BEFORE THE NATIONAL GREEN TRIBUNAL (EZ), KOLKATA

(Under Section 18(1) read with Sections 14 & 15 of National Green Tribunal Act 2010)

Original Application No. 93 of 2024 (EZ)

Ashish Kothari ….Applicant

v.

MoEFCC and Anr. …Respondents

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Certified to be true copies of the respective originals.

Dated on this the 16th day of September, 2025

(MS 1421/2011)

A Yogeshwaran
Counsel for the Applicant
Ph: 9566254546
Email: yogeshwaranadv@gmail.com

BEFORE THE NATIONAL GREEN TRIBUNAL (EZ), KOLKATA

(Under Section 18(1) read with Sections 14 & 15 of National Green Tribunal Act, 2010)

Original Application No. 93 of 2024 (EZ)

Between:

Ashish Kothari
S/o Rajni Kothari,
G1 Chaitraban Residency, Aundh,
Pune 411007
Email: yogeshwaranadv@gmail.com
Phone No. : 9566254546 ....Applicant

Vs.

1. The Ministry of Environment, Forest and Climate Change
   Rep by its Secretary
   Indira Paryavaran Bhavan ,Jor Bagh Road, New Delhi 110003
   Email: mefcc@gov.in, Phone: +91-11-23014243
2. Andaman and Nicobar Islands Integrated
   Development Corporation Limited (ANIIDCO Ltd)
   Rep by its Managing Director
   Vikas Bhawan, PB No,1B0,
   Port Blair, Andaman & Nicobar Islands
   Pin – 744101
   Phone : 03192 236086, 234108,
   Email : aniidco@gmail.com …Respondents

Additional reply filed by the Applicant

The Applicant respectfully submits as follows:

1. It is submitted that during the hearing of the subject application and connected applications on 24.07.2025, it was pointed out from the record that the revised layout of the port project in Galathea Bay, even according to the A&N CZMA recommendation dated 08.07.2022 included 0.57 Sq KM of CRZ IA and total of 7.07 Sq KM of CRZ IA areas for all the

components of the project. It is admitted by the respondents that the subject projects cannot be constructed / implemented in CRZ IA areas.

2. It was submitted by the MoEF&CC that the entire CRZ IA areas – i.e. turtle nesting grounds, nesting ground of birds, corals, biologically active mudflats, mangroves etc. classified as CRZ IA as per clause 2(ii) of the ICRZ Notification, 2019 have been excluded from the project layout. Reference was made to the minutes of the 306th meeting of the EAC held on 22-23rd August, 2022 where at para 3.10.1 (iv) it has been stated that the CRZ IA areas and IB areas falling within the port area shall be excluded from the revised layout of the master plan. Based on this, it was contended that CRZ IA areas within the port area have been excluded in the revised layout (page 439 of the file). MoEF&CC sought time to file a copy of this alleged revised layout of the project, excluding CRZ IA areas, but has not been filed till date. No such revised layout exists.

3. It is necessary to note that only the revised layout, for which revised recommendations were obtained on 08.07.2022, includes CRZ IA areas and is extracted below at para 3.10.1 (xviii) of the same minutes (page 442 of the file). The MoEF&CC's EAC considered this revised layout and at para 3.10.3 of the same meeting, recommended the project for clearance, which was issued on 11.11.2022.

4. It is submitted that no subsequent revision has taken place and it is not even the case of the respondents that such revision took place post the issuance of the clearance.

5. It is submitted that to obviate any doubt, the following documents and proceedings of the respondents from the clearance process are filed for the consideration of this Hon'ble Court.

    a. In March 2022, the 2nd respondent as part of their form 2 (application form for EC) submitted a report titled "High Tide Line, Low Tide Line And Island Coastal Regulation Zone For The Proposed Holistic Development Of Great Nicobar Island, Union Territory Of Andaman & Nicobar Islands' prepared by NCSCM. CZMP sheet wise observations in this report, which were made after field investigations, are provided from section 8.0 of the report. The presence of CRZ IA ecologically sensitive areas within the project area in each sheet of the CZMP has been clearly stated in this report. A sample is extracted below for convenience.

"Sheet Number 10 (Galathea Bay, Great Nicobar)

Part of the proposed activities such as port area falls within the ICRZ category of ICRZ IA (turtle nesting grounds, nesting ground of birds, protected forest and biosphere reserved area), ICRZ IB (intertidal zone) and ICRZ IVB (creek/river). Proposed port reclamation area falls within the ICRZ category of ICRZ IA (turtle nesting grounds, and protected

forest), ICRZ IB (Intertidal Zone) and ICRZ IV (waterbody) and tribal reserve area. Proposed Road (55m) falls within the ICRZ category of ICRZ IA (protected forest and biosphere reserved area), ICRZ IB (intertidal zone) and ICRZ IVB (creek/river). Other proposed activities such as Road (26m), power plant, green, and eco -tourism area does not fall within any ICRZ Category in this sheet. (Refer T able 2)."

Copy of this report is annexed as **Annexure A 36.**

b. In the 297th meeting of the EAC, held on 24-25 May, 2022, the EAC observed that the port included CRZ IA and IB areas and the revised layout after excluding such areas has not been submitted. The minutes are available at page 375 of the file.

c. The project proponent submitted reply (ADS) to the queries of the EAC raised in the 297th meeting and submitted that revised ICRZ recommendations had been received vide letter dated 08.07.2022 and "the master plan has been revised based on these recommendations". The ADS enclosed documents including A&N CZMA revised recommendation as enclosure 13, the revised master plan as enclosure 2, the project proponent's map regarding exclusion of CRZ-IA areas as enclosure 5 and a map of active Megapode mounds as enclosure 17. Copy of ADS reply and enclosure 2, 5, 13, 17 submitted along with the ADS reply are collectively annexed as **Annexure A-37.** Thus, it is evident that the revision of layout was based on the revised recommendation of the A&N CZMA dated 08.07.2022, which reduced the ICRZ-IA

area in the port area from 0.67 sq.km to 0.57 sq.km. Thus, it is borne out from the record that the entire ICRZ-IA area was not excluded.

d. In the 306th meeting of the EAC held on 22-23 August, 2022, the EAC takes into the account the above revised recommendation and recorded the submissions of the project proponent regarding the revised extent of ICRZ-IA in different components of the project at para 3.10 (xviii). Please see page 410 at 437. Based on the above, the EAC recommended the project for grant of clearance.

e. The EC was granted on 11.11.2022 for the subject project which included CRZ-IA areas, despite the express prohibition in law. This Hon'ble Tribunal in its judgement dated 03.04.2023 took note of the fact that ports were prohibited in CRZ-IA areas and directed the committee constituted by the Tribunal to examine all these issues and revisit the clearance.

6. Therefore, it is incorrect to state that the project layout has been revised, and all ecologically sensitive CRZ-IA areas have been excluded.

7. It is submitted that now the Respondents are contending that the entire project area contains no ICRZ-IA, i.e. ecologically sensitive area, based on the alleged NCSCM report. Such contention apart from being factually

wrong, contrary to all available scientific evidence, is also contrary to NCSCM's own report submitted at the beginning of the clearance process.

8. It is submitted that even the EC at condition IB refers to enclosure 17 submitted by the proponent and mentions that 51 active mounds of Megapode are located within the project site and 30 will be destroyed permanently. The project proponent's own map has recorded megapode mounds inside the port area as well as other components. Thus, there can be no dispute that Galathea bay, apart from being one of the most important nesting grounds for leatherback turtle is also a megapode bird nesting ground. While leatherback nesting is reported in other bays on Nicobar Island, the fact that even according to the forest department, 649 leatherback turtles nested in Galathea Bay in the year 2022, 505 leatherback turtles nested in 2023 and 617 leatherback turtles nested in 2024 is irrefutable proof that the bay is critical for the species, especially considering the number of nests in the other bays and the nesting population in the Indian ocean. RTI reply dated 06.03.2025 from the A&N Forest Department containing data of turtle nesting for the years 2022-24 is annexed as **Annexure A-38.** Copy of the report on ICRZ plan of Great Nicobar dated April 2023 prepared by NCSCM, Article on corals in India by Sivaperuman, ZSI etc and extract from Allen Coral Atlas is annexed as **Annexure A-39**.

9. Copy of the Memo dated 05.04.2023 filed by the Appellant (Applicant herein) in Appeal No. 32 of 2022 and the article in Scroll by Vaishnavi Rathore titled "Why the Great Nicobar project could spell doom for the island's unique fauna" dated 03.12.2024 (at webpage URLhttps://scroll.in/article/1076098/why-the-great-nicobar-project-could-spell-doom-for-the-islands-unique-fauna) were annexed to the note on submissions filed by the applicant and are also respectively annexed as Annexure **A-40** and Annexure **A-41** to this reply.

10. It is therefore prayed that this Hon'ble Tribunal be pleased to allow the applications as prayed for and thus render justice.

Ashish Kothari
x

Applicant

VERIFICATION

I, Ashish Kothari, the applicant herein, do hereby verify that the contents in the above paragraphs are true to the best of my knowledge and based on legal advice and that I have not suppressed any material fact.

Date : 6 Aug. 2025

Place : Pune

Ashish Kothari
x

Applicant

NOTARY * GOVERNMENT OF MAHARASHTRA * LAXMI L. PARANJAPE REGD. NO. 27 EXPIRY DATE 20/09/2025

Noted and Registered at Serial Number 5/25

NOTARIAL NOTARIAL NOTARIAL NOTARIAL NOTARIAL

BEFORE ME
LAP 6-8-25
L. A. PARANJAPE
NOTARY, STATE OF MAHARASHTRA
PUNE DISTRICT

HIGH TIDE LINE, LOW TIDE LINE AND ISLAND COASTAL REGULATION ZONE FOR THE PROPOSED HOLISTIC DEVELOPMENT OF GREAT NICOBAR ISLAND, UNION TERRITORY OF ANDAMAN & NICOBAR ISLANDS

1.0 Introduction

The Andaman and Nicobar Islands are a cluster of about 836 offshore islands of India located to the east of the Bay of Bengal and west of the Andaman Sea. The cluster comprises of two island groups, the Andaman Islands and the Nicobar Islands, separated by the 150 km wide Ten Degree Channel, with the Andaman Islands to the north and the Nicobars to the south. The Union Territory's capital city is Port Blair.

A Master Plan for a Holistic Development of the Great Nicobar Island in the Andaman & Nicobar Islands is being prepared to provide a framework for development of a new 'greenfield city' with a diverse and robust economy based on maritime services and tourism, amongst other drivers. The development of the new economic base will depend heavily on investment in catalytic infrastructure facilities, including an International Container Transshipment Terminal (ICTT), Greenfield International Airport, and Power Plant. A new Township will link the infrastructure facilities to complete the physical framework of the new city. These four interlinked projects (Port, Airport, Power Plant, and Township) form the core of the new city and the main components of the holistic master plan, while some part of the proposed Great Nicobar Island Holistic Development area falls in the Island Coastal Regulation Zone of Great Nicobar Island, Andaman & Nicobar Islands. In this regard, NITI Aayog has appointed AECOM India Pvt. Ltd. as "Master Planning Consultant for preparation of Holistic plan for Great Nicobar island and provide support in obtaining necessary statutory approvals including EIA and CRZ".

In line with above M/s. AECOM India Pvt. Ltd., requested the National Centre for Sustainable Coastal Zone Management (NCSCM), Ministry of Environment, Forests & Climate Change (MoEF&CC), Government of India, Chennai to prepare an Island Coastal Regulation Zone map at the scale of 1:4000 by demarcating the High Tide Line (HTL), Low

Tide Line (LTL) and Ecological Sensitive Areas (ESAs) for the project site. Demarcation of the HTL, LTL, ESAs and identification of Island Coastal Regulation Zones (ICRZ) have been carried out on 1:4000 scale to provide information on the ICRZ categories with respect to the proposed project site.

2.0 **Objective**

The objectives of the study are:

- Identification and demarcation of HTL and LTL for the proposed project area
- Demarcation of Ecological Sensitive Areas
- ICRZ categorization as per ICRZ Notification, 2019
- Preparation of ICRZ map based on approved ICRZ Plan as per ICRZ Notification, 2019
- Superimposing of the proposed project layout on the ICRZ map.

3.0 Location

The Great Nicobar Island is the southernmost of the group of Nicobar islands with an area about 910 Sq.Km and is located at a distance of approximately 520 kms from Port Blair. Total area of the proposed development is about 166.1 sq.km and proposed reclamation area is about 3.38 sq km along the south-eastern and southern coastlines of Great Nicobar Island. It extends from the north of Campbell Bay to Indira Point and further up to the Pemayya Bay area in the south. The geographical location of the proposed project site is between the latitude/longitude (93°56'55.948"E 7°4'42.76"N and 93°49'42.816"E 6°45'5.606"N) (Refer Fig. 1 Location Map).

Fig. 1: Location map of the proposed project site

4.0 Approach & Methodology

4.1 ICRZ Notification, 2019

The Ministry of Environment, Forest and Climate Change, Government of India, New Delhi issued Notification No. S.O.1242(E) dated 8th March, 2019 which is referred to as the Island Coastal Regulation Zone (ICRZ) Notification, 2019 in supersession of IPZ Notification 2011, declaring the designated areas as Island Coastal Regulation Zone (ICRZ), with a view to conserve and protect the unique environment of coastal stretches and marine areas, besides livelihood security to the fisher communities and other local communities in the coastal areas and to promote sustainable development, based on scientific principles taking into account the dangers of natural hazards, sea level rise due to global warming.

Definition of ICRZ under ICRZ Notification 2019:

Under the ICRZ Notification 2019, the following areas were notified as Island Coastal Regulation Zone (ICRZ):

(i) The eight larger oceanic islands in Andaman and Nicobar (ICRZ Islands) shall be grouped as follows:

Group-I: Islands with geographical areas >1000 sq.km such as South Andaman, Middle Andaman and North Andaman.

Group-II: Islands with geographical areas >100 sq.km but < 1000 sq.km such as Baratang, Little Andaman, Havelock, Car Nicobar and Great Nicobar.

(ii) The land area from High Tide Line (hereinafter referred to as the HTL) to 200 meters on the landward side along the sea front for Group-I Islands and 100 meters on the landward side along the sea front for Group-II Islands.

Explanation- For the purposes of this Notification, the expression “High Tide Line” means the line on the land upto which the highest water line reaches during the spring tide, as demarcated by the NCSCM, Chennai in accordance with the laid down procedures.

(iii) (a) The ICRZ shall apply to the land area between HTL to 20 meters or width of the creek, whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are

experienced which shall be determined based on salinity concentration of five parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Island Coastal Regional Zone Plans (hereinafter referred to as the ICRZ Plans).

(b) The distance of the ICRZ along the tidal influence water bodies, thus determined, shall be demarcated accordingly in the Island Coastal Zone Management Plan (hereinafter referred to as the ICRZP).

(c) The ICRZ boundaries along the creeks etc. as above shall however be subject to revision and final approval of the respective ICRZ Plans as per this Notification, framed with due consultative process and public hearing etc. and environmental safeguards enlisted therein. Till such time the ICRZ Plans to this notification is approved, the limit of 100 meters or width of the creek whichever is less, shall continue to apply.

Explanation: For the purposes of this sub-paragraph the expression tidal influenced water bodies means the water bodies influenced by tidal effects from sea in the bays, estuaries, rivers, creeks, backwaters, lagoons and ponds etc. that are connected to the sea.

(d) The intertidal zone means the land area between the HTL and the Low Tide Line (hereinafter referred to as the LTL).
(e) The water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

Classification of the ICRZ

For the purpose of conserving and protecting the coastal areas and marine waters, the ICRZ area shall be classified as follows, namely: -

(i) **ICRZ-I** areas are environmentally most critical and shall be further classified as under:
(ii) ICRZ-IA:

(a) The ICRZ-I A shall constitute the following ecologically sensitive areas and the geo- morphological features which play a role in the maintaining the integrity of the coast viz.:

(i) Mangroves. In case mangrove area is more than 1000 square meters, a buffer of 20 meters along the mangroves shall be provided and such area shall also constitute CRZ –I A.
(ii) Corals and coral reefs;
(iii) Sand Dunes;
(iv) Biologically active Mudflats;
(v) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, the Forest (Conservation) Actor Environment (Protection) Act; including Biosphere Reserves;
(vi) Salt Marshes;
(vii) Turtle nesting grounds;
(viii) Horse shoe crab's habitat;
(ix) Sea grass beds;
(x) Seaweeds,
(xi) Nesting grounds of birds;
(xii) Areas or structures of archaeological importance and heritage sites.

(b) A detailed environment management plan shall be formulated by the Union territories for such ecologically sensitive areas (ESAs) in respective territories, as mapped out by NCSCM, based on guidelines as contained in **Annexure-I** and integrated in the ICRZ Plans.

(iii) **ICRZ-I B:** The ICRZ-IB shall consist of the intertidal zone i.e. the area between Low Tide Line and High Tide Line shall constitute the ICRZ-I B.

(iv) ICRZ-II:

(a) The ICRZ-II shall constitute the developed land areas up to or close to the shoreline, within the existing municipal limits or in other existing legally designated urban areas, which are substantially built-up with a ratio of built up plots to that of total plots being more than 50% and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains etc.

(b) The Land areas along the creeks or tidal influence water bodies, located in the ICRZ II shall also be earmarked as ICRZ II and the distance upto which the ICRZ is to be reckoned as the land area between HTL to 20 meters or width of the creek, whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity concentration of five parts per thousand (ppt) measured during

the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Island Coastal Regional Zone Plans (hereinafter referred to as the ICRZ Plans).

(v) **ICRZ-III:** The land areas that are relatively undisturbed (viz. rural areas etc.) and those do not fall under ICRZ-II, shall constitute ICRZ-III.

Explanation: -

1. *For Group-I Islands, the area up to 100 meter from the HTL on the landward side shall be earmarked as the No Development Zone (NDZ). Provided that the NDZ for development of eco-tourism activities shall be 50 m and the Andaman and Nicobar administration shall ensure that the concerns of the fishing community are fully protected.*
2. *For Group-II Islands, the area up to 50 mts from the HTL on the landward side shall be earmarked as the No Development Zone (NDZ).*

   Provided that the NDZ for development of eco-tourism activities shall be 20 m and the A&N administration shall ensure that the concerns of the fishing community are fully protected.

(vi) Land area up to 20 m from the HTL, or width of the creek whichever is less, along the tidal influenced water bodies in the ICRZ III, shall also be earmarked as the NDZ and the distance upto which the NDZ is to be reckoned as the land area between HTL to 20 meters or width of the creek, whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity concentration of five parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Island Coastal Regional Zone Plans (hereinafter referred to as the ICRZ Plans).

Note: The NDZ shall not be applicable in such areas falling within notified Port limits.

(vii) **ICRZ-IV:** The ICRZ - IV shall constitute the water area and shall be further classified as under:

(viii) **ICRZ- IVA:** The water area and the sea bed area between the Low Tide Line up to twelve (12) nautical miles on the seaward side shall constitute ICRZ-IV A.

(ix) **ICRZ- IVB:** ICRZ-IV B areas shall include the water area and the bed area between LTL at the bank of the tidal influenced water body to the LTL on the

opposite side of the bank, extending from the mouth of the water body at the sea up to the influence of tide, i.e., salinity of five parts per thousand (ppt) during the driest season of the year.

4.2 Base map

The project level ICRZ map (1:4000 scale) is prepared to facilitate easy and accurate implementation of ICRZP in the field. Cadastral map on scale 1:4000, was used as the base map for the present study. The HTL/LTL is identified following the guidelines issued by MoEF& CC Govt. of India.

The key elements of the approach and methodology are:

- Demarcation of HTL based on the satellite imageries during 2011-2012.
- Identify the HTL based on the geomorphic signature and map the HTL and control points.
- Transfer the HTL to the cadastral map with respect to the ground control point mapped.
- Prepare the ICRZ map delineating the HTL, LTL and the ICRZ categories.

4.3 Data Source

Approved Island Coastal Regulation Zone Plan (ICRZP) prepared as per ICRZ notification, 2019 was used as the base database for preparation of ICRZ map on 1:4000 scale for the proposed project site. In addition to field information, data from various sources were used for the compilation of the final ICRZ map and preparation of the ICRZ report. These are follows:

- Hydrographic charts of Naval Hydrographic Office
- Survey of India Toposheets
- Satellite images

5.0 Tide

Island Coastal Zone Regulations are restricted to the sea coast and banks of water bodies influenced by tidal action. The tidal range is an important parameter that decides the landward extent of the reach of seawater into the land and the location of the HTL including the extent of ICRZ. The distance up to which development along rivers, creeks and backwaters is regulated depends on the landward extent of tidal influence. The Tidal range data with respect to Chart Datum pertaining to Port Blair (11°41'0.52"N, 92°43'24.07"E) is given below in (Table 1.)

Table 1: Tidal range at Port Blair

Tide Condition	Height (m)
Mean High Water Spring	2.01
Mean High Water Neap	1.97
Mean Sea Level	4
Mean Low Water Neap	0.21
Mean Low Water Spring	0.41

Source: ***https://www.tide-forecast.com/locations/Port-Blair-Andaman Islands/tides/latest***

6.0 Field Investigation

Field investigations were carried out during February 2022. HTL used in the approved ICRZ of Great Nicobar Island prepared as per ICRZ Notification, 2019 were verified in the field based on geomorphologic features and other features such as ESA, Beach, Seawall, Embankments, landward boundaries of Tidal flats etc. (MoEF & CC, 2019) using high precision Trimble GPS. An appraisal of existing land use/landform in the project area was also carried out.

7.0 Coastal Land use/Landcover

The land use of the proposed project area mainly consists of existing dense forest, habitation or settlement area, agricultural land, and associated facilities. Medium to fine grained sandy beaches along with dead coral and sheet rock exposure are seen along the cuspate beach side.

8.0 Island Coastal Regulation Zone Plan for the Proposed Holistic Development of Great Nicobar Island

Parts of the proposed Holistic Development Project activity starting from Ranganatha Bay and Campbell bay in the North East via Galathea Bay and Indira Point towards the South and upto Pemmaya Bay on the South West fall within the Island Coastal Regulation Zone of Great Nicobar Island in Union Territory of Andaman & Nicobar. The proposed project site is superimposed in 1:4000 Scale ICRZ map and it is shown in the Figure 2 Sheet Number 1 to 38. The ICRZ categories around the project area are ICRZ IA (Mangroves, 20m Mangrove Buffer Zone, Corals and Coral Reefs, Nesting Grounds of Birds, Biosphere Reserved Area, National Park and Protected Forest etc.), ICRZ IB (Intertidal Zone), CRZ III (No Development Zone and 50 to 100m from HTL), ICRZ IVA (Sea 12nm) and ICRZ IVB (River/Creek). The ICRZ 1:4000 scale map has been prepared in accordance with the ICRZ Notification, 2019 and approved ICRZ plan maps of Great Nicobar Island in Union Territory of Andaman & Nicobar. The proposed project site falls within the Sheets B 46 J 13/SW, B 46 J 13/SE, B 46 J 13/NW, B 46 J 13/NE, B 46 D 16/SW and B 46 D 16/SE and Map Numbers GN 01, GN 02, GN 04, GN 05, GN 07, and GN 08 of approved ICRZ Plan (Great Nicobar Island in Union Territory of Andaman & Nicobar) prepared as per ICRZ Notification, 2019. Sheet wise observation as follows: -

Figure 2: Sheet Number 1 (Mata Taruwa Beach, Great Nicobar)

Part of the proposed development activity viz., defense land falls within the ICRZ category of ICRZ IA (protected forest), and ICRZ IB (intertidal zone) and tribal reserve area.
Proposed coastal tourism area does not fall in any ICRZ Category (Refer Table 2).

Figure 2: Sheet Number 2 (Indira Point, Great Nicobar)

Part of the proposed activity viz., defense land falls within the ICRZ category of ICRZ IA (turtle nesting grounds and protected forest), ICRZ IB (intertidal zone), and ICRZ IVA (sea - 12nm) and tribal reserve area. Proposed Green area, Institutional area and Road (26m) does not fall in any ICRZ Category (Refer Table 2).

Figure 2: Sheet Number 3 (Indira Point, Great Nicobar)

The proposed development site does not fall any ICRZ category (Refer Table 2).

Figure 2: Sheet Number 4 (West of Indira Point, Great Nicobar)

Part of the proposed activity viz., defense land falls within the ICRZ category of ICRZ IA (protected forest), and ICRZ IB (intertidal zone) and tribal reserve area. Proposed coastal tourism and institutional area does not fall within any ICRZ Category. (Refer Table 2).

Figure 2: Sheet Number 5 (Chingenh and Dak Aleh, Great Nicobar)

Part of the proposed development activity viz., Road (26m) and Port falls within the ICRZ category of ICRZ IA (nesting ground of birds and protected forest), CRZ IB (intertidal zone) and tribal reserve area. Proposed defense land, green, coastal tourism, logistics and institutional does not fall within any ICRZ Category in this sheet. (Refer Table 2).

Figure 2: Sheet Number 6 (Galathea Bay, Great Nicobar)

Part of the proposed activity such as port and Port reclamation area falls within the ICRZ category of ICRZ IA (protected forest), ICRZ IB (intertidal zone) and ICRZ IV (waterbody) and tribal reserve area. Proposed green area does not fall within any ICRZ Category. (Refer Table 2).

Figure 2: Sheet Number 7 (Sarvekshak point and Sastri Nagar, Great Nicobar)

Some portion of the proposed development activities viz., port reclamation area, and port area falls within the ICRZ category of ICRZ IA (protected forest), ICRZ IB (intertidal zone), and ICRZ IV (waterbody) and tribal reserve area. Whereas, proposed airport area falls within the ICRZ category of ICRZ IA (protected forest and turtle nesting ground), ICRZ IB (intertidal zone), ICRZ III (NDZ and 50 to 100m from HTL) and ICRZ IVA (Sea - 12nm) and tribal reserve area. Proposed road (26m and 45m) does not fall within any ICRZ Category. (Refer Table 2).

Figure 2: Sheet Number 8 (Dak Ain and Inhenyolol, Great Nicobar)

Part of the proposed activities such as Road (18m and 26m), Logistics, Coastal Tourism and Medium Density Residential does not fall within any ICRZ Category in this sheet. (Refer Table 2).

Figure 2: Sheet Number 9 (Dak Air, Great Nicobar)

Some part of the proposed activity such as port falls within the ICRZ category of ICRZ IA (protected forest), ICRZ IB (intertidal zone) and tribal reserve area. Whereas, proposed road (26m and 55m), logistics, green, power plant, residential -medium density and coastal tourism does not fall within any ICRZ Category in this sheet. (Refer Table 2).

Figure 2: Sheet Number 10 (Galathea Bay, Great Nicobar)

Part of the proposed activities such as port area falls within the ICRZ category of ICRZ IA (turtle nesting grounds, nesting ground of birds, protected forest and biosphere reserved area), ICRZ IB (intertidal zone) and ICRZ IVB (creek/river). Proposed port reclamation area falls within the ICRZ category of ICRZ IA (turtle nesting grounds, and protected forest), ICRZ IB (Intertidal Zone) and ICRZ IV (waterbody) and tribal reserve area. Proposed Road (55m) falls within the ICRZ category of ICRZ IA (protected forest and biosphere reserved area), ICRZ IB (intertidal zone) and ICRZ IVB (creek/river). Other proposed activities such as Road (26m), power plant, green, and eco -tourism area does not fall within any ICRZ Category in this sheet. (Refer T able 2).

Figure 2: Sheet Number 11 (Gandhi Nagar and Sastri Nagar, Great Nicobar)

Some portion of the proposed activities such as airport area falls within the ICRZ category of ICRZ IA (protected forest and turtle nesting ground), ICRZ IB (intertidal zone), ICRZ III (NDZ and 50 to 100m from HTL) and ICRZ IVA (sea - 12nm) and tribal reserve area. Whereas, proposed reclamation area falls within the ICRZ category of ICRZ IA (protected forest and turtle nesting ground), ICRZ IB (intertidal zone), ICRZ III (NDZ) and ICRZ IV (waterbody)

and tribal reserve area. Proposed Road (45m) falls within the ICRZ category of ICRZ IB (Intertidal Zone), ICRZ III (NDZ) and Tribal reserve area. The proposed development activities such as port, residential - medium density area, eco -tourism area and road (55m, 26m and 18m) does not fall within any ICRZ Category. (Refer Table 2).

Figure 2: Sheet Number 12 (Gandhi Nagar, Great Nicobar)

Part of the proposed activity viz., airport area falls within the ICRZ category of ICRZ IA (turtle nesting grounds, and protected forest), ICRZ IB (intertidal zone), ICRZ III (NDZ and 50m to 100m from HTL) and ICRZ IVA (sea - 12nm) and tribal reserve area. (Refer Table 2).

Figure 2: Sheet Number 13 (Kokeon, Great Nicobar):

Some part of the proposed activities such as road (26m and 55m), residential -medium density, coastal tourism, logistics and green does not fall within any ICRZ Category in this sheet. (Refer Table 2).

Figure 2: Sheet Number 14 (Galathea National Park, Great Nicobar)

Proposed development activities viz., green, coastal tourism, and residential- medium density does not fall within any ICRZ Category in this sheet. (Refer Table 2).

Figure 2: Sheet Number 15 (Gandhi Nagar, Great Nicobar)

Some portion of proposed activities such as airport falls within the ICRZ category of ICRZ IA (turtle nesting grounds, and protected forest), ICRZ IB (intertidal zone), ICRZ III (NDZ and 50m to 100m from HTL) and ICRZ IVA (sea - 12nm) and tribal reserve area. Part of the proposed road (55m, 45m and 18m) falls within the ICRZ category of ICRZ IA (protected forest), ICRZ IB (intertidal zone), ICRZ III (NDZ) and tribal reserve area. Part of the proposed tourism & hospitality, and coastal tourism falls within the ICRZ category of ICRZ III (50m to 100m from HTL). Proposed residential -medium density, and eco –tourism does not fall within any ICRZ Category in this sheet. (Refer Table 2).

Figure 2: Sheet Number 16 (Laxmi Nagar, Great Nicobar)

Proposed eco-tourism activity does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 17 (Laxmi Nagar, Great Nicobar)

Some portion of the proposed development activities such as coastal tourism falls within the ICRZ category of ICRZ III (50m to 100m from HTL). Whereas, part of proposed road (18m) falls within the ICRZ category of ICRZ III (NDZ and 50m to 100m from HTL).

The proposed road (26m and 55m), commercial mixed use, green, residential - medium density, eco –tourism, tourism & hospitality and utilities does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 18 (Laxmi Nagar and Vijay Nagar, Great Nicobar)

Part of the proposed activities viz., road (55m) falls within the ICRZ category of ICRZ IA (protected forest), ICRZ IB (intertidal zone), and ICRZ IVB (river or creek). Part of proposed coastal tourism area falls within ICRZ category of ICRZ III (50m to 100m from HTL). Proposed road (18m and 26m), commercial mixed use, green, eco -tourism, residential mixed-use high density, residential -medium density, residential- low density and utilities does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 19 (Vijay Nagar, Great Nicobar)

Some portion of the proposed development activities viz., coastal tourism and eco – tourism falls within the ICRZ category of ICRZ III (50m to 100m from HTL). Whereas part of propose road (26m) falls within the ICRZ category of ICRZ III (NDZ and 50m to 100m from HTL). Proposed Commercial mixed use and utilities does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 20 (Joginder Nagar, Great Nicobar)

Proposed development activity such as eco-tourism does not fall in any ICRZ Category (Refer Table 2).

Figure 2: Sheet Number 21 (Joginder Nagar, Great Nicobar)

Proposed activities such as road (18m, 26m and 55m), commercial mixed use, green, residential- medium density, residential - low density, residential mixed high density and eco -tourism does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 22 (Dillon Point and Vijay Nagar, Great Nicobar)

Proposed development activities viz., road (18m and 26m), commercial mixed use, green, residential -medium density, residential mixed-use high density, coastal tourism, eco -tourism, and tourism & hospitality does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 23 (Rosen Point, Great Nicobar)

Proposed activities viz., road (26m), green and coastal tourism does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 24 (Joginder Nagar, Great Nicobar)

Proposed eco-tourism development activity does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 25 (Joginder Nagar and Govind Nagar, Great Nicobar)

Part of the proposed development activities viz., road (18m, 26m and 55m), green, commercial mixed use, residential -medium density, eco -tourism, institutional area and utilities does not fall in ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 26 (Chisen Point and Govind Nagar, Great Nicobar)

Proposed activities viz., road (18m and 26m), commercial mixed use, green, residential - medium density, eco –tourism and tourism & hospitality does not fall in ICRZ Category in this sheet(Refer Table 2).

Figure 2: Sheet Number 27 (Joginder Nagar, Great Nicobar)

Proposed development activities viz., green and eco-tourism does not fall in ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 28 (Govind Nagar, Great Nicobar)

Proposed Eco-Tourism development activity does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 29 (Govind Nagar, Great Nicobar)

Part of the proposed development activities such as road (55m) falls within the ICRZ category of ICRZ IA (mangroves, 20m mangrove buffer zone and protected forest), ICRZ IB (intertidal zone), ICRZ III (No Development Zone) and ICRZ IVB (river or creek).

Proposed road (18m and 26m), green, coastal tourism, eco –tourism, residential -medium density, institutional, residential mixed-use high density and utilities areas does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 30 (Govindnagar, Campbell Bay, Great Nicobar)

Part of the proposed development activities such as road (26m) falls within the ICRZ category of ICRZ III (NDZ) and ICRZ IB (intertidal zone). Proposed road (18m, 45m and 55m), green, coastal tourism, and residential- medium density, commercial mixed use, residential mixed-use high density, defence land, industrial, commercial office, utilities does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 31 (Campbell Bay, Koal-ta-pain, Great Nicobar)

Some portion of the proposed road (18m and 26m), falls within the ICRZ category of ICRZ III (NDZ). Whereas, proposed defence land falls within the ICRZ category of ICRZ IA (protected forest), ICRZ IB (intertidal zone), ICRZ III (NDZ and 50m to 100m from HTL), ICRZ IVA (sea - 12nm).

Proposed coastal tourism falls within the ICRZ category of ICRZ III (50m to 100m from HTL). Proposed residential mixed-use high density, commercial mixed use, industrial and helipad does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 32 (Campbell Bay, Great Nicobar)

Proposed eco-tourism activity does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 33 (Campbell Bay, Great Nicobar)

Proposed road (18m, 26m and 55m), coastal tourism, eco - tourism, tourism & hospitality, green, institutional, defence land, residential -medium density does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 34 (Tenlaa and Campbell Bay, Great Nicobar)

Some part of the proposed Development Activities viz., defence land falls within the ICRZ category of ICRZ IA (mangroves, 20m mangrove buffer zone, nesting ground of birds, and protected forest), ICRZ IB (intertidal zone), ICRZ IV (waterbody) and tribal reserve area. Part of proposed road (18m and 26m) falls within the ICRZ category of ICRZ IA (protected forest). Proposed coastal tourism, residential mixed-use high density, tourism & hospitality, green, commercial mixed use does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 35 (Campbell Bay, Great Nicobar)

proposed residential mixed-use high density does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 36 (Campbell Bay, Great Nicobar)

Proposed ecotourism activity does not fall in any ICRZ Category in this sheet (Refer Table 2).

Figure 2: Sheet Number 37 (Campbell Bay, Great Nicobar)

Some portion of the proposed road (55m) falls within the ICRZ category of ICRZ IA (protected forest). Proposed road (18m and 26m), coastal tourism, ecotourism, green, residential mixed-use high density, tourism and hospitability does not fall in any ICRZ Category in this sheet (Refer Table 2).

The Area (Area in Square Meter) of the Proposed Holistic Development Project Activity under the ICRZ categories - sheet wise is shown in the Table5.

Table 5: Sheet wise area statistics (sq m) of ICRZ categories

Sheet No.	ICRZ I		ICRZ III		ICRZ IVB
	ICRZ IA	ICRZ IB	NDZ	50 to 100m	
	Area in Square Meter				
1	2223037.17	924155.65	0.00	0.00	0.00
2	729115.50	642640.13	0.00	0.00	0.00
3	419614.25	0.00	0.00	0.00	0.00
4	3634723.71	772372.61	0.04	0.00	0.00
5	263287.87	479105.46	0.14	0.00	55694.30
6	66292.08	44286.16	0.04	0.00	0.00
7	2223367.33	140706.60	61235.55	64366.40	0.00
8	905171.09	1005305.22	0.31	0.00	575972.00
9	174956.04	91003.67	0.00	0.00	25503.53
10	2548358.69	470647.46	0.02	0.00	345760.72
11	171636.07	766333.09	279960.83	25746.38	465649.00
12	710248.13	35205.50	7198.01	2125.23	0.00
13	315866.27	657200.43	0.00	0.00	772417.00
14	2019795.82	0.00	0.00	0.00	0.00
15	921547.52	203943.27	239290.42	97728.45	0.00
16	0.00	0.00	0.00	0.00	0.00

17	566932.50	187948.20	271230.43	156315.54	19573.20
18	78916.40	497878.00	214490.32	13537.89	266581.90
19	3836427.28	245469.00	261745.00	143766.77	191697.00
20	0.00	0.00	0.00	0.00	0.00
21	3512.34	106725.40	62941.02	0.00	77986.70
22	2405166.09	548051.76	433396.34	0.00	583510.00
23	4662264.65	47234.40	0.49	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00
26	242149.49	109507.00	7024.37	0.00	0.00
27	2402060.84	28998.20	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00
29	191205.06	205842.34	56627.03	0.00	311228.01
30	86879.46	263641.20	182640.40	0.00	676959.31
31	4036641.58	140627.43	52334.86	28791.36	0.00
32	0.00	0.00	0.00	0.00	0.00
33	25931.51	45480.50	0.03	0.00	0.00
34	3711354.50	812854.08	2572.76	0.00	79985.28
35	5712951.31	23117.90	35.64	0.00	0.00
36	18538.49	0.00	0.00	0.00	0.00
37	1618204.81	20878.70	0.00	0.00	0.00
38	5391861.11	145748.00	0.00	0.00	0.00

A ICRZ map covering about 7 Km radius of the project site (figure 2 sheet no 1 to 6) representing ICRZ categories based on approved ICRZP is given in Figure 3.

11.0SUMMARY AND CONCLUSIONS

- The HTL, LTL and ICRZ categories are superimposed on 1:4000 scale cadastral maps with survey plot information (Refer Fig. 2).
- The HTL and LTL are demarcated from satellite images by taking into consideration different signatures such as boundaries of embankments, vegetation line etc and verified in the field observation.
- Part of the proposed project site starting from Ranganatha Bay and Campbell bay in the North East via Galathea Bay and Indira Point towards the South and upto Pemayya

Bay on the South West fall within the Island Coastal Regulation Zone of Great Nicobar Island in Union Territory of Andaman & Nicobar.

- The proposed project site is superimposed in 1:4000 scale ICRZ map and it is shown in the Figure 2 Sheet Number 1 to 38. The ICRZ categories within 7Km radius in and around the project area are shown in Figure 3. The Ecologically Sensitive Areas (ESAs) in and around the proposed project site are mangroves, 20m mangrove buffer zone, corals and coral reefs, nesting grounds of birds, biosphere reserved area, national park and protected forest. ICRZ classification of the proposed project site are ICRZ IA (ESAs), ICRZ IB (Intertidal Zone), CRZ III (no development zone and 50 to 100m from HTL), ICRZ IVA (sea 12nm) and ICRZ IVB (river/creek).

- The ICRZ of 1:4000 scale map is prepared in accordance with the ICRZ Notification, 2019 and approved ICRZ plan maps of Great Nicobar Island in Union Territory of Andaman & Nicobar as per ICRZ notification, 2019.

- Part of Proposed project activities such as defence land, airport, port, port reclamation area, reclamation area (airport), road fall under the ICRZ category of ICRZ IA, ICRZ IB, ICRZ III and ICRZ IV. Whereas, part of proposed tourism & hospitality, coastal tourism, eco-tourism falls within the ICRZ category of ICRZ III (50m to 100m from HTL).

- Proposed project activities such as commercial office, commercial mixed use, green, industrial, institutional, logistics, power plant, residential - low density, residential - medium density, residential - mixed use high density and utilities falls outside ICRZ area.

- The proposed holistic development project site falls within the Sheets B 46 J 13/SW, B 46 J 13/SE, B 46 J 13/NW, B 46 J 13/NE, B 46 D 16/SW and B 46 D 16/SE and Map Numbers GN 01, GN 02, GN 04, GN 05, GN 07, and GN 08 of approved ICRZ Plan (Great Nicobar Island in Union Territory of Andaman & Nicobar) prepared as per ICRZ Notification, 2019

REFERENCE

MoEF, 1991. Notification No.S.0114 dated 19th February, 1991, Ministry of Environment and Forest, Government of India, New Delhi.

MoEF, 1996. Letter No. Letter No. J-17011/8/95-IA-111, dated 27-9-1996 dated 27th September 1996 to the Chief Secretary, Govt. of Maharashtra. Ministry of Environment and Forest, Government of India, New Delhi.

MoEF, 2011. IPZ Notification No. S.O.20 (E) dated 19.2.1991, Ministry of Environment and Forest, Government of India, New Delhi.

MoEF, 2019. ICRZ Notification No. S.O.20 (E) dated 6.1.2011, Ministry of Environment and Forest, Government of India, New Delhi.

https://www.tide-forecast.com/locations/Port-Blair-Andaman Islands/tides/latest

PLATES

Plate1: Turtle Hatchery at Joginder Nagar Beach

Plate 2 : Joginder Nagar Beach

Plate 3 : Agricultural land

Plate 4 : Mangrove

plate 5 : Mangrove near Laxmi nagar

plate 6 : Existing Jetty at Nemo Beach

Plate 7 : Turtle Hatchery at Shastri nagar Beach

Plate 8 : Proposed airport site

Plate 9: Proposed port reclamation site near Galathea Bay

.

Plate 10: Beach at Galathea Bay

Plate 11: Turtle Hatchery at Galathea Bay

Plate 12: Road under construction by GRIF

Plate 13: Intertidal area

Plate 14: B-Quarry Beach

Details sought by EAC regarding Integrated development of International Container Transshipment Terminal (ICTT), Township & Area Development and Power Plant in Great Nicobar Island vide 297th meeting of Expert Appraisal Committee (EAC) held on 24th – 25thMay, 2022 at INDUS Conference hall in the Ministry of Environment, Forests & Climate Change (MoEF&CC), Indira Paryavaran Bhavan, New Delhi.

Response to3.1.24. EAC Observations

Township

EAC Observation (i)

Some of the township clusters seems to have several defence installations abutted by commercial and tourism infrastructure. It is not advisable considering strategic and safety requirements. Revised layout in this regard shall be submitted.

Response (i)

Suggestion/ opinion from Ministry of Defence will be sought to finalise the buffer zones around Defence land parcels. Specific requirement for buffers if any received from Ministry of Defence shall be incorporated in the Zonal plans of specific parcels at a later stage.

EAC Observation (ii)

Golf course will not be permitted considering extremely water intensive activity and also considering very high number of endemic species that inhibit GNI. It is misfit in the holistic vision for the island.

Response (ii)

Golf courses are now not proposed as any specific landuse in the master plan.

EAC Observation (iii)

Many parts of the proposed road are falling within the CRZ IA, CRZ IB yet no details have been given about the location and design of the road in such areas. Location of such parts of the road should be clearly spelt with undertaking that roads will be on stilt in such stretches. RoW of 55 meters has been proposed for the road which appears to be very wide even as per the standards fixed for National Highways and Expressways as per IRC guidelines of MoRTH. The Committee suggested that the width of RoW shall be revised in the master plan keeping the ROW not more than 30 m. Revised layout of master plan should be submitted after excluding such excess width of 25 meter which instead be kept and shown as green belt/ shelter belt without cutting existing trees on both side of road in revised layout.

Response (iii)

The observation related to road crossing CRZ IA and IB being on stilts has been incorporated in the master plan. All development within CRZ area shall be in compliance with ICRZ Notification 2019.

The North South road of 55m ROW is the main arterial road connecting different pockets of development across the master plan area. It also serves as the key connector between the development on the eastern and western side of the master plan area and serves the overall function of distributing traffic and enabling access. The 55m RoW has been envisaged as an urban arterial road and the proposed design for this road is in compliance with guidelines for Urban Roads.

A traffic modelling study was taken up for the proposed land-uses in the master plan and the area divided into Traffic Assessment Zones (TAZs). Based on the demarcation of Traffic Assessment Zones (TAZs) and the associated land uses related trip assignments have been studies with the maximum morning peak hour on the central arterial spine road as 3037 PCUs. To understand the capacity requirement based on the maximum PCUs, a volume/capacity analysis was done and a level of service (LOS) was established. Based on the analysis of the proposed network of roads, majority of the roads had an LoS of A, B and C thereby suggesting that the proposed roads were under stable traffic conditions.

LoS	V/C Ratio	Remarks
A	0.00-0.15	Free Flow
B	0.15-0.45	Reasonably Free flow
C	0.45-0.75	Stable Operation
D	0.75-0.85	Borderline Unstable
E	0.85-1.00	Extremely Unstable
F	>1.00	Breakdown

Table 1: Level of service of urban roads.

Accordingly, three categories of roads with varying RoW have been suggested.

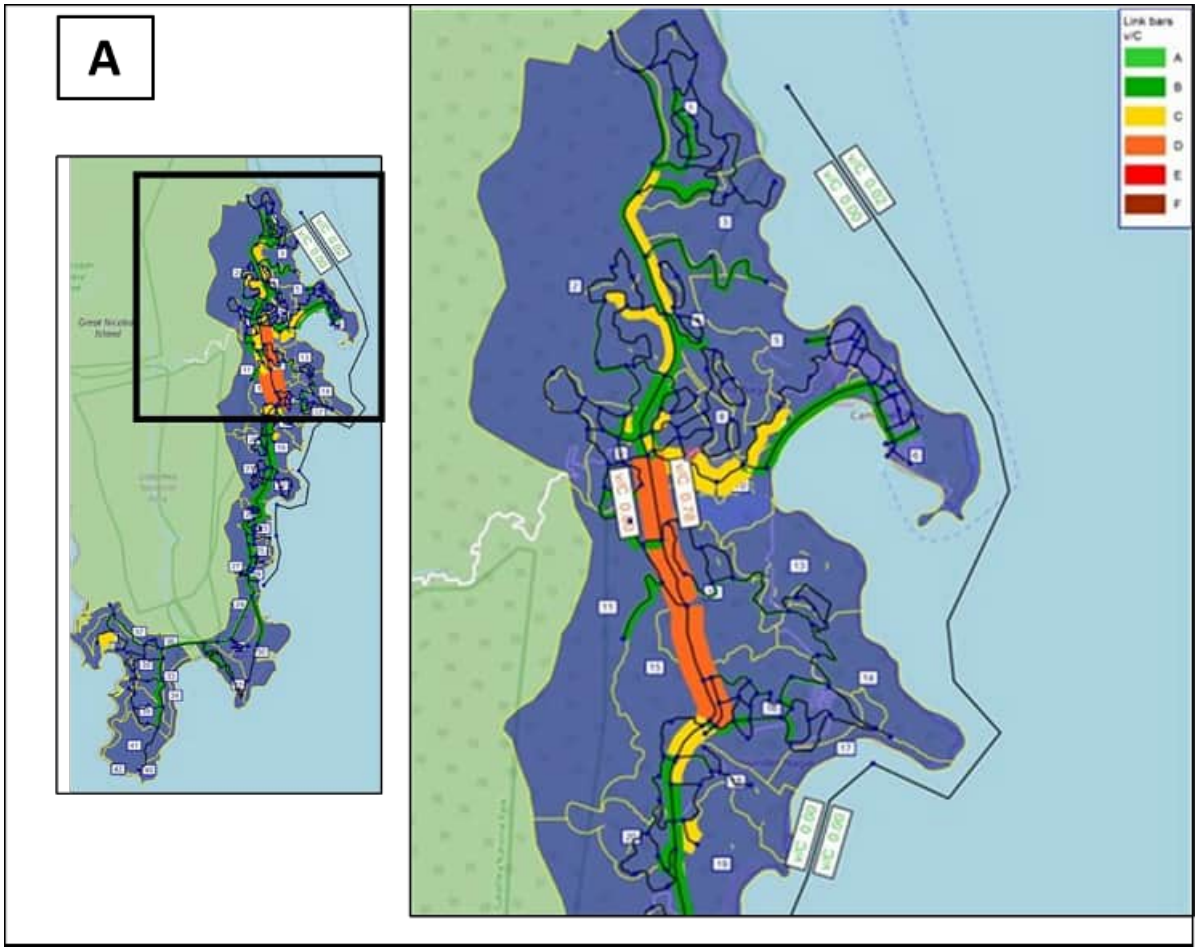
S. No	Name of the Road	Hierarchy	Configuration		
			Main carriageway	Service Road	Remarks
1	Spine Road	Arterial Road	4 Lane Divided Carriageway	7.0 m wide service road on either side	Provision of 11m space for future widening and a mass transit
2	30m RoW	Sub Arterial Road	4 Lane Divided Carriageway	-	-
3	18 m RoW	Collector Road	2 Lane undivided Carriageways	-	-

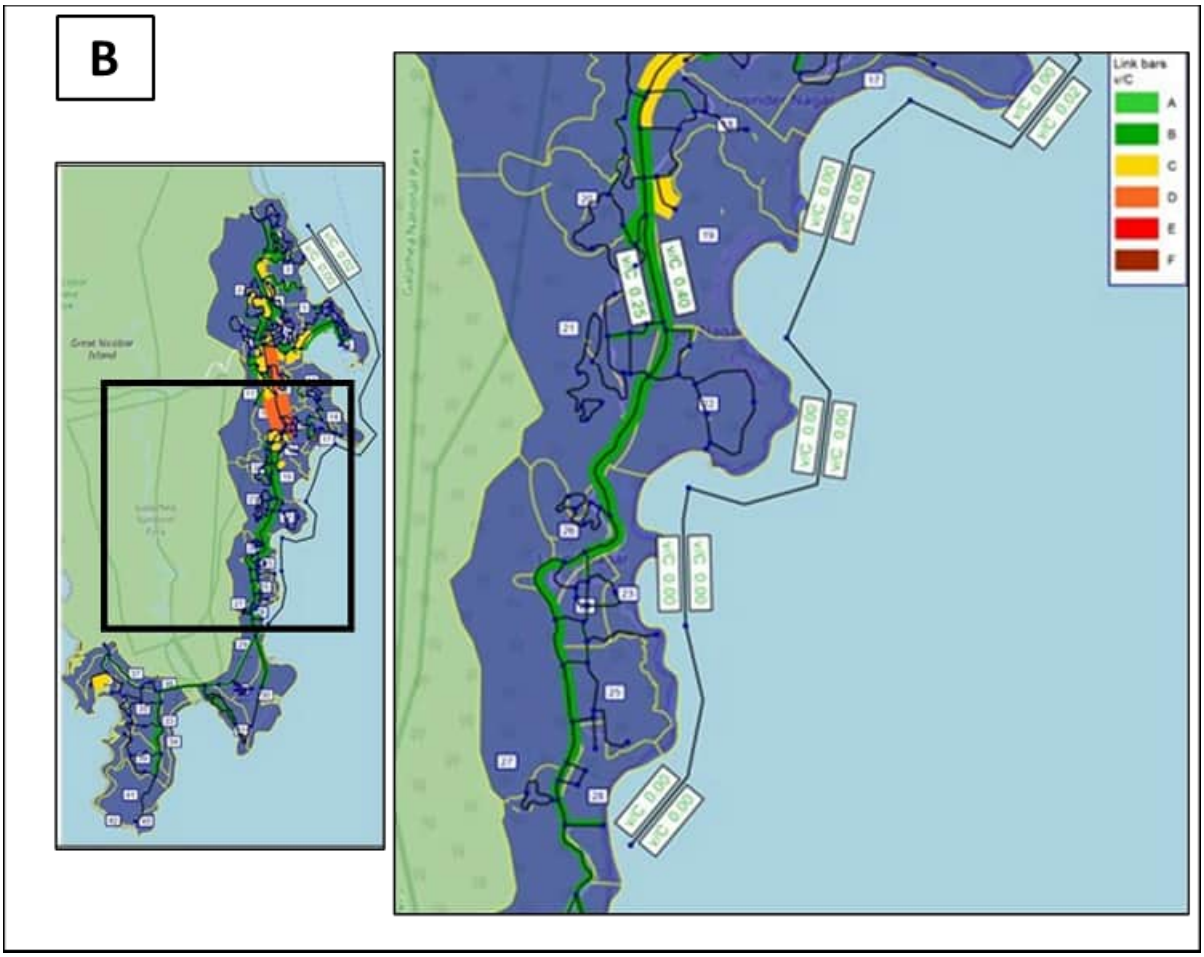
Table 2: Proposed road hierarchy and configuration.

From a sustainability perspective, it is essential to promote unhindered public transport (Battery operated buses, BRT/ LRT in the form of battery-operated Trams)on the island. An 11m dedicated corridor towards provision of public transport has hence been made an integral part of the 55m wide arterial road. The central location of the public transport corridor ensures future ease of access from either side of the road.

Based on the outcome of the modelling study, if the public transport allocation within the RoW is removed, it will result in traffic congestion. Refer the figure below for implication of not including the public transport.

To understand the sustainable mobility choice effects of the LRT/BRT on the spine road, capacity analysis of the road network in a non-mass transit scenario is also modelled using PTV Visum software. Results of the same are shown in figures A, B and C below.

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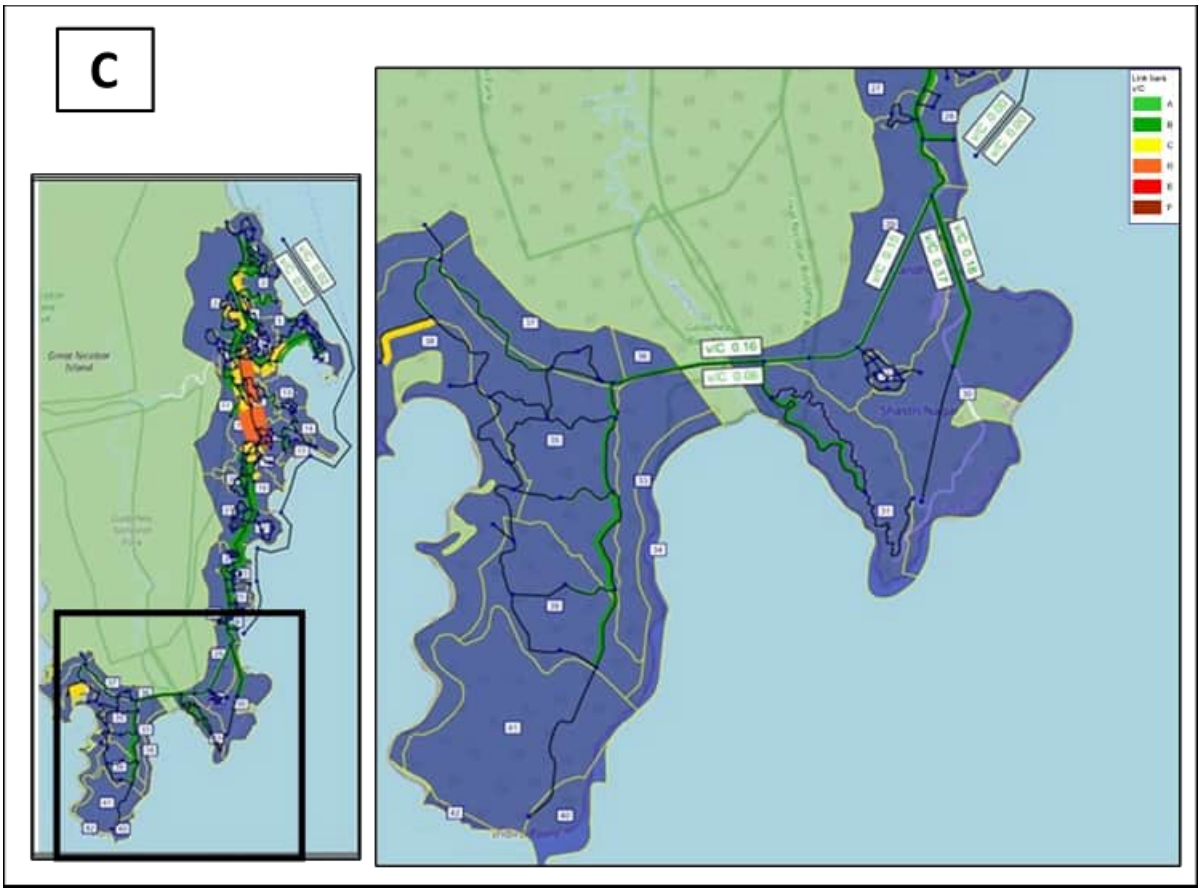


From the capacity analysis of non-mass transit scenario, it can be understood that in the absence of a transit on the main spine road, the level of service of the main spine road in the north of the development has dropped to a Level D and bordering on Level E. Hence, it can be inferred that presence of LRT/BRT on the main spine shall have positive results in terms of alleviating congestion and seamless mobility of the people of the Greater Nicobar Island.

