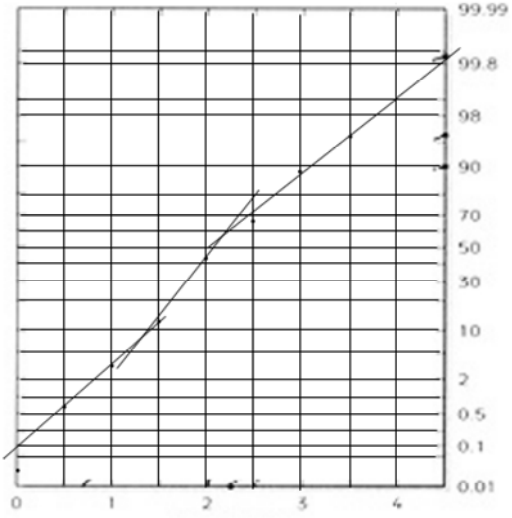

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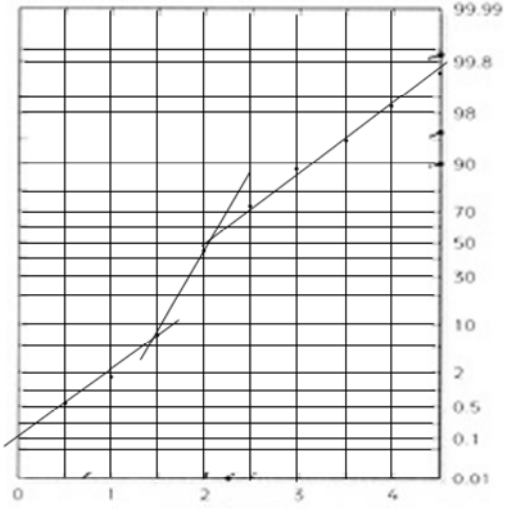

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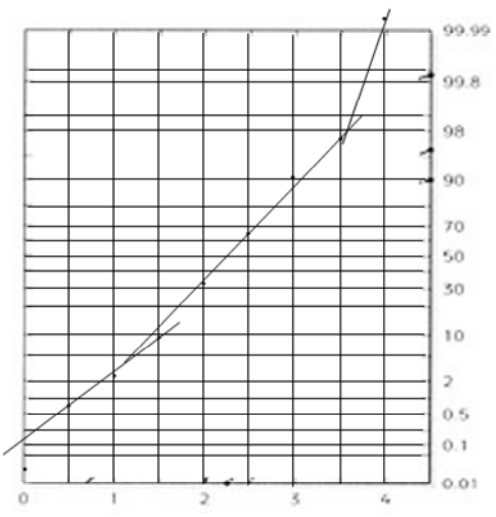

30

Annexure 4

Prosopis juliflora is an invasive weed in several countries ([1]www.ildis.org; [2]Gunasekara, 2009; [3]Mughal and Aurang Zeb, 2013) such as in India, Ethiopia, in Hawaii, in Sri Lanka, Jamaica, the Middle East, Nigeria, Sudan, Somalia, Senegal and southern Africa. It is also a major weed in the southwestern United States. It is hard and expensive to remove as the plant can regenerate from the roots ([4]www.environment.gov.au).

In Australia, *Prosopis* has colonized more than 800,000 hectares of arable land, having severe economic and environmental impacts. With its thorns and many low branches it forms impenetrable thickets which prevent cattle from accessing watering holes, etc. It also takes over pastoral grasslands and uses scarce water. Livestock which consume excessive amounts of seed pods are poisoned. It causes land erosion due to the loss of the grasslands that are habitats for native plants and animals (www.environment.gov.au)

In the Afar Region in Ethiopia, *Prosopis sp* introduced in the late 1970s and early 1980s, by its aggressive growth lead to monoculture, denying native plants water and sunlight, and not providing food for native animals and cattle. The Regional government with the non-governmental organisation FARM-Africa and pastoralists call it the "Devil Tree" and have taken measures that *P. juliflora* be eradicated. ([5]Irby, 2009)

In Sri Lanka this mesquite was planted in the 1950s as a shade and erosion control tree, invaded the grass lands in and around the Bundala National Park, causing similar problems as in Australia and Ethiopia. (Gunasekara, 2009)

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[1] *ILDIS LegumeWeb- "Prosopis juliflora - ". www.ildis.org.*

[2] Lalith Gunasekera, *Invasive Plants: A guide to the identification of the most invasive plants of Sri Lanka*, Colombo 2009, pp. 101-102.

[3] Mughal, Muhammad Aurang Zeb. 2013. "Persian Gulf Desert and Semi-desert." *Biomes & Ecosystems*, Vol. 3, Robert Warren Howarth (ed.). Ipswich, MA: Salem Press, pp. 1000-1002.

[4] Mesquite (Prosopis species)" Department of Sustainability, Environment, Water, Population and Communities,Canberra. http://www.environment.gov.au/biodiversity/invasive/weeds/publications/guidelines/wons/pubs/prosopis.pdf

[5] Caroline Irby, "Devil of a problem: the tree that's eating Africa"

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