BEFORE THE NATIONAL GREEN TRIBUNAL

WESTERN ZONE BENCH, PUNE

APPEAL NO. 26 OF 2025 (WZ)

SERIAL No. 924 2025
HIMATLAL R. JADEJA
NOTARY
GOVT. OF GUJARAT
6 DEC 2025

IN THE MATTER OF:

GO GREEN FOUNDATION TRUST ...

APPELLANT

NOTARY
NAME
HIMATLAL R. JADEJA
GA...
REGD NO ...07/09
GOVT. OF GUJARAT

VERSUS

UNION OF INDIA THROUGH SECRETARY & ORS.

...RESPONDENTS

AFFIDAVIT IN REPLY ON BEHALF OF RESPONDENT NO. 5 - GUJARAT COASTAL ZONE MANAGEMENT AUTHORITY

I, Dipali Tank, adult, having my office at Forest & Environment Department, Block No. 14, 8th Floor, Sachivalaya,

GUJARAT COASTAL ZONE MANAGEMENT AUTHORITY (GCZMA)

Dipali Tank

Gandhinagar-382010, Gujarat do hereby solemnly affirm and state on oath as under:

1. I am presently serving as Member Secretary of Gujarat Coastal Zone Management Authority in the State of Gujarat. I am conversant with the facts of the case and the status of preparation of management plans. I am authorised to file the present affidavit on behalf of the Coastal Zone Management Authority and am otherwise competent to make the present affidavit.

2. The appellant has filed the present appeal praying for the following principal reliefs:

> *"A. Quash and set aside the Environmental Clearance granted to the project proponents for the project for to produce Light Soda Ash (LSA) of 11,00,000 TPA capacity, 5,00,000 TPA capacity of Dense Soda Ash (DSA) and 2,00,000 TPA Sodium Bicarbonate (SBC) located at near village Bada, Taluka – Mandvi, District – Kutch in the Gujarat by "Greenfield Chemical Complex" of GHCL Ltd.*

GUJARAT COASTAL ZONE MANAGEMENT AUTHORITY (GCZMA)

B. Appropriate actions may kindly be taken against the Respondent No. 1, 2, 5 & 6 for recommending, granting the environmental clearance to the project in violation of the provision of EIA Notification, 2006 and CRZ Notification – 2011 for Non-compliance of the terms and conditions of the previous EC dated 12.12.2024.

C. Direct Respondent No. 1 & 2 – MoEF & EAC-2 and Respondent No. 8 & 9 – GPCB to initiate appropriate action including prosecution against the project."

3. M/s GHCL Limited submitted an application to the answering respondent on 11.10.2021 for obtaining CRZ Clearance recommendation for "seawater intake and effluent disposal facilities" for their greenfield chemical complex at Village Bada, Taluka Mandvi, District Kutch. The application was submitted along with the following documents:

- Superimposed Map of the project on the approved Coastal Zone Management Plan- on 1:4000 scale

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from Institute of Remote Sensing, Anna University, Chennai.

- Environment Impact Assessment Report by M/s. Council of Scientific & Industrial Research (CSIR) and NEERI including Marine Environment Assessment Report.
- Disaster Management Plan and Risk Assessment Report.
- Consent to Establish obtained from Gujarat Pollution Control Board.

4. M/s GHCL Limited submitted that it shall withdraw 16,00,000 m^3/day of seawater from two intake locations and dispose 15,80,000 m^3/day of treated effluent at two outfall locations. M/s GHCL Limited submitted following studies in support of its proposal submitted to the answering respondent:

- Baseline Marine Environmental Assessment, Effluent Dispersion Modeling and Sand Dune Morphology by CSIR NIO (Goa, Mumbai).

GUJARAT COASTAL ZONE MANAGEMENT AUTHORITY (GCZMA)

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As per the findings in this study, a suitable corridor was identified for laying seawater intake and outfall facility. Moreover, the coast area near the project site was stated to be stable based on satellite image analysis and was declared to be suitable for tunnelling activity.

- Conservation plan as per Schedule-1, Species by Gujarat Institute of Desert Ecology, Gujarat.
- Conservation plan as per Schedule-1, suggested by Forest Department, State of Gujarat in view of presence of endangered plant species "Commiphorawightii" in the buffer area of the project.
- Report on Sea Turtle by Zoological Survey of India, Kolkata.
- Seawater Intake and Effluent Disposal Feasibility Consultancy by STUP Consultancy, Ahmedabad.

5. Sub-committee of the answering respondent, comprising of expert member of GCZMA, officers from GPCB and

Technical Cell (FED) and representatives of M/s GHCL Limited visited the site on 27.04.2023. They prima facie found that there will be no impact on sand dunes due to underground construction of tunnel for the sea water suction and disposal of treated water in sea. The unit declared that it shall use the best available technology for underground tunnel construction to ensure minimum impact on the surface soil. Ultimately after evaluating all factors, the answering respondent in its 67th meeting held on 04.08.2023 decided to recommend grant of CRZ clearance for seawater intake and disposal facility to the Ministry of Environment, Forest and Climate Change basis the data and technical studies conducted and presented by M/s GHCL Limited.

6. The answering respondent by its letter dated 26.12.2023 issued a CRZ Clearance recommendation letter with various specific and general conditions keeping in mind the need for preservation of environment. Some of the specific conditions incorporated by the answering

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respondent in its CRZ Clearance recommendation letter are as follows:

- 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. M/s GHCL Limited shall install necessary facilities for this purpose and shall strictly ensure the compliance with the GPCB norms, round the clock.
- The pipelines for seawater intake and effluent disposal shall be laid in a safe manner so that the sand dunes stretch between the plant boundary and respective land fall points (LFP) are protected without any disturbance to their natural appearance and stability.
- The pipeline shall be monitored regularly by M/s GHCL Limited and it shall be ensured that there is no leak from the pipeline. In case of any such eventualities, M/s GHCL Limited shall immediately stop disposal through the said pipeline and take the

GUJARAT COASTAL ZONE MANAGEMENT AUTHORITY (GCZMA)

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corrective measures in consultation with the GPCB and the District Collector.

- There shall not be any blockage of creek/river etc due to laying of pipeline, and free flow of water shall be maintained.
- All the recommendations and mitigation measures suggested for sea turtle conservation plan shall be complied with by the GHCL.
- The GHCL shall ensure that there will not disturbance to nearby Ecologically Sensitive area for their proposed project.

A copy of CRZ Clearance recommendation letter dated 26.12.2023 is annexed herewith and marked as **Annexure R-1**.

7. The role of the State Coastal Zone Management Authority is limited to making a recommendation on grant of the clearance. The final decision is to be taken by the Ministry of Environment and Forest Clearance, Government of India.

GUJARAT COASTAL ZONE MANAGEMENT AUTHORITY (GCZMA)

8. In the instant case, post the receipt of recommendation from the State Coastal Zone Management Authority, the proposal of the project proponent was independently examined and evaluated by the Expert Appraisal Committee of the Ministry. The Committee too recommended the clearance. Basis the recommendations and not finding any other legal or factual infirmity in the positive opinion given by the State Coastal Zone Management Authority as well as by the Expert Appraisal Committee, the Ministry of Environment and Forest Clearance, Government of India granted the CRZ clearance to M/s GHCL Limited subject to compliance of conditions mentioned by the answering respondent in its CRZ Recommendation letter dated 26.12.2023 by its letter dated 12.12.2024.

9. The appellant has assailed the clearance by contending that the project site is a nesting place for various species of sea turtle and that "forest department and organisations working in the field of the environment confirmed the existence of the endangered sea turtles."

The appellant has also alleged that the construction activity involved in the project is likely to disturb the nesting process of sea turtles. The assertion made by the appellant in support of its allegation is not based on any cogent documentary material. As against that, M/s GHCL Limited has submitted an study conducted by Zoological Survey of India, Kolkata on the presence of sea turtles wherein it is categorically opined that the project area is unfavourable for nesting of sea turtles and that during the monitoring period of six months i.e. between September, 2018 to March, 2019 no turtle, fresh /old nests or crawl marks were found. Thus, the possibility of nesting of sea turtle species was stated to be comparatively less. Nevertheless, M/s GHCL Limited has submitted a conservation plan prepared by Gujarat Institute of Desert Ecology to Principal Chief Conservator of Forest, State of Gujarat for protection of animal species as per Schedule-I of Wildlife Protection Act, 1972. The conservation plan has been duly approved by Principal Chief Conservator of Forest, State of Gujarat on 24.04.2023. A copy of the

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GUJARAT COASTAL ZONE MANAGEMENT AUTHORITY (GCZMA)

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study conducted by Zoological Survey of India, Kolkata is annexed herewith and marked as **Annexure R-2**. A copy of conservation plan Principal Chief Conservator of Forest, State of Gujarat is annexed herewith and marked as **Annexure R-3**. The State Coastal Zone Management Authority has taken a holistic view and has included strict conditions in its recommendation so as to sufficiently address the issue.

10. The other ground alleged by the appellant to assail the recommendation and the clearance is that the laying of pipelines is likely to harm the sand dunes and adversely impact the ecology. The pipelines are proposed to be laid below the surface level. M/s GHCL Limited has obtained and submitted a report from Gujarat Institute of Desert Ecology which states that that the laying of pipelines is not likely to affect the sand dunes and provides for mitigation measures to be observed by M/s GHCL Limited at the time of digging the tunnel and laying the pipelines. A copy of the report prepared by Gujarat Institute of

Dipali Tank

Desert Ecology is annexed herewith and marked as **Annexure R-4**. Strict monitoring shall be done to ensure total compliance of the condition mandating exercise of utmost care and caution while undertaking the construction activity.

11. I submit that for these reasons and any other reasons which may be advanced at the time of arguments, the present appeal deserves to be dismissed.

Dipali Tank

DEPONENT

VERIFICATION

Verified at Gandhinagar on this 6th day of December, 2025 that the contents of the above affidavit are true and correct, nothing stated therein is false and nothing material has been concealed therefrom.

Dipali Tank

DEPONENT

Director (Environment) &
Member Secretary, GCZMA
Forests & Environment Department
Government of Gujarat
Gandhinagar

SOLEMNLY AFFIRMED
BEFORE ME

HIMATLAL R. JADEJA
NOTARY
GOVT. OF GUJARAT

6 DEC 2025

D. M. Thaker
Director (Environment) &
Member Secretary (GCZMA)

Government of Gujarat
Forest & Environment Department
Block No-14/8th Floor,
Sachivalaya, Gandhinagar

Phone:079- 23255854
E-mail: direnv@gujarat.gov.in

File no. ENV/10/2021/184/T-cell Date: 26 DEC 2023

To,
Dr. H. Kharkwal
Director (CRZ)
Ministry of Environment, Forest and Climate Change,
Government of India,
Room No. 215, 2nd Floor, Agni Block
Indira Paryavaran Bhavan, Jor Baugh,
Aliganj Road, New Delhi – 110 003.

Subject: CRZ Clearance for Proposed Greenfield Chemical Complex seawater intake and effluent disposal facilities at village Bada, Ta –Mandvi, Dist-Kutchh by M/s.Gujarat Heavy Chemicals Limited(GHCL).

Reference: CRZ application dated.11.10.2021

Dear Sir,

M/s. Gujarat Heavy Chemicals Limited (GHCL)vide application dated. 11-10-2021 submitted an application seeking recommendation from Gujarat Coastal Zone Management Authority (GCZMA) for obtaining CRZ Clearance from the Ministry of Environment, Forests and Climate Change, Government of India for Greenfield Chemical Complex seawater intake and effluent disposal facilities at village Bada, Taluka Mandvi, Dist-Kutchh.

M/s. GHCL has submitted the following documents along with their application and processing fees:

1. Form -1 as per CRZ Notification 2011,

2. CRZ Maps in 1:4000 scale, prepared by Institute of Remote sensing, Anna University, Chennai,
3. EIA report prepared by Council of Scientific & Industrial Research (CSIR) and NEERI.
4. Marine EIA prepared by CSIR- National Institute of Oceanography.
5. Feasibility study report by STUP Consultant Private Limited, Ahmedabad.
6. Consent to Establish from Gujarat Pollution Control Board issued on 09.09.2011.
7. NOC from GMB issued on 10.02.2022.
8. Various Undertaking Submitted by Project Proponent for CRZ Clearance.

M/s. Gujarat Heavy Chemicals Limited (GHCL) submitted EIA report including introduction and project overview (chapter – 1), Project Description (Chapter - 2), Description Environment (chapter – 3), Anticipated impacts & Mitigation Measures (chapter – 4), Analysis of Alternatives (chapter – 5), Environmental Monitoring Program (chapter – 6), Additional Studies (chapter – 7), Project Benefits (chapter – 8), Environmental Cost Benefit Anlysis (chapter – 9), Environmental Management Plan (chapter – 10), Summary and Conclusions (chapter – 11) and Disclosure of Consultant Engaged (chapter – 12). Council of Scientific & Industrial Research (CSIR) and NEERI consultant carried out EIA.

The Proposal of GHCL was discussed in the GCZMA committee during 67th meeting held on 4th August 2023.

The Member Secretary, GCZMA apprised the Authority that M/s. GHCL presented their case in GCZMA meeting held on 17.01.2022. Additional detail sought (ADS) by GCZMA via mail on 01.02.22. PP replied on 29.11.22 & 26.12.22 and requested for conducting site-visit. GCZMA constituted a sub- committee and got visited the site on 27.04.23.

PP submitted details sought by the committee vide its letter dated 29.04.23. PP submitted final EIA report and public hearing details submitted on 29.11.22 to GCZMA. As forestland involved in the proposed project, they got Stage-1 approval on

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18.07.23 and submitted Olive Riddly Turtle conservation plan approved on 24.04.23 from Forest Department along with Sand dunes conservation plan on 29.11.22.

The representative of M/s GHCL Ltd made a detailed presentation before the Authority and submitted that GHCL is a diversified company with footprint in Chemicals, Textiles and Consumer product segment. In Chemical sector, the company is mainly in the business of manufacturing Soda Ash (i.e. Anhydrous Sodium Carbonate) and Sodium Bicarbonate. It is one of the leading producers of Soda Ash in the country since 1988.

- The site is in proximity to Sea, which is the only source available for uninterrupted water supply to manufacturing plant. Seawater is required for meeting requirements for RO-DM plant, process cooling, dilution requirements, domestic use etc.

- A huge and increasing focus on renewable energy with government and private sector investment in such sources is strongly driving global demand for soda ash. This project will also support the demand of Soda Ash as it is a key raw material in the processing of lithium, a key component of lithium-ion batteries which is used in electric vehicles. Another key downstream product manufactured from Soda Ash, is emerging as a solution of choice for emission control applications.

- GHCL had signed an M.O.U in Jan-2017 during Vibrant Gujarat Summit, 2017 for establishment of Greenfield Chemical complex in district Kutch, Gujarat. GHCL proposes to set up a Greenfield Chemical complex having
  - ✓ Light Soda Ash (11,00,000 TPA),
  - ✓ Dense Soda Ash (5,00,000 TPA) and
  - ✓ Sodium bicarbonate (2, 00,000 TPA) manufacturing plants
  - ✓ supported by utilities like solid fuel based captive Co-generation power plant (120 MW),
  - ✓ seawater intake (16,00,000 m3/day) and
  - ✓ effluent outfall system (15, 80,000 m3/day),
  - ✓ RO-DM system and associated infrastructure.

- As per the proposal, M/s GHCL will withdraw 16,00,000 m^3/day of water from two intake locations and the disposal of 15,80,000 m^3/day of effluent at two out fall locations and its co-ordination are as follows,

Label	Latitude	
Intake Point 1	22^0 52' 1.070'' N	69^0 7' 28.900'' E
Intake Point 2	22^0 51' 57.440'' N	69^0 7' 32.440'' E
Outfall Point 1	22^0 52' 15.790'' N	69^0 6' 14.350'' E
Outfall Point 2	22^0 52' 6.650'' N	69^0 5' 59.080'' E

- Total length of sea water intake and out fall effluent disposal pipeline falls in various CRZ area are as follows,

Pipeline	CRZ- Classification	Length in m
Intake Pipeline 1	CRZ IA	267.17
	CRZ IB	60.25
	CRZ III (200 m to 500 m from HTL)	105.81
	CRZ IVA	948.76
	Total	**1381.99**
Intake Pipeline 2	CRZ IA	270.37
	CRZ IB	57.44
	CRZ III (200 m to 500 m from HTL)	98.57
	CRZ IVA	962.26
	Total	**1388.64**
Outfall Pipeline 1	CRZ IA	380.92
	CRZ IB	81.78
	CRZ III (No Development Zone)	17.88
	CRZ III (200 m to 500 m from HTL)	66.4
	CRZ IVA	2101.48
	Outside CRZ	121.71
	Total	**2770.17**
Outfall Pipeline 2	CRZ IA	379.67
	CRZ IB	83.36
	CRZ III (No Development Zone)	17.88
	CRZ III (200 m to 500 m from HTL)	67.66
	CRZ IVA	2623.88
	Outside CRZ	110.03
	Total	**3281.88**

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As per the CRZ map prepared by the Institute of Remote Sensing, Anna University, Chennai. Proposed project activities are permissible under the clauses no. 3 (I) (a) , 4 (II) (d), 8 I (i)-b, (ii)- b, 8 III A(iii) j, k , 8 (IV) a of CRZ notification, 2011. Activity wise details of CRZ zone are as under:

Activities	Zone
Construction of process plant and utilities etc.	outside CRZ area
Effluent collection	outside CRZ area
Seawater Intake system i.e. sump and pump house	CRZ III
Intake Pipeline	CRZ IA, CRZ IB and CRZ IV
Outfall Pipeline	CRZ IA, CRZ IB and CRZ IV

Following Studies have been conducted by Project Proponent:

- Baseline Marine Environmental assessment, Effluent Dispersion Modeling, Sand dune Morphology by CSIR NIO (Goa, Mumbai). As per the findings, Suitable Corridor for laying seawater intake and outfall identified. Coast near site is Stable based on satellite image analysis and Sand dunes are found to be stable and suitable for tunneling activity.
- Conservation plan of Schedule - 1 Species by Gujarat Institute of Desert Ecology, Gujarat
- Status Survey and Conservation by Zoological Survey of India, Kolkata: Finding of the study stated that during monitoring period any turtle, fresh /old nests or crawl marks were not found. Due to narrow beach width, vegetation cover, slope, presence of pebbles and rubbles and presence of predators at project site which are unfavorable for sea turtle nesting.
- Gujarat Sea Turtle: Status Survey and Conservation by Gujarat Institute of Desert Ecology,
- Seawater Intake & Effluent Disposal Feasibility Consultancy by STUP Consultancy, Ahmedabad.

As the study on Biodiversity and Wild life, No notified protected area within Study area, Presence of critically endangered plant species Commiphora wightii in

buffer area, Conservation plan suggested for Schedule I Flora and Fauna & approved by forest department and No important wetland or bird areas are located within project vicinity.

Design and detailed construction methodology:

- Micro tunneling are done using the pipe jacking method. The pipelines for seawater intake and effluent disposal are required to be laid in a safe manner so that the sand dunes stretch between the plant boundary and respective land fall points (LFP) are protected without any disturbance to their natural appearance and stability.
- In such sensitive and difficult terrains tunneling offers a reliable technological solution. The treated effluent will be discharged at a suitable location off Bada coast through buried pipeline up to shore and submarine pipeline up to disposal location in sea.
- Minor change of alignment of pipeline may be required as per required depth for intake well construction & hydraulics requirement without changing landfall point and CRZ corridor. Reputed agency M/s RHDHV is engaged .
- For sand dune stretch the effluent disposal pipeline will be laid through tunneling. There will be no disturbance to stable sand dunes along the coast, as pipeline will be laid underground through micro tunneling method.
- The predicted max. water temperature in a small area around diffuser 33°Which is lower than threshold of 35°C. Incremental increase of SS in a limited area around diffuser is unlikely to negatively influence the biota even in the vicinity of diffuser. Fine SS particles would remain in suspension for longer duration and impart a milky hue around diffuser, as SS in effluent is non toxic this will not impact the water quality. Estimated benthic loss due to seawater intake is about 141.6 kg. and 331 kg. For outfall. Such loss is unlikely to be reflected on overall bio potential of Bada coast. This loss would be temporary and benthos will recolonize in due course after construction phase gets completed. The new structures will provide additional surface area for sub-tidal benthos to colonies.
- As the study on Biodiversity and Wild life, No notified protected area within Study area, Presence of critically endangered plan species Commiphora wightii

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in buffer area, Conservation plan suggested for Schedule I Flora and Fauna & approved by forest department and No important wetland or bird areas are located within project vicinity.

- It was further submitted by the representative of GHCL that there is no existence of mangrove in proposed project areas for lying of intake and outfall pipelines and there would not be any impact on mangroves due to proposed activities.

Diffuser details:

Installation depth of water at the outfall location-OF2_1	: 9.4 m CD
Installation depth of water at the outfall location-OF2_2	: 10.7 m CD
Outfall Pipe Diameter (ID)	: 2.0 m
Number of outfall pipelines	: 2 Nos.
Length of the pipelines(L)	: 2185 & 2686 m
Design outfall flow rate (Q)	: 1580 MLD
HDPE Inner Diameter of Pipe	: 2000 mm
Pipe friction factor	: 0.001
Density of sea water	: 1025 kg/m^3
Effective depth for dilution	: 9.4 to 10.7m
No. of ports provided	: 20 in each diffuser
Diameter of port	: 440 mm
Length of Diffuser Block	: 100m each
Height of vertical riser	: 1.0m
Ports space	:@ 6000 mm c/c
The main diffuser pipe is buried	:2.0 m below the sea bed
Initial dilution estimated as	30 to 40 times.
Diffuser Port Velocity	: 3.01 m/sec

The port configuration consists of a riser pipe of 440 mm diameter at 15 degrees to the main diffuser pipe segment with a height of 1500 mm below the sea bed and 500 mm above the sea bed. From the model results, it is found that the average dilutions of 30 to 40 times would be achieved along with the tidal variation in the case of 1580000 m^3/day discharge. To get this dilution time, the diffuser system should

contain 40 ports having a 0.44 m diameter. The diffusers should be separated at a distance of 6 m. The elevation of ports from the sea bed should be 0.5 m. The velocity of release of effluent should be maintained at 3.01 m/s.

Details of Environment Protection Measures:

- It was submitted that as per the numerical flow model run for seawater intake of 1600 MLD and dispersion model for effluent disposal of 1580 MLD, Model run for post monsoon and pre monsoon for various tidal conditions. No significant changes in flow regime are observed due to continuous withdrawal from recommended seawater intake locations.
- CSIR NIO has recommended effluent disposal points after evaluating 03 alternative options.
- Ambient conditions for temperature, SS, Ammonical nitrogen will be attained within 300 m distance from the diffuser.
- CSIR NIO Goa study suggested that sand dunes along the coast are stable and recommended suitable Landfall points and tunneling method for pipelines.
- From the model results, it is found that the average dilutions of 30 to 40 times would be achieved along with the tidal variation in the case of 1580000 m^3/day discharge. To get this dilution time, the diffuser system should contain 40 ports having a 0.44 m diameter. The diffusers should be separated at a distance of 6 m.
- The elevation of ports from the sea bed should be 0.5 m. The velocity of release of effluent should be maintained at 3.01 m/s.

MS, GCZMA appraised the authority that, GCZMA constituted a sub- committee and got visited the site on 27.04.23. As per the report of the sub-committee, GHCL submitted final EIA, public hearing details, copy of approved conservation plan for significant species, conservation management plan for sand dunes. As included in the report there will no impact on sand dunes due to underground construction of tunnel for the sea water suction and disposal of treated water into sea. As informed by PP, they will use highest technology to underground tunnel construction and due to which no major impacts will be on the sand dunes.

After the detailed discussion and deliberation on the presentation, it was decided by the GCZMA to recommend the project of M/s Gujarat Heavy Chemicals Limited located

at village Bada, ta - Mandvi, District -Kutch for Proposed Greenfield Chemical Complex seawater intake and effluent disposal facilities to the Ministry of Environment, Forest and Climate Change, Government of India for granting CRZ clearance with specific condition.

In view of the above the State Government hereby recommend to the Ministry of Environment, Forests and Climate Change, Government of India grant CRZ clearance for Proposed Greenfield Chemical Complex seawater intake and effluent disposal facilities of M/s. Gujarat Heavy Chemicals Limited with following conditions:

1. 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. M/s GHCL shall install necessary facilities for this purpose and shall strictly ensure the compliance with the GPCB norms, round the clock.
2. The pipelines for seawater intake and effluent disposal shall be laid in a safe manner so that the sand dunes stretch between the plant boundary and respective land fall points (LFP) are protected without any disturbance to their natural appearance and stability.
3. The pipeline shall be monitored regularly by the company and it shall be ensured that there is no leak from the pipeline. In case of any such eventualities, the company shall immediately stop disposal through the said pipeline and take the corrective measures in consultation with the GPCB and the District Collector.
4. There shall not be any blockage of creek/river etc. due to laying of pipeline and free flow of water shall be maintained.
5. M/s. GHCL shall carry out mangrove plantation in 50 ha area in consultation with Forest Department/Gujarat Ecology Commission (GEC). The amount for the same shall be deposited within 06 months to Forest Department/GEC.
6. All the recommendations and mitigation measures suggested for sea turtle conservation plan shall be complied with by the GHCL.
7. The GHCL shall ensure that there will not disturbance to nearby Ecologically Sensitive area for their proposed project.

8. The pipeline shall be monitored regularly by the company and it shall be ensured that there is no leak from the pipeline. In case of any such eventualities, the company shall take immediate corrective measures.
9. Project proponent (PP) shall have to carry out marine water quality environment monitoring regularly on quarterly basis and submit the report to GCZMA, GPCB, IRO & MOEF & CC, GoI.
10. PP shall contribute through its CER fund for environmental infrastructure up-gradation, awareness programs etc.
11. PP shall obtain all necessary clearances from competent authorities/ departments before construction and commissioning of the activities.
12. No groundwater shall be taped to meet with the water requirements during the construction and/or operation phases.
13. There shall no discharge of any kind of wastewater / sewage / effluent/ wastes into the creek or sea or in CRZ areas except allowed by this permission.
14. PP shall implement all the suggestions / recommendations given by their consultants in their EIA report.
15. PP shall develop 33% greenbelt within premises and shall maintain greenbelt.
16. PP shall prepare and execute Disaster Management Plan and submit to the concerned offices including the District Authorities.
17. PP shall ensure that the labour construction camps are kept outside the CRZ areas and the construction labour are provided with adequate amenities like drinking water, fuel, sanitation, etc. to ensure that the existing environmental condition is not deteriorated by them.
18. PP shall bear the cost of the external agency that may be appointed by this Department for supervision / monitoring of proposed activities.
19. PP shall take up socio-economic upliftment activities in consultation with the District Collector / DDO. A separate budget shall be provided for this purpose.
20. PP shall regularly submit the half-yearly compliance report on the conditions stipulated by this Department/GCZMA/ MoEFCC.
21. The provisions of the CRZ notification, 2011 and as amended from time to time shall be strictly adhered to by the PP.
22. PP shall obtain consents/ authorisation/ permission of the Gujarat Pollution Control Board under applicable Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act'1981 and Rules made

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under Environment (Protection) Act' 1986. Discharge of pollutants shall not exceed the limits prescribed under the Environmental Acts/ Rules.

23. PP shall adopt the necessary soil conservation measures to prevent any exposed soil from being eroded or blown over.
24. A Disaster Management Plan to meet with any eventualities that may arise during construction and/or operation phase shall be prepared and implemented.
25. A separate Environmental Cell with qualified personnel shall be created to implement the Environmental Management Plan and a separate budget shall be provided for this purpose.
26. Any additional conditions that may be imposed by MoEF&CC, this Department/GCZMA shall be complied by the PP

Thanking you,

D. M. Thaker
26/12/2023
(D. M. Thaker)

Copy to:
Chief Operating Officer,
M/s. Gujarat Heavy Chemical Limited,
GHCL House, Swastik Society, opp Punjabi Hall, Navarangpura ,
Ahmedabad-380009---------- For Your kind information

રવાના કરવા
સહી
તારીખ 26 DEC 2023

Received
GHCL & MOEF CC, GOI
27/12/2023

ANNEUXRE R- 2

सत्यमेव जयते

A REPORT ON THE
" STUDY ON STATUS SURVEY AND CONSERVATION PLAN FOR SEA TURTLES ALONG MANDVI TALUKA OF BHUJ, GUJARAT"

Zoological Survey of India
M-Block, New Alipore,
Kolkata – 700 053

April 2019

Published:

Zoological Survey of India
Prani Vigyan Bhawan,
535, M-Block, New Alipore,
Kolkata – 700 053 (West Bengal)
E.mail : zsi.kolkata@gmail.com

Anonymous, 2019. Report of Study on STUDY ON STATUS SURVEY AND CONSERVATION PLAN FOR SEA TURTLES ALONG MANDVI TALUKA OF BHUJ, GUJARAT, Zoological Survey of India, Kolkata.

Published as Final Report of "Study on Status Survey and Conservation Plan for Sea Turtles along Mandvi Taluka of Bhuj, Gujarat" *by Zoological Survey of India, Kolkata for the M/s GHCL, Ahmedabad, Gujarat.*

Cover Photo: Beach at the Project Location

Back Cover Photographs: Beach during low tide at Project Location

Photographs © Basudev Tripathy

DISCLAIMERS

1. The outcome of the STUDY ON STATUS SURVEY AND CONSERVATION PLAN FOR SEA TURTLES ALONG MANDVI TALUKA OF BHUJ, GUJARAT presented is based on the work done by ZSI as per the Scope of the study submitted to M/s. GHCL, Ahmedabad.
2. The Report submitted by ZSI to M/s. GHCL, Ahmedabad on the STUDY ON STATUS SURVEY AND CONSERVATION PLAN FOR SEA TURTLES ALONG MANDVI TALUKA OF BHUJ, GUJARAT is solely on the request of M/s. GHCL, Ahmedabad.
3. The report on the STUDY ON STATUS SURVEY AND CONSERVATION PLAN FOR SEA TURTLES ALONG MANDVI TALUKA OF BHUJ, GUJARAT submitted by ZSI to M/s. GHCL, Ahmedabad is not binding on the part of the State Environmental Impact Assessment Authority of Gujarat/ Gujarat State Coastal Zone Management Authority/National Coastal Zone Management Authority or any concerned agency to issue the NoC/ Environmental Clearance for the said project or any other statutory clearance of central and state government. Also there is no legal binding on the result of the report by ZSI submitted to GHCL, Ahmedabad.
4. All expenses related to the field/ office expenditure for the study were borne by M/s. GHCL, Ahmedabad, for the purpose.
5. There was no financial involvement from Zoological Survey of India, Kolkata for the study and there was no honorarium or otherwise raised by the study team from M/s. GHCL, Ahmedabad, for the study.

Zoological Survey of India,
Kolkata

CONTENTS

1. INTRODUCTION

1.1. Background:

GHCL Limited is a leading company in the manufacturers of chemicals, textiles and edible salt and other consumer products. In chemical sector, the company manufactures Soda Ash (Anhydrous Sodium Carbonate). M/s. GHCL Ltd., Ahmedabad is now proposing for setting up a Green field Chemical Complex near village Bada, Taluka Mandvi, District Kutch, State Gujarat for which site has been identified near the stable coastal stretch along Arabian sea coast near village Bada, about 30 km from Mandvi (22°52'25.38"N, 69° 8'21.15"E - 22°52'57.10"N, 69° 7'33.09"E).

In this context, M/s GHCL, Ahmedabad requested the Director, Zoological Survey of India vide his email 14.08.2018 to undertake a study related to sea turtles (Green Sea Turtles, Olive Ridley Turtle) in the proposed project plot area of approx. 1350 acres and area facing the sea side, so that the suitability of the area from ecological point of view could be assessed and conservation and management plans could be taken up in coordination with the Gujarat State Forest Department.

1.2. Genesis for Sea Turtle Nesting study:

Accordingly, a proposal and scope of the study was sent to M/s GHCL and to undertake the work on sea turtle nesting in the project location and on the basis of the proposal submitted by ZSI to M/s GHCL, a Work Order was released by M/s GHCL for carrying out detailed study on "Status survey and Conservation plan for sea turtle" at the project location.

The above study was carried out in the proposed Green field Chemical Complex project location of M/s GHCL, LTD along the Arabian Sea Coast near village Bada district Kutch Gujarat on the status of sea turtle nesting and suggest conservation and management as part of

the wildlife conservation plan and company's approach to protect and support conservation of wildlife around the project as per below objectives:

2. OBJECTIVES

1. Survey on the status of breeding / nesting ground of sea turtles at the project location.

2. Recommendation for action plan for conservation of sea turtle in the project location.

3. STUDY DURATION:

The olive ridley turtle reported to nest between June and early November on the Gujarat coast while green turtle nesting takes place between July and ends of January. However, the data sources silent on the exact nesting season. Moreover, olive ridley peak nesting occurs between July and November. Sporadic nesting takes place throughout the year along Gujarat coast (Sundarraj *et* al. 2013). Therefore, a rapid survey was done for duration of approx. six months from end of September 2018 to end of March 2019, so that sea turtle nesting activities during the peak breeding season, if any in the study area could be documented effectively.

The coastal stretch from Mota Layja end to the Bada village (upto the creek) beach was surveyed on foot by the field personnel engaged for the purpose for recording any nesting/crawl marks of turtles along the coastal stretch including stretches along which the project is proposed. Field visits to the project location was made by the ZSI team of scientists twice from last week of September 2018 and last week of March 2019. The team also made an assessment of the coastal and marine habitat along with overall biodiversity of the sites in line with the objectives.

The following were the team members for the study on assessment of sea turtle nesting.

1. Dr. Kailash Chandra, Scientist-G Director, ZSI.
2. Dr. Basudev Tripathy, Scientist-D, ZSI HQ, Kolkata
3. Dr. R. Chandran, DST-SERB-NPDF, ZSI

3.1. Description of the Project Location:

3.1.1. Location:

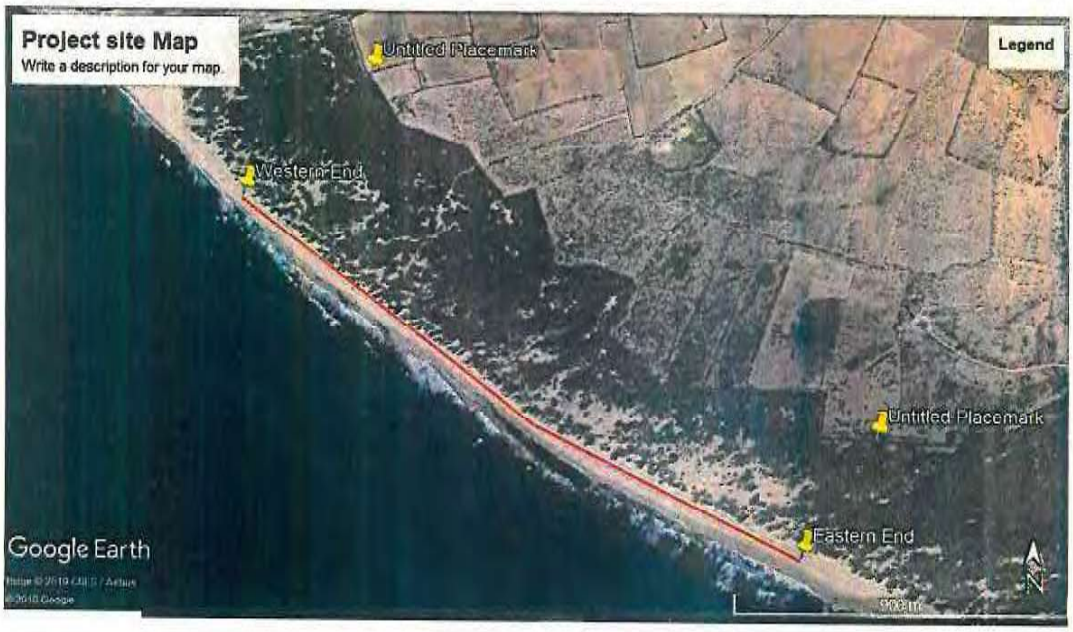
The location details of the project components are as follows:

As per the details submitted by M/s GHCL, the proposed site is recognised to set up a green field chemical complex with Soda Ash, Sodium bi carbonate manufacturing plant supported by utilities like solid fuel based captive co-generation power plant, sea water intake and effluent disposal system, RO system and associated infrastructure near village Bada, taluka Mandvi, District Kutch, Gujarat for which site has been identified near the stable coast off Bada stretch near Mandvi.

The Soda Ash process along with captive co-generation power plant in totality requires huge quantity of cooling water. The seawater requirement for process cooling, RO/DM plant, utilities and process plant effluent dilution etc. would be met by drawing seawater from the Arabian Sea coast in proximity to the project location.

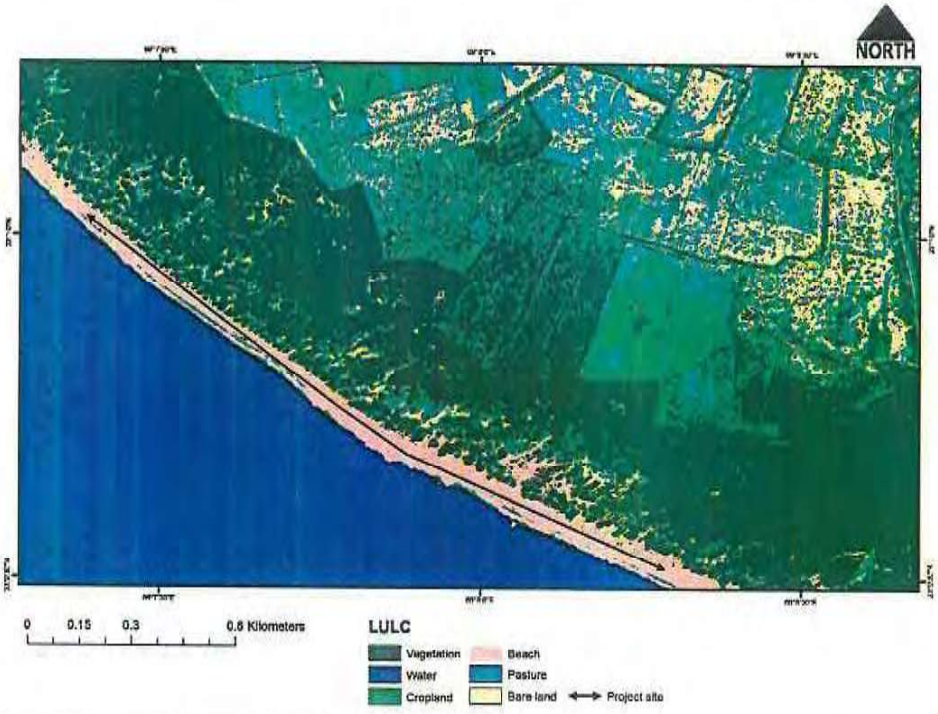
The diluted combined effluent generated from process, brine preparation/purification rejects, RO/DM plant rejects, utility rejects etc. after mixing/diluting with return cooling water/fresh seawater will be released at an appropriate location in the marine coastal zone of Arabian Sea meeting norms specified.

The pipelines for seawater intake and effluent disposal will be passed through the coastal stretch nearby project boundary. The pipeline will be laid underground to avoid any disturbance to sand dunes.



The geographical co-ordinates specified are as below:

Location: 22°52'25.38"N, 69° 8'21.15"E - 22°52'57.10"N, 69° 7'33.09"E



The project location and the adjacent coastal stretch does not fall within any notified eco-sensitive areas (ESAs) declared by state government / government of India. Also, there are no marine Protected Areas.

The plant/ complex will be set up away from the shore and sand dune area. The sand dune and shore area will be used for laying seawater intake and effluent disposal pipelines. The pipelines will be laid through tunneling in sand dune stretch to avoid and disturbance to sand dune area. The laying of pipeline will be one time activity and restricted to construction only. There will be no significant source of illumination for the pipelines.

4. METHODOLOGY

4.1. Coastal geomorphology and vegetation:

Data collections:

Table 1. Data collection on coastal geomorphology and vegetation at Project location

Habitat	Groups	Sampling	Remarks
beach profile	Length and width of beach	Measurement of beach width and height of dune from HTL to the vegetation line/sand dune at every 100 m of the project location buffering 1000 m on east and west	Measurement was taken on a weekly basis with a PVC tape, GPS and Range Finder and average of beach width was calculated
Coastal/sand dune vegetation	Flora on the beach/dune	Visual observation	Identification based on photograph
Background vegetation	Plantation/natural vegetation in the beach background	Visual observation	Identification based on photograph
Fauna (Vertebrates and Invertebrates), other than sea turtle	Coastal and marine animals, intertidal fauna	Direct sighting, evidence from pugmark, dead carcasses	Identified based on taxonomic characters

4.2. Literature review/secondary sources of information

Information on sea turtle nesting along the coastal stretch of Mandvi in Kutch district and especially in the project location was collated from secondary sources *viz.* unpublished and published literature by Gujarat State Forest Department on sea turtle nesting surveys and data on sea turtle hatcheries managed by GSFD and other government and non-government agencies on sea turtle nesting along Gujarat coast including Kutch. Local fisherfolks /villagers/coastal dwellers were interviewed for information if any on sea turtle nesting at the project location and adjacent coastal stretch.

4.3. Site specific survey:

For recording nesting of sea turtles, if any, along the proposed project site coastal stretch, the stretch west of Mota Lyaja, (Bhada) beach to Bada village (including approx. 1.4 km proposed site in the seafront [Sector-1 to 14], buffering 1000 m east and 1000 m west) was monitored on a daily basis by field personnel deployed for the purpose and information was also obtained on beach dynamics on the coastal area. The coastal stretch along proposed site and adjacent coastal areas were also visited during low tide. The beach profile viz. geomorphology, dune height, undulation, approach to HTL, width of the beach etc. were noted at every 300 m with the help of GPS (Garmin Inc.) and Range Finder. The 1.4 km coastal stretch from east to west was physically marked with a red ribbon in the background vegetation for subsequent monitoring and observations. For this the entire beach was divided into 14 sectors (Sector 0-14) (see Table 2). The detail beach profile of the coastal stretch surveyed is given in Table 2. The landuse pattern in the proposed site was assessed through Google earth imagery and by ground truth during field visits.

Table 2. beach profiling and vegetation composition of the project location

Beach Sector (300 m)	Distance from HTL to vegetation (in m)	Sand Dune Height (m)	Remarks
L-0 (Sector-0)	9.3	0.5	Flat beach with beach grass and binders
L-1 (Sector-1)	8.9	0.5	Flat beach with beach grass and binders
L-2 (Sector -2)	9.9	1.5	Dune approximately 1.5 m with beach grass and sand binders *viz.Launea sarmetosa, Cyperus arenarius, Fimbristylis miliacea, Ipomea pes-capre, Spinifex littoreus*
L-3 (Sector -3)	7.4	5	Dune approximately 5 m height with *Prosopis* vegetation mixed with beach grass and binder as above
L-4 (Sector -4)	7.8	10	HTL upto Vegetation (*Prosopis juliflora*)
L-5 (Sector -5)	11.8	3	Dune approximately 3 m with beach grass and sand binders *viz.Launea sarmetosa, Cyperus arenarius, Fimbristylis miliacea, Ipomea pes-capre, Spinifex littoreus*
L-6 (Sector -6)	13.8	1.8	Dune approximately 1.8 m with beach grass and sand binders *viz.Launea sarmetosa, Cyperus arenarius, Fimbristylis miliacea, Ipomea pes-capre, Spinifex littoreus*
L-7 (Sector -7)	9.3	2	Dune approximately 2 m with beach grass and sand binders *viz.Launea sarmetosa, Cyperus arenarius, Fimbristylis miliacea, Ipomea pes-capre, Spinifex littoreus*
L-8 (Sector -8)	14	7	HTL upto Sand dune approx. 7 m height and background vegetation (*Prosopis juliflora*)
L-9 (Sector -9)	15.8	2	Dune approximately 2 m height with *Prosopis* vegetation
L-10 (Sector -10)	14.1	3	Dune approximately 3 m height with *Prosopis* vegetation
L-11 (Sector -11)	8.2	5	HTL upto Vegetation (*Prosopis juliflora*)
L-12 (Sector -12)	12.8	5	HTL upto Vegetation (*Prosopis juliflora*)
L-13 (Sector -13)	16.5	0	HTL upto Vegetation (*Prosopis juliflora*)
L-14 (Sector -14)	25.5	0	Creek mouth towards Bada village

All potential habitats suitable for sea turtle nesting as per the literature published were surveyed and frequent field visits were made (on a fortnight basis by the scientists of ZSI and on a daily basis by the field personnel) and coastal /marine habitats of ecological and conservation importance was gathered during the field works were enumerated and taken into accounts.

Based on the information collated from field as well as from literature, a spatial data was generated with the help of a GPS (Global Position System, Garmin Inc.) and plotted in a map using GIS.

5. OBSERVATIONS

5.1. Sea turtle nesting along Gujarat (Kutch) Coast:

5.1.1. Information from secondary sources:

Four species of sea turtles are known to occur in the coastal waters of Gujarat of which two species are reported to nest along the Kachchh coastal stretches. Along the Kachchh coast, nesting of two species of sea turtle *viz.* olive ridley turtle (*Lepidochelys olivacea*) and Green turtle (*Chelonia mydas*) have been reported of which olive ridley turtle is known to be predominant (Sundarraj *et* al. 2002; based on Gujarat State Forest Department (GSFD) data on egg translocation and Sundarraj *et* al. 2013). Among four coastal districts (Jamnagar, Porbandar, Junagarh and Kutch), number of nests reported along the Kutch coast is less than the other districts. A summary of number of nests reported by studies conducted recently are presented in Table 3.

Table 3. Sea turtle nesting along Gujarat coast (4 districts) based on information from GSFD/GUIDE/GEC/WWF REPORT

District	GSFD/GUIDE/GEC REPORT				WWF REPORT
	Beach length (Potential sites) [in km]	No of Nests Observed			Number of Nests (Km)
		2000-01	2006	2011-12	
Kutch	73	61	17	68*	3 nests (15 km)
Jamnagar	92	250	1398**	91	53 nests (116 km)
Porbundar	83	155	494	53	74 (83 km)
Junagadh	98	124	508	61	104 (86 km)
TOTAL		590	1019	205	

* Based on GSFD data on nest translocation to hatchery at Mandvi/Nalia for 2007-08 to 2010-11.
** 1398 nests recorded in 12 years.

The Kachchh coast has a length of 300 km and average width of 10 m with 3-8 m tidal amplitude and soil type as silt/sandy. Of the nine Talukas in Kutch district, only the Mandvi takula is reported to have maximum sandy beaches and least mangrove area (0.27 sq. km). The Kutch coastline reported to have stabilized dunes especially around Mandvi.

Most of the studies on sea turtle nesting have been carried out along the Saurashtra coast and information available for Kachchh coast is only the data from state Forest Department. Except for one-time survey by Sundarraj et al. (2002), there is no long term data available for the coast. **The nesting of sea turtles along the coastal stretch Mandvi is quite sporadic as well as high nest predation and therefore it is possible that forest department translocated all the nests to the hatchery.**

Ex-situ conservation programme are in operation in Gujarat since 1985-86 and sea turtle hatcheries have been established in Nalia and Mandvi along Kachchh coast. Sea turtle eggs are reported to have been collected by the forest department staff and hired trained personnel. The published information on hatcheries managed by GSFD is presented in Table 4.

Table 4. Collection of sea turtle eggs and hatching success from 1985-2006 at Mandvi and Nalia hatcheries

Year	Site	No. of eggs collected	No. of successful hatchlings			Success Rate (%)
			Olive ridley	Green turtle	Leatherback	
1985-86	Mandvi	-	-	-	-	-
	Nalia	65	43	-	-	66
1986-87	Mandvi	-	-	-	-	-
	Nalia	134	100	-	-	74.62
1990-91	Mandvi	1271	778	-	-	61.25
	Nalia	-	-	-	-	-
1991-92	Mandvi	2038	1230	-	-	60.35
	Nalia	-	-	-	-	-
1992-93	Mandvi	3391	2251	-	-	66.39
	Nalia	-	-	-	-	-
2000-01	Mandvi	4399	1963	110	-	40.00
	Nalia	321	105	-	50	48.00
2001-02	Mandvi	1273	404	-	-	31.73
	Nalia	210	138	-	-	65.00
2004-05	Mandvi	1446	750	-	-	51.00
	Nalia	533	368	-	-	69.00
2005-06	Mandvi	556	416	-	-	75.00
	Nalia	135	-	72	-	53.33
TOTAL		**15637**	**8546**	**182**	**50**	**54.50**

Data source:* Meena *et* al. 2007, *Indian Ocean Turtle Newsletter No. 05, p.19-20.

The olive ridley turtle reported to nest between June and early November on the Gujarat coast while green turtle nesting takes place between July and ends of January. However, the data sources silent on the exact nesting season. Moreover, olive ridley peak nesting occur between July and November. Sporadic nesting takes place throughout the year along Gujarat coast, and therefore the nesting seasonality is not known. Based on the report of Sundarraj *et* al. (2002; 2004), 61 olive ridley turtle nests were reported along the entire coast. The Gujarat State Forest Department – Kachchh circle data of 2004-05 indicates 19 nests of both olive ridley (17) and green turtles (02). Thereafter, between 2007-08 and 2010-11, 68 nests were reported and all were of green turtles (Meena *et* al. 2007). The potential nesting site for sea turtles are reported to be available from Mandvi beach to Gundiyali, beach and from Ashapura Mandir to Pingaleshwar. Nevertheless, among the 10 stretches of Kachchh coast, seven stretches have been identified by Sundarraj *et* al. (2013). The beach between Layja Nana – Mandvi palace reported high threatened value and gained nesting site rank 1.0 and therefore it secured top conservation rank and given high conservation priority (Sundarraj *et* al. 2013). **However, due to the data deficiency and discrepancy, Sundarraj et al. (2013) could not ascertain on species specific nesting for Kachchh coast.**

There are only two reports available for Kachchh coast (Sundarraj et al. 2002; Gujarat State Forest Department). As per the forest department hatchery data available for the period 1985-86 to 2005-06 for 15637 eggs, 8546 successful hatchlings were of olive ridley turtles, 182 were of green turtles and 50 leatherback turtle hatchlings, that have been reared at Mandvi and Nalia (Meena *et* al. 2007). However, there is no separate figure available for Mandvi and Nalia. Also, the 8546 hatchlings of olive ridley reared from the hatcheries at Mandvi and Nalia indicate that olive ridley is predominately nests along the Kachchh (Mandvi-Nalia) coast. During the survey of 2000-2001 (Sundarraj *et* al. 2002) reported a total of 61 nests along Kachchh coast and all belonging to olive ridley turtles. The data of forest department for the year 2004-05 reported 19 nests, of which 17 were olive ridley turtles and 02 were green turtles. However, the nesting data available for the period from 2007-08 to 2011-12 reported 68 nests, and all were green turtles. **Therefore, it seems there is a discrepancy in the data collections in terms of season and there is no systematic long term survey and monitoring of the sea turtle nesting along the Kachchh coast.**

Nevertheless, the secondary information revealed from the data source of Gujarat State Forest Department, Kachchh circle, Sundarraj *et* al. (2013) identified five stretches along Kachchh coast with nesting of 68 green turtles based on the survey of 2000-2001 (Sundarraj *et* al. 2002) and among the stretches, a maximum of 29 nests were reported between Mandvi palace and Mandvi beach followed by Bada and Layja Nana with 27 nests. In contrast, the report of GOI-UNDP Sea Turtle Project on status of the breeding population of sea turtle along the Gujarat coast by Sundarraj *et* al. (2002), reported no nests of green turtle and 61 nests of olive ridley turtles of which highest of 22 nests along the 13 km stretch of Bada – Nana Layja (1.61 nest/km) and 21 nests along 13 km stretch of Layja Nana – Mandvi coastal stretch (1.69 nest/km). Nevertheless, the data is based only on 05 nests, crawl marks and information from local egg

collectors and not actual sighting of nests. Again as per the report of Sundarraj et al. (2013), the Forest Department identified 11.5 km along Bada – Nana Layja coastal stretch as potential for nesting with 27 nests (2.35 nests/km) and 6.0 km coastal stretch between Layja Nana–Mandvi palace with 6 nests (1.0 nest/km). Therefore, **comparison of the data and reporting of nesting of the two species of turtles along the Kachchh coast require corroboration.**

5.2. Status of sea turtle nesting at the proposed Project Location of M/s GHCL:

5.2.1. ZSI Observations:

The olive ridley turtle reported to nest between June and early November on the Gujarat coast while green turtle nesting takes place between July and ends of January although sporadic nesting have been reported to takes place throughout the year along Gujarat coast (Sundarraj *et* al. 2002; 2013). For documentation of nesting of sea turtles, if any, along the coastal stretch of the GHCL, the entire ~ 1.4 km beach surveyed (project location in the seafront (sector 1-14), ~ 1000 m buffer (Sector 1-3) on both east and west end of the project location) was monitored intensively by the field personnel deployed for the purpose and information was also obtained on beach dynamics on the coastal area on a weekly basis.

Data collected on the beach dynamics of proposed GHCL project site and adjacent coastal stretch indicate that average beach width is < 15 m and get inundated during high tide upto the *Prosopis* vegetation/dunes, except at creek mouth which is considerably widen (see Table 2). Therefore, **the entire coastal stretch of beach is narrow, varying in width with the backshore sandy ridge rising abruptly from 5-7 m above and dense *Prosopis juliflora* vegetation touching HTL**. In particular, the proposed project site has narrow width of beach except at the western end of creek mouth (> 10 m) and at middle (Sector 7-9; ~ 10 m). Also, the entire coastal stretch between sectors 4 to 11 **due to its narrow beach width, gets inundated during high tide and are not suitable/not preferred by sea turtle for laying eggs.**

Apart from background dense vegetation of Babul (*Prosopis juliflora*) close to the high tide line (landuse pattern), the predominant floral beach composition are that of beach grass and

beach binding creekers *viz. Launea sarmetosa, Cyperus arenarius, Fimbristylis miliacea, Ipomea pes-capre* and *Spinifex littoreus*. Presence of animals in the coastal stretch of the proposed GHCL project site was assessed by direct sighting and tracks and signs. During the field visit, Feral dogs (*Canis familiaris*) were frequently observed canids on the beach, and common Jackal (*Canis aureus*) was encountered once. This could be due beach due to dense vegetation cover. Also, fecal pallets of Blue Bull (*Boselaphus tragocamelus*) observed on the beach indicating this animal visiting the coast during low tide. **Considering high level of presence of feral animals and carnivores all along the beach, Gujarat State Forest Department translocating all the nests to the turtle hatchery at Mandvi and Nalia.**

The selection of a suitable nesting site is very important at many levels: not only for the female turtle but also for a proper embryo development, and the subsequent hatchling survival (Miller *et* al., 2003). Nesting site selection is governed by a number of clues, depending on both internal physiological factors and external environmental factors. According to Mortimer (1990; 1995), environmental factors of a suitable nesting beach must have: easy accessibility to the beach, nest placement at enough height for avoiding tidal inundations, sand properly cohesive for building a nest and ease gas diffusion, and specific temperatures for a proper maturation of the egg. Wood and Bjorndal (2000), also suggested that the nest placement must avoid being too close (to avoid inundation or erosion). Beach slope, width and length Beach slope not only influences the female trying to ascend to the top of the beach but also the new hatchlings going all the way seawards. According to Wood and Bjorndal (2000), slope is the most important factor influencing the nest site selection in sea turtles. Studies by López-Castro *et* al. (2004), defined that the characteristics of olive ridley nesting sites include smooth-sloped beaches and without vegetation cover and determined an average of width of 17-65 m (López-Castro et al., 2004). Nest elevation is an important factor in order to isolate and protect the nest from tidal inundation. Green turtles tend to place their nests in elevations between 1-3 m (Johannes and Rimmer, 1984). Although no substantial information is available, the presence of beach vegetation seems to affect the choice of a nesting site (Mortimer, 1982) and so, vegetation is a factor that may affect sea turtle nesting also. Green turtles and loggerhead turtles prefer areas where supra-littoral vegetation occurs (Whitmore and Dutton, 1985; Hays and Speakman, 1993; Garmestani et al., 1997). According

to Bilinski et al (2001) thick vegetation or refuse carried by tides (generally logs) can obstruct the nesting areas and thus reduce the hatchling success.

During the nearly six months daily monitoring of the ~ 3 km beach between September 2018 – March 2019 (from Mota Layja side to the Bada village creek), we did not encounter any sea turtle and fresh/old nests or crawl marks of turtles on the beach. Since many of the factor for selection of a suitable nesting site are not conducive (beach width, vegetation cover, rocky substratum and slope in the intertidal and subtidal region, tidal inundation, presence of animals on the beach), nesting, if all, occurring is therefore highly sporadic at the project location of GHCL and on occasionally. However, the ~ 7 km stretch between Rukmawati river mouth and Mandvi palace is sandy, vegetation to HTL is wide and much of the sporadic nesting could be taking along this coastal stretch.

The olive ridley and the green turtles are annual nesters and lay eggs more than once in a single season. The data of Gujarat Forest Department and Sundarraj *et* al. (2013) about 68 nests over five years (2007-08 to 2012-13) along the Mandvi coastal stretch (73 km) averages for 14 nests per year that implies 1 nest/5 km beach, which is highly sporadic and is a scenario of entire coastline of India, so far as sea turtle nesting is concern. Also, the 6 km beach between Mandvi palace and Nana Layja reported to be only 6 nests in five years in this coastal stretch.

The nesting of sea turtles along the coastal stretch Mandvi is highly sporadic as well as high nest predation and therefore it is possible that forest department translocated all the nests to the hatchery (Sundarraj *et* al. 2013). **During the present study, interview with local fisherman/coastal dwellers could not confirm the exact nesting location from which these coastal dwellers bring sea turtle eggs for translocation at hatchery maintained by Gujarat State Forest Department at Mandvi.**

There are smaller fishing hamlets present along the coastline of the study area. Although fishing is not rampant, but fishing is known to be a practice for local consumptions and for local demands. Discussion with them during field visits revealed that most of the nests are brought to Mandvi by fisherfolks/coastal dwellers within the coastal stretch of Madhva, Kathda, Mandvi palace and Mandvi beach as well as from Salaya side (Table 6). Therefore, sea turtle nesting on the coastal stretch of GHCL proposed project site is not observed during survey period, may be seldom, very low and considered to be quite sporadic.

Table 5. Details of sea turtle egg collections done and release of turtle hatchlings by fishermen/coastal dwellers of Mandvi coast (secondary sources of information from villagers through verbal discussion with them)

Place of Collection Location for turtle eggs* (2013 to 2015)	No. of eggs collected	Place of release of sea turtle hatchlings
Near to coast at Bhada-Aashar Mataji Temple	> 100	Windfarm Beach-Mandvi
Near to coast at Layja-Nana	> 80	Windfarm Beach-Mandvi
Near to last wind mill at Mandvi beach	> 100	Windfarm Beach-Mandvi
Near to coast at Mandvi-Ganganaal	> 90	Windfarm Beach-Mandvi
Near to coast between Nana Layja to Kathda	> 120	Windfarm Beach-Mandvi
Near to coast at Pingleshwar temple, Rampar (Gadhwali)	> 110	Windfarm Beach-Mandvi
Near to coast at Panchotiya temple	> 127	Windfarm Beach-Mandvi
Near to coast at Nana Layja	> 130	Windfarm Beach-Mandvi
Near coast at Maska-between Rawalpir to Mandvi	> 100	Windfarm Beach-Mandvi
Near coast at last wind mill at Mandvi beach	> 100	Windfarm Beach-Mandvi
Near coast at Dhabrudi	> 90	Windfarm Beach-Mandvi
Near coast at Mandvi-Ganganaal	> 120	Windfarm Beach-Mandvi

*Data available till 2015 only

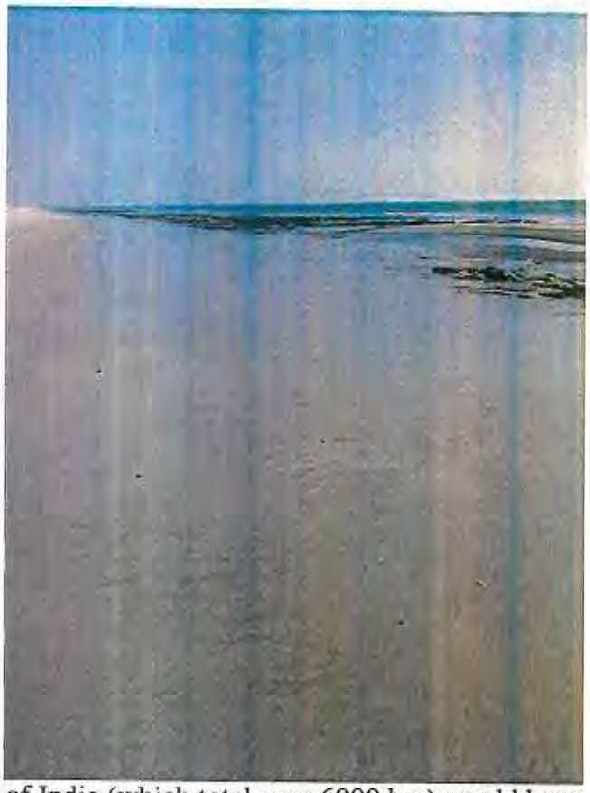
Table 6. Fishermen/coastal dwellers interview and their remarks on sea turtle nesting/egg translocation to Mandvi hatchery

Sl. No.	Name	Address	Response
01.	Abdu Rahman Vagher	Fishermanm Nana Layja	No nesting of sea turtle seen on Nana Layja beach
02.	Jurab Ismail Vagher	Fishermanm Nana Layja	No nesting of sea turtle seen on Nana Layja beach
03.	Abdul Kudan Taijab	Fisherman, Madhva	Nesting seen in Madhva beach, Mandvi Palace beach
04	Ismail Hussain	Fisherman, Madhva	Nesting seen in Madhva beach, Mandvi Palace beach and turtle eggs translocated to Forest Department hatchery at Mandvi, two years back
05	Mamud Hussain Isha	Fisherman, Madhva	Nesting seen in Madhva beach, Mandvi Palace beach and turtle eggs translocated to Forest Department hatchery at Mandvi, long back
06	Abdul Taijab	Fisherman, Madhva	Nesting seen in Madhva beach, Mandvi Palace beach
07	Hussain Taijab	Fisherman, Madhva	Nesting seen in Madhva beach, Mandvi Palace beach
08	Md. Taijab	Fisherman, Madhva	Nesting seen in Madhva beach, Mandvi Palace beach and turtle eggs translocated to Forest Department hatchery at Mandvi, two years back
09	Aubkhan Mubarak	Fisherman, Madhva	Nesting seen in Madhva beach, Mandvi Palace beach and turtle eggs translocated to Forest Department hatchery at Mandvi

Sea turtle nest all along the coast of India and its Bay Islands of Andaman & Nicobar and Lakshadweep archipelago. The olive ridley turtle is considered the most abundant sea turtle in the world, with an estimated 800,000 nesting females annually. Solitary nesting occurs extensively throughout this species' range, and nesting has been documented in approximately 40 countries worldwide. The olive ridley may be the most abundant sea turtle on the planet, but some argue that it is also the most exploited. Some nesting populations are currently stable and/ or increasing. The olive ridley and green turtles are reported share beaches for nesting in Andaman & Nicobar, Lakshadweep and in mainland Gujarat. The olive ridley is very oceanic in the Eastern Pacific and probably elsewhere too (http://seaturtlesofindia.org). Similarly, green turtles are found on large, open beaches to small coves covered with sea grasses, or in areas where seaweeds are found. The species (like the hawksbill turtle) is

also known to prefer nesting on island beaches mainly, the beaches of tropical and subtropical areas near continental coasts and around islands.

For regulating development activities, the coastal stretches within 500 metres of High Tide Line (HTL) on the landward side are classified as Category I (CRZ-I): (i) Areas that are ecologically sensitive and important, such as national parks/marine parks, sanctuaries, reserve forests, wildlife habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty/historically/heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rise in sea level consequent upon global warming and such other areas as may be declared by the Central Government or the concerned authorities at the State/Union Territory level from time to time, (ii) Area between Low Tide Line (LTL) and the high Tide Line (HTL). However, using this logic, most sandy beaches on the east and west coasts of India (which total over 6000 km) would have to be designated as CRZ-I, simply by virtue of the low-density ridley nesting that occurs, and this hardly seems practical given human population densities along the Indian coast (Shanker, 2002) and will restricts the setting up and expansion of any industry, operations or processes.



The shoreline protection to be any defensive measures used to protect areas from inundation, the effects of waves on structures, beach erosion, salinity intrusion, and the loss of natural resources (Witham, 1990). Protection methods are often divided into two types: hard stabilization methods and soft stabilization methods. Soft stabilization methods include beach nourishment and dune construction. Beach nourishment is the most often utilized soft stabilization method. An important benefit of beach nourishment is that it can assist with replacing the sand supply along the shoreline, which the stabilization of navigational inlets often disrupts. Due to the popularity of beach nourishment as a shore protection method, it is important

to ensure that differences between the sand used for nourishment and the natural sand do not cause adverse impacts to nesting sea turtles.

Although some sand characteristics are crucial to nest survival (Packard and Packard 1988), females apparently choose nesting sites without control to most of them (i.e. sand grain size, shape, and distribution; hydric properties; pore spacing; and mineral content; Mortimer, 1982; Mortimer, 1990). Therefore, a beach can be attractive to females as a nesting site, but contain sands, which are less than optimal for nest survival (Steinitz *et al.* 1998).

Although, generalizations cannot be made on the effects of nourishment on nesting sea turtles, but nourishment appeared to have an immediate positive effect on turtle nesting success and turtle nesting habitat. Every nesting beach and nourishment project is unique; therefore assessments of nourishment's effect on turtles must be done on a case by case basis until more definitive data are available. Future studies should further evaluate the effects of sand compaction and sand temperature on sea turtle nesting activities.

Loggerheads and Green turtles maintain levels of fidelity to nesting beaches that vary over short timescales in response to beach dynamics (Godley *et al.* 2001). This suggests that when nourished beaches are unfavorable for nesting, sea turtles are capable of re-emerging on adjacent beaches that are favorable. Thus, a mosaic of nourished and non-nourished beach sections or adjacent nourished beach sections applied during different years would have a smaller impact on nesting.

The nourished beach did not significantly affect reproductive success as measured by hatching and emerging success for Loggerheads or Green turtles. These rates were nearly equal and not significantly different from those for the non-nourished area. This indicates that hatchlings did not encounter difficulties extricating themselves from the nourished substrate. The results indicate that the nourished beach provided an incubation microhabitat for Loggerhead and Green turtle reproduction similar to that of adjacent nonnourished areas.

In the present case, the intake and outfall pipeline of the GHCL proposed on the shore where sand/gravel/pebble filling if to be done should be replaced with sand of similar nature (grain size, organic content) to that which was dodged out, thereby maintaining the suitability of the beach for the incubation of sea turtle eggs. Restoration should not be during nesting and

hatching period since heavy equipment and activity can deter nesting, crush eggs, and/or prevent hatchlings from successfully emerging out of the nest from nearly shore.

Migration and movement of sea turtles from Indian coastal waters is not adequately known except for two studies by Wildlife Institute of India on olive ridley migration and movement in the Bay of Bengal based on satellite telemetry on turtles. Based on the study, WII has recommended that (a) inviolate onshore nesting areas that requires special protection, restoration and management approaches and (b) concentrated and diffused offshore breeding congregation zones in the marine habitat that requires different protection, monitoring and management strategies. Also, considering the fact that the olive ridley is Vulnerable and Green turtle is endangered species and included in the Schedule-I of the Wildlife (Protection) Act, 1972 as well as species of international conservation importance due to inclusion in CITES (Convention of International Trade in Wildlife Flora and Fauna) Appendix and CMS (Convention on Migratory Fauna), the following measures are suggested as recommendations.

6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion:

1. During approx. six months daily monitoring from September 2018 – March 2019, no sea turtle nest / fresh crawl marks were observed along the shore/beach surveyed. However, secondary sources of information revealed the coastline of Mandvi about 20 km form proposed site as important sea turtle nesting habitat along Kutch.

2. Based on the detailed field survey & monitoring of sea turtle nesting, due to its narrow width, the proposed GHCL site beach gets inundated during high tide and thereby unfavorable for sea turtles for laying eggs. It was observed that due to its narrow beach width, vegetation cover, slope, presence of pebbles and rubbles and presence of predators on the beach sea turtles may not favoring this area for laying eggs.

3. However the 7 km stretch between Rukmavati river mouth (about 20 km from proposed project site) and Mandvi palace (about 16 km from project site) is sandy, vegetation to HTL is wide and much of the sporadic nesting could be taking place along this coastal stretch.

6.2. Recommendations

1. Sandy beach of proposed GHCL site and adjoining areas have sporadic nesting habitats for sea turtles and nesting activities are quite rare. There is less probability of nesting in proposed project coastline considering the beach slope, availability of beach beyond HTL for nesting. Nevertheless, monitoring of sea turtle nesting along the coast is required and adherence to the precautionary principles.
2. Although sea turtle seems to avoid areas such as above being unsuitable for laying eggs, however M/s. GHCL should monitor the surrounding areas and nesting observed/reported if any, the same to be informed to the Forest Department officials and the eggs to be translocated immediately to the nearest hatchery at Mandvi/Naliya or along nearby beaches being maintained by Gujarat Forest Department, since they are as such is subjected to predation.
3. It is observed from the literature review that nesting data/hatchery data available for Kutch coast (Mandvi and Naliya) does not clearly record the exact species of sea turtle nesting (Green sea turtle/Olive Ridley sea turtle). Accurate information is highly important as green sea turtle numbers are declining worldwide and being migratory species, its conservation is of primary importance. The egg collectors may be trained to observe the turtle species while collecting and transporting the eggs to the hatchery. Towards this capacity building training programme on identification of species of sea turtles nesting in the area and hatchery management of sea turtles for stakeholders *viz.* fishermen/coastal dwellers may be organized by Gujarat Forest Department.
4. In-situ protection of nest by fencing or safe translocation of nests to hatchery at Mandvi or close-by areas being maintained by Gujarat State Forest Department be done immediately and further improvement in the hatchery development along Mandvi coast should be done.
5. Periodic monitoring of sea turtle nesting should be carried out by a scientific agency with credibility on coastal and marine faunal study.
6. M/s GHCL should prepare an Environment Management Plan and should support sea turtle conservation and management measures taken up by PCCF & Chief Wildlife Warden of Gujarat State Forest Department.

7. The M/s GHCL upon obtaining permission for the project should prepare a construction schedule taking care of the peak sea turtle nesting season of Kuchchh region for any direct or indirect impact on sea turtle for their breeding and the schedule to be efficiently followed.

8. The M/s GHCL upon obtaining permission for the project should prepared an excavation plan for the beachfront area and require to be kept minimum, so as not to cause direct or indirect impact on sea turtles and other intertidal marinelife. The excavated area to be properly restored as per the standard protocols available.

7. CONSERVATION PLAN FOR SEA TURTLES

Though sea turtle nesting at the project location seems to be rare and low probability, however considering that Mandvi beach seems to be an important sporadic sea turtle nesting site of Kutch, the following conservation plans are recommended:

I. Artificial illumination on the beach can affect the sea turtle nesting and hatchlings. Compared to any other kinds of coastal development, light pollution is probably one of the problems that can be solved with relative easy, if committed for conserving sea turtles. Using a smaller number or lower wattage of lights; repositioning, shielding, redirecting, lowering, or recessing fixtures are some of the available options for reducing illumination to the beach. Sea turtles are less affected by red, yellow, and low-pressure sodium-vapor lights, and therefore can be substituted with ordinary lights.

II. Creation of awareness among villagers and fishermen on the importance of turtle conservation is required. Proper identification of species of sea turtle nesting on a particular beach is important.

III. Monitor of shoreline for sea turtle nesting is required to assess nesting potential of the beach and any possible impact on nesting due to developmental activities.

IV. Any conservation and management plan for sea turtles should be developed in consultation with the Gujarat Forest Department.

* * * * *

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Website: http://seaturtlesofindia.org

Website: www.seaturtle.org

ZOOLOGICAL SURVEY OF INDIA

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE,
GOVERNMENT OF INDIA

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3205

No. WLP/32/A/50-52/2023-24

Office of the
Principal Chief Conservator of forests
Block No. B/1, Aranya Bhavan,
Ch-3 Circle, Sector - 10/A,
Gujarat State, Gandhinagar.
Date: 24/04.2023

To,
Sri M.S.Rathore,
Sr. General Manager (Liasion & Admin),
Ahmedabad, Gujarat.

Sub:- Granting of Approval of Conservation Plan of selected scheduled – I species for M/s GHCL.

Ref :- Your letter dated. 10.04.2023

With referece to your letter and subject quoted above, an approval for coscripting and documenting a conservation plan for Flap Shell turtle, Green Sea turtle, Indian Monitor Lizard, Olive Ridley Sea turtle, Black shoulder kite, Eurasian Spoonbill, Indian pea fowl, Marsh Harrier, Oriental Honey buzzrd, Shikra, Short toed Snake Eagle, Chinkara and Gugal-Schedule-I Species prepared by M/s GHCl, Ahmedabad for Industries unit in village – Bada, Taluka- Mandvi, Dist. Kutch, Gujarat. The Conservation Plan of Rs. 136.50 lakhs is duly approved. Kindly note, that this amount will be either deposited in the central fund account (to be opened shortly) or the indicating activities will be executed by GHCL as per the order issued from this office.

(N. Srivastava)
Chief Wildlife Warden
Gujarat State, Gandhinagar

Copy to: The Chief Conservator of Forests, Kutch Circle, Bhuj for information and necessary action.

Copy to: The Deputy Conservator of Forests, Kutch West Division, Kutch for information and necessary action.

Table 8.1: Budget estimate (10 year plan) for Implementation of the Wildlife Conservation Plan for Bada Soda Ash Plant of GHCL

Sl. No.	Conservation Objective	Activities	Location of activities	Implementing Agency	Year of Implementation & Targets										Rate/Cost (In Rupees)	Rs in Lakhs
					1	2	3	4	5	6	7	8	9	10		
1	Habitat Conservation, Protection and Improvement	Plantation & Greenbelt development	Soda Ash Plant area and Periphery of plant (30 ha)	GHCL	LP	10 ha	10 ha	10 ha	GF	GF	GF	GF	GF	GF	Rs. 52000/ha	15.60
			Roadside plantation to minimise pollution& attract birds (20 ha)	GHCL	LP	5 ha	5 ha	10 ha	GF	GF	GF	GF	GF	GF	Rs. 52000/ha	10.40
			Bada, Bambhadai and other RF. (50 ha) (Location will be decided by FD)	FD	LP	20 ha	20 ha	10 ha	GF	GF	GF	GF	GF	GF	Rs. 52000/ha	26.00
		Water hole creation	Reserve forest area (creation of water hole structures)	FD	-	5 St	5 St	5 St	-	-	-	-	-	-	Rs. 100000/ structure	15.00
		Plantation management	**Water tanker* (1) and Tractor* (1) with driver and diesel for 10 years**	FD	-	√	-	-	-	-	-	-	-	-	Rs. 2000000	20.00
			Utility vehicle* (1) with driver and diesel for 10 years	FD	-	√	-	-	-	-	-	-	-	-	Rs. 1200000	12.00
2	Research and Monitoring	Plantation Monitoring	Plantation Area	CCF Kachchh	-	-	√	-	√	-	-	√	-	-	Rs. 100000	1.00
		Wildlife Monitoring	Coastal protection by Paryavaran Mitra	FD	-	-	√	-	√	-	-	√	-	-	Rs. 750000	7.50
			Coastal Hatchery & Research centre	FD	-	-	√	-	√	-	-	√	-	-	Rs. 750000	7.50
3	Education & Awareness	Workshop, NEC, Sign board, etc.	GHCL& Nearby Schools & Colleges	FD	-	√	-	√	-	√	-	√	-	√	Rs. 1000000	10.00
4	Miscellaneous	Contingency	-	2.5 GHCL & 2.5 FD	√	√	√	√	√	√	√	√	√	√	Lump sum	5.00
															Sub-total	**130.00**
	Monitoring of works		Implementation Areas of WCP	FD	-	√	-	√	-	√	-	√	-	√	@5% of total	6.50
															Grand Total	**136.50**

GHCL: Gujarat Heavy Chemical Ltd.; FD: Forest Dept; GUIDE: Gujarat Institute of Desert Ecology; LP: Land preparation; GF: Gap filling; NEC: Nature Education Camp

*Note: Vehicles are required for the efficient management of plantation activities and it will be the asset for the forest department in future.

Chief Wildlife Warden
Gujarat State,
Gandhinagar.

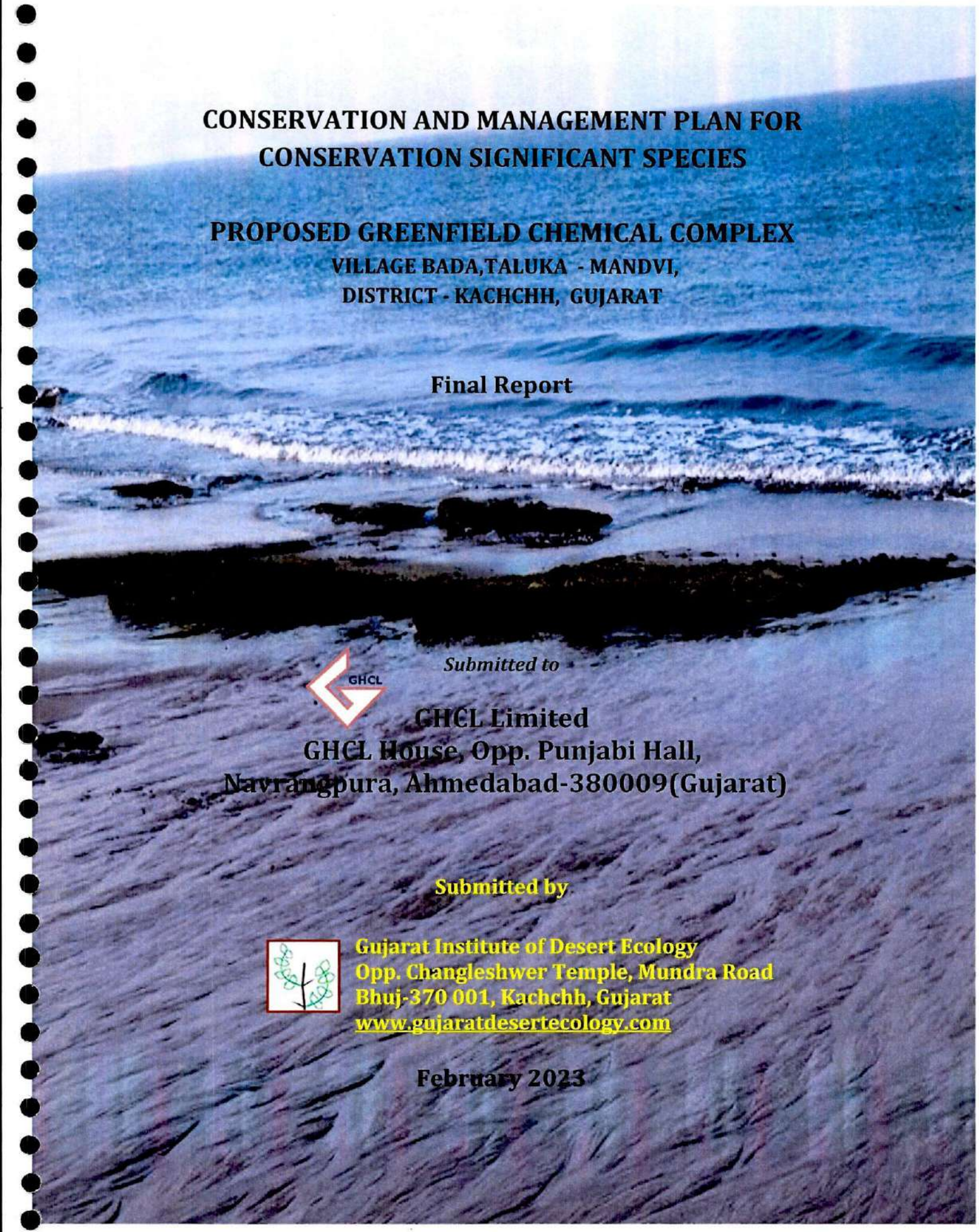
3207

CONSERVATION AND MANAGEMENT PLAN FOR CONSERVATION SIGNIFICANT SPECIES

PROPOSED GREENFIELD CHEMICAL COMPLEX

VILLAGE BADA,TALUKA - MANDVI,
DISTRICT - KACHCHH, GUJARAT

Final Report



Submitted to

GHCL Limited
GHCL House, Opp. Punjabi Hall,
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Submitted by

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February 2023

Foreword

GHCL Ltd. is a reputed Soda Ash manufacturing chemical unit, established in 1983 located at Sutrapada of Gir Somnath district in the State of Gujarat. This was India's first integrated Soda Ash plant based on Akzo's Dry Liming Technology. It caters to about 25% of domestic soda ash demand in the country. GHCL, is now proposing to set-up a Greenfield Chemical Complex to produce \ Light Soda Ash Plant having capacity of 11,00,000 TPA, dense soda ash plant with the capacity of 5,00,000 TPA and sodium bicarbonate plant with the capacity of 2,00,000 TPA near the village Bada, Taluka – Mandvi, District Kutch in Gujarat state. Along with above production capacities necessary utilities like Captive Power plant of 120 MW capacity, seawater intake and effluent disposal system were also planned to support manufacturing infrastructure.

Industrial developments are essential for the economic growth and creating employment opportunity in the state. Needless to mention that the development projects should respect the ecological integrity, biodiversity values and social feasibility of the region as these are going to be the determinants of the quality of environment as well as the sustainability of the development interventions.

Keeping these in view and considering the statuary requirement of environmental clearance and conservation of wildlife, the GHCL planned to take up a rapid study to assess the status of biodiversity and wildlife, and its conservation and management measures for the existing biodiversity in core and buffer areas around the proposed projects. In this connection, the GHCL have given the study to Gujarat Institute of Desert Ecology (GUIDE), Bhuj.

The details of the status of biodiversity in core zones and buffer zones of the area were presented in the report. The possible impacts on biodiversity due to proposed project and its associated developments in the core and buffer zones were assessed and Conservation and Management Plan (CMP) is framed to mitigate the possible impacts on conservation significant wildlife in study area due to project development and its associated activities. The Conservation and Management Plan also addressed the concern of Officials of State Forest Services.

Dr. V. Vijay Kumar
Director
Gujarat Institute of Desert Ecology
Bhuj-Kachchh, Gujarat

ANNEXURE R-3

Conservation and Management plan for Conservation significant species

Proposed Greenfield Chemical complex

Village Bada,Taluka - Mandvi, District - Kachchh, Gujarat

Co-ordinator

Dr. V. Vijay Kumar, ***Director***

Principal Investigators

Dr. Nikunj B. Gajera, ***Scientist***

Co-Investigator

Dr. Arun Kumar Roy Mahato, ***Senior Scientist***

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1. INTRODUCTION

Biodiversity refers to the variety of species and ecosystems thriving on Earth (Gaston, 2000). Biodiversity supports human societies on ecological, economical, cultural and spiritual levels (MEA 2005). Its benefits are, however, compromised by anthropogenic activity which, in conjunction with population growth, results in the rapid deterioration of earth ecosystems and a decline in the number of species and their genetic heterogeneity (Prescott *et al.*, 2000).

The biodiversity and wildlife conservation is referred as the development of habitats in a rational and scientific manner to sustain and flourish the entire biodiversity and genetic resources for the welfare of human society and maintenance of inherent ecological balance in a long-term manner in a geographical region. The natural ecosystems of the planet support human life by providing energy, food, water, and other resources.

During the last few decades, there is a massive decline as well as alteration of wildlife habitats and wild population, attributed by the tremendous increase in human and livestock population, destruction of habitats for the development of agriculture, increased dependency on natural resources from forests, development of infrastructure, mining, industrialization and urbanization, etc. Anthropogenic activities like agricultural expansion, road construction, urbanization, and other developmental activities are envisaged as major threats to biodiversity that have resulted in the extinction of species at a rate of 1000 to 10,000 times faster than the ancient times (Wilson, 1988). Thus, the conservation of wildlife becomes a global responsibility.

Development projects in any given region should respect the ecological integrity and biodiversity values of the region as these are going to make an impact on environmental quality as well as the sustainability of the developmental interventions. With determination and effort, these unwanted consequences that emerge from a development initiative can be reduced or prevented or mitigated substantially through technological innovations and managerial skills. Due to the manifold pressure from natural as well as anthropogenic causes, many of the species which are familiar to us are now disappearing on daily basis. Some of the species are facing threats of extinction locally, nationally and globally. Therefore, conservation of biodiversity is our prime duty for our

very survival and sustainable utilization of biological resources (MEA 2005). At this juncture, it is crucial to develop appropriate policy and plan for the sustainable utilization of resources along with conservation and management of biodiversity.

Gujarat state is bestowed with rich mineral resources which accounts for 18 major minerals and the state is placed at 3rd position in production of major mineral within India. Soda Ash the common name given for the technical grade anhydrous sodium carbonate (Na_2CO_3) forms an important part of Indian inorganic chemical industry. It is a high volume, low-value product and finds application mainly in the production of detergents (42% light soda ash), glass (23% dense soda ash), chemicals (17% mainly light soda ash), sodium silicate, pulp & paper industries, and water treatment. India has the advantage of the abundance of raw materials viz. limestone and salt and growing domestic demand that favours the establishment of soda ash plants in the state of Gujarat. GHCL Ltd. is one of the largest Soda Ash manufacturing companies in India and caters to around 25% of country domestic demand. The proposed soda ash plant at Kachchh will meet the increased domestic and industrial demand.

1.1 ABOUT GHCL LIMITED

Gujarat Heavy Chemicals Limited (hereafter GHCL) is a reputed Soda Ash manufacturing chemical unit, established in 1983 located at Sutrapada of Gir Somnath district in the State of Gujarat. This was India's first integrated Soda Ash plant based on Akzo's Dry Liming Technology. The Sutrapada plant was commissioned in the year 1988 with the production capacity of 4,20,000 tons per annum (TPA) capacity. Over the time capacity has been expanded up to 11,00,000 TPA.

GHCL, is now proposing to set-up a Greenfield Chemical Complex to produce the Light Soda Ash Plant having the capacity of 11,00,000 TPA, dense soda ash plant with the capacity of 5,00,000 TPA and sodium bicarbonate plant with the capacity of 2,00,000 TPA near the village Bada, Taluka – Mandvi, District Kutch in Gujarat state. Along with above products, salt based derivative plants will also be planned in the future. The Soda Ash process requires uninterrupted and stable power supply, which will be met from the proposed 120 MW solid fuel based captive cogeneration power plant. The entire envisaged capacity will be achieved in two phases. The major raw materials are solar salt, chemical grade limestone, fossil fuel and other chemicals. The process is being

exothermic and requires a large quantity of seawater for cooling purpose, RO-DM and diluting process effluent to meet statutory norms. Seawater will be withdrawn from nearby Arabian Sea. The other associated utilities will be part of the project. The diluted/treated effluent generated from various process units and utility rejects will be dispersed through the marine outfall system in the Arabian Sea.

1.2 RATIONALE

M/s GHCL Limited was incorporated in 1983. The company is mainly in business of Soda Ash and Sodium Bi-carbonate manufacturing. The manufacturing plants are located at Sutrapada, of Gir-Somanth District, in the State of Gujarat, India. It contributes to almost 25% to 29% of the annual domestic demand. Soda Ash product is significant because of its use in major consumption related sectors like chemicals, detergents, water treatment, glass manufacturing, pulp and paper, textile and mining industry etc. Sodium Bicarbonate is widely used in Food industry.

GHCL Ltd. has signed an M.O.U with Govt. of Gujarat during the Vibrant Gujarat Summit in 2017 for the establishment of Greenfield Chemical Complex in Kachchh District. Thus, in order to create new Greenfield capacity for Soda ash and Sodium bicarbonate to meet the growing demand from user industry and to honor the commitment made during Vibrant Gujarat Summit (VGS), it has proposed to set up Greenfield Chemical Complex in KachchhDistrict. The Greenfield Chemical Complex comprise of manufacturing units for Soda Ash (Light and dense), Sodium Bicarbonate, Captive Power plant and Seawater Intake and Effluent Disposal System.

The MoEF&CC had granted TOR for the project in August 2021. GHCL had engaged CSIR-NEERI and CSIR-NIO for the preparation of EIA reports with respect toTerrestrial and Marine environment. Company has also engaged CSIR-NIO Goa unit for carrying out Sand Dune morphology study and Wildlife and ecology related studies had been carried out by a NABET accredited Functional Area Expert. There are some literatures available on the nesting of Sea Turtles along the sandy coast of Mandvi. The study related to Sea Turtles Status Survey and Conservation had been carried out by Zoological Survey of India (ZSI). Therefore, GHCL has consulted Gujarat Institute of Desert Ecology (GUIDE), Bhuj for preparation of Conservation plan for Schedule-I species including Sea Turtles as part of TOR compliance and GCZMA meeting minutes.

1.3 OBJECTIVES AND SCOPE OF THE STUDY

The following scope of work had been formulated under the study on the proposed Greenfield Chemical complex project.

1. ***Identify and assess the status of floral components of different habitats within core and buffer zones of the proposed project site***
2. ***Identify and assess the status of major faunal components of different habitats within core and buffer zones of the proposed project site.***
3. ***Identify and evaluate species and habitat of conservation significance (Threatened species and crucial habitats) within the project area.***
4. ***Suggest mitigation measures to minimize the identified impacts on the project components***
5. ***Prepare the Species Conservation Management Plan for the proposed project.***

2. STUDY AREA

Project Location

The proposed Project site and the study area are located on the coast of Bada village, in Mandvi Taluka of Kachchh district in the state of Gujarat (Map-1).

For the convenience of the study and the user agencies, the study area was divided into two major parts i.e. 1) Core area/project area and 2) Buffer area i.e. 10.0 km, in the periphery of the project boundary (Map-2).

1. Core Area

The core area is the proposed land area for the establishment of the project plant (Map 2), that covers about 1350 Acres of private, unirrigated agricultural land and Sarkar-shree land/Government land, near the Bada village of Mandvi Taluka in Kachchh district. The proposed project area is composed of sparsely distributed thorny scrub species, dominated by invasive species *Prosopis juliflora*. There are no rivulets or drainage traversing through the project area.

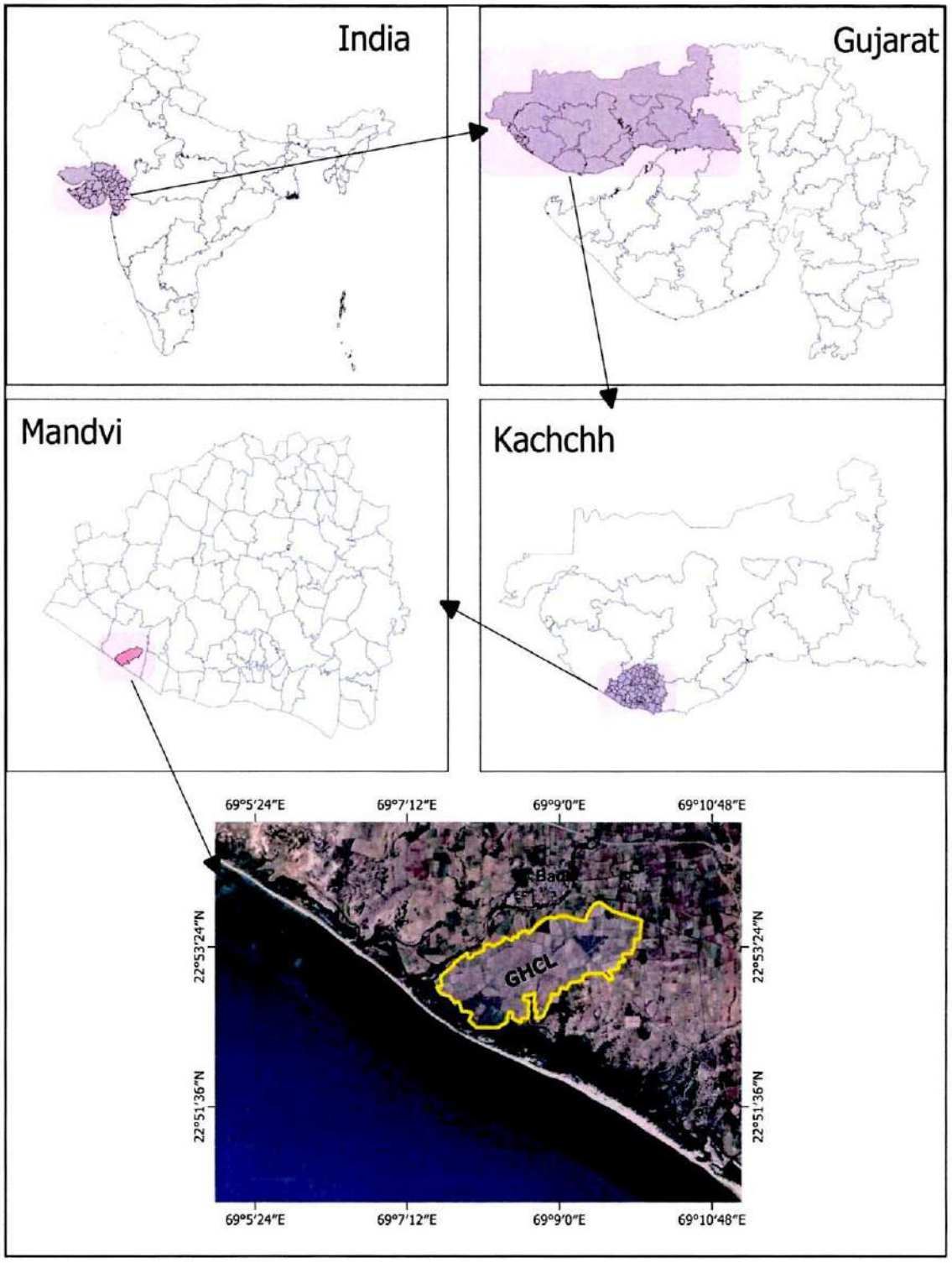
The Arabian Sea coast is located south of the proposed boundary of the project. The area is located at 6.0 km distance from the National Highway NH-41. As there is no major natural vegetation and human settlements present within the proposed land, therefore there is no requirement for relocation of any human settlements from the project site. The project site does not fall in 10.0 km periphery of any protected areas such as National Park or Sanctuary or eco-sensitive zones.

2. Buffer Area

The representative sampling locations within the villages within the 10 km buffer area are as below:

Table-1: Sampling locations in villages within 10 km buffer area

Sr. No.	Village Name	Sr No.	Village Name
1	Bada	7	Bhisara
2	Bhamdai	8	Panchatiya
3	Padampur	9	Bhada
4	Janakpur	10	Layija Nana
5	Chagdai	11	Laiyja Mota
6	Mapar	12	Bayath



Map- 1: Proposed project location near Bada village of Mandvi Taluka of Kachchh district in Gujarat

3. APPROACH AND METHODOLOGY

1. Reconnaissance Survey

A reconnaissance survey was conducted during March and April 2022 in core and buffer areas of the proposed Greenfield Chemical complex project site to take a note of existing flora, fauna and eco-sensitivity zone status.

The survey was conducted to identify various habitats within the study area and fix the sampling locations for the intensive survey and data collection on various aspects of the present study.

2. Land use and Land Cover Classification

The reconnaissance field survey was undertaken to get acquainted with the general land cover pattern of the area. Field observations were carried out along the core and buffer area for ground truthing to understand the patterns and characters using satellite imageries. Various features identified during the ground truthing were correlated with the information collated from the satellite imageries.

Major land use land cover in the study area observed to be waste land, rain fed agriculture land, water bodies, Arabian Sea and sand dunes and transport network. Due to sandy nature of shoreline the mangrove system is found to be absent in site.

3. Intensive Survey

Intensive field surveys were carried out from March to April 2022 for the data collection on the existing flora and fauna within the core and buffer zone of the study area.

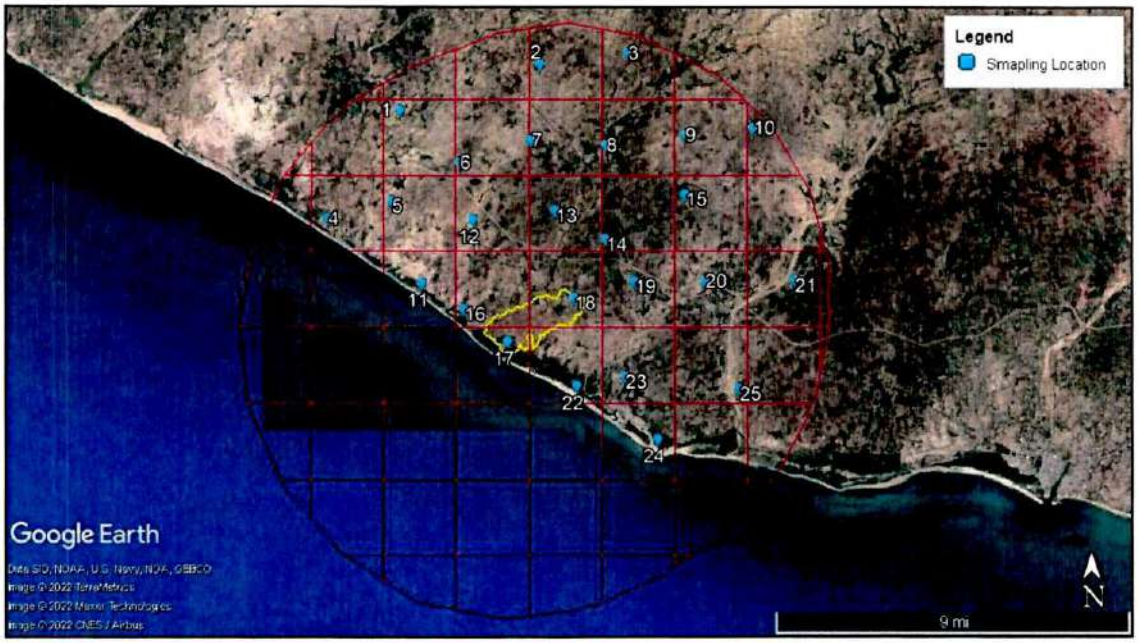
Sampling Locations

In order to assess the biodiversity status of the project study area, 25 locations (Transects) (Map 2) were sampled covering different habitats. These locations were randomly selected based on the availability of extent of area falling under different habitat types.

Distribution of sampling locations

Among the 25 sampling transects, 04 were selected within the Project Area (Core area) and the rest are in Buffer Area. Since the site is predominated by single crop

Agricultural habitat, wasteland with *Prosopis* thickets and Scrub land, maximum of 25 locations were sampled in this area.



Map-2: Core and Buffer area with sampling location of proposed plant in Kachchh, Gujarat.

The approach and methodology applied for assessing terrestrial biodiversity of the study area is described in respective sections below.

3.1. Terrestrial Biodiversity

Micro level approach mainly involving field based primary data collection on faunal diversity in the core and buffer zones within study area was undertaken. The various groups of faunal species including mammal, bird, reptile and amphibian were surveyed using standard methods in habitats such as forest, wetland, scrubland, grassland, human habitation, fallow land, mudflats, creeks, and agriculture, etc.

3.1.1. Floral status

Floral species existing was surveyed in all the representative habitats covering wetland, forest, grassland, scrubland and wastelands in core and buffer area of the proposed project site. Quantitative data on floristic diversity were collected using Standard Quadrate Sampling Methods followed by Mueller-Dombois and Ellenberg (1967), Kershaw and Wright (1980). Random vegetation surveys were also made at some locations to assess the plant diversity.

3.1.2. Faunal Status

3.1.2.1. Herpetofauna (Amphibia and Reptiles)

An intensive search method was made along the hedges of water bodies including ponds, Lakes River and streams to quantify the amphibian species. Status of herpetofauna was monitored and assessed using standard methods (Campbell and Christman, 1982; Welsh, 1987; Corn and Bury, 1990; Heyer *et. al.,* 1994).

3.1.2.2. Birds

Intensive avifaunal surveys were made in both terrestrial and aquatic habitats located within the study area. Total count or flock count method (Sridharan, 1989; Bhupathy, 1991; Thompson, 2002; Steinkamp *et. al.,* 2003) were applied for monitoring and assessment of the aquatic birds in wetlands and waterlogged areas. Point centered count method/perambulation techniques (Hutto *et al.,* 1986; Bibly *et. al.,* 1992; Rosenstock *et. al.,* 2002) were applied to monitor and assess the status of terrestrial bird species.

3.1.2.3. Mammals

Status and distribution of different mammal species in various habitats were quantified through direct sighting while walking along the transect) (Burnham *et al.,* 1980; Sale and Berkmuller, 1988; Rodger, 1991). The indirect evidences the mammalian fauna was also collected following standard methods (Thompson *et. al.,* 1989; Daniel, 1992; Henke and Knowlton, 1995; Allen *et. al.,* 1996).

4. Identification of Rare and Threatened Species

The species recorded during the survey were identified using standard taxonomic tools, literature, handbooks and pictorial guides of plants and animal species (Shah, 1978; Bhandari, 1990; Ali, 2002; Daniels, 2005; Prater, 2005; Grimmett *et. al.,* 2006). Achecklists of plant and animal species were prepared and the conservation status of each species were collated as per Redlist of threatened species of IUCN (2022), World Conservation Monitoring Centre (WCMC), Indian Wildlife (Protection) Act (1972) (with amendments 2002) and Rare, Endangered and Threatened (RET hereafter) Plant list of Gujarat.

5. Threat and Impact assessment

The natural and anthropogenic threats were identified as per the threat assessment tools guideline of IUCN. The assessment was made to determine and predict the likely impacts of the activities of proposed project. The probable threats on biological attributes viz. habitats, ecosystems, biodiversity of surrounding environment by the proposed project were assessed. Special care was given to predict the impact of proposed project and associated development on wildlife and biodiversity present in the surrounding areas.

6. Preparation of Wildlife Conservation and Management Plan

After identification of rare and threatened biodiversity and wildlife present in the study area, the present threats and the likely impact on them in due course of proposed project time period were also evaluated. Further, suitable measures were conceived for conservation and management of wildlife and biodiversity in core and buffer area.

4. Status of Biodiversity in the Study Area

4.1 Habitat diversity

The study area is undulating and predominately dominated by major habitat types i.e., scrubland, wasteland and agricultural land (dryland agro-ecosystem). The second dominant habitat type is wasteland which are either private (uncultivable wasteland) or comes under revenue department (revenue wastelands) and can be categorized into two types of sub habitats i.e., land purely dominated by *Prosopis juliflora* Scrub (PS) and Open Scrub Forest dominated by medium sized wild tree and thorny shrub vegetation cover. The waste lands within the study area have considerable patches of *Salvadora sp.*, belonging to private uncultivable wasteland, and revenue waste lands, riverine land, coastal sand dune habitat, etc. **However, the core area doesn't have any** Gauchar land.

However, for the purpose of present study, the entire study area has been delineated into five major habitat types based on the nature of vegetation existing and use by faunal species.

Open scrubland: Mainly small patches of wastelands (Gauchar lands, cultivable waste) with wild species of scrub vegetation and scattered tree species which belong to government revenue department or private. These patches are not true and designated forest areas.

***Prosopis* Scrub: A**ll the categories of waste lands which includes; Gauchar land, and permanent fallow lands, mostly dominated by *Prosopis juliflora* (Gando baval).

Agro-ecosystem: Areas currently under intensive agriculture use (irrigated lands, un-irrigated lands/rain fed irrigation) and its surrounding hedge vegetation (locally known as - Wadis) are private lands, owned by people. The study area is located in arid landscape with very minimum rainfall; therefore, cultivable area is very less compared to other habitats in the study area.

Stream Beds: This includes the areas situated on the banks of seasonal rivers, rivulets, streams and small nallahs.

Wetland: The major wetland in the study area was the check dam located in the northern side of the buffer area (10 km) which supports good population of birds in the area during the monsoon season.

Plate 1: List of different habitats observed in the Study area

Agriculture land in the study area

Sand dune habitat on the beach

Wetland Habitat

ProsopisJulifora thickets in the study area

Dry River in the Study area

4.2 Status of Species Diversity

During the study period different plant and animal species belonging to both terrestrial and marine environments were recorded. An account of the floral and faunal diversity recorded during the study is given in the following sections.

4.2.1 Floral Diversity

Based on the preliminary survey on flora of the study area, a total of 110 species (Annexure I) of plants belong to 96 genera and 39 families were recorded (Figure 4.1). Among the recorded plants, 13 species were trees, 11 species of shrub, 47 species of herbs, 24 species of Grass and 15 species of climbers (Figure 4.2).

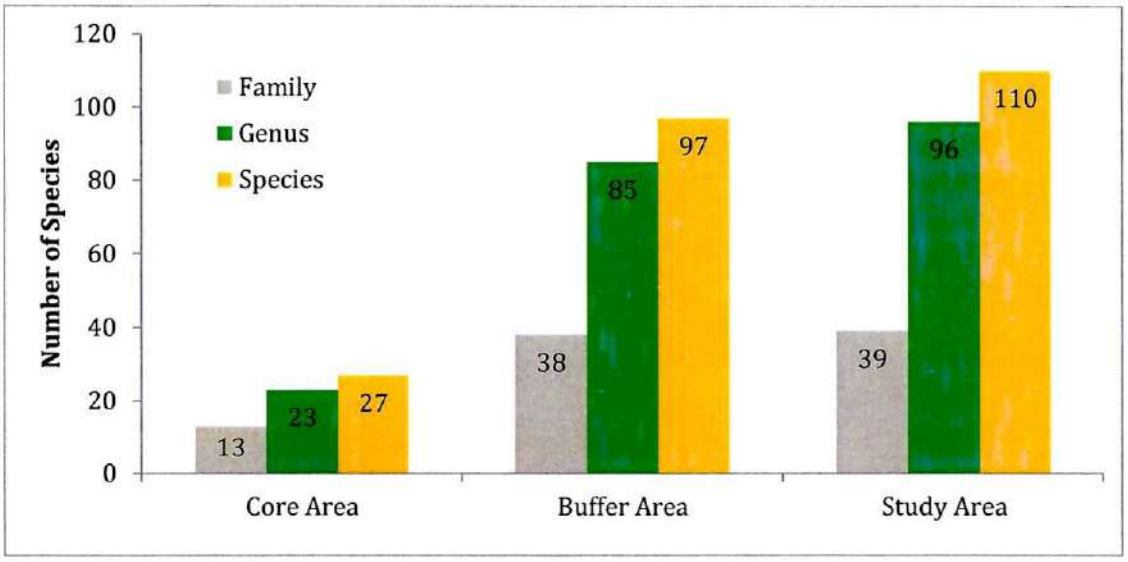


Figure 4.1: Floral Species diversity of the study area of GHCL, Kachchh

The buffer area of 447.24 km^2 was surveyed for biodiversity assessment and21 transects (for faunal survey) and 105 quadrates (for vegetation assessment) were laid. Nested quadrate sampling for trees (10 x10 m), shrubs and climbers (5 x5 m) and herbs (1 x1 m) were carried out. A total of 97 plant species were recorded belonging to 38 families and 85 genera. The species diversity of the recorded plants in the buffer area highlights that the highest number of plants were Herbs and Grasses (59) followed by Climber (15), Tree (13) and Shrub (10). The value of Shannon-wiener diversity index H' was 2.34 which depicted medium species diversity in the buffer area.

The core area was assessed through 4 transects for fauna and 20 quadrates for floral species. A total of 27 plant species belonging 13 families and 23 genera were recorded. The species diversity of core area is low compared to the buffer area and only 4 species of trees, 10 species of herbs and 12 species of grass was recorded. The Shannon-wiener diversity (H') index was 1.19 depicting very low diversity. The analysis of the floral diversity from the core and buffer areas revealed that the floral diversity increases from core to buffer area.

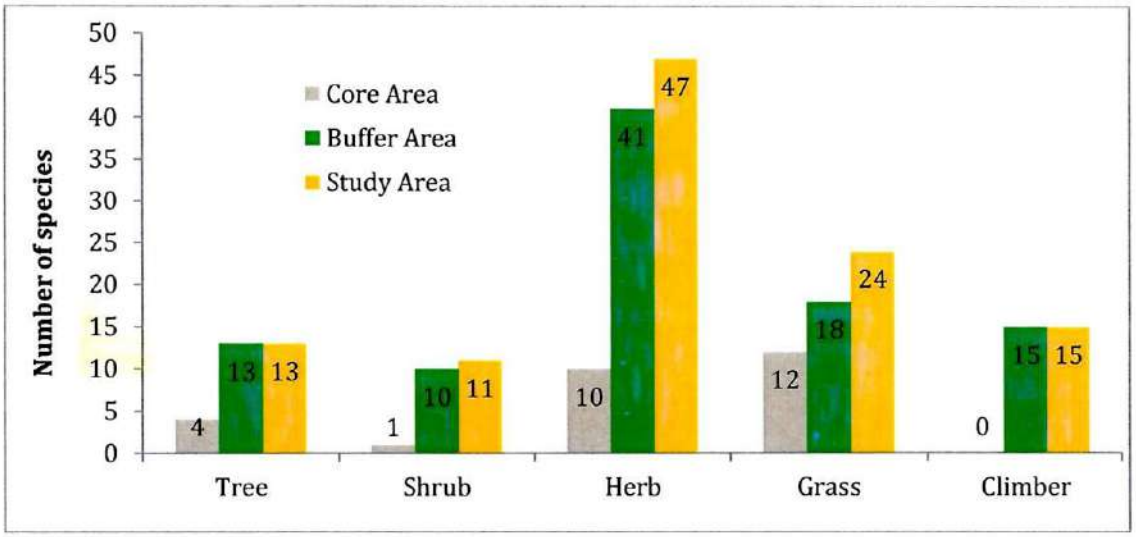


Figure 4.2: Diversity of species in different habits of plants in the study area

Thorn Scrub vegetation:

The thorn scrub vegetation is located in most of the buffer area of the project site. The terrain of forest area is gentle undulating in nature and the top layer is mainly dominated by *Acacia nilotica, Acaccia leucophloea, Acaccia senegal, Salvadora olieodes, Salvadora persica* etc. Most of the forest areas have been degraded by the invasion of *Prosopis juliflora*. Whereas shrub layer is mainly composed of *Euphorbia caducifolia, Zyziphus numularia, Balanitesa egyptica, Capparis decidua, Laptedenia pyrotecnica* etc. The species like *Indigofera cordifolia, Borhevia diffusa, Citrulus colosynthis, Cynadon dactylon, Cenchrus setigerous, Chloris barbata*, etc. constitutes the ground cover.

Wetland vegetation:

The seasonal wetland vegetation is dominated by *Ficus benghalensis, Prosopis cineraria, Acaccia nilotica, Tamarix aphylla, Prosopis juliflora, etc.* with herbaceous growth of species like *Cyperus compressus, Juncusma ritimus, Phyla nudiflora, Bacopa*

moniera etc. Occasional records of *Glinusl otoides, Coldemia procumbens, Heliotropium supinum, Argemon mexicana* etc. were also there in this habitat.

Coastal Vegetation:

Coastal areas in buffer zone have been represented mainly by halophytes and scrub forests. The halophytes such as *Cyperus arenarius, Hallopyrum mucronatum, Cyperus bulbosus, Lasiurus scindicus, fimbrist lyscymosa, Sporoboulus helvolus* etc. were observed.

Endangered/Threatened/Protected Species:

There were no RET species and species of conservation concern present in the core area of the project site, however the sporadic occurrence of *Commiphora wightii* with low abundance and frequency of occurrences in buffer zone was observed. The important and noteworthy plant species observed in the study area are, *Commiphora wightii, Hallopyrum mucronatum, Citrulus colosysnthis, Prosopis cineraria, Tribuluster restris* etc.

4.2.2 Faunal Diversity

The survey recorded 120 terrestrial vertebrate faunal species including 13 species of herpetofauna, 91 species of birds, and 16 species of mammals. All the 120 faunal species recorded from buffer area, whereas 68 species recorded from core area. The taxa wise distribution and abundance status in core and buffer area is described below:

1. Herpetofauna

Species Richness

Altogether, in the study area, a total of 16 species (two species of sea turtle and mugger crocodile recorded through secondary literature in both the core and buffer area, but no direct or indirect evidence found from the study area during the study) belonging to 16 genera and 8 families of herpetofauna recorded during the survey.

Core area: Within the core area, a total of 8 species of reptiles were recorded which included; four (4) species of lizards, two (2) species of skinks, one (1) species of monitor lizard and one (1) species of snake. The recorded species are belonged to 8 genera and 4 families (Table 4.1).

Buffer area: Fifteen (15) species of herpetofauna belonging to 15 genera and 7 families were recorded in the buffer area

Table 4.1: Taxonomic status and abundance of Herpetofauna in Study Area

S. No.	Family/Species	Common name	IWPA, 1972	IUCN 2022	Presence/ Absence		Abundance		
					CA	BA	CA	BA	SA
	REPTILE								
	Lizards								
	Gekkonidae								
1	Garden Lizard	*Calotes versicolor*	IV	LC	+	+	2	8	10
2	Fan-throated Lizard	*Sitana ponticeriana*	IV	LC	+	+	5	11	16
3	Spiny-tailed Lizard	*Uromastix hardwickii*	II	LC	+	+	1	3	4
4	Indian Fringe-Toed Lizard	*Acanthodactylus cantoris*	IV	LC	+	+	1	2	3
	Monitor lizard								
	Varanidae								
5	Indian monitor lizard	*Varanus bengalensis*	I	LC	+	+	2	8	10
	Skinks								
	Scincidae								
6	Common Skink	*Mubuy acarinata*	IV	LC	+	+	2	2	4
7	Short-tailed Agama	*Agama minor*	IV	LC	+	+	1	1	2
	Snakes								
	Colubridae								
8	CheckeredKeelback	*Natrix piscator*	IV	LC		+	0	4	4
9	John Sand Boa	*Eryx johni*	IV	LC	+	+	1	1	2
10	Glossy-bellied racer snake	*Platycepsven tromaculatus*	IV	LC		+			
11	Rat Snake	*Ptyas mucosus*	IV	LC		+	0	3	3
	Viperidae								
12	Saw-scaled viper	*Echis carinatus*	IV	LC		+	0	1	1
	Crocodylidae								
13	Mugger	*Crocodylus palustris*	I	VU		+	0	0	0
	AMPHIBIAN								
	Tryonychidae								
14	Flap Shell Turtle	*Lissemus punctata*	I	LC		+	0	2	2
	Cheloniidae								
15	*Olive Ridley Sea turtle	*Leoidochelys olivacea*	I	VN	Through literature		0	0	0
16	*Green Sea turtle	*Chelonia mydas*	I	EN	Through literature		0	0	0
		Total			**8**	**14**	**15**	**46**	**61**
	CA= Core area, BA= Buffer Area, SA= Study area, EN=Endangered, VU=Vulnerable, NT=Near Threatened, LC=Least Concerned, * As per available literature based on single available survey data of 2000-2001 Note: The client has carried out Sea Turtle Status Survey and Conservation study through ZSI, Kolkata (GOI) during 2019 and the report findings conclude no sighting of sea turtle species during survey period.								

Abundance status

During the survey it is recorded that a total of 61 individuals of herpetofauna were observed during the survey which include maximum of Fan-throated lizard (16) and Monitor Lizard (10), followed by Indian Garden Lizard (10).

Core area: Core area has 8 species with a total of 15 individuals which include; five individuals of Fan-throated Lizard, two individuals of Monitor Lizard, two individuals of Garden Lizard during the survey (Table 4.1).

Buffer area: A total of 46 individuals of herpetofauna were recorded from the buffer area during the survey. Among these, maximum number of individuals of Fan-throated lizard (16), followed by Monitor Lizard (10), Indian Garden Lizard (10), was encountered during the survey (Table 4.1).

2. Avifauna

Species Diversity Status

Overall, within the study area a total of 91 species belongs to 70 genera of 41 families were recorded during the study (Table 4.2). The overall species diversity of the study area was H' = 3.97.

Core area: Within the core area a total of 53 species of birds belonging to 41 genera and 26 families were recorded. The species diversity (H') was 3.55 (Table 4.3).

Buffer area: Within the buffer area a total of 91 species of 70 genera and 41 families were recorded and the species diversity (H') was 3.97 (Table 4.3).

Table 4.2 Taxonomic diversity status of Birds in the Study Area

Category	Core Area	Buffer Area	Total
Order	10	18	18
Family	26	41	41
Genus	41	70	70
Species	53	91	91

Table 4.3 Species Diversity status of birds in the study area

Sl. No	Species Diversity	Core Area	Buffer Area	Study area
1	No. of Species	53	91	91
2	Individuals	368	1795	2163
3	Dominance_D	0.03708	0.02491	0.02452
4	Shannon_H	3.559	3.976	3.974
5	Evenness_e^H/S	0.6628	0.5858	0.5844
6	Menhinick	2.763	2.148	1.957
7	Margalef	8.802	12.01	11.72
8	Equitability_J	0.8964	0.8814	0.8809
9	Chao-1	58	93.15	92.25

Abundance Status

Though the study area recorded 91 species, the overall abundance of most of the species were low. About 86.81% of the species (79 species) were enumerated in low abundance category.

Core area: A total of 53 bird species were recorded from core area, all the 53 species (100%) were recorded with low abundance (below 1-50). Blue-rock pigeon showed higher in abundance in the core area (Table 4.4).

Buffer area: Within the buffer area, a total of 1795 individuals of birds were encountered during the survey. Among the encountered birds, nine species recorded highest in number (Medium 52-100) and rest of the species were recorded in low abundance with individuals less than 50 individuals (Table 4.4).

Table 4.4 Species Abundance categories of birds in Study Area.

Abundance Category	**Core area**	**R%**	**Buffer area**	**R%**	**Study Area**	**R%**
Low -1-50 individuals	53	100	82	90.11	79	86.81
Medium -51-100 individuals	0	0	9	9.89	10	10.99
High – 101-250 individuals	0	0	0	0	2	2.20
Very High > 250 individuals	0	0	0	0	0	0
Total species	**53**	**100**	**91**	**100**	**91**	100
Abundance	**368**	**17.01**	**1795**	**82.99**	**2163**	**100**

R%- Relative Percent, SA- Study Area

Foraging Status

Among the recorded birds, seven different types of foraging guilds used by birds were identified from the study area. The maximum number of species are insectivores followed by omnivores, carnivores and granivores. However, 40% and 31% of the species recorded in core and buffer area belongs to Insectivores species (Table 4.5).

Migratory status

Altogether, within the study area, 73.63% (67 species) species were resident, 18.68% were (17 species) migratory while rest of 7 species were resident migrant (Table 4.6).

Core area: Out of 53 species recorded within the core area, 42 species (79%) were resident while only 8 species were winter visitors (migratory) and 3 resident-migrants (Table 4.6).

Buffer area: Similar to core area, within the buffer area 73.63% of the species were resident while only 18.68% of the species were migratory (Table 4.6).

Table 4.5 Foraging Status of Birds in Study Area

Feeding Guild	Core Area	Relative Percentage	Buffer Area	Relative percentage	Study Area	Relative percentage
Carnivore	15	28.30	22	24.18	22	24.18
Frugivore	1	1.89	2	2.20	2	2.20
Granivore	8	15.09	12	13.19	12	13.19
Insectivore	16	30.19	28	30.77	28	30.77
Nectorivore	1	1.89	1	1.10	1	1.10
Omnivore	11	20.75	18	19.78	18	19.78
Piscivore	1	1.89	8	8.79	8	8.79
Total	**53**	100	**91**	100	**91**	100

Table 4.6 Migratory status of Birds in Study Area

Migratory types	Core Area	Relative percentage	Buffer Area	Relative percentage	Study Area	Relative percentage
Resident	42	79.25	67	73.63	67	73.63
Migrant	8	15.09	17	18.68	17	18.68
Resident-Migrant	3	5.66	7	7.69	7	7.69
Total	**53**	100.00	**91**	100.00	**91**	100.00

Chestnut Bellied Sandgrouse

House Crow

Common Stonechat

Ashy-crowned Sparrow Lark

Black-naped Ibis

Yellow-wattled Lapwing

Indian Peafowl

3. Mammal Diversity Status

Species Status

Altogether, the study area recorded 16 species belonging to 15 genera and 10 families based on direct (10 species) and indirect (6 species) observation (Figure 4.3).

Core area: Within the core area a total of seven species of mammalian fauna belonging to seven genera and six families were recorded during the survey (Figure 4.3).

Buffer area: A total of 16 species of mammals belonging to 15 genera and 10 families were recorded from the buffer area (Figure 4.3).

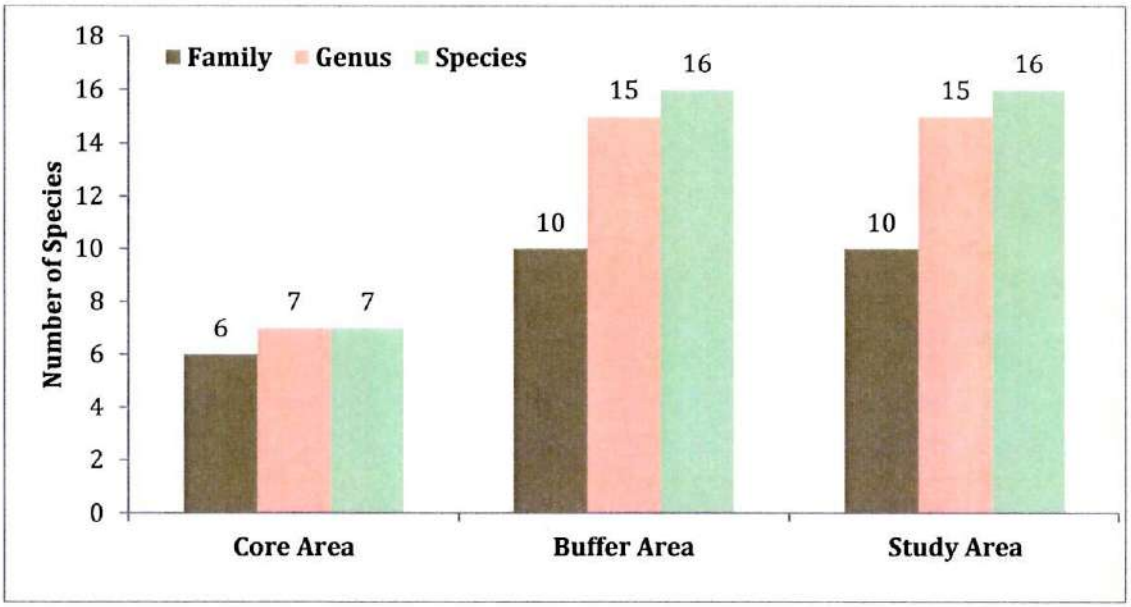


Figure 4.3: Taxonomic status of Mammals (Direct/Indirect evidence) in Study Area

Abundance status

Status of mammalian fauna was assessed based on both field sampling like direct sightings, indirect evidences (tracks & signs, pellets, scats, burrows & holes, trail, pellets, dung, dropping, etc.) and through secondary information collected from the local people. Though, the study area recorded 16 species, direct sighting was only for 10 species while 6 species were included based on the indirect evidences (Table 4.7). Maximum evidences of Desert Gerbil (19 colony) were recorded from the area, followed by Nilgai or Blue bull (18 pellet group), Indian Hare (13), Indian Porcupine (12 pellet group) and Chinkara (10 pellet).

Table 4.7: Abundance Status of Mammals (Direct/Indirect evidence) in Study Area

S. No	Order/Family/Sci. Name	Common Name	IWPA 1972	IUCN 2022	Presence /Absence		Abundance		
					CA	BA	CA	BA	SA
	ARTIODACTYLA								
	Bovidae								
1	*Boselaphus tragocamelus*	Nilgai	Sch-III	LC	+	+	4	14	18
2	*Gazella gazelle bennettii*	Chinkara	Sch-I	LC		+	0	10	10
	Suidae								
3	*Sus Scrofa*	Wild Boar	Sch-III	LC	+	+	1	1	2
	CARNIVORA								
	Canidae								
4	*Canis aureus*	Golden Jackal	Sch-II	LC		+	0	2	2
5	*Felis chaus*	Jungle Cat	Sch-II	LC		+	0	1	1
6	*Vulpus bengalensis*	Indian Fox	Sch-II	LC		+	0	1	1
	Herpestidae								
7	*Herpestes edwardsii*	Grey Mongoose	Sch-II	LC	+	+	4	6	10
8	*Herpestes javanicus*	Small Indian Mongoose	Sch-II	LC		+	0	7	7
	Hyaenidae								
9	*Hyaena hyaena*	Striped Hyena	Sch-III	NT		+	0	2*	2*
	EULIPOTYPHLA								
	Erinaceidae								
10	*Ghemiechinus collaris*	Long-eared hedgehog	Sch-IV	LC		+	0	1	1
	LAGOMORPHA								
	Leporidae								
11	*Lepus nigricollis*	Indian Hare	Sch-IV	LC	+	+	1	12	13
	RODENTIA								
	Hystricidae								
12	*Hystrix indica*	Indian Porcupine	Sch-IV	LC		+	0	12*	12*
	Muridae								
13	*Merioneshur rianae*	Desert Gerbil	Sch-IV	LC	+	+	7	12	19
14	*Tatera indica*	Indian Gerbil	Sch-IV	LC	+	+	3	5	8
15	*Golunda ellioti*	Kutch Rat	Sch-IV	LC		+	0	5	5
	Sciuricidae								
16	*Funambulus pennantii*	Five-Striped Squirrel	Sch-iv	LC	+	+	1	2	3
Overall Abundance					**7**	**16**	**24**	**70**	**110**

Indian hare

Golden Jackal

Grey Mongoose

Nilgai

Spiny-tailed Lizard

Flap Shell Turtle

5. Threatened Biodiversity/Wildlife

5.1 Threatened Plant: There were no rare, endangered or conservation concern species present in the core area of the project site, however the sporadic occurrence of *Commiphora wightii* (Critically Endangered) with low abundance and frequency of occurrences in buffer zone was observed. The important and noteworthy plant species observed in the study area are, *Commiphora wightii, Hallopyrum mucronatu, Citrulus colosysnthis, Prosopis cenaraia, Tribulus terrestris* etc.

5.2 Threatened herpetofauna: In the present study we identified a total of 8 species of reptiles within the core area and 15 species in the buffer area (Table 4.1). The Mugger reported from the buffer area is listed as Schedule-I in the Wildlife (protection) Act, 1972 and vulnerable by the IUCN. The Indian Flap-shell turtle and Indian monitor lizard were also reported from the buffer area. These two species are common throughout the country and listed as Schedule-I in the Wildlife (Protection) Act, 1972 and least concerned by the IUCN. Among the other species Spiny-tailed Lizard belongs to Schedule-II whereas, rest of the species belongs to Schedule-IV. Majority of the reptiles (except Green and Olive Ridley Sea turtles which were added in the list from literature review of previous published reports) reported from the buffer area falls under 'Least Concern' category of IUCNRed list of threatened species. No endangered, rare, threatened or endemic species of reptiles was reported from the project core area.

The sandy stretches of Kachchh district are known for sporadic nesting of two species of sea turtles *i.e.*, Olive ridley (*Lepidochelys olivacea*) and Green Sea turtle (*Chelonia mydas*). Gujarat Ecology Commission a Government of Gujarat Organization has carried out a study as part of World Bank aided Integrated Coastal Zone Management (ICZM) Project titled "*Evaluation of Sea Turtle Nesting Population and Threats to Nesting Beaches: Suggest Conservation and Management Strategies*" (also referred as Sunderraj *et. al.*, 2013). The study based on secondary data (from Gujarat Forest Department and Sunderraj *et. al.*, 2002) identified total 10 stretches of Sea turtle nesting beaches on Kachchh coast.

The survey of 2000-2001 (Sunderraj *et. al.* 2002) is mentioned and considered by ZSI experts also while making site specific observation and report writing for the GHCL. The report mentions about sea turtle nesting information available for Kachchh coast is based on the data collected from Forest department, except for one-time survey by

Sunderraj *et. al.* (2002). However, ZSI has carried out site specific survey in 2019 for the proposed project and they did not sight or recorded any sea turtle in the study area. Further, there were no direct or indirect evidences on the nesting of Sea turtle on the Bada coast near to the project site was recorded during the rapid field visits carried out in the month of March and April 2022. Also, during the field visits the presence of rock was recorded in all over the beach during the low tide, with abrupt slope and dense vegetation in the supra tidal region on the beach near proposed project site. Presence of vegetation such as *Prosopis juliflora* is seen to hold sand and stabilized sand dunes. We also observed higher presence of predators such as jackals and dogs along the beach.

Based on the above primary observations it can be depicted that due to the presence of rocky patches, tidal inundation due to narrow strip, abrupt slope, dense thorny vegetation and presence of predators such as dogs and jackals, sea turtle nesting might have been hindered near the proposed study area. However, it is envisaged that sandy beach along the coast of Bambhdai, Pachotiya, Bhada and Nana Layja appear to be an ideal and viable habitat for sea turtle nesting based on the suitable habitat in terms of morphology and past records. Therefore, a detailed study is required to understand the exact status and nesting of Sea turtles.

Threatened birds: During the study a total of 91 bird species was observed in the study area. Majority of the species (67) are resident species whereas only 17 species were found to be migratory and seven species are resident migratory (Annexure II). Of these 91 bird species **recorded, 84 belong to 'Least Concern' category rated by IUCN,** whereas total 4 species *i.e.* Painted Stork (*Mycteria leucocephala*), Oriental White Ibis (*Threskiornisme lanocephalus*), Eurasian Curlew (*Numenius arquata*), and Pallied harrier (*Circus macrourus*) belong to Near Threatened category (Annexure II) and one species i.e. River Tern (*Sterna aurantia*) falls under Vulnerable category. Of the recorded species, five species belong to Schedule-I, 85 species belong to Schedule-IV and one species belong to Schedule-V.

Threatened Mammals: Total 16 mammal species was recorded from buffer area and seven from core area of the project site (Table-4.7). The common mammalian species that were directly observed in the core area include Wild boar (*Sus scrofa*), Grey Mongoose (*Herpestes edwardsii*), Indian Hare (*Lepus nigricollis*), Nilgai (*Boselaphustra*

gocamelus), Pale Hedgehog (*Ghemiechinus collaris*) and Five Striped Squirrel (*Funambulus pennantii*), etc. There were no Threatened or Schedule-I species reported from the core area of the project site (Table-4.7). Chinkara (*Gazella gazelle bennettii*) is the only Schedule-I species reported from the buffer area. Jackal (*Canis aureus*), Jungle cat (*Felis chaus*), Indian Fox (*Vulpus bengalensis*), Common Mongoose (*Herpestes javanicus*) belongs to Schedule-II of Indian Wildlife (Protection) Act, 1972. Whereas, Nilgai (*Boselaphustrago camelus*), Wild boar (*Sus Scrofa*) belong to Schedule-III. Rest of the species belong to Schedule-IV of IWPA, 1972. Majority of the common mammalian species recorded during the survey in the core and buffer area are present throughout semi-arid, non-forested and non-protected landscapes especially in Kachchh region.

Table-5.1: Species of high conservation significance (Threatened/Sch.-I) present in the study area.

No.	Taxa	Name of Species		IWPA Status	IUCN Status
		Common Name	Scientific Name		
1	Reptile	Flap shell Turtle	*Lissemus punctatea*	Sch.-I	LC
2	**Reptile**	***Green Sea turtle**	***Chelonia mydas***	**Sch.-I**	**EN**
3	Reptile	Indian monitor lizard	*Varanus bengalensis*	Sch.-I	LC
4	**Reptile**	***Olive Ridley Sea turtle**	***Leoidochelys olivacea***	**Sch.-I**	**VU**
5	**Reptile**	**Mugger/Crocodile**	***Crocodylus palustris***	**Sch.-I**	**VU**
6	Bird	Black shoulder kite	*Elanus caeruleus*	Sch.-I	LC
7	Bird	River Tern	*Sterna aurantia*	Sch.-IV	VU
8	Bird	Indian Peafowl	*Pavo cristatus*	Sch.-I	LC
9	Bird	Marsh Harrier	*Circus aeruginosus*	Sch.-I	LC
10	Bird	Pallid Harrier	*Circus macrourus*	Sch.-I	NT
11	Bird	Shikra	*Accipiter badius*	Sch.-I	LC
12	Bird	Short-toed Snake Eagle	*Circaetus gallicus*	Sch.-I	LC
13	Mammal	Chinkara	*Gazalla bennettii*	Sch.-I	LC
14	Plant	Gugal	*Commiphora wightii*	-	CR
	*Green Sea turtle and Olive Ridley Sea turtle were reported through secondary data. Sea Turtle visit only during the breeding season. However, no study has established exact breeding season and timing for the regions in study area. Mugger also reported from the study area.				

6. Impact Identification and Evaluation

The developmental programs, policies and projects operated or managed by government or private bodies can potentially impart significant changes in the physical, biological and socioeconomic systems. In some cases, the changes may be beneficial but in most of the time it used to be detrimental to the environment. Accordingly, environmental impacts studies are required for systematic identification, qualification and interpretation of the anticipated changes.

The main environmental problems associated with any development plan will be the intrusion of pollutants (water, air and noise), which ultimately impact the floral and faunal health existing within and in the vicinity of the proposed project area. However, the occurrence and magnitude of these impacts depends on project location, mode of operation and adoption of latest technologies.

In general, impact prediction methods argue that the foremost step in impact appraisal must consider and identify project actions that are likely to bring significant changes in the project environment. The present study determined the impacts of the GHCL proposed project in the surrounding environment with specific focus on biological attributes covering habitats/ecosystems and associated biodiversity. In addition to it, the project related activities can be helpful in improving the socio-cultural status of the surrounding in terms of improvement in infrastructural facility, social and cultural development of the local community, etc.

1. Impact to threatened faunal species

Presence of any threatened faunal species in the study area likely to impact due to project related activities in the form of habitat degradation, fragmentation, loss of corridor that affects the movement of animals and loss of specific habitat.

Evaluation: The study recorded one species of bird the Indian Peafowl (*Pavo cristatus,*) and one species of mammalian fauna the Chinkara (*Gazella bennettii*) falling under Schedule-I category of Indian Wildlife (Protection) Act 1972 and one species each of bird the River Tern (*Sterna aurantia*) and mammal (*Hyaena hyaena*) categorized as Vulnerable and Near Threatened respectively, as per the IUCN Red list of Threatened species (2022) within the buffer area. Abundance status of these species and their

habitat use were low except Indian Peafowl therefore the project activities has negligible impaction these wildlife species.

Reptiles: The abundance of Indian Monitor lizard and Spiny-tailed lizard in the core area of GHCL was very low (Table 4.1). The project activities may have minimum effect on Mugger species as they were recorded from inland water bodies.

Terrestrial birds: Indian peafowl were reported in low abundance in the study area. Although it uses diverse habitats like; scrub forests, agriculture area, *Prosopis* scrub and stream beds. Therefore, the proposed project activities will not have any significant impact on the Indian Peafowl.

Aquatic birds: The species like Eurasian Spoonbill is mainly distributed in wetlands of the study area which is about 5-6 km far from the core area of the project activities (Jethwa 2019). The effluent after meeting discharge, standards notified by CPCB for Soda Ash industry released from the proposed plant at a location in Arabian Sea. The discharge location is recommended by CSIR NIO after carrying out EIA studies. There will be no discharge of any effluent on terrestrial site and any wetland area which can affect avifauna. Therefore, the proposed project activities unlikely affect the species and its dependent habitat.

Mammals: The core and buffer areas are the habitat for Chinkara and other mammal species which were recorded during the field survey and also confirmed through the discussion with local people. Since, the project area is not located in vicinity of the Narayan Sarovar Sanctuary (Approx dist. 70 km), Occasional visit of Chinkara is expectedin the buffer area in case of shortage of food. Overall, it can be concluded that, the core area is not a potential habitat for this species and they are only occasional visitors in this area. Due to these reasons minimum threats could be predicted on this animal in terms of loss and fragmentation of habitats and isolation of population. Appropriate conservation and management guidelines are given in the successive chapters.

2. Effect on general environment and habitats of wildlife

The proposed project for the GHCL and its associated activities would expect some degradation of habitat and environment quality in and around the project area due to

project based activities. The probable impacts may arise if not controlled through environment management measures include;

A. *Deposition of dust and particulate pollution in the nearby habitat and vegetation cover.*

B. *Air pollution due to the suspended particulate manner*

C. *Noise generated from the plant will also affect the normal behavioral patterns (feeding, movement, resting) of the major faunal groups inhabits in the vicinity of the project.*

D. *Effluent releasing in the sea water.*

Evaluation: GHCL is adopting proven and efficient technology (ESP, desulphurization, adequate stack height dust collectors etc.) and has more than 4 decades of industrial operations experience. The transportation of raw materials to chemical operating plants will be mechanized handling and covered transport. The expected impacts like: air pollution, dust deposition in open water bodies and vegetation will be resolved by selecting adequate and efficient control measures and **equipment's** which restricts the emission to remain within norms stipulated by regulatory authorities. Thus likelihood of quantum of emission release which may pose a risk to surrounding environment is minimal. Regular use of mobile sprinklers in roads can also minimize the suspended particulate matter. The efforts may lead to minimal deposition of dust particles in the surrounding vegetation cover. The disturbance to faunal group due to ground vibration and increase in noise level will be minimized or resolved by using modern technologies.

The site of proposed manufacturing plants is not having any forest or protected area within, therefore minimal impacts may be visualized only on the population of wildlife occasionally traversing around the periphery of the forest areas or accidently visiting the surrounding areas of villages within the 10 km buffer of the proposed plant. Although there are some village reserve forest adjacent to the study area where minimal impact is envisaged.

7. Conservation and Management Plan for Biodiversity and Wildlife

Wildlife conservation and management include "the management of wildlife populations in the context of the ecosystem, providing them suitable habitat and resources for feeding, breeding, roosting, nesting, and movement".

Most critical aspect of wildlife conservation is habitat management. Habitat loss presents the greatest threat to wildlife. Habitats management is the foremost need in order to support wildlife. Majority of the developmental activities now-a-days, reducing the natural habitat of wildlife and as a result certain population of wildlife is getting locally extinct day by day. Therefore, balance is needed to maintain between management of wildlife habitat and developmental activities.

Every habitat has a carrying capacity to support vital resources viz. food, water, cover to certain quantity of wildlife for a period of time. Maintaining carrying capacity of a habitat is a challenging task for the wildlife managers.

The formulation of a biodiversity and wildlife conservation and management plan for developmental project is one of the steps towards the environmental conservation. There are some basic principles that should always be considered when creating a long-term vision for successful species conservation and its management. These include:

- Conservation of populations within the major ecological settings across the species' natural range; and conservation of the species' genetic diversity across that range;
- Ecological functionality for Conservation of large populations requires enough habitat to support self-sustaining populations interacting with the full range of the species' natural predators, parasites, competitors, and prey and/or food plants;
- Human socio-economic and cultural needs and desires for conservation and management of the species across the geographic range, mainly to ensure the basic socio-economic and cultural needs of the human beings in a manner consistent with the above principles

This Conservation and Management Plan (CMP) is for Schedule-I faunal species as per the Indian Wildlife (Protection) Act, 1972 recorded in the study area (core and buffer) of proposed Greenfield Chemical Complex located in Mandvi taluka, Kachchh district of Gujarat. A total of Twelve species under Schedule-I fauna were recorded from the study area. **The wildlife conservation plan for each of the conservation significant species is given in Table 7.1 to Table 7.5. It is also recommended that GHCL Ltd. shall follow Conservation measures mentioned in Status Survey Report for Sea Turtles prepared by ZSI, Kolkata for Greenfield Project. Conservation and management plan for rest of Schedule-I faunal species is given in table 7.6.**

Mugger Crocodile (*Crocodylus palustris*)

Habit and Habitat: The mugger is a medium-sized crocodile (maximum length ca. 4-5m), and has the broadest snout of any living member of the genus *Crocodylus.* This species is found in freshwater habitats including, rivers, lakes, reservoirs, hill streams, village ponds and manmade tanks. It may also be found in coastal saltwater lagoons. Mugger is a hole-nesting species, with egg-laying taking place during the annual dry season. Females become sexually mature at approximately 1.8-2 m, and lay 25-30 eggs (Whitaker and Whitaker 1989). Nests are located in a wide variety of habitats, and females have even been known to nest at the opening of, or inside, their burrow. Like a number of other crocodilians, *C. palustris* is known to dig burrows. These burrows play a critical role in the survival of crocodiles living in harsh environments (Whitaker *et al.* 2007), allowing them to avoid exposure to excessively low and high temperatures.

Distribution: Muggers are principally restricted to the Indian subcontinent (India, Sri Lanka, Pakistan, Nepal and possibly from Bangladesh) where they may be found in a number of freshwater habitat types including rivers, lakes and marshes. In India and Sri Lanka, mugger crocodiles have adapted well to reservoirs, irrigation canals and manmade ponds, and in some areas may even be found in coastal saltwater lagoons (Whitaker and Whitaker 1989). The species has become locally extinct over large parts of its range, and viable populations only occur in protected areas (Santiapillai and Silva 2001). In Gujarat a sizable number of mugger crocodiles are found in many water bodies located in various parts of the state.

Population Trend: Stable

Muggers are reported from 15 States of India and the wild population is tentatively estimated as 3,021 to 4,287 non-hatchlings (Whitaker and Andrews 2003).

Threats: The current threats to the mugger crocodile are principally habitat destruction due to agricultural and industrial expansion, entanglement and drowning in fish nets, egg predation by people, and the use of crocodile parts for medicinal purposes (Groombridge 1982). Adequate survey data exist only for India and Sri Lanka, and indicate that populations while generally small and isolated, are widespread. There are increasing incidents of human conflict with this species and this is due to encroachment by humans into the species' natural habitats.

Conservation Status: IUCN: Vulnerable; **CITES**: Appendix-I; **IWPA, 1972**: Schedule-I

Conservation Measure Undertaken: Management of the species is largely based on the legal protection of wild populations and captive breeding for restocking natural populations. In India, a large-scale captive rearing program was initiated in 1975. The project has collected eggs from the wild, as well as produced young from captive adult breeding stock. The resulting juveniles have been used to restock natural populations in 28 national parks, wildlife reserves and crocodile sanctuaries throughout the country.

Conservation Plan: The conservation plan for the species in buffer areas of GHCL is given in table 7.1.

Olive Ridley, *Lepido chelysolivacea*

Distribution: The Olive Ridley Sea turtle has a circumtropical distribution, with nesting occurring throughout tropical waters and migratory circuits in tropical and some subtropical areas (eg. Indian Ocean). Nesting occurs in nearly 60 countries worldwide. The coastal stretch between Mandvi to Pingleshwar is important nesting site of this species.

Population trend: Decreasing

Habit and Habitat: Olive Ridleys display a complex life cycle, which requires a range of geographically separated localities and multiple habitats (Márquez *et al.*, 1998). Females lay their nests on coastal sandy beaches from which neonates emerge and enter the marine environment to continue their development. They remain in a pelagic

phase, drifting passively with major currents that disperse far from their natal sites, with juveniles sharing some of the adults' habitats (Kopitsky *et al.* 2000) until sexual maturity is reached (Musick and Limpus 1997). Reproductively active males and females migrate toward coastal zones and concentrate near nesting beaches. Their post-breeding migrations are complex, swimming hundreds or thousands of kilometers over large ocean expanses (Morreale *et al.* 2007). They make nest one, two or three times per season, with approximately 100–110 eggs per clutch (Pritchard and Plotkin 1995). Presumably, like other sea turtles, Olive Ridleys experience high mortality in their early life stages.

Threats: Olive Ridleys are prone to population declines because of slow intrinsic growth rate in combination with anthropogenic impacts. These can accumulate over a protracted development through various life stages, multiple habitats (nesting beaches, migratory routes and pelagic foraging zones) and vast geographic expanses. The major threats identified for this Species are;

1. **Bycatch in fisheries:** The incidental capture of this species in trawl fisheries, longline fisheries, gill net and other net fisheries.
2. **Habitat impacts:** Degradation, transformation and destruction of natural conditions at nesting beaches from coastal developments.
3. **Global warming**: The impact of global warming on incubation temperatures of eggs, which influence the sex ratio of the embryos (Hays *et al.* 2003).
4. **Predation and Infestation**: The predation by wild pigs and/or feral dogs can be substantial. Infestation of developing eggs by fly and beetle larvae can cause significant mortality of embryos.

Conservation Status: Vulnerable, CITES: Appendix-I, IWPA, 1972: Schedule-I (Part II)

Conservation and Management Plan: Most of the Conservation and Management Plans on behalf of the Olive Ridley at national and international levels have been based on the species' listing under the vulnerable category in the IUCN Red List. As an Appendix I species under CITES the international trade of skins from the species, which fuelled the large scale commercial exploitation of the Olive Ridley. It is listed as a Schedule I species in Indian Wildlife (Protection) Act, 1972.

Conservation Plan: The conservation plan for the species in buffer areas of GHCL is given in table 7.2.

Green Sea Turtle (*Chelonia mydas*)

Habit and Habitat: Like most sea turtles, green turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (Hirth, 1997). Upon leaving the nesting beach, it has been hypothesized that hatchlings begin an oceanic phase (Carr 1987), perhaps floating passively in major current systems that serve as open-ocean developmental grounds (Carr and Meylan 1980, Witham 1991). Upon attaining sexual maturity green turtles commence breeding migrations between foraging grounds and nesting areas that are undertaken every few years (Hirth 1997). Migrations are carried out by both males and females and may traverse oceanic zones, often spanning thousands of kilometers (Carr 1986, Mortimer and Portier 1989).

Distribution: The Green Turtle has a circumglobal distribution, occurring throughout tropical and to a lesser extent, subtropical waters (eg. Indian Ocean). Green turtles are highly migratory and they undertake complex movements and migrations through geographically disparate habitats. Nesting occurs in more than 80 countries worldwide (Hirth 1997). The sandy beaches located along the coastal stretches between Mandvi to Pingleshvar are important natural nesting sites of this species.

Population Trend: Decreasing

Threats: Green turtles, like other sea turtle species, are particularly susceptible to population declines because of their vulnerability to anthropogenic impacts during all life-stages: from eggs to adults. Perhaps the most detrimental human threats to green turtles are the intentional harvests of eggs and adults from nesting beaches and juveniles and adults from foraging grounds. The incidental threats impact green turtles around the world, it include bycatch in marine fisheries, habitat degradation at nesting beaches and feeding areas, and disease. The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1990). Habitat degradation in the marine environment results from increased effluent and contamination from coastal development, construction of marinas, increased boat traffic, and harvest of nearshore marine algae resources. Incidental mortality of green turtle is due to intensive marine fisheries and degradation of nesting habitats. Over the last few decades the threats to marine turtle population have increased.

Conservation Status: IUCN: Endangered; **CITES**: Appendix-I; **IWPA**: Schedule-I

(Part II)

Conservation and Management Plan: Green turtles have been afforded legislative protection under a number of treaties and laws. Among the more globally relevant designations are those of Endangered by IUCN and Appendix I of CITES.

Conservation Plan: The conservation plan for the species in buffer areas of GHCL is given in table 7.3.

Indian Peafowl, *Pavo cristatus*

Indian peafowl (*Pavo cristatus,* Linnaeus 1758), is a large sized brightly colored bird, designated as national bird of India due to its wide distribution, ranges from outer Himalaya to peninsular India. This is a flagship animal of India, and is protected by religious sentiments and its mythological values in Indian tradition and culture. Indian peafowl is a resident breeder normally found in dry deciduous forests usually near to water bodies, and it can adopt to live in cultivation areas near human habitations.

Distribution: It is mainly distributed in countries of Indian sub-continent include; Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, etc. Gujarat is one of the important areas of distribution of Peafowl. Limited studies exits on the details about the status, distribution, habitat use, resource selection, behavior and conservation of Indian peafowl in arid and semi-arid region of Kachchh. Therefore, it is critical that urgent efforts are made to understand the habitat and population status of the species through field-based research and in situ conservation projects in the state.

Threat: Indian peafowl once abundant over a wide range of area in Indian sub-continent is now threatened in most of their range due to large-scale habitat degradation and poaching for their feathers and plumage. In last few decades, the distribution and behavior of many large and medium sized birds including peafowl were affected, primarily due to loss of habitat coupled with developmental pressures, expanding human settlements, changing agro-practices, intensive use of agricultural pesticide and impacts of climate change.

Population Trend: Stable

Conservation Status: IUCN: Least Concern, **CITES:** Appendix-II, **IWPA**: Schedule-I

Conservation Measure Undertaken: The wide distribution in all parts of India and threats possess by various means, this bird has given full protection (Schedule I species) under Indian Wildlife (Protection) Act, 1972 and is included in least concern category of IUCN (IUCN, 2022).

Conservation Plan: The conservation plan for the species in buffer areas of GHCL is given in table 7.4.

Chinkara, *Gazelle bennettii*

Chinkara, a medium sized antelope, found in arid and semi-arid open areas. It inhabits arid areas, including sand deserts, flat plains and hills, dry scrub and open forest. They have partial dependency on water, and can live in arid areas. They sometimes raid fields cultivated with rape seed and sorghum in desert regions (Habibi, 2001).

Habit and Habitat: Chinkara generally avoid flat and steep terrain. They are primarily browsers, but frequently graze on new shoots of grasses, especially during the monsoon. They are sedentary and live in groups of one to three, though sometimes larger herds were also recorded (Rahmani, 1990a). They used to give litters during monsoon, although temporal variation was observed is different geographical space.

Distribution and population: The distributionrange covers nine states of western and central India, extending through Pakistan, south-western Afghanistan to north-central Iran (Rahmani, 1994). It is estimated that a minimum of 80,000 Chinkara are found in the Thar Desert alone, and the total population in India is certainly more than 100,000 (Rahmani 1994). In some Vishnoi areas in the Thar Desert of western Rajasthan, population density reaches 31.6 individuals/ km^2 (Rahmani 1994). The Thar Desert of western India and arid and semi-arid parts of Gujarat remains a stronghold for chinkara population. This species is mainly distributed in some Wildlife Sanctuary of Gujarat state and its fringe areas.

Conservation measures taken: Hunting and shooting are totally prohibited in India as the species is listed as Schedule I in India Wildlife (Protection) Act, 1972. Chinkara were found in more than 80 protected areas (Rahmani, 1990) in India. Although in the state of Gujarat, Narayan Sarovar Chinkara Sanctuary one of the strongholds for Chinkarawas partially de-notified in past for mineral exploration and mining-based

industries. A state wise survey of chinkara distribution and numbers in Gujarat is not carried out.

Threats: Habitat loss through overgrazing, mining and other associated activities, infra-structure development, conversion to agriculture and industrial development are the major threats for this species.

Conservation Status:

IUCN: Lower Risk Least Concern **CITES:** Appendix-II **IWPA:** Schedule-I (Part I)

Conservation Plan: The conservation plan for the species in buffer areas of GHCL is given in table 7.5.

Conservation and Management plan of other Schedule I species is given in Table 7.6.

7.1. Marine Environment Management Plan (Suggested by CSIR-NIO)

The Marine Environment Impact assessment carried out for Seawater Intake and and Effluent Disposal for Greenfield Chemical Complex off Bada Coast, Arabian Sea has been carried out by Council of Scientific & Industrial Research (CSIR) – National Institute of Oceanography (NIO), Mumbai. The Executive Summary of the report is annexed along with this report. However, the findings of effluent release are mentioned as below:

The proponent proposed to release the effluent into the sea at two sites (CSIR-NIO EIA report 2021). Both the effluent release site would attain the ambient levels within 300m (max) distance. Since the area is devoid of mangroves and corals their destruction due to the development is unlikely. Well established sand dunes of sea shore would not be disturbed as the land base pipe line will be through tunnelling.

Based on the results of the Buoyant / Forced-Jet Model, it is suggested that the effluent should be released with a minimum initial jet velocity of 3.01 m/s through a 20 port diffuser at 9.47 m and 10.71 m below CD depth above 0.5 m from the bottom. As the effluent plume descends through the water column, it would attain initial dilution by 30-40 times.

Operation phase Impacts:

Effect on Water quality: The predicted maximum water temperature in a small area around the diffuser would be 33°C which is lower than the threshold of 35°C considered for tropical marine areas. Hence the release of the effluent is unlikely to cause thermal shock to the flora and fauna even in the vicinity of the diffuser. An incremental increase of Suspended Solids (SS hereafter) in a small area is unlikely to

negatively influence the biota even in the vicinity of the diffuser. The ambient conditions would be attained within 300 m distance from the outfall location. A major fraction of the SS would settle but fine particles would remain in suspension for a longer duration. This would impart a milky hue to the water around the diffuser under continuous release of effluent. This however would not affect the flora and fauna since the SS in the effluent in non-toxic.

Effect on Sediment quality: The SS in the effluent is inorganic in nature and largely composed of constituents commonly occurring in the marine environment. Considering the sediment type off Bada, the settlement of the effluent associated SS is unlikely to grossly modify sediment character of the region.

Effect on Flora and fauna: The general water quality of the coastal area would not be affected negatively. Hence, by and large, the biological characteristics of the region would not be affected adversely except for some negative impact on macro-benthos in the vicinity of the diffuser, due to the settlement of SS. The SS though not harmful, it may change the sediment character locally and the macro-benthos community would have to adjust to this modified habitat.

Hence, as per the Marine EIA report submitted by CSIR-NIO, it is recommended that M/s GHCL can withdraw 16,00,000 M^3/day of water from two intake locations (IT1: 22o 52' 1.07"N; 69o 07' 28.96"E and IT2: 22°51'57.44" N; 69°07'32.44" E).

The disposal of 15,80,000 M^3/day at two out fall locations OF2_1: 22°52'15.79"N; 69°06'14.35"E (depth 9.47 m below CD), OF2_2: 22°52'6.65" N; 69°05' 59.08"E (depth 10.71 m below CD) will not impact the marine environment. The GHCL has to take approval from concerned authorities before commencement of the work.

Table 7.1

Conservation and Management Plan of Mugger Crocodile in Buffer areas of GHCL, Mandvi Taluka, Kachchh District

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
1	Habitat Conservation and Protection	Conservation and Protection of freshwater bodies like pond, lake, river, etc.	√	√	√	-	-	√	-	-	-	√	-
		Protection of hedge of river and nala which are important site for making borrow by the crocodile.	-	√	-	-	-	-	-	-	-	√	√
2	Habitat Improvement	Development of new water bodies in the area for the animal.	√	√	√	-	-	-	-	-	-	√	-
3	Minimize road killing	Crocodiles are migrating from one water body to another water body during breeding season through movement in land. Therefore, appropriate measure should be taken to avoid road killing of this animal by vehicular traffic.	√	√	√	√	-	-	-	√	√	-	-
4	Research and Monitoring	Regular Monitoring the crocodile in nearby water bodies to understand their local population.	-	√	√	-	-	-	-	-	√	√	√
		Research should be conducted on its population, dispersal patterns, breeding, etc.	-	√	√	-	-	-	-	-	√	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
5	Conservation education	Organization of Nature Education Program included creating awareness in the local community, college students, school children, etc. in regular basis.	√	√	√	-	-	-	-	√	√	√	√
6	Awareness generation	Creating awareness about Mugger Crocodile conservation can be done with active participation from the community, NGOs, school students, forest staffs for achieving educational goals.	√	√	√	-	-	-	-	√	√	√	√
7	Enhancing cooperation	Putting of boards with animal photographs/slogan along road sides, public places, schools, etc. to increase awareness about wildlife conservation.	-	√	√	-	-	-	-	-	√	-	-
		Interdepartmental cooperation, public private partnership, NGOs, Institutions and local community relationship need to be enhance conservation of Mugger crocodile	√	√	√	-	-	-	-	-	-	√	√
8	Pollution Control	Appropriate measure should be taken to minimize water pollution in all water bodies in the area.	√	√	√	√	√	-	-	-	√	√	√
9	Capacity building	Training is needed for forest staffs, community members, and local NGOs for rescue, captive breeding and conservation of Mugger crocodile.	-	√	√	-	-	-	-	√	-	√	√

Table 7.2

Conservation and Management Plan of Olive Ridley in Buffer areas of GHCL, Mandvi Taluka, Kachchh District

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
1	Habitat Conservation and Protection	Conservation and Protection of Sandy beaches which are natural sites for its nesting and egg lying.	√	√	√	-	-	-	-	-	-	√	-
		Protection of coastal sites from all kinds of pollution to manage its natural egg lying habitat	-	√	-	-	-	-	-	-	-	-	√
2	Habitat Improvement	Development of sandy beaches for nesting and egg laying and free from all kinds of disturbance	√	√	√	-	-	-	-	-	-	√	-
3	Reduce mortality due to accidental catch by marine fishing	Awareness generation among local fishermen about the accidental catch of this species. **Also provide fund for sea turtle hatchery and for collection of eggs to hatchery to reduce eggs mortality.**	√	√	-	-	-	-	-	√	√	√	√
		Rescue of the accidental individuals and release in sea or in rescue centre of forest department	√	√	-	-	-	-	-	√	√	-	-
4	Research and Monitoring	Regular Monitoring the sandy beaches located along the coastal stretch between Mandvi to Pingleshvar to understand their nesting ecology.	√	√	√	-	-	-	-	-	√	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
		Research should consist of its population dynamics, dispersal patterns, movement, nesting and breeding ecology, etc.	√	√	√	-	-	-	-	-	√	√	√
5	Conservation education	Organization of Nature Education Program included creating awareness in the local community, college students, school children, etc. in regular basis.	√	√	√	-	-	-	-	√	√	√	√
6	Awareness generation	Putting of boards with animal photographs/slogan along coastal areas, fish landing centres, fish market, etc. to aware fisherman and local community about the importance of marine turtle.	√	√	√	-	-	-	-	√	√	√	√
		Preparation of leaflets in local language highlighting the importance of this species and its conservation. The leaflets should be distributed among the fisherman communities.	√	√	√	-	√	√	-	√	√	√	√
		Creating awareness about sea turtle conservation through active participation from the community, NGOs, school students, forest staffs for achieving educational goals.	√	√	√	-	√	√	-	√	√	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
7	Enhancing cooperation	Interdepartmental cooperation, public private partnership, NGOs, Institutions and local community relationship need to be enhance to share the information about the wildlife, its rescue and its conservation	√	√	√	-	√	√	-	√	√	√	√
8	Pollution Control	Control of all source of pollution in coastal areas which are directly or indirectly impact on the marine turtle population.	√	√	√	√	√	-	-	-	√	√	√

(GHCL: Gujarat Heavy Chemical Ltd., FD: Forest Dept., GBB: Gujarat Biodiversity Board, GPCB: Gujarat Pollution Control Board, Short Term: 2 years, Medium term: 5 Years, Long Term: 10 years)

Table 7.3

Conservation and Management Plan of Green Sea Turtle in Buffer areas of GHCL, Mandvi Taluka, Kachchh District

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
1	Habitat Conservation and Protection	Conservation and Protection of Sandy beaches which are natural sites for its nesting and egg lying.	√	√	√	-	-	-	-	-	-	√	-
		Protection of coastal sites from all kinds of pollution to manage its natural egg lying habitat	-	√	-	-	-	-	-	-	-	-	√
2	Habitat Improvement	Development of sandy beaches for nesting and egg laying and free from all kinds of disturbance	√	√	√	-	-	-	-	-	-	√	-
3	Reduce mortality due to accidental catch by marine fishing	Awareness generation among local fishermen about the accidental catch of this species. **Also provide fund for sea turtle hatchery and for collection of eggs to hatchery to reduce eggs mortality.**	√	√	-	-	-	-	-	√	√	√	√
		Rescue of the accidental individuals and release in sea or in rescue centre of forest department	√	√	√	√	-	-	-	√	√	-	-
4	Research and Monitoring	Regular Monitoring the sandy beaches located along the coastal stretch between Mandvi to Pingleshvar to understand their nesting ecology.	√	√	√	-	-	-	-	-	√	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
		Research should consist of its population dynamics, dispersal patterns, movement, nesting and breeding ecology, etc.	√	√	√	-	-	-	-	-	√	√	√
5	Conservation education	Organization of Nature Education Program included creating awareness in the local community, college students, school children, etc. in regular basis.	√	√	√	-	-	-	-	√	√	√	√
6	Awareness generation	Putting of boards with animal photographs/slogan along coastal areas, fish landing centres, fish market, etc. to aware fisherman and local community about the importance of marine turtle.	√	√	√	-	-	-	-	√	√	√	√
		Preparation of leaflets in local language highlighting the importance of this species and its conservation. The leaflets should be distributed among the fisherman communities.	√	√	√	-	√	√	-	√	√	√	√
		Creating awareness about sea turtle conservation through active participation from the community, NGOs, school students, forest staffs for achieving educational goals.	√	√	√	-	√	√	-	√	√	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
7	Enhancing cooperation	Interdepartmental cooperation, public private partnership, NGOs, Institutions and local community relationship need to be enhance to share the information about the wildlife, its rescue and its conservation	√	√	√	-	√	√	-	√	√	√	√
8	Pollution Control	Control of all source of pollution in coastal areas which are directly or indirectly impact on the marine turtle population.	√	√	√	√	√	-	-	-	√	√	√

(GHCL: Gujarat Heavy Chemical Ltd., FD: Forest Dept., GBB: Gujarat Biodiversity Board, GPCB: Gujarat Pollution Control Board, Short Term: 2 years, Medium term: 5 Years, Long Term: 10 years)

Table 7.4

Conservation and Management Plan of Peafowl in Buffer areas of GHCL, Mandvi Taluka, KachchhDistr

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
1	Habitat Conservation and Protection	Conservation and Protection of Scrubland, River bed, Agriculture, wasteland, etc.	√	√	√	-	-	-	-	-	-	√	-
		Conservation of Mandvi taluka Reserve Forest is very much essential to conserve this species in the areas	-	√	-	-	-	-	-	-	-	-	√
2	Habitat Improvement	Development of scrubland and grassland patches which are site for nesting and egg laying	√	√	√	-	-	-	-	-	-	√	-
3	Reduce mortality due to vehicular traffic	Vehicular traffic and its speed limit should be minimised to check the chance of accident of animal along the coastal highway between Mandvi and Suthri.	√	√	√	√	-	-	-	√	√	-	-
4	Research and Monitoring	Regular Monitoring the Peafowl population is essential to understand their population dynamics.	√	√	√	-	-	-	-	-	√	√	√
		Research should consist of its population dynamics, social organization and dispersal patterns, movement, breeding, etc.	√	√	√	-	-	-	-	-	√	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
5	Conservation education	Organization of Nature Education Program included creating awareness in the local community, college students, school children, etc. in regular basis.	√	√	√	-	-	-	-	√	√	√	√
6	Awareness generation	Creating awareness about peacock conservation can be done with active participation from the community, NGOs, school students, forest staffs for achieving educational goals.	√	√	√	-	-	-	-	√	√	√	√
7	Enhancing cooperation	Putting of boards with animal photographs/slogan along road sides, public places, schools, etc. to increase awareness about wildlife conservation.	-	√	√	-	-	-	-	-	√	-	-
		Interdepartmental cooperation, public private partnership, NGOs, Institutions and local community relationship need to be enhance its conservation	√	√	√	-	-	-	-	-	-	√	√
8	Pollution Control	Control of water, soil and sound pollution created by various sources which are directly or indirectly impact on the Peafowl population.	√	√	√	√	√	-	-	-	√	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
9	Organic cultivation and cultivation of folk varieties	Emphasis should be given for organic cultivation and cultivation of folk/traditional varieties of crop to increase prey base of this animal in agricultural habitat	-	-	√	-	-	-	√	-	-	√	√

(GHCL: Gujarat Heavy Chemical Ltd., FD: Forest Dept., GBB: Gujarat Biodiversity Board, GPCB: Gujarat Pollution Control Board, Short Term: 2 years, Medium term: 5 Years, Long Term: 10 years)

Table 7.5

Conservation Plan for Chinkara in Buffer areas of GHCL, Mandvi taluka, Kachchh District

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
1	Habitat Conservation and Protection	Conservation and Protection of *Prosopis* Scrubland, patches of grassland and coastal sand dune which are the probable habitat of Chinkara.	-	√	√	-	-	-	-	-	-	√	√
		Conservation of Mandvi taluka Reserve Forest is very much essential to conserve this species in the areas	-	√	-	-	-	-	-	-	-	√	√
2	Habitat Improvement	Water hole exclusively fresh water and salt licking sites should be developed along the costal belt.	√	√	√	-	-	-	-	-	√	√	-
		Development of grassland patches and scrubland in the areas for fodder security of this species.	-	√	√	-	-	-	-	-	√	√	-
3	Protection of home range	Protection of the home range of this animal along coastal belt is required to manage the population	-	√	√	-	-	-	-	-	-	√	√
4	Reduce mortality due to vehicular traffic	Vehicular traffic should be minimised to check the chance of accident along the coastal highway between Mandvi and Suthari	-	√	√	-	-	-	-	-	-	√	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
5	Research and Monitoring	Regular Monitoring the Chinkara population is essential to understand their population dynamics.	-	√	√	-	-	-	-	-	√	√	√
		Research should consist of basic demographics parameters, Social organization and dispersal patterns, Home range, breeding, etc.	-	√	√	-	√	-	-	-	-	√	√
6	Conservation education	Organization of Nature Education Program included creating awareness in the local community, college students, school children, etc. in regular basis.	√	√	√	-	-	-	-	-	√	√	-
7	Awareness generation	Creating awareness about Chinkara conservation can be done with active participation from the community, NGOs, school students, forest staffs for achieving educational goals.	√	√	√	-	-	-	-	-	√	√	-
		Putting of boards with animal photographs/slogan along road sides, public places, schools, etc. to increase awareness about wildlife conservation.	√	√	√	-	-	-	-	-	√	√	-

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/Responsibilities								Timeline		
			GHCL	Forest Dept.	GBB	GPCB	CRZ	Fisheries Dept	Agri. Dept	NGOs	Short term	Medium term	Long term
8	Enhancing cooperation	Interdepartmental cooperation, public private partnership, NGOs, Institutions and local community relationship need to be enhance to share the information about the wildlife, its rescue and its conservation	√	√	√	√	√	√	√	√	-	√	√
9	Pollution Control	Control of sound pollution due to vehicular traffic along state highways during night hours.	√	√	√	-	-	-	-	-	√	√	-

(GHCL: Gujarat Heavy Chemical Ltd., FD: Forest Dept., GBB: Gujarat Biodiversity Board, GPCB: Gujarat Pollution Control Board, Short Term: 2 years, Medium term: 5 Years, Long Term: 10 years)

Table 7.6

Conservation Plan for other Schedule-1 Wildlife (Hyena, Raptors, Lizards, etc.) fauna existing in Buffer areas of GHCL, Mandvi taluka, Kachchh district

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/ Responsibilities			Implementation area	Implementing agency	Funding agency	Time-line	
			GHCL	FD	GBB				Short term	Long term
1	Habitat conservation and protection	Protection measures need to be undertaken for conservation of natural/suitable habitats of species *viz.* tropical thorn forests, scrub forests, grassland, wetlands, etc. of the area. Along with protection, it is also crucial to develop these habitats by planning suitable site-specific plant species.	-	√	√	NSS & OSA	FD & GHCL	GHCL	-	√
		Species like; *Acacia leucopholea, Prosopis cineraria, Acacia auriculiformis* and *Salvadora persica* could be planted near water bodies. These species could also be planted in village gaucher and Common Property Land Resources (CPLRs) at the density of 30 trees per hectare. These species provide nesting, roosting site for birds, and shades for animal and also some extend of fodder to herbivores.	√	√	√	Bada, Bambhadai, Pachotiya	FD & GHCL	GHCL	-	√
		Development of scrubland and grassland patches which are site for nesting and egg laying of many species of birds, reptile and small mammals should be carried out.	-	√	√	RFs	FD & GHCL	GHCL	-	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/ Responsibilities			Implementation area	Implementing agency	Funding agency	Time-line	
			GHCL	FD	GBB				Short term	Long term
		Large trees are normally used for nesting and roosting purposes by many of wildlife species. Therefore, large trees need to be conserved and plantation of suitable trees in the buffer areas needs to be undertaken.	√	√	√	RFs	FD & GHCL	GHCL	-	√
		Yearly monitoring of habitats of threatened species which are frequently utilized for feeding, nesting and breeding purpose should be done.	-	√	-	NSS & OSA	GUIDE	GHCL	√	-
2	Habitat improvement / management	Management and protection of natural water bodies with minimum human interventions. If possible, new water bodies should be constructed in forest and its adjoining areas or areas having dense population of wildlife. Also, cemented water holes need to be developed and frequent wildlife movement areas and is to be regularly filled through tankers for constant supply of water for wildlife and free grazing livestock.	-	√	-	Buffer area villages	FD & GHCL	GHCL	-	√
		Prosopis juliflora invasion in natural areas should be controlled. Pruning is also essential for maintaining this species. During fruiting season, the pods falling on the ground needs to be removed manually for preventing its spread through livestock.	-	√	√	Bada, Bambhadai,	FD & GHCL	GHCL	-	√

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/ Responsibilities			Implementation area	Implementing agency	Funding agency	Time-line	
			GHCL	FD	GBB				Short term	Long term
		Plantation in community places like road sides, school campus, gardens, and wasteland for improving general environment. *Ficusbenghalensis, Ficusracemosa, Salvadora persica* and some of other suitable species (given in Annexure V) for planting along the road sides, school campuses and gardens.	√	√	-	Within buffer area villages	FD & GHCL	GHCL	√	-
		Preference to be given for plantation of natural species of plants in greenbelt or suitable areas to provide habitat for feeding, resting and nesting of species.	√	-	-	Bada, Bambhdai,	GHCL	GHCL	-	√
		Grassland development should be done in suitable areas for fodder security of livestock and ecological securities of dependent biodiversity. *Chloris, Dactyloctenium, Cenchrus, Sporobolus,* etc. are some of the productive and nutritive grasses suitable for grassland development in the area.	-	√	√	Bada Bambhadai.	GHCL	GHCL	-	√
		Plantation of large tree species in some areas which are used for nesting by some bird species like raptors should be done.	√	√	-	Buffer villages	GHCL	GHCL	√	-

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/ Responsibilities			Implementation area	Implementing agency	Funding agency	Time-line	
			GHCL	FD	GBB				Short term	Long term
3	Protection and management of wildlife Population	The movement corridor used by various wildlife animal viz. carnivore, herbivore, reptile, birds need to be protected.	√	√	√	NSS & OSA	FD	FD	-	√
		The river bed, its tributaries, natural nala, wasteland which is used as a corridor by the wild animal should be protected.	-	√	√	NSS & OSA	FD	FD	-	√
		Yearly monitoring and population census of Schedule-1 species (WPA, 1972) / Threatened species should be recorded in the buffer zone of the study area.	√	√	-	NSS & OSA	GUIDE	GHCL	√	-
		Food and water availability for wildlife especially in drought period/summer season should be ensured.	-	√	-	NSS & OSA	FD	FD	-	√
		Speed and vehicular traffic should be minimised to check the chance of accident along the road used for project related activities, especially during evening and early morning hours.	√	-	-	Along roads in buffer area	Transport Dept.	GHCL	√	-

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/ Responsibilities			Implementation area	Implementing agency	Funding agency	Time-line	
			GHCL	FD	GBB				Short term	Long term
		Measures should be taken for controlling spreads of wildlife diseases like infectious and epidemic diseases by way of vaccination to livestock. Maintaining precautionary measures where wildlife and domestic animal share common feeding grounds.	-	√	-	NSS & OSA	FD	GHCL	-	√
4	Conservation education/ Awareness and Outreach activities	Conservation education/awareness programme like nature education camp involving local forest departments/NGOs to create awareness among various stakeholders with active participation from the community, school students, and local industrial houses for achieving conservation goals should be conducted.	√	-	-	Buffer area of GHCL	GHCL& GUIDE	GHCL	√	-
		Preparation of booklets, leaflets, pamphlets, calendars, and other printing material on biodiversity and its conservation importance to distribute among various stakeholders like local communities, schools, other departments, NGOs, etc.	√	√	√	NA	GHCL	GHCL	-	√
		Fixing of boards with animal photographs/slogan along road sides, public places, schools, etc. to increase awareness about biodiversity/wildlife conservation.	√	-	-	NA	GHCL& GUIDE	GHCL	√	-

Sl. No.	Specific Conservation and Management Objective	Conservation and Management Action	Role/ Responsibilities			Implementation area	Implementing agency	Funding agency	Time-line	
			GHCL	FD	GBB				Short term	Long term
		Supports Local NGOs/Vanya Prani Mitra/Eco-clubs of schools and colleges for wildlife conservation activities	√	-	-	NA	GHCL	GHCL	√	√
5	Pollution Control	Avoid water, soil and air pollution in project areas and roads uses for transportation	√	-	-	Buffer area of GHCL	GHCL& GUIDE	GHCL	√	-
		Plantation of dust capturing trees species (Annexure VI)	√	-	-				√	√
		Control of sound pollution created by project related activities/ transportation along the roads passing through wildlife habitat especially during night hours.	√	-	-				√	-

(GHCL: Gujarat Heavy Chemical Ltd., GBB: Gujarat Biodiversity Board, FD: Forest Dept., NSS: Narayan Sarovar Sanctuary, RFs: Reserve Forests, OSA: Outside Sanctuary Area, RFs: Reserve Forests, Short Term: 2 years, Long term: 5 Years)

8. Fund Allocation for Implementation of Conservation Plan

The successful conservation and protection of wildlife in natural habitat is prime duty of all stakeholders using the natural resources of such area for their livelihood. The detailed plan for the conservation and management of wildlife in the buffer areas of proposed Greenfield Chemical Complex of GHCL is given in table 7.1 to table 7.6. Since there is a good population of Chinkara and Peafowl present outside sanctuary areas, special focus is required to ensure effective conservation measures of Schedule-I faunal species through habitat improvement programmes. There are some reports on few marine species like **Finless Porpoise, Common Dolphin, Dugong and some species of Whales in the marine environment near the proposed Greenfield Chemical Complex of GHCL which was obtained through secondary literature. Therefore, periodical monitoring of marine environment is a prerequisite and in case of any sighting of these animals near the effluent discharge location, appropriate mitigation measures needs to be taken by the proponent in consultation with the forest department and marine experts and budget will also be allocated.**

To implement the above-mentioned Wildlife Conservation and Management Plan in the buffer areas of proposed Greenfield Chemical Complex of GHCL the budget is proposed (breakup given in table 8.1) for each activity to meet the goal of successful conservation of Schedule-I wildlife species. The proposed estimated budget of Rs. 1,36,50,000/- (One crore thirty-six lakhs and fifty lakhs only) has been allocated for upcoming 10 years from the date of inception of the project to implement various conservation actions as suggested in table 7.1 to table 7.6. The budget has been estimated as per the present market price/ Schedule of Rate (SoR) of activities. The estimated budget for some activities under wildlife conservation plan as mentioned in table 8.1 will be revised on yearly basis as per the current market rate/Schedule of Rate (SoR) of the Government of Gujarat to the implementation of such activities.

In addition to the fund allocation made for conservation and management activities of Schedule-I faunal species located in buffer areas of the GHCL, environmental/ habitat improvement programmes could be undertaken as part of CSR activities focussing on the conservation of Schedule-I faunal species. Along with that the budget is already allocated for the conservation of marine environment given in Marine EIA report prepared by the CSIR-NIO.

Table 8.1: Budget estimate (10 year plan) for Implementation of the Wildlife Conservation Plan for Bada Soda Ash Plant of GHCL

Sl. No.	Conservation Objective	Activities	Location of activities	Implementing Agency	Year of Implementation & Targets										Rate/Cost (In Rupees)	Rs in Lakhs
					1	2	3	4	5	6	7	8	9	10		
1	Habitat Conservation, Protection and Improvement	Plantation & Greenbelt development	Soda Ash Plant area and Periphery of plant (30 ha)	GHCL	LP	10 ha	10 ha	10 ha	GF	GF	GF	GF	GF	GF	Rs. 52000/ha	15.60
			Roadside plantation to minimise pollution& attract birds (20 ha)	GHCL	LP	5 ha	5 ha	10 ha	GF	GF	GF	GF	GF	GF	Rs. 52000/ha	10.40
			Bada, Bambhadai and other RF. (50 ha) (Location will be decided by FD)	FD	LP	20 ha	20 ha	10 ha	GF	GF	GF	GF	GF	GF	Rs. 52000/ha	26.00
		Water hole creation	Reserve forest area (creation of water hole structures)	FD	-	5 St	5 St	5 St	-	-	-	-	-	-	Rs. 100000/ structure	15.00
		Plantation management	**Water tanker* (1) and Tractor* (1) with driver and diesel for 10 years**	FD	-	√	-	-	-	-	-	-	-	-	Rs. 2000000	20.00
			Utility vehicle* (1) with driver and diesel for 10 years	FD	-	√	-	-	-	-	-	-	-	-	Rs. 1200000	12.00
2	Research and Monitoring	Plantation Monitoring	Plantation Area	CCF Kachchh	-	-	√	-	√	-	-	√	-	-	Rs. 100000	1.00
		Wildlife Monitoring	Coastal protection by Paryavaran Mitra	FD	-	-	√	-	√	-	-	√	-	-	Rs. 750000	7.50
			Coastal Hatchery & Research centre	FD	-	-	√	-	√	-	-	√	-	-	Rs. 750000	7.50
3	Education & Awareness	Workshop, NEC, Sign board, etc.	GHCL& Nearby Schools & Colleges	FD	-	√	-	√	-	√	-	√	-	√	Rs. 1000000	10.00
4	Miscellaneous	Contingency	-	2.5 GHCL & 2.5 FD	√	√	√	√	√	√	√	√	√	√	Lump sum	5.00
															Sub-total	**130.00**
	Monitoring of works		Implementation Areas of WCP	FD	-	√	-	√	-	√	-	√	-	√	@5% of total	6.50
															Grand Total	**136.50**

GHCL: Gujarat Heavy Chemical Ltd.; FD: Forest Dept; GUIDE: Gujarat Institute of Desert Ecology; LP: Land preparation; GF: Gap filling; NEC: Nature Education Camp

*Note: Vehicles are required for the efficient management of plantation activities and it will be the asset for the forest department in future.

8.1 Review and Monitoring of Wildlife Conservation Plan

The conservation plan proposed for the Schedule-I fauna existing in buffer area of GHCL should be monitored continuously to assess any short comings and to remediate further and implement the plan to achieve the goal for conservation and improvement of the wildlife population and its habitat. In order to do this a team comprising experts from the field of ecology, environment and wildlife from a reputed organization will monitor the works implemented for conservation of threatened and Schedule-I fauna by the GHCL Ltd. The team will review the progress and evaluate the works and submit reports periodically. The report should also suggest remedial measures for effective conservation and management of the threatened and Schedule-I faunal species.

8.2 Field Monitoring

It will be difficult to assess the results and success of this proposed conservation plan unless the status of threatened fauna, associated wild animals and its habitat are monitored on a regular or timeline basis. **The monitoring committee selection will be done by Deputy Conservator of forest (DCF) West Kachchh division -Bhuj. This monitoring can be done scientifically through experienced wildlife experts/Institute/Organization with the support of local Forest Department and result needs to be submitted to the monitoring committee for further discussion and future policy implementation with necessary changes. The field review can preferably do at the post-monsoon period or winter season of every year.** The above activities will be monitored by MoEF& CC and respective agencies.

8.3 Success Indicators

Following factors will be undertaken as measurable indicators of success of the plan:

1. Increase in vegetation density and ground cover in buffer area.
2. Increase in population and abundance of rare, threatened and Schedule-I faunal species as mentioned in the plan.
3. Increase in population and abundance of biodiversity and other wildlife in the area.
4. Overall health of the habitat and ecosystem in buffer areas

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Annexure I

List of plants species Recorded in the study area of GHCL, Mandvi Taluka, Kachchh

Sr no	Species Name	Family	Local name	Habit	Core	Buffer
1	*Abutilon indicum*	Malvaceae	Khapat	Herb		P
2	*Acacia nilotica*	Mimosaceae	DeshiBaval	Tree	P	P
3	*Acacia senegal*	Mimosaceae	Goradiobaval	Tree		P
4	*Achyranthes aspera*	Amaranthaceae	Agado	Herb		P
5	*Aerva persica*	Amaranthaceae	Bou, Bour	Herb		P
6	*Ageratum conyzoides*	Asteraceae	Mankadmari	Herb		P
7	*Alternanthera pungens*	Amaranthaceae	Kantaro	Herb		P
8	*Alternanthera sessilis*	Amaranthaceae	PaniniBhaj	Herb		P
9	*Amaranthus lividus*	Amaranthaceae	Tandaljo	herb		P
10	*Apluda mutica*	Poaceae	_	Grass		P
11	*Argemone mexicana*	Papavaraceae	Darudi	Herb		P
12	*Aristida adscensionis*	Poaceae	Lapdu	Grass	P	P
13	*Aristida funiculata*	Poaceae	Lasolampdo	Grass	P	P
14	*Asparagus racemosus*	Liliaceae	Shatavari	Climber		P
15	*Azadirachta indica*	Meliaceae	Limdo	Tree		P
16	*Balanites aegyptiaca*	Balanitaceae	Hingor, Hingod	Shrub		P
17	*Barleria prionitis*	Acanthaceae	Kadhaserio	Herb		P
18	*Blephariss indica*	Acanthaceae	Kandhero	Herb	P	
19	*Boerhavia diffusa*	Poaceae	Punarava	Grass		P
20	*Brachiaria ramosa*	Poaceae	_	Grass		P
21	*Butea monosperma*	Lamiaceae	Khakharo,	Tree		P
22	*Calotropis gigantea*	Geraniaceae	Bhuroankdo	Shrub		P
23	*Calotropis procera*	Periplocaceae	Ankdo	Shrub		P
24	*Capparis decidua*	Euphorbiaceae	Kerdo	Shrub		P
25	*Cassia auriculata*	Mimosaceae	Aval	Tree		P
26	*Cenchrus setigerus*	Poaceae	Dhaman	Grass		P
27	*Chloris barbata*	Aizoaceae	Mindadiyu	Grass	P	P
28	*Citrullus colocynthis*	Tiliaceae	Truja Val	Climber		P
29	*Coccinia grandis*	Aizoaceae	Ghiloda	Climber		P
30	*Cocculus hirsutus*	Rhamnaceae	Vegai, Vagval,	Climber		P
31	*Coldenia procumbens*	Boraginaceae	Okhrad	Herb		P
32	*Corchorus capsularis*	Tiliaceae	Chunch	Herb		P
33	*Corchorus depressus*	Tiliaceae	Mundheri	Herb		P
34	*Cordia gharaf*	Boraginaceae	DesiGunda	Tree		P
35	*Cressa cretica*	Convolvulaceae	Paliyo	Herb	P	P
36	*Crotalaria burhia*	Fabaceae	Khirasan	Herb		P
37	*Cucumis prophetarum*	Cucurbitaceae	Kantalo	Climber		P

Sr no	Species Name	Family	Local name	Habit	Core	Buffer
38	*Cymbopogon martinii*	Poaceae	RoshaGha	Grass		P
39	*Cynodon dactylon*	Poaceae	Daro	Grass	P	P
40	*Cyperus arenarius*	Cyperaceae	_	Grass	P	P
41	*Cyperus bulbosus*	Cyperaceae	Ghodachiyo	Grass	P	
42	*Cyperus difformis*	Cyperaceae	_	Grass	P	P
43	*Dactyloctenium aegypticum*	Poaceae	_	Grass		P
44	*Dalechampia scandens*	Euphorbiaceae	Khanjavariya	Climber		P
45	*Desmostachya bipinnata*	Poaceae	_	Grass		P
46	*Dichanthium annulatum*	Poaceae	Zinzvo,	Grass	P	
47	*Echinops echinatus*	Asteraceae	Utkanto	Herb		P
48	*Eclipta prostrata*	Bhangaro,	_	herb		P
49	*Enicostemma axillare*	Gentianaceae	Mamejavo	Herb		P
50	*Eragrostis cilianensis*	Poaceae	_	Grass		P
51	*Euphorbia caducifolia*	Euphorbiaceae	Tidhara	Shrub		P
52	*Euphorbia hirta*	Euphorbiaceae	Vadidudhi	Herb		P
53	*Evolvulus alsinoides*	Convolvulaceae	Kali	Herb		P
54	*Fagonia schweienfurthii*	Zygophyllaceae	Dhramau	Herb	P	P
55	*Ficus benghalensis*	Moraceae	Vad	Tree		P
56	*Fimbristylis cymosa*	Cyperaceae	_	Grass	P	
57	*Goniogyna hirta*	Papilionaceae	_	Herb		P
58	*Grewia tenax*	Tiliaceae	Gangati, Gangi,	Shrub		P
59	*Grewia villosa*	Tiliaceae	Dhaman	Shrub		P
60	*Halopyrum mucronatum*	Poaceae	_	Grass	P	
61	*Heliotropium ovalifolium*	Boraginaceae	Hathisundha	Herb		P
62	*Heliotropium supinum*	Boraginaceae	Chediyo-okhrad	Herb		P
63	*Heteropogon contortus*	Poaceae	_	Grass		P
64	*Indigofera cordifolia*	Fabaceae	Gadargari	Herb	P	P
65	*Indigofera linnaei*	Fabaceae	Fatakiya,	Herb	P	
66	*Indoneesiella echioides*	herb	kariyatu	Herb		P
67	*Ipomoea pes-tigridis*	Convolvulaceae	Photial	Climber		P
68	*Ischaemum indicum*	poaceae	_	Grass		P
69	*Juncus maritimus*	Juncaceae	Aquatic Herb	Herb	P	
70	*Justicia simplex*	Acanthaceae	_	Herb		P
71	*Lasiurus scindicus*	Poaceae	_	Grass	P	
72	*Launaeare sedifolia*	Asteraceae	DhariyaiGurval	Herb	P	
73	*Lepidagathis trinervis*	Acanthaceae	Harancharo	Herb	P	P
74	*Leptadenia pyrotechnica*	Asclepiadaceae	Khip	Shrub		P
75	*Leucas biflora*	Lamiaceae	_	Herb		P
76	*Leucas cephalotes*	Lamiaceae	Khetraukubo	Herb		P

Sr no	Species Name	Family	Local name	Habit	Core	Buffer
77	*Maerua oblongifolia*	Capparaceae	Hemkand	Climber		P
78	*Merremia aegyptia*	Convolvulaceae	Panchpan	Climber		P
79	*Momordica balsamina*	Cucurbitaceae	Chochida	Climber		P
80	*Ocimum tenuiflorum*	Lamiaceae	Tulsi	Herb		P
81	*Oligochaeta ramosa*	Asteraceae	Kandhari	Herb		P
82	*Parkinsonia aculeata*	Caesalpiniaceae	Rambaval	Tree		P
83	*Pentatropis capensis*	Asclepiadaceae	Shingroti	Climber		P
84	*Pergularia daemia*	Asclepiadaceae	Dudhariyal,	Climber		P
85	*Phoenix sylvestris*	Arecaceae	Khajuri Jo Zad	Tree		P
86	*Phragmites karka*	Poaceae	Narkul	Grass		P
87	*Phyla nodiflora*	Verbenaceae	Ratvelio	Herb		P
88	*Phyllanthus maderaspatensis*	Euphorbiaceae	Amario	Herb		P
89	*Pluchea arguta*	Asteraceae	-	Shrub	P	
90	*Prosopis cineraria*	Mimosaceae	Kandhi, Khajdo,	Tree		P
91	*Prosopis juliflora*	Mimosaceae	Gandobavl	Tree	P	P
92	*Rhynchosia minima*	Fabaceae	Hathdhonani	Climber		P
93	*Rivea hypocrateriformis*	Convolvulaceae	Fang vel	Climber		P
94	*Saccharum spontaneum*	Poaceae	KanGha, Nadi,	Grass		P
95	*Salvadora persica*	Salvodoraceae	Mithipiludi	Tree	P	P
96	*Sericostema pauciflorum*	Boraginaceae	_	Herb	P	
97	*Sesbania sesban*	Fabaceae	Sevari,	Shrub		P
98	*Sesuvium sesuvioides*	Aizoaceae	_	Herb	P	
99	*Solanum indicum*	Solanaceae	UbhiBhoringni	Herb		P
100	*Solanum surattense*	Solanaceae	BethiBhoringni	Herb		P
101	*Sporobolus helvolus*	Poaceae	Khevai	Grass	P	
102	*Suaeda nudiflora*	Chenopodiaceae	Moras	Herb		P
103	*Tamarix aphylla*	Tamaricaceae	Lai	Shrub		P
104	*Tephrosia purpurea*	Fabaceae	Sarpankho	Herb		P
105	*Tinospora cordifolia*	Menispermaceae	Gulvel	Climber		P
106	*Tribulus terrestris*	Zygophyllaceae	Gokharu	Herb		P
107	*Trichodesma indicum*	Boraginaceae	UndhFuli, AagiyaKharsan	Herb		P
108	*Tridax procumbens*	Asteraceae	Pardesi	Herb		P
109	*Vernonia cinerea*	Asteraceae	Sahadevi	Herb		P
110	*Zizyphus nummularia*	Rhamnaceae	Bordi, Boedi,	Tree	P	P

Annexure II

Checklist of Bird species recorded from the study area

Sr. No	Order	Family	Species	MS	IUCN 2022	IWPA 1972	CA	BA
1	Columbiformes	Columbidae	Rock Pigeon (*Columba livia*)	R	LC	SCH. IV	+	+
2	Passeriformes	Cisticolidae	Plain Prinia (*Prinia inornata*)	R	LC	SCH. IV	+	+
3	Passeriformes	Cisticolidae	Ashy Prinia (*Prinia socialis*)	R	LC	SCH. IV	+	+
4	Passeriformes	Sturnidae	Common Myna (*Acridotheres tristis*)	R	LC	SCH. IV	+	+
5	Passeriformes	Sturnidae	Bank Myna (*Acridotheres ginginianus*)	R	LC	SCH. IV		+
6	Passeriformes	Sturnidae	Brahminy Starling (*Sturnia pagodarum*)	R	LC	SCH. IV	+	+
7	Coraciiformes	Meropidae	Green Bee-eater (*Merops orientalis*)	R	LC	SCH. IV	+	+
8	Passeriformes	Nectariniidae	Purple Sunbird (*Cinnyris asiaticus*)	R	LC	SCH. IV	+	+
9	Pelecaniformes	Ardeidae	Great Egret (*Ardea alba*)	R	LC	SCH. IV	+	+
10	Charadriiformes	Charadriidae	Red-wattled Lapwing (*Vanellus indicus*)	R	LC	SCH. IV	+	+
11	Passeriformes	Passeridae	House Sparrow (*Passer domesticus*)	R	LC	SCH. IV	+	+
12	Passeriformes	Corvidae	House Crow (*Corvus splendens*)	R	LC	SCH. V	+	+
13	Passeriformes	Hirundinidae	Dusky Crag Martin (*Ptyonoprogne concolor*)	R	LC	SCH. IV	+	+
14	Cuculiformes	Cuculidae	Asian Koel (*Eudynamys scolopaceus*)	R	LC	SCH. IV	+	+
15	Columbiformes	Columbidae	Red Collared Dove (*Streptopelia tranquebarica*)	R	LC	SCH. IV	+	+
16	Columbiformes	Columbidae	Eurasian Collared Dove (*Streptopelia decaocto*)	R	LC	SCH. IV	+	+
17	Passeriformes	Pycnonotidae	White-eared Bulbul (*Pycnonotus leucotis*)	R	LC	SCH. IV	+	+
18	Passeriformes	Leiothrichidae	Common Babbler (*Argya caudate*)	R	LC	SCH. IV	+	+
19	Passeriformes	Dicruridae	Black Drongo (*Dicrurus macrocercus*)	R	LC	SCH. IV	+	+
20	Passeriformes	Alaudidae	Crested Lark (*Galerida cristata*)	R	LC	SCH. IV	+	+
21	Passeriformes	Muscicapidae	Common Stonechat (*Saxicola maurus*)	RM	LC	SCH. IV	+	+
22	Psittaciformes	Psittaculidae	Rose-ringed Parakeet (*Psittacula krameri*)	R	LC	SCH. IV		+
23	Passeriformes	Laniidae	Lesser Grey Shrike (*Lanius minor*)	R	LC	SCH. IV	+	+
24	Passeriformes	Alaudidae	Ashy-crowned Sparrow Lark (*Eremopterix griseus*)	R	LC	SCH. IV	+	+
25	Passeriformes	Pycnonotidae	Red-vented Bulbul (*Pycnonotus cafer*)	R	LC	SCH. IV	+	+
26	Pelecaniformes	Ardeidae	Cattle Egret (*Bubulcus ibis*)	R	LC	SCH. IV	+	+
27	Pelecaniformes	Threskiornithidae	Indian Black Ibis (*Pseudibis papillosa*)	R	LC	SCH. IV	+	+
28	Ciconiiformes	Ciconiidae	Painted Stork (*Mycteria leucocephala*)	R	NT	SCH. IV	+	+
29	Charadriiformes	Laridae	River Tern (*Sterna aurantia*)	R	VU	SCH. IV	+	+
30	Pelecaniformes	Ardeidae	Little Egret (*Egretta garzetta*)	R	LC	SCH. IV	+	+
31	Suliformes	Phalacrocoracidae	Little Cormorant (*Microcarbo niger*)	R	LC	SCH. IV		+
32	Accipitriformes	Accipitridae	Pallid Harrier (*Circus macrourus*)	M	NT	SCH. I	+	+
33	Galliformes	Phasianidae	Grey Francolin (*Francolinus pondicerianus*)	R	LC	SCH. IV	+	+
34	Pterocliformes	Pteroclidae	Painted Sandgrouse (*Pterocles indicus*)	R	LC	SCH. IV		+
35	Passeriformes	Motacillidae	Paddyfield Pipit (*Anthus rufulus*)	R	LC	SCH. IV	+	+
36	Pelecaniformes	Ardeidae	Indian Pond Heron (*Ardeola grayii*)	R	LC	SCH. IV	+	+

Sr. No	Order	Family	Species	MS	IUCN 2022	IWPA 1972	CA	BA
37	Coraciiformes	Alcedinidae	White-throated Kingfisher (*Halcyon smyrnensis*)	R	LC	SCH. IV		+
38	Passeriformes	Hirundinidae	Red-rumped Swallow (*Cecropis daurica*)	R	LC	SCH. IV	+	+
39	Charadriiformes	Recurvirostridae	Black-winged Stilt (*Himantopus himantopus*)	R	LC	SCH. IV		+
40	Pelecaniformes	Ardeidae	Grey Heron (*Ardea cinerea*)	R	LC	SCH. IV	+	+
41	Charadriiformes	Laridae	Black-headed Gull (*Chroicocephalus ridibundus*)	M	LC	SCH. IV		+
42	Passeriformes	Motacillidae	White Wagtail (*Motacilla alba*)	M	LC	SCH. IV		+
43	Charadriiformes	Scolopacidae	Common Sandpiper (*Actitis hypoleucos*)	M	LC	SCH. IV	+	+
44	Passeriformes	Hirundinidae	Barn Swallow (*Hirundo rustica*)	RM	LC	SCH. IV		+
45	Passeriformes	Muscicapidae	Desert Wheatear (*Oenanthe deserti*)	RM	LC	SCH. IV	+	+
46	Passeriformes	Muscicapidae	Isabelline Wheatear (*Oenanthe isabellina*)	M	LC	SCH. IV		+
47	Passeriformes	Hirundinidae	Wire-tailed Swallow (*Hirundo smithii*)	R	LC	SCH. IV	+	+
48	Galliformes	Phasianidae	Indian Peafowl (*Pavo cristatus*)	R	LC	SCH. I		+
49	Passeriformes	Emberizidae	Striolated Bunting (*Fringillaria striolata*)	R	LC	SCH. IV		+
50	Passeriformes	Sturnidae	Rosy Starling (*Pastor roseus*)	M	LC	SCH. IV	+	+
51	Passeriformes	Sylviidae	Lesser Whitethroat (*Curruca curruca*)	M	LC	SCH. IV		+
52	Accipitriformes	Accipitridae	Black-winged Kite (*Elanus caeruleus*)	R	LC	SCH. I		+
53	Passeriformes	Muscicapidae	Black Redstart (*Phoenicurus ochruros*)	RM	LC	SCH. IV		+
54	Passeriformes	Aegithinidae	Marshall's Iora (*Aegithina nigrolutea*)	R	LC	SCH. IV		+
55	Passeriformes	Laniidae	Long-tailed Shrike (*Lanius schach*)	R	LC	SCH. IV	+	+
56	Accipitriformes	Accipitridae	Shikra (*Accipiter badius*)	R	LC	SCH. I	+	+
57	Charadriiformes	Scolopacidae	Eurasian Curlew (*Numenius arquata*)	M	NT	SCH. IV	+	+
58	Charadriiformes	Scolopacidae	Sanderling (*Calidris alba*)	M	LC	SCH. IV	+	+
59	Charadriiformes	Scolopacidae	Dunlin (*Calidris alpine*)	M	LC	SCH. IV		+
60	Coraciiformes	Alcedinidae	Pied Kingfisher (*Ceryle rudis*)	R	LC	SCH. IV		+
61	Charadriiformes	Scolopacidae	Marsh Sandpiper (*Tringa stagnatilis*)	M	LC	SCH. IV	+	+
62	Coraciiformes	Alcedinidae	Common Kingfisher (*Alcedo atthis*)	R	LC	SCH. IV		+
63	Pelecaniformes	Ardeidae	Western Reef Egret (*Egretta gularis*)	R	LC	SCH. IV	+	+
64	Charadriiformes	Charadriidae	Little Ringed Plover (*Charadrius dubius*)	R	LC	SCH. IV	+	+
65	Charadriiformes	Charadriidae	Lesser Sand Plover (*Charadrius mongolus*)	RM	LC	SCH. IV	+	+
66	Charadriiformes	Charadriidae	Greater Sand Plover (*Charadrius leschenaultii*)	M	LC	SCH. IV	+	+
67	Accipitriformes	Accipitridae	Western Marsh Harrier (*Circus aeruginosus*)	M	LC	SCH. I	+	+
68	Columbiformes	Columbidae	Laughing Dove (*Streptopelia senegalensis*)	R	LC	SCH. IV	+	+
69	Pelecaniformes	Threskiornithidae	Glossy Ibis (*Plegadis falcinellus*)	R	LC	SCH. IV		+
70	Charadriiformes	Laridae	Little Tern (*Sternula albifrons*)	R	LC	SCH. IV		+
71	Passeriformes	Alaudidae	Rufous-tailed Lark (*Ammomanes phoenicura*)	R	LC	SCH. IV		+
72	Falconiformes	Falconidae	Common Kestrel (*Falco tinnunculus*)	R	LC	SCH. IV		+
73	Charadriiformes	Laridae	Brown-headed Gull (*Chroicocephalus brunnicephalus*)	RM	LC	SCH. IV		+
74	Apodiformes	Apodidae	Indian House Swift (*Apus affinis*)	R	LC	SCH. IV	+	+

Sr. No	Order	Family	Species	MS	IUCN 2022	IWPA 1972	CA	BA
75	Passeriformes	Motacillidae	Tree Pipit (*Anthus trivialis*)	RM	LC	SCH. IV		+
76	Passeriformes	Ploceidae	Baya Weaver (*Ploceus philippinus*)	R	LC	SCH. IV		+
77	Bucerotiformes	Upupidae	Common Hoopoe (*Upupa epops*)	R	LC	SCH. IV		+
78	Piciformes	Megalaimidae	Coppersmith Barbet (*Psilopogon haemacephalus*)	R	LC	SCH. IV		+
79	Cuculiformes	Cuculidae	Greater Coucal (*Centropus sinensis*)	R	LC	SCH. IV		+
80	Falconiformes	Falconidae	Lesser Kestrel (*Falco naumanni*)	M	LC	SCH. IV		+
81	Passeriformes	Estrildidae	Indian Silverbill (*Euodice malabarica*)	R	LC	SCH. IV		+
82	Anseriformes	Anatidae	Indian Spot-billed Duck (*Anas poecilorhyncha*)	R	LC	SCH. IV		+
83	Pelecaniformes	Threskiornithidae	Black-headed Ibis (*Threskiornis melanocephalus*)	R	NT	SCH. IV		+
84	Podicipediformes	Podicipedidae	Little Grebe (*Tachybaptus ruficollis*)	R	LC	SCH. IV		+
85	Passeriformes	Laniidae	Bay-backed Shrike (*Lanius vittatus*)	R	LC	SCH. IV	+	+
86	Passeriformes	Alaudidae	Greater Short-toed Lark (*Calandrella brachydactyla*)	M	LC	SCH. IV		+
87	Passeriformes	Leiothrichidae	Jungle Babbler (*Turdoides striata*)	R	LC	SCH. IV		+
88	Passeriformes	Laniidae	Isabelline Shrike (*Lanius isabellinus*)	M	LC	SCH. IV		+
89	Charadriiformes	Scolopacidae	Wood Sandpiper (*Tringa glareola*)	M	LC	SCH. IV		+
90	Passeriformes	Muscicapidae	Indian Robin (*Saxicoloides fulicatus*)	R	LC	SCH. IV	+	+
91	Coraciiformes	Coraciidae	Indian Roller (*Coracias benghalensis*)	R	LC	SCH. IV	+	+

Annexure III

List of plant species suggested for plantation to improve the vegetation cover

Sr. No.	Name of plant	Family	Local name	Habit
1	*Acaccia nilotica*	Mimosaceae	Deshibaval	Tree
2	*Azadirachta indica*	Meliaceae	Liamdo	Tree
3	*Accacia senegal*	Momosacea	Gorad	Tree
4	*Salvadora persica*	Salvadoraceae	KhariPilu	Tree
5	*Salvadora oleoides*	Salvadoraceae	Mithopilu	Tree
6	*Grewia tenax*	Malvaceae	Gangeti	Small tree
7	*Zizyphus numularia*	Rhamnaceae	Bor	shrub
8	*Maytenuse marginata*	Celastreceae	Vikado	Shrub
9	*Prosopis spicegera*	Mimosaceae	Bethikhijadi	Small Tree
10	*Laptadenia pyrotechnica*	Asclepidaceae	Khip	Shrub
11	*Luceana laticiliqua*	Momosaceae	Subabaval	Tree
12	*Sesbania sesban*	Fabaceae	Ekad	Shrub
13	*Boerhavia diffusa*	Nyctaginaceae	Satodi	Herb
14	*Alysicarpus monilifer*	Fabaceae	Samervo	Herb
15	*Desmodium gangeticum*	Fabaceae	Godakan	Herb
16	*Indigofera linaeae*	Fabaceae	patgari	Herb

Sr. No.	Name of plant	Family	Local name	Habit
17	*Sporobolus coromandelianus*	Poaceae	Khevai	Grass
18	*Sehima nervosum*	Poaceae	-	Grass
19	*Paspalidium flavidum*	Poaceae	Sano sau	Grass
20	*Eragrostis japonica*	Poaceae	-	Grass
21	*Eragrostis ciliaris*	Poaceae	Fuliyu Gah	Grass
22	*Dichanthium annulatum*	Poaceae	Jinjavo	Grass
23	*Dactyloctenium scindicum*	Poaceae	Chund Gha	Grass
24	*Cynodon dactylon*	Poaceae	Durva	Grass
25	*Cenchrus ciliaris*	Poaceae	Dhaman	Grass
26	*Cenchrus setigerous*	Poaceae	Kali Dhaman	Grass
27	*Aristida adscensionis*	Poaceae	Lampdo	Grass
28	*Eleusine compressa*	Poaceae	Gantharo	Grass

Annexure IV

List of Plant Species suggested for plantation to control air pollution

Sl. No	Scientific Name	Common &Local Name
1	*Accacia nilotica*	Babul, DeshiBaval,
2	*Aegle marmelos*	Bel, Bili Patra, Bili
3	*Butea monosperma*	Palas, Kesudo
4	*Dalbergia sissoo*	Shesham
5	*Ficus benghalensis*	Banyan, Vad
6	*Ficus religiosa*	Peepal, Piparo, Piplo

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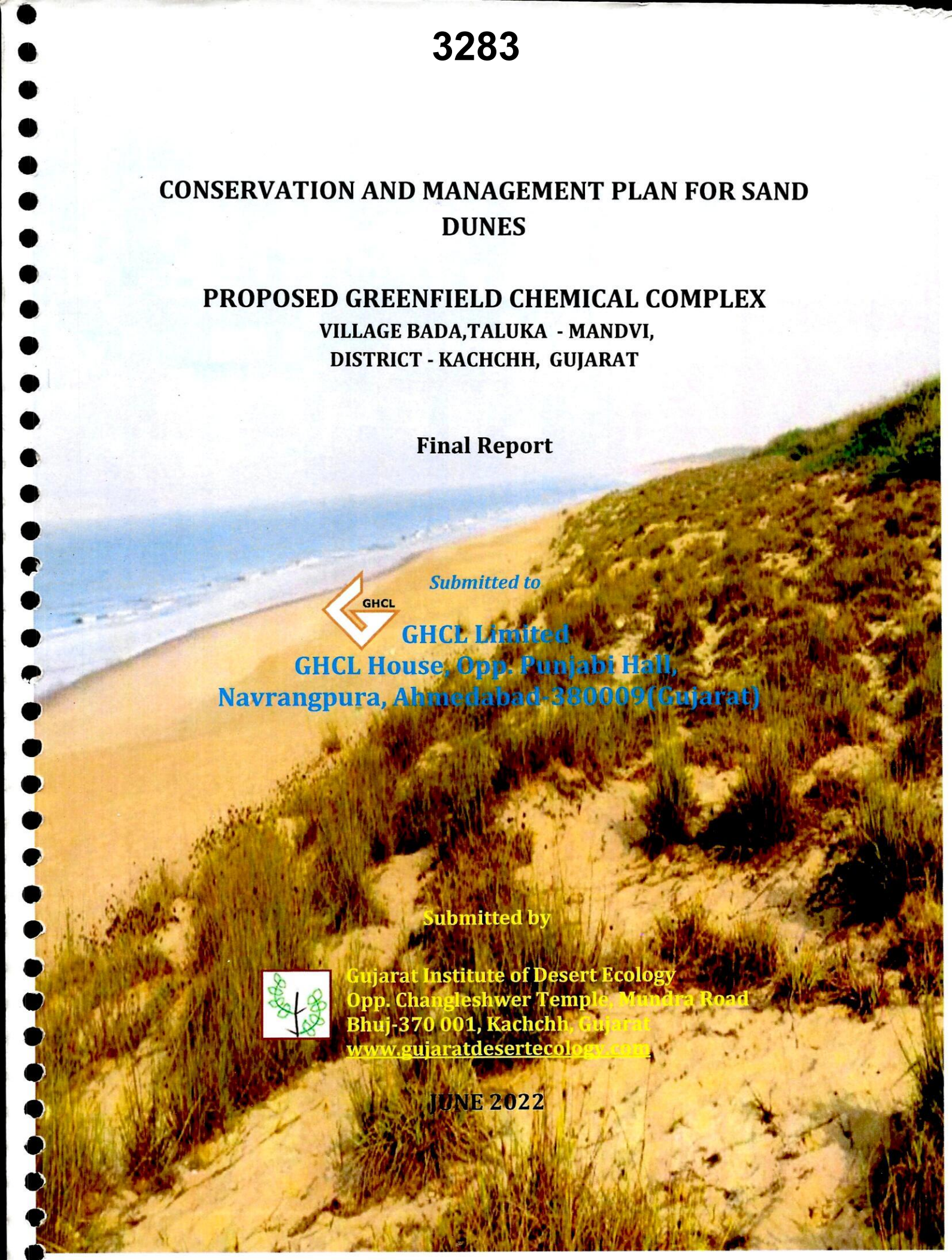
CONSERVATION AND MANAGEMENT PLAN FOR SAND DUNES

PROPOSED GREENFIELD CHEMICAL COMPLEX

VILLAGE BADA,TALUKA - MANDVI,
DISTRICT - KACHCHH, GUJARAT

Final Report



Submitted to

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JUNE 2022

Foreword

GHCL Ltd. is a reputed Soda Ash manufacturing chemical unit, established in 1983 located at Sutrapada of Gir Somnath district in the State of Gujarat. This was India's first integrated Soda Ash plant based on Akzo's Dry Liming Technology. It caters to about 25% of domestic soda ash demand in the country. GHCL, is now proposing to set-up a Greenfield Chemical Complex to produce \ Light Soda Ash Plant having capacity of 11,00,000 TPA, dense soda ash plant with the capacity of 5,00,000 TPA and sodium bicarbonate plant with the capacity of 2,00,000 TPA near the village Bada, Taluka – Mandvi, District Kutch in Gujarat state. Along with above production capacities necessary utilities like Captive Power plant of 120 MW capacity, seawater intake and effluent disposal system were also planned to support manufacturing infrastructure.

Industrial developments are essential for the economic growth and creating employment opportunity in the state. Needless to mention that the development projects should respect the ecological integrity, biodiversity values and social feasibility of the region as these are going to be the determinants of the quality of environment as well as the sustainability of the development interventions.

Keeping these in view and considering the statuary requirement of environmental clearance and conservation of wildlife, the GHCL planned to take up a study to assess the status of Sand Dunes and its conservation and management measures in project areas around the proposed projects. In this connection, the GHCL have given the study to Gujarat Institute of Desert Ecology (GUIDE), Bhuj.

The details of the status of sand dunes in the study area were presented in the report. The possible impacts on sand dunes due to proposed project and its associated developments in the project area were assessed and Conservation and Management Plan (CMP) is framed to mitigate the possible impacts on sand dunes in study area due to project development and its associated activities.

Dr. V. Vijay Kumar
Director
Gujarat Institute of Desert Ecology
Bhuj-Kachchh, Gujarat

ANNEXURE R-4

Conservation and Management plan for Sand Dune
Proposed Greenfield Chemical complex
Village Bada,Taluka - Mandvi, District - Kachchh, Gujarat

Co-ordinator

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Principal Investigators

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Co-Investigator

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Core Team Member

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Content

INTRODUCTION

Coastal sand dunes are common coastal landforms occurring along the majority of the World's coast. Dunes are also commonly found around river mouths where the sand carried through the water is deposited (Carter *et al.* 1990). The sand dune ecosystem form a spatial transition between terrestrial and marine environments and provides natural protection from the coastal hazards and have an important role in the ecosystem values of the coast (Kaneko *et al.* 2013). They are aeolian (deposited) landforms established by the supply of loose sediment transported by the ambient winds. The coastal sand dunes have been developed in the places where there is adequate supply of sand in the intertidal zone and where prevailing winds are strong enough for sand movement (Everard *et al.*, 2010). Sand dune biodiversity contains many specific fauna and flora species which can adapt to live in such harsh conditions in salty, marshy and swampy areas. Around 20% of landscapes of the world coastal areas have been distributed by sand dunes (van der Maarel, 2003), and provide a wide range of ecosystem services such as provisioning, regulatory, cultural and supporting services (Everard *et al.*, 2010). They are providing suitable habitat for reptiles, birds, rodents, and ungulates (Carter, 1990; Pye and Tsoar, 1990).

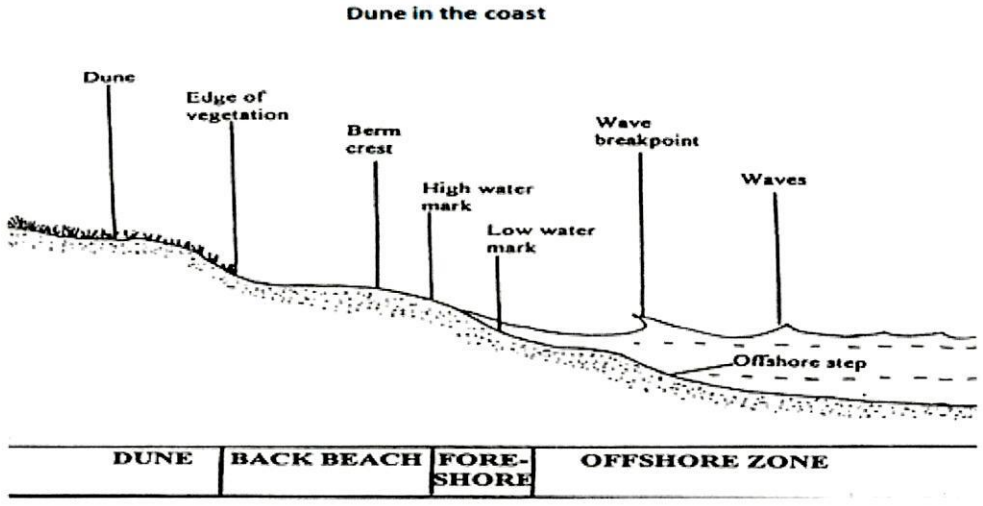
Dune vegetation are much important as it has the ability to: 1) prevent wind erosion by decreasing wind speed at ground level and by providing a protective cover over the dune; 2) build up sand dunes and thereby increase the sand reserve for storm waves; 3) regenerate naturally after storm damage and facilitate natural dune recovery; 5) tolerate gradual movements of the dunes both vertically and horizontally; 6) provide habitat for native fauna.

Coastal sand dunes provide an array of essential services, besides providing the alluring landscape for recreation and tourism. Since the onset of human civilization coastal ecosystems including the dunes used to have direct and indirect anthropogenic pressure. The major issues of sand dune throughout the world are the vulnerability and degradation of the dunes, the encroachment, construction and trampling within and near the dunes, and waste deposition and developmental activities near the shoreline.

Genesis of the Sand Dune

Sand dunes are created when wind deposits sand to form a small mound first. Once that first mound forms, sand piles up on the windward side more and more until the edge of the dune collapses under its own weight. The dynamic nature of the coastal geomorphology and climate due to the wind and wave, sea level variation, sediment supply vegetation and regional and local climate dynamics affect the genesis of aeoline dune. The genesis of the dune is divided in three phases, the dune field formation, followed by the accumulation of sediment deposits and the preservation of the deposited sediments (Clemmensen *et al.,* 2001).

Islands or other depositional coasts, where there is abundant sediment available that is not removed by storms, tend to develop dunes. Wind patterns are such that most coasts experience winds with at least some onshore component. This wind coupled with extensive beaches results in dunes. Sand dune ecosystem, helps to understand a superficially simple-looking ecosystem with a complicated interrelation of climate, vegetation and sandy substrate, and complex dynamics in space and time (Everard *et al.*, 2010, Carter *et al.* 1990).



Sketch: 1 Typical Geomorphology of Sand dunes

Dynamics of Sand Dune

Coastal dunes are very dynamic systems offering a wide variety of habitats with different physical and biotic conditions, and this allows for the existence of species with very diverse life-history traits. They can be visualized as a permanently changing environment with distinct degrees of stabilization that is closely correlated

with topography, the disturbance produced by sand movement, and distance to the sea. Dune habitats can be classified into three types: (1) those where sand movement dominates, sea spray is sometimes important, and nutritionally poor soils prevail (they are formed by the sandy beach, embryo or incipient dunes, foredunes, blowouts, and active dunes); (2) humid and wet slacks or depressions, that is, those habitats which become inundated during the rainy season when the water table rises and they sometimes may even form dune lakes with wetland vegetation; (3) stabilized habitats, which show no sand movement, conditions are less stressful, and there is more organic matter in the soil (Anwar Maun, 2009).

Status of Coastline and Sand Dune in Gujarat and Kachchh

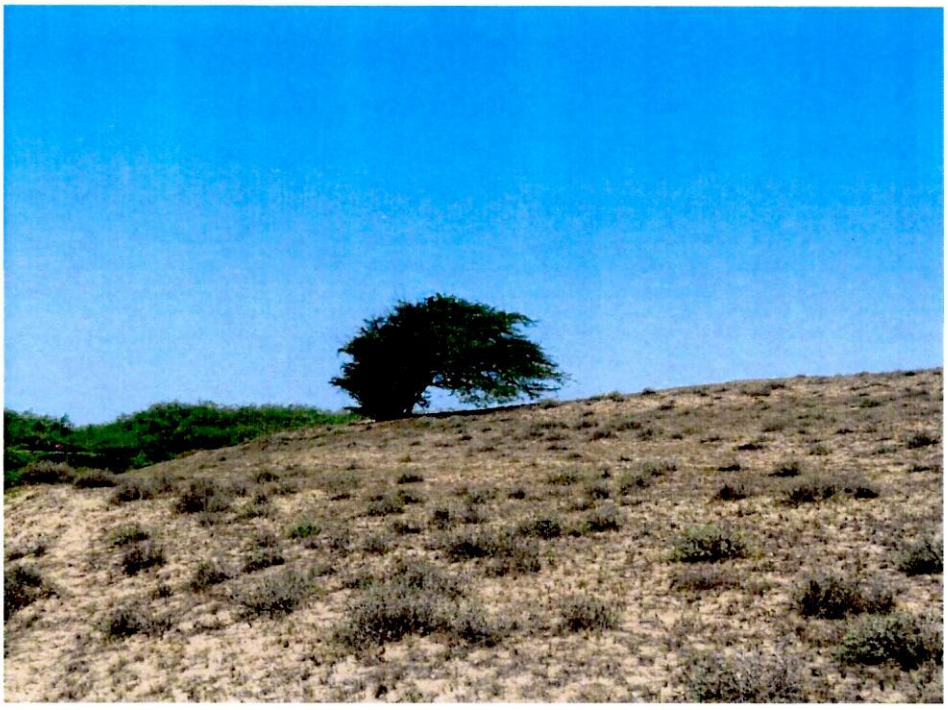
The coastal region of the Arabian Sea harbour numerous sandy beaches consists of dunes, cliffs, promontories and drowned estuaries. The coastal stretch of Gujarat state along the Arabian seas has the longest coastline of India. Various types of anthropogenic developmental activities viz. tourism to defence installation and industrial establishments are started and undergoing in the coastline of Gujarat state. The coastline of Kachchh district stretches over 400 km from the Surajbari creek in the east to Kori creek in the western limit of the district, among which the sandy coastline is located from the Mundra coast to Jakhau in Abdasa taluka. This sandy coastline provides important ecosystem services and acts as a natural barrier/defence line from the disaster that arises from the Gulf of Kachchh. Over the years, many developmental activities are undergone in the area and increasing anthropogenic activities have poses several threats to the sandy coastline of Kachchh.

Therefore, assessment and planning are pre-requisite to understand the sand dunes system, and prepare conservation plan for the sand dune ecosystem and protection of the coastline from natural hazards from the sea and larger benefits of mankind. Along the natural boundary of sand dune present in the coastal area of Bada village, Mandvi taluka, a Soad ash plant is proposed by the GHCL. GHCL has strong commitment for the protection of the above-mentioned sand dune present, thus, GHCL approached Gujarat Institute of Desert Ecology, Bhuj to study and prepare conservation plan for the sand dune. The present study highlighted the status of the sand dune, impact of the proposed project and conservation of the sand dune in view of the probable impacts.

OBJECTIVES

The aim of the study was to assess the ecological status of coastal sand dunes present in the coastal areas of Bada village and impact assessment in view of the proposed project of GHCL, if any and suggest conservation plan. Sand Dunes require location specific some conservation efforts as they are classified as CRZ IA under prevailing CRZ Notification. With above aim, the objectives of study are as follows:

1. Assessment of Sand dune status in the GHCL Project site and its buffer area along the coast.
2. Identification of natural and anthropogenic threats faced by the sand dunes in GHCL Project site.
3. Conservation and management plan for sand dunes in the vicinity of the GHCL Project site.



View of Stable Sand Dunes

STUDY AREA

Background

India is having 7,500 km coastline, of which, Gujarat contributes 1600 km^2. Among the Gujarat coastline, Kachchh alone has 406 km^2 of coast comprises a wide range of habitats such as coral reefs, mangroves, creeks, sand dunes and estuaries. Gujarat has 137 sand dune patches in coastal areas and sand dune distribution ranges to 6650.16 ha. Sandy beaches and dunes are found along the coast in Mandvi, Mundra and Naliya talukas. Mandvi taluka has around 25 km^2 coastal area. The sandy coastline of Gujarat has sporadic nesting of two species of sea turtles viz. Green sea turtle (*Chelonia mydas*) and the Olive ridley turtle (*Lepidochelys olivacea*) as reported by Sundarraj *et. al.* (2002)

Topography

Study area is a narrow area of well-developed beach–dune–complexes with an approximately 500m wide intertidal zone, providing a microhabitat for intertidal fauna. The major seasonal rivers found around the study area are Rukmawati and Nagavanti.

Vegetation of Sand Dunes of Study Area

The shore is made up of a natural supra littoral sand dune with dominant growth of *Prosopis juliflora.* There is presence of clumps of grasses on the shoreward and seaward side of the sand dunes. No creepers and other halophytes such as *Halophyrum mucronatum*, *Seuda nudiflora* and *Aleuropus lagoporides* and *Ipomea pes-capri* etc., are found on the upper side of the supra littoral zone. Sea grasses are absent on the site. The intertidal area of the Bada coast was found as rocky in nature having presence of sea weeds mainly include *Ulva lactuca*, *Enteromorpha compressa*, *Iyengaria stellata*, *Ectocarpus siliculosus*, *Hormophysa triquetra* and *Gelidiella acerosa*.

Project Location

The proposed Project site and the study area are located on the coast of Bada village, in Mandvi Taluka of Kachchh district in the state of Gujarat (Figure-1). For the convenience of the assessment, the study area was divided into two parts i.e. 1) Core area/project area and 2) Buffer area i.e. 10.0 km, long stretch along the coast, in the

periphery of the project boundary (Figure-2). The sand dunes are present all along the coast adjacent to proposed project. The sand dunes are outside the proposed project boundary towards south and lies between the Arabian Sea front and project area on land ward side. Thus, restricting any natural passage available for withdrawal of seawater which is required for manufacturing units.

1. Core Area

The core area is the proposed land area for the establishment of the project plant (Figure-1), that covers about 1350 acres of private, un-irrigated agricultural land and Sarkarshree land/Government land, near the Bada village of Mandvi Taluka in Kachchh district. The proposed project area is composed of sparsely distributed thorny scrub species, dominated by the invasive species *Prosopis juliflora.* There is no rivulets or drainage traversing through the project area.

2. Buffer Area

A continuous patch of sand dunes exists along the coast of the Greenfield Chemical Complex developmental area. Although the sand dunes are outside the plant boundary, the effect of the developmental activity was assessed in the 10 km long stretch along the coast lying next to the manufacturing plant (Figure-2)

Partial open and vegetated Sand Dune

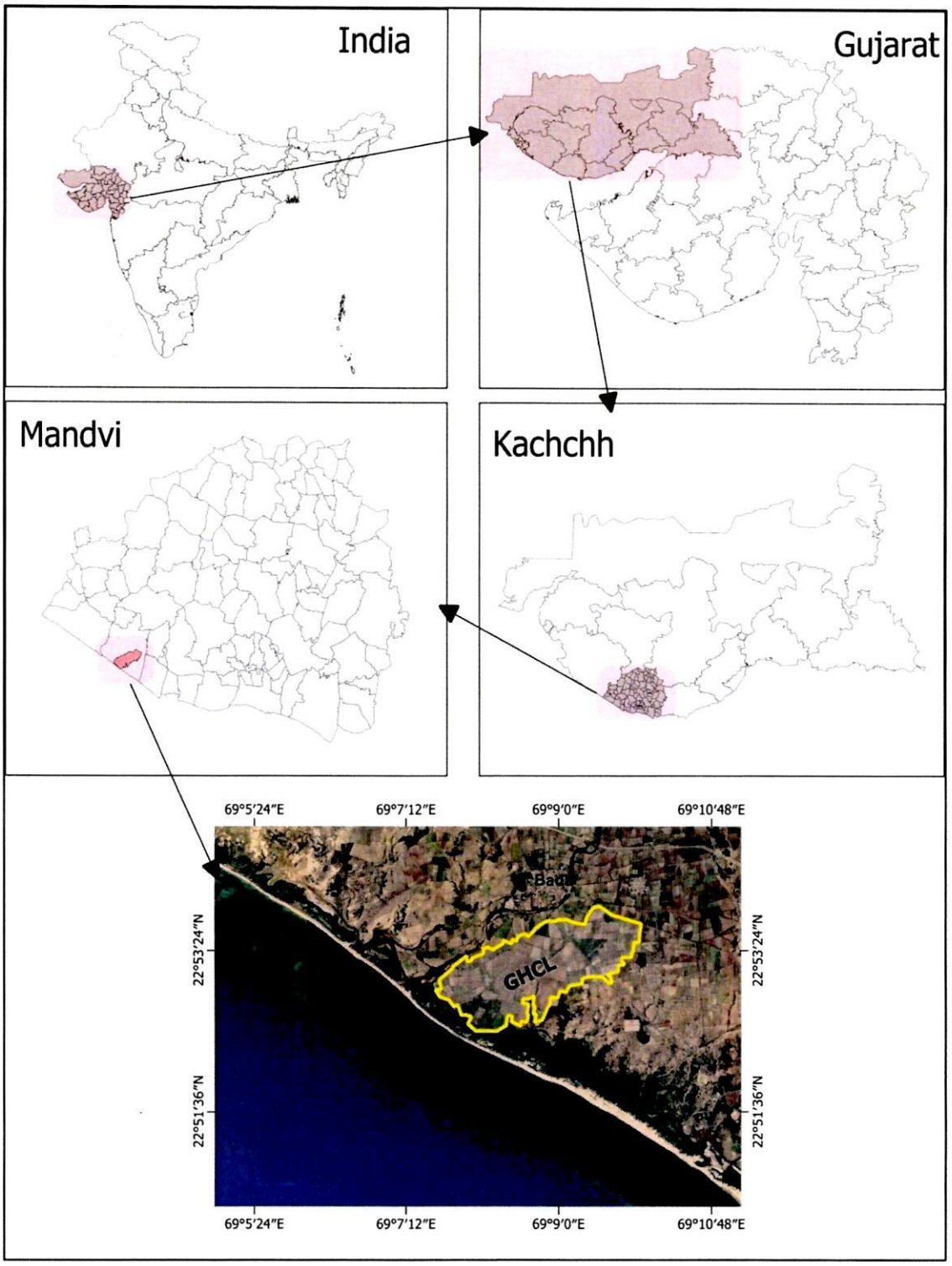


Figure 1. Proposed Project Location Near Bada Village of Mandvi Taluka of Kachchh District in Gujarat

APPROACH AND METHODOLOGY

The survey and sampling were planned considering the aspects to be studied and the topographical setting of the site.

Survey Design: The present study includes collection and collation of existing secondary information, and generation of primary information through appropriate means and following standard methodologies.

Collation of Secondary Information: The preliminary desk review in this study includes a detailed literature review to ascertain the background / baseline of the sand dunes status of the proposed area. The sources of such information include research articles published in scientific journals, prevailing statutory rules and notification, research reports and dissertations from academic and research institutions, records from various line departments of Government of Gujarat, Government of India, District statistical handbook, newspaper reports/articles, information available online through authentic websites, and online journals archives, viz., JSTOR, Springer Verlag and Current Contents. The marine EIA study for "Seawater Intake and Effluent Disposal for Greenfield Chemical Complex off Bada Coast, Arabian Sea carried out by NIO, Mumbai for client reported shoreline and Sand Dune as Stable.

Primary Data Collection

Reconnaissance Survey: A reconnaissance survey was conducted during March and April 2022 in core and buffer areas of the proposed Greenfield Chemical complex project site to assess the existing biodiversity and habitat. The survey was conducted to identify various habitats within the study area and fix the sampling locations for the intensive survey and data collection on various aspects of the present study.

Sampling Locations: In order to take the vegetation sampling and sand dune elevation data we select random location within the buffer area (Table 1), and collected data on habitat of the area and geo-coordinates were recorded

Vegetation Survey: Quadrates of 10 x 10 m^2, 5 x 5 m^2 and 1 x 1 m^2 were laid randomly for trees, shrubs and herbs, respectively, in stratified random locations at

3300

different distance gradients from the shoreline in the study area. Plant species encountered in the laid quadrates were enumerated.

Table 1: Sampling Elevation Locations Under Study Area (Map-2)

Sr. No	Lat	Long	Elevation (In Meter)
1	22.908001	69.088291	5
2	22.894651	69.106247	6
3	22.880379	69.12365	7
4	22.868584	69.14626	21
5	22.861201	69.16669	6
6	22.852312	69.174643	9
7	22.87236	69.13696	19
8	22.87256	69.13651	22
9	22.87157	69.13567	11
10	22.87237	69.134937	11
11	22.875979	69.129189	10

Digital elevation model was used to prepare the elevation class of the sand dunes in the buffer area using the elevation data downloaded from NASA (https://earthdata.nasa.gov/esds/competitive-programs/measures/nasadem) (Figure 2). The elevation of the area under survey ranges up to 22 m, however, the elevation was seen decreasing towards the sea front in southern direction following natural gradient towards sea of the study area.

Preparation of Conservation and Management Plan for Sand Dunes:

After identification of important sand dune's locations, the present threats and the likely impact on them in due course of proposed project time period were also evaluated. Further, suitable measures were conceived for conservation and management of sand dunes.

FINDINGS OF THE STUDY

Status of Vegetation on Sand Dunes:

Presence of sand dunes in the study area suggests high energy wave dominated sea coast. These sand dunes are formed due to deposition of fine to medium, well sorted sand particles. Sediments of the dunes consist of windblown deposits of fine to very fine sand and silt.

The survey for sand dune has been done in the 10 km long stretch along the coast (5 km on either side). Around 18-20 different points have been surveyed along the 10 km stretch. Most of the sand dunes are covered with 70-80% dense grass vegetation while 20-30% sand area is covered with sparse vegetation. The density of *Prospis juliflora* increases away from the sea.

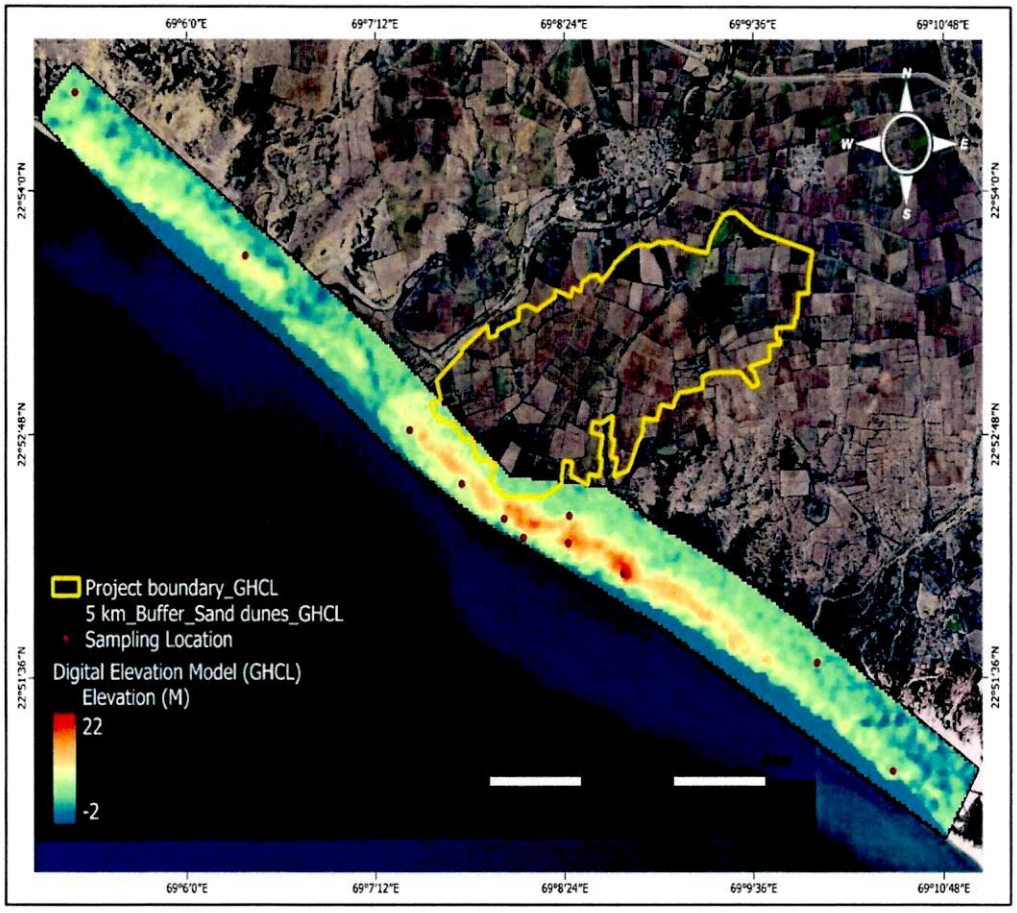
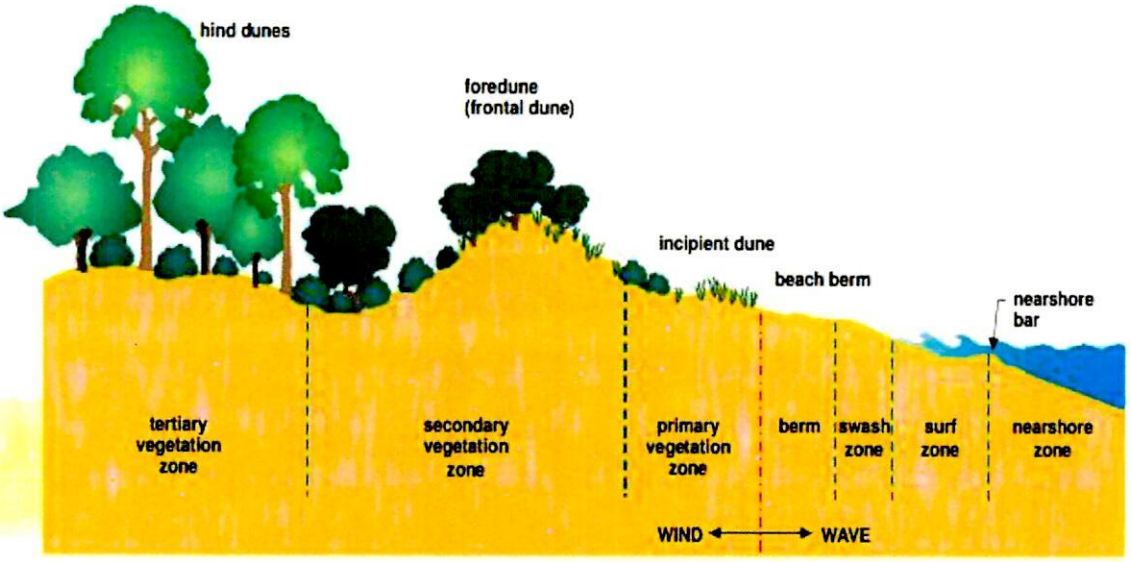


Figure 2. Digital Elevation Models of the Study Area and Sampling Location Around the Study Area



Sketch 2. Geomorphological Zones of a Costal Dune System (Pliatsika, 2018.)

On the basis of secondary literature, the major part of the sand dunes is covered with dense vegetation dominated by *Prosopis juliflora, Acacia nilotica, Acacia leucophloea, Salvadora persica, Caparis decidua, Ipomoea pes-caprae, Cressa cretica, Tamarix aphyla etc.*, and with salt tolerant grass species such as *Cenchrus biflora, Cenchrus Ciliaris, Urochondra setulosa,* Sporobulus helvous and *Aleurops lagopoides.* However, during the present investigation, few species of grass such as *Halopyrum mucronatum, Fimbrystylist milicea, Cyperus arenarius, Cymbopogon martini* were found growing along with *Prosopis juliflora and Salvadora persica*. Presence of this vegetation suggests the stabilized status of sand dunes. The sand dunes towards plant side are also covered with good vegetation shows stabilised sand dune system. The list of plant species recorded during the survey was given in Table 2.

Table 2: List of plants recorded in and around sand dune area

Sr. No.	Scientific Name	Family
1	*Acacia nilotica (L.) Del.*	Mimosaceae
2	*Aristida funiculata Trin & Rupr.*	Poaceae
3	*Asparagus dumosus Baker*	Liliaceae
4	*Blepharis sindica*	Acanthaceae
5	*Chloris barbata Sw.*	Aizoaceae
6	*Cressa cretica L.*	Convolvulaceae

Sr. No.	Scientific Name	Family
7	*Cynodon dactylon (L.) Pers.*	Poaceae
8	*Cyperus bulbosus*	Cyperaceae
9	*Desmostachya bipinnata*	Poaceae
10	*Dichanthium annulatum (Forssk.) Stapf*	Poaceae
11	*Enicostemma axillare (Poir. ex Lam.)*	Gentianaceae
12	*Fagonia schweienfurthii (Hadidi) Hadidi*	Zygophyllaceae
13	*Fimbristylis cymosa R. Br.*	Cyperaceae
14	*Halopyrum mucronatum (L.) Stapf*	Poaceae
15	*Indigofera linnaei Ali*	Fabaceae
16	*Juncus maritimus L.*	Juncaceae
17	*Lasiurus scindicus Henrard.*	Poaceae
17	*Launaea resedifolia (L.) Druce*	Asteraceae
18	*Lepidagathis trinervis Wall.*	Acanthaceae
19	*Pluchea arguta Boiss.*	Asteraceae
20	*Polycarpaea corymbosa*	Caryophyllaceae
21	*Prosopis juliflora (Sw.) DC.*	Mimosaceae
22	*Salvadora persica L.*	Salvodoraceae
23	*Sericostema pauciflorum*	Boraginaceae
24	*Sesuvium sesuvioides (Fenzl) Verdc.*	Aizoaceae
25	*Sporobolus coromandelianus*	Poaceae
26	*Sporobolus helvolus (Trin.) Th. Dur. et Sch*	Poaceae
27	*Tephrosia senticosa (L.) Pers.*	Fabaceae
28	*Ziziphus mauritiana Lam.*	Rhamnaceae
29	*Zizyphus nummularia (Burm. F.) W. & A.*	Rhamnaceae
30	*Zygophyllum simplex L.*	Zygophyllaceae

Different elevations points have been taken for up to 4-5 km coastal stretch covering the core area under the study. The data shows that the lowest elevation recorded was 5 m whereas the highest elevation was up to 22 m. The DEM results show that the dune portion adjacent to project boundary has higher elevations and elevation decreases in east and west direction away from project stretch. The high elevation area of sand dune has dense vegetation of *Prosopis juliflora*, whereas towards the sea

side sparse vegetation of grasses such as *Halopyrum mucronatum, Fimbrystylist milicea, Cyperus arenarius, Cymbopogon martini* have been observed (Table 3).

Photo: 1. Sand Dune Covered with *Prosopis juliflora* Vegetation

Table 3. Characterization of sand dunes in the study area

Sr. No.	Classification of Height	Habitat (vegetation)	Remarks
1	0-5 m	*Halopyrum mucronatum (L.), Stapf Fimbristylis cymosa R. Br., Desmostachya bipinnata, Lasiurus scindicus Henrard*	Flat beach with beach grass and binders
2	6-10 m	*Indigofera linnaei Ali, Enicostemma axillare (Poir. ex Lam.)*	Undulated beach with beach shrubs and binders
3	11-15 m	*Cyperus bulbosus, Pluchea arguta Boiss, Juncus maritimus L., Salvadora persica*	Undulated beach with beach shrubs
4	16-20 m	*Spinifex littoreus, Lepidagathis trinervis Wall., Tephrosia senticosa (L.) Pers., Salvadora persica*	Undulated beach with beach shrubs and small tress
5	21-25 m	*Sesuvium sesuvioides (Fenzl) Verdc., Fagonia schweienfurthii (Hadidi), Salvadora persica L, Prosopis juliflora*	Undulated beach with beach shrubs and small and large tress

Photo: 2. Stabilized Sand Dunes with Grasses

THREAT PREDICTION AND IMPACT ASSESSMENT

Dunes may be degraded physically and/or ecologically and it is important to understand the processes at work before predicting impact of the proposed project and providing suitable measures to minimise or mitigate impacts.

The proposed project development encompasses establishment of soda ash manufacturing units and utilities. In order to provide uninterrupted water supply to manufacturing units it is essential to have a sustainable source in vicinity. Thus, in absence of any other sustainable water source the Arabian Sea front off Bada coast is selected for withdrawal of seawater.

The sand dunes are present all along the coast which doesn't allow natural passage for withdrawal of seawater. Further creating seawater open intake channel will have larger impact on the nearby intertidal area. Thus, to withdraw seawater; pipeline laying is selected. As there is no natural passage available to lay the pipelines it is selected to lay the same through underground tunnelling through established engineering practices and geotechnical studies. Tunnelling will ensure there will not be any alteration to existing stable sand dunes. Similarly for effluent disposal, pipeline will be laid through underground tunnelling in sand dune area.

Various factors are interplay for the loss of sand dune which are as follows:

1. Erodibility and Erosion Hazard

Erodibility is an intrinsic property of soil materials and refers to their potential for erosion. Grain detachability is the major determinant. For water erosion, moisture absorptivity is also an important factor whereas for wind erosion, surface roughness is more relevant. In addition to inherent erodibility, other site characteristics such as slope length, slope steepness and vegetation cover are used to predict the likelihood of erosion.

2. Climatic Influences

Climate plays a crucial role in coastal landscapes generally and through wind, air temperature and rainfall it impacts either directly or indirectly on coastal dunes. In recent years, change in the local climate has been observed which may pose threats to the dune in future.

3. Wind

Wind directly influences waves, currents, water levels and sand transport and thereby moulds many coastal features into shapes that reflect wind strength, direction and duration. Local wind patterns also play a critical role in dune rehabilitation through their effect on plant establishment and survival.

4. Weeds and Invasive Species

Weeds are pests that cause a range of environmental, social and economic problems. Weeds cause many problems in coastal and other environments because they often grow faster than native plants and successfully compete for sunlight, water, nutrients and pollinators. *Prosopis juliflora* is a highly invasive species of the area and major parts of the sand dune in close vicinity of the project are covered. This species minimised the growth of natural vegetation of the sand dune over the years.

5. Anthropogenic Disturbances

Anthropogenic disturbances are the major threats to the sand dune in many locations. During the survey, minimum anthropogenic activities were observed in the area except grazing and movement of people for fishing. Recreational activities were not observed in the area during the survey period. However following observation have been made which may impact on the sand dune of the area:

- In the event of establishing of the proposed project some anthropogenic activities may occur due to the construction and operation of the proposed plant/industry, influx of population and recreational activities.
- The installation of intake and outfall pipeline beneath the sand dune may impact on the geo-morphology of the sand dune if not done through appropriate engineering measures which are suitable for such terrains.
- Further, intake of sea water and outfall of water may interfere with the natural wave pattern of the near shore area temporarily during construction stage which may impact on the narrow sandy coastline of the Project site.
- The cliff of dune facing towards sea in some area in vicinity of the project is facing erosion due to the high tidal wave action and lack of vegetation (Figure 3), coastal morphology and sea wards wave action. Due to the little human

interference or disturbance observed in such area, however these areas may be eroded in near future if suitable dune conservation measure will be not undertaken. Below photo plates of the project area sand dunes is a self-explanatory of eroded cliffs and erosion.

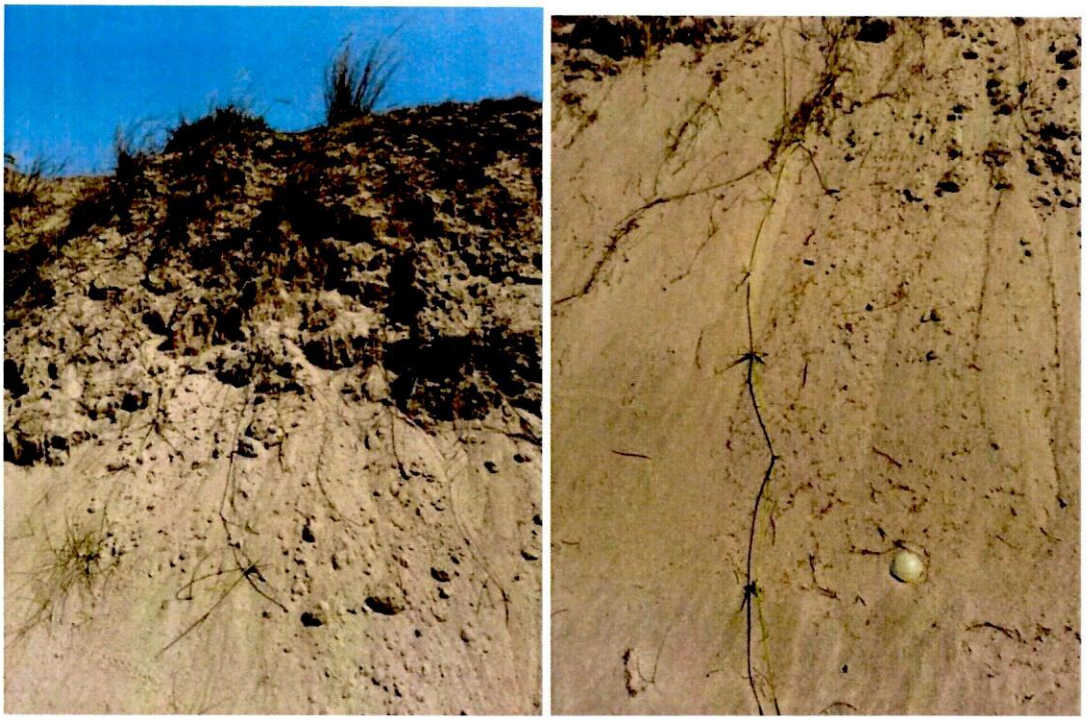


Photo 3: a) Cliff b) Eroded Cliff

Photo 4. Sand Dunes with Sparse Grass Vegetation Cover along the Seaward Side

SAND DUNE CONSERVATION MEASURES

Conservation and management of natural ecosystem and habitat are the prime importance in recent time for ecological balance, natural flow of ecosystem services, conservation of biodiversity and our sustainable development. Sand dune are one among the threatened ecosystem which are critical in view of the recent developmental activities along the coastal areas all over the world.

Though the sand dune present in vicinity of the proposed project is very much stable sand dune system due to its vegetation cover except some cliff areas and minimum human interference or activities are observed in the area (due to the narrowness of the beach, lack of approachable roads, etc.). However, in the event of coastal development activities, increasing anthropogenic pressure and ongoing climate change, impact on the sand dune couldn't be neglected in future. Therefore, priority should be given for sand dune conservation and management measures may involve access way construction, signage and a community awareness program. It is applicable to the nearby coastal areas of GHCL Project area.

Therefore, some suitable measure and implementable action to be undertaken for conservation and management of the natural sand dune in the area which are as follows:

1. Erosion Control

The sand dune may face erosion threats due to high wind and tidal action prevailing in the area. The erosion of sand dune is likely in cliff areas facing towards the coastline due the lack of substantial vegetation. The coastal dunes are relying primarily on maintaining a uniform protective cover of suitable vegetation. Therefore, plantation of the cliff area is required with suitable native species of grasses, herbs and shrub which naturally grows on sand.

To provide sufficient plant cover to protect fragile dunes against wind erosion, species that are native to the coastal dunes are adapted to survive the hostile environment of drifting sand, strong winds, salt spray and infertile soils. The plantation activity may be promoted by using CBO (Community Based Organisation) or Forest Department They provides long term stability.

2. Sand Dune Restoration

Tropical storms are primarily responsible for the damage in many parts of the coastal dune ecosystem. Restoring vegetation on coastal dunes is important because vegetation helps stabilize dunes and provides essential habitat and food for many species of wildlife naturally dependent on sand dune. Therefore, key species of plants needs to be planted with coordinated efforts to restore degraded sites within the sand dune area.

3. Stabilising Sand Dune Through Re-vegetation (Sand Dune with Sparse or without Vegetation Cover)

Re-vegetation is a general term that includes stabilising a land surface with plants that need not be native. In coastal dune management the emphasis should be on regeneration; re-establishing a range of indigenous plants that would occur normally in the local environment. This is applicable in the areas or patches of sand dune where there is no vegetation or sparse vegetation. For this there is no need for removing existing vegetation from the dunes.

A healthy dune ecosystem will display a range of plant communities and locally indigenous species that reflect the geographical distribution of species along the coast, zonation within the dune system and the age of the dunes. These communities provide habitats for a diverse range of native fauna, providing them with resources such as food, breeding sites and protection from predators.

For the re-vegetation suitable seed collection is prime important and this can be done through selecting the target plants, establish their locations, understand their fruiting times and the logistics of gathering their seed. Collect local progeny from naturally occurring remnant vegetation as close as possible to the project site. To obtain good genetic quality for each species by collecting from healthy, vigorous plants. Further, it should be ensuring that plants and populations are not over exploited, and collect small amounts of seed from a large number of individual plants that are well separated from each other.

4. Plantation of Native Sand Dune Adopted Vegetation (Psammophytes):

Sand dunes are maintained with the help of sand dune vegetation as wind traps, sand binders of dune stabilizers. Dunes can be stabilized using indigenous grasses and

other plants which can help by "reducing the velocity of waves and absorbing their energy". These plants take root and begin to form a strong, thick barrier which anchors the sand dune and helps keep sand in place. Planting takes an extensive amount of work to complete. First, indigenous plant seeds must be obtained, then site preparation, planting, fertilization, and mulching are required. Following the planting process, irrigation needs to be done in order to maintain required moisture level. Installing dune stabilization vegetation and structures is not the end of the process. The dune must be continuously maintained. Beach grasses are pioneer plants in stabilization of coastal sand dunes. They create an environment more attractive to other species of flora and thus encourages colonization by fauna subsequently changes the dune characteristic features. However, as the plants become established, the dune becomes more stable.

5. Fire Control and Management

Naturally occurring fires are not considered to be a regular feature of the coastal dune environment. It is recognised that active fire management may be required to reduce the risk of wildfire to life and property that has been built in the dune environment.

Though, the present sand dune area has no any sign of fire in present time, however, increasing human population in the event of plant establishment chance of fire cannot be neglected. Therefore, care should be taken to manage fire or fire management system needs to be installed, if fire occurs in future so that vegetation to be managed to conserve the dune environment.

6. Control of Invasive Species

Presently, most of the sand dune area has been covered by the *Prosopis juliflora*. Though, it acts as a sand stabiliser in the area, however, further, invasion of *P. juliflora* to be checked and focus to be given for the plantation or re-vegetation of native species for sand dune conservation.

7. Minimise Anthropogenic Activity in Coastal Ecosystem

Increased human activity such as recreational tourism, fishing, and coastal developmental activity, mainly the economic activities may degrade the dune stability and its ecosystem quality. Though, the major parts of the dune are covered

by the *P. juliflora* and minimum anthropogenic activities noticed during the survey, however, the rapid pace of developmental activities are undergoing in the entire coastal areas of Kachchh including the Mandvi coast, may degrade the ecosystem in future. Therefore, minimum human interference to be allowed in the dune and its sandy coast and focus to be given for awareness among various stakeholders about importance of dune ecosystem and conservation of sand dune.

8. Removal of Beach Debris

Removal of beach debris/waste from such area is an appropriate management practice to promote dunes in the project area. Accumulation of beach debris and other waste by wave action or by dumping leads to damage of dune vegetation and in course of time may affect further dune formations. Beach cleaning occurs in those locations with high levels of recreational use, especially near urbanizations. In addition to its adverse impact on the foreshore flora and fauna, it can exacerbate erosion. The only requirement in most cases is to cease the activity and allow dune vegetation to re-establish.

9. Conservation Education and Awareness Programme

It is normally observed that people have lack of knowledge and awareness about the importance of sand dune ecosystem for the environment and for the human being. Therefore, focus should be given in organizing activities, sign board and other awareness programme on the conservation of sand dune and its dependent fauna.

10. Monitoring and Evaluation

Regular monitoring and evaluation of the sand dune ecosystem and its floral and faunal composition is pre-requisite to manage the sand dune in future and in the event of establishing Greenfield complex by the M/S GHCL Ltd. through expert agencies.

Fund Allocation for Implementation of Conservation Plan

The successful conservation and protection of natural ecosystem/habitats is the prime duty of all stakeholders using the natural resources of such areas for their livelihood and economic development activity. The conservation measure suggested for the conservation sand dune present in the buffer area of the proposed project area of the GHCL is given in the previous section. Since, sand dune is a crucial ecosystem for some threatened wildlife species, special focus is required to ensure effective conservation measures to be implemented in future for conservation and restoration of the sand dune.

To implement the above-mentioned conservation measure for the sand dune, budget has been proposed (breakup given in table 4) for each activity to meet the goal of successful conservation of sand dune and its threatened biodiversity. The proposed estimated budget of Rs. 30,00,000/- (Rupees Thirty lakhs only) has been allocated for the upcoming 10 years from the date of inception of the project to implement various conservation actions as suggested in the previous section of the report.

In addition to the fund allocation made for conservation of sand dune in the buffer areas of the GHCL proposed project, environmental/ habitat improvement programmes could be undertaken as part of CSR activities focussing on the conservation of sand dune environment.

Table 4: Proposed budget for implementation for conservation measure

Sl. No.	Specific Conservation and Management Objective	Proposed Expenditure
		Long term (10 years)
1	Sand dune Conservation and Protection	6,00,000.00
2	Habitat Improvement & Plantation	7,00,000.00
3	Research and Monitoring	6,00,000.00
4	Conservation education & Awareness generation	4,00,000.00
	Total	**23,00,000.00**

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