Until such time that the dedicated public transport is introduced, the 11m corridor within the centre of the 55m RoW will be maintained as a green corridor.

In order to promote safety on the arterial, service roads have been introduced with 2-way movement on either side within the 55m RoW to enable safe and unhindered traffic flows. The 55 m arterial also includes dedicated cycle tracks and pedestrian footpaths for low-carbon NMV movement.

The 55 m arterial road serves multiple functions enabling movements through different modes of transport including non-motorised transport i.e. cycles as well as pedestrians. Since the public transport in future is expected to be a dedicated public transport it will promote sustainable and green development. The dedicated public transport would result in minimizing localized air pollution. Stations for public transport also enable opportunities for safe crossing of pedestrians. Further, the requirement of RoW may be looked at from the prospective of future growth of the township and an anticipated growth in the floating population due to increased activities including tourism resulting in an increase in the number of vehicles on the road. Hence, 55 metres RoW proposed in the Master Plan needs to be retained/approved.

Best Practices Case Study:

Bogota, Columbia – Successful implementation of Bus Rapid Transit (BRT) system.

The 'TransMilenio' Bus Rapid Transit (BRT) system in the city of Bogota, Colombia provides residents with efficient and safe mass transit that encourages high ridership.

TransMilenio is based on high-capacity buses operating on dedicated bus lanes on trunk routes, being supplied with passengers by feeder buses that connect residential areas to BRT bus stops. From **the initial 41km of bus lanes** completed in 2000 to the expansion to 207km in 2015, the TransMilenio system has become the largest BRT in the world.

Bogotá lies in central Colombia and is 2,640 metres about sea level in the Northern Andes Mountains. It is the capital and largest city of Colombia and the educational, cultural, commercial, administrative, financial, and political center. Bogotá is a territorial entity and has the same administrative status as the Departments of Colombia.

TransMilenio is a sustainable mass urban transport system based on a BRT scheme. The objectives of the project are:

- improve the public transport system with respect to accessibility, efficiency, safety, speed, convenience and comfort ensuring high ridership
- restrict private automobile use
- expand and improve bicycle paths
- enhance public space
- reduce air pollution and greenhouse gas emissions

The BRT provides a variety of benefits to the city of Bogota and its residents:

- improved fuel efficiency per passenger due to new and larger buses. The reduced transport times, along with increased safety, reliability and comfort attract many car and taxi drivers to the new system, which in turn leads to an improved traffic flow in the city.
  environmental benefits in the form of reduced GHG and other air pollutant emissions (CO_2, PM and NOx). From 2013 to 2019, the annual average estimated reduction of CO_2 emissions amounts to 5,78,918 tCO_2eq which is equivalent to the emissions of around 1,23,174 cars per year. Furthermore, a reduced number of vehicles in the city leads to less noise pollution.
- the social well-being of residents has increased as a result of less time spent in congestion, less respiratory diseases, less noise pollution and fewer accidents per passenger transported.

- in the areas where TransMilenio operates, there has been a reduction of 92% in road related deaths, 75% in injuries and 79% in collisions. Robberies at bus stops have been reduced by 83%.
- approximately 1,500 temporary jobs are created during the construction period.

Encouraged by the successful implementation of TransMilenio in Bogota, the government of Colombia embarked on a major program to replicate similar systems in other Colombian cities. **The project has been successfully replicated in the cities of Pereira and Cali**. **The TransMilenio model can be successfully scaled down and adapted to metropolitan areas of less than 1 million inhabitants while the performance and economic viability of the bus system remains unaffected.**

(Source- https://use.metropolis.org/case-studies/transmilenio-bus-rapid-transit-system#casestudydetail)

EAC Observation (iv):

Over 50 Km of low-lying coastal area of the eastern side of the GNI is now being developed in the form of township and port as well as power plants which will obstruct the forest-sea shore- forest movement of several animals like Robber or Coconut Crab and birds, especially coastal birds like megapod. However, no provision for forest- sea shore wildlife corridors have been kept in the Master Plan Therefore, there is a need to revise the master plan layout keeping natural forest corridor between Campbell Bay / Galathea NPs and seashore of at least 300-500-meter width generally at every 3 km interval. Such corridors shall be excluded from project area. Location of such corridors shall be identified in consultation with ANFD. Roads crossing such wildlife/ animal corridors shall have animal underpasses in the form of elevated roads or animal over bridges depending upon the terrain. No provision for canopy bridges for road crossing by Nicobar Long-tailed Macaque, Nicobar tree shrew and other arboreal animal as well as passages for like crocodiles, crabs, frogs, snakes and other amphibians/reptiles are made. Same need to be made in road design. Such provision shall be made in road design and revised layout of the masterplan generally at every 2 Km interval between green belt on both sides of roads as per WII guidelines and in consultation with SFD. Provide chainage wise details of canopy crossings and underpasses as mentioned above.

Response (iv):

Safe wildlife corridors at eight (8) locations along the eastern side of the island connecting forest and seashore through via-ducts (elevated crossings) on the north south arterial road have been proposed and incorporated in the master plan. In addition to wildlife corridors, number of culverts and canopy crossings will be provided at appropriate locations and the same will be incorporated in the detailed engineering design for movement of wildlife. The locations of the proposed wildlife corridors i.e. via ducts have been selected based on the ground situation and input provided by ZSI and Department of Environment & Forest. The width of the corridor ranges from 250 m to 1100 m and the eastern side of the corridors towards the seashore would be maintained as green area.

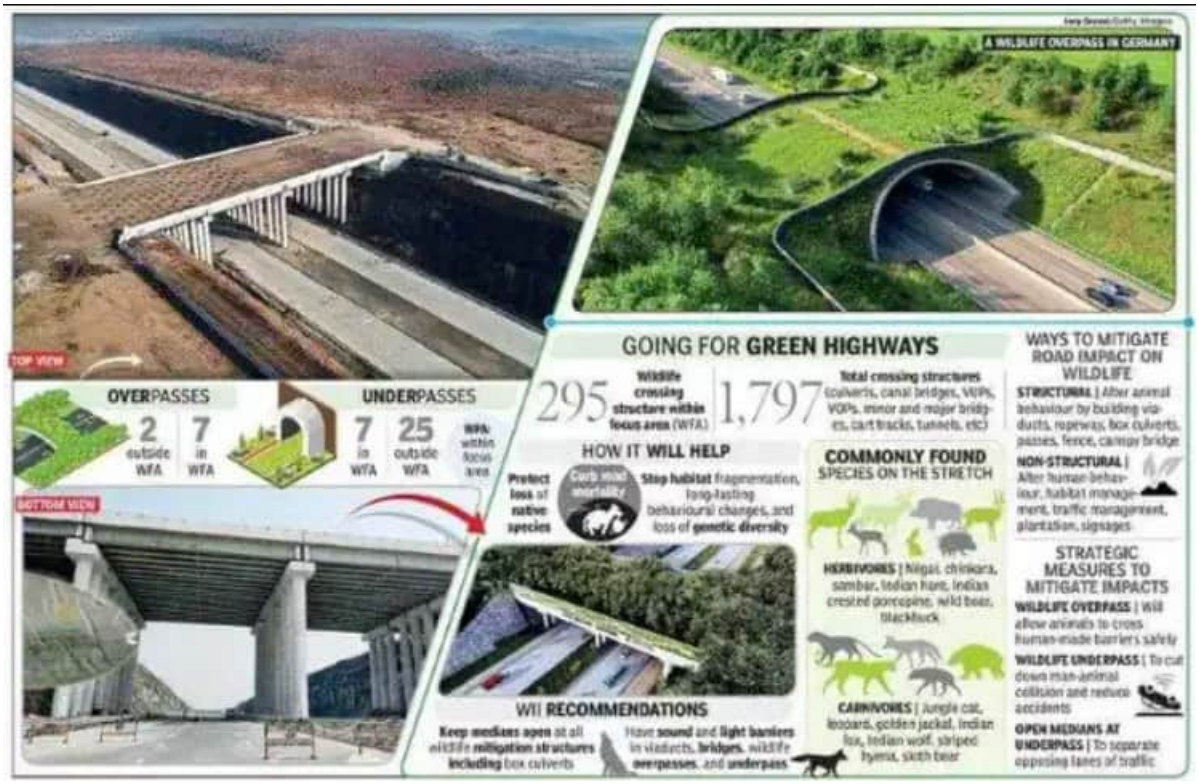
Best Practices

Case Study 1: Mumbai-Nagpur Expressway, Maharashtra, India – provision of animal crossing corridors.

The Balasaheb Thackeray Samruddhi Mahamarg (expressway) between Nagpur and Mumbai will be the first highway in the country where nine green bridges (overpasses) and 17 underpasses for wild animal movement are being constructed as part of mitigation measures.

Also, all along the highway, leopard-proof fences will also be constructed so that the animal doesn't jump over on to the 701 km expressway which will see vehicles plying at speed upto 150 kmph. **The 120-meter wide road runs through 10 districts of Maharashtra and will cut the travel time from 16 to 8 hours.**

Of this 701 km, 117 km passes through wildlife habitats, tiger corridors, and eco-sensitive zone (ESZ) of three sanctuaries – Tansa, (corridor of Harishchandragadh sanctuary), katepurna, and Karanja Sohol called as wildlife focused area (WFA).



(Source: [First in country: A flyover for animals on Mumbai-Nagpur highway | Nagpur News - Times of India (indiatimes.com)](#)).

Case Study 2: Santa Monica mountains, California, USA –Wallis Annenberg wildlife crossing (Under construction as per below information).

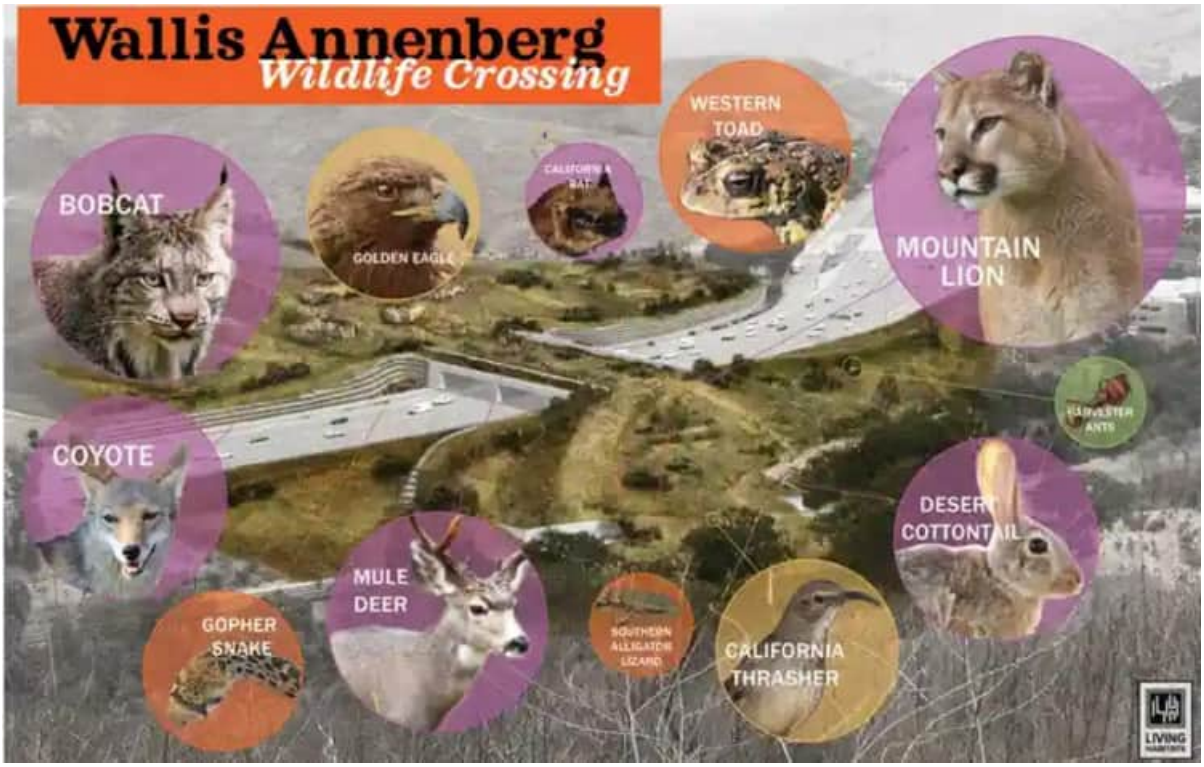
The Wallis Annenberg Wildlife Crossing is a project comprising a green bridge built across the 101 highway near Los Angeles, creating a corridor between two parts of the Santa Monica mountains. Stretching 210 ft long and 165 ft wide, the overpass will allow safe passage for lizards, snakes, toads and mountain lions, with an acre of local plants on either side and vegetated sound walls to dampen light and noise for nocturnal animals as they slip across.

The project, nearly a decade in the making, comes at a crucial time. Highways in this car-heavy landscape crisscross critical habitat for the protected mountain lions and other animals, forcing them to make what can be deadly crossings. At least 25 of the big cats have been killed on Los Angeles freeways since 2002. The latest death was just weeks ago, on 23 March, when a young lion was struck and killed on the Pacific Coast highway.

The project is breaking the mold in many ways: not only is it the largest crossing in the world, stretching over 10 lanes of one of the busiest roadways in the country, but it's also an engineering marvel. The crossing is designed to seamlessly integrate into the mountains, offering big cats, coyotes, deer, lizards, snakes and other creatures a safe way to travel to different parts of open territory in the Santa Monica mountains recreation area – a 150,000-acre space.

The scientists say there is a learning curve for animals, and they will slowly begin to explore the bridge. For wary creatures, it may take up to five years to use the crossing successfully. Cats will follow smaller prey species, who generally more quickly adapt to the new territory.

The stretch of Highway 101 where groundbreaking was set to begin in April 2022. Photograph: John Antczak/ AP.



A rendering of the wildlife bridge crossing, which will feature native plants and vegetated walls. Photograph: AP

Some of the species that are expected to use the wildlife bridge. Photograph: Living Habitats and National Wildlife Federation.

(Source: [Animal crossing: world's biggest wildlife bridge comes to California highway | Wildlife | The Guardian]).

EAC Observation (v)

It is observed by the Committee that the building components do not have detailed information like waste management plan, its size and management, built-up area, amenities, water requirement, waste-water treatment etc. The Committee therefore suggested that a detailed plan for Phase-I may be submitted at this stage which shall have all details specifically for Phase-I. Broad plan for the other phases of the building component may also be submitted along with the detailed Phase-I plan.

Response (v):

Following is the phase wise break-up of the anticipated waste generated in the development.

Source of Waste	Phase-I	Phase-II	Phase-III
Domestic	26.5 MT	67 MT	68.5 MT
Commercial/institutional	3.5 MT	15 MT	15 MT

Integrated Waste Management Facility for GNI

The Solid Waste Management System and hazardous wastes treatment system in the Centralized Solid Waste Management Facility(CSWMF) has been described in detail in section 2.7.4 of the EIA report. The gists of the CSWM system are as under:

a. Door to door collection and transportation system will be implemented. All the waste material will be collected, segregated and transported to CSWM facility. However, individual projects like Airport, Port, Power Plant and Township will have its own collection system and the collected waste will be transported to the CSWM facility for treatment and disposal.

b. The CSWM facility will have the following:

   i. Collection center to store the waste for 7 days.

   ii. Waste segregation facility to segregate recyclable wastes like bottles, cans and plastic. The segregation plant will be semi-automatic with conveyers, magnetic and air separation and storage facility.

   iii. Modular Bio-methanation Plant.

   iv. Bottling Plant to capture the methane from the bio-methanation plant.

   v. Though no hazardous industries are envisaged, hazardous wastes like used oil, batteries, paints, lubricant wastes etc. would be generated.

   vi. A Double Chamber incinerator with wet scrubber and built-in emission monitoring system. The incinerator will have facility to incinerate liquid and solid wastes including plastics. The incinerator will have a capacity of about 1 TPH and will be operated when the waste quantity is available.

   vii. All e-waste including batteries will be transported back to mainland through authorized vendors and shall be disposed as per the guidelines of Ministry of Environment, Forest and Climate Change.

c. The recyclable wastes viz. plastic, bottles, cans, cardboards, wood, etc. will be sold to local approved recyclers. SPV will make it operational thru its own resources.

d. After construction, it is expected that many construction scraps will be left at the site. The contract with the construction companies will stipulate strict compliance to the removal of scraps. Stringent provisions shall be made in the contract agreements for removal of all kinds of scrap from the island post completion of work. The scraps will be taken to a scrap management facility either in Port Blair or to the mainland India for proper disposal.

e. Chance of spill of substances like diesel, solvents, etc. cannot be ruled out during transportation and transfers. Spillage of any substance will be remediated immediately as per the Dutch Standards (Dutch Target and Intervention Values, 2000, https://www.esdat.net/environmental%20standards/dutch/annexs_i2000dutch%20environmental%20standards.pdf).

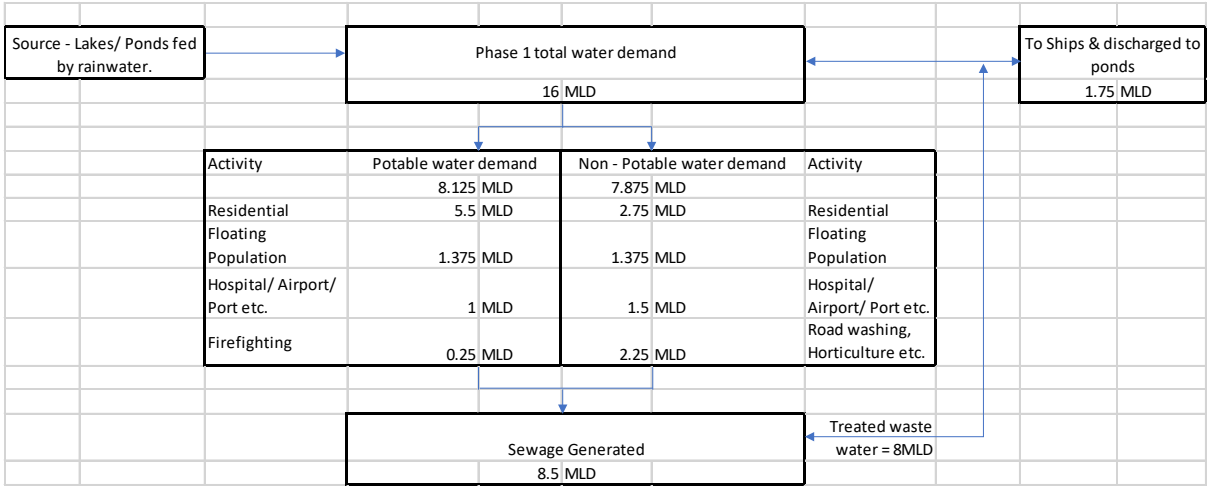
f. Waste management including collection, segregation, transportation and disposal will be done as per the provisions contained in Solid Waste Management Rules, 2016, Hazardous and Other Waste (Management & Transboundary, Movement) Rules, 2016, Construction and Demolition Waste Management Rule, 2016, Biomedical Waste (Management & Handing) Rule, 2016 and Battery Waste Management Rules, 2016 and as per guidelines issued by Govt. of India and the UT Administration from time to time.

Water Demand:

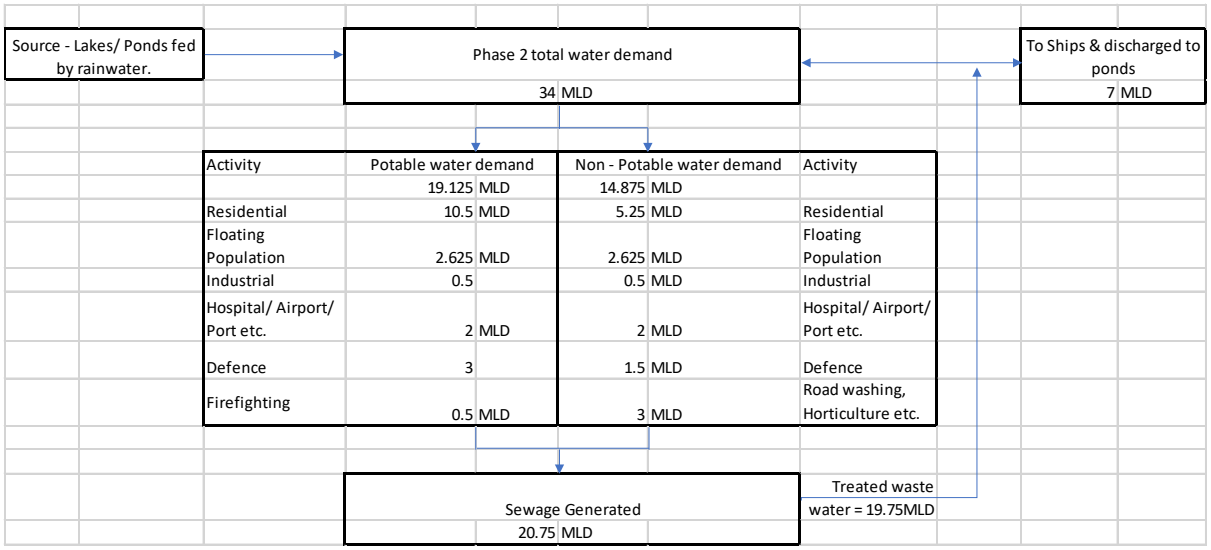
The water demand for phases 1,2 and 3 has been estimated and accordingly a water balance has been established. For the phase wise development, the water will be sourced from the proposed reservoir at two (2) locations identified on the eastern side of GNI within the development area identified.

Also, at present there is about 0.7 MLD water supply operational on the island against the similar demand. The existing resource will be augmented to a capacity of approximately 2.5 MLD to take care of construction and construction labour requirements till the time the reservoir supply is operationalised. In addition, rain water harvesting will be made mandatory for conserving and use of rain water on the buildings and other structures.

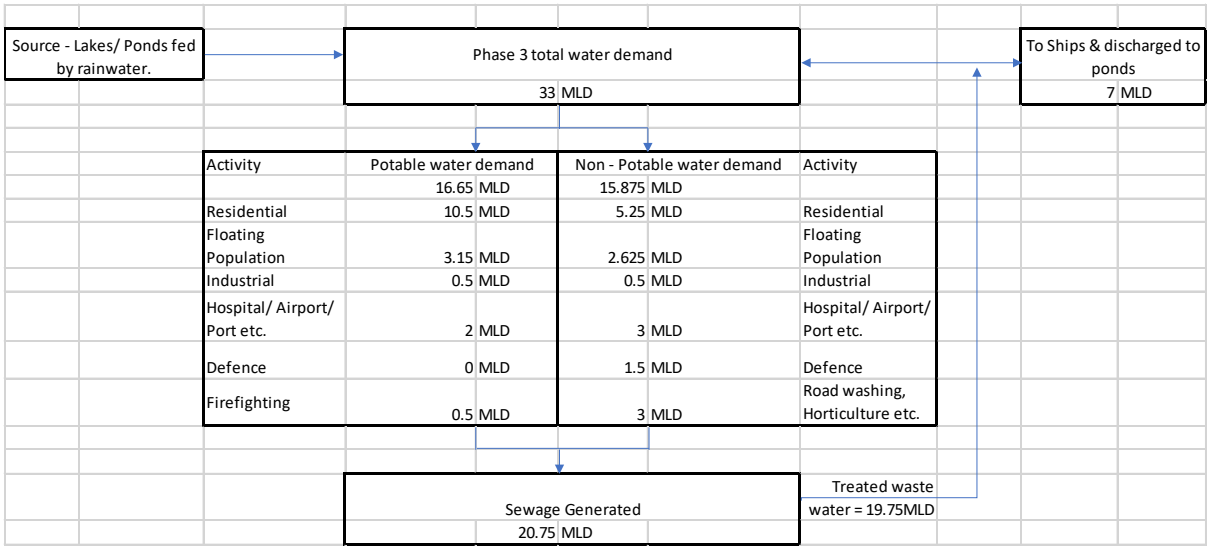
Following is the phase -1 water balance – Water demand and re-cycled water generated.



Following is the phase -2 water balance – Water demand and re-cycled water generated.



Following is the phase -3 water balance – Water demand and re-cycled water generated.



EAC Observation (vi):

Considering above observations, revised plan for township be submitted.

Response (vi):

Updated Landuse Plan enclosed. **Refer Enclosure 2.**

Revised landuse distribution.

LANDUSE	Phase I (Area in Sq.km.)	Phase II (Area in Sq.km.)	Phase III (Area in Sq.km.)	Total (Area in Sq.km.)
Airport	8.45	0.00	0.00	8.45
ICTT	4.50	2.42	0.00	6.92
Power Plant	0.39	0.00	0.00	0.39
Residential	6.78	6.45	3.39	16.62
Commercial- Mixed Use	1.59	1.08	1.85	4.51
Commercial- Office	0.18	0.00	0.00	0.18
Commercial- Tourism & Hospitality	2.53	2.48	0.01	5.01
Commerical- Coastal Tourism	1.31	2.16	4.72	8.19
Institutional	1.26	4.52	0.00	5.77
Industrial & Logistics	0.13	4.68	0.07	4.88
Eco-Tourism	16.51	10.62	13.42	40.55
Green and Recreational	9.56	10.92	3.39	23.87
Utilities-Others	0.13	0.21	0.08	0.42
Utilities-Water Reservoir	1.27	1.30	0.00	2.57
Jetty	0.10	0.00	0.00	0.10
Defence land	12.61	0.00	0.00	12.61
Special Use (Defence Purpose)	0.43	0.00	0.00	0.43
Special Use (National Memorial)	0.08	0.00	0.00	0.08
Special Use (Pemayya Buffer Area)	0.00	0.69	3.83	4.52
Coastal Regulatory Zone (CRZ)	4.39	6.82	8.81	20.02
Grand Total	**72.20**	**54.34**	**39.56**	**166.10**

Commercial- Tourism and Hospitality:

Walkable commercial development at the edge of town centres, with access to the sea and the forest. The anticipated permissible development will be Hotel, Food & beverage, Entertainment, Retail, MICE (Convention Centres, etc.), Staff housing etc

Commercial- Coastal Tourism:

The band of land at the coast after the CRZ area to give an additional protection to the cost from development activities whihc combines conservation areas with low-impact tourism development such as resorts, cabanas and elevated structures. The anticipated permissible development are resorts, sports, Recreation, Low-impact hotel and entertainment

Eco-Tourism:

Vertical development limited to Welcome Centre, museum or other facility. Vehicular access to facility. Walking paths in forest.

Eco-Tourism - It is also proposed to develop approximately 4055 ha. of area buffering the Ecological Sensitive Zone of National Parks from the proposed development as green areas with provision of Eco Tourism Activities. This will be predominantly part of Green area within the overall development. There will be minimal alteration to the natural terrain and ecology of the area and only eco tourism activities shall be permitted within this landuse. Infrastructure development required to support the proposed township development shall be permitted within the Eco Tourism areas. The anticipated permissible development are Museum, Cultural Centre, Camping etc.

Green, Parks and Recreational:

Open spaces, Natural parks at all scales, Recreational facilities etc The anticipated permissible development are Regional park, Nature reserves, Local park, Playground, Sports fields / facilities, entertinament, sports etc.

ICTT

EAC Observation (vii):

Considering the fact that due to ICTT construction in Galathea Bay, township development and other development activities as part of integrated development of Great Nicobar Islands the movement of Leatherback turtles as well as Nicobar Megapods and their nesting is likely to be disturbed and therefore the turtles and Nicobar Megapod birds are likely to shift their nesting sites in nearby western coast of the GNI and other areas. Though Andaman and Nicobar administration has declared some of the islands as WLS in Little Andaman and other places for Leatherback turtles and Nicobar Megapods yet considering the Pemayya Bay, Casuarina Bay and Alexandria Bay as established sites for Leatherback and Nicobar Megapod nesting are potential site for developing them as Wildlife Sanctuaries/ Conservation Reserve in to additional legal protection for these species. All the areas except the area proposed for defense purpose in western coast of GNI including Pemayya and Casuarina Bay shall be excluded from the master plan as stated in the previous meeting observations as well.

Response (vii):

1. Nesting beaches management and protection of nests

In GNI nesting of leatherback turtles have been reported in East of Indira point, West of Indira Point, Koshindon, Laxmi Nagar, North of Alexandria, South of Alexandria, North of Dogmar, South of Dogmar, Pulo Bed, Pulo Kunji, re Pinsuot, Renhong, Safed Balu, Patatiyo and South of Galathea besides Galathea bay.

All major nesting beaches in Great Nicobar Islands including Alexandria bay, Casuarina bay, Pemaya bay, Dogmar will be protected by establishing protection camp and kept under 24X7 surveillance and monitoring. Sufficient manpower will be deployed during nesting season for round the clock protection of all major nesting beaches. Hatcheries will be established in each of the nesting beaches to improve the survival rates of the hatchlings. Hatcheries will be established to support the main method of conservation and will be used alongside other conservation measures. Beach patrolling, clear demarcation of nests and providing protective fencing around the nests will be done to avoid predation.

Through effective protection and hatchery management, the survival rate of the hatchlings will be improved to 80-90%. The hatchlings so reared in the hatcheries will be released back into the sea as per standard procedures. The Department is having adequate expertise in management of turtle nesting beaches and hatcheries management. Efforts are on to establish the camps during October this year in all the major nesting beaches in GNI. Hatcheries will be managed by a qualified and experienced frontline staff of the department who has an expertise in turtle conservation. Capacity building programmes will be organised on regular basis for the frontline staff and employees involved in turtle conservation.

A detailed monitoring and evaluation system will be put in place by the department as that of Curthbert Bay in Middle Andaman to ensure that the hatchery is effective. Data on the number of nests and eggs, and the percentage of eggs that hatch successfully will be maintained as part of the hatchery management.

In addition to the nesting beaches in Great Nicobar Island, protection camps will also be established in nesting beaches of Little Nicobar, Kamorta, Katchal and Nancowry and necessary

care will be taken to protect the nests from the predators and hatcheries will also be established to improve the survival of hatchlings.

Sufficient fund provision has been kept under EMP for conservation of leatherback turtles and other sea turtles and management of nesting beaches. Further, the Administration, through the UT plan scheme will also take up turtle conservation programmes in other parts of the islands including the Andaman group of islands.

2. Effective measures proposed under the Leather Back Conservation plan are::

i. Systematically monitor the nesting population of Leatherback and other sea turtles in the Nicobar group of Islands.
ii. Track fine-scale movements and migration of Leatherback turtles and other sea turtle species to identify critical nearshore areas, inter-rookery movement or use of nesting beaches in the Nicobar group of islands.
iii. Conduct stable isotope studies of leatherback sea turtles to understand the factors affecting reproductive output and remigration intervals.
iv. Identify the genetic population structure of leatherback sea turtles from the Andaman & Nicobar Islands and assess their relatedness to populations of other RMUs.
v. Characterize all nesting beaches along with threat assessments and guide management to strategies protection measures (eg. establishing PA network, development of hatchery management guidelines, etc.) for critical nesting beaches considering futuristic scenarios.
vi. Conduct training workshops and awareness programs for forest personnel and local communities to develop their capacity in turtle population monitoring, habitat management, nest protection and hatchery management practices.
vii. Collection of extensive information on population and nesting ecology of leatherback turtles and other turtles of the Nicobar Islands
viii. Insights on the fine-scale movements, site-fidelity to nesting beaches, high use areas, inter-nesting intervals, and migration corridors of turtles of the Nicobar Islands will be generated.
ix. Information on the non-breeding regions and foraging areas of sea turtles, specifically of the threatened leatherback turtle will be established.
x. Information on the genetic identity of the leatherback turtle populations of the Nicobar Islands that represent the Northeast Indian Ocean RMU will be generated.
xi. List of priority nesting sites of each of the sea turtle species of the Nicobar Islands will be generated. Further, information on the vulnerability of these priority turtle nesting sites due to various influencing factors will be generated.
xii. Site-specific management interventions for the long-term conservation of sea turtles is developed and will include guidelines for legal protection measures (eg. Establishment of Protected Area Network) to offset population declines in sites with high development pressure.
xiii. Local communities, forest personnel and other stake holders will be made aware about sea turtles and their significance in marine ecosystems.
xiv. Capacity development programmes for the forest personnel and local communities to systematically monitor nesting turtle populations, manage nesting habitats and training to develop turtle hatcheries.

3. Declaration of new wildlife sanctuary;

Already 3 new wildlife sanctuaries have been identified at Little Nicobar, Menchal and Meroe Islands for conservation and protection of Leatherback turtles, Megapode and Corals respectively and intention notifications for declaration of wildlife sanctuaries have already been issued for the same. **Refer Enclosure 3**.

Status of the notification for new Wildlife Sanctuaries

- 21.03.2022 – Ministry of Home Affairs (MHA) accorded approval for new wildlife sanctuaries to be created. These include the following –

  a. Leatherback turtle sanctuary of 13.75 sq.km at Little Nicobar Island
  b. The entire Menchal Island of 1.29 sq.km as a Megapode Sanctuary.
  c. The entire Meroe Island of 2.73 sq.km as a Coral Sanctuary.

- 21.04.2022 – Intention notification issued for leatherback turtles, Megapode & Corals.

- 18.05.2022 – Proclamation has been issued on by Deputy Commissioner (Nicobars) inviting claims and objections to settle their rights.

DC (Nicobar) vide order no. 123 dated 19.07.2022 stated that there no person has any rights within the limits of proposed three wildlife sanctuaries. Based on the said order, the process of issuing final notification has been initiated.

4. Protection of Pemayya Bay

In case of Pemayya Bay, a buffer of 500 mts from the HTL around Pemayya Bay has been demarcated as special use area for Costal Protection and no development activities have been proposed in the buffer area of Pemayya Bay and the area will be kept as green and shall restrict any activity which may impact protection of Leatherback turtles in the area. **Refer Enclosure 4.**

5. Additional beaches identified for leather Back conservation and protection

Further, areas namely Alexandria Bay and Casuarina Bay are located far away and fall outside the project area on the western coast. All these areas including Pemayya Bay have been made part of the leatherback conservation plan. Also, the Pemayya Bay, Alexandria Bay, Casuarina Bay and other potential leatherback turtle nesting sites such as Nanjappa Bay, Dogmar, Pulo Bed, Pulokunji, etc. have been included as part of Leatherback turtle conservation plan. As such, adequate measures have been proposed for protection of nesting beaches and sea turtles including leatherback turtles.

Since effective measures have been proposed for conservation of turtles and their nesting beaches in Great Nicobar Island besides declaration of leatherback turtle sanctuary and protection of nesting beaches in other islands of Nicobar group and Little Andaman, declaration of further WLS in GNI is not proposed.

EAC Observation (viii):

PP shall clearly demarcate the proposed dredging area, avoiding the dredging activity in Rocky areas to avoid any type of Disaster risk. The same shall be submitted to the Ministry.

Response (viii):

As per the available information, the area proposed for dredging does not have sea-bed rock. Dredging will be confined within the blue highlighted area as shown in the map below:

Figure Limits of the dredging confined to the blue highlighted area

EAC Observation (ix):

Though attempt have been made to mitigate the impact of ship movement on the movement of turtles to and from nesting sites in western flank of the Galatea Bay by way of providing isolated breakwater yet it may not be very useful because ship movement inside the port boundary beyond breakwaters may discourage the turtles to enter in the bay for nesting in western flank. However, if an undisturbed channel is created for turtle movements by way of extending the western breakwater between port area and western flank there may be some possibility of turtles approaching the western flank of the Bay. The same shall be explored and submitted to the Ministry.

Response (ix):

All necessary mitigation measures and conservation strategies have already been included in the EMP. Extending the breakwater further towards Galathea river will have an adverse impact on the shore line of the western flank of Galathea Bay. This may cause erosion to the beach and will severely impact the turtle nesting areas. It is thus not recommended to extend the breakwater towards the mouth of Galathea river.

Further, ships operation at the port in Galathea Bay shall abide by the MARPOL Convention and the relevant Annexes related to pollution, namely the following –

- Annex I: Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)
- Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)
- Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992)
- Annex IV: Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003)
- Annex V: Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988)
- Annex VI: Prevention of Air Pollution from Ships (entered into force 19 May 2005)

It is proposed that the Port operator will prepare an oil spill prevention, control, and counter measure plan which will be consistent with the IMO Manual on Oil Pollution Section II – Contingency Planning. All the ship related waste with a potential to cause pollution to the marine environment will be disposed according to the guidelines stipulated by the MARPOL Convention.

(Source: International Convention for the Prevention of Pollution from Ships (MARPOL) (imo.org)).

EAC Observation (x):

Though many parts of the proposed master plan for port falling within CRZ IA and CRZ IB (Viz area B, C, D etc) are proposed to be eliminated from master plan yet the revised layout map of the project after excluding such areas have not been submitted.

Response (x):

The areas highlighted in the observation (x) above have been removed from the proposed port plan. **Refer Enclosure 5.**

EAC Observation (xi):

Wildlife Institute of India (who have done sea turtle monitoring and satellite tracking across parts of India for several decades) should submit detail road map with financial requirement for monitoring Leatherback Turtle movement through satellite tracking in GNI and habitat restoration & nest protection measures at all other nesting sites in A & N for minimum 10 years.

Response (xi):

WII has prepared the plan for Conservation and long-term monitoring of Sea Turtles of the Nicobar Islands with special focus on the Leatherback Sea Turtle for a period of 10 years primarily aimed at conservation of leatherback turtles and other sea turtles in Great Nicobar Islands and other islands in Nicobar group.

The conservation plan will be implemented in two phases and will involve intensive efforts to systematically monitor nesting beaches and at the same time involve extensive use of technology to understand the turtles in the offshore environment.

Phase I will involve the following activities –

a. Population monitoring and nesting ecology
b. Movement Ecology: tracking movements, identification of high use areas in the breeding sites and non-breeding regions
c. Determining foraging areas using stable isotopes
d. Population genetic structure of leatherback turtles
e. Assessing vulnerability of turtle nesting beaches and adoption of appropriate management strategies
f. Multi-stakeholder involvement in the long-term conservation of sea turtles

The Phase II of this conservation plan will focus mostly on building up the scientific knowledge gained from Phase I and incorporate these findings in developing effective site-specific actions for the conservation of sea turtles.

The activities listed are proposed to be taken up during the Phase II-

a. Annual population assessment surveys as per the standardized protocol developed during Phase 1.
b. Implementation of site-specific nesting habitat management interventions such as removal of dune vegetation and explore possibility of thinning tree or shrub cover in the immediate vicinity of nesting beach.
c. Implement measures to control introduced predators to eliminate or reduce sea turtle nest predation.

d. Development of site-specific nesting beach management plans
e. Strengthening the research wing of the forest department by conducting special training programs on using advanced scientific tools for data collection and analysis.

The budget requirement for the proposed 10-year Sea Turtle Conservation Plan for the Nicobar Islands is INR 29.83 Crores where INR 20.88 Crores for WII and INR 8.95 Crores for A&N Forest Department for its implementation in two phases. Refer Enclosure 15 for details of the 'Conservation and long-term monitoring plan'.

EAC Observation (xii):

SACON is requested to submit Nicobar Megapod monitoring and conservation plan for minimum 10 years.

Response (xii):

As desired by EAC under conclusion and recommendation, the SACON/WII were asked to submit a Monitoring and conservation Plan for a minimum period of ten years and both the institutions have been asked to submit a joint proposal for monitoring and conservation plan for Nicobar megapode for ten years. They have also been requested to take on board any scientists or organisations working on this particular species at present or in the past, in the interest of conservation of the said species and its habitat. However, in spite of our efforts to get a proposal jointly from WII/SACON, both the institutions have submitted a separate proposal.

The Conservation and monitoring plan submitted by WII focuses on the standardisation of population estimation techniques for Nicobar megapode across its distributional range to understand population trend of the species over time (long-term), role of habitat features in structuring megapode populations within and across islands, nesting patterns of the Nicobar Megapodes across ecological gradients and document potential factors that influence their reproductive success, fine-scale movements and ranging patterns of Nicobar Megapodes within and across islands using advance technology, investigate dispersal, colonisation and meta-population dynamics of Nicobar Megapode populations across the islands, threat assessments to the Megapode populations due to natural and anthropogenic drivers through vulnerability and risk mapping and create awareness among local communities on the Nicobar Megapode and assist in the identification and establishment of Conservation Areas and conduct capacity-building programs for local stakeholders for effective conservation of Nicobar Megapodes. The expected outcome of the implementation conservation and monitoring in next 10 years will provide population estimation of Nicobar Megapode and population trend across all the Islands on an annual basis, standardised protocol for long-term population monitoring, habitat and diet requirement of Nicobar Megapode, baseline information on the breeding strategies, breeding success, and nest site preferences of Nicobar Megapode, the genetic diversity and genetically distinct populations, magnitude of genetic flow and dispersal within and between Islands, habitat suitability models developed considering current drivers and future scenarios, risk assessment and vulnerability mapping with regard to various drivers, identified sites for establishing conservation reserves for in-situ conservation, and capacity developed among front-line forest staff on population monitoring techniques, data collection and compilation. The budget requirement of Rs. 22.02 crores is projected for implementation of the plan in next 10 years.

The SACON submitted a comprehensive conservation plan for nicobar megapode and the proposed plan focuses on standardised population monitoring protocol, distribution of the Nicobar megapode, Spatio-temporal monitoring, identification of the critical breeding habitats, study the breeding ecology to strategies for future interventions, monitoring of the movement pattern, landscape level habitat use, dispersal ability, and colonization, genetic diversity, assessment of the threats to

Nicobar megapode to provide site/island-specific interventions, development and implementation of a participatory conservation model through capacity building and awareness, development and implementation of a relocation and captive management plan for the Nicobar megapode population in the proposed project site. The budget requirement for the proposed Comprehensive Plan for Nicobar Megapode Conservation in the Nicobar Archipelago is INR 18.21 Crores for its implementation in two phases.

Since WII has been identified as a scientific agency to prepare and implement conservation plans for leatherback turtles and saltwater crocodiles and to have proper coordination in the field, it is suggested that WII may include SACON and implement the conservation plan. Coordinated and collaborative research will have better outcome and in the larger interest of the endemic species of Nicobar megapode, WII may co opt SACON in implementation of the plan. They can also include institutions like ZSI as ZSI has worked on the species in the recent past and have come out with the mapping of the megapode mounds in Great Nicobar Island.

Refer Enclosure 16 A Comprehensive conservation plan –Long term monitoring and conservation of the endemic Nicobar Megapode in the Nicobar Archipelago submitted by WII, Dehra Dun.

Refet Encloser 16 B ‘Comprehensive Plan for Nicobar Megapode Conservation in the Nicobar Archipelago’ submitted by SACON, Coimbatore.

Gas-based power plant

EAC Observation (xiii):

The clarity on power demand for phase 1 to be estimated and based on that gas/solar based power generation to be proposed. The numbers are to be quantified.

Response (xiii):

The Phase-I power demand is estimated to be 106 MVA. Of which 40 MVA is to be supplied through DG sets.

Source wise split for power demand of Phase – I.

Sl. No.	Source wise split	Split of overall power demand
1	DG Sets	40 MVA
2	Additional through Solar	20 MVA
3	Balanced Gas based	46 MVA
	Total for Phase - 1	**106 MVA**

About 20% of the demand will be met through Solar power for Phase-I. (This shall have a construction time frame 12-18 Months). Area for solar plant will be about 100 acres.It is suggested to use pond/reservoir area to utilization. Balance shall be gas for Phase-I &other phases.

For storage of diesel required for DG Sets in Phase-1, the existing diesel storage facility has been examined and found that there is no additional capacity for further storage. **Refer Enclosure 6.** Further, a letter by the A&N Administration, Office of the Deputy Commissioner/ Nicobar District, dated 4th September 2021, stating that an area of four(4) hectares recorded in favour of Andaman Harbour Works is unutilized and could be resumed by conducting a proper survey for early process of allotment of land to IOCL in a proposal shape. **Refer Enclosure 7A.** See figure below for location and coordinates of the site. Refer **Enclosure 7B** for risk assessment of the proposed HSD storage site.

EAC Observation (xiv):

Oil spills are not modelled. Diesel/LNG is required for Power Plant. Impacts of accidental oil spill etc shall be submitted.

Response (xiv):

The demand for oil has been estimated to be 7,000 KL per month. This would require smaller vessels to transport Diesel. In case of an accident, the spill quantity is likely to be small. The oil spill contingency plan for GNI which is in accordance with "A&NI Disaster Management Plan 2016, is adequate to take care of any spill events. Summary of the oil spill contingency are mentioned below, however, for the detailed oil spill contingency plan, refer **Enclosure8**.

Summary of oil spill contingency plan based on the MARPOL Convention.

The size, location and timing of an oil spill are both unpredictable and varied. Oil spill risks and the responses they require are classified according to the size of spill and its proximity to the operating facilities leading to the concept of 'tiered Response' to oil spills.

Tiered response area categorised as:

Tier 1 – Local or can be handled with the available resources

Tier 2 – Regional or which requires additional resource other than the locally available resources

Tier 3 – National / International or which require additional support of expert team and larger resources

Tier 1: response capability for dealing with spills arising out of bunkering operations at a jetty, anchorage, or moorings; grounding / collision of cargo ships. The personnel and equipment with response capability aimed at quickly containing and, if possible, recovering the spilt oil, are to be made available to respond immediately to an 'on-site' incident. In other words, Tier I is site-specific, and vessels are expected to be able to provide a clearly identifiable first response to pollution incidents for which they are responsible. The management of an oil spill would require rapid assessment of the spill and the mobilization of appropriate response resources. Establishing a comprehensive response plan with clear channel of communication between those responsible for on-site action group and crisis management team is a pre-requisite to a well-coordinated response.

Tier 2: provides to increase response capacity or to introduce more specialist technical expertise compared to the Tier 1. However, a given operation in a remote location with poor logistical links is likely to require greater Tier 1 and 2 capabilities compared to similar operations in areas that are easier to access. Great Nicobar Island is isolated location and away from the mainland. In this case Great Nicobar Island must have capability to handle the oil spill at tire 2 level.

Tier 3: spills were classified as those that, due to their scale and likelihood to cause major consequences, call for substantial further resources from a range of national and international sources. However, at the initial stage of the project the existing facility at Chennai or Vishakhapatnam Port may be utilised for Tier 2 & Tier 3. Same shall be established with a contract agreement with these port authorities.

Resources / Tier	Tier 1	Tier 2	Tier 3
Responders	Trained response staff on-site and available for emergencies in addition to their normal duties. Local contractors trained in oil spill response.	Dedicated response staff and additional responders. Locally sourced workforce may be supervised by the Tier 2 provider.	Dedicated response staff equipped with specialized skills. Tier 3 responders integrate with local and Tier 2 responders at all levels, including the incident management structure.
Equipment	On-site or locally available arrangements in place for rapid and effective mobilization. Amount and type of equipment is commensurate with risk, including location factors (e.g. weather, seasonality or logistical constraints due to remote geographies). Deployment times and methodologies) are often predetermined. Supporting logistics provided.	Tier 1 resources used to mount initial response and industry's response toolbox, including: ▪ Surface dispersant capabilities; ▪ At-sea containment and recovery equipment; ▪ Protection booms; ▪ Shoreline and inland clean-up equipment; ▪ Recovered oil storage ▪ capabilities. Amount and type appropriate for potential scenarios.	Tier 1 and Tier 2 resources used to mount an initial response and industry's response toolbox, including: ▪ High-volume aerial, surface and subsea dispersant capabilities; ▪ Large-scale containment and recovery equipment; ▪ Protection booms; ▪ In-situ burning capabilities; ▪ Specialized shoreline and inland clean-up equipment; ▪ Logistics capabilities. Amount and type appropriate for
Additional Resources	Some elements of Tier 1 capability may not be kept permanently onsite, but are readily available at the time of need, such as: ▪ Non-specialized equipment such as waste skips, storage trucks, personnel transport, etc.; ▪ Support/infrastructure elements such as additional security, accommodations, etc.; ▪ Technical advice and/or specialized resources.	Designated oil spill response cooperatives. Specialized Tier 3 services. Cooperation at the local/regional government level. Network of additional responders.	Dedicated industry Tier 3 response centres. Governmental or cooperative Tier 3 capabilities. Network of additional expert responders.

EAC Observation (xv):

Regarding the proposed Power Plant, the Committee proposed that Gas-Based power plant may take time to commission, therefore an alternate plan for the power supply and the location of such temporary plant may be submitted.

Response (xv):

Till such time that the proposed gas-based power plant is commissioned, the power demand for the construction phase will be met through DG sets. As per information available, the existing HSD storage facilities do not have any spare capacity. Accordingly, a four (4) ha. Site has been identified and coordinates provided. The proposed land identified for HSD storage is revenue land and close to the existing jetty in Campbell Bay. Within this site, a storage facility of at least 7,000 KL/month HSD for ~40 MVA power generation will be provided. See figure below for location and coordinates of the site.

Enclosure 7B for risk assessment of the proposed HSD storage site.

EAC Observation (xvi):

PP should carry out load carrying capacity in addition the location of FSRU (LNG) as to why it needs to be on the western bay. Committee asked to explore having Gas-based power plants on the eastern part of GNI instead of at Galathea Bay.

Response (xvi):

The proposed location was finalised after conducting detailed assessment of 3 alternate sites which were filtered using environmental and technical parameters forsiting the proposed power plant.

The alternative sites were examined for the development of the Power Project facilities for selection of the most suitable site based on the multicriteria analysis which include the following criteria:

- Fuel supply source and transportation
- Equitable growth of different areas
- Proximity of shipping routes especially for the site under question
- Open, level and well drained site.
- Environmental concerns, such as National Parks, Tribal areas etc.
- Earthwork Economics
- Connectivity, access to population centres; existing roads vis a vis new developments/ alignment.
- Storage space of fuel
- CRZ etc.

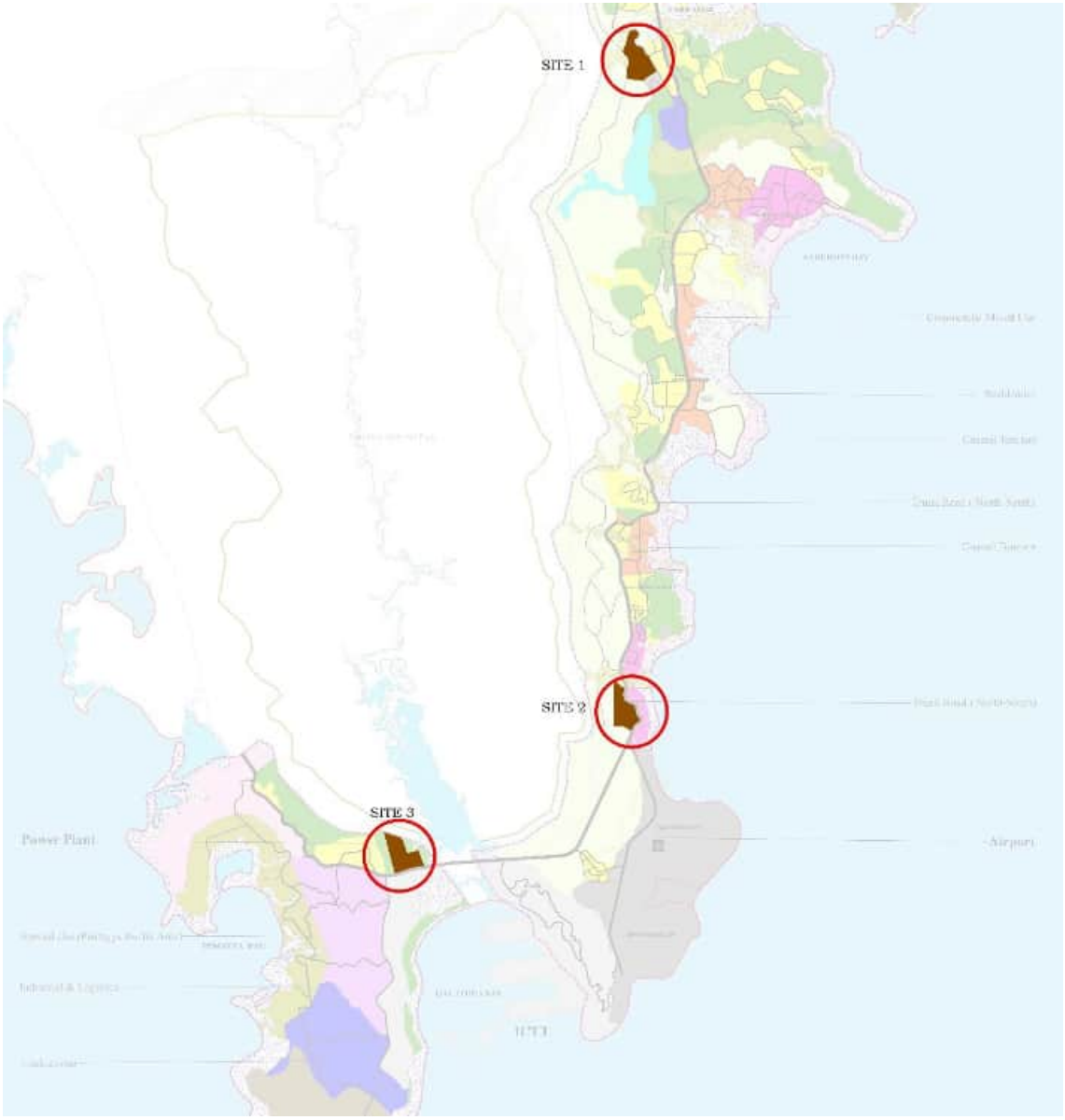
Based on the parameters three sites were assessed for suitability. These include the following:

- **Alternative Site 1 – Near Campbell Bay**
  Proposed site falls near the Campbell bay with the vicinity of INS BAZZ airstrip, permanent settlements and habitation. The proposed location has densely populated development and defence land. It is in a highly restricted zone. The site is coming close to the revenue land; hence the land cost shall be high. The cost of transportation of fuel (gas and fuel) shall also be expensive, as it is at far distance from the proposed Trans-shipment terminal, hence generation cost shall be on higher side.

- **Alternative Site 2 – Near Shastri Nagar**
  Proposed site falls near the Shastri Nagar residential area with the vicinity existing settlements and habitation. The proposed location is under densely populated development and shall have influence on population from the view of environment sustainability. The site is coming near the revenue land, so the land cost is high and transportation of fuel (gas and fuel) from long distance shall also be expensive, hence generation cost shall be on higher side.

- **Alternative Site 3 – Near Proposed Trans-shipment Terminal**
  This site is located near the southern tip of the Great Nicobar Island near to the Proposed Trans-shipment Port Terminal. The Proposed Site is not habituated and has no streams/ ponds. The Land cost and transportation of fuel (gas and fuel) shall also be cheaper comparison to other sites; hence generation cost would be cheaper.

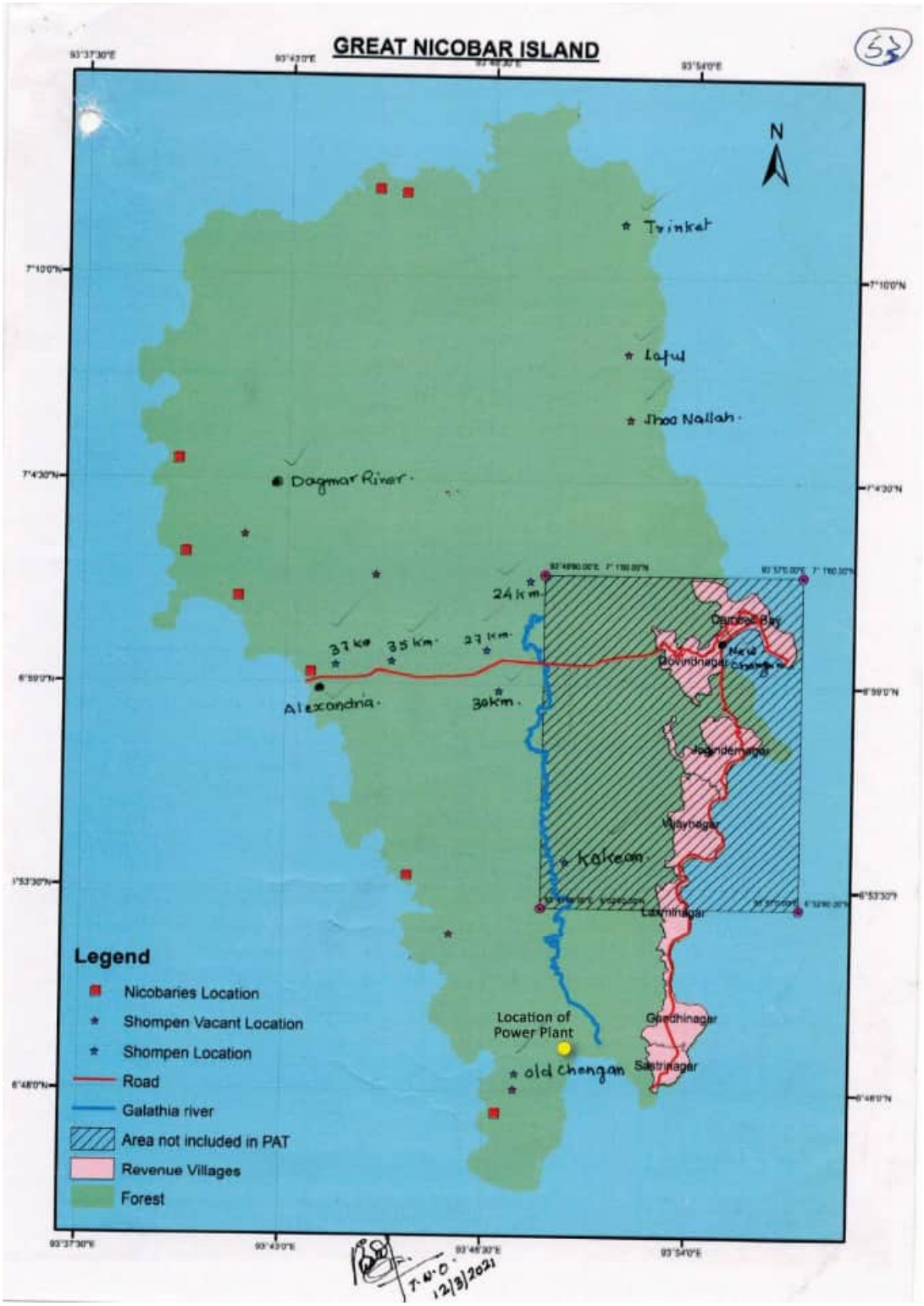
Above three alternative sites were examined for the proposed LNG and Diesel Based power plant. The alternate sites for Power Plant are shown in Figure below.



Based on assessment of all three sites, the present location was found to be most suitable from an environment, ecological and economic perspective. Proposing power plant away from Port is not technically and environmentally feasible and may have a severe impact on the rest of the development. It is thus recommended to consider the site as per granted TOR.

It is hereby clarified that there is no land acquisition involved in the proposed power plant site as it is not within the revenue area. Further, the site is away from Galathea river and its associated CRZ areas and is not near any of the Shompen Habitats identified till date (map below shows the location of tribal habitat within Great Nicobar Island). The proposed site is not within any national park, or any of the eco sensitive areas.

The below map illustrates location of Aboriginal tribes as identified on the island. The proposed location of Power Plant site is not overlapping with any Shompain or Nicobaries habitats. The Old Chingen village which was rehabilitated after Tsunami of 2004 is not in the vicinity of proposed power plant site and is approximately 2 kms south of power plant site.



EAC Observation (xvii):

No details are available on what will be the alternate source of fuel for power till such time LNG facilities are commissioned. A detailed "plan of action" on how they plan to meet the power demands for the construction phase of ICTT, Airport etc to be provided. Committee felt that ideally, they should use the existing HSD storage facility (may be with enhanced storage) instead of creating a new one.

Response (xvii):

Till such time that the proposed gas-based power plant is commissioned, the power demand for the construction phase as well as initial days of operational Phase shall be met through DG sets. As per information available, the existing HSD storage facilities do not have any spare capacity. Accordingly, a four (4) ha. Site has been identified and coordinates provided. Within this site, a storage facility of at least 7,000 KL HSD for ~40 MVA power generation through DG sets will be provided. See figure below for location and coordinates of the site.

It is proposed to install 1st turbine for Power Plant by end of year 5 which is also the year of commissioning of Phase I of ICTT.

Phase	Year	Power Demand (MVA)	DG Capacity installed (MVA)	Gas Capacity installed (MVA)	Solar Capacity Installed (MVA)	Total installed capacity (MVA)
Phase I	1	2	5	0	0	5
	5	35	40	50	0#	90

 # though the floating solar power plant will be commissioned by end of year 5 but can be operationalised from Phase II onwards.

Gas is the cleanest source of energy being proposed for this development. Government will ensure uninterrupted gas supply for continuous functioning of this power plant.

India strives for increasing the share of natural gas to 15% by 2030 from 6.5% at present. Government is also working actively on regulatory and policy interventions to facilitate the growth of the natural gas market in the country. India is committed towards smooth transition and promoting the green economy with the greater role of natural gas. There are major projects being proposed for Natural gas infrastructure developments, including liquefied natural gas (LNG) importing terminals, cross-country natural gas pipelines network, LNG tankers, refueling stations, and city gas distribution (CGD) network. India being a natural gas deficient country, all efforts by Government of India area being made to improve gas import infrastructure. Proactive measures by the government and its agencies will boost investment to create the desired infrastructure for achieving higher natural gas penetration in India (Sinha, 2022).The government's progressive policies including viability gap funding for cross-country pipeline and promotion of LNG/hydrogen-CNG as transport fuels will spur natural gas market developments. Additionally, the government is committed to removing the bottlenecks to enhance penetration of natural in the country. Natural gas will play a critical role in developing India's green economy.

In addition, all efforts will be made in future to increase the share of renewable energy including wind, solar and other source of energy to meet the overall demand for GNI development .

EAC Observation (xviii):

With regards to Solar power the land requirement for installation of solar panels needs to be highlighted.

Response (xviii):

In Phase I, the Solar Plant of 20 MVA capacity is proposed to be constructed over the water reservoir on an area of 0.5 Sq.km.

For Phase-II and III the balance 80 MVA is also proposed over the water reservoirs on an area of about 1.75 sq km.

Total Power Demand and supply through various options is as below:

Phase	Year	Power Demand (MVA)	DG Capacity installed (MVA)	Gas Capacity installed (MVA)	Solar Capacity Installed (MVA)	Total installed capacity (MVA)
Phase I	1	2	5	0	0	5
	5	35	40	50	0#	90
Phase II	10	106	40	100	20	160
	15	181	0*	150	70	220
Phase III	20	253	0*	250	100	350
	25	293	0*	300	100	400
	30	350	0*	300	100	400

* *though there will be a backup power of 40 MVA installed capacity available through DG's but it shall only be used as contingency power.*

\# *though the floating solar power plant will be commissioned by end of year 5 in Phase I, but can be operationalised from Phase II onwards.*

i. The above table states, the source of power planned to meet the power demand against the respective year/phase. Since the proposed development being a greenfield development, and the gas-based power plant construction and commissioning is linked to Port, which is also a green field development, therefore in the initial phase of development, the power demand shall be meet through DG sets. DG sets are planned for about 40 MVA), which shall suffice for 3-5 initial years. These shall keep on operating till the other sources such gas based power plant and solar power plants are operational.

ii. The First phase of Gas based power plant shall be operational by end of 5th Year in line with commissioning of Port.

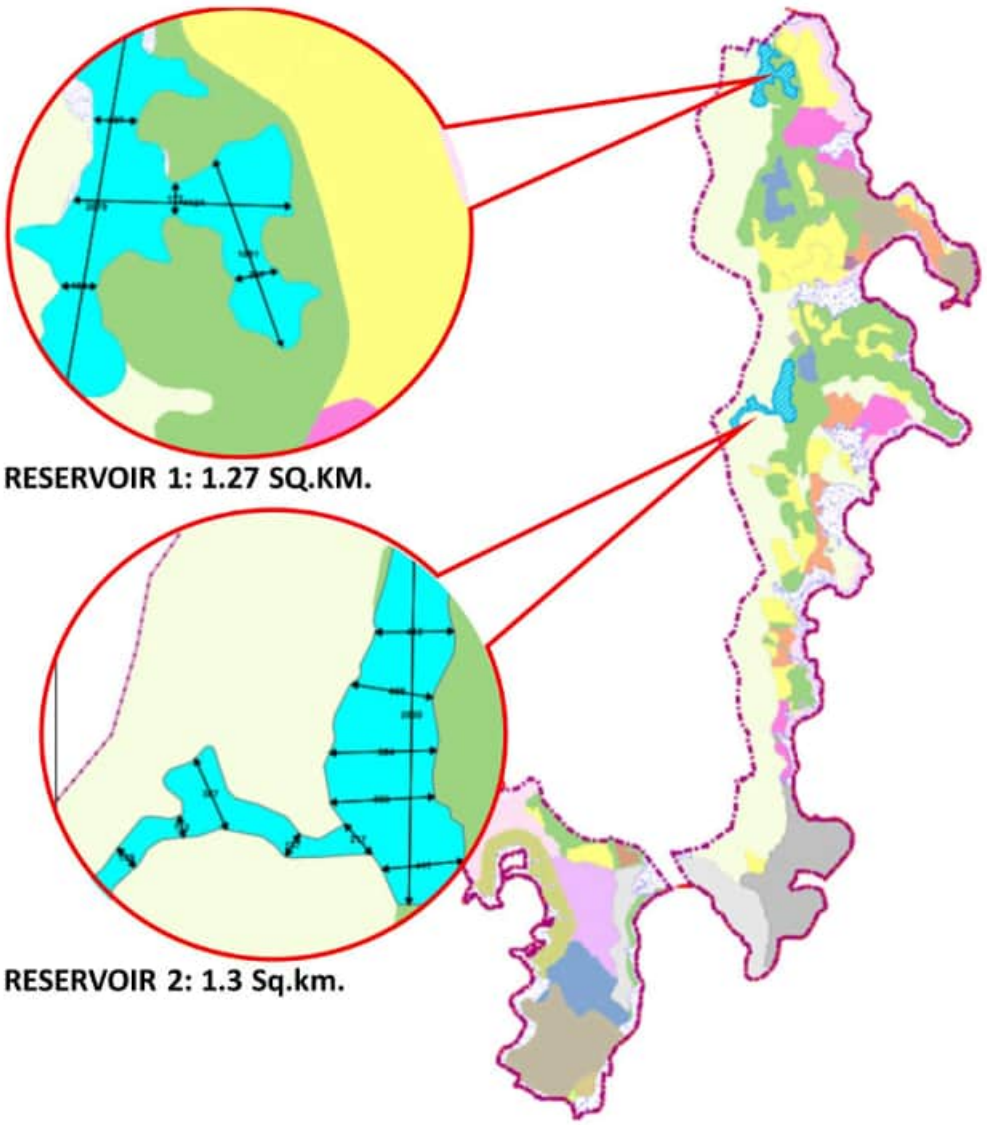
iii. The Solar Plants are planned over the water reservoirs. The Phase -I water Reservoir would require about 12 months for commissioning, hence the solar plant for Phase-I about 20 MVA can be commissioned by end of 24 months to add to the facility. However, as cited above since the DG sets proposed can meet the power demand till about the 4th Year, the solar will be commissioned by end of 5th year, so to be operational in Phase-II. The area required for 20 MVA would be about 0.4-0.5 sq m which is in line with the area required for Phase-I Water Reservoir of 0.5 sq km.

iv. A Total area of about 2.57 sq km is en-marked for reservoirs for the full development for all phases. As a fall-back option, in the case of contingency against the commissioning of gas based power plant, the water reservoirs can be developed, over which about 90-100 MVA of Solar plant systems can be erected and commissioned to meet power demand.

v. In addition to the above,

- Buildings shall be mandated to have rooftop solar panels as per IGBC green-building requirements
- All efforts shall be made for additional installation of solar panels over the areas which have no environmental constraints.

Location of Floating Solar Power plant in the proposed water reservoirs



Advantage of floating Solar Power Plants:

At COP26 in November 2021, Prime Minister Narendra Modi announced that India plans to reduce emission intensity by more than 45% by 2030 to below 2005 levels. He also announced a net-zero by 2070 target. Central Electricity Authority forecasts that the country's reliance on coal to drop from 53% of installed capacity in 2021 to 33% in 2030, whereas solar and wind together make up 51% by then, up from 23% in 2021.

The proposed Solar Plant at GNI is in line with Government of India objective to minimise dependency on fossil fuels. Solar energy has significant environmental benefits, and floating solar panels will undoubtedly contribute to those benefits. The water in floating solar panel installations doesn't only cool the solar-powered systems, but it also works the other way. The floating solar panel installation gives shade to the water body and minimizes evaporation in ponds, reservoirs, and lakes. Water loss due to evaporation can mount up over time and lead to a shortage.

The shade provided by the floating solar panels may aid in the reduction of algae blooms in freshwater. Algae can be hazardous to human health if found in a source of drinking water, and it can also cause the death of aquatic plants and animals. source: https://thesolarlabs.com/ros/floating-solar-farms/

The proposed floating solar power plant is not on any natural reservoir. It is proposed to be installed on the man made reservoir for supplying water to the proposed development. All parameters for ensuring the quality water is preserved shall be adopted while designing the reservoir and its floating solar plant. There will not be any impact on the water quality of the reservoir from the solar floating plant.

India is actively promoting commissioning of floating solar power plants as they demonstrate multiple benefits as compared to land based solar power plants. India’s largest floating solar plant is now fully operational at Ramagundam in Telangana’s Peddapalli district. The 100-megawatt (MW) floating solar power photovoltaic project was commissioned by the National Thermal Power Corporation, the country’s foremost public-sector power generator.

Tata Power Solar Systems, in July 2022 have commissioned 101.6 Megawatt Peak (MWp) in Kerala backwaters. The project is installed on a 350-acre water body in Kayamkulam, Kerala

Floating farms do not require land to be acquired for the installation of photovoltaic panels. They are more efficient as the presence of water underneath helps them keep cool. They also reduce water evaporation, thereby saving more water.

Other Comments

EAC Observation (xix):

Measures taken for the notified sanctuaries shall be incorporate in the EIA/EMP report.

Response (xix):

Already 3 new wildlife sanctuaries have been identified at a location feasible for conservation and preservation of Leatherback turtles, Megapode and Corals. An intention notification has been issued for the same. **Refer Enclosure 3**.

Status of the notification for new Wildlife Sanctuaries

- 21.03.2022 – Ministry of Home Affairs (MHA) accorded approval for new wildlife sanctuaries to be created. These include the following –

  d. Leatherback turtle sanctuary of 13.75 sq.km at Little Nicobar Island
  e. The entire Menchal Island of 1.29 sq.km as a Megapode Sanctuary.
  f. The entire Meroe Island of 2.73 sq.km as a Coral Sanctuary.

- 21.04.2022 – Intention notification issued for leatherback turtles, Megapode & Corals.

- 18.05.2022 – Proclamation has been issued on by Deputy Commissioner (Nicobars) inviting claims and objections to settle their rights.

DC (Nicobar) vide order no. 123 dated 19.07.2022 stated that there no person has any rights within the limits of proposed three wildlife sanctuaries. Based on the said order, the process of issuing final notification has been initiated.

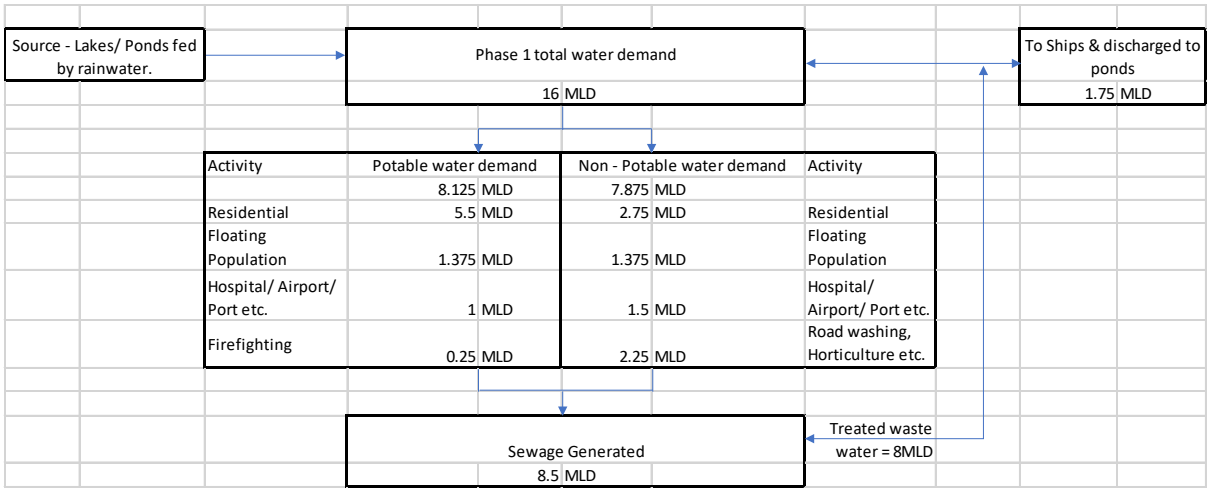
The updated EMP cost is enclosed as **Enclosure 21**.

Observation (xx):

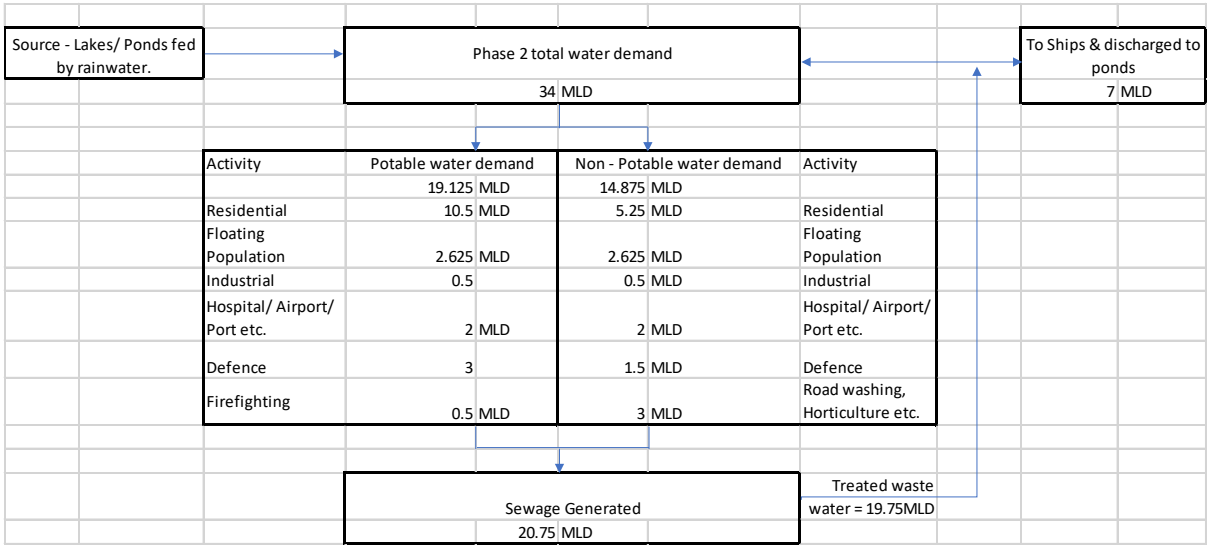
Water balance and Power consumption for all components has to be detailed in EIA/ EMP report.

Response (xx):

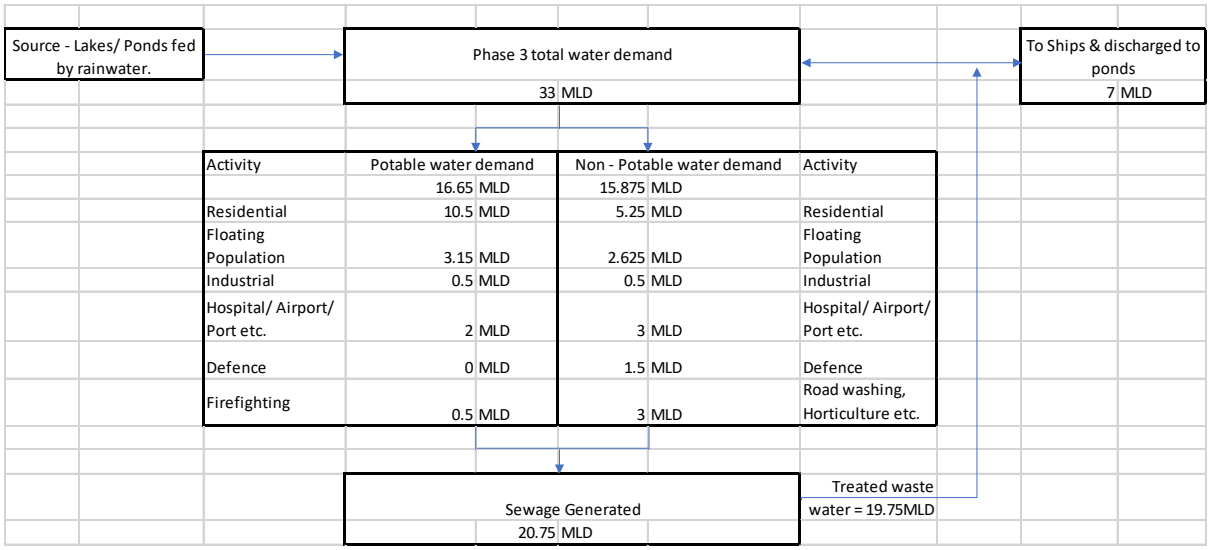
Following is the phase -1 water balance – Water demand and re-cycled water generated.



Following is the phase -2 water balance – Water demand and re-cycled water generated.



Following is the phase -3 water balance – Water demand and re-cycled water generated.



Also at present there is about 0.7 MLD water supply operational on the island against the similar demand. The existing resource will be augmented to a capacity of approximately 2.5 MLD to take care of construction and construction labour requirements till the time the reservoir supply is operationalised. In addition rain water harvesting will be made mandatory for conserving and use of rain water on the buildings and other structures

Following is the Phase wise detail for power consumption –

Sl. No.	Phases of development	Demand load in MVA
1.	**By end of 10th year** – Residential, commercial, institutional, Industrial, Transport, Utilities (WTP, STP, Pumping Stn. Etc.), Open Space, Defence Area, CRZ.	106 MVA
2.	**By end of 20th year** – Residential, commercial, institutional, Industrial, Transport, Utilities (WTP, STP, Pumping Stn. Etc.), Open Space, Defence Area, CRZ.	253 MVA
3.	**By end of 30th year** – Residential, commercial, institutional, Industrial, Transport, Utilities (WTP, STP, Pumping Stn. Etc.), Open Space, Defence Area, CRZ.	350 MVA*

Note – In addition to the above the total power demand also includes demand for Port of 50 MVA, demand for Airport of 10 MVA and a contingency of 10% totalling 438 MVA. Hence the power plant has been designed for a total capacity of 450 MVA.

Phase	**Year**	**Power Demand (MVA)**	**DG Capacity installed (MVA)**	**Gas Capacity installed (MVA)**	**Solar Capacity Installed (MVA)**	**Total installed capacity (MVA)**
Phase I	1	2	5	0	0	5

	5	35	40	50	0#	90
Phase II	10	106	40	100	20	160
	15	181	0*	150	70	220
Phase III	20	253	0*	250	100	350
	25	293	0*	300	100	400
	30	350	0*	300	100	400

EAC Observation (xxi):

PP shall submit the number of mounts of Nicobar Megapod are located over the proposed area and its impact on mounts shall be mapped, it is also requested to submit the measures taken for its protection and sustainability for Migratory birds.

Response (xxi):

A total number of 102 active mounds of Nicobar Megapode and their locations in GNI have been mapped by ZSI. Out of the 102 mounds, only 19 mounds are falling in the project area. Further, it is seen that several mounds are falling in the green area of the development and the same will be protected. Further, it is also observed that the birds are present in the vicinity of the east west road.

The Long term monitoring and conservation plan of the endemic nicobar megapode will address the issues and may provide strategies to conserve and protect the mounds in the long run. Further, the past studies have only been confined to coastal stretches aned nearby forest patches and it presence in other areas including deep inside forests will be known once the long term monitoring studies and conservation plan is implemented.

Refer **Enclosure 17** for the number of mounts of Nicobar Megapode and their location as per information from the ZSI on Nicobar Megapode.

EAC Observation (xxii):

Any alternate site proposed for inactive and active mounts shall be prepared along with the location maps showing in KML.

Response (xxii):

The long term monitoring and conservation plan addresses the issues related to insitu conservation and possibilities will be explored for inactive and active mounds management and relocation through scientific assessment.

EAC Observation (xxiii):

Project proponents were asked to furnish the details of loss of mangrove cover with mitigation/ conservation plan for the loss of mangrove. PP has not submitted any Mangrove conservation Plan/coral conservation plan which normally forms the part of EIA/EMP for CRZ purposes. No justification has been given for not including mangrove conservation plan including the plan for compensatory planting in lieu of loss of mangrove cover.

Response (xxiii):

The Mangrove Conservation and Management Plan for Great Nicobar Island has been prepared by the Department of Environment and Forests, A&N Administration and the same is enclosed as **Enclosure 18**. Refer **Enclosure 19** for Map for location of mangroves. The mangrove conservation plan is aimed at restoration and restocking of the tsunami impacted mangrove areas besides enhancement/enrichment through plantations. The plan also aims at improving the diversity of mangroves, its richness and stand density through proper assessment of distribution and status of mangrove species found in Great Nicobar Island alongwith the locations. The conservation plan addresses the strategies to restore and revive the mangrove areas through ecological restoration and enrichment planting.

As part of the conservation plan, the following strategies namely establishment of mangrove nursery, habitat enhancement/rehabilitation, mangrove plantation, establishment and management, development of mangrove/plantation techniques, management techniques, revival of critical taxa, research and monitoring and education outreach have been included.

An amount of Rs.7.5 crores is kept for mangrove conservation and management as part of EMP.

The updated EMP cost is enclosed as **Enclosure 21**.

EAC Observation (xxiv):

Similarly, coral conservation plan has not been included in the EIA/EMP without giving any justification for non-inclusion in EIA/EMP.

Response (xxiv):

The Coral Conservation Plan prepared by ZSI addresses both, the conservation strategies for coral colonies around GNI as well as translocation strategies for ten (10) hectares of impacted corals. A total of 245 species of scleractinian corals under 53 genera and 15 families (including 2 genera under Scleractinia IncertaeSedis) are recorded from seven sites including the Great Nicobar Island. No major coral reef exists within the work area of the project. However, scattered coral reefs are available at the peninsular part of the Galathea Bay.

As part of the assessment for conservation and management of Coral reefs, the Coral cover required to be translocated from the proposed site is around 10 ha which includes around 20668 Coral colonies out of which approximately 16150 colonies will be translocated. The plan addresses the probable sites for translocation, the methodology, the coral colonies for transplantation, conservation and management of coral reefs both at the translocated sites, donor sites and other sites in Great Nicobar Islands. The conservation and management strategies include physicochemical assessment of water, survey methods for macro benthos both qualitative and quantitative analysis, etc. The approximate cost of coral conservation plan is estimated to INR 53.57 Crores. **Refer Enclosure 9** for detailed Coral Conservation Plan.

The updated EMP cost is enclosed as **Enclosure 21**.

EAC Observation (xxv):

In response to EACs request for Saltwater Crocodile management plan, no plan have been submitted except the assurance of following Action plan for mitigation of Human crocodile conflict in A&N Islands along with the SOP. These areas of GNI being good nesting sites of Saltwater Crocodile are likely to fall in category of Crocodile Conservation Zones (CCZ) and therefore as per prescriptions of Action plan no human activities including tourism is permitted unless it is prescribed in wildlife management plan/working plan. Prescriptions for mitigation of conflict as per Action plan will be applicable only if areas within project site fall in human-crocodile co-existence zone or crocodile free zone. Therefore, there is a need to submit the actual status of the Saltwater Crocodile habitat/nesting sites falling within the project area as per Action plan for mitigation of human crocodile conflict areas along with a Saltwater Crocodile conservation plan in case areas inside project fall in Crocodile conservation Zone category.

Response (xxv):

In Great Nicobar Island the crocodiles have been sighted in Magar nallah, Dillon nallah, Vihjay Nagar, Laxmi nagar, galathea bay and navy dera in the project area in the past and also in Casuarina bay and

Alexandria bay in the west coast falling outside the project area. The potential habitats include Gandhi nagar, and Shastri nagar, etc. Accordingly, WII has been asked to prepare a crocodile conservation plan. WII has prepared a 'Conservation & Management Plan of Salt Water Crocodile (Crocodylus porosus) in Great Nicobar Island'.

aimed at long term conservation of Saltwater Crocodile and its habitat in GNI based on robust scientific data, rigorous monitoring and scientific rescue and rehabilitation practices.

The conservation plan proposes to study the population size, occupancy, ecology and genetics on salt water crocodile of GNI, monitor movement and ranging pattern of different age and sex of individual in selected crocodile habitats and identification of nesting sites, their protection, conservation and management including monitoring of the population including mitigation strategies.

The programme will have the following objectives:

- Identification and characterization of crocodile habitats.
- To ensure public safety through prohibition, regulation and crocodile rehabilitation.
- Improve community awareness for crocodile human coexistence.

The conservation and management plan of salt water crocodile in Great Nicobar Island addresses the issue of creating a crocodile rescue and rehabilitation centre. Based on the outcome of the study and looking at the population size at different crocodile habitats and potential habitats. The management strategies including the spatial planning and zonation will be carried out for effective conservation of the species and its habitats based on the outcome of assessment for status and distribution of crocodiles with their abundance.

The Conservation & Management Plan is divided into two components as Monitoring and Management. The budget requirement for the Monitoring is INR 9.7 Crores and for Management is INR 32.2 Crores. The implementation of the plan will be done in two phases of 5 years each post approval of the plan. Refer **Enclosure 20** for the 'Conservation and Management Plan of Salt Water Crocodile' prepared by WII.

EAC Observation (xxvi):

Evacuation plans for natural disaster needs to spell out clearly and in detail since this area is prone to Tsunami, frequent earthquakes and Cyclone etc.

Response (xxvi):

An 'Evacuation Plan' has been prepared and the details of the same are given below.

Evacuation Plan

Andaman and Nicobar Island (ANI) is seismically very active and is situated in Zone V of Seismic Zoning Map of India (as per IS-1893 Part 1-2002). These islands are one of the Multi hazard prone areas of India.

Disasters for which action plan is prepared are:

- Tsunami
- Cyclone
- Earthquake

The above disasters require immediate actions to support and facilitate with basic shelters, food and medicines.

To make the workable action plan the plan or the Standard Operating Procedure (SOP) is sub divided into five major sections as listed below:

(i) Preparedness Phase
(ii) Early Warning Phase
(iii) Response Phase
(iv) Relief Phase
(v) Restoration Stage

(i) Preparedness Phase – This phase will include taking all necessary measures for planning, capacity building and other preparedness so as to be in a state of readiness to respond, in the event of a natural disaster. This Stage will also include development of Search & Rescue Teams, mobilization of resources and taking measures in terms of equipping, providing training, conducting mock drills/exercises etc.

It has been presumed that in case of a big Tsunami, a 20 m wave may strike GNI. This large wave may be followed by smaller waves. The affected area includes, part of coastal tourism area, and few pockets of commercial, Institutional land uses. (Map 1 in Enclosure 10 showing the proposed location of Tsunami Shelters)

As per the design Indian Tsunami Early Warning System (ITEWS), the early warning will come between 10 to 20 minutes time. In case of emergency, one can rush to upto to 2.5 km distance approximately. Some can walk to the nearest higher levels (above 20 M) in the development area. The areas above 20 m should be designated and published widely amongst residents and visiting population. Those who cannot move to higher places due to distance, can rush to nearby tsunami centers. It is proposed to construct tsunami wave resistant structure at 2.5 km where those who present during the incident at below 20 m level can rush to the designated buildings. These building will have Tsunami and Earthquake resistant design. These shelters can also be used post an earthquake event or during a heavy cyclone event.

During the incident of Tsunami, people from the affected area who might be present at the affected areas can rush to the tsunami resistant buildings. The tsunami resistant buildings during normal time can be used as School, community centers, club houses, community centers etc.

The ITEWS provides a warning of incoming tsunami between 10 to 20 minutes. An application will be developed linking to ITEWS which can be downloaded to all mobile phones. Adequate budgetary provisions have been kept in the EMP. It will be mandatory for all the tourists, workers or anyone entering the development area to have this app on their mobile device so that they get the warning for an intending tsunami.

(ii) Early Warning Phase – This phase will include all necessary measures to provide timely, qualitative and quantitative warnings to the disaster managers to enable them to take preemptive measures for preventing loss of life and reducing loss/damage to the property. On the occurrence of a natural disaster or imminent threat thereof, all the concerned Agencies will be informed/notified for initiating immediate necessarily follow up action.

The Ministry of Earth Sciences has established the Indian Tsunami Early Warning System (ITEWS). The ITEWS was established in 2007 and is based at & operated by Indian National Center for Ocean Information Services (INCOIS), Hyderabad. The ITEWS is an integrated effort of different organizations including the Department of Space (DOS), Department of Science and Technology

(DST), the Council of Scientific and Industrial Research (CSIR), Survey of India (SOI) and National Institute of Ocean Technology (NIOT).

The ITEWS comprises a real-time network of seismic stations, Bottom Pressure Recorders (BPR), tide gauges and 24X7 operational tsunami warning centre to detect tsunamigenic earthquakes, to monitor tsunamis and to provide timely advisories to vulnerable community by means of latest communication methods with back-end support of a pre-run scenario database and Decision Support System (DSS).

The ITEWS has the responsibility to provide tsunami advisories to Indian Mainland and the Island regions. It is capable of issuing Tsunami bulletins in less than 10 minutes after any major earthquake in the Indian Ocean thus leaving us with a response/lead time of about 10 to 20 minutes for near source regions in the Andaman & Nicobar and a few hours in the case of mainland.

The ITEWS disseminates tsunami bulletins to various stakeholders through multiple dissemination modes simultaneously (Fax, Phone, Emails, GTS and SMS etc.). Users can also register on the website for receiving earthquake alerts and tsunami bulletins through emails and SMS.

(iii) Response Phase – This phase will include all necessary measures to provide immediate succor to the affected people by undertaking search, rescue and evacuation measures. Campbell Bay has a state emergency operation center (SEOC) from where the rescue operation can be directed.

(iv) Relief Phase - This phase will include all necessary measures to provide immediate relief and succor to the affected people in terms of SOP, their essential needs of food, drinking water, health & hygiene, clothing, shelter etc.

(v) Restoration Stage – This phase will include all necessary measures to stabilize the situation and restore the utilities. This SOP does not cover long-term measures needed either for mitigation or for rehabilitation/recovery of the affected people and reconstruction of the area.

This SOP is being reviewed annually. The overall responsibility of the disaster management lies with District Administration where the Deputy Commissioner will be the Responsible Officer (RO) for each Districts and in case of situation is worsened and will have its affect in larger area, then the Chief Secretary, A&N Administration will be the (RO). In case the disaster level exceeds a certain threshold, the help of Central Government is sought.

At the time of disaster, not only the above stated SOP shall be followed but assistance from defence force also be involved to help to citizens.

Assistance from Defence Forces

The Commander-in-Chief, Andaman and Nicobar Command shall keep the Armed Forces on alert following the receipt of information from Director, Disaster Management or from the Deputy Commissioner or on receipt of forewarning about the impending occurrence of a Disaster so that, Defence Forces shall plunge into action as soon as their assistance is sought by the UTDMA/DDMAs.

The Andaman and Nicobar Command and the Indian Coast guard to involve during the occurrence of any disaster like situation with the following action plan:

a. Representatives to be stationed in the Armed Force Room earmarked in the Directorate of Disaster Management.
b. A detachment of forces to be stationed at the premises of the SCR with mobile communication equipment for SAR Operations & MFR.

c. All other establishments of ANC will remain on alert.
d. Respond to request of assistance of RO/ICs/SCR.

The extent and nature of assistance required from the Defence Forces in the first instance shall be assessed by the District Disaster Management Authority and intimated to Union Territory Disaster Management Authority.

The Union Territory Disaster Management Authority shall hold quick deliberations on the nature and extent of help to be sought from the Government of India. This assistance shall be for (a) Short(Immediate) Term Measures(b)Medium Term Measures and (c) Long Term Measures.

The assistance for Immediate Term Measures is meant for the Rescue and Relief Operations. The Rehabilitation Operations after a Disaster constitute the medium term measures. The assistance from Government of India for the medium term measures could be to restore the public utility services and to help the general public to restart their occupations. Assistance from the Government of India for long term measures will be sought under the Annual Plan.

The concerned Departments shall make a quick assessment of damage in their sector/ activities and project the requirement of funds to the Union Territory Disaster Management Authority. The District Disaster Management Authority/Deputy Commissioner shall with the assistance of Government Departments make a quick estimate of damage/ impact and requirement of funds.

In addition, request for the immediate assistance from Government of India may be placed for dealing of the situation effectively. Further, the 'Andaman and Nicobar Disaster Management Plan' may be referred for protocols in the event of a Tsunami, Earthquake and Cyclone. Refer to **Enclosure 10** for map of Tsunami shelters and **Enclosure 11**for ANI disaster management plan.

Response to **3.1.27. Conclusions and Recommendations** by the EAC.

A. Exclusion of areas from total project area

EAC Comment (i):

Areas proposed for any activity other than defense in the western coast of the GNI especially the areas of Pemayya Bay, Casuarina Bay and Alexandria Bay which can be used by Leatherback and other sea turtles and Nicobar Megapods and even by crocodiles as alternative nesting sites.

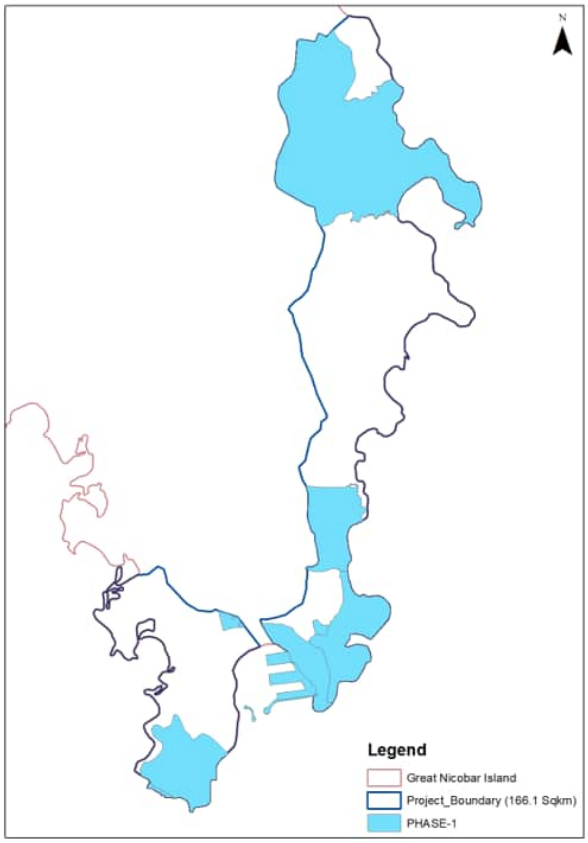
Response (i):

The western coast of Galathea Bay excluding the defence installation and power plant is excluded from Phase I development.

It is recommended to have a buffer area of 500 mts from high tide line around Pemayya to be declared as Costal Protection Area with stringent controls on any development within the area. Revised map is enclosed as **Enclosure 4**.

Alexandria Bay and Casuarina Bay are located far away and fall outside the project area on the western coast. All these areas including Pemayya Bay have been made part of the leatherback conservation plan. Adequate measures have been proposed for protection of nesting beaches and turtles.

Proposed Phase I development:



Note: the trunk infrastructure for the entire project will be developed in Phase I.

EAC Comment (ii):

RoW for the roads should be not more than 30 meters and remaining 25-meter width shall be excluded from the total project area and shall be kept as natural green belt on both sides of road without cutting any trees. Accordingly revised tree enumeration be submitted.

Response (ii):

The observation related to road crossing CRZ IA and IB being on stilts has been incorporated in the master plan. All development within CRZ area shall be in compliance with ICRZ Notification 2019.

The North South road of 55m ROW is the main arterial road connecting different pockets of development across the master plan area. It also serves as the key connector between the development on the eastern and western side of the master plan area and serves the overall function of distributing traffic and enabling access. The 55m RoW has been envisaged as an urban arterial road and the proposed design for this road is in compliance with guidelines for Urban Roads.

A traffic modelling study was taken up for the proposed land-uses in the master plan and the area divided into Traffic Assessment Zones (TAZs). Based on the demarcation of Traffic Assessment Zones (TAZs) and the associated land uses related trip assignments have been studies with the maximum morning peak hour on the central arterial spine road as 3037 PCUs. To understand the capacity requirement based on the maximum PCUs, a volume/capacity analysis was done and a level of service (LOS) was established. Based on the analysis of the proposed network of roads, majority of the roads had an LoS of A, B and C thereby suggesting that the proposed roads were under stable traffic conditions.

LoS	V/C Ratio	Remarks
A	0.00-0.15	Free Flow
B	0.15-0.45	Reasonably Free flow
C	0.45-0.75	Stable Operation
D	0.75-0.85	Borderline Unstable
E	0.85-1.00	Extremely Unstable
F	>1.00	Breakdown

Table 1: Level of service of urban roads.

Accordingly, three categories of roads with varying RoW have been suggested.

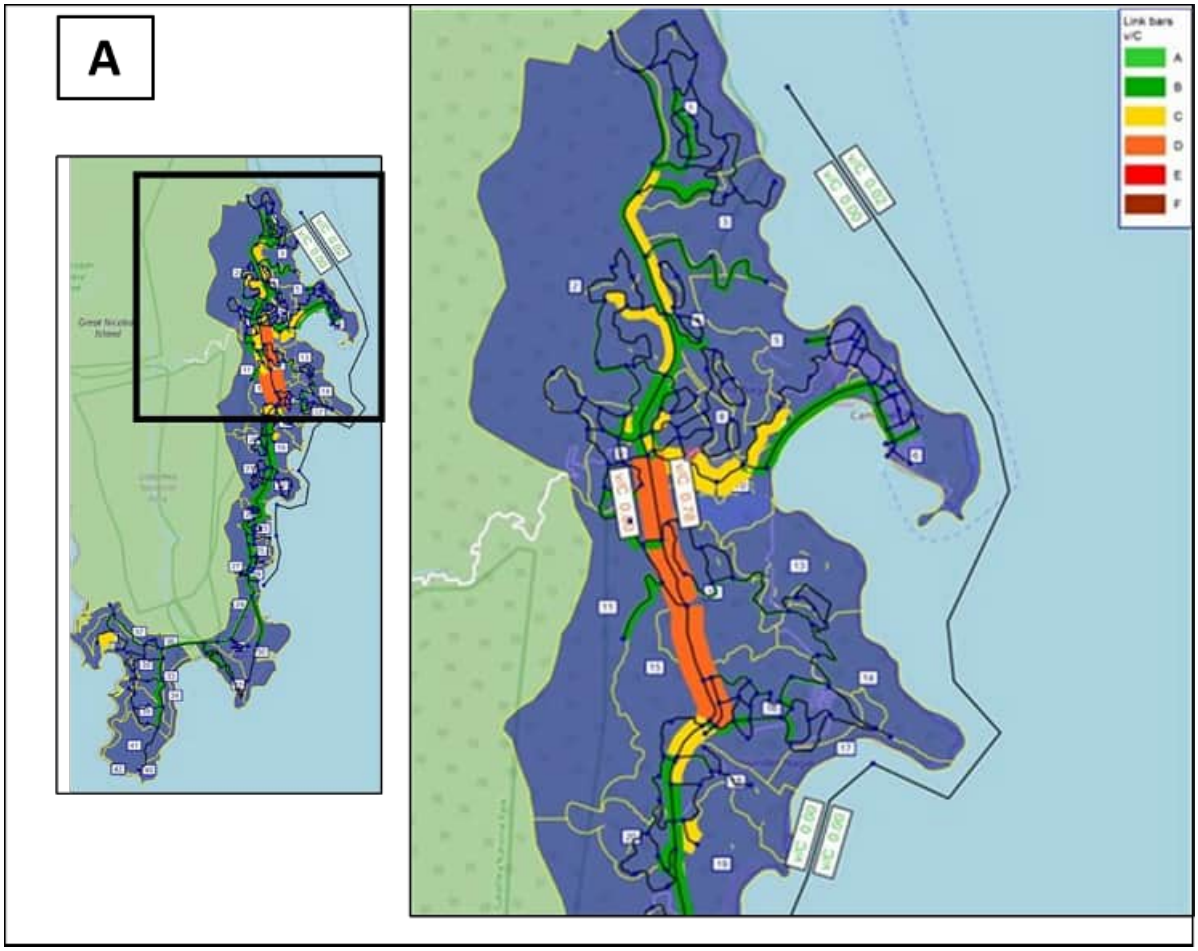
S. No	Name of the Road	Hierarchy	Configuration		
			Main carriageway	Service Road	Remarks
1	Spine Road	Arterial Road	4 Lane Divided Carriageway	7.0 m wide service road on either side	Provision of 11m space for future widening and a mass transit
2	30m RoW	Sub Arterial Road	4 Lane Divided Carriageway	-	-
3	18m RoW	Collector Road	2 Lane undivided Carriageway	-	-

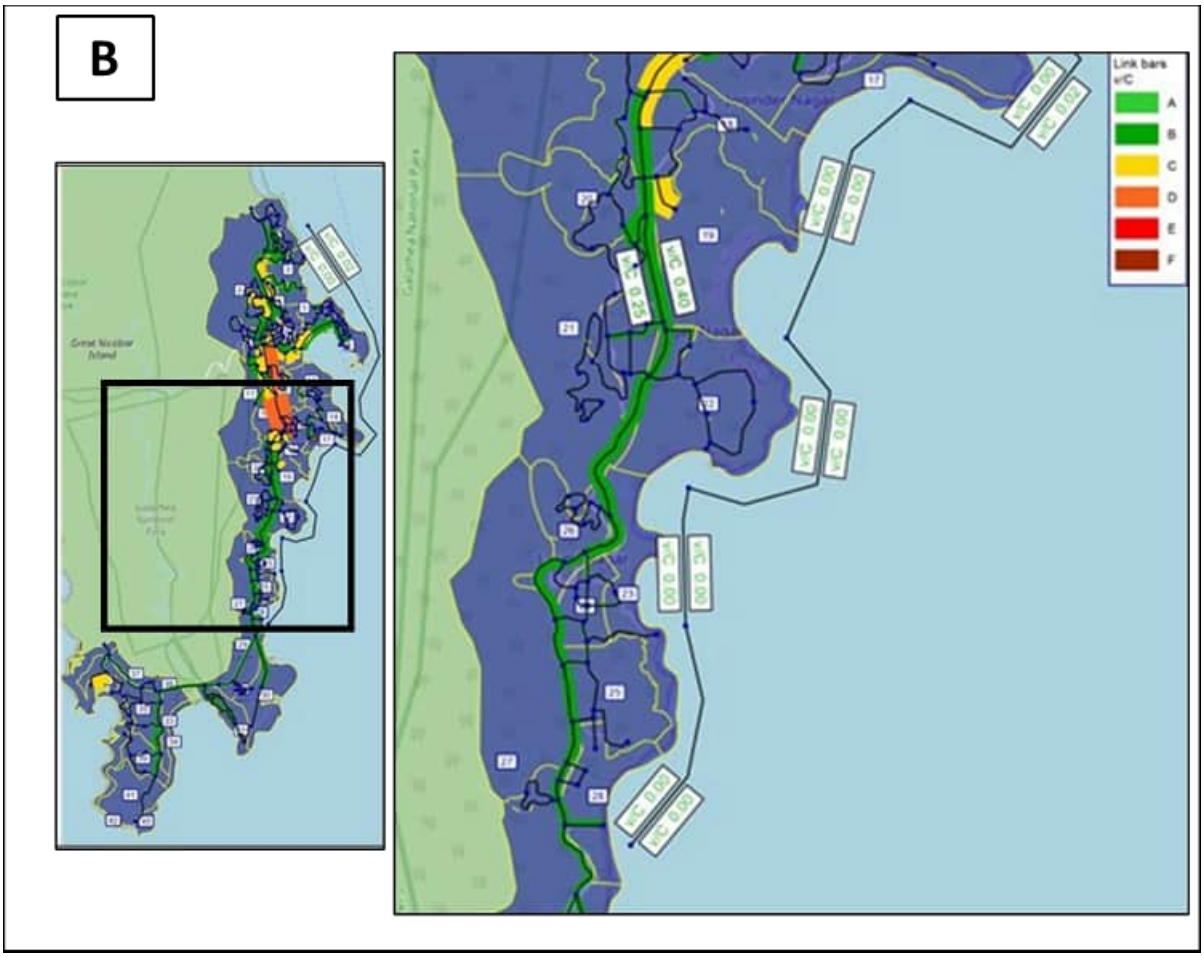
Table 2: Proposed road hierarchy and configuration.

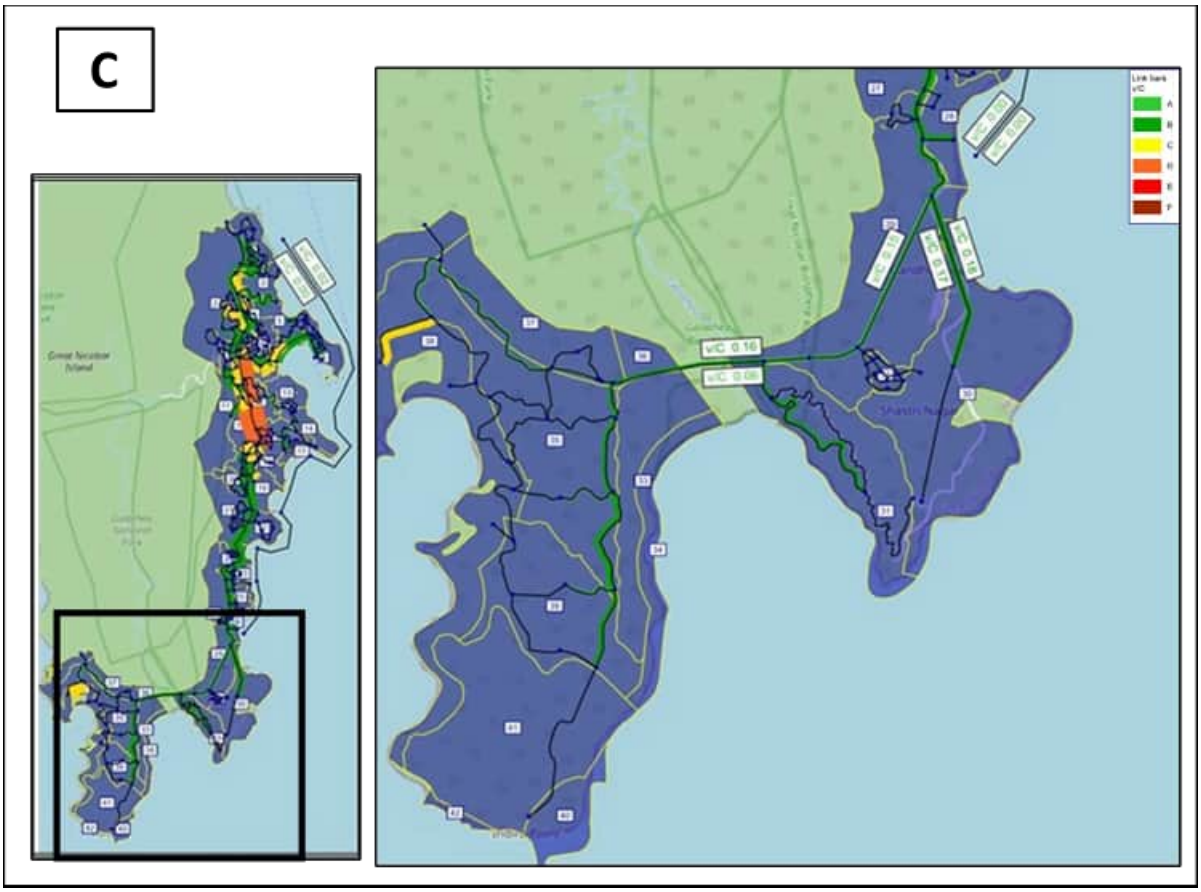
From a sustainability perspective, it is essential to promote unhindered public transport (Battery operated buses, BRT/ LRT in the form of battery-operated Trams)on the island. An 11m dedicated corridor towards provision of public transport has hence been made an integral part of the 55m wide arterial road. The central location of the public transport corridor ensures future ease of access from either side of the road.

Based on the outcome of the modelling study, if the public transport allocation within the RoW is removed, it will result in traffic congestion. Refer the figure below for implication of not including the public transport.

To understand the sustainable mobility choice effects of the LRT/BRT on the spine road, capacity analysis of the road network in a non-mass transit scenario is also modelled using PTV Visum software. Results of the same are shown in figures A, B and C below.




B
Link bars
v/C
A
B
C
D
E
F



From the capacity analysis of non-mass transit scenario, it can be understood that in the absence of a transit on the main spine road, the level of service of the main spine road in the north of the development has dropped to a Level D and bordering on Level E. Hence, it can be inferred that presence of LRT/BRT on the main spine shall have positive results in terms of alleviating congestion and seamless mobility of the people of the Greater Nicobar Island.

Until such time that the dedicated public transport is introduced, the 11m corridor within the centre of the 55m RoW will be maintained as a green corridor.

In order to promote safety on the arterial, service roads have been introduced with 2-way movement on either side within the 55m RoW to enable safe and unhindered traffic flows. The 55 m arterial also includes dedicated cycle tracks and pedestrian footpaths for low-carbon NMV movement.

The 55 m arterial road serves multiple functions enabling movements through different modes of transport including non-motorised transport i.e. cycles as well as pedestrians. Since the public transport in future is expected to be a dedicated public transport it will promote sustainable and green development. The dedicated public transport would result in minimizing localized air pollution. Stations for public transport also enable opportunities for safe crossing of pedestrians. Further, the requirement of RoW may be looked at from the prospective of future growth of the township and an anticipated growth in the floating population due to increased activities including tourism resulting in an increase in the number of vehicles on the road. Hence, 55 metres RoW proposed in the Master Plan needs to be retained/approved.

Best Practices Case Study:

Bogota, Columbia – Successful implementation of Bus Rapid Transit (BRT) system.

The 'TransMilenio' Bus Rapid Transit (BRT) system in the city of Bogota, Colombia provides residents with efficient and safe mass transit that encourages high ridership.

TransMilenio is based on high-capacity buses operating on dedicated bus lanes on trunk routes, being supplied with passengers by feeder buses that connect residential areas to BRT bus stops. From **the initial 41km of bus lanes** completed in 2000 to the expansion to 207km in 2015, the TransMilenio system has become the largest BRT in the world.

Bogotá lies in central Colombia and is 2,640 metres about sea level in the Northern Andes Mountains. It is the capital and largest city of Colombia and the educational, cultural, commercial, administrative, financial, and political center. Bogotá is a territorial entity and has the same administrative status as the Departments of Colombia.

TransMilenio is a sustainable mass urban transport system based on a BRT scheme. The objectives of the project are:

- improve the public transport system with respect to accessibility, efficiency, safety, speed, convenience and comfort ensuring high ridership
- restrict private automobile use
- expand and improve bicycle paths
- enhance public space
- reduce air pollution and greenhouse gas emissions

The BRT provides a variety of benefits to the city of Bogota and its residents:

- improved fuel efficiency per passenger due to new and larger buses. The reduced transport times, along with increased safety, reliability and comfort attract many car and taxi drivers to the new system, which in turn leads to an improved traffic flow in the city.
  environmental benefits in the form of reduced GHG and other air pollutant emissions (CO_2, PM and NOx). From 2013 to 2019, the annual average estimated reduction of CO_2 emissions amounts to 5,78,918 tCO_2eq which is equivalent to the emissions of around 1,23,174 cars per year. Furthermore, a reduced number of vehicles in the city leads to less noise pollution.
- the social well-being of residents has increased as a result of less time spent in congestion, less respiratory diseases, less noise pollution and fewer accidents per passenger transported.

- in the areas where TransMilenio operates, there has been a reduction of 92% in road related deaths, 75% in injuries and 79% in collisions. Robberies at bus stops have been reduced by 83%.
- approximately 1,500 temporary jobs are created during the construction period.

Encouraged by the successful implementation of TransMilenio in Bogota, the government of Colombia embarked on a major program to replicate similar systems in other Colombian cities. **The project has been successfully replicated in the cities of Pereira and Cali**. **The TransMilenio model can be successfully scaled down and adapted to metropolitan areas of less than 1 million inhabitants while the performance and economic viability of the bus system remains unaffected.**

(Source- https://use.metropolis.org/case-studies/transmilenio-bus-rapid-transit-system#casestudydetail)

EAC Comment (iii):

Parts of proposed master plan for Ports which are falling within CRZ IA and IB areas (viz areas B C D etc shown in presentation) shall be excluded from the revised layout of master plan.

Response (iii):

The above-mentioned areas have been excluded from port area. **Refer Enclosure 5.**

EAC Comment (iv):

Some of the township clusters seems to have several Defence installations abutted by commercial and tourism infrastructure. It is not advisable considering strategic nature and safety requirements.

Response (iv):

Suggestion/ opinion from MoD will be sought to finalise the buffer zones around Defence parcels in case required.

EAC Comment (v):

Golf course will not be permitted considering extremely water intensive activity and also considering very high number of endemic species that inhibit GNI. It is misfit in the holistic vision for the island.

Response (v):

Golf courses are now not proposed as any specific landuse in the master plan.

EAC Comment (vi):

Patches of wildlife corridors as explained under (b)(ii) below shall also be excluded from the project area ROW for 55 mts wide road to be reduced to 30 mts and rest area to be excluded from project boundary.

Response (vi):

Refer to response to comment (ii) above on the rationale for the provision of a 55m wide RoW. The 55m wide arterial road has been proposed based on traffic modelling and the resultant demand. The road sections have been arrived at to maintain the Level of Service and accommodate the overall volume of traffic at any given time. We recommend that the 55m wide RoW be maintained without alteration to the configuration.

The project boundary has been carefully delineated considering sufficient buffers around existing National parks and their ESZ. This is the bare minimum land area required for development after approval of UT administration. No further area can be removed from the delineated boundary and it is not technically possible to exclude area adjoining to main trunk road from the project boundary.

Further, we have provided safe and unhindered wildlife crossing corridors at eight locations in the form of via-ducts and an adequate number of culverts and canopy crossings will be provided at appropriate locations, along the eastern part of the development during detail design stage. **Refer Enclosure 12.**

The wildlife corridors proposed in eight (8) locations ranging from 250 meters to 1100 meters width all along North South Road have been kept as green area. No other activity have been proposed in

wildlife corridors areas and will be exclusively kept for movement of wildlife, therefore excluding the said areas outside the purview of the project area does not arise.

B. Amendment in Port, Township and Road designs:

EAC Comment (vii):

Possibility of extending the western isolated breakwater up to base of the Galathea bay parallel to the eastern flank shall be explored so that an independent channel can be created between the port and the western flank of the bay for the possible unhindered movement of the turtles to and for nesting grounds in western flank.

Response (vii):

Various mitigation measures and conservation strategies have already been included in the EMP. Extending the breakwater further towards Galathea river will have an adverse impact on the shore line of the western flank of Galathea Bay.

Effect due to reduction of currents

The flow field for the modified condition (extended breakwater): The modelling study carried out using MIKE 21 HD for the extended breakwater condition shows that the circulation will be limited between the western shore and the western breakwater. This region would form as a sheltered region with 730 m width and 2500 m length. The modelling result shows that flow velocity will reduce, and it will go less than 0.1 m/s. There will not be a free flow and it would lead to a formation of a quasi-stagnant water. There will be a possibility that if any debris washed to shore from open ocean, they would get accumulated over the period, due to low flushing. This will lead to contamination of the water. Such fall in water quality will hamper the turtles to choose and reach this region.

On the other hand, the arrangement as proposed earlier, i.e., only a detached breakwater of short length will maintain the present current circulation and help the water to be clean for every tidal cycle. This will help the turtle nesting to continue without any fall in water quality.

Effect due to amplification of waves

The modified wave tranquillity condition shows that the waves entering the mouth, i.e., between the western shore and the western breakwater tip throughout the year will get amplified due to the convergence effect and high waves will break on the northern side of this region. Again, the waves entering the funnel shaped region will break on the breakwater, and part of the waves will get reflected, which will create a kind of 'oscillation' and 'seiche effect' in the funnel shaped region. Such highly disturbed region with direct waves and reflected waves will make turtles to avoid the region. The wave activity during November to January will be very high due to northeast monsoon and it coincides with turtle nesting period which in-turn will affect the turtles reaching for the ideal place. On the other hand, for the earlier arrangement, due to bay type morphological configuration, the waves will get diffracted inside the basin and along the western shore; and give a relatively protected region.

It is suggested that the port may place series of Ecological Marker Buoys for every 200 m along the proposed extended breakwater line. Also, Marker Booms may be connected in between the buoys. Such arrangement will clearly mark the 'AREA TO BE AVOIDED TO AID TURTLES', warn restriction of the navigational route, thereby neither ships nor boats can enter the 'TURTLE NESTING AREA'. It would protect the turtles from the port operation.

All necessary mitigation measures and conservation strategies have already been included and are part of the EMP. Extending the breakwater further towards Galathea river will have an adverse impact on the shore line of the western flank of Galathea Bay. This may cause erosion to the beach and will severely impact the turtle nesting areas. It is thus not recommended to extend the breakwater towards the mouth of Galathea river.

EAC Comment (viii):

300 to 500 Mtr wide natural forest corridor should be kept as animal corridor at every 3 Km interval all along project area for facilitating movement of wildlife between forest and the sea shore so that development plants at GNI does not stop the access of several endemic and endangered wild animals like Nicobar Long-tailed Macaque, Nicobar tree shrew, Robber or Coconut crabs, Saltwater Crocodiles Nicobar Megapod, Nicobar Crake etc. to the sea which is actually the part of their habitat. This shall be done in consultation of A&NFD and wildlife experts. Chainage wise details to be provided in the road alignment.

Response (viii):

Safe wildlife corridors at 8 locations along the eastern side of the island connecting forest and seashore through via-ducts in the north south arterial road have been proposed and incorporated in the master plan. In addition, several culverts and canopy crossings will be provided at appropriate locations and the same will be incorporated in the detailed engineering design for the safe movements of wildlife. The locations of the proposed wildlife corridors i.e. via ducts have been selected based on the ground situation and inputs provided by ZSI and Department of Environment & Forest. The width of the corridor ranges from 250 meters to 1100 meters and the eastern side of the corridors via ducts towards the seashore would be maintained as green area and no development is proposed in the said areas. Refer **Enclosure 1**.

EAC Comment (ix):

Stretches of road crossing these above-mentioned wildlife corridors shall be elevated to facilitate the movement of wildlife under these elevated road stretches or alternatively wildlife over bridges can be constructed if terrain demands. Chainage wise details to be provided in the road alignment.

Response (ix):

Safe wild-life corridors at multiple locations along the eastern side of the island connecting forest-sea shore through via-ducts in the 55m wide arterial road have been incorporated in the master plan. Further, adequate number of culverts and canopy crossings will also be provided at appropriate locations and incorporated in the detail design stage. Refer **Enclosure 1..**

EAC Comment (x):

Provision shall be made in road design for canopy walks/bridges for crossing the arboreal animals as well as for passage of snakes, crabs crocodiles etc and other amphibians/ reptiles. Chainage wise details to be provided in the road alignment.

Response (x):

Safe wildlife corridors at 8 locations along the eastern side of the island connecting forest- sea shore through via-ducts on the 55 m wide arterial road have been incorporated in the master plan. Adequate number of culverts and canopy crossings will also be provided in addition to the 8 via ducts at appropriate locations during the detail design stage. **Refer Enclosure 1.**

EAC Comment (xi):

The stretches of the road falling in CRZ IA and IB area shall be on stilts as per the prescriptions in CRZ notification. Revised layout of plan shall clearly indicate such stretches along with geo coordinates and the mention of road on stilts shall also be made in the master plan as per this revised lay out. Chainage wise details to be provided in the road alignment

Response (xi):

The suggestion has been incorporated in master plan. **Refer Enclosure 2**.

C. Submission of revised project area and layout of the masterplan: -

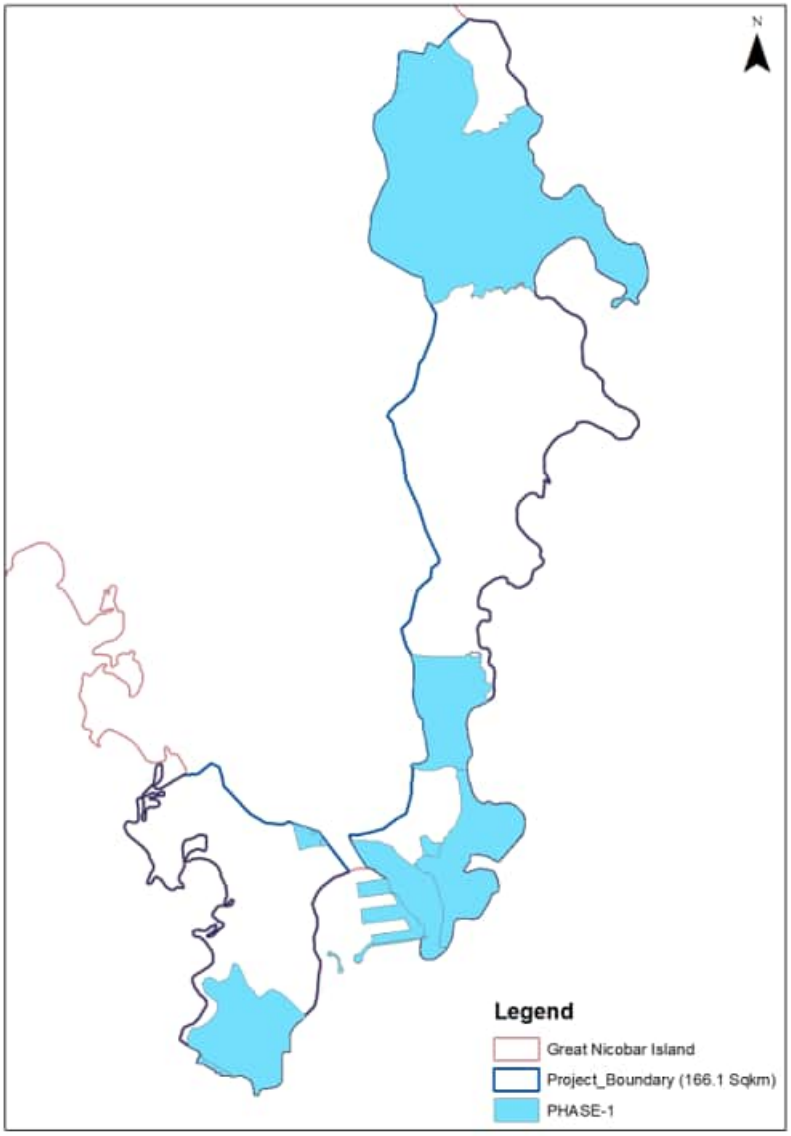
EAC Comment (xii):

After exclusion of the areas as mentioned in para A above and doing necessary amendment in master plan as mentioned in Para B above a revised project area and revised layout /master plan shall be submitted.

Response (xii):

Revised layout / master plan incorporating the relevant changes is enclosed. Refer Enclosure 5.The following changes have been incorporated as per suggestions from EAC and discussion with relevant authorities.

No development is proposed on the western side of Galathea Bay in Phase I development apart from Defence area development, power plant and basic infrastructure to sustain defence and power plant site.

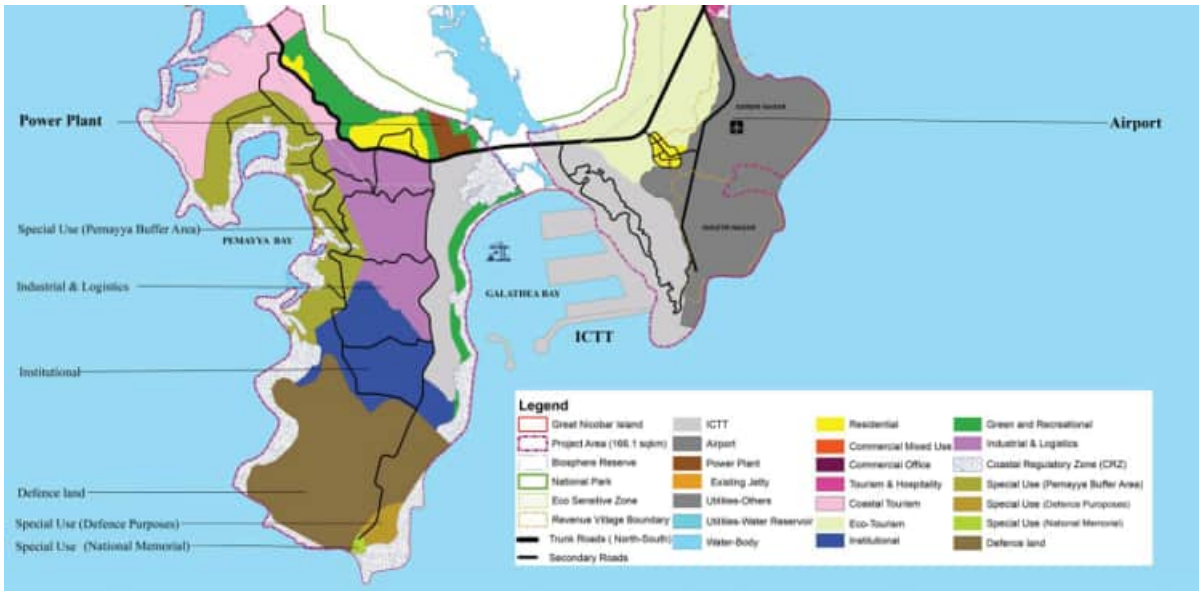


Note: the trunk infrastructure for the entire project will be developed in Phase I.

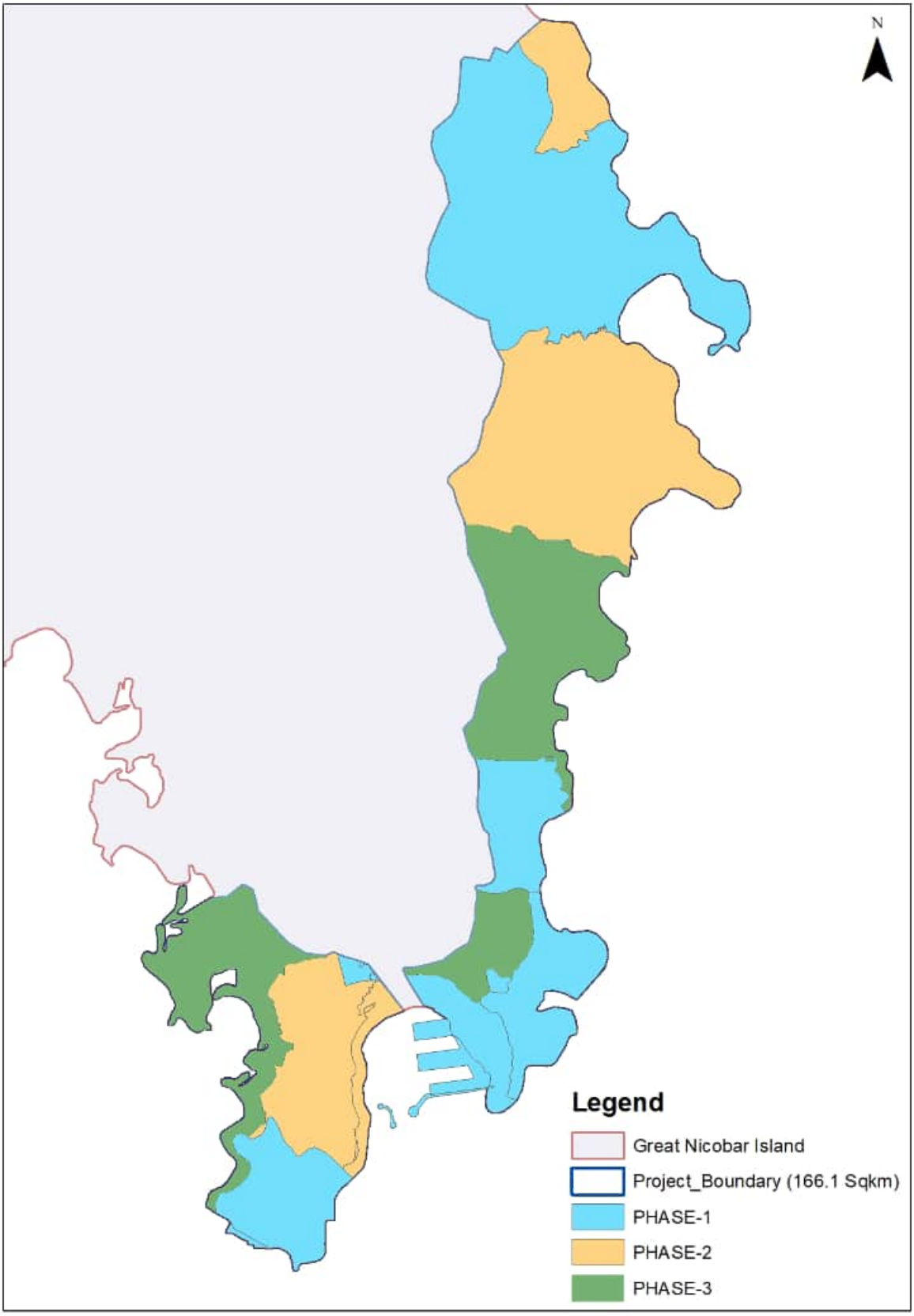
A separate land use category “Special Use” has been included in the land use plan. The subcategories under “Special Use” are:

- National Memorial (Western tip of Galathea Bay),
- Defence Purpose (Western tip of Galathea Bay),
- Pemayya Buffer Area (Buffer area of 500m from HTL for safe nesting of Leatherback turtles),
- Green areas have been re-planned to accommodate safe wildlife crossing corridors. **Refer Enclosure 1.**

Areas of the port land use falling over CRZ IA and IB have been amended. **Refer Enclosure 5** for overall updated Landuse plan. Refer figure below for visuals of LU changes stated above.



Phasing plan for proposed development :



Revised Landuse distribution table:

LANDUSE	Phase I (Area in Sq.km.)	Phase II (Area in Sq.km.)	Phase III (Area in Sq.km.)	Total (Area in Sq.km.)
Airport	8.45	0.00	0.00	8.45
ICTT	4.50	2.42	0.00	6.92
Power Plant	0.39	0.00	0.00	0.39
Residential	6.78	6.45	3.39	16.62
Commercial- Mixed Use	1.59	1.08	1.85	4.51
Commercial- Office	0.18	0.00	0.00	0.18
Commercial- Tourism & Hospitality	2.53	2.48	0.01	5.01
Commerical- Coastal Tourism	1.31	2.16	4.72	8.19
Institutional	1.26	4.52	0.00	5.77
Industrial & Logistics	0.13	4.68	0.07	4.88
Eco-Tourism	16.51	10.62	13.42	40.55
Green and Recreational	9.56	10.92	3.39	23.87
Utilities-Others	0.13	0.21	0.08	0.42
Utilities-Water Reservoir	1.27	1.30	0.00	2.57
Jetty	0.10	0.00	0.00	0.10
Defence land	12.61	0.00	0.00	12.61
Special Use (Defence Purpose)	0.43	0.00	0.00	0.43
Special Use (National Memorial)	0.08	0.00	0.00	0.08
Special Use (Pemayya Buffer Area)	0.00	0.69	3.83	4.52
Coastal Regulatory Zone (CRZ)	4.39	6.82	8.81	20.02
Grand Total	**72.20**	**54.34**	**39.56**	**166.10**

Commercial- Tourism and Hospitality:

Walkable commercial development at the edge of town centres, with access to the sea and the forest. The anticipated permissible development will be Hotel, Food & beverage, Entertainment, Retail, MICE (Convention Centres, etc.), Staff housing etc

Commercial- Coastal Tourism:

The band of land at the coast after the CRZ area to give an additional protection to the cost from development activities whihc combines conservation areas with low-impact tourism development such as resorts, cabanas and elevated structures. The anticipated permissible development are resorts, sports, Recreation, Low-impact hotel and entertainment

Eco-Tourism:

Vertical development limited to Welcome Centre, museum or other facility. Vehicular access to facility. Walking paths in forest.

Eco-Tourism - It is also proposed to develop approximately 4055 ha. of area buffering the Ecological Sensitive Zone of National Parks from the proposed development as green areas with provision of Eco Tourism Activities. This will be predominantly part of Green area within the overall development. There will be minimal alteration to the natural terrain and ecology of the area and only eco tourism activities shall be permitted within this landuse. Infrastructure development required to support the proposed township development shall be permitted within the Eco Tourism areas. The anticipated permissible development are Museum, Cultural Centre, Camping etc.

Green, Parks and Recreational:

Open spaces, Natural parks at all scales, Recreational facilities etc The anticipated permissible development are Regional park, Nature reserves, Local park, Playground, Sports fields / facilities, entertainment, sports etc.

D. Declaration of Protected Areas for conservation of Turtles, Megapode bird and crocodiles: -

EAC Comment (xiii):

A&N FD in consultation with WII shall identify the areas in Pemayya Bay, Casuarina Bay and Alexandria Bay suitable for habitat and nesting ground of Leatherback turtles, Nicobar Megapode and Saltwater Crocodiles. Additional legal protection to these areas by way of declaring these areas as WLS or Conservation Reserves as per provisions of Wildlife Protection Act. This may help in ensuring the continued nesting of these animal/birds in Great Nicobar Islands. These will be in addition to the PAs already in the process of notification.

Response (xiii):

Already 3 new wildlife sanctuaries have been identified at Little Nicobar, Menchal and Meroe Islands for conservation and protection of Leatherback turtles, Megapode and Corals respectively and intention notifications for declaration of wildlife sanctuaries have already been issued for the same. **Refer Enclosure 3**.

Status of the notification for new Wildlife Sanctuaries

- 21.03.2022 – Ministry of Home Affairs (MHA) accorded approval for new wildlife sanctuaries to be created. These include the following –

  a. Leatherback turtle sanctuary of 13.75 sq.km at Little Nicobar Island
  b. The entire Menchal Island of 1.29 sq.km as a Megapode Sanctuary.
  c. The entire Meroe Island of 2.73 sq.km as a Coral Sanctuary.

- 21.04.2022 – Intention notification issued for leatherback turtles, Megapode & Corals.

- 18.05.2022 – Proclamation has been issued on by Deputy Commissioner (Nicobars) inviting claims and objections to settle their rights.

DC (Nicobar) vide order no. 123 dated 19.07.2022 stated that there no person has any rights within the limits of proposed three wildlife sanctuaries. Based on the said order, the process of issuing final notification has been initiated.

In case of Pemayya Bay, a buffer of 500 mts from the HTL around Pemayya Bay has been demarcated as special use area for Costal Protection and no development activities have been proposed in the buffer area of Pemayya Bay and the area will be kept as green and shall restrict any activity which may impact protection of Leatherback turtles in the area. **Refer Enclosure 4.**

Further, areas namely Alexandria Bay and Casuarina Bay are located far away and fall outside the project area on the western coast. All these areas including Pemayya Bay have been made part of the leatherback conservation plan. Also, the Pemayya Bay, Alexandria Bay, Casuarina Bay and other potential leatherback turtle nesting sites such as Nanjappa Bay, Dogmar, Pulo Bed, Pulokunji, etc. have been included as part of Leatherback turtle conservation plan. As such, adequate measures have been proposed for protection of nesting beaches and sea turtles including leatherback turtles.

Since effective measures have been proposed for conservation of turtles and their nesting beaches in Great Nicobar Island besides declaration of leatherback turtle sanctuary and protection of nesting beaches in other islands of Nicobar group and Little Andaman, declaration of further WLS in GNI is not proposed.

EAC Comment (xiv):

Wildlife corridors as proposed in above paras can also be declared as Conservation Reserves/ Community Reserves under WLPA.

Response (xiv):

For facilitating movement of wildlife between forest and the seashore to several endemic and endangered wild animals like Nicobar Long-tailed Macaque, Nicobar tree shrew, Robber or Coconut crabs, Saltwater Crocodiles Nicobar Megapod, Nicobar Crake etc. Eight numbers of strips of varying widths ranging from 220 m to 1100 m have been envisaged as a part of dedicated wildlife corridors in the project for unhindered and safe movement of animals to travel freely between the forest and the seashore without crossing the roads. The wildlife corridors have been designated as open green area where no development activities have been proposed and separate Development Control Regulations (DCRs) will be crafted to ensure protection, operation and maintenance of the designated corridors. These will form a part of the overall DCRs which will be formulated at a later stage.

As adequate safeguards and protection from the wildlife corridors have been provided declaring them as conservation reserves /community reserves does not arise.

EAC Comment (xv):

Mangrove Conservation Plan: Mangrove areas falling inside the project areas should be clearly demarcated and area calculated. Total loss of Mangrove cover shall be intimated which shall form the basis for Mangrove Conservation Plan. Detailed Mangrove Conservation Plan should be prepared by PP in consultation with A&NFD which shall include compensatory planting of Mangrove as well as re-densification of the degraded mangrove areas in Great Nicobar, and other islands of Nicobar group and Andaman group of Islands. This plan shall form the part of EIA/EMP reports. PP shall also indicate the time frame for preparation of the plan and its inclusion in the EIA/EMP report.

Response (xv):

The Mangrove Conservation and Management Plan for Great Nicobar Island has been prepared by the Department of Environment and Forests, A&N Administration and the same is enclosed as **Enclosure 18**. Refer **Enclosure 19** for Map for location of mangroves. The mangrove conservation plan is aimed at restoration and restocking of the tsunami impacted mangrove areas besides enhancement/enrichment through plantations. The plan also aims at improving the diversity of mangroves, its richness and stand density through proper assessment of distribution and status of mangrove species found in Great Nicobar Island alongwith the locations. The conservation plan addresses the strategies to restore and revive the mangrove areas through ecological restoration and enrichment planting.

As part of the conservation plan, the following strategies namely establishment of mangrove nursery, habitat enhancement/rehabilitation, mangrove plantation, establishment and management, development of mangrove/plantation techniques, management techniques, revival of critical taxa, research and monitoring and education outreach have been included..

The updated EMP cost is enclosed as **Enclosure 21**.

EAC Comment (xvi):

Coral Conservation Plan: A detailed Coral Conservation/Translocation Plan shall be prepared by the PP in consultation with A&NFD and ZSI following IUCN sp translocation protocols and the same shall be made the part of EIA/EMP report. PP shall also indicate the time frame for preparation of the plan and its inclusion in the EIA/EMP report.

Response (xvi):

The Coral Conservation Plan prepared by ZSI addresses both, the conservation strategies for coral colonies around GNI as well as translocation strategies for ten (10) hectares of impacted corals. A total of 245 species of scleractinian corals under 53 genera and 15 families (including 2 genera under Scleractinia IncertaeSedis) are recorded from seven sites including the Great Nicobar Island. No major coral reef exists within the work area of the project. However, scattered coral reefs are available at the peninsular part of the Galathea Bay.

As part of the assessment for conservation and management of Coral reefs, the Coral cover required to be translocated from the proposed site is around 10 ha which includes around 20668 Coral colonies out of which approximately 16150 colonies will be translocated. The plan addresses the probable sites for translocation, the methodology, the coral colonies for transplantation, conservation and management of coral reefs both at the translocated sites, donor sites and other sites in Great Nicobar Islands. The conservation and management strategies include physicochemical assessment of water, survey methods for macro benthos both qualitative and quantitative analysis, etc. The approximate cost of coral conservation plan is estimated to INR 53.57 Crores. **Refer Enclosure 9** for detailed Coral Conservation Plan.

The updated EMP cost is enclosed as **Enclosure 21**.

EAC Comment (xvii):

Crocodile Conservation and Management Plan: PP shall indicate the crocodile habitats and nesting grounds inside the project area along with the geo coordinates and intimate the status of such crocodile habitat and nesting grounds as per the Action Plan for Mitigation of Human-Crocodile Conflict in Andaman & Nicobar Islands. In case these identified crocodile habitats/nesting grounds are categorized as Crocodile Conservation Zone attempts shall be made to exclude these crocodile habitats/nesting grounds from the project area and in case it is unavoidable to exclude such areas then a crocodile Conservation Plan shall be made by PP in consultation with A&NFD and WII and same shall be part of EIA/EMP reports. PP shall also indicate the time frame for preparation of the plan and its inclusion in the EIA/EMP report.

Response (xvii):

In Great Nicobar Island the crocodiles have been sighted in Magar nallah, Dillon nallah, Vihjay Nagar, Laxmi nagar, galathea bay and navy dera in the project area in the past and also in Casuarina bay and Alexandria bay in the west coast falling outside the project area. The potential habitats include Gandhi nagar, and Shastri nagar, etc. Accordingly, WII has been asked to prepare a crocodile conservation plan. WII has prepared a 'Conservation & Management Plan of Saltwater Crocodile (Crocodylus porosus) in Great Nicobar Island'. aimed at long term conservation of Saltwater Crocodile and its habitat in GNI based on robust scientific data, rigorous monitoring and scientific rescue and rehabilitation practices.

The conservation plan proposes to study the population size, occupancy, ecology and genetics on salt water crocodile of GNI, monitor movement and ranging pattern of different age and sex of individual in selected crocodile habitats and identification of nesting sites, their protection, conservation and management including monitoring of the population including mitigation strategies.

The programme will have the following objectives:

- Identification and characterization of crocodile habitats.
- To ensure public safety through prohibition, regulation and crocodile rehabilitation.
- Improve community awareness for crocodile human coexistence.

The conservation and management plan of salt water crocodile in Great Nicobar Island addresses the issue of creating a crocodile rescue and rehabilitation centre. Based on the outcome of the study and looking at the population size at different crocodile habitats and potential habitats. The management strategies including the spatial planning and zonation will be carried out for effective conservation of the species and its habitats based on the outcome of assessment for status and distribution of crocodiles with their abundance.

The Conservation & Management Plan is divided into two components as Monitoring and Management. The budget requirement for the Monitoring is INR 9.7 Crores and for Management is INR 32.2 Crores. The implementation of the plan will be done in two phases of 5 years each post approval of the plan. Refer **Enclosure 20** for the 'Conservation and Management Plan of Salt Water Crocodile' prepared by WII.

The updated EMP cost is enclosed as **Enclosure 21**.

EAC Comment (xviii):

Wildlife Institute of India should submit detail road map with financial requirement for monitoring Leatherback Turtle movement in GNI and habitat restoration & nest protection measures at all other nesting sites in A & N for minimum 10 years.

Response (xviii):

WII has prepared the plan for Conservation and long-term monitoring of Sea Turtles of the Nicobar Islands with special focus on the Leatherback Sea Turtle for a period of 10 years primarily aimed at conservation of leatherback turtles and other sea turtles in Great Nicobar Islands and other islands in Nicobar group.

The conservation plan will be implemented in two phases and will involve intensive efforts to systematically monitor nesting beaches and at the same time involve extensive use of technology to understand the turtles in the offshore environment.

Phase I will involve the following activities –

a. Population monitoring and nesting ecology
b. Movement Ecology: tracking movements, identification of high use areas in the breeding sites and non-breeding regions
c. Determining foraging areas using stable isotopes
d. Population genetic structure of leatherback turtles

e. Assessing vulnerability of turtle nesting beaches and adoption of appropriate management strategies
f. Multi-stakeholder involvement in the long-term conservation of sea turtles

The Phase II of this conservation plan will focus mostly on building up the scientific knowledge gained from Phase I and incorporate these findings in developing effective site-specific actions for the conservation of sea turtles. The activities listed are proposed to be

taken up during the second phase:

1. Annual population assessment surveys as per the standardized protocol developed during Phase 1.
2. Implementation of site-specific nesting habitat management interventions such as removal of dune vegetation and explore possibility of thinning tree or shrub cover in the immediate vicinity of nesting beach.
3. Implement measures to control introduced predators to eliminate or reduce sea turtle nest predation.
4. Development of site-specific nesting beach management plans
5. Strengthening the research wing of the forest department by conducting special training programs on using advanced scientific tools for data collection and analysis.

The budget requirement for the proposed 10-year Sea Turtle Conservation Plan for the Nicobar Islands is INR 29.83 Crores where INR 20.88 Crores for WII and INR 8.95 Crores for A&N Forest Department for its implementation in two phases. Refer **Enclosure 15** for details of the 'Conservation and long-term monitoring plan'.

EAC Comment (xix):

SACON/ Wildlife Institute of India is requested to submit Nicobar Megapod monitoring and conservation plan for minimum 10 years.

Response (xix):

As desired by EAC under conclusion and recommendation, the SACON/WII were asked to submit a Monitoring and conservation Plan for a minimum period of ten years and both the institutions have been asked to submit a joint proposal for monitoring and conservation plan for Nicobar megapode for ten years. They have also been requested to take on board any scientists or organisations working on this particular species at present or in the past, in the interest of conservation of the said species and its habitat. However, in spite of our efforts to get a proposal jointly from WII/SACON, both the institutions have submitted a separate proposal.

The Conservation and monitoring plan submitted by WII focuses on the standardisation of population estimation techniques for Nicobar megapode across its distributional range to understand population trend of the species over time (long-term), role of habitat features in structuring megapode populations within and across islands, nesting patterns of the Nicobar Megapodes across ecological gradients and document potential factors that influence their reproductive success, fine-scale movements and ranging patterns of Nicobar Megapodes within and across islands using advance technology, investigate dispersal, colonisation and meta-population dynamics of Nicobar Megapode populations across the islands, threat assessments to the Megapode populations due to natural and anthropogenic drivers through vulnerability and risk mapping and create awareness among local communities on the Nicobar Megapode and assist in the identification and establishment of Conservation Areas and conduct capacity-building programs for

local stakeholders for effective conservation of Nicobar Megapodes. The expected outcome of the implementation conservation and monitoring in next 10 years will provide population estimation of Nicobar Megapode and population trend across all the Islands on an annual basis, standardised protocol for long-term population monitoring, habitat and diet requirement of Nicobar Megapode, baseline information on the breeding strategies, breeding success, and nest site preferences of Nicobar Megapode, the genetic diversity and genetically distinct populations, magnitude of genetic flow and dispersal within and between Islands, habitat suitability models developed considering current drivers and future scenarios, risk assessment and vulnerability mapping with regard to various drivers, identified sites for establishing conservation reserves for in-situ conservation, and capacity developed among front-line forest staff on population monitoring techniques, data collection and compilation. The budget requirement of Rs. 22.02 crores is projected for implementation of the plan in next 10 years.

The SACON submitted a comprehensive conservation plan for nicobar megapode and the proposed plan focuses on standardised population monitoring protocol, distribution of the Nicobar megapode, Spatio-temporal monitoring, identification of the critical breeding habitats, study the breeding ecology to strategies for future interventions, monitoring of the movement pattern, landscape level habitat use, dispersal ability, and colonization, genetic diversity, assessment of the threats to Nicobar megapode to provide site/island-specific interventions, development and implementation of a participatory conservation model through capacity building and awareness, development and implementation of a relocation and captive management plan for the Nicobar megapode population in the proposed project site. The budget requirement for the proposed Comprehensive Plan for Nicobar Megapode Conservation in the Nicobar Archipelago is INR 18.21 Crores for its implementation in two phases.

Since WII has been identified as a scientific agency to prepare and implement conservation plans for leatherback turtles and saltwater crocodiles and to have proper coordination in the field, it is suggested that WII may include SACON and implement the conservation plan. Coordinated and collaborative research will have better outcome and in the larger interest of the endemic species of Nicobar megapode, WII may co opt SACON in implementation of the plan. They can also include institutions like ZSI as ZSI has worked on the species in the recent past and have come out with the mapping of the megapode mounds in Great Nicobar Island.

Refer Enclosure 16 A Comprehensive conservation plan –Long term monitoring and conservation of the endemic Nicobar Megapode in the Nicobar Archipelago submitted by WII, Dehra Dun.

Refet Encloser 16 B ‘Comprehensive Plan for Nicobar Megapode Conservation in the Nicobar Archipelago’ submitted by SACON, Coimbatore.

EAC Comment (xx):

The PP has to submit revised ICRZ recommendation letter issued on 22/03/2022 by Andaman & Nicobar Islands Coastal Zone Management Authority (ANCZMA) especially regarding effective ICRZ area involved in various activities has been revised and part of holistic project now declared for Defence, Strategic, National Security, and Public Purpose.

Response (xx):

Revised ICRZ recommendations have been received via letter ‘No.PCCF/EPA/1/Vol-XVI/154, ANDAMAN & NICOBAR ADMINISTRATION, DEPARTMENT OF ENVIRONMENT AND FORESTS, PCCF (CRZ & FC) / Nodal Officer, FCA & MS, A&N CZMA/ VAN SADAN, HADDO, PORT BLAIR, Dated 8th July,

2022’ addressed to Additional Director and Member Secretary (CRZ), Ministry of Environment, Forests and Climate Change, Government of India. **Refer Enclosure 13.**

The master plan has been revised based on these recommendations. **Refer Enclosure 2.**

Other Critical Comments

EAC Comment (1):

Zonal plans to be provided for Phase I area.

Response (1)

Following are the details of the zonal plans developed.

The key strategic development in the Great Nicobar Island such as the Port, Airport, ICTT will be supported with the development of a 'Township'. The total area of the proposed Township is about 150 sq.km. The Township comprises of a mix of land-uses including the following –

I. Residential

The Residential component comprises of areas with mix of residential densities. The residential development is envisaged to cater to the resident population of about 3,83,000 (Including existing population with projections and defence population). This will comprise of different types of dwelling units.

The residential mixed-use will comprise of compact, walkable, high-density residential development located near transit stations or adjacent to Commercial Mixed-Use districts. Multiple housing types are envisaged. Neighborhood serving commercial development is also permitted. The mixed-use zone will have high quality public realm.

The residential medium density will comprise of compact, walkable, high-density residential development. The residential medium density will have multiple housing types for the residential purpose only. The apartment typology will be larger than high density units but are envisaged as low-rise.

The residential low density will comprise of single-family villa type development. These will be limited in number.

II. Commercial development – Commercial Mixed-Use, Commercial Office, Commercial tourism and hospitality

The commercial mixed-use development will comprise of offices, retail, hotels, food and beverage, entertainment, institutional uses, and multi-family residential development. Envisaged as a compact, walkable, medium-density mixed-use development located in city Centre or near transit stations. The development will have high quality public realm.

Commercial offices areas will have multi-storey development with high quality public realm.

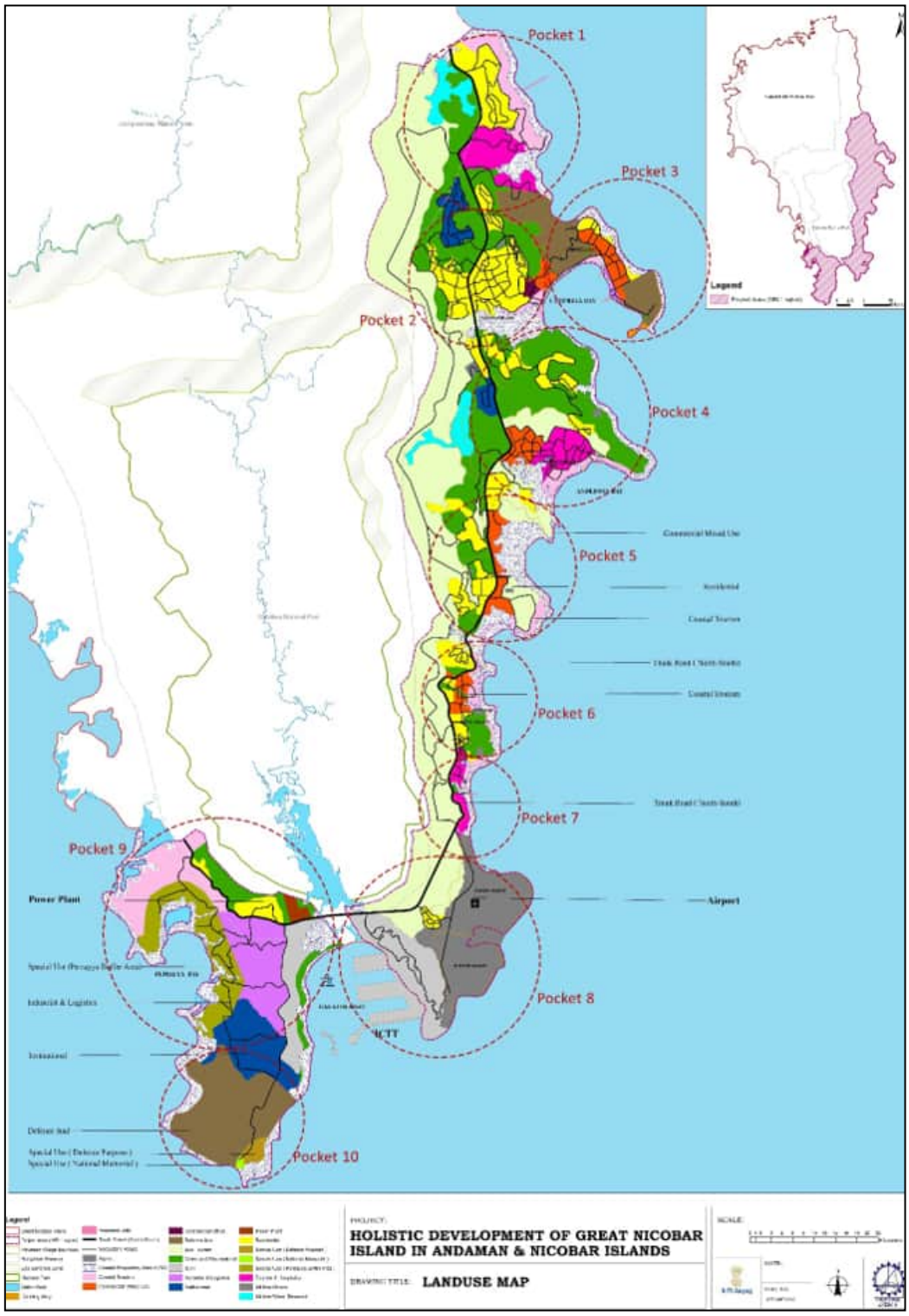
The commercial tourism and hospitality will comprise of hotel, food & beverage outlets, entertainment areas, retail outlets, MICE (Convention Centres, etc.) along with staff housing. This is envisaged as walkable medium- to low-density development at the edge of town centres.

III. Institutional uses – Urban Social Infrastructure, Institutional Campus

The mix of uses is complemented by supporting social infrastructure. The social infrastructure requirements are computed based on the prevailing standards prescribed under the URDPFI

guidelines. An illustration of the pockets 1 to 10 is provided in the Figure below. The pocket 10 will hold regional facilities which will be used for the entire captive population on the Island as well as the visiting population.

For Zonal Plan development, 10 pockets have been identified and the landuses have been compartmentalized along with social infrastructure requirement which have been computed based on population envisaged to be residing in each pocket.



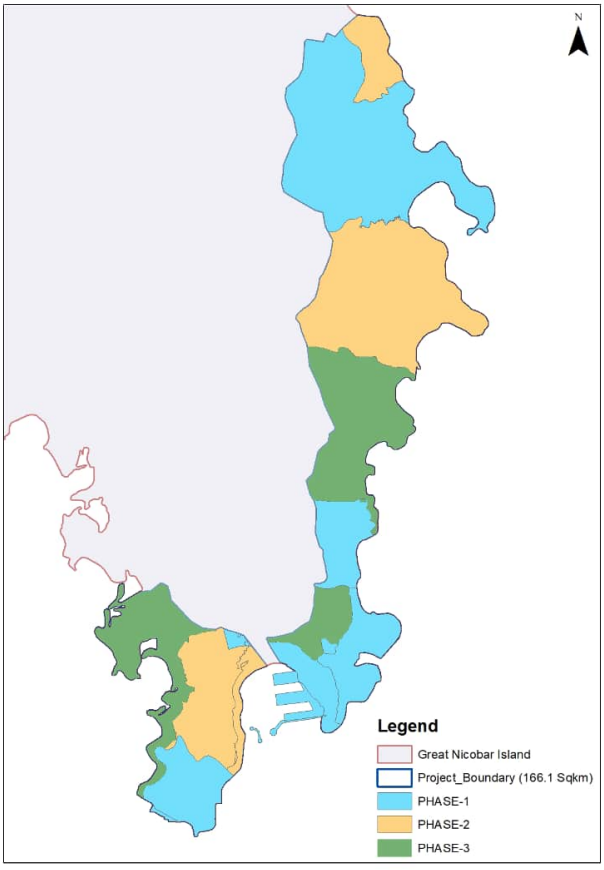
Development proposed within the identified zones in Phases is as below:

Development Phases	Zones for development	area (Sq.km.)	Residential population
Phase I (5 year)	Pocket-2	18.23	1,64,512
	Pocket-3	4.76	
	Pocket-7	4.20	
Phase II (10 year)	Pocket-1	26.92	1,08,678
	Pocket-4	31.66	
Phase III (15 year)	Pocket-5	14.21	1,10,672
	Pocket-6	9.46	
	Pocket-9	25.10	

Notes:

- entire trunk infrastructure including the North South road is proposed to be developed in Phase I.
- for development of Pockets, the complete infrastructure will be developed in each pocket at the onset of designated Phase but the complete habitation/ occupancy will spill into subsequent Phases also. The infrastructure will be planned for maximum population in Pocket.
- Pockets for defence, ICTT, Airport are in addition to the above mentioned details.

Proposed Phasing plan



Zonal Plan level Social Infrastructure Framework:

The key strategies and recommendations for each community level amenity to be provided in the specific pockets/ Zones is as below:

Education

The following considerations have been taken into account while spatially locating the education related facilities within the GNI planning area:

i. Clustering nursery and primary schools that are located away from main arterial roads and have been located close to neighborhood streets and adjacent to neighborhood parks due to safety and security concerns.
ii. Secondary schools have been located along primary roads for ease of access and traffic movement. Secondary schools are located such that they serve multiple neighborhood clusters.
iii. Integrated Schools have been located such that they can be accessed from the primary roads and are central to the inhabitants of the GNI planning area.
iv. The higher education or skill development component including Vocational Training Centre have all been placed close to Arterial roads for easy access.

Residential Amenities

Subsequent considerations have been taken into account while spatially locating the residential related facilities within the GNI planning area:

i. Clustering old age homes with orphanage/ childcare center that are located away from main arterial roads and have been located close to neighborhood streets and adjacent to neighborhood parks due to safety and security concerns.
ii. One working men – women hostel is also proposed for the people coming here for work for short duration.
iii. All these social residential facilities are located with easy and safe access and are to be connected with parks or natural scenic areas.

Community shopping facilities

While spatially locating the amenities necessary for the daily functioning of the communities, which would reside in the neighborhoods, the stated considerations have been taken into account:

i. Provision of a day care center along with an Aanganwadi to cater to the changing Indian family demographics where both husband-and-wife work. Such facilities would address the early child development needs both for skilled workers as well as workers' families those would be working in the industrial development.
ii. Aanganwadi and day care facility have been clustered with Open Green Spaces and other health and education facilities. They have been located both in residential and industrial uses.
iii. Community markets and informal bazaars have been located within the neighborhood centers for the convenience of the residents. One such facility has been located in each residential cluster. Informal bazaars are an important center of economic activity at community level while serving needs of inhabitants. In order to avoid a situation where community level markets, such as farmers market, whole sale vendors, etc. haphazardly

utilize spaces creating traffic or cleanliness issues, they have been clustered with community markets with dedicated spaces.

Community Healthcare

Considering that Great Nicobar Island is not well developed and is mostly rural in nature, there is complete lack of healthcare facilities. In future for the communities to come and settle in the GNI planning area, it is paramount that certain healthcare facilities must be provided.

Listed are the considerations for the spatial location of healthcare facilities:

i. The approach for the provision of Health Care facilities within the GNI planning area is that of clustering similar facilities in one location for optimum use of land, hence healthcare facilities such as Family Welfare Centre, Paediatric Centre, and Geriatric Centre, etc. are clubbed together.
ii. Hospital serving a larger population has been located close to arterial road, at a central location from the perspective of visibility, access and catchment area. Healthcare is an essential requirement for any industrial area to deal with industrial accidents in case of disasters and also to cater to health needs of the resident population.
iii. The dispensary and polyclinic have been distributed throughout the GNI planning area and have been clustered within neighborhood centers in residential areas as well as mixed use / commercial areas.

Community level cultural/recreational amenities

In order to create livable places within the GNI planning area, a strong educational, entertainment and cultural mix has been proposed so that residents, visitors and workers of all age groups have an opportunity to live-work-play-relax-recreate. This coupled with public arts to visually enhance the look and feel as well as to spread awareness about cleaner and greener city will not only promote local artists to engage in community development but will also generate employment. In addition to the above, provisions such as religious places, socio-cultural centers, multi-purpose community halls and cinema halls have also been proposed. Following are the considerations have been taken into account while spatially locating the cultural and entertainment related social amenities:

i. Religious centers are provided within neighborhood centers in residential areas as well as clustered with other community amenities in the industrial area. These have also been clustered with Open Space and other community amenities.
ii. Banquet halls have been provided in residential areas, in the neighborhood centers and at some locations clubbed with religious centers.
iii. Cinema halls have been located along major roads and clubbed together with other cultural and entertainment facilities such as socio-cultural center and multi-purpose hall.
iv. Socio-cultural centers have been clubbed with other cultural and entertainment facilities to create a social event destination.

Other community facilities

Apart from the above-mentioned social amenities certain other community facilities are also required to be considered for the efficient functioning of new communities in the future development.

Following are the considerations for spatial distribution of the other community facilities:

i. Police posts have been provided along primary roads for visibility and ease of access during emergency situations. They have been clustered with other community amenities.
ii. Fire station's locations have been distributed between residential and industrial areas. They have provided along primary roads for ease of access during emergency situations.
iii. Facilities such as three-wheeler and taxi stand have been located within easy walking distance for inhabitants within the residential areas and clustered with other community amenities in the industrial areas. They have also been located along with commercial amenities, jobs, schools, medical facilities, entertainment, and cultural amenities and distributed throughout the GNI planning area. In addition to the private vehicles and transit that people will use for mobility, three wheelers and taxis form an important mode of transport and are an integral part of a multi-modal transportation framework. Whether land is allocated for such amenities or not, they will still be serving transport needs of the inhabitants but in the process, this will cause traffic disruption and conflict with the pedestrian movements since they have nowhere to park. It's evident in our existing cities where such a provision has not been kept and has resulted into troubles.
iv. Bus stops are located along major arterial roads based on ease of access considerations.
v. Petrol pumps have been distributed throughout the GNI planning area. They are clustered together with other amenities such as convenience retail. As per the URDPFI standards higher numbers of petrol pumps are required but after spatially locating these adjacent to other community amenities, a comparatively lesser number is provided as the GNI development is a linear development and does not have large spread catchment. This was also done to avoid isolated land parcels dedicated only for petrol pumps.
vi. Along with the petrol pumps, it is recommended to make provision for electric car charging stations. With the rapid changes in technology and greater awareness about our environments, electric cars are the near future. Electric cars are already in operation in India but at a small scale.
vii. LPG godowns have been provided primarily in the areas away from core residential areas.

Social Infrastructure distribution strategy

For the zonal plan exercise the distribution of community amenities is based on the standards specified in the URDPFI guidelines and the Delhi Master Plan. Based on the comparison matrix, the detail zonal plan exercise arrived at certain assumptions for community amenities distribution and their related sizes.

The distribution of the community amenity has been done on the basis of population thresholds. The minimum unit of population considered for the provision of community amenities is that of 5000 people. The below illustrator shows pocket wise population and area reservation for social infrastructure.

Pocket No.	Design Population*	Proposed area in each zone for social infrastructure (Ha.)
Pocket-1	49,852	51
Pocket-2	109,675	94
Pocket-3	29,911	37
Pocket-4	44,867	60
Pocket-5	69,793	54
Pocket-6	34,897	57
Pocket-7	19,941	40
Pocket-9	19,941	21
Pocket-8	4,985	Pocket 8 consists of Port and Airport which planned for all required social and physical infrastructure within their boundaries. Pocket 10 will not have residential areas
Pocket-10	-	

* the population projected is ultimate population in each pocket and will spread over all proposed Phases.

Along with the assumed population threshold, spatial testing of community amenities was conducted, context and access criterion were also considered in order to determine the ideal location for such facilities. For the GNI planning area, the strategy included identification of three typical neighborhood centers that included:

- Centre for residential areas including existing villages
- Centre for commercial and institutional areas
- Non-residential areas including port & airport

Provided that each of the abovementioned centers should provide amenities catering to the needs of the land use category they fall in, accordingly community amenities were distributed.

For residential areas strategy included clustering education, health, community amenities/facilities, neighborhood level commercial, EWS and other compatible amenities can be clustered together around or along an open green space. By doing so, the neighborhood centers would become nodes of social, cultural, economic activities at a neighborhood level that are walkable and centrally located with neighborhood clusters.

For commercial and institutional the strategy included clustering health, community amenities/facilities, neighborhood level commercial, and other compatible amenities can be clustered together around or along an open green space.

The community amenities for the GNI planning area are divided into six broad categories, namely education; residential; local retail/shopping; healthcare; cultural/ entertainment; and other facilities.

Below illustrator shows the social amenities distribution for each of the pockets:

Educational
- E0 Nursery + Primary School
- E1 Secondary School
- E2 Integrated School w/oHostel facility
- E3 Integrated School w/Hostel facility
- E4 College
- E5 Scientific Research Institute
- E7 Vocational Training Centre
- E14 Sports Institute

Shopping
- S0 Convenience Shopping
- S1 Local shopping including service centre
- S2 Community Market + Informal Bazar
- S3 Community Centre with service centre
- S4 Zonal Commercial Centre
- S5 Weekly Markets
- S6 Organised Informal eating spaces
- S7 District Centre
- S8 Service Market
- S9 **Regional Retail Centre/Mall**

Residential
- R0 Old age home
- R2 Working men-women hostel

Health Care
- H0 Dispensary/ Poly Clinic
- H1 Nursing home/ Poly Clinic +
- H2 Maternity Home
- H3 Hospital A (100- 200 beds)
- H4 Hospital B (20-80 beds)
- H5 Multi speciality hospital(100-200 beds)
- H6 General Hospital (300-500 Beds)
- H8 Family Welfare centre +Paediatric Centre + Geriatric Centre + Diagnostic Centre

Community Facilities
- C0 Aanganwari + Day Care Facility
- C1 Religious Center_01
- C2 Community Room
- C3 Community Hall, library+ Banquet Hall
- C4 Multipurpose Community Hall
- C5 Music, dance and drama centre
- C6 Meditation and Spiritual Centre
- C7 Recreational Club
- C8 **Cinema Hall (LIG)**
- C9 Community level Multipurpose ground
- C10 **Socio Cultural Center**
- C11 **District level multipurposeground**

Community Facilities (other)
- F0 Public Library
- F3 City Museum
- F4 Exhibition cum fair ground
- F5 Milk Distribution
- F6 LPG Godown/Gas godown
- F7 Sub fire station/Fire post (3-4 km radius)
- F8 Fire Station (5-7 km radius)
- F9 Police Post
- F13 **Civil defence and home guards**
- F14 **Head Post Office and Administrative Offic**
- F16 **Telephone Exchange**
- F19 **Police line**
- F20 **Dhobi Ghat**
- F21 **"Cremation ground"**
- F22 **Burial ground**
- F23 **"Electric Cremation"**
- F24 **"Passenger intermodel transport facility"**
- F29 **"Reservation/Check-in Counters"**
- F30 **Public Toilet**
- F31 **Urban Haat**
- F32 **Petrol Pump**

Pocket 1

				C0	09				
				C1	08	F5	09		
				C2	09	F6	01		
				C3	03	F7	01		
				C4	01	F9	01		
		S0	10	H4	04	C6	01	F20	01
E0	10	S1	02	H1	01	C7	01	F29	01
E1	03	S2	02	H2	01	C8	01	F30	10
E2	01	S3	01	H4	01	C9	01	F32	01

Pocket 2

				C0	14				
				C1	14	F5	18		
		S0	20	H0	06	C2	16	F6	01
E0	22	S1	04	H1	01	C3	05	F7	02
E1	05	S2	04	H2	01	C4	01	F8	01
E3	01	S3	01	H3	01	C5	01	F24	01
E4	01	S4	01	H6	01	C7	01	F30	13
E5	01	R0	01	S6	01	H8	01	C12	01	F32	01

Pocket 3

						F5	07		
						F6	01		
						F7	01		
				C0	05	F13	01		
				C1	05	F14	01		
		S0	05	C2	04	F19	01		
E0	06	S1	01	C7	01	F22	01		
E1	02	S2	02	H0	02	C3	01	F29	01
E2	01	S5	01	H2	01	C7	01	F30	06

Pocket 4

						F0	01		
		S0	10			C0	10	F5	10
		S1	04			C1	08	F7	01
		S2	03			C2	09	F16	01
E0	09	S4	01	H0	05	C3	02	F29	01
E1	03	S5	01	H1	01	C4	01	F30	11
E2	01	S6	01	H4	01	C5	01	F31	01
E14	01	S9	01	H8	01	C8	01	F32	01

Pocket 5

						C0	15		
						C1	11		
						C2	11	F5	14
		S0	16			C3	03	F6	01
		S1	05			C5	01	F7	02
		S2	04	H0	08	C6	01	F8	01
		S3	01	H1	01	C7	01	F9	01
E0	14	S5	01	H3	01	C8	01	F29	01
E1	01	R0	01	S7	01	H4	01	C11	01	F30	17

Pocket 6

						C0	07		
						C1	07	F3	01
		S0	07			C2	07	F4	01
E0	07	S1	03	H0	05	C3	02	F5	08
E1	02	S2	01	H1	01	C4	01	F6	01
E2	01	S3	01	H2	01	C8	01	F7	02
E5	01	S6	01	H6	01	C9	01	F30	09
E7	01	R2	01	S8	01	H8	01	C12	01	F32	02

Pocket 7

						F5	05		
						F6	01		
						F7	01		
						F8	01		
		S0	04			C0	04	F9	01
		S1	02	H0	03	C1	05	F24	01
E0	04	S2	01	H1	01	C2	05	F29	02
E1	01	S4	01	H3	01	C3	01	F30	09
E7	01	S5	01	H4	01	C6	01	F32	01

Pocket 9

						F5	05		
						F6	01		
						F7	02		
				C0	03	F9	01		
				C1	05	F20	01		
		S0	04	H0	04	C2	06	F21	01
		S1	02	H1	01	C3	02	F23	01
E0	04	S2	01	H3	01	C5	01	F30	06
E1	01	S4	01	H8	01	C9	01	F32	01

Pocket 8 consists of the Port and the Airport. Pocket 10 is part of the township, but will not have a captive population. Regional facilities are being proposed which can be used by all residents.

EAC Comment (2):

Gas-based power plants on the eastern part of GNI instead of at Galathea Bay.

Response (2):

The proposed location was finalised after conducting detailed assessment of 3 alternate sites which were filtered using environmental and technical parameters forsiting the proposed power plant.

The alternative sites were examined for the development of the Power Project facilities for

selection of the most suitable site based on the multi criteria analysis which include the following criteria:

- Fuel supply source and transportation
- Equitable growth of different areas
- Proximity of shipping routes especially for the site under question
- Open, level and well drained site.
- Environmental concerns, such as National Parks, Tribal areas etc
- Earthwork Economics
- Connectivity, access to population centres; existing roads vis a vis new developments/ alignment.
- Storage space of fuel
- CRZ etc.

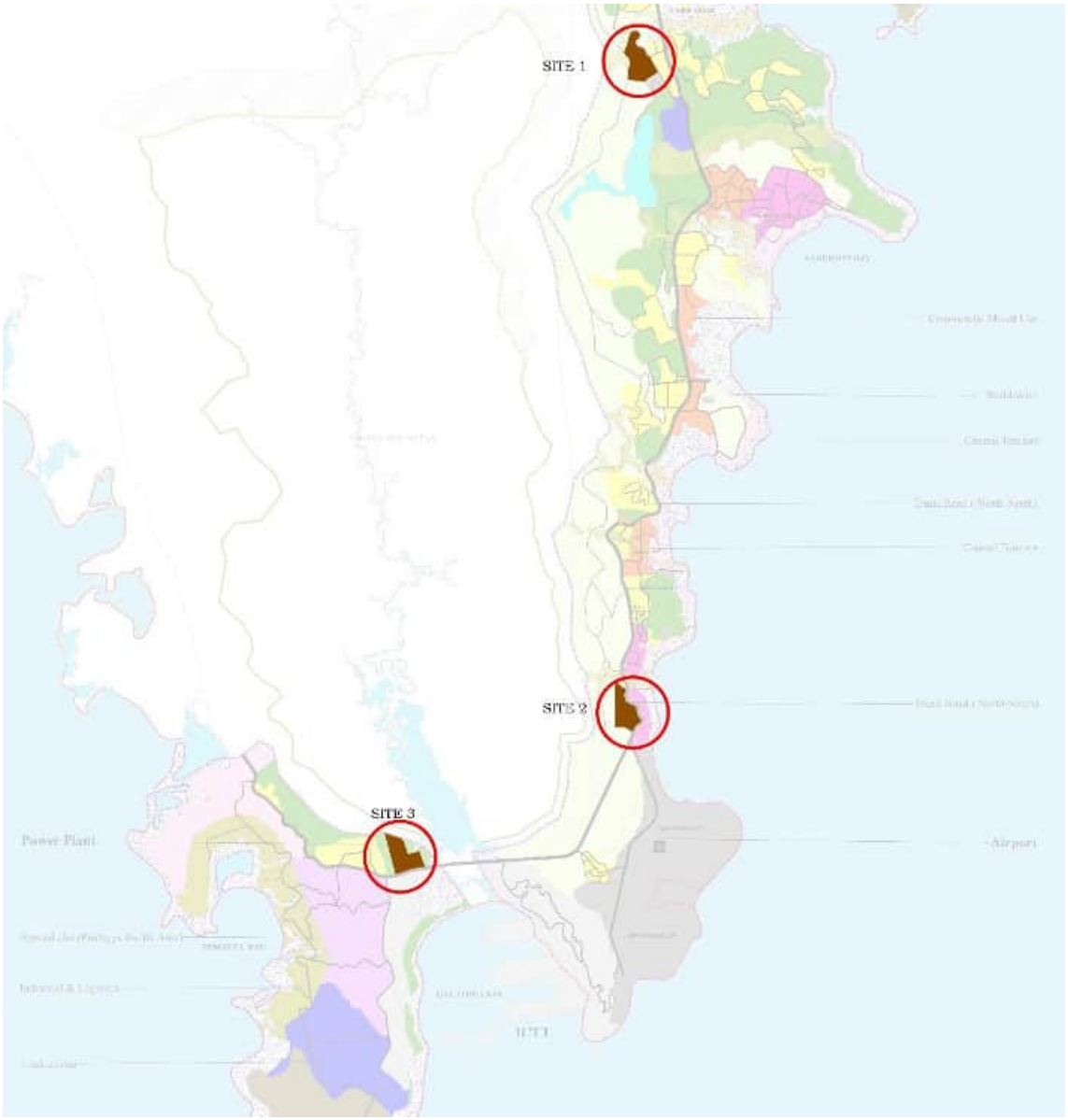
Based on the parameters three sites were assessed for suitability. These include the following:

- **Alternative Site 1 – Near Campbell Bay**
  Proposed site falls near the Campbell Bay with the vicinity of INS BAZZ airstrip, permanent settlements and habitation. The proposed location has densely populated development and defence land. It is in a highly restricted zone. The site is coming close to the revenue land; hence the land cost shall be high. The cost of transportation of fuel (gas and fuel) shall also be expensive, as it is at far distance from the proposed Trans-shipment terminal, hence generation cost shall be on higher side.

- **Alternative Site 2 – Near Shastri Nagar**
  Proposed site falls near the Shastri Nagar residential area with the vicinity existing settlements and habitation. The proposed location is under densely populated development and shall have influence on population from the view of environment sustainability. The site is coming near the revenue land, so the land cost is high and transportation of fuel (gas and fuel) from long distance shall also be expensive, hence generation cost shall be on higher side.

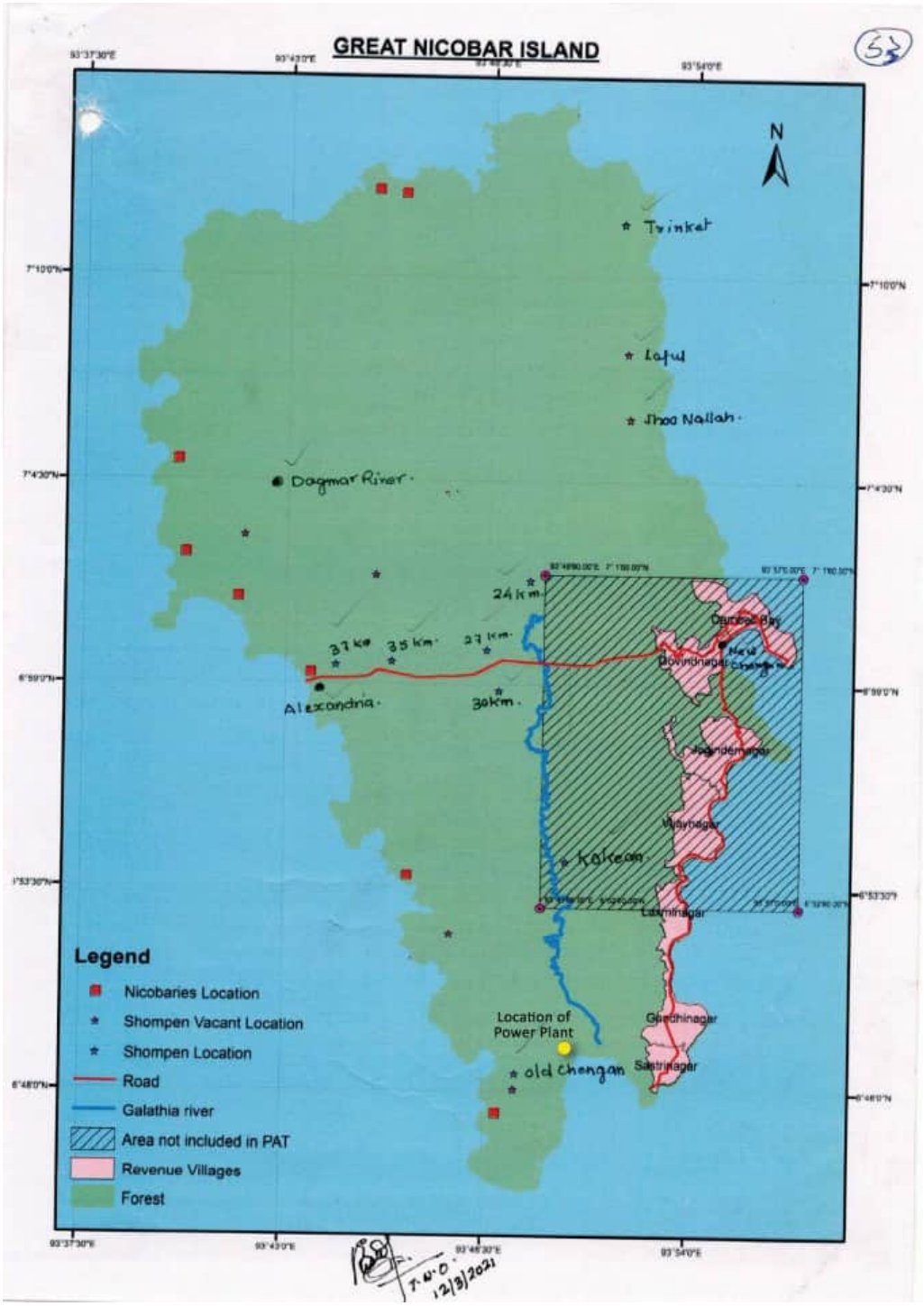
- **Alternative Site 3 – Near Proposed Trans-shipment Terminal**
  This site is located near the southern tip of the Great Nicobar Island near to the Proposed Trans-shipment Port Terminal. The Proposed Site is not habituated and has no streams/ ponds. The Land cost and transportation of fuel (gas and fuel) shall also be cheaper comparison to other sites; hence generation cost would be cheaper.

Above three alternative sites were examined for the proposed LNG and Diesel Based power plant. The alternate sites for Power Plant are shown in Figure below.



Based on assessment of all three sites, the present location was found to be most suitable from an environment, ecological and economic perspective. Proposing power plant away from Port is not technically and environmentally feasible and may have a severe impact on the rest of the development. It is thus recommended to consider the site as per granted TOR.

The below map illustrates location of Aboriginal tribes as identified on the island. The proposed location of Power Plant site is not overlapping with any Shompain or Nicobaries tribes habitats. The Old Chingen village which was rehabilitated after Tsunami of 2004 is also approximately 2 kms from proposed power plant site.



EAC Comment (3):

The clarity on power demand for phase 1 to be estimated and based on that gas/solar based power generation to be proposed. The numbers are to be quantified.

Response (3):

In Phase I, the Solar Plant of 20 MVA capacity is proposed to be constructed over the water reservoir on an area of 0.5 Sq.km.

For Phase-II and III the balance 80 MVA is also proposed over the water reservoirs on an area of about 1.75 sq km.

Total Power Demand and supply through various options is as below:

Phase	Year	Power Demand (MVA)	DG Capacity installed (MVA)	Gas Capacity installed (MVA)	Solar Capacity Installed (MVA)	Total installed capacity (MVA)
Phase I	1	2	5	0	0	5
	5	35	40	50	0#	90
Phase II	10	106	40	100	20	160
	15	181	0*	150	70	220
Phase III	20	253	0*	250	100	350
	25	293	0*	300	100	400
	30	350	0*	300	100	400

* *though there will be a backup power of 40 MVA installed capacity available through DG's but it shall only be used as contingency power.*

\# *though the floating solar power plant will be commissioned by end of year 5 in Phase I, but can be operationalised from Phase II onwards.*

i. The above table states, the source of power planned to meet the power demand against the respective year/phase. Since the proposed development being a greenfield development, and the gas-based power plant construction and commissioning is linked to Port, which is also a green field development, therefore in the initial phase of development, the power demand shall be meet through DG sets. DG sets are planned for about 40 MVA), which shall suffice for 3-5 initial years. These shall keep on operating till the other sources such gas based power plant and solar power plants are operational.

ii. The First phase of Gas based power plant shall be operational by end of 5th Year in line with commissioning of Port.

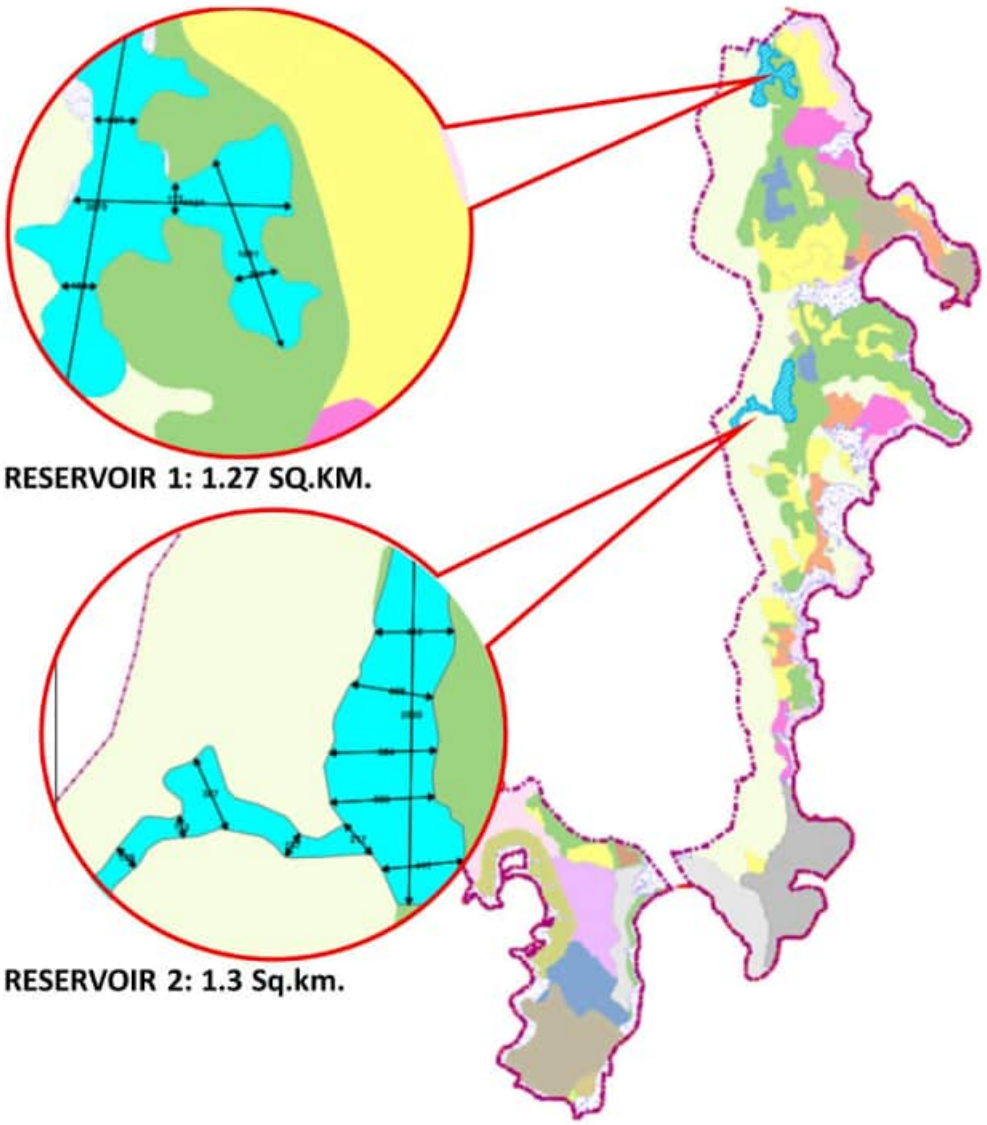
iii. The Solar Plants are planned over the water reservoirs. The Phase -I water Reservoir would require about 12 months for commissioning, hence the solar plant for Phase-I about 20 MVA can be commissioned by end of 24 months to add to the facility. However, as cited above since the DG sets proposed can meet the power demand till about the 4th Year, the solar will be commissioned by end of 5th year, so to be operational in Phase-II. The area required for 20 MVA would be about 0.4-0.5 sq m which is in line with the area required for Phase-I Water Reservoir of 0.5 sq km.

iv. A Total area of about 2.57 sq km is en-marked for reservoirs for the full development for all phases. As a fall-back option, in the case of contingency against the commissioning of gas based power plant, the water reservoirs can be developed, over which about 90-100 MVA of Solar plant systems can be erected and commissioned to meet the power demand.

v. In addition to the above,

- Buildings shall be mandated to have rooftop solar panels as per IGBC green-building requirements
- All efforts shall be made for additional installation of solar panels over the areas which have no environmental constraints.

Location of Floating Solar Power plant in the proposed water reservoirs



Advantage of floating Solar Power Plants:

At COP-26 in November 2021, Prime Minister Narendra Modi announced that India plans to reduce emission intensity by more than 45% by 2030 to below 2005 levels. He also announced a net-zero by 2070 target. Central Electricity Authority forecasts that the country's reliance on coal to drop from 53% of installed capacity in 2021 to 33% in 2030, whereas solar and wind together make up 51% by then, up from 23% in 2021.

The proposed Solar Plant at GNI is in line with Government of India objective to minimise dependency on fossil fuels. Solar energy has significant environmental benefits, and floating solar panels will undoubtedly contribute to those benefits. The water in floating solar panel installations doesn't only cool the solar-powered systems, but it also works the other way. The floating solar panel installation gives shade to the water body and minimizes evaporation in ponds, reservoirs, and lakes. Water loss due to evaporation can mount up over time and lead to a shortage.

The shade provided by the floating solar panels may aid in the reduction of algae blooms in freshwater. Algae can be hazardous to human health if found in a source of drinking water, and it can also cause the death of aquatic plants and animals. source: https://thesolarlabs.com/ros/floating-solar-farms/

The proposed floating solar power plant is not on any natural reservoir. It is proposed to be installed on the man made reservoir for supplying water to the proposed development. All parameters for ensuring the quality water is preserved shall be adopted while designing the reservoir and its floating solar plant. There will not be any impact on the water quality of the reservoir from the solar floating plant.

India is actively promoting commissioning of floating solar power plants as they demonstrate multiple benefits as compared to land based solar power plants. India’s largest floating solar plant is now fully operational at Ramagundam in Telangana’s Peddapalli district. The 100-megawatt (MW) floating solar power photovoltaic project was commissioned by the National Thermal Power Corporation, the country’s foremost public-sector power generator.

Tata Power Solar Systems, in July 2022 have commissioned 101.6 Megawatt Peak (MWp) in Kerala backwaters. The project is installed on a 350-acre water body in Kayamkulam, Kerala

EAC Comment (4):

PP shall submit the number of mounts of Nicobar Megapod are located over the proposed area and its impact on mounts shall be mapped, it is also requested to submit the measures taken for its protection and sustainability for Migratory birds.

Response (4):

Refer **Enclosure 17** for the number of mounts of Nicobar Megapode and their location as per information from the ZSI on Nicobar Megapode. Refer the **Enclosure 16** for 'Comprehensive Plan for Nicobar Megapode Conservation in the Nicobar Archipelago' prepared by SACON.

EAC Comment (5):

Evacuation plans for natural disaster needs to be spelt out clearly and in detail since this area is prone to Tsunami, frequent earthquakes and Cyclone etc.

Response (5):

An 'Evacuation Plan' has been prepared and the details of the same are given below.

Evacuation Plan

Andaman and Nicobar Island (ANI) is seismically very active and is situated in Zone V of Seismic Zoning Map of India (as per IS-1893 Part 1-2002). These islands are one of the Multi hazard prone areas of India.

Disasters for which action plan is prepared are:

- Tsunami
- Cyclone
- Earthquake

The above disasters require immediate actions to support and facilitate with basic shelters, food and medicines.

To make the workable action plan the plan or the Standard Operating Procedure (SOP) is sub divided into five major sections as listed below:

(i) Preparedness Phase
(ii) Early Warning Phase
(iii) Response Phase
(iv) Relief Phase
(v) Restoration Stage

(i) Preparedness Phase – This phase will include taking all necessary measures for planning, capacity building and other preparedness so as to be in a state of readiness to respond, in the event of a natural disaster. This Stage will also include development of Search & Rescue Teams, mobilization of resources and taking measures in terms of equipping, providing training, conducting mock drills/exercises etc.

It has been presumed that in case of a big Tsunami, a 20 m wave may strike GNI. This large wave may be followed by smaller waves. The affected area includes, part of coastal tourism area, and few pockets of commercial, Institutional land uses. (map 1 showing the proposed location of Tsunami Shelters)

As per the design Indian Tsunami Early Warning System (ITEWS), the early warning will come between 10 to 20 minutes time. In case of emergency, one can rush to upto to 2.5 km distance approximately. Some can walk to the nearest higher levels (above 20 M) in the development area. The areas above 20 m should be designated and published widely amongst residents and visiting population. Those who cannot move to higher places due to distance, can rush to nearby tsunami centers. It is proposed to construct tsunami wave resistant structure at 2.5 km where those who present during the incident at below 20 m level can rush to the designated buildings. These building will have Tsunami and Earthquake resistant design. These shelters can also be used post an earthquake event or during a heavy cyclone event.

During the incident of Tsunami, people from the affected area who might be present at the affected areas can rush to the tsunami resistant buildings. The tsunami resistant buildings during normal time can be used as School, community centers, club houses, community centers etc.

The ITEWS provides a warning of incoming tsunami between 10 to 20 minutes. An application will be developed linking to ITEWS which can be downloaded to all mobile phones. Adequate budgetary provisions have been kept in the EMP. It will be mandatory for all the tourists, workers or anyone entering the development area to have this app on their mobile device so that they get the warning for an intending tsunami.

(ii) Early Warning Phase – This phase will include all necessary measures to provide timely, qualitative and quantitative warnings to the disaster managers to enable them to take preemptive measures for preventing loss of life and reducing loss/damage to the property. On the occurrence of a natural disaster or imminent threat thereof, all the concerned Agencies will be informed/notified for initiating immediate necessarily follow up action.

The Ministry of Earth Sciences has established the Indian Tsunami Early Warning System (ITEWS). The ITEWS was established in 2007 and is based at & operated by Indian National Center for Ocean Information Services (INCOIS), Hyderabad. The ITEWS is an integrated effort of different organizations including the Department of Space (DOS), Department of Science and Technology (DST), the Council of Scientific and Industrial Research (CSIR), Survey of India (SOI) and National Institute of Ocean Technology (NIOT).

The ITEWS comprises a real-time network of seismic stations, Bottom Pressure Recorders (BPR), tide gauges and 24X7 operational tsunami warning centre to detect tsunamigenic earthquakes, to monitor tsunamis and to provide timely advisories to vulnerable community by means of latest communication methods with back-end support of a pre-run scenario database and Decision Support System (DSS).

The ITEWS has the responsibility to provide tsunami advisories to Indian Mainland and the Island regions. It is capable of issuing Tsunami bulletins in less than 10 minutes after any major earthquake in the Indian Ocean thus leaving us with a response/lead time of about 10 to 20 minutes for near source regions in the Andaman & Nicobar and a few hours in the case of mainland.

The ITEWS disseminates tsunami bulletins to various stakeholders through multiple dissemination modes simultaneously (Fax, Phone, Emails, GTS and SMS etc.). Users can also register on the website for receiving earthquake alerts and tsunami bulletins through emails and SMS.

(iii) Response Phase – This phase will include all necessary measures to provide immediate succor to the affected people by undertaking search, rescue and evacuation measures. Campbell Bay has a state emergency operation center (SEOC) from where the rescue operation can be directed.

(iv) Relief Phase - This phase will include all necessary measures to provide immediate relief and succor to the affected people in terms of SOP, their essential needs of food, drinking water, health & hygiene, clothing, shelter etc.

(v) Restoration Stage – This phase will include all necessary measures to stabilize the situation and restore the utilities. This SOP does not cover long-term measures needed either for mitigation or for rehabilitation/recovery of the affected people and reconstruction of the area.

This SOP is being reviewed annually. The overall responsibility of the disaster management lies with District Administration where the Deputy Commissioner will be the Responsible Officer (RO) for each Districts and in case of situation is worsened and will have its affect in larger area, then the Chief

Secretary, A&N Administration will be the (RO). In case the disaster level exceeds a certain threshold, the help of Central Government is sought.

At the time of disaster, not only the above stated SOP shall be followed but assistance from defence force also be involved to help to citizens.

Assistance from Defence Forces

The Commander-in-Chief, Andaman and Nicobar Command shall keep the Armed Forces on alert following the receipt of information from Director, Disaster Management or from the Deputy Commissioner or on receipt of forewarning about the impending occurrence of a Disaster so that, Defence Forces shall plunge into action as soon as their assistance is sought by the UTDMA/DDMAs.

The Andaman and Nicobar Command and the Indian Coast guard to involve during the occurrence of any disaster like situation with the following action plan:

a. Representatives to be stationed in the Armed Force Room earmarked in the Directorate of Disaster Management.
b. A detachment of forces to be stationed at the premises of the SCR with mobile communication equipment for SAR Operations & MFR.
c. All other establishments of ANC will remain on alert.
d. Respond to request of assistance of RO/ICs/SCR.

The extent and nature of assistance required from the Defence Forces in the first instance shall be assessed by the District Disaster Management Authority and intimated to Union Territory Disaster Management Authority.

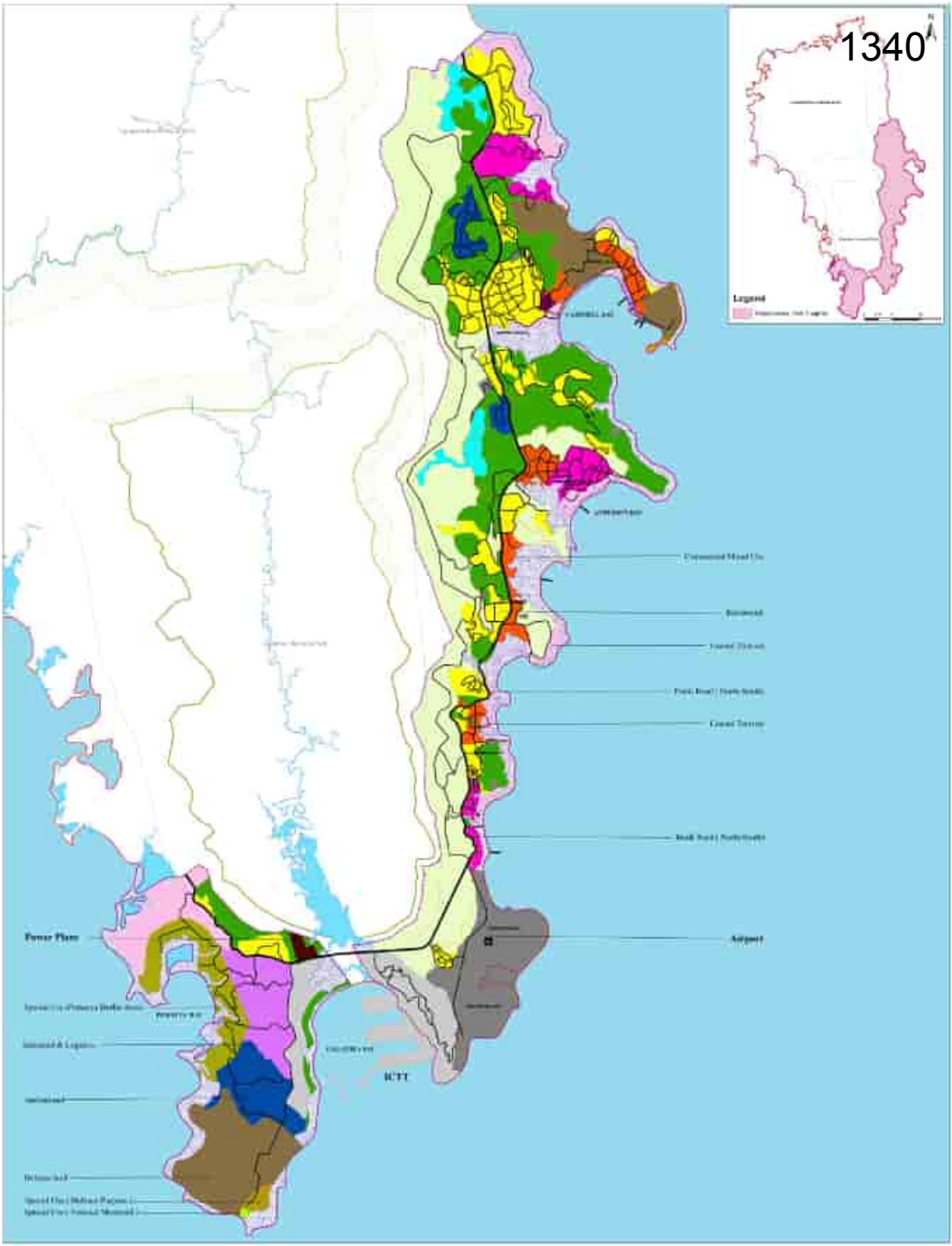
The Union Territory Disaster Management Authority shall hold quick deliberations on the nature and extent of help to be sought from the Government of India. This assistance shall be for (a) Short(Immediate) Term Measures(b)Medium Term Measures and (c)Long Term Measures.

The assistance for Immediate Term Measures is meant for the Rescue and Relief Operations. The Rehabilitation Operations after a Disaster constitute the medium term measures. The assistance from Government of India for the medium term measures could be to restore the public utility services and to help the general public to restart their occupations. Assistance from the Government of India for long term measures will be sought under the Annual Plan.

The concerned Departments shall make a quick assessment of damage in their sector/ activities and project the requirement of funds to the Union Territory Disaster Management Authority. The District Disaster Management Authority/Deputy Commissioner shall with the assistance of Government Departments make a quick estimate of damage/ impact and requirement of funds.

In addition, request for the immediate assistance from Government of India may be placed for dealing of the situation effectively. Further, the 'Andaman and Nicobar Disaster Management Plan' may be referred for protocols in the event of a Tsunami, Earthquake and Cyclone. Refer to **Enclosure 10** for map of Tsunami shelters and **Enclosure 11**for ANI disaster management plan.

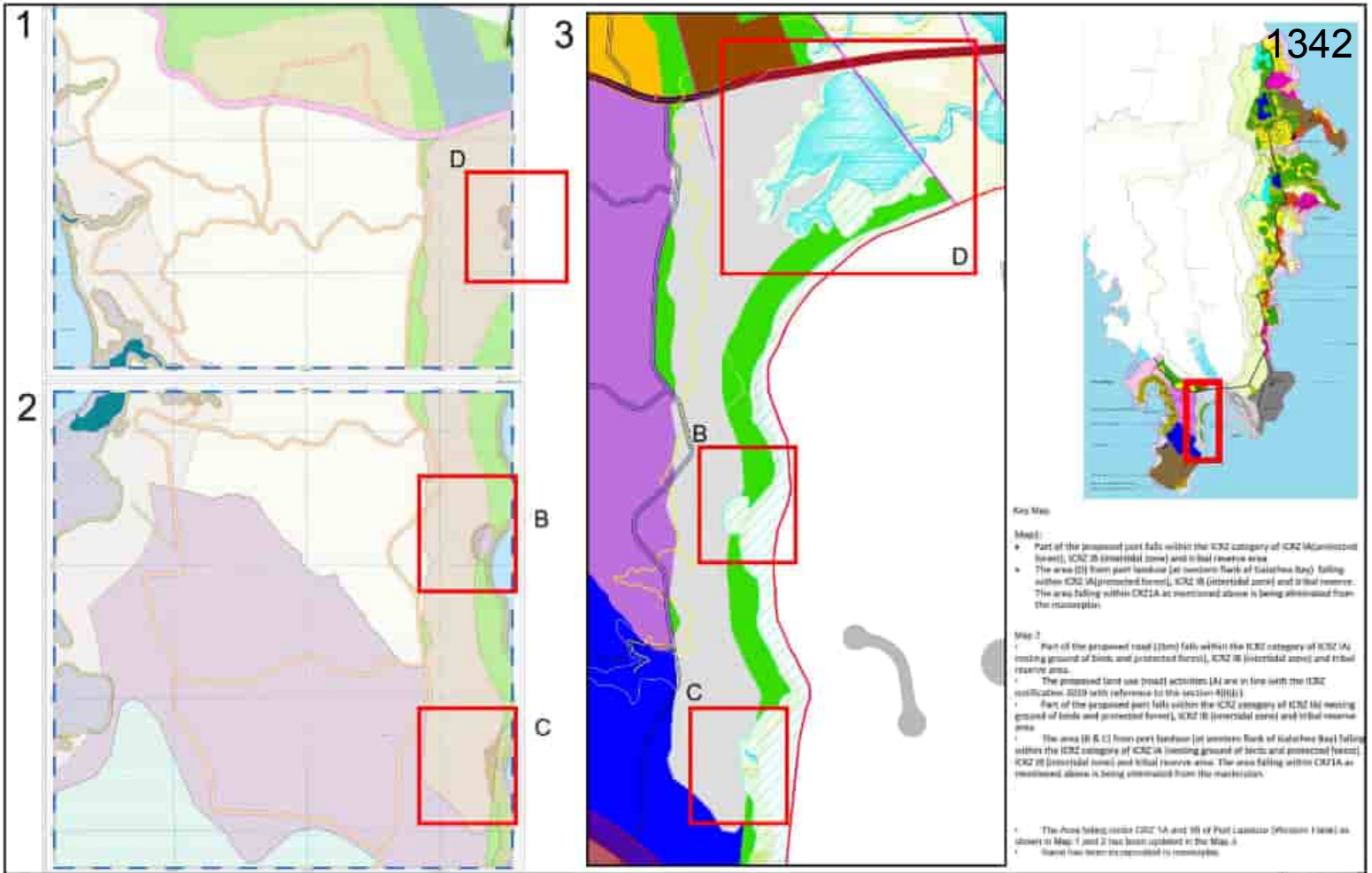
Enclosure - 2



HOLISTIC DEVELOPMENT OF GREAT NICOBAR ISLAND IN ANDAMAN & NICOBAR ISLANDS

LANDUSE MAP

Enclosure - 5



Revised map with exclusion of CRZ 1A & 1B area from the Port land use (Western flank)

Enclosure - 13

No.PCCF/EPA/1/Vol-XVI/154
अण्डमान तथा निकोबार प्रशासन
ANDAMAN AND NICOBAR ADMINISTRATION
वन एंव पर्यावरण विभाग
DEPARTMENT OF ENVIRONMENT & FORESTS
प्रधान मुख्य वन संरक्षक (तटवर्ती अंचल विनियम एंव वन संरक्षण)/नोडल अधिकारी, वन(संरक्षण)अधिनियम/सदस्य सचिव, अण्डमान तथा निकोबार तटवर्ती अंचल प्रबंध प्राधिकरण
PCCF (CRZ & FC) / NODAL OFFICER, FCA & MS, A&NCZMA
वन सदन, हैडो, पोर्ट ब्लेयर/**VAN SADAN, HADDO, PORT BLAIR**
****

पोर्ट ब्लेयर/ Port Blair, दिनांक/Dated 8th July, 2022

सेवा में/To

Dr. H. Kharkwal
Additional director and Member Secretary (CRZ)
Ministry of Environment, Forest and Climate Change
Indira Paryavaran Bhawan,
Prithvi Wing, 2nd Floor, No.215,
Jor Bagh Road,
New Delhi-110003.

विषय/Sub: **Integrated Development of International Container Transhipment Terminal (ICTT)-14.2 Million TEU along with Greenfield International Airport (4000 Peak Hour Passengers-PHP), township and Area Development and 450 MVA Gas and Solar based Power Plant in 16610 ha Great Nicobar Islands, Nicobar District by M/s Andaman and Nicobar Islands Integrated Development Corporation Ltd –reg.**

Sir,

The ANCZMA during its meeting held on 17.03.2022 deliberated and recommended the proposal to Govt of India, MoEF&CC for according composite ICRZ clearance under ICRZ notification 2019 and Environmental Clearance under EIA Notification, 2006 with certain conditions. The recommendation of the ANCZMA was communicated to MoEF&CC with a copy to Project Proponent vide letter No. PCCF/EPA/1/Vol-XV/653 dated 22.03.2022.

The Expert Appraisal Committee (EAC) of MoEF&CC in its 297th meeting held on 24-05.2022 considered the said proposal for environmental clearance and observed that the project proponent has to submit revised ICRZ recommendation letter issued on 22/03/2022 by Andaman & Nicobar Islands Coastal Zone Management Authority (ANCZMA) especially regarding effective ICRZ area involved in various activities has been revised and part of holistic project now declared for Defence, Strategic, National Security, and Public Purpose.

Proposal brief:

Accordingly the project proponent M/s ANIIDCO submitted a proposal mentioning that Ministry of Home Affairs vide letter No. 15020/10/2022 dated 30.03.2022 mentioned that the Greenfield International Airport proposed in Great Nicobar Island as part of Integrated Development of the Island will be developed as a joint military-civil, dual use airport, under the operational control of Indian Navy. This project is for defence, strategic, National Security and public purpose.

The effective ICRZ areas involved in various activities of the project are given as under.

S.No	Name of the Activity	Total area in Sq.km	ICRZ I		ICRZ III		ICRZ IV	
			IA	IB	NDZ	50-100M	IVB	IVA
1	Port	7.39	0.67	0.38	0.00	0.00	0.18	0.62
2	Airport	8.49	0.58	0.82	0.38	0.10	0.14	0.56
3	Power Plant	0.39	0.00	0.00	0.00	0.00	0.00	0.00
4	Township Defence	12.60	0.81	1.43	0.02	0.00	0.07	0.20
5	Township Other Landuse	137.27	4.93	5.92	1.69	0.45	2.50	3.55
6	Port reclamation area	2.27	0.06	0.11	0.00	0.00	0.00	2.10
7	Airport Reclamation area	0.71	0.02	0.08	0.04	0.00	0.32	0.02
	Total	**169.08**	**7.07**	**8.74**	**2.13**	**0.55**	**3.21**	**7.05**

The project proponent submitted the revised area falling under various categories of ICRZ and the details are as follows.

Sr. No	Activity	Area in Sq.km	ICRZ I		ICRZ III		ICRZ IV	
			CRZ IA	CRZ IB	NDZ	50-100m	IVB	IVA
1	Port (ICTT)	7.39	0.57	0.25	0	0	0.18	0.62
2	Airport	8.45	0.60	0.82	0.38	0.1	0.14	0.56
3	Power Plant	0.39	0.00	0.00	0	0	0	0
4	Township (Defence)	12.6	0.81	1.43	0.02	0	0.07	0.2
5	Township (other landuses)	137.27	5.03	6.05	1.69	0.45	2.5	3.55
Total		**166.1**	**7.01**	**8.55**	**2.09**	**0.55**	**2.89**	**4.93**
A	Port (reclamation area)	2.27	0.06	0.11	0	0	0	2.1
B	Airport (reclamation area)	0.71	0.00	0.33	0.04	0	0.32	0.02
Total (including reclaimed area)		**169.08**	**7.07**	**8.74**	**2.13**	**0.55**	**3.21**	**7.05**

It is mentioned that the revised effective area ICRZ involved in the project includes the same area of 7.07 sq.km in ICRZ IA and 8.74 Sq.km in ICRZ IB, 2.13 Sq.km in ICRZ III NDZ, 0.55 Sq.km in ICRZ III, 3.21 sq.km in ICRZ VI B and 7.05 Sq.km in ICRZ IVA. The only difference in the revised effective area mentioned by the project proponent is 0.57 sq.km and 0.25 sq.km instead of 0.67 sq.km and 0.38 sq.km in ICRZ IA and IB respectively in case of Port and 5.03 sq.km and 6.05 sq.km instead of 4.93 sq.km and 5.92 sq.km in ICRZ

IA and IB respectively in the case of township (other land uses). In case of Airport reclamation, there is no CRZ IA involved and the area involved in ICRZ IB is 0.33 sq.km, 0.04 sq.km in NDZ of ICRZ III, 0.32 sq.km in ICRZ IV B and 0.02 Sq.km in ICRZ IV B. The proposed activities are permissible in ICRZ areas as per ICRZ notification 2019 as the Greenfield Airport Project is part of holistic Development of GNI project is now for Defence, Strategic, National Security, and Public Purpose.

Recommendation:

Taking into consideration of the above facts namely the revised ICRZ area involved in the holistic development of Great Nicobar Island and the green field airport project is for defence, strategic, National Security and public purpose, ANCZMA further recommends the project with revised ICRZ area involved in the project as above. The conditions stipulated in the earlier meeting dated 17.03.2022 and communicated vide letter No. PCCF/EPA/1/Vol-XVI/653 dated 22.03.2022 continue to remain valid and the project proponent has to follow those conditions while executing/implementing the project.

Encl: As above.

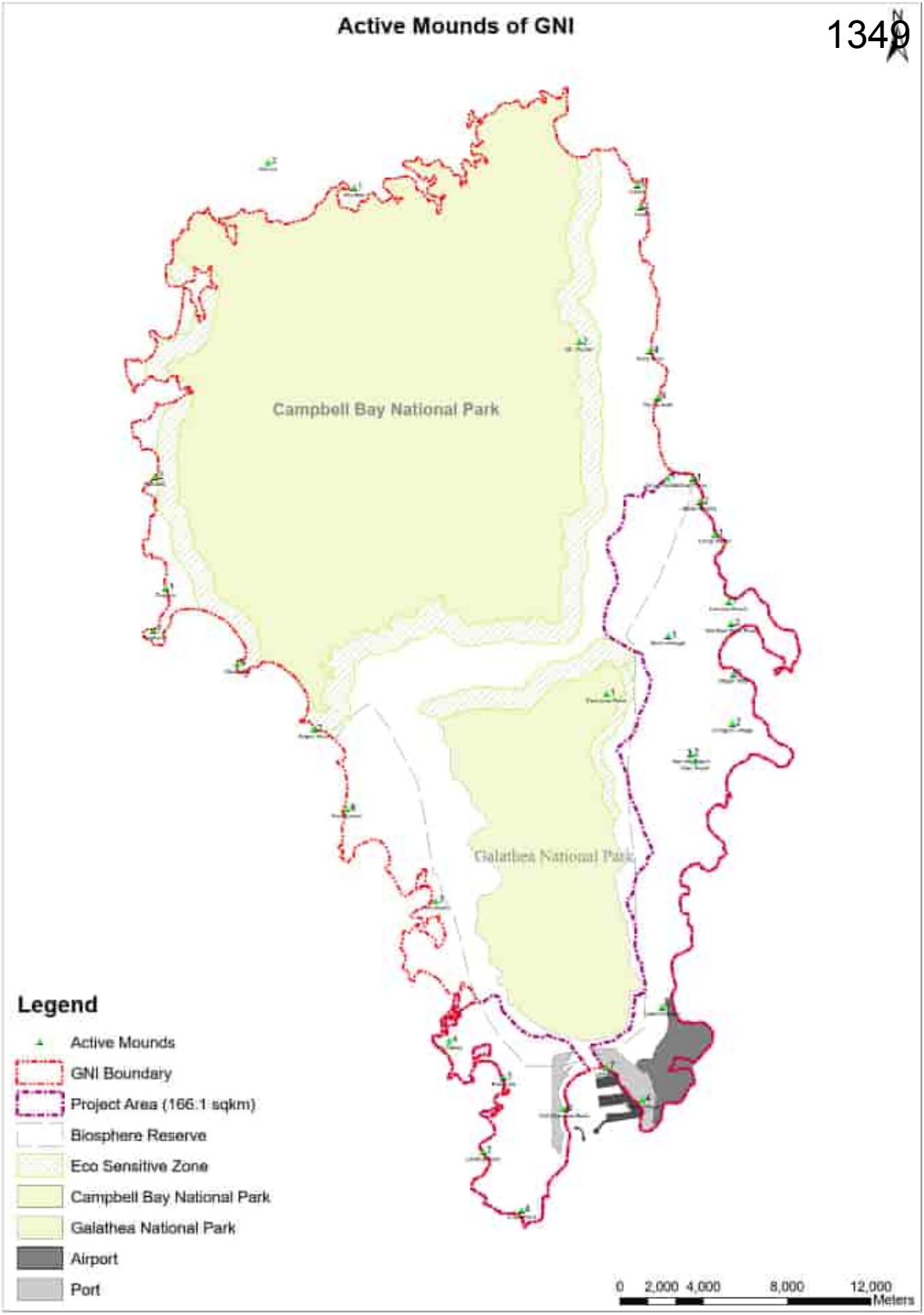
अपर प्रधान मुख्य वन संरक्षक /
Additional Principal Chief Conservator of Forests
(तटवर्ती अंचल एवं वन संरक्षण/CRZ & FC)
सदस्य सचिव, अण्डमान तथा निकोबार तटवर्ती अंचल प्रबंध प्राधिकरण
and Member Secretary, A&N CZMA
वन सदन, हैडो, पोर्ट ब्लेयर/Van Sadan, Haddo, Port Blair

Copy to :

1. SPS to the Chief Secretary, A&N Administration for favour of information of the Chairman, ANCZMA/the Chief Secretary, A & N Administration.
2. The Managing Director, ANIIDCO, Port Blair for information and necessary action.
3. The Additional Director and Member Secretary, IA (Nuclear & Defence), MoEF&CC, Indira Paryavaran Bhawan, Jor Bagh, New Delhi-110003

Enclosure - 17

Active Mounds of GNI



English

(https://fastbordercopy.com/) Login (/accounts/login/) Sign Up (/accounts/register/)

Look up request: Reference code Submit

Request Details

Information Regarding Turtle nesting data in Great Nicobar Share

J838MSYY

Please keep this reference code. You will need it to check on the status of this request.

Request

Government level: Andaman and Nicobar Islands (India)
Agency/Ministry: Department of Environment and Forests Andaman & Nicobar (/agencies/jecs87vb/)
Addressed to: Public Information Officer
Great Andaman Trunk Road Haddo, Port Blair , AN 744102

Date Created: May 3, 2024
Last Updated: March 13, 2025
Response Due Date: June 8, 2024
Privacy Status: Public
Language: English
Status: Fulfilled
Responses: View
Date Fulfilled: March 6, 2025

Translate request to: Bengali Translate

1. Please provide the number of Leatherback, Olive Ridley, Hawksbill and Green sea turtles that visited for nesting in Galathea Bay (both camps) and Joginder Nagar Bay during 2022-2024.

2. Please provide the total number of nests of the four aforementioned sea turtle species that were made in Galathea Bay (both camps) and Joginder Nagar Bay during 2022-2024.

3. Please provide the total number of eggs retrieved from each nest of the four aforementioned sea turtle species from Galathea Bay (both camps) and Joginder Nagar Bay during 2022-2024.

4. Please provide the number of hatchlings released to the sea (if any) of the four aforementioned sea turtle species from Galathea Bay (both camps) and Joginder Nagar Bay during 2022-2024.

5. Please provide a copy of the sea turtle management plan for Nicobar Island or any document providing guidelines for the conservation and management of sea turtles on Great Nicobar Island.

Please note that the graph uploaded on the website of the department at http://ls1.and.nic.in/doef/index.php does not contain the above data and hence we request you to furnish this data as quickly as possible. Please do not direct us to visit the website for the information sought in this RTI.

1352

S. No. 68

69

MONTHLY REPORT OF TURTLE NESTING UPTO MONTH OF MAY, 2022.

Name of the Division/Rang	Name of Species	NESTING						HATCHLING								
		Up to Previous		During the month		Progressive total		Up to Previous month			During the month			Progressive total		
		No. of nesting	No. of egg laid	No. of nesting	No. of egg laid	No. of nesting	No. of egg laid	No. of nest hatched out	No. of hatchling released		No. of nest hatched out	No. of hatchling released		No. of nest hatched out	No. of hatchling released	
									LPE	DPE		LPE	DPE		LPE	DPE
Laxmi Nagar 4 Km. Beach	Olive Ridley	31	3140	0	0	31	3140	29	2109	868	2	104	59	31	2213	927
	Leather Back	6	619	0	0	6	619	5	348	160	1	75	36	6	423	196
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shastri Nagar 25 Km. Beach	Olive Ridley	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Leather Back	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galathea-I & II 41 Km. Beach	Olive Ridley	31	3346	0	0	31	3346	27	2153	756	4	320	117	31	2473	873
	Leather Back	649	53448	0	0	649	53448	623	38384	12933	26	1472	659	649	39856	13592
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No.ND/GS/64/Vol-VI/ 479 Campbell Bay dated the 11th July, 2022.

Submitted to theThe Principal Chief Conservator of Forests (Wildlife), Andaman and Nicobar Islands,Vanya Prani Bha

8/7/22

प्रभागीय वन अधिकारी | Divisional Forest Offic
निकोबार प्रभाग | Nicobar Divisi

O/C

1353

Sl. No. 155

(156)

MONTHLY REPORT OF TURTLE NESTING UPTO MONTH OF MAY, 2023

Name of the Division/Rang	Name of Species	NESTING						HATCHLING								
		Up to Previous		During the month		Progressive total		Up to Previous month			During the month			Progressive total		
		No. of nesting	No. of egg laid	No. of nesting	No. of egg laid	No. of nesting	No. of egg laid	No. of nest hatched out	No. of hatchling released		No. of nest hatched out	No. of hatchling released		No. of nest hatched out	No. of hatchling released	
									LPE	DPE		LPE	DPE		LPE	DPE
nder Nagar Km. Beach	Olive Ridley	60	6205	0	0	60	6205	57	4455	1503	3	146	101	60	4601	1604
	Leather Back	3	210	0	0	3	210	3	154	516	0	0	0	3	154	516
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
mi Nagar Km. Beach	Olive Ridley	6	595	0	0	6	595	6	397	198	0	0	0	6	397	198
	Leather Back	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green Sea	2	172	0	0	2	172	2	136	36	0	0	0	2	136	36
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
si Nagar Km. Beach	Olive Ridley	3	334	0	0	3	334	3	292	42	0	0	0	3	292	42
	Leather Back	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green Sea	14	1535	0	0	14	1535	14	1088	447	0	0	0	14	1088	447
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rmea-I & II	Olive Ridley	48	5262	0	0	48	5262	44	3909	944	4	235	174	48	4144	1118
m. Beach	Leather Back	505	48017	0	0	505	48017	477	35078	11105	28	127/8	556	505	36356	11661
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ND/GS/64/Vol-VI/ 331 Campbell Bay dated the 28th June, 2023.

mitted to the The Principal Chief Conservator of Forests (Wildlife), Andaman and Nicobar Islands, Vanya Prani Bhawan

प्रभागीय वन अधिकारी | Divisional Forest Officer
निकोबार प्रभाग | Nicobar Division

1354

Is. No. 4

(4)

MONTHLY REPORT OF TURTLE NESTING UPTO MONTH OF MARCH 2024

Name of the Division/ Range	Name of Species	NESTING						HATCHLING								
		Up to Previous month		During the month		Progressive total		Up to Previous month			During the month			Progressive total		
		No. of nesting	No. of egg laid	No. of nesting	No. of egg laid	No. of nesting	No. of egg laid	No. of nest hatched out	No. of hatchling released		No. of nest hatched out	No. of hatchling released		No. of nest hatched out	No. of hatchling released	
									LPE	DPE		LPE	DPE		LPE	DPE
Jogindernagar 13 Km. Beach	Olive Ridley	22	2156	1	108	23	2264	2	183	38	8	633	136	10	816	174
	Leather Back	15	1261	0	0	15	1261	6	246	209	6	378	191	12	624	400
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laxmi Nagar 24 Km. Beach	Olive Ridley	31	3099	2	200	33	3299	1	84	59	11	1006	88	12	1090	147
	Leather Back	4	355	0	0	4	355	1	61	33	2	144	29	3	205	62
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shastri Nagar 55 Km. Beach	Olive Ridley	4	390	0	0	4	390	0	0	0	2	137	40	2	137	40
	Leather Back	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galathea-I Beach 42 Km.	Olive Ridley	2	210	0	0	2	210	0	0	0	2	131	79	2	131	79
	Leather Back	2	104	0	0	2	104	2	70	34	0	0	0	2	70	34
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galathea- II Beach 140 Km.	Olive Ridley	21	~~2478~~	~~2~~	219	23	~~2697~~	2	166	~~28~~	~~13~~	1184	464	~~15~~	1350	492
	Leather Back	614	46559	3	225	617	46784	256	13516	4779	291	17670	5152	547	31186	9931
	Green Sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hawks Bill	1	167	1	3	2	170	0	0	0	1	139	28	1	139	28

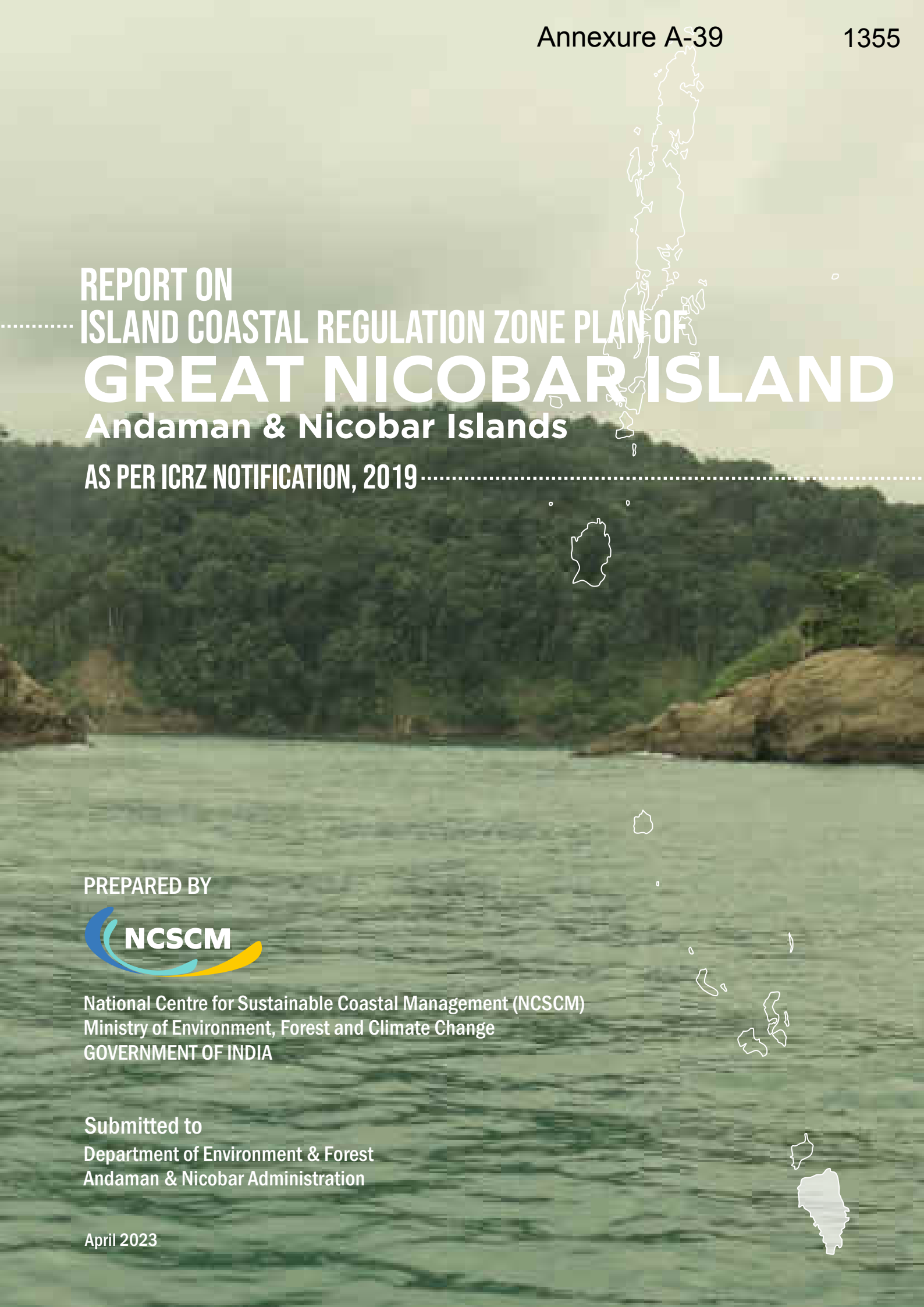
No.ND/GS/64/Vol-VII/ 160 Campbell Bay dated the 20 H ~~April~~ May. 2024

Submitted to the The Principal Chief Conservator of Forests (Wildlife), Andaman and Nicobar Islands. Vanya Prani Bhawan. Chatham. Port Blair.

9/c

Divisional Forest Officer
Nicobar Division

REPORT ON
ISLAND COASTAL REGULATION ZONE PLAN OF
GREAT NICOBAR ISLAND
Andaman & Nicobar Islands
AS PER ICRZ NOTIFICATION, 2019



PREPARED BY

National Centre for Sustainable Coastal Management (NCSCM)
Ministry of Environment, Forest and Climate Change
GOVERNMENT OF INDIA

Submitted to
Department of Environment & Forest
Andaman & Nicobar Administration

April 2023

REPORT ON
ISLAND COASTAL REGULATION ZONE PLAN OF
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS
AS PER ICRZ NOTIFICATION, 2019

PREPARED BY

NCSCM

National Centre for Sustainable Coastal Management (NCSCM)
Ministry of Environment, Forest and Climate Change
GOVERNMENT OF INDIA

Submitted to

Department of Environment & Forest
Andaman & Nicobar Administration

APRIL 2023

Acknowledgement

NCSCM is thankful to the Principal Chief Conservator of Forest, Department of Environment & Forest, Union Territory of Andaman and Nicobar Administration, Government of India, for providing all technical support to execute the field surveys for preparation of the Island Coastal Regulation Zone Plans (ICRZPs) of Greater Nicobar Island, as per the ICRZ Notification, 2019.

The Department of Environment & Forest, Union Territory of Andaman and Nicobar Administration is immensely thanked for their periodic interaction with our scientists and timely co-ordination and execution of the project.

The contribution of the team members of NCSCM, whose dedication and meticulous work have led to the timely completion of the Island Coastal Regulation Zone Plans of Greater Nicobar is duly acknowledged.

Director, NCSCM

DOCUMENTATION SHEET

1	Authorised Institute with Letter No. & Date	National Centre for Sustainable Coastal Management J-17011/8/92-IA-III dt. 14th March, 2014
2	Report No.	NCSCM/CRZ-Cell/ICRZ-2019/PM/GN/04/2023/3
3	Client's/Institute Name	Department of Environment & Forest, U T of Andaman Nicobar Islands
4	Project Coordinator	Dr Ramesh Ramachandran
5	Co-Coordinator	Dr Purvaja Ramachandran
6	Adviser	Shri Dharma Raj M
7	Principal Investigator	Dr Badarees KO
8	Co-Investigator	Dr Manik Mahapatra
10	Project staffs	Mr Vimal KC
		Mr Balaguru B
		Mr Karunanidhi V
		Mrs Rama Subbu Lakshmi T
		Mr Soundararajan K
		Mr Yogaraju, R
11	Technical Team	Mr Sundaramanikandan S
		Mr Boobalan M
		Mr Prabakaran B
		Mr Madhava Rao Chennupati
		Mr Subramanian E
		Mr Manodeepan KK
12	Type of Report	ICRZ - Prepared for ICRZ Notification 2019
13	Title of Report	Report on Island Coastal Regulation Zone Plan of Great Nicobar Island, Andaman & Nicobar Islands as per ICRZ Notification, 2019
14	Key words	ICRZ Notification 2019, ICRZPs, NDZ, HTL, ESAs, LTL, ICRZ category
15	Distribution Statement	For Official/Administrative/Public/Operational Use Only

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LIST OF ABBREVIATIONS

ICRZ	Island Coastal Regulation Zone
IPZ	Island Protection Zone
IIMP	Integrated Island Management Plan
ESA	Ecologically Sensitive Areas
GIS	Geographic Information System
HTL	High Tide Line
NDZ	No Development Zone
EMP	Environment Management Plan
ANCZMA	Andaman & Nicobar Coastal Zone Management Authority
LTL	Low Tide Line
MOEF&CC	Ministry of Environment, Forest and Climate Change
NCSCM	National Centre for Sustainable Coastal Management
NCZMA	National Coastal Zone Management Authority
SoI	Survey of India
OSM	Open Series Map published by Survey of India

EXECUTIVE SUMMARY

The Ministry of Environment, Forest and Climate Change, Government of India, New Delhi issued Notification No. S.O.1242(E) dated 8th March, 2019, referred to as the Island Coastal Regulation Zone (ICRZ) Notification, 2019, in supersession of IPZ Notification 2011, declaring the designated areas as Island Coastal Regulation Zone (ICRZ), with a view to conserving and protecting the unique environment of coastal stretches and marine areas, besides ensuring livelihood security to the fisher communities and other local communities in the coastal areas and to promote sustainable development based on scientific principles, taking into account the dangers of natural hazards and sea level rise due to global warming. The ICRZ notification, 2019 declares the coastal stretches of the eight bigger oceanic islands in Andaman and Nicobar such as Middle Andaman, North Andaman, South Andaman, Baratang, Havelock, Little Andaman, Car Nicobar and Great Nicobar Islands and the water area up to territorial water limits of the country, as the Island Coastal Regulation Zone (hereinafter referred to as the ICRZ).

The Union Territory Administration was directed to revise or update the Island Coastal Zone Management Plan (ICRZP) framed under IPZ Notification, 2011 number S.O. 20(E), dated 6th January, 2011. All the project activities attracting the provisions of ICRZ notification, 2019 shall be required to be appraised as per the updated ICRZP under this notification and until and unless the ICRZP is so revised or updated, provisions of this notification shall not apply and the plans prepared as per provisions of IPZ Notification, 2011 shall continue to be followed for appraisal and CRZ clearance to such projects.

As per the provisions of the ICRZ Notification, 2019, the Department of Environment & Forest, Andaman & Nicobar Administration entrusted the responsibility of preparation of the Island Coastal Regulation Zone Plan to the National Centre for Sustainable Coastal Management (NCSCM), Chennai, which is an authorized agency approved by the Government of India, for the said purpose, vide Ministry of Environment & Forest Government of India order No. J-17011/8/92-IAIII dated 8th August, 2019. The NCSCM, Chennai has completed the preparation of ICRZP of Great Nicobar Island on 1:25000 scale as per the guidelines of ICRZ Notification 2019. The Island Coastal Regulation Zone Plan (ICRZP) of Great Nicobar Island comprises of HTL, LTL, various regulation lines such as 20m, 50m, and 100m, ICRZ classes such as ICRZ I, ICRZ III, and ICRZ IV etc.

The ICRZ Plans database (shapefiles) prepared as per the IPZ Notification, 2011 which were finalized by the National Centre for Sustainable Coastal Management (NCSCM) and approved by the MoEFCC, have been used as the base for revision or updation of the ICRZ plans, as per the provisions contained in the ICRZ Notification, 2019. The HTL, LTL, ESAs, & the other data were taken from above database in preparation/updation the ICRZ plan, as required under the provisions of the ICRZ Notification, 2019. Based on the

ICRZ notification, 2019, various regulatory lines viz. at a distance of 20 metres, 50 metres, and 100 metres landward from HTL respectively, as applicable in various ICRZ categories were demarcated. Classification of different ICRZ categories was done as per the ICRZ notification, 2019. In case of mangrove areas of greater than 1000 sq.m, a mangrove buffer of 20m has been provided. Other buffer lines were drawn wherever necessary, as specified in the ICRZ Notification, 2019. HTL, LTL, ICRZ categories, and infrastructure were superimposed on the cadastral map and the ICRZ maps on 1:25,000 scale were prepared with Survey of India toposheets as base maps.

The turtle nesting grounds, coral reefs, megapod nesting ground, biosphere reserve, National park, tribal reserve area etc were as provided by Department of Environment and Forest, Union Territory of Andaman and Nicobar Administration were used for the preparation of ICRZ Plans of Great Nicobar Island.

Geo-referenced cadastral maps in soft copies (shapefile format) were obtained from the Department of Environment and Forest, Union Territory of Andaman and Nicobar Administration. The datum used for preparation of the ICRZ maps of Great Nicobar Island was WGS 84 and the projection was UTM Zone 46N. Field work was carried out all along the coast of Great Nicobar Island during 2019-2020 to validate the details and to collect better ground truth/data for the preparation of coastal land use maps. At the same time, various location errors and spatial errors that could get magnified in large-scale maps such as cadastral maps were contained through appropriate spatial approaches. Two sets of maps were prepared in 1:25,000 scale namely (i) ICRZ map depicting different ICRZ categories; and (ii) Coastal land use maps (i.e., land use map used to define ICRZ). There are 11 ICRZ maps covering the coastal areas of Great Nicobar Island on 1:25,000 scale and 11 corresponding Coastal land use maps on 1:25,000 scale.

The ICRZ of Great Nicobar Island consists of ICRZ I (ICRZ IA & ICRZ IB), ICRZ III (NDZ, 50 to 100m from HTL) and ICRZ IV (ICRZ IVA & ICRZ IVB). ICRZ area statistics is shown in Table 4 of the report.

1. INTRODUCTION

The Coastal Regulation Zone (CRZ) Notification was first issued by the Government of India on 19.2.1991 under sub-section (1) of section and clause (V) of subsection (2) of section 3 of the Environment (Protection) Act, 1986 with the aim to provide comprehensive measures for the protection and conservation of India's coastal environment. The notification was reissued in 2011 vide notification No S. O 19 (E), dated 6th January, 2011. The MOEF&CC once again issued ICRZ notification, 2019 vide No. S.O.1242(E) dated 8th March, 2019 in supersession of the Island Protection Zone Notification, 2011 vide S.O. 20(E), dated the 6th January, 2011.

By the ICRZ notification, 2019, a specified width of the coast is sought to be protected by restricting setting up and expansion of any industry, operation or process and manufacture or handling or storage or disposal of hazardous substances. The objective of the ICRZ Notification, 2019 is to conserve and protect the unique environment of coastal stretches and marine areas, besides ensuring livelihood security to the fisher communities and other local communities in the coastal areas and to promote sustainable development based on scientific principles taking into account the dangers of natural hazards and sea level rise due to global warming. The coastal zone, consisting of ecologically sensitive areas and other geomorphological features play a vital role in maintaining the integrity of the coast. These ecological sensitive areas that are extremely vulnerable have to be managed judiciously by maintaining a balance between ecology and development. The ICRZ Notification regulates human activities on the coast with a view to maintaining coastal sustainability.

As per the ICRZ notification, 2019, the eight bigger oceanic islands in Andaman and Nicobar (ICRZ Islands) such as South Andaman, Middle Andaman and North Andaman, Baratang, Little Andaman, Havelock, Car Nicobar and Great Nicobar Islands are grouped as (a) Group-I: Islands with geographical areas >1000 sq.km and (b) Group-II: Islands with geographical areas >100 sq.km but < 1000 sq.km. The Great Nicobar Island falls under the the Group-II Island category (Amendment to the ICRZ notification 2019 vide S.O.2. (E) dated 1st January 2021).

As per the ICRZ notification, 2019, ICRZ of Great Nicobar Island is the land area from High Tide Line (HTL) up to 100m on the landward side along the sea front and 20 m or width of the creek whichever is less for the tidal influenced water bodies; the inter-tidal zone and water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, in case of tidal influenced water bodies.

1.1. ICRZP Planning Process

Para 5(i) of the ICRZ Notification of 2019 inter-alia provides that the Union Territory shall revise or update their respective island coastal zone management plan (ICRZP) framed under IPZ Notification, 2011 number, as per provisions of this notification and submit to the Ministry of Environment, Forest and Climate Change for approval at the earliest.

The Union territories of Andman and Nicobar administration shall prepare draft ICRZ plans in 1:25,000 scale map identifying and classifying the ICRZ areas within the territories in accordance with the guidelines given in Annexure-IV to this notification, which involve public consultation. All developmental activities listed in this notification shall be regulated by the Union territory administration, the local authority or the Andaman and Nicobar Coastal Zone Management Authority within the framework of such approved ICRZP, as the case may be, in accordance with provisions of this notification.

Para 5(iv) of the said Notification of 2019 further provides that the ICRZ plans may be prepared or updated by the Union territory by engaging reputed and experienced scientific institution(s) or the agencies including the National Centre for Sustainable Coastal Management (hereinafter referred to as the NCSCM) of Ministry of Environment, Forest and Climate Change and in consultation with the concerned stakeholders. Para 3(ii) of Annexure -IVA of ICRZ notification, 2019 stipulates that ICRZ Maps on scale 1:25,000 shall be got prepared by any of the agencies identified by the MoEF&CC vide its Office order number J-17011/8/92-IA-III dated 14th March 2014 using the demarcation of the High Tide Line or LTL, as carried out by NCSCM.

As per the ICRZ Notification, 2019, the draft ICRZ plan shall be submitted to the A&N CZMA for appraisal, including appropriate consultations and recommendations in accordance with the procedure(s) laid down in the Environment (Protection) Act, 1986. Thereafter, the the Ministry of Environment, Forest and Climate Change shall consider and approve the draft plans.

1.2. Development of a coastal database and information system

Coastal Information System refers to Geographic Information System (GIS) applied to the coastal zones for acquiring, storing, organizing, analysing, modelling and managing geospatial data. The approved database as per IPZ notification, 2011 will be utilized for updating the existing ICRZ plans and it comprises information on the following areas:

a) coastal protection
b) fisheries
c) aquaculture
d) tourism
e) mining

f) ports and harbours
g) coastal resource management
h) infrastructure development and planning, etc
i) coastal land use/land cover including ESAs
j) coastal population

The above databade was enriched based on the requirement as per ICRZ notification, 2019. For the updation/preparation of the ICRZPs, the above essential details were inducted in the information system.

1.3. Generation of ICRZ maps

As per the ICRZ Notification, 2019, ICRZ Maps on scale 1:25,000 shall be got prepared by any of the agencies identified by the MoEF&CC vide its Office order number J-17011/8/92-IA-III dated 14th March 2014 using the demarcation of the High Tide Line or LTL, as carried out by NCSCM. Various regulatory lines viz. at a distance of 20 metres, 50 metres, and 100 metres from HTL respectively, as applicable in various ICRZ categories, were demarcated and superimposed in the ICRZ Maps. HTL, LTL and ICRZ boundaries, as applicable, were also demarcated in the ICRZ maps along the banks of tidal influenced inland water bodies. The ICRZ classification such as CRZ I (ESAs, archaeological and heritage sites), ICRZ II (Developed area/ municipal areas), ICRZ III (undeveloped /rural areas) and ICRZ IV (water body) have been incorporated in the plans. In case of mangrove areas of greater than 1000 sq.m, a buffer line of 20m has been provided and the buffer zone is classified as ICRZ IA. With the above information, including other data as mentioned in the notification, the draft ICRZ maps on 1: 25,000 scale were generated as per the Annexure -IVA of the of the ICRZ Notification, 2019. The same were submitted to the Department of Environment and Forest, U.T. of Andaman and Nicobar Administration.

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2. GREAT NICOBAR ISLAND, UNION TERRITORY OF ANDAMAN AND NICOBAR ISLAND

2.1. Union Territory of Andaman and Nicobar Islands

The Islands are situated in the Bay of Bengal between 60 45' and 130 41' North Latitudes and 92^0 12' and 93^0 57' East Longitudes (Figure 1). The Islands located North of 10 ^{0} North Latitude are known as Andaman Group of Islands while Islands located South of 10^0 North Latitude are called Nicobar Group of Islands. The total area of ANIs. is 8249 Sq. Km There are about 572 islands, islets and rocks with a coastal line of about 1962 Kms. As per Census, 2011, 21 major islands in Andaman Group and 10 major islands in Nicobar Group are inhabited (Forest Statistics, 2019).

The original inhabitants of the Andaman Group of Islands are the tribes such as the Great Andamanese, the Jarawas, the Onges, and the Sentinelese. The Nicobar Group of Islands are occupied by people of Mongoloid origin and two major distinct groups of tribal people are present (Nicobaris and the Shompens). Though there has been substantial increase in the human population of the Islands, the population of most of the indigenous tribes. Particularly Vulnerable Tribal Groups has marginally increased. The increase in human population has been mainly due to settlement under colonization schemes and immigrationfrom other parts of the country (Forest Statistics, 2019).

The population of A & N Islands as per 2011 census is 3, 80,581 of which 2, 02,871 are males and 1, 77,710 females and this contributes to 0.031 % of the country's total population. The population density as per 2011 Census is 46 persons per sq.km against 43 persons per sq.km recorded in 2001 Census. There is only one urban area, of 16.6 per Sq. km. (Port Blair Municipal town), which caters to a population of 1,08,058 persons as per census 2011. The total population of the ANI is 3,80,581. (South Andaman District: 2,38,142; North & Middle Andaman District: 1,05,597 and Nicobar District: 36,842). Rural population constitute 62.29% and urban population constitute 37.70 %. An overview of the Andaman and Nicobar Island is given in Table 1 and 2

Table 1: Overview of A&N Islands

1	Geographical Area of A & N Islands	8249 sq km
2	Population	3,80,581(as per 2011 census)
3	Forest Cover	6742 Km2 (ISFR, 2019)
4	Percentage of Forest Cover	81.74 %
5	Reserved Forest	5613 sq km
6	Protected Forest	1558 sq km
7	Total Recorded Forest/Recorded Forest Area	7171 sq km
8	Mangrove Cover	616 sq km
9	Mini rehabilitation centre	1No.

10	Biological Park	1No.
11	National Park	06 Nos.
12	Wildlife Sanctuaries	01 No.
13	Biosphere Reserve	01 No.
14	State Bird	Andaman Wood Pigeon (Columba palumboides)
15	State Tree	Andaman Padauk (Pterocarpusdalbergioides)
16	State Animal	Dugong or Sea Cow (Dugong dugon)
17	State Flower	Pyinma (Lagerstroemia hypoleuca)
18	Actual Rainfall at Port Blair 2019	3405.4 mm
19	Mean Maximum Temperature Recorded at Port Blair during the year 2019	31.0 mm
20	Mean Minimum Temperature Recorded at Port Blair during the year 2019	24.5 mm
21	Highest Point in A&N Islands	Saddle Peak (732 m above Mean North Andaman Sea Level)
22	Highest Point in South Andaman Dist.	Mt. Harriet (365 m above Mean Sea Level)
23	Highest Point in Nicobar Dist.	Mt. Thullier (642 m above Mean Sea Level)
24	Distance by Sea (a) Port Blair to Kolkata (b) Port Blair to Chennai (c) Port Blair to Visakhapatnam	 1255 Km 1190 Km 1200 Km
25	Distance by Air (a) Port Blair to Kolkata (b) Port Blair to Chennai (c) Port Blair to Visakhapatnam	 1303 Km 1330 Km 1220 Km

Source: - Directorate of Economics & Statistics; Forest Statistcs, 2019.

Table 2: General information about A&N Islands

26	Location	Bay of Bengal
	Longitude	92°12’ to 94°16’ E
	Latitude	6°45’ to 13°41’N
27	Altitude	
	Saddle Peak (North Andaman Islands)	732 m AMSL
	Mt.Thullier (Great Nicobar Islands)	642 m AMSL
28	Length and Breadth of Andaman Group of Islands	
	Total length (in Km.)	467
	Maximum Width (in Km.)	52
	Average Width (in Km.)	24

29	Length and Breadth of Nicobar Group of Islands	
	Total Length (in Km.)	259
	Maximum Width (in Km.)	58
30	*Islands/Villages	
	Revenue villages	209
	Census Villages	555
	Inhabited Villages	396
	Uninhabited villages	159
	Total Islands/Islets (approx.)	572
	i)Inhabited Islands	38
	ii) Uninhabited Islands and rocks	541
	1. Largest inhabited islands in Andaman Group	
	Middle Andaman Island (Area in Sq.Km.)	1536
	2. Largest inhabited island in Nicobar Group	
	Great Nicobar Island (Area in Sq.Km.)	1045
	3. Smallest inhabited island in Andaman Group	
	Curlew Island (Area in Sq.Km.)	
	4. Smallest inhabited island in Nicobar Group	
	Pillomillow Island (Area in Sq.Km.)	1.3
31	i) Area of A & N Islands (in Sq. Km)	
	Total Area	8249
	South Andaman District	2672
	Nicobar District	1841
	North & Middle Andaman District	3736
	Urban area	37.92
	1. Rural area	8211.08
	2. Per capita Land Area (As per 2011 Census)	0.022
	3. Per Capita Forest & Tree Cover (As per ISFR-2019)	1.77 ha
32	4. Length of Coast line (in Km.)	1962

Source: - Directorate of Economics & Statistics; Forest Statistcs, 2019.

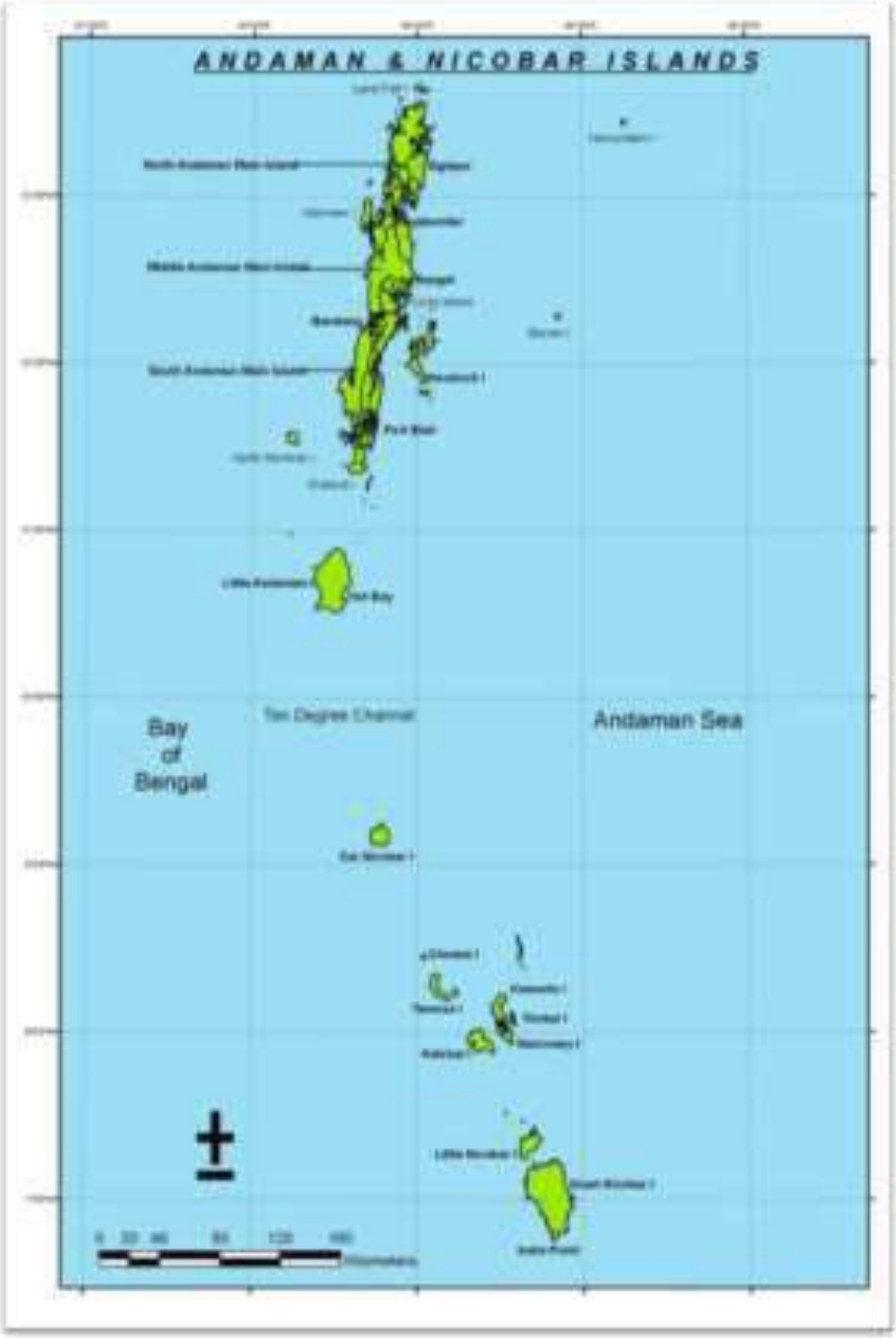

Figure 1: Map of the Andman & Nicobar Islands

2.2. Great Nicobar Island (GNI)

2.2.1. Location:

The Great Nicobar Island (GNI) is located in the Nicobar district to the south of the Andaman Islands (Figure 2). It is the largest of the cluster of islands with an area of about 910.074 sq. km and the southernmost of the group of Nicobar Islands located at a distance of approximately 520 km from Port Blair. Indira Point, earlier known as Pygmalion Point, lies at the southern tip of the GNI and is the southernmost point of the country. It is at an approximate distance of 144 km from the Sumatra Island of Indonesia. The GNI is situated between 6°44'52.94"N to 7°14'57.76"N and 93°38'43.07"E to 93°57'5.91"E. The headquarters of the GNI is Campbell Bay, where most of the Government offices are situated. The total length of the coast is approximately 202 km.

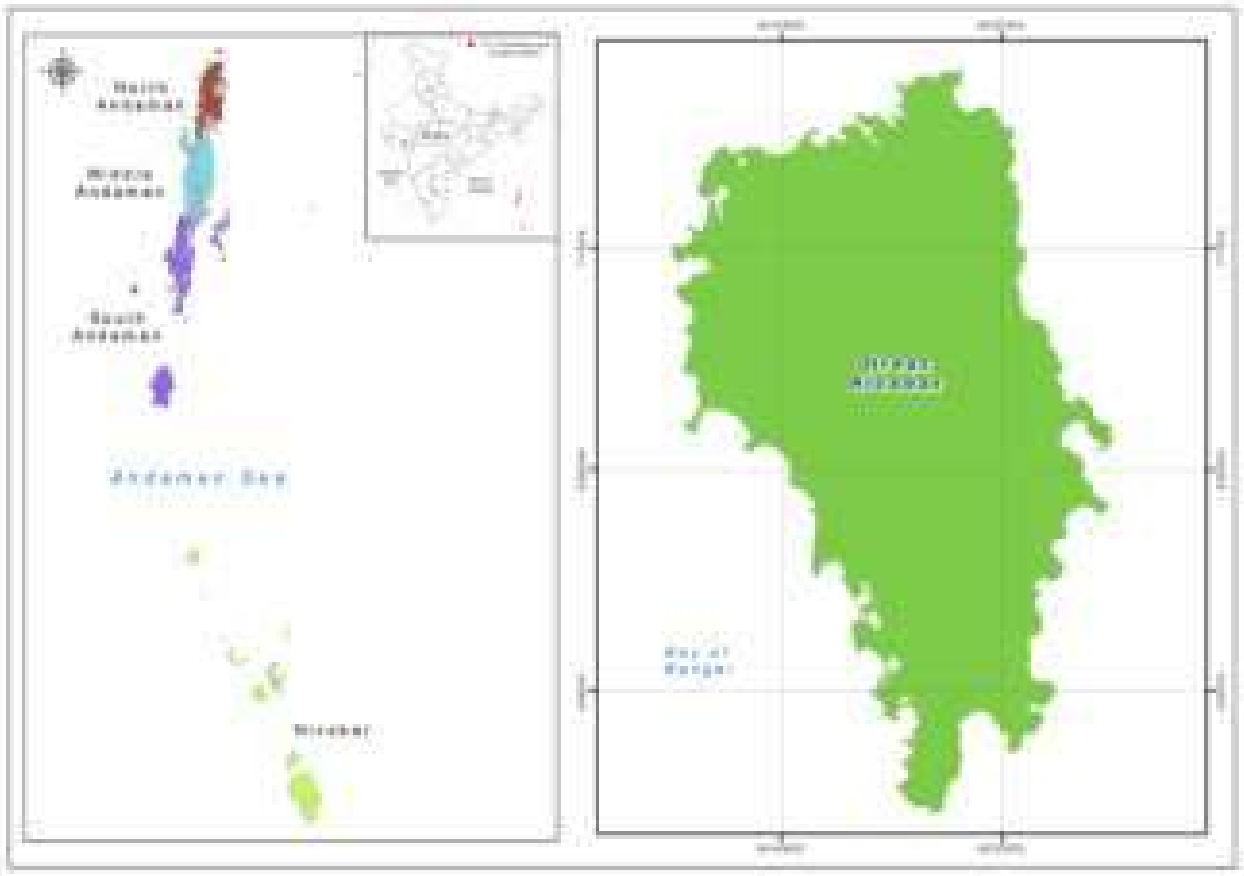

Figure 2: Location Map of Great Nicobar Island

2.2.2. Topography:

The island is highly rugged with very narrow flat land along the sea coasts and hill ranges running in north south direction. The reef consists of numerous spurs and ridges enclosing narrow valleys which culminate in a peak known as the Mr. Thullier (670m above M.S.L.). From this peak, 5 main ranges of hills radiate i.e. Das range, Chaturvedi range, Nanda range, Shani range and Mani range. These hill ranges rise abruptly to substantial height from the seashore/resulting in a spectacular panoramic view of the island.

The island is about 55km long between Murray point in the north to Indira point in the south. It has a width of about 30km in the north but the island narrows down to only about 3km in the southern tip.

2.2.3. Demography

As per 2011 census, the total population of Nicobar district is 36,842, with Great Nicobar Tehsil having a population of 8367 persons which includes 5025 males and 3342 females respectively. The Primary occupation of the tribal population is agriculture, which is basically limited to coconut, arecanut and banana plantations. (https://nicobars.andaman.nic.in/demography/)

2.2.4. Coastal Geomorphology and Ecosystem

The coastline is highly indented and several creeks penetrate into the island from inland bays. Some of the bay mouths are studded with several damaged and partially submerged rocky pinnacles which become visible at low tide. The principal bays around the island are Galathea, Casuarina, Ganges harbor, Valdora and Trinkat Champlong. The coastline is generally coralline with magnificent coral reefs at certain places, extending far away from the shoreline. (https://bsi.gov.in/uploads/documents/Public_Information/publication/books/district_flora/Flora%20of%20Great%20Nicobar%20Island.pdf)

The Galathea Bay Wildlife Sanctuary hosts diverse habitats. The sanctuary is shaped by the Galathea River that originates on Mount Thullier, the island's tallest peak at the northeastern end of the island, and empties on its southern bay. This teal river cuts through hilly tropical evergreen rainforests and marches towards a coralline coast. The rainforests shelter several species including the endemic Nicobar tree shrew (*Tupaia nicobarica*) and the Nicobari scrubfowl (*Megapodius nicobariensis*). Just before the river meets the sea, it feeds mangrove-lined marshlands and lagoons that shelter saltwater crocodiles. But the silver beaches that form at the river's mouth are its most spectacular habitats. They are India's and Southeast Asia's largest nesting site for leatherbacks. (https://roundglasssustain.com/habitats/galathea)

The Great Nicobar Biosphere Reserve harbours a wide spectrum of ecosystems comprising tropical wet evergreen forests, mountain ranges reaching a height of 642 m (Mt. Thullier) above sea level, and coastal plains. The region is noted for its rich

biodiversity. It houses 650 species of angiosperms, ferns, gymnosperms, bryophytes and lichens among others. The tract is rich in plant diversity and fosters a number of rare and endemic species, including Cyathea albosetacea (tree fern) and Phalaenopsis speciosa (orchid). A total of 14 species of mammals, 71 species of birds, 26 species of reptiles, 10 species of amphibians and 113 species of fish have been reported. The region also harbours a large number of endemic and endangered species of fauna. To date, 11 species of mammals, 32 species of birds, 7 species of reptiles and 4 species of amphibians have been found to be endemic. Of these, the well-known Crab-eating Macaque, Nicobar Tree Shrew, Dugong, Nicobar Megapode, Serpent Eagle, salt water crocodile, marine turtles and Reticulated Python are endemic and/or endangered. (https://en.unesco.org/biosphere/aspac/great-nicobar)

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3. PURPOSE & SCOPE OF ICRZ Plans

The primary purpose and utility of the ICRZ plans is to describe proposed actions to be implemented by administrative or other public authorities and potentially by the private sector to address priority management issues in the coastal zone over a defined implementation period. These issues include:

1. Ensuring livelihood security to the fisher communities and other local communities, living in the coastal areas
2. Conserving and protecting coastal stretches, its unique environment and its marine area and
3. Promoting sustainable development.

The ICRZ plans should support the goals and objectives of the ICRZ Notification, 2019 and assist in implementing an integrated coastal zone management plan. The ICRZ plans has to be prepared in accordance with Annexure - IVA of the ICRZ Notification, 2019. The ICRZ notification, 2019 has made it mandatory for the U.T. to prepare/update the Island Coastal Zone Management Plan (ICRZP) as per the provision of ICRZ notification, 2019 and get it approved by the Government of India. Island Coastal Regulation Zone map for Great Nicobar Island has been prepared accordingly as part of the study and submitted to the Department of Environment and Forest, Andaman and Nicobar Administration for their review, public consultation and acceptance. Thereafter, the maps were appraised by the ANCZMA. The A&N administration subsequently submitted the final ICRZ map to the Ministry of Environment Forest and Climate Change for their approval for implementation.

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4. ISLAND COASTAL REGULATION ZONE PLAN

The Island Coastal Regulation Zone maps are prepared on 1:25,000 scale with Survey of India toposheets as base maps. The maps were submitted to MoEF&CC, Government of India for approval after stakeholder/public consultations. The local level ICRZ maps of 1:4000 cadastral scale will be prepared for the use of local bodies and other agencies to facilitate implementation of the ICRZ plans. The present study and report provide the ICRZ maps on 1:25,000 scale.

4.1. Demarcation of High Tide Line (HTL) and Low Tide Line (LTL)

The HTL is defined as "*the line on the land up to which the highest waterline reaches during the spring tide*" which is different from the well-known and widely accepted definition of High Tide Level. The above definition of HTL takes into consideration not only the level of inundation due to maximum tide (spring tide) but also the wave set up (having a seasonal periodicity). The sea level thus formed due to the combined effect of spring tide and wave set up gives the line of maximum reach of water on the land. Unlike the HTL, the Low Tide Line (LTL) has not been defined for ICRZ. The HTL required specific definition since the 50, 200 and 500m setback lines are defined with respect to the HTL. The conventional definition of lowest low water level and the resultant low water line during spring tide is taken as the LTL.

As per Para IB.8 of Annexure-I of CRZ notification 2011, the following geomorphological features shall be considered while demarcating in HTL or LTL:

- Landward (monsoonal) berm crest in the case of sandy beaches
- Rocks, Headlands, Cliffs
- Seawalls or revetments or embankments.

Morphological signatures are good indicators of shoreline oscillation and inundation of coastal waters, which could be used for identifying the HTL. The inundation of coastal waters on to the land and seasonal shoreline oscillations are dependent on coastal morphology. Shoreline remains stable and would not retreat significantly along cliffy coasts. The shoreline retreats up to the cliff base along pocket beaches. Artificial morphologies like seawalls confine the oscillation of shoreline along the line of the structure itself. Sandy beaches are prone to seasonal and long-term shoreline oscillation. Long-term stability of the beach and the position of the stable part of the beach would be evident from morphological signatures such as berm and berm crest.

This has been done by using satellite data. Manual on "Demarcation of High Tide Line and Low Tide line" prepared by NCSCM is referred during the delineation of HTL and LTL.

The following signatures/ geomorphologic/ man-made structures used to demarcate the HTL are explained below using suitable illustrations.

4.1.1. Landward (monsoonal) berm crest for beaches

In all the well-formed wide beaches, one or more berms (which are the nearly horizontal part of the beach formed by the deposition of sand by wave action) are usually observed. The seaward end of the berm, which shows a sudden downward slope, is called the berm crest. When there is only one berm, it normally gets eroded during the monsoon with a berm crest on the landward side. But when there are two berms, the landward berm is the monsoonal berm, which normally does not get eroded. Or else we can say that the erosion reaches only to the second berm crest. Since the tidal waters do not reach the coast beyond this landward berm crest, it is taken as the HTL.

4.1.2. Seawall/revetments/embankments

In highly erosion-prone areas, there are no landward second berms. Such locations will be protected mostly by seawalls. During monsoon season, a majority of these are devoid of beaches. The waves impinge upon the seawall during the monsoon season, especially during high tide. Thus, they are the artificial barriers stopping the waves/tides at the coast. Since the seaward part of the seawall in most cases is defaced due to erosion, the landward toe is taken as the HTL boundary in such locations.

4.1.3. Permanent Vegetation Line

Permanent vegetation develops on the stable part of the beach. The part of the beach landward of monsoon berm crest is mostly stable. Hence, the line of permanent vegetation/perennial plants normally follows the line of monsoon berm crest, which is considered as the HTL.

4.1.4. Coastal sand dune

Coastal sand dunes are ridges or a series of ridges that form at the rear of the beach. Sometimes sand dunes are covered with vegetation. If the vegetation is present then the seaward limit of vegetation boundary is considered as HTL. For eroding dunes, the toe of the foreshore face of dune is considered as HTL.

4.1.5. Mangroves

These are evergreen, tropical coastal plants/ trees occurring in the intertidal zone, bays, estuaries, deltas, lagoons, creeks or any low energy zones of the coast. Landward boundary of mangrove to the extent where tidal water reaches, is considered as the HTL.

4.1.6. Rocks, Headlands, Cliffs

At rock outcrops, headlands and cliffs, the water is quite deep in that there is virtually no spatial displacement in the waterline. Hence, the High-Water Line available in the topographical maps (transferred to the base map) can be taken as such.

4.1.7. Other geomorphic/land cover features

Some coasts have a fairly large inter-tidal zone fringed by vegetation or coastal alluvial plain. In such cases, the HTL is demarcated using tonal differentiation between clayey or silty clay region along with salt encrustation upto supra- tidal mudflat and adjoining

sandy alluvial plain. Other geomorphic/ land cover features such as marshes, mangroves, fringing corals, saltpans, aquaculture ponds, and seaward side of agricultural/ horticulture land are also used for some of the coastal regions.

4.1.8. Influence of Tidal action

The distance up to which CRZ is applicable upstream of estuaries, creeks, backwaters and lagoons depends on the extent of tidal influence. The distance up to which tidal influence is experienced is dependent on salinity concentration: if it is 5 ppt or more (during the driest month) the water body is considered to be influenced by tidal action (CRZ, 2011). Salinity measurements are carried out during the driest month (usually during March-April) to determine the limit. Tidal barrages/lock and bunds constructed are also taken as the limit of tidal influence.

High Tide Line (HTL) and Low Tide Line (LTL), demarcated by NCSCM, Chennai, were used for preparation the ICRZPs, as required under the provisions of the ICRZ Notification, 2019.

4.2. Demarcation of Ecologically Sensitive Areas

Ecologically Sensitive Areas (ESAs), demarcated by NCSCM, Chennai using high resolution satellite imageries and the data provided by the A&N Administration were used for preparation the ICRZPs, as required under the provisions of the IPZ Notification, 2011. The database of ICRZ plan of Great Nicobar Island prepared as per the IPZ Notification, 2011 which have been scrutinized by the Technical Scrutiny Committee, finalized by NCSCM and approved by the MoEFCC, were used as the base for revision or updation of the ICRZP, as per the provisions contained in the ICRZ Notification, 2019. Apart from the above database, Hydrographic charts of Naval Hydrographic Office, Toposheets of the Survey of India, and Satellite image were used. In the present work, the above approved database including HTL, LTL, ESAs, etc. were used as a base database for updation of draft ICRZ maps prepared as per ICRZ notification, 2019. However, the data provided by the A&N Administration comprises Administrative Boundaries, Fish landing Centre, National Park, Wild Life Santuaries, Biosphere Reserve, Tribal and Jarawa Reserve Boundaries, etc.

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5. ECOLOGICALLY SENSITIVE AREAS AND COASTAL LAND USE

Coastal land use is one of the most essential information for assessing the status of natural resources and the coastal environment. It is also a pre-requisite for zonations of the coast as well as for making a sustainable coastal zone management plan. As per the "Manual on Demarcation of High Tide Line and Low Tide Line and Preparation of CZMP of the Coast of India", the coastal land use maps on 1:25000 scale were prepared using satellite images during 2018 - 2019. The landward extent of coastal land use area is the landward limit of CRZ boundary or hazard line whichever is more landward. For classification of coastal land use, the classification system mentions in the "HTL Manual" was followed (Annexure – I). The coastal land use map also depicted the ESAs, HTL and other details within the ICRZ jurisdiction of Great Nicobar Island. Administrative boundaries, infrastructure details etc. were superimposed on the map and the draft map was prepared.

In Great Nicobar Island, coral reefs are the largest component of land use, occupies 161.18 sq km. The second largest component is the Biosphere reserve which occupies 43.57 sq km. Protected Forest occupies 19.16 sq km. The total area covered by mangroves in is 4.53 sq. km. Table 3 provides the details of the coastal land use classes for Great Nicobar Island.

Table 3: Area statistics of coastal land use classes (within ICRZ Jurisdiction)

Landuse classes	Area in sq km
Coral Reefs	161.18
Biosphere reserve	43.57
National Park	19.30
Protected forest	19.16
Mangroves	4.53
20m Mangroves Buffer	2.48
Turtle nesting site	1.77
Megapod nesting site	1.33
Beach	3.27
Creek or river	21.96
Agriculture land	2.57
Habitation/Settlement	0.08
Jetty	0.03
Tribal area with in ICRZ	69.79

5.1. Mangroves

Mangroves are trees of various species of several families, which grows only where they can come into permanent contact with sea water or brackish water. They occur at the edges of the tropical or subtropical seas, bays, lagoons and estuarine regions *(Gerlech, 1973)*. Mangroves occur in quiet depositional coastal environments. Although mangroves grow in a variety of sediments including coral sands, they attain full development on the fine grained, soft organic mud deposited on the sheltered coast. Mangrove roots help accumulation of the silt, which gradually builds up to, form dry land, thus extending the coastline. Mangroves support in maintaining a rich coastal biodiversity.

Total mangroves area of Great Nicobar island is 4.53 sq km. Most of the mangroves in Great Nicobar island are of the patches along the river or estuarine banks. A mangroves area greater than 1000 sq m, a buffer of 20m has been provided as per the ICRZ notification, 2019. However, mangroves in private land will not require a buffer.

Mangroves are found in the mangrove swamp north of Campbell bay near Pigeon island, near Tenlao and also to its north, east of Magarnala beach near Campbell bay, near Anderson bay and a small patch to the north of Matait Anla. In the south, it is it is found inside the Galathea bay wildlife sanctuary along the Galathea river. Whereas, in the west mangroves are found near Kokeon and a small patch is found to its north.

5.2. Coral Reefs

Corals are exclusively polypoid, marine organisms which belong to Class: Anthozoa of Phylum: Coelenterata/ Cnidaria, capable of secreting a massive calcareous skeleton. Hermotypic or reef building corals, colonize suitable sea floor substrates in tropical and sub-tropical shallow waters with appropriate ecological conditions (summer maximum mean temperature of 28°C and winter minimum mean temperature generally above 18°C, colonizing mainly photic depths, salinity 35±2 psu etc (SAC, 2012). Coral reef is defined as 'a complex organogenic framework of calcium carbonate (primarily of corals), which forms a rocky eminence on the sea floor and customarily grows upwards to the tide limit' (Fairbridge, 1968). Coral reefs are one of the most productive and complex coastal ecosystems with high biological diversity. The high productivity is owing to the combination of its own primary production and support from its surrounding habitat. All corals are protected in India as they are listed as Schedule I species under the Wildlife Protection Act, 1972. This implies that touching, removing, dislocating corals in any fashion is a prohibited activity in the Indian territorial waters.

In Great Nicobar Island, coral reef is linear and extensively well-developed fringing reef. The coral reef data was provided by the Environment and Forest department, Andaman

and Nicobar Administration. The total area of Corals reef in Great Nicobar island is 161.80 sq km

5.3. Protected Forests

The Indian Forest Act, 1927 contains provisions pertaining to reserved forest whereby the state government could constitute any forest land or wasteland as a reserved forest or protected forest by a notification in the official gazette. Forest conservation act 1980 defines the term "Forest". No state government or other authority can, without the prior approval of the central Government, make any order to: (1) de-reserve forest, (ii) use any forest land for non-forestry purpose; (iii) lease out forest land to a private agency; (iv) cut naturally grown trees in forest land for the purpose of using it for re-afforestation. Total Protected forest area of great Nicobar island is 19.16 sq. km.

5.4. Nesting Ground of Birds

Nesting Ground of Birds are the designated area where large number of birds/migratory birds are nesting and that area is highly susceptible to changes by human activities and requires special protection. Megapod Nesting ground data provided by the Environment and Forest department, Andaman and Nicobar Administration. The total area of Megapod nesting area in Great Nicobar island is 1.33 sq km. Megapod nesting sites are found in the north of crocodile creek, to the south of Laful south, to the south of Pigeon island, and near Tenlao. On the south it is found in the Galathea bay wildlife sanctuary. It isalso found to the north and south of Casuariana bay near Pulo Kunji, Teesta point and north of Alexandra river mouth.

5.5. Turtle Nesting Grounds:

Sea turtles or marine turtles are generally found in waters over continental shelves; females come ashore to sandy beaches where they were born where they dig nests and lay eggs during the nesting season. These beaches are known as turtle nesting grounds/sites. India has five of the seven species of known sea turtles. Mass nesting occurs along sandy beaches on the west and east coast. After hatching, the turtles find their way back to the sea.

The Turtle nesting ground data was provided by the Environment and Forest department, Andaman and Nicobar Administration. It covers total area of 1.77 sq km in Great Nicobar island.

5.6. Biosphere reserve

The Great Nicobar Biosphere Reserve harbours a wide spectrum of ecosystems comprising tropical wet evergreen forests, mountain ranges and coastal plains. The

region is noted for its rich biodiversity. It houses 650 species of angiosperms, ferns, gymnosperms, bryophytes and lichens among others. The tract is rich in plant diversity and fosters a number of rare and endemic species, including Cyathea albosetacea (tree fern) and Phalaenopsis speciosa (orchid). A total of 14 species of mammals, 71 species of birds, 26 species of reptiles, 10 species of amphibians and 113 species of fish have been reported. The region also harbours a large number of endemic and endangered species of fauna. To date, 11 species of mammals, 32 species of birds, 7 species of reptiles and 4 species of amphibians have been found to be endemic. Of these, the well-known Crab-eating Macaque, Nicobar Tree Shrew, Dugong, Nicobar Megapode, Serpent Eagle, salt water crocodile, marine turtles and Reticulated Python are endemic and/or endangered. (https://en.unesco.org/biosphere/aspac/great-nicobar).

The Biosphere reserve data was provided by the Environment and Forest department, Andaman and Nicobar Administration. It covers total area of 43.57 sq km in Great Nicobar island.

5.7. National Park

An area, whether within a sanctuary or not, can be notified by the state government to be constituted as a National Park, by reason of its ecological, faunal, floral, geomorphological, or zoological association or importance, needed to for the purpose of protecting & propagating or developing wildlife therein or its environment. No human activity is permitted inside the national park except for the ones permitted by the Chief Wildlife Warden of the state under the conditions given in CHAPTER IV, WPA 1972. (http://www.wiienvis.nic.in/Database/npa_8231.aspx).

In Great Nicobar Island having two national parks. One is Campball Bay national park which cover an area of 15.22 sq km and another is Galathiea national park which cover an area of 4.08 sq km.

The details of data used in preparation of ICRZ plan is shown Annexure -II.

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6. METHODOLOGY FOR PREPARATION OF ICRZ Plans

The ICRZ Plans database (shapefiles) prepared as per the IPZ Notification, 2011 which have been scrutinized by the Technical Scrutiny Committee, finalized by the National Centre for Sustainable Coastal Management (NCSCM) and approved by the MoEFCC, have been used as the base for revision or updation of the ICRZ plans, as per the provisions contained in the ICRZ Notification, 2019. The HTL, LTL, ESAs, & the other data were taken from above database in preparation/updation the ICRZ plan, as required under the provisions of the ICRZ Notification, 2019. Based on the ICRZ notification, 2019, various regulatory lines viz. at a distance of 20 metres, 50 metres, and 100 metres landward from HTL respectively, as applicable in various ICRZ categories were demarcated. Classification of different ICRZ categories were done as per the ICRZ notification, 2019. In case of mangrove areas of greater than 1000 sq.m, a buffer line of 20m has been provided. Other buffer lines were drawn wherever necessary, as specified in the CRZ Notification, 2019. HTL, LTL, ICRZ categories, and infrastructure were superimposed on the cadastral map and a ICRZ maps in 1:25,000 scale was prepared with Survey of India toposheets as base maps.

The turtle nesting grounds, coral reefs, megapod nesting ground, biosphere reserve, natioal park, tibal reserve area etc were as provided by Department of Environment and Forest, Union Territory of Andaman and Nicobar Administration were used for the preparation of ICRZ Plans of Great Nicobar Island. Data sources used in the preparation of ICRZ plans is given in Annexure II.

6.1. Field mapping and map preparation

Geo-referenced cadastral maps in soft copies (shapefile format) for Department of Environment and Forest, Union Territory of Andaman and Nicobar Administration. The datum used was WGS 84 and the projection was UTM Zone 46N for Great Nicobar island. In addition of the above database, fieldwork was carried out all along the coast during 2019-2020 to validate the details and to provide better results in the preparation of coastal land use maps. At the same time, various location and spatial errors that could get magnified in large-scale maps such as cadastral maps were contained through appropriate approaches. Photographs taken during the fieldwork has been given as Annexure-III. Steps involved in the preparation of ICRZ maps are shown in Figure 3.

Two sets of maps were prepared on 1:25000 scale namely **(i) ICRZ map depicting different ICRZ categories; and (ii) Coastal land use maps** (i.e. land use map used to define ICRZ).

With the above information, the draft maps in 1: 25,000 scales were generated as per ICRZ Notification, 2019 and were submitted to the Department of Environment and Forest, Union Territory of Andaman and Nicobar Administration.

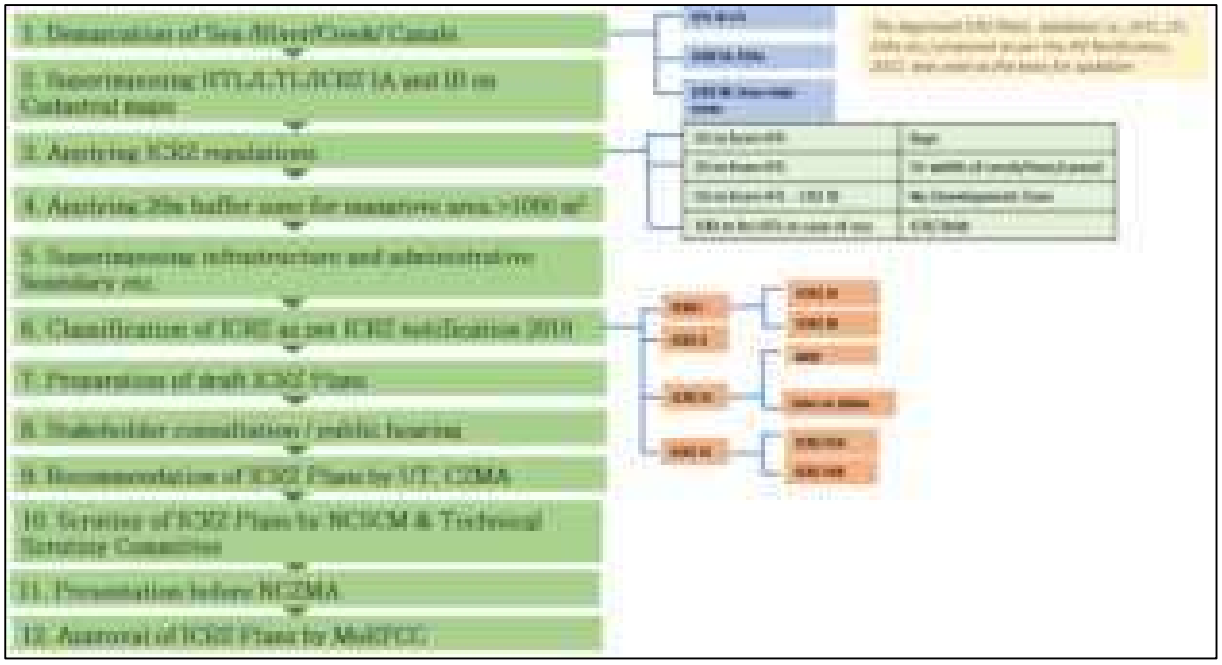

Figure 3: Various steps involved in the preparation of ICRZ Plans

The 33rd Meeting of the National Coastal Zone Management Authority (NCZMA) was held on 24.05.2018 under the chairmanship of Secretary (EF&CC). The relevant portion of the Minutes of the meeting is given below for ready reference

4. Draft CZMPs/ICRZPs presented by the respective States were deliberated upon and the Chairman, NCZMA directed as under:

"All the draft CZMPs shall be routed through NCSCM for a final round of technical scrutiny. Additional inputs, information and clarification etc., if any, envisaged by the States to be incorporated in their CZMPs, may be provided to NCSCM in the intervening period. After the technical scrutiny, a briefing note may be prepared for the guidance of the NCZMA"

Accordingly, NCSCM constituted a Technical Scrutiny Committee under the Chairmanship of Dr. Shailesh Nayak, former Secretary, Ministry of Earth Sciences, Govt. of India, to scrutinize the Coastal Zone Management Plans (CZMPs) and Island Coasral Regulation Zone (ICRZPs) and Integrated Island Management Plans (IIMPs) prepared by agencies authorized by MoEF&CC and provide recommendation for NCZMA.

Hence, after the public hearing the modified maps need to be presented before the TSC for scrutiny and recommendation. After that the maps need to be apprised by the ANCZMA. The final draft map neeed to be presented to the NCZMA for recommendation and finnaly to the MoEF&CC for approval.

Accordingly, the ICRZ maps of Great Nicobar Island were prepared on 1:2500 scale to clearly identify, demarcate and represent different categories of Island coastal regulation zone such as ICRZ IA, ICRZ IB, ICRZ NDZ-CRZ III, 50 to 100m - ICRZ -III, ICRZ IVA, ICRZ IVB in distinct colors and symbols. Whereas, in coastal land use map (used to define ICRZ Plans) Ecologically Sensitive Areas (ESAs) such as biosphere reserve, coral reefs, national park, megapod nesting ground, protected forest, mangroves, turtle nesting ground, etc etc as required under the ICRZ Notification, 2019 were integrated.

*****

7. ICRZ CLASSIFICATIONS

For the purpose of conserving and protecting the coastal areas and marine waters, the ICRZ areas were classified as follows, ICRZ I which includes ecologically sensitive areas and the geomorphological features which play a role in maintaining the integrity of the coast (ICRZ IA) as well as the inter-tidal zone (ICRZ IB) and in case of mangrove areas of greater than 1000 sq.m, a buffer line of 20m has been provided which is considered as ICRZ IA; ICRZ II - the developed land areas up to or close to the shoreline; ICRZ III are land areas that are relatively undisturbed (viz. rural areas, etc.) and those which do not fall under ICRZ-I, ICRZ-II and ICRZ IV (the water and bed) area as per the ICRZ Notification 2019. The ICRZ III area has been classified into two categories such as No Development Zone (NDZ) and 50m to 100m from HTL.

The schematic diagram showing various ICRZ categories is given below (Figure 4).

Figure 4: Classification of CRZ area

7.1. ICRZ I

For the purpose of conserving and protecting the coastal areas and marine waters, the ICRZ area shall be classified as follows, namely: -

(i) ICRZ-I areas are environmentally most critical and shall be further classified as under:

ICRZ IA:

(a) areas are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast, include the following:

(i) Mangroves (in case mangrove area is more than 1000 square meters, a buffer of 20 meters along the mangroves shall be provided and such area shall also constitute ICRZ–I A);

(ii) Corals and coral reefs;

(iii) Sand dunes;

(iv) Biologically active mudflats;

(v) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 0f 1986), including Biosphere Reserves;

(vi) Salt marshes;

(vii) Turtle nesting grounds;

(viii) Horse shoe crabs' habitats;

(ix) Sea grass beds;

(x) Seaweeds

(xi) Nesting grounds of birds;

(xii) Areas or structures of archaeological importance and heritage sites.

(b) A detailed environment management plan shall be formulated by the Union territories for such ecologically sensitive areas (ESAs) in respective territories, as mapped out by NCSCM, based on guidelines as contained in Annexure-I and integrated in the ICRZ Plans.

ICRZ IB: The area between Low Tide Line and High Tide Line is the Inter Tidal Zone and categorized as ICRZ IB.

7.2. ICRZ II

(a) The ICRZ-II shall constitute the developed land areas up to or close to the shoreline, within the existing municipal limits or in other existing legally designated urban areas, which are substantially built-up with a ratio of built up plots to that of total plots being more than 50% and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains etc.

(b) The developed Land areas along the creeks or tidal influence water bodies, located in the ICRZ II shall also be earmarked as ICRZ II and the distance upto which the ICRZ is to be reckoned as the land area between HTL to 20 meters or width of the creek, whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity

concentration of five parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Island Coastal Regional Zone Plans (hereinafter referred to as the ICRZ Plans).

7.3. ICRZ III

The land areas that are relatively undisturbed (viz. rural areas etc.) and those do not fall under ICRZ-II, shall constitute ICRZ-III
Explanation: -
1. For Group-I Islands, the area up to 100 meter from the HTL on the landward side shall be earmarked as the No Development Zone (NDZ). Provided that the NDZ for development of eco-tourism activities shall be 50 m and the Andaman and Nicobar administration shall ensure that the concerns of the fishing community are fully protected.
2. For Group-II Islands, the area up to 50 mts from the HTL on the landward side shall be earmarked as the No Development Zone (NDZ). Provided that the NDZ for development of eco-tourism activities shall be 20 m and the A&N administration shall ensure that the concerns of the fishing community are fully protected.

As per paragraph 1, clause (ii) of ICRZ notification 2019, the Great Nicobar Island falls under the ICRZ (Group-II) Island category (Amendment to the ICRZ notification 2019 vide S.O.2. (E) dated 1st January 2021).

(vi) Land area up to 20 m from the HTL, or width of the creek whichever is less, along the tidal influenced water bodies in the ICRZ III, shall also be earmarked as the NDZ and the distance upto which the NDZ is to be reckoned as the land area between HTL to 20 meters or width of the creek, whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance upto which development along such tidal influenced water bodies is to be regulated shall be governed by the distance upto which the tidal effects are experienced which shall be determined based on salinity concentration of five parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Island Coastal Regional Zone Plans (hereinafter referred to as the ICRZ Plans). Note: The NDZ shall not be applicable in such areas falling within notified Port limits.

7.4. CRZ IV

The ICRZ - IV shall constitute the water area and shall be further classified as under:.

ICRZ- IVA: The water area and the sea bed area between the Low Tide Line up to twelve (12) nautical miles on the seaward side shall constitute ICRZ-IV A.

ICRZ- IVB: ICRZ-IV B areas shall include the water area and the bed area between LTL at the bank of the tidal influenced water body to the LTL on the opposite side of the bank, extending from the mouth of the water body at the sea up to the influence of tide, i.e., salinity of five parts per thousand (ppt) during the driest season of the year.

7.5. Regulation lines

The 20, 50 and 100m regulated lines were drawn landward from the HTL. Once the HTL, bays are well defined and demarcated, the above CRZ lines could be drawn without any ambiguity following planimetric spatial methods. In case of mangrove area >1000 sq. m, a 20 m buffer zone was drawn which is also considered as ICRZ IA.

*****

8. HAZARD LINE

As per para 2 of Annexure -IVA, A 'Hazard line' being demarcated by the Survey of India (SOI) taking into account the extent of the flooding on the land area due to water level fluctuations, sea level rise and shoreline changes(erosion/accretion) occurring over a period of time. The hazard line shall be used as a tool for disaster management plan for the coastal environment, including planning of adaptive and mitigation measures. With a view to reduce the vulnerability of the coastal communities and ensuring sustainable livelihood, while drawing the CZMPs, the land use planning for the area between the Hazard line and HTL shall take into account such impacts of climate change and shoreline changes. However, the Hazard line for the Andman and Nicobar island is not available. Hence, it is not shown in the ICRZ Maps.

*****

9. ICRZ CATEGORIES OF GREAT NICOBAR ISLAND

9.1 ICRZ categories of Great Nicobar Island

The ICRZ of Great Nicobar Island consists of ICRZ I (ICRZ IA & ICRZ IB), CRZ III (NDZ, 50 to 100m from HTL) and ICRZ IV (ICRZ IVA & ICRZ IVB). ICRZ area statistics is shown in Table 4. Figure 5 displays the Index map showing the numbering of ICRZ maps at Great Nicobar Island.

Table 4: Area statistics in different ICRZ categories

ICRZ Category	Area in sq km
ICRZ – IA	212.32
ICRZ - IB	14.96
No Development Zone	2.13
50m to 100m from HTL	0.53
ICRZ IVB	13.54
Total ICRZ area (except ICRZ IVA)	243.48

9.1.1. ICRZ I

The ICRZ IA are those ecologically sensitive and the geomorphological features which play a role in maintaining the integrity of the coast. These are Mangroves, Coral reefs, Turtle nesting grounds, Protected Forest, Megapod Nesting ground, National Park, Biosphere reserve are available in Great Nicobar Island coast. The above mention features/ thematic layer was merged to make ICRZ IA. Mangroves area greater than 1000 sq m, a 20m buffer has been provided which is also considered as ICRZ IA.

Total CRZ IA area of Great Nicobar Island is 212.32 sq. km. which includes the mangroves buffer area. The ICRZ IB (Intertidal Zone) is the area between HTL and LTL which covers total area of 14.96 sq km. Total ICRZ I area occupies 227.28 sq. km of Great Nicobar Island.

9.1.2. ICRZ II

CRZ-II shall constitute the developed land areas up to or close to the shoreline, within the existing municipal limits or in other existing legally designated urban areas, which are substantially built-up with a ratio of built-up plots to that of total plots being more than 50 per cent and have been provided with drainage and approach roads and other infrastructural facilities, such as water supply,sewerage mains, etc.

There is no ICRZ II area in Great Nicobar Island.

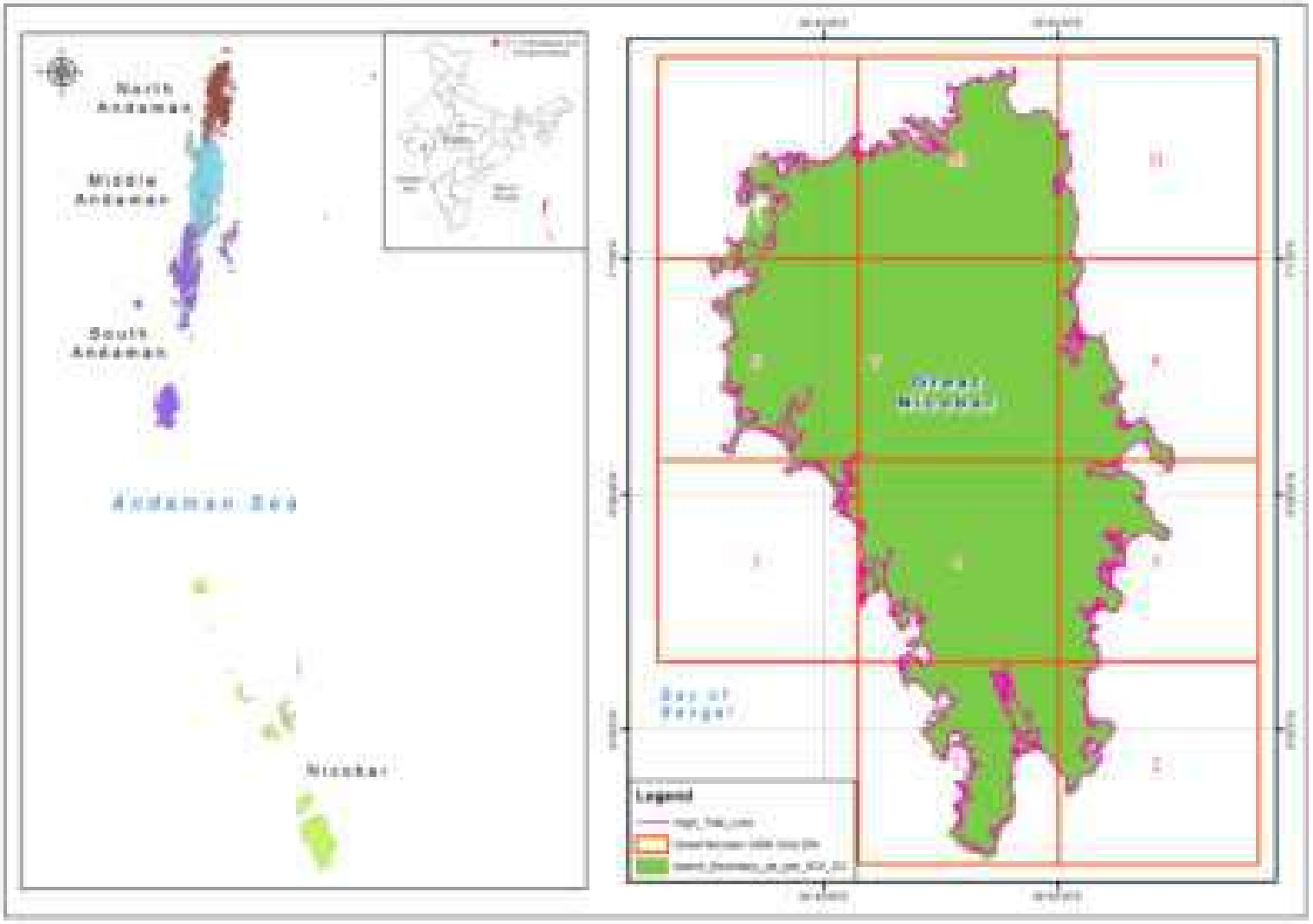

Figure 5: Index Map showing the number of ICZMP MAPs in Great Nicobar Island

9.1.3. ICRZ III

Land areas that are relatively undisturbed (viz. rural areas, etc.) and those which do not fall under ICRZ I, ICRZ-II, and ICRZ IV shall constitute ICRZ–III. ICRZ-III area are classified into two categories such as No Development Zone (NDZ), 50m to 100m landward from HTL.

The total ICRZ III area of Great Nicobar Island is 2.66 sq km. The calculated area of No Development Zone is 2.13 sq km and 50m to 100m from HTL is 0.53 sq km.

9.1.4. ICRZ IV

The water area comes under CRZ IV and is further classified into IVA and IVB.

i. ICRZ IVA: The water area and the sea bed area between the Low Tide Line up to twelve nautical miles on the seaward side;
ii. ICRZ-IV B areas shall include the water area and the bed area between LTL at the bank of the tidal influenced water body to the LTL on the opposite side of the bank, extending from the mouth of the water body at the sea up to the influence of tide, i.e., salinity of five parts per thousand (ppt) during the driest season of the year.

The ICRZIVB category covers an area of 13.54sq km at Great Nicobar Island.

10. CONCLUSIONS

- High Tide Line (HTL), Low Tide Line (LTL) and Ecologically Sensitive Areas (ESAs), demarcated by the National Centre for Sustainable Coastal Management (NCSCM), Chennai, were used in preparation/updation the ICRZPs, as required under the provisions of the ICRZ Notification, 2019.
- Based on the ICRZ notification, 2019, various regulatory lines viz. at a distance of 20 metres, 50 metres, and 100 metres from HTL respectively, as applicable in various ICRZ categories, were superimposed in the ICRZ maps.
- Survey of India topographical sheets were used as base maps.
- HTL, LTL, ESAs etc. were superimposed over the cadastral map. Various administrative boundaries, infrastructure etc. as required in ICRZ notification 2019 were overlaid over the above map.
- The draft ICRZ maps were published on the website seeking suggestions/comments from the public and stakeholders.
- Island Coastal Regulation Zone Plan (ICRZPs) of Great Nicobar Island on 1:25000 scale has been prepared as per the provision of ICRZ notification 2019
- Coastal land use maps (i.e. land use map used to define ICRZ including Ecologically Sensitive Areas) were prepared on 1: 25000 scale.
- There are eleven ICRZ maps and corresponding 11 numbers of coastal land use maps covering the coastal areas of Great Nicobar Island in 1:25000 scale.
- The dominant ESAs are Coral reefs, Mangroves, Turtle nesting grounds, Protected Forest, Megapod Nesting sites, National Park, Biosphere reserve etc.
- The calculated area of ICRZ I is 227.28 sq km (including ICRZ IA and IB), NDZ area is 2.13 sq km and 50m to 100m from HTL is 0.53 sq km in Great Nicobar Island.
- The ICRZ Plans of Great Nicobar Island were approved by MoEF&CC, Government of India, vide MOEF&CC letter No. F. No. 12-3/2021-IA.III dated 1/06/2021 (enclosed at Annexure-IV).
- All developmental activities listed in the ICRZ notification 2019 shall be regulated by the Union Territory administration, the local authority or the A&N CZMA within the framework of the approved ICRZ plan prepared under ICRZ notification, 2019

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REFERENCES

- Census of India, 2011, Ministry of Home Affairs, Government of India, www.censusindia.gov.in
- CRZ notification, 2011 (https://parivesh.nic.in/writereaddata/ENV/crz23.PDF)
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- https://www.green.earth/blog/intertidal-zone-ecosystems-what-are-they-and-why-are-they-under-threat
- Central Pollution Control Board, Government of India, (https://cpcb.nic.in/uploads/plasticwaste/Annual_Report_2018-19_PWM.pdf)
- Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India, (https://agricoop.nic.in/sites/default/files/Maharashtra-SAP_V1.3-2.pdf)

ANNEXURES

I. Classification system for coastal land use

II. Data sources used in the preparation of ICRZP maps

III. Photographs taken during field work

IV. Approval of ICRZ Plans of Great Nicobar Islkand as per ICRZ Notification, 2019 – MOEFCC letter dated 1/06/2021

Annexure – I

CLASSIFICATION SYSTEM FOR COASTAL LAND USE

Level I	Level II	Level III
Agricultural land		
Forest (Non-tidal)	Natural	
	Manmade	
Wetlands	Mud/tidal flat	Sub-tidal
		Inter-tidal
		High tidal (with/without salt encrustations)
		Mud with vegetation
	Sand	Beach/ Sand Patch
		Spit
		Sand Bar/ Barrier Island
		Shoals
		Sand vegetation
	Rocks	Rocky coast
		Rock exposure
	Coral Reef	Reef flat
		Sand Patch /Beach
		Coral Lagoon
		Coralline shelf
	Mangroves	Dense/sparse/degraded
	Marsh vegetation	(Density wise)
	Algae	(Density wise)
	Seagrass	Dense/sparse/degraded
Water bodies	Estuary	
	Creek	
	Lagoon	
	Bay	
Barren land	Mining areas /dumps	
	Rock outcrops/ Gullied land	
Shoreland	Saline area	Vegetated
	Coastal dune	Vegetated
	Reclaimed mudflat	
Built-up land	Habitation/ settlement	With vegetation
	Open/vacant land	
	Transportation	Roads
		Railways
		Port/Harbour/ jetty
		Waterways
		Airport
Other features	Aquaculture pond	
	Reclaimed area	
	Salt pan	
	Seawall / Embankment	
	Tanks/ Ponds/ Lakes	

Level I	Level II	Level III
	Rivers/ streams/ Drains	
	outfalls/effluents/ canals	
HTL		
LTL		
Hazard Line		
Village/ Taluk/ District/ State/ MPA/ Forest boundary		
CRZ boundary	100m/ 200m/ 500m/ 50m buffer zone of mangroves/ width of the creek/	

Annexure – II

DATA SOURCES

Data Source used in the preparation of ICRZ maps

Source	Data
Department of Environment & Forest Andaman and Nicobar Administration /ANCZMA, U.T. of Andaman & Nicobar	• Administrative boundaries • Cadastral data in 1:4,000 scale • Fish Landing Centre • Road • National Park • Wild Life Sanctuaries • Biosphere Reserve • Turtle nesting grounds • Megapod nesting site • Coral reefs • Tribal and Jarawa Reserve Boundary
Survey of India	• Open Series Maps (OSM) Grid • Toposheets on 1:25,000 scale
NCSCM	• Lighthouse • High Tide Line • Low Tide Line • Breakwater/Jetty • ESAs and geomorphological features • ICRZ Regulation Line, boundary, categories and coastal land use
Others	• NHO charts • High Resolution Satellite images

Annexure - III

PHOTOGRAPHS TAKEN DURING FIELD WORK

View of jetty at Campbell Bay

Another view of jetty at Campbell Bay

View of breakwater at Campbell Bay

Another view of breakwater at Campbell Bay

Another view of breakwater at Campbell Bay

View of the exposed corals near Campbell Bay port during low tide

Another view of the exposed corals and dead trees near Campbell Bay during low tide

View of existing infrastructure facility (Bridge) near Magarnala Beach

View of Magarnala beach

Turtle hatchery at Joginder nagar beach

Another view of Joginder nagar beach

Land cultivated with areca nut, coconut and other crops near Joginder nagar

Another view of the cultivated land near Joginder nagar

Afforestation of mangrove, south of Joginder nagar beach

Another view of the existing mangrove trees near by the agricultural land, south of Goginder nagar beach

View of jetty at Nemo beach

View of the intertidal area near Shastri nagar

Another view of the intertidal area near Shastri nagar

View of the turtle hatchery at Shastri nagar beach

View of Shastri nagar beach with the coastal protection

Another view of Shastri nagar beach with the coastal protection

Another view of Shastri nagar beach with the coastal protection

View of Indira point light house

View of Galathea Bay

Another view of Galathea Bay

Another view of Galathea Bay

Leatherback turtle hatchery at Galathea Bay wildlife sanctuary

Another view of the leatherback turtle hatchery at Galathea Bay wildlife sanctuary

View of the turtle nesting beach at Galathea Bay

View of Galathea River joining the sea water at Galathea Bay

Temporary road across the Galathea River that leads into wildlife sanctuary

Another view of the Galathea river from the temporary bridge

Settlements near Shastri nagar

Coconut plantation near Shastri nagar settlement along with the infrastructure facility

Government Primary School at Shastri nagar

Agricultural plantation on the way to Joginder nagar from Shastri nagar

View of Laxman beach, near Campbell Bay

View of mangroves near Laxman beach

View of B-Quarry Beach

Another view of B-Quarry Beach

Intertidal zone with mangroves, north of Tenlao

Another view of the intertidal area with mangroves

Annexure - IV

F. No. 12-3/2021-IA.III
Government of India
Ministry of Environment, Forest and Climate Change
IA-III Division (CRZ)

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi -3
Dated: 1st June, 2021

To,

The Member Secretary,
Andaman & Nicobar Coastal Zone Management Authority,
Department of Environment & Forests,
Van Sadan, Haddo, Port Blair-744101

Subject: Island Coastal Regulation Zone Plans of Great Nicobar Island as per ICRZ Notification, 2019 -regarding.

Sir,

This has reference to letter No. PCCF/EPA/1/Vol-XVII/493, dated 24/02/2021 furnishing therein the Island Coastal Regulation Zone (ICRZ) Plans of Great Nicobar Island, drawn as per the provisions of the Island Coastal Regulation Zone (ICRZ) Notification, 2019.

2. In this regard, it is to state that based on recommendation of the National Coastal Zone Management Authority in its 42nd meeting held on 23/03/2021, the Ministry of Environment, Forest and Climate Change hereby conveys its approval of the ICRZ Plans for the Great Nicobar Island. Further, it is to inform that all proposals received henceforth for ICRZ clearance shall be considered as per ICRZ Notification 2019 only. However, pending proposals under IPZ Notification 2011, if any, may be considered at the discretion of project proponent.

This issues with the approval of the Hon'ble Minister, EFCC.

Yours faithfully,

(Dr. H. Kharkwal)
Additional Director /
Scientist 'E' & MS CRZ

Copy to:

1. The Chief Secretary, Andaman & Nicobar Administration, Department of Environment & Forests, Van Sadan, Haddo, Port Blair-744101
2. The Deputy Director General of Forests (C), Integrated Regional Office, Chennai, Ministry of Environment, Forest and Climate Change, I and II Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai – 600034, Tamil Nadu

3. The Director National Centre for Sustainable Coastal Management, Anna University, Chennai - 600025 Tamil Nadu.

4. Office copy/Guard file

(Dr. H. Khastwal)
Additional Director /
Scientist 'E' & MS CRZ

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 13/SW

Edition - 1: June, 2021 | Projection - UTM | Datum - WGS 1984 | Map No: GN 1

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Meters
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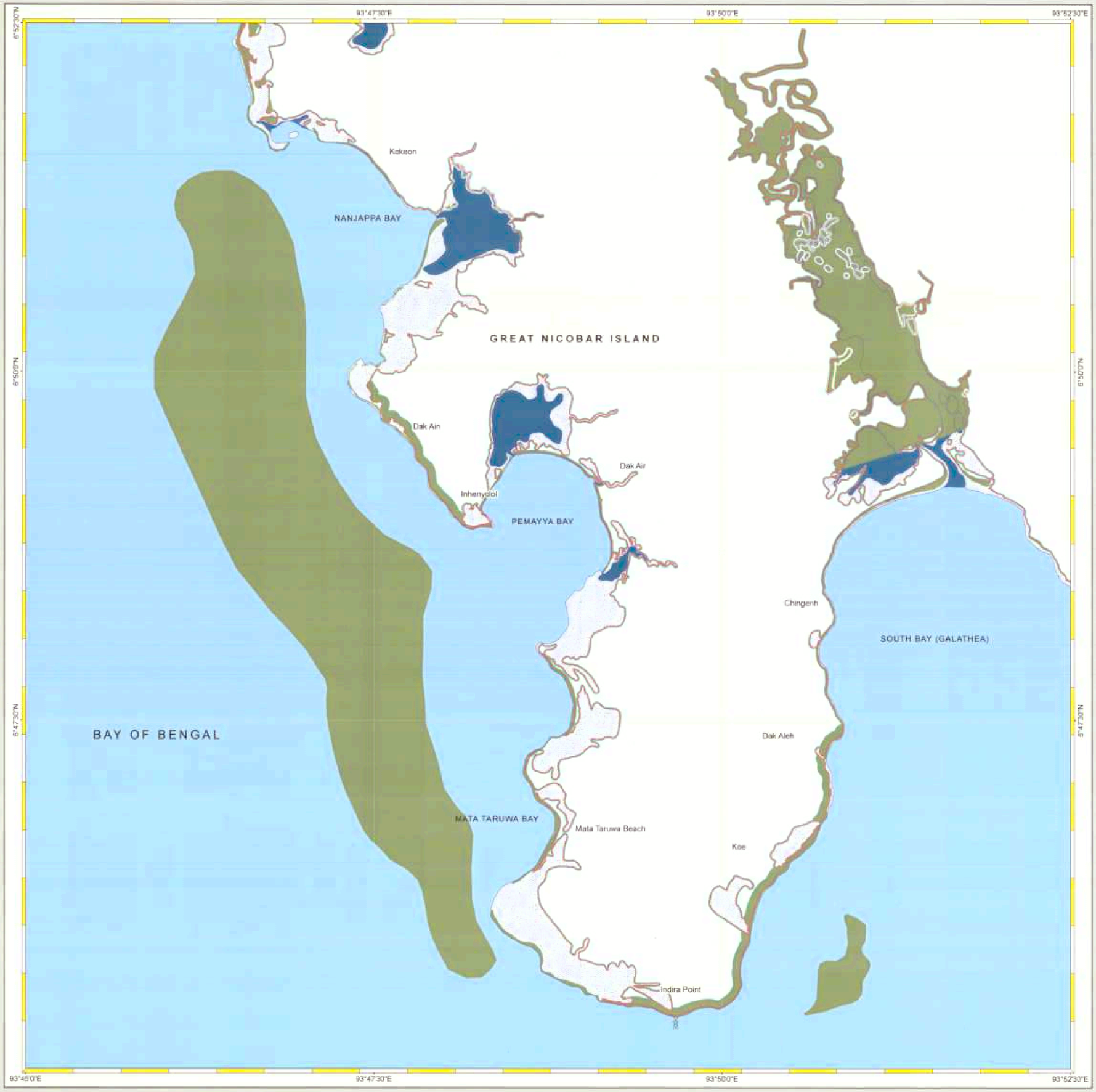

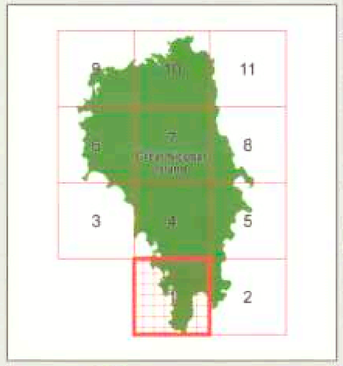

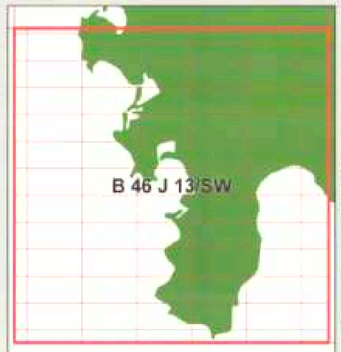

LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

- 20m ICRZ Line - NDZ for Eco-Tourism Activities
- 50m ICRZ Line - NDZ
- ICRZ Boundary
  (100m Line, 20m for Bay 20 m or width of the creek whichever is less along the tidal influenced water bodies)

ICRZ CATEGORY

ICRZ - I

- ICRZ - IA
- 20m Mangrove Buffer Zone
- ICRZ - IB

ICRZ - III

- No Development Zone
- 50m to 100m from HTL

ICRZ - IV

- ICRZ - IVA
- ICRZ - IVB

Note: Mangroves in private land will not require a buffer zone

DATA SOURCE

i) National Centre for Sustainable Coastal Management
1) HTL, LTL, 2) ICRZ Lines; 3) ICRZ Categories;
4) Infrastructure facilities such as Road, Lighthouse, Jetty etc.

ii) Union Territory of Andaman and Nicobar Administration
1) Administrative Boundaries, Fish Landing Centre, National Park, Biosphere Reserved, Turtle Nesting Ground, Nesting Ground of Bird Tribal Reserve, etc.

ABBREVIATIONS
ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

PREPARED AS PER ICRZ NOTIFICATION, 2019

Scrutinized by	Certified by	Concurred by	Approved by
Technical Scrutiny Committee, National Centre for Sustainable Coastal Management, MoEF & CC	DIRECTOR, National Centre for Sustainable Coastal Management, MoEF&CC	Principal Chief Conservator of Forests, Andaman & Nicobar Islands, Port Blair	

Prepared by

NCSCM

National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

Ref: MoEF & CC Let. No. 12-3/2021-IA.III Dt. 01.06.2021

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 13/SE

Edition - 1: June, 2021 | Projection :- UTM | Datum :- WGS 1984 | Map No: GN 2

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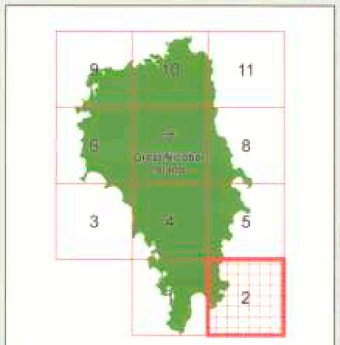

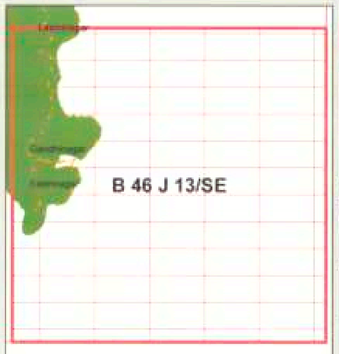

LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

- 20m ICRZ Line - NDZ for Eco-Tourism Activities
- 50m ICRZ Line - NDZ
- ICRZ Boundary (100m Line, 20m for Bay, 20 m or width of the creek whichever is less along the tidal influenced water bodies)

ICRZ CATEGORY

ICRZ - I

- ICRZ - IA
- 20m Mangrove Buffer Zone
- ICRZ - IB

ICRZ - III

- No Development Zone
- 50m to 100m from HTL

ICRZ - IV

- ICRZ - IVA
- ICRZ - IVB

Note: Mangroves in private land will not require a buffer zone

DATA SOURCE

I) National Centre for Sustainable Coastal Management
1) HTL, LTL; 2) ICRZ Lines; 3) ICRZ Categories;
4) Infrastructure facilities such as Road, Lighthouse, Jetty etc.

II) Union Territory of Andaman and Nicobar Administration

1) Administrative Boundaries, Fish Landing Centre, National Park, Biosphere Reserved, Turtle Nesting Ground, Nesting Ground of Bird, Tribal Reserve, etc.

ABBREVIATIONS
ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

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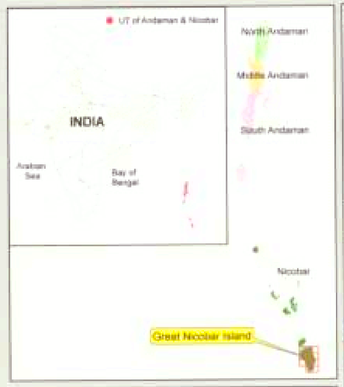
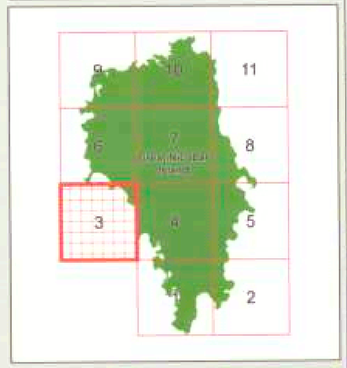
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 9/NE

Edition - 1: June, 2021 Projection :: UTM Datum :: WGS 1984 Map No: GN 3





LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

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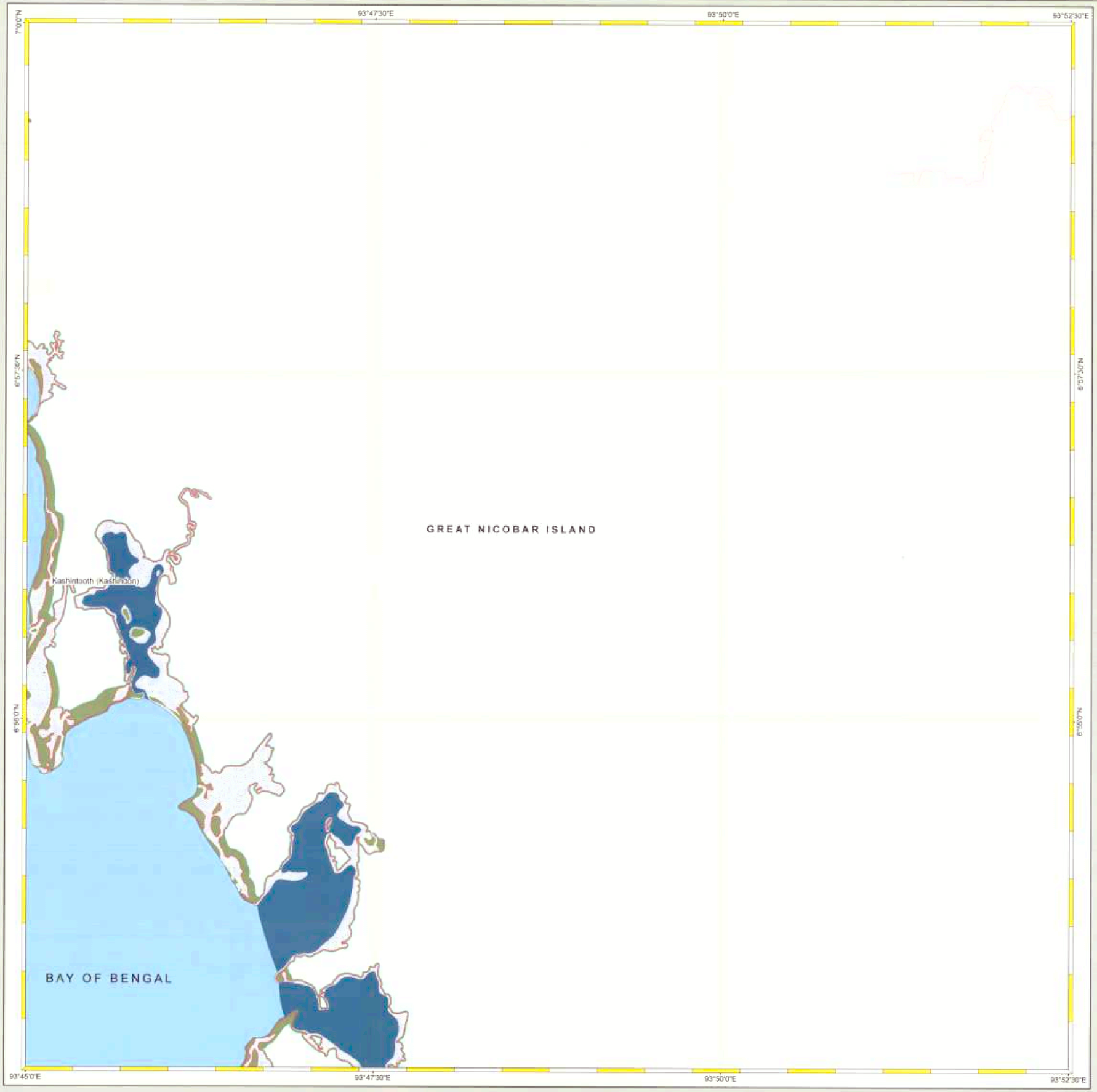
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

Ref: MoEF & CC Let. No. 12-3/2021-IA.III Dt. 01.06.2021

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 13/NW

Edition - 1: June, 2021 Projection : UTM Datum : WGS 1984 Map No: GN 4



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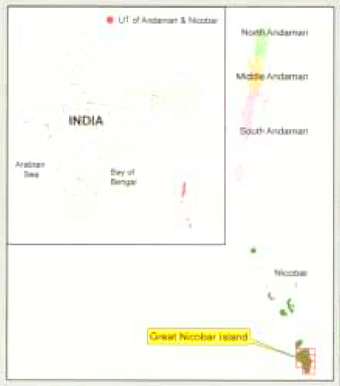

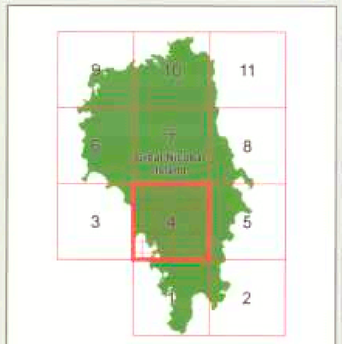

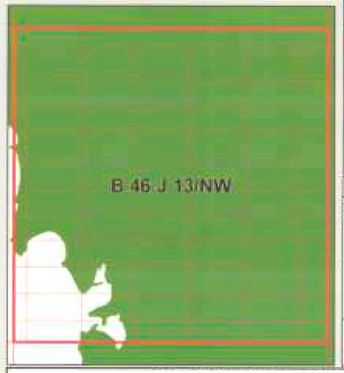

LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

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ICRZ - III

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DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

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ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 13/NE

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 5

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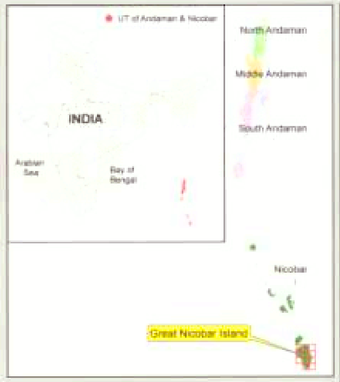

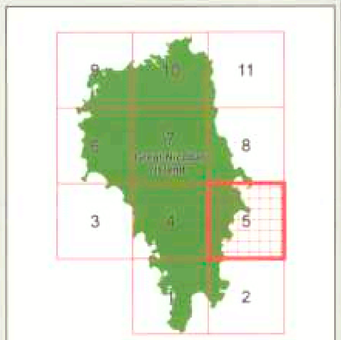

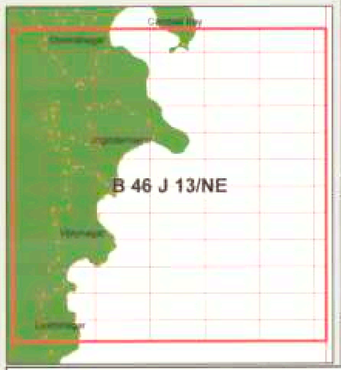

LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

- 20m ICRZ Line - NDZ for Eco-Tourism Activities
- 50m ICRZ Line - NDZ
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ICRZ CATEGORY

ICRZ - I

- ICRZ - IA
- 20m Mangrove Buffer Zone
- ICRZ - IB

ICRZ - III

- No Development Zone
- 50m to 100m from HTL

ICRZ - IV

- ICRZ - IVA
- ICRZ - IVB

Note: Mangroves in private land will not require a buffer zone.

DATA SOURCE

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Mapped During 2017-18

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Prepared by Andaman & Nicobar Administration

NCSCM
National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 12/SE

Edition - 1: June, 2021 | Projection : UTM | Datum : WGS 1984 | Map No: GN 6

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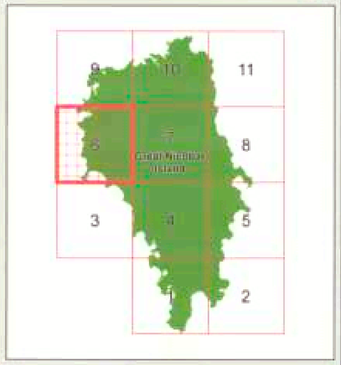

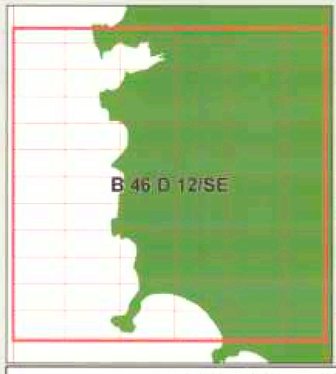

LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

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ICRZ - III

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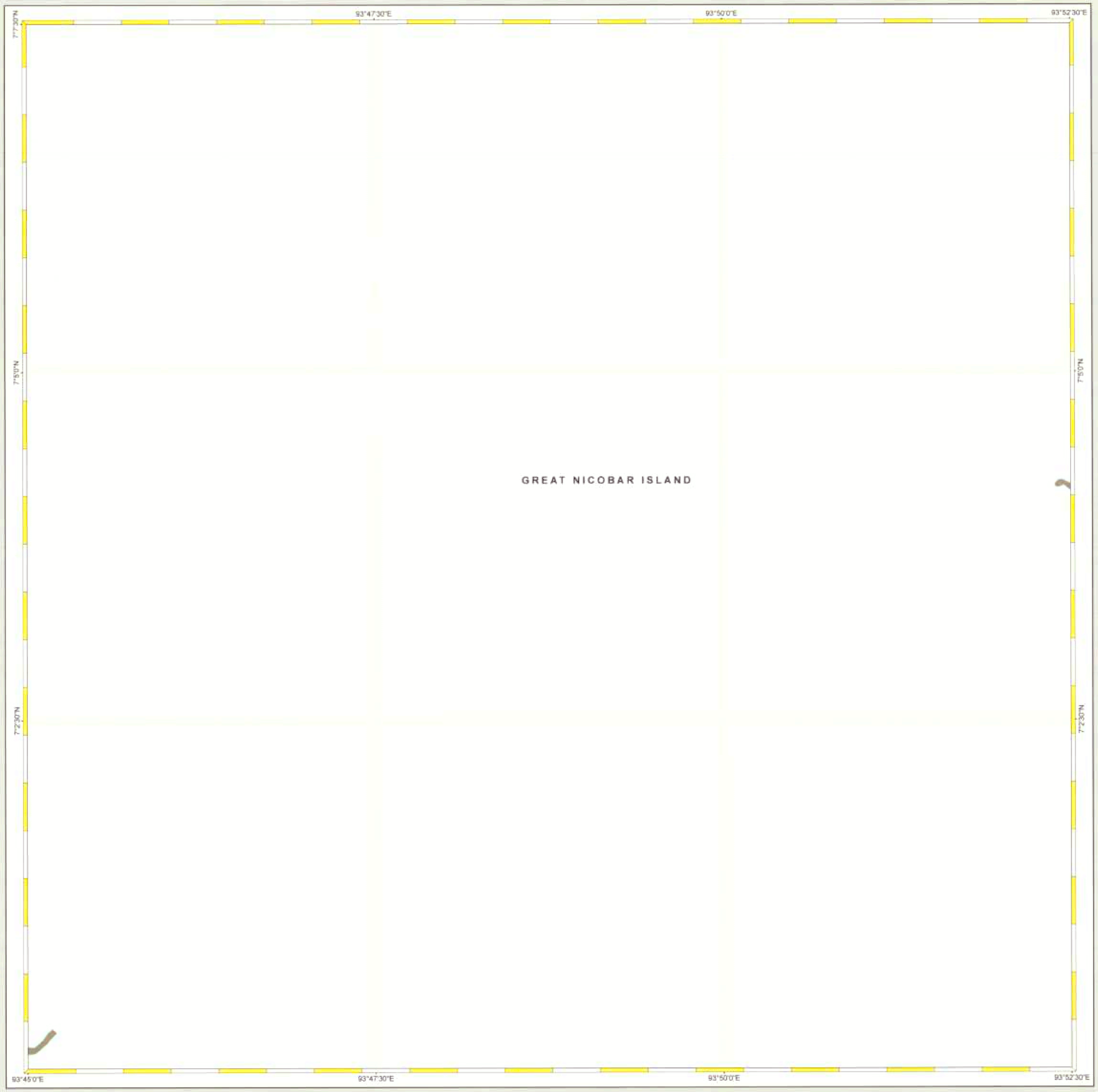
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/SW

Edition - 1: June, 2021 Projection - UTM Datum - WGS 1984 Map No: GN 7



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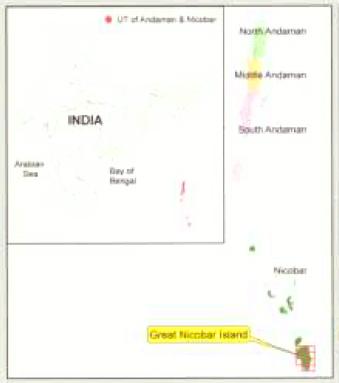

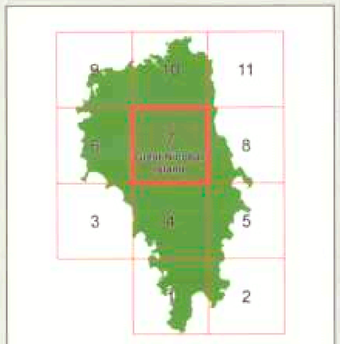

B 46 D 16/SW

LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

- 20m ICRZ Line - NDZ for Eco-Tourism Activities
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  (100m Line, 20m for Bay, 20 m or width of the creek whichever is less along the tidal influenced water bodies)

ICRZ CATEGORY

ICRZ - I

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- 20m Mangrove Buffer Zone
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ICRZ - III

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ICRZ - IV

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Note: Mangroves in private land will not require a buffer zone

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DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/SE

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 8

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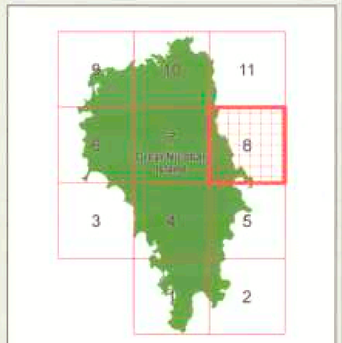

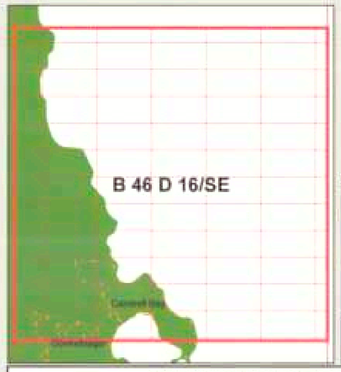

LEGEND

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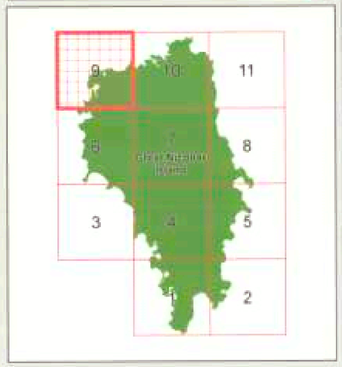
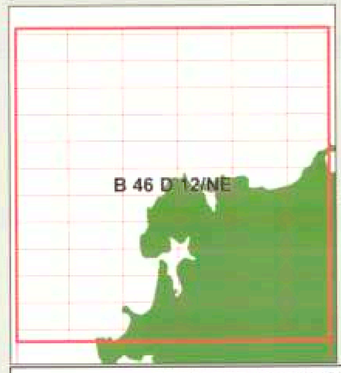
ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 12/NE

Edition - 1: June, 2021 Projection : UTM Datum : WGS 1984 Map No: GN 9





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LEGEND

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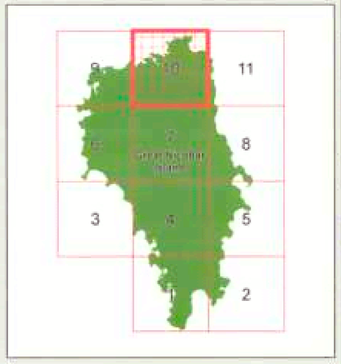
ANDAMAN & NICOBAR ADMINISTRATION

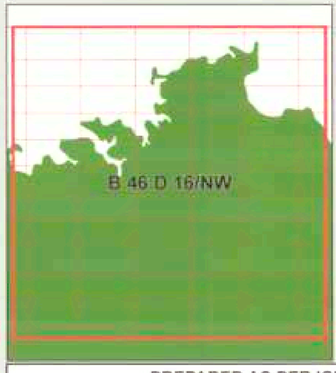
Ref: MoEF & CC Let. No. 12-3/2021-IA.III Dt: 01.06.2021

ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/NW

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 10





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LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

- 20m ICRZ Line - NDZ for Eco-Tourism Activities
- 50m ICRZ Line - NDZ
- ICRZ Boundary (100m Line, 20m for Bay, 20 m or width of the creek whichever is less along the tidal influenced water bodies)

ICRZ CATEGORY

ICRZ - I

- ICRZ - IA
- 20m Mangrove Buffer Zone
- ICRZ - IB

ICRZ - III

- No Development Zone
- 50m to 100m from HTL

ICRZ - IV

- ICRZ - IVA
- ICRZ - IVB

Note: Mangroves in private land will not require a buffer zone

DATA SOURCE

i) National Centre for Sustainable Coastal Management
1) HTL, LTL; 2) ICRZ Lines; 3) ICRZ Categories;
4) Infrastructure facilities such as Road, Lighthouse, Jetty etc

ii) Union Territory of Andaman and Nicobar Administration

1) Administrative Boundaries, Fish Landing Centre, National Park, Biosphere Reserved, Turtle Nesting Ground, Nesting Ground of Bird, Tribal Reserve, etc

ABBREVIATIONS
ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

PREPARED AS PER ICRZ NOTIFICATION, 2019

Scrutinized by	Certified by	Concurred by	Approved by
Technical Scrutiny Committee, National Centre for Sustainable Coastal Management, MoEF & CC	DIRECTOR, National Centre for Sustainable Coastal Management, MoEF&CC	Principal Chief Conservator of Forests, Andaman & Nicobar Islands, Port Blair	

Prepared by

NCSCM

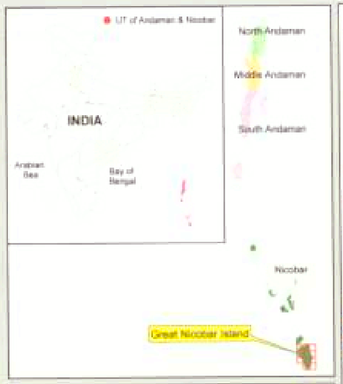
National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

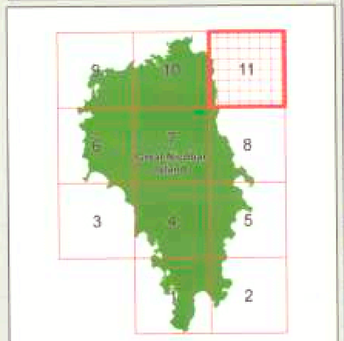
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

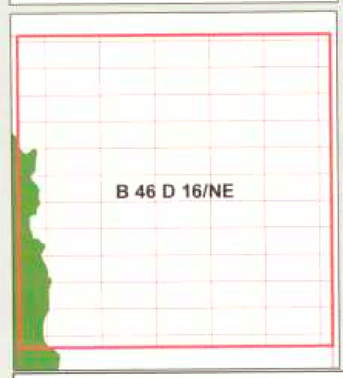
ISLAND COASTAL REGULATION ZONE PLAN
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/NE

Edition - 1: June, 2021 Projection : UTM Datum : WGS 1984 Map No: GN 11







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LEGEND

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- Survey Plots
- Village Boundary
- Jetty

ICRZ Lines & Boundary

- 20m ICRZ Line - NDZ for Eco-Tourism Activities
- 50m ICRZ Line - NDZ
- ICRZ Boundary (100m Line, 20m for Bay, 20 m or width of the creek whichever is less along the tidal influenced water bodies)

ICRZ CATEGORY

ICRZ - I

- ICRZ - IA
- 20m Mangrove Buffer Zone
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- 50m to 100m from HTL

ICRZ - IV

- ICRZ - IVA
- ICRZ - IVB

Note: Mangroves in private land will not require a buffer zone

DATA SOURCE

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1) HTL, LTL; 2) ICRZ Lines; 3) ICRZ Categories;
4) Infrastructure facilities such as Road, Lighthouse, Jetty etc

II) Union Territory of Andaman and Nicobar Administration
1) Administrative Boundaries; Fish Landing Centre, National Park, Biosphere Reserved, Turtle Nesting Ground, Nesting Ground of Bird, Tribal Reserve, etc

ABBREVIATIONS
ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-19

PREPARED AS PER ICRZ NOTIFICATION, 2019

Scrutinized by	Certified by	Concurred by	Approved by
Technical Scrutiny Committee, National Centre for Sustainable Coastal Management, MoEF & CC	DIRECTOR, National Centre for Sustainable Coastal Management, MoEF&CC	Principal Chief Conservator of Forests, Andaman & Nicobar Islands	

Prepared by NCSCM

National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

Ref: MoEF & CC Let. No. 12-3/2021-IA III Dt. 01.06.2021

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 13/SW

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 1

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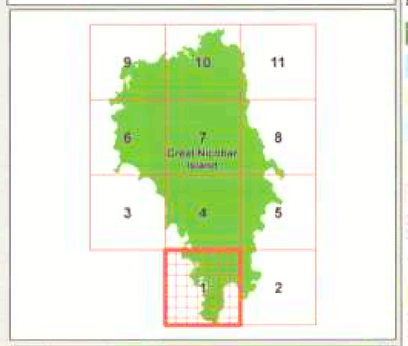

Legend

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- 20m ICRZ Line for Bay
- 100m ICRZ Line
- ICRZ Line for Creek or River
- Village Boundary

LANDUSE CATEGORIES

ESA's

- Mangrove
- Coral Reef
- Protected Forest
- National Park
- Biosphere Reserve
- Turtle Nesting Ground
- Megapod Nesting Ground

Others

- Agricultural Land
- Habitation or Settlement
- Beach or Sand patch
- Jetty
- Tribal Reserve
- Creek or River
- Intertidal Zone

DATA SOURCE

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ABBREVIATIONS :

ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

Prepared by

NCSCM

National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
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DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 13/SE

Edition - 1: June, 2021 Projection - UTM Datum - WGS 1984 Map No: GN 2

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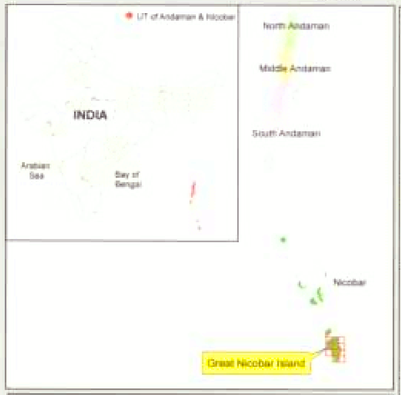

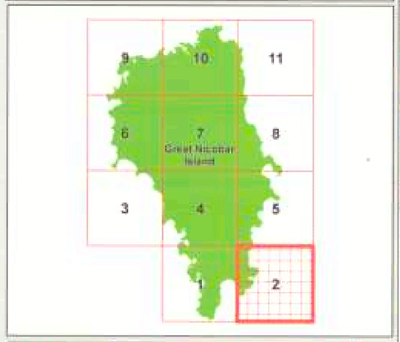

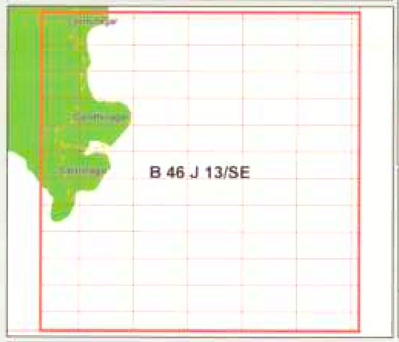

Legend

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- 20m ICRZ Line for Bay
- 100m ICRZ Line
- ICRZ Line for Creek or River
- Village Boundary

LANDUSE CATEGORIES

ESA's

- Mangrove
- Coral Reef
- Protected Forest
- National Park
- Biosphere Reserve
- Turtle Nesting Ground
- Megapod Nesting Ground

Others

- Agricultural Land
- Habitation or Settlement
- Beach or Sand patch
- Jetty
- Tribal Reserve
- Creek or River
- Intertidal Zone

DATA SOURCE

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ABBREVIATIONS

ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

Prepared by
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Chennai - 600 025

DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 9/NE

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 3

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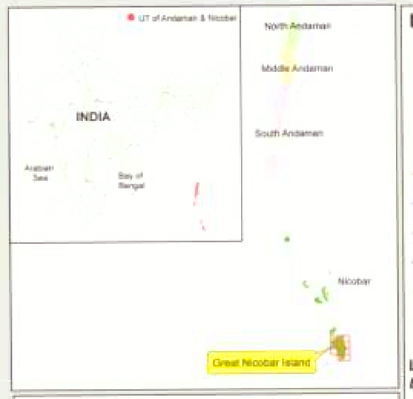

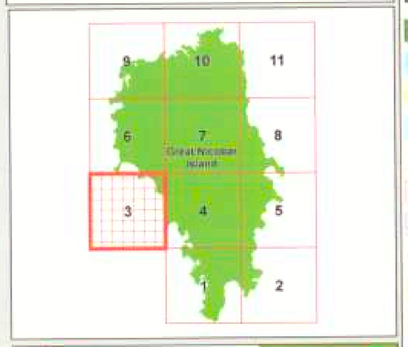

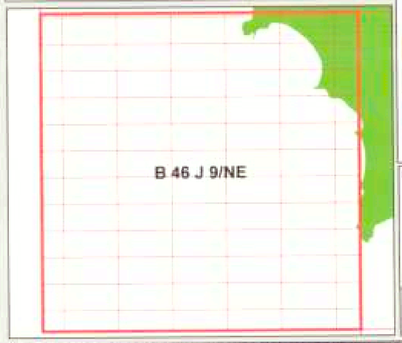

Legend

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- 20m ICRZ Line for Bay
- 100m ICRZ Line
- ICRZ Line for Creek or River
- Village Boundary

LANDUSE CATEGORIES

ESA's

- Mangrove
- Coral Reef
- Protected Forest
- National Park
- Biosphere Reserve
- Turtle Nesting Ground
- Megapod Nesting Ground

Others

- Agricultural Land
- Habitation or Settlement
- Beach or Sand patch
- Jetty
- Tribal Reserve
- Creek or River
- Intertidal Zone

DATA SOURCE

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1) HTL, LTL 2) ICRZ Lines 3) ICRZ Categories
4) Infrastructure facilities such as Road, Lighthouse, Jetty etc.

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1) Administrative Boundaries, Fish landing Centre, National Park, Biosphere Reserved, Turtle Nesting Ground, Nesting Ground of Bird, Tribal Reserve, etc

ABBREVIATIONS

ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

Prepared by

NCSCM

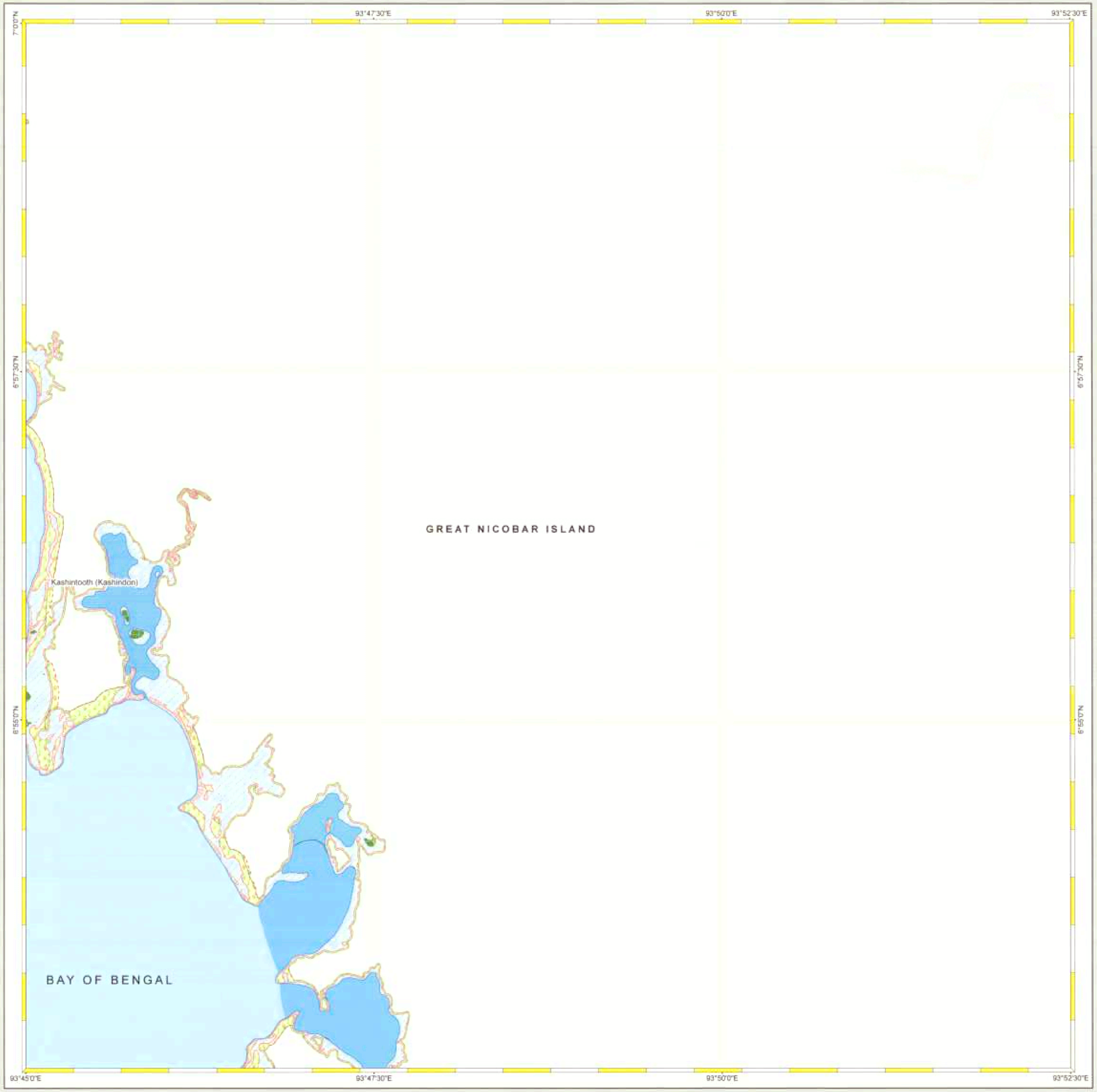
National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

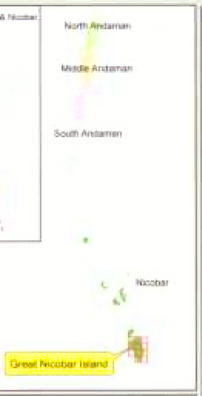
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

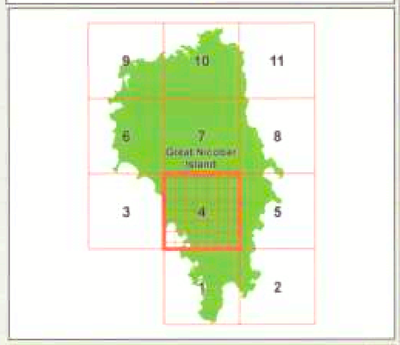
COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

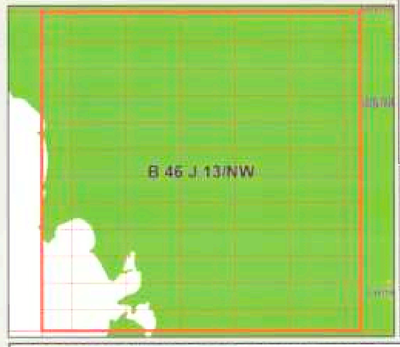
Sheet No: B 46 J 13/NW

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 4









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Legend

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- 20m ICRZ Line for Bay
- 100m ICRZ Line
- ICRZ Line for Creek or River
- Village Boundary

LANDUSE CATEGORIES

ESA's

- Mangrove
- Coral Reef
- Protected Forest
- National Park
- Biosphere Reserve
- Turtle Nesting Ground
- Megapod Nesting Ground

Others

- Agricultural Land
- Habitation or Settlement
- Beach or Sand patch
- Jetty
- Tribal Reserve
- Creek or River
- Intertidal Zone

DATA SOURCE

i) National Centre for Sustainable Coastal Management
1) HTL, LTL, 2) ICRZ Lines, 3) ICRZ Categories,
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ABBREVIATIONS

ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

Prepared by

NCSCM

National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 J 13/NE

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 5

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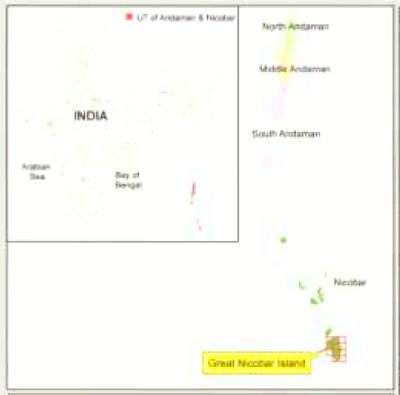

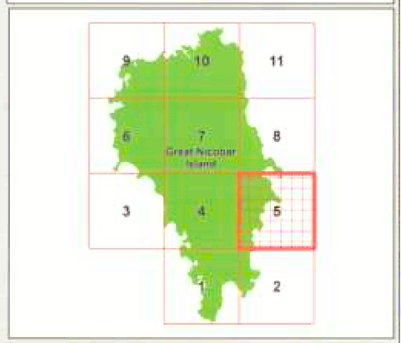

Legend

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- 20m ICRZ Line for Bay
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LANDUSE CATEGORIES

ESA's

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ABBREVIATIONS

ICRZ - Island Coastal Regulation Zone
NDZ - No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

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DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 12/SE

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 6

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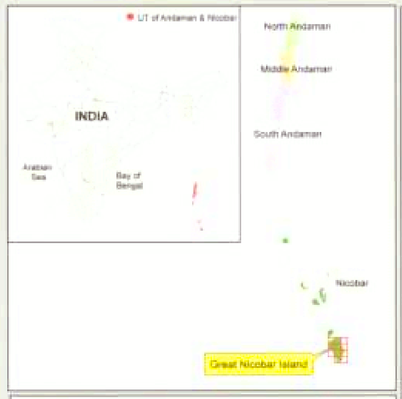

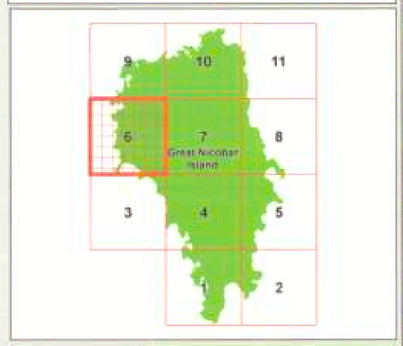

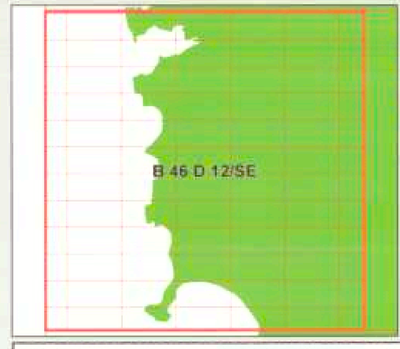

Legend

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- 20m ICRZ Line for Bay
- 100m ICRZ Line
- ICRZ Line for Creek or River
- Village Boundary

LANDUSE CATEGORIES

ESA's

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Others

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ABBREVIATIONS

ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

Prepared by

NCSCM

National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/SW

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 7

93°45'0"E 93°47'30"E 93°50'0"E 93°52'30"E
7°7'30"N 7°5'0"N 7°2'30"N

GREAT NICOBAR ISLAND

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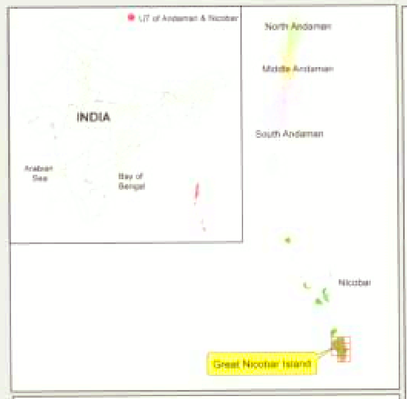

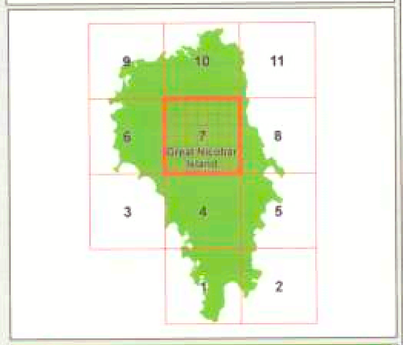

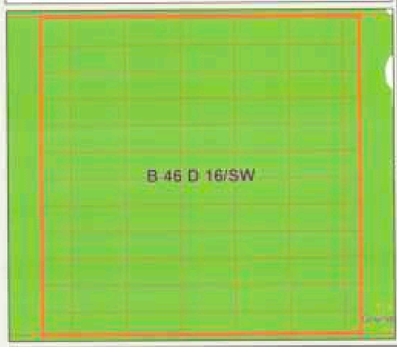

Legend

- Lighthouse
- Fish Landing Centre
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- Road
- High Tide Line
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- 20m ICRZ Line for Bay
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- ICRZ Line for Creek or River
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LANDUSE CATEGORIES

ESA's

- Mangrove
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- Habitation or Settlement
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ABBREVIATIONS

ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

Prepared by

NCSCM

National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

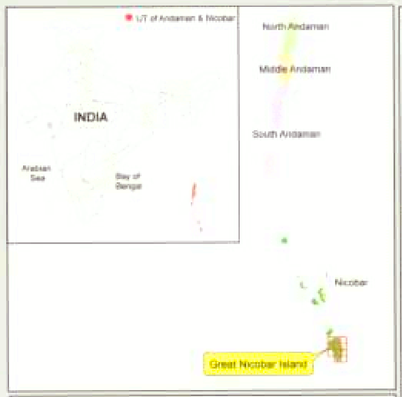
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

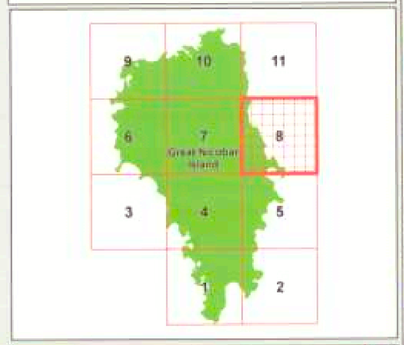
Ref: MoEF & CC Let. No. 12-3/2021-IA-III Dt. 01.06.2021

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/SE

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 8





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Legend

- Lighthouse
- Fish Landing Centre
- School
- Road
- High Tide Line
- Low Tide Line
- 20m ICRZ Line for Bay
- 100m ICRZ Line
- ICRZ Line for Creek or River
- Village Boundary

LANDUSE CATEGORIES

ESA's

- Mangrove
- Coral Reef
- Protected Forest
- National Park
- Biosphere Reserve
- Turtle Nesting Ground
- Megapod Nesting Ground

Others

- Agricultural Land
- Habitation or Settlement
- Beach or Sand patch
- Jetty
- Tribal Reserve
- Creek or River
- Intertidal Zone

DATA SOURCE

i) National Centre for Sustainable Coastal Management
1) HTL, LTL, 2) ICRZ Lines; 3) ICRZ Categories;
4) Infrastructure facilities such as Road, Lighthouse, Jetty etc.

ii) Union Territory of Andaman and Nicobar Administration
1) Administrative Boundaries, Fish landing Centre, National Park, Biosphere Reserve, Turtle Nesting Ground, Nesting Ground of Bird, Tribal Reserve, etc.

ABBREVIATIONS
ICRZ Island Coastal Regulation Zone
NDZ No Development Zone

Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

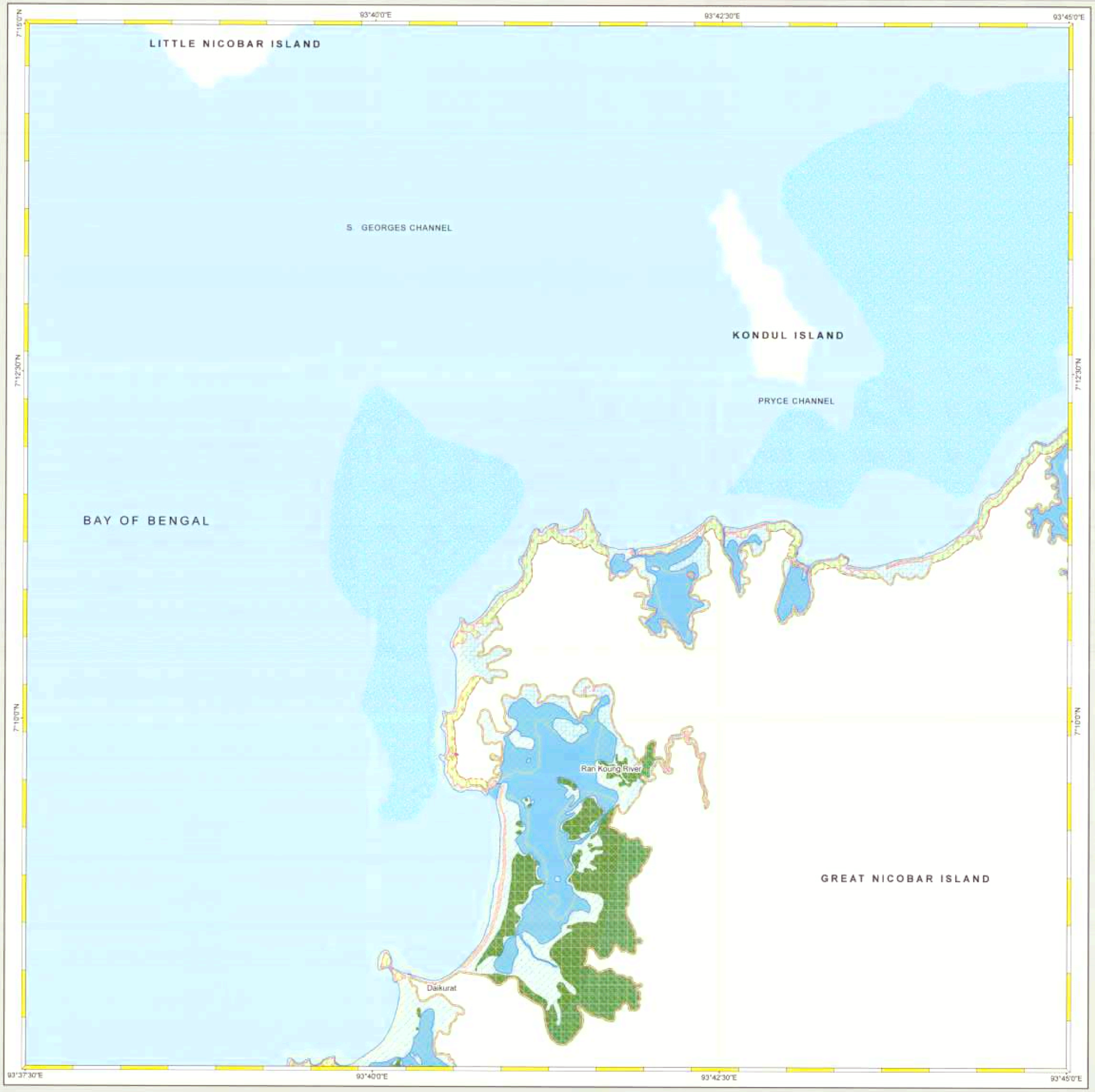
Prepared by
NCSCM
National Centre for Sustainable Coastal Management
(Ministry of Environment, Forest & Climate Change)
Chennai - 600 025

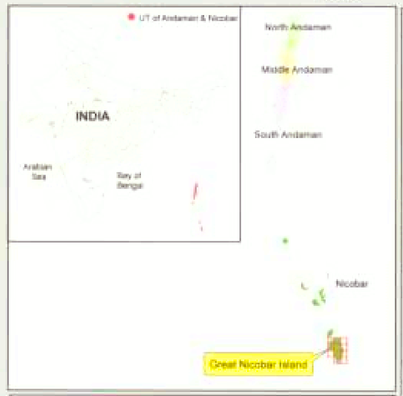
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

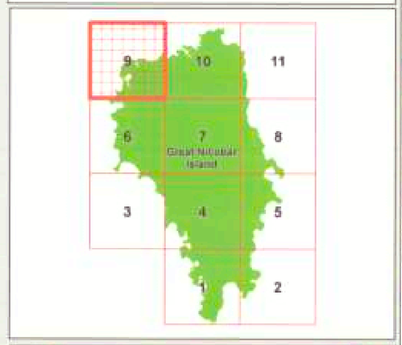
COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 12/NE

Edition - 1: June, 2021 Projection :- UTM Datum :- WGS 1984 Map No: GN 9







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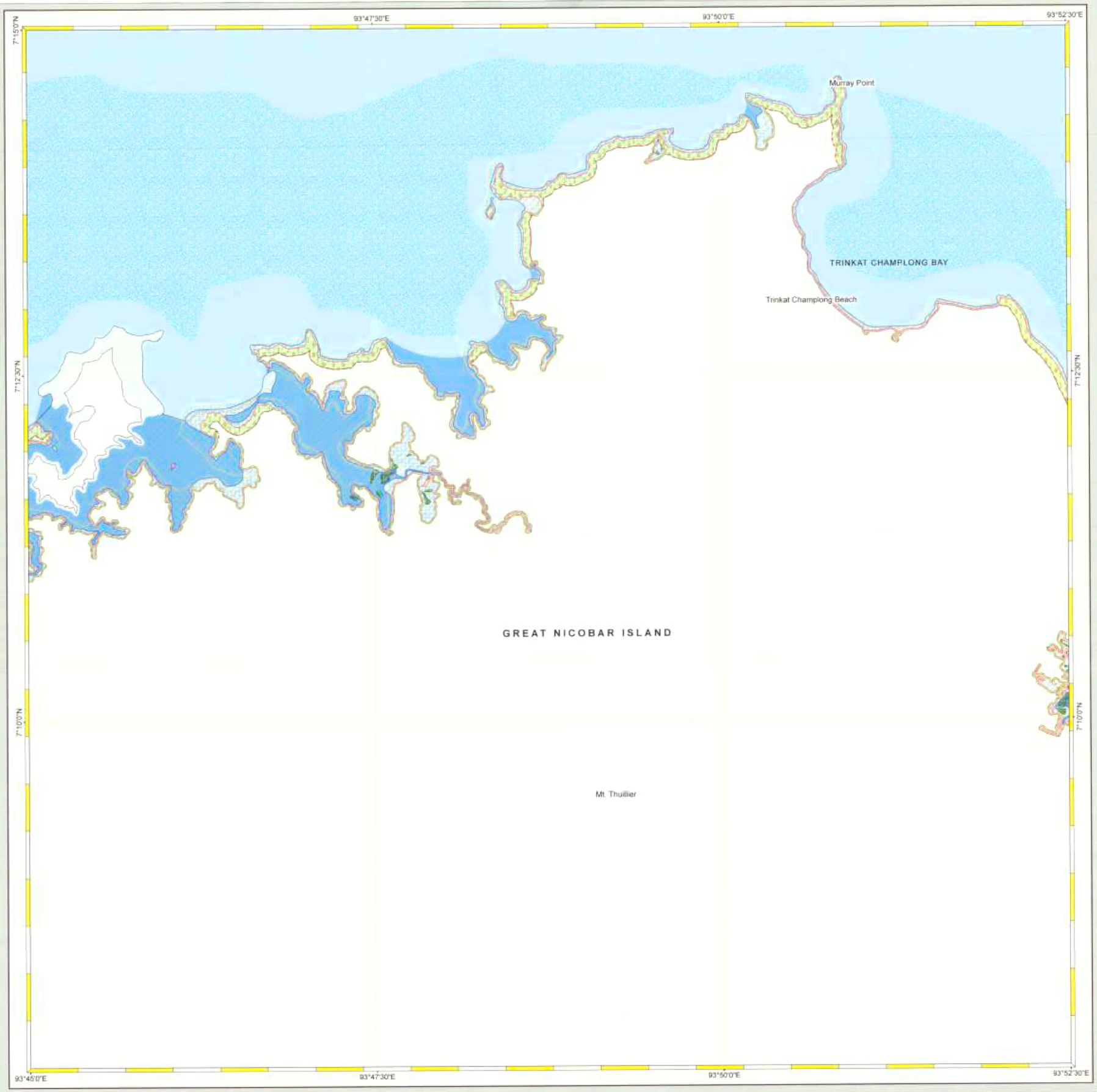
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/NW

Edition - 1: June, 2021 Projection : UTM Datum : WGS 1984 Map No: GN 10



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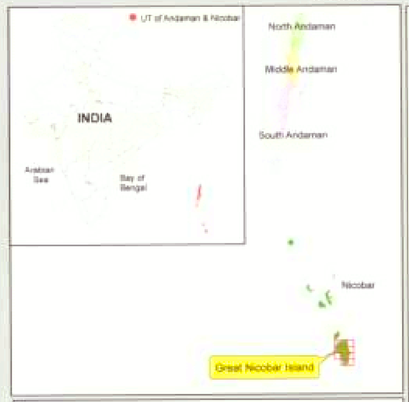

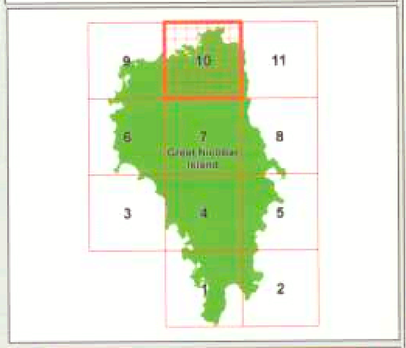

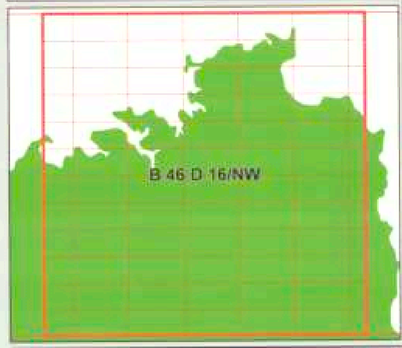

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Mapped During 2017-19

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

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DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION

Ref: MoEF & CC Let. No. 12-3/2021-IA.III Dt. 01.06.2021

COASTAL LAND USE MAP
GREAT NICOBAR ISLAND
ANDAMAN & NICOBAR ISLANDS

Sheet No: B 46 D 16/NE

Edition - 1: June, 2021 Projection : UTM Datum : WGS 1984 Map No: GN 11

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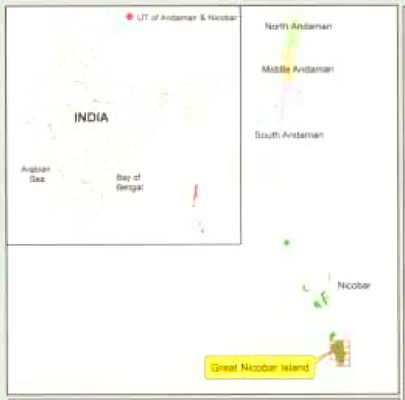

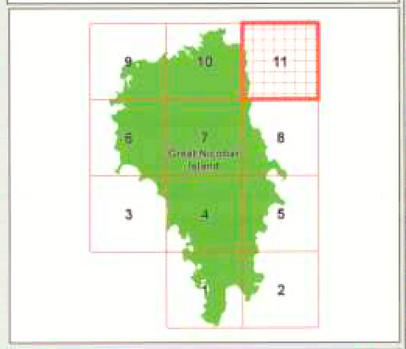

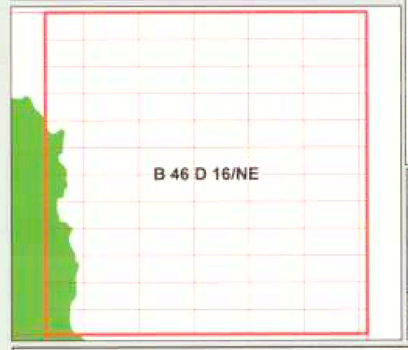

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Mapped During 2017-18

COASTAL LANDUSE MAP PREPARED ALONG WITH APPROVED ICRZP (AS PER ICRZ NOTIFICATION, 2019)

OFFICE SEAL

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NCSCM

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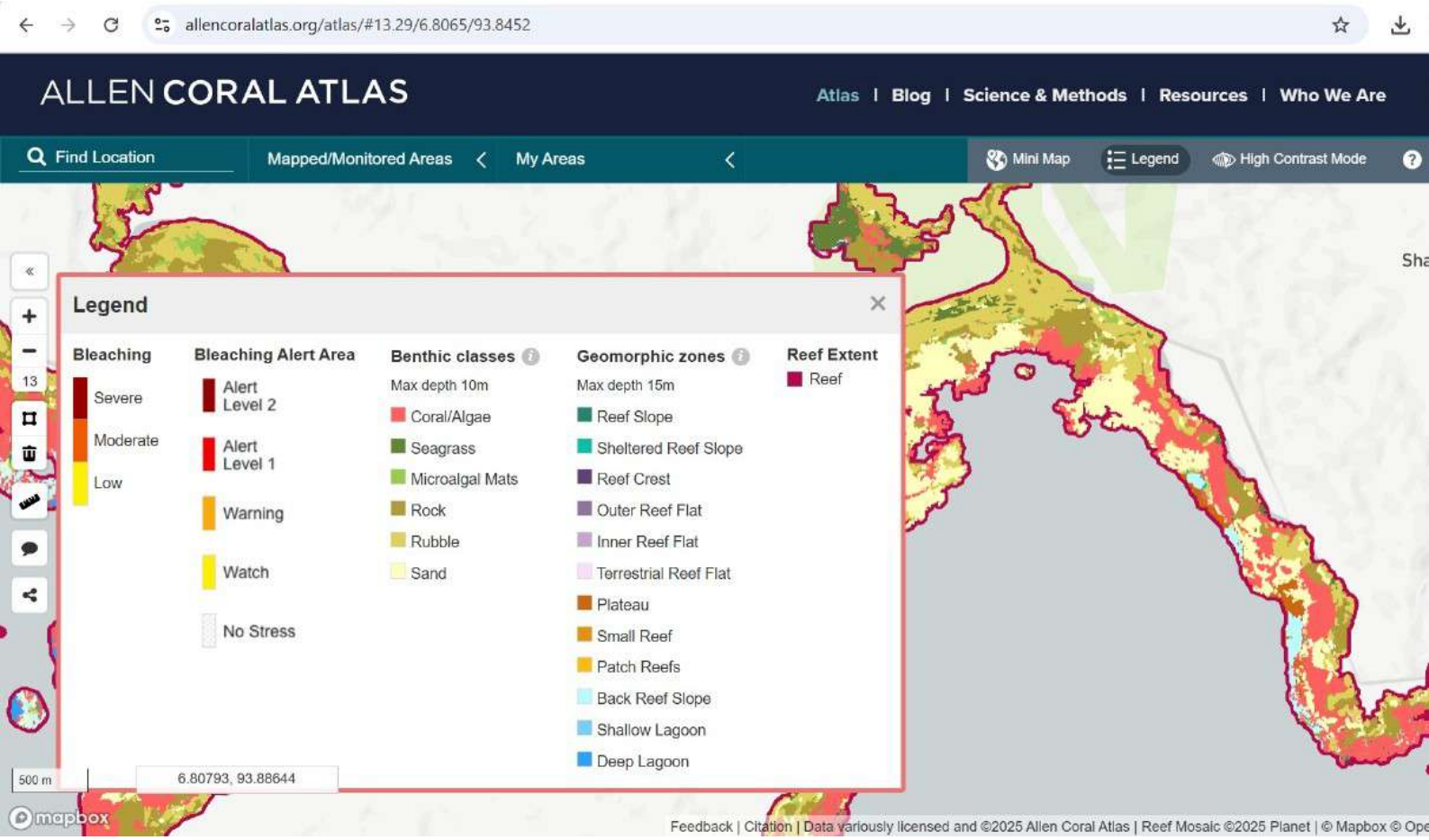
DEPARTMENT OF ENVIRONMENT & FORESTS
ANDAMAN & NICOBAR ADMINISTRATION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Mapped/Monitored Areas
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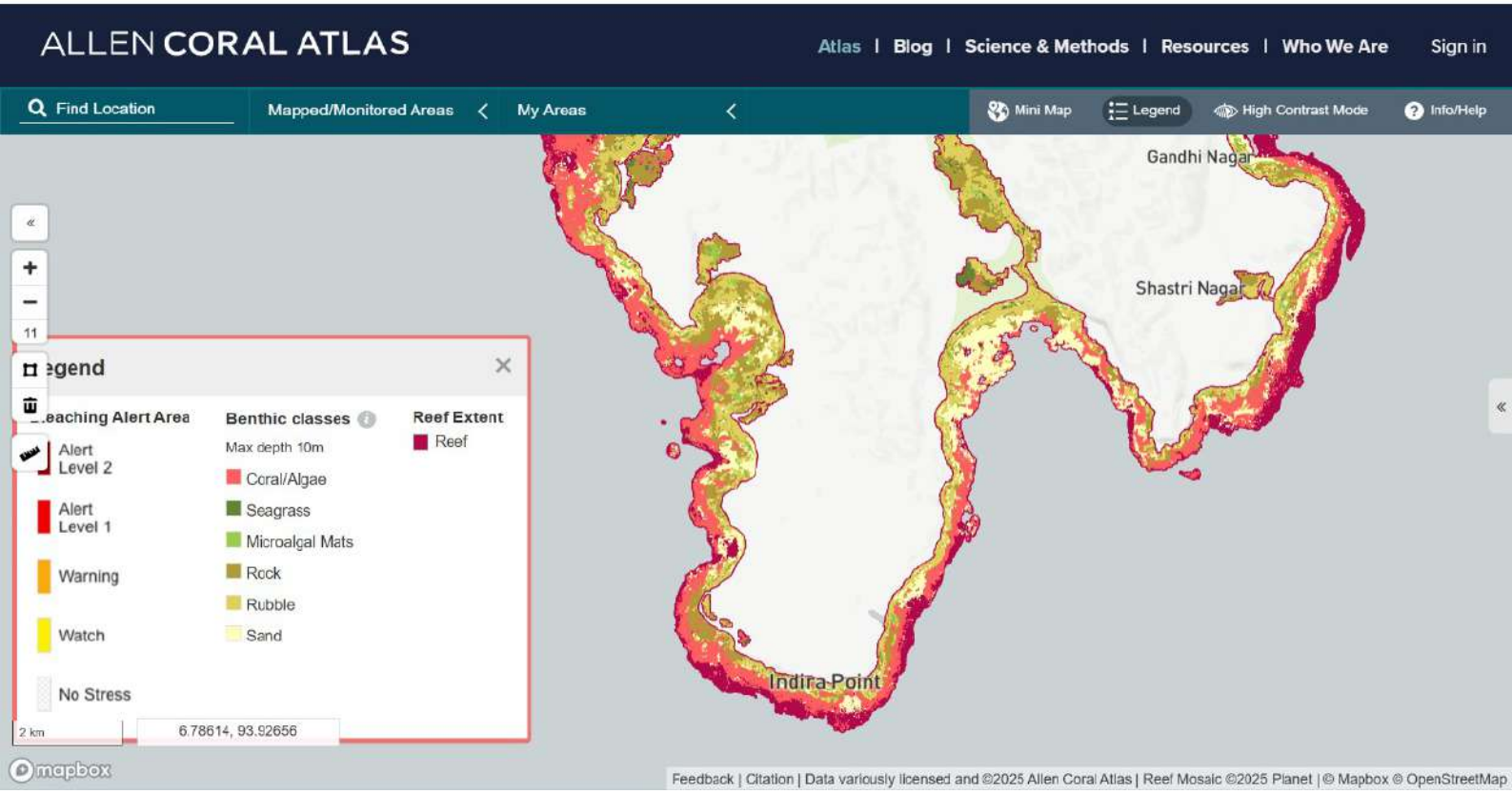
Mini Map
Legend
High Contrast Mode
Legend
Bleaching
Severe
Moderate
Low
Bleaching Alert Area
Alert Level 2
Alert Level 1
Warning
Watch
No Stress
Benthic classes
Max depth 10m
Coral/Algae
Seagrass
Microalgal Mats
Rock
Rubble
Sand
Geomorphic zones
Max depth 15m
Reef Slope
Sheltered Reef Slope
Reef Crest
Outer Reef Flat
Inner Reef Flat
Terrestrial Reef Flat
Plateau
Small Reef
Patch Reefs
Back Reef Slope
Shallow Lagoon
Deep Lagoon
Reef Extent
Reef
13
500 m
6.80793, 93.88644
mapbox
Feedback | Citation | Data variously licensed and ©2025 Allen Coral Atlas | Reef Mosaic ©2025 Planet | © Mapbox © Ope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Gandhi Nagar
Shastri Nagar
Indira Point
egend
Benthic classes
Max depth 10m
Coral/Algae
Seagrass
Microalgal Mats
Rock
Rubble
Sand
Reef Extent
Reef
Alert Level 2
Alert Level 1
Warning
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No Stress
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mapbox
Feedback | Citation | Data variously licensed and ©2025 Allen Coral Atlas | Reef Mosaic ©2025 Planet | © Mapbox © OpenStreetMap

GEOMORPHIC MAP CLASSES

ALLEN CORAL ATLAS

Short description of twelve shallow coral reef internal structure geomorphic mapping categories for *Allen Coral Atlas* global geomorphic maps

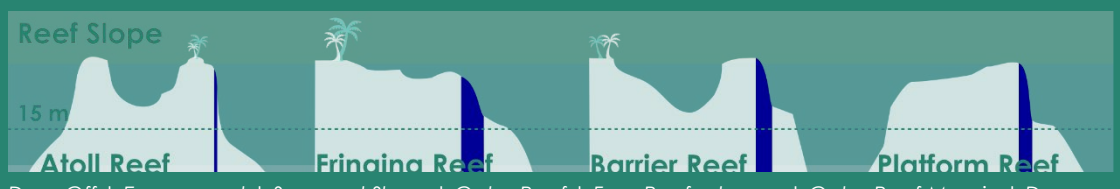
The *Allen Coral Atlas* is a global-scale coral reef habitat mapping project that is using Planet Dove 3.7m resolution daily satellite imagery (in combination with wave models and ecological data) to create consistent global coral reef habitat maps with the purpose of supporting science and conservation.

The twelve Global Geomorphic Zones mapped by the *Allen Coral Atlas* are listed below, in logical order from external seaward-facing through to internal coral reef structural features. These zones are known to be fairly consistent across different biogeographic regions, and often associated with regionally distinct ecological assemblages of benthic animals and plants. Moreover, geomorphic classes like these have been shown to be reliable predictors of biological habitat richness and diversity.

Reef Slope

Definition and examples

Reef Slope is a submerged, sloping area extending seaward from the Reef Crest (or Flat) towards the shelf break. Windward facing, or any direction if no dominant prevailing wind or current exists.



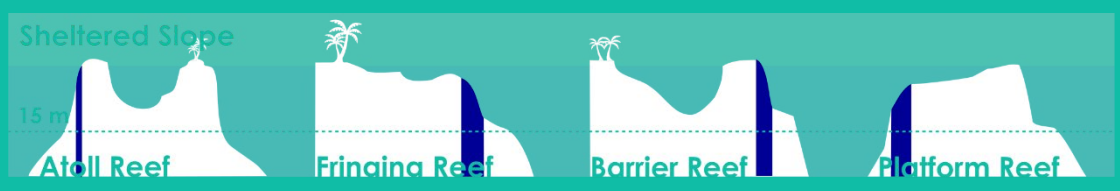
Other terms: *Drop Off* | *Escarpment* | *Seaward Slope* | *Outer Reef* | *Fore Reef subzone* | *Outer Reef Margin* | *Deep Reef Slope* | *Outer Fore Reef* | *Windward Slope* | *Exposed Slope*

Also known as: Terumbu depan | Pendiente arrecifal frontal | Pente externe | المرجاني الشعب منحدر

Sheltered Slope

Definition and examples

Sheltered Reef Slope is any submerged, sloping area extending into Deep Water but protected from strong directional prevailing wind or current, either by land or by opposing reef structures.



Other terms: *Leeward Slope* | *Protected Slope* | *Sheltered Slope*

Also known as: Terumbu depan terlindung | Pendiente arrecifal frontal protegidos | Pente externe abrité | منحدر المحميه المرجاني الشعب

Reef Crest

Definition and examples

Reef Crest is a zone marking the boundary between the Reef Flat and the Reef Slope, generally shallow and characterised by highest wave energy absorbance.

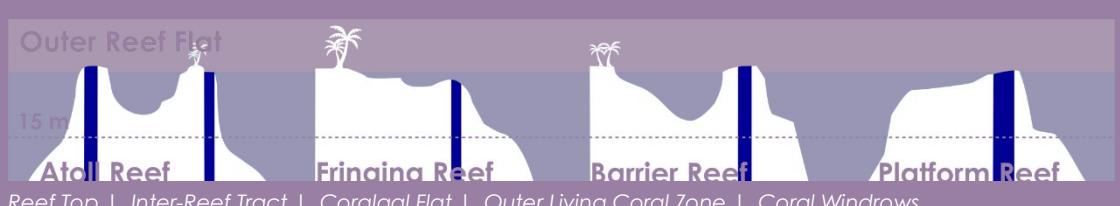
Other terms: *Surf Zone* | *Breaker Zone* | *Reef Edge* | *Reef Rim* | *Reef Margin* | *Rim Margin* | *Hardline Perimeter*

Also known as: Igir terumbu | Cresta arrecifal | Crête récifale | المرجاني الشعب قمة

Outer Reef Flat

Definition and examples

Adjacent to the seaward edge of the reef, Outer Reef Flat is a levelled (near horizontal) broad and shallow carbonate platform, displaying distinct wave-driven zonation.



Other terms: *Reef Top* | *Inter-Reef Tract* | *Coralgal Flat* | *Outer Living Coral Zone* | *Coral Windrows*

Also known as: Rataan terumbu luar | Arrecife plano exterior | Exterieure du platier récifal | خارجي مرجاني مسطح

Inner Reef Flat

Definition and examples

Inner Reef Flat is a low energy, sediment-dominated, horizontal to gently sloping platform behind the Outer Reef Flat.

Other terms: *Sand Flat* | *Sand Zone* | *Leeward Reef Flat* | *Coral Patches* | *Unfused Coral Windrows*

Also known as: Rataan terumbu dalam | Arrecife plano interior | Extérieure du platier récifal | داخلي مرجاني مسطح

Terrestrial Reef Flat

Definition and examples

Terrestrial Reef Flat is a broad, flat, shallow to semi-exposed area fringing reef flat found directly attached to land at one side. It is subject to freshwater run-off, nutrients and sedimentation.

Back Reef Slope

Definition and examples

Back Reef Slope is a complex, interior - often gently sloping - reef zone occurring behind the Reef Flat. Of variable depth (but deeper than Reef Flat and more sloped), it is sheltered, sediment-dominated and often punctuated by coral outcrops.

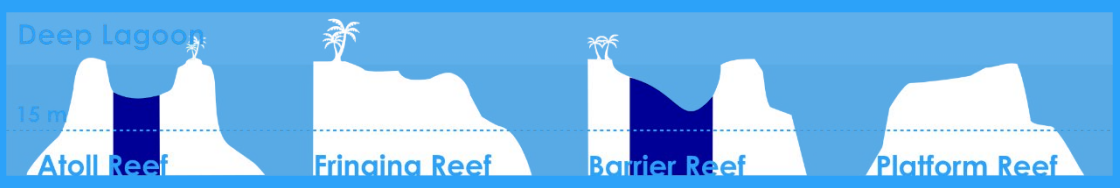
Other terms *Open Complex Lagoon* | *Subtidal Reef Flat* | *Lagoon Reef Slope* | *Back Reef* | *Escarpment* | *Back Barrier* | *Sediment Apron*

Also known as Lereng terumbu belakang | Pendiente de arrecife posterior | Pente récifale interne | الخلفي الشعب منحدر

Deep Lagoon

Deep Lagoon is any sheltered broad body of water, fully to semi-enclosed by reef, with a variable depth (but deeper than 5 m approx. and shallower than surrounding ocean) and a soft bottom dominated by reef-derived sediment.

Definition and examples



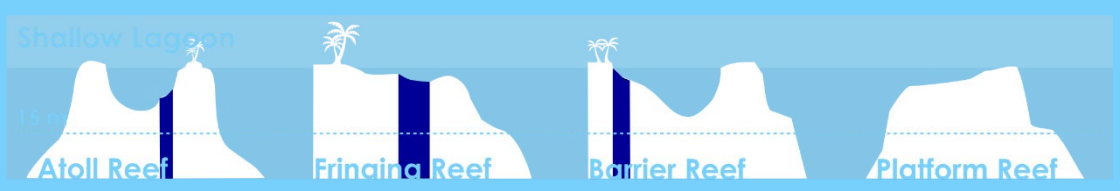
Other terms *Blue Lagoon* | *Lagoon*

Also known as Laguna (dalam) | Laguna (profunda) | Lagon (profound) | بحيرة

Shallow Lagoon

Shallow Lagoon is any fully to semi-enclosed, sheltered, flat-bottomed sediment-dominated lagoon area, shallower than 5 m approx.

Definition and examples



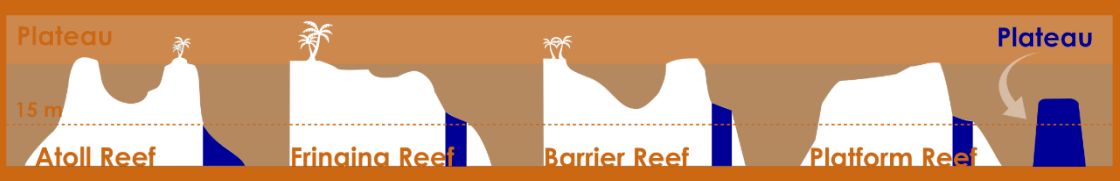
Other terms *Boat Channel* | *Pseudo-Lagoon* | *Lagoonlet* | *Miniature Lagoon* | *Back Reef Channel* | *Tidal Flat* | *Moat* | *Sand channel* | *Shallow Water Body*

Also known as Laguna dangkal • Laguna somera / Laguna Pre-Arrecifal • Lagon peu profound • ضحلة بحيرة

Plateau

Plateau is any deeper submerged (> 5 m approx), hard-bottomed, horizontal to gently sloping (angle shallower than 10 ° approx), seaward facing reef platform.

Definition and examples



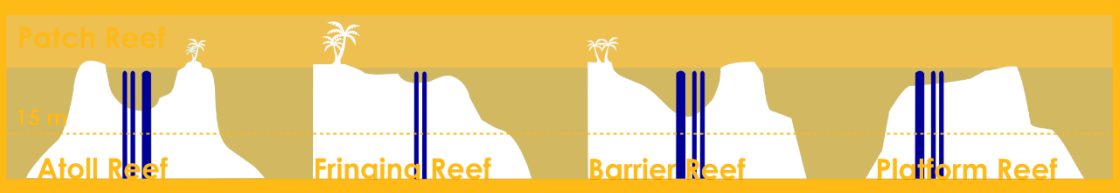
Other terms *Platform* | *Bank* | *Shelf* | *Shoal* | *Bank Shelf* | *Offshore Platform*

Also known as Laguna dangkal | Laguna somera / Laguna Pre-Arrecifal | Lagon peu profound | ضحلة بحيرة

Patch Reef

Patch Reef is any small, detached to semi-detached lagoonal coral outcrop arising from a sheltered, sandy-bottomed area.

Definition and examples



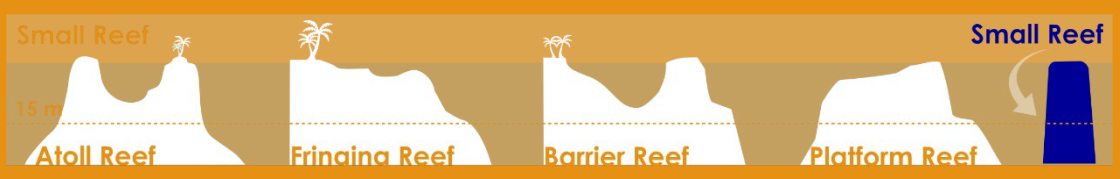
Other terms *Lagoonal Reef* | *Mesh* | *Bommies* | *Coral Patches* | *Pinnacles* | *Knolls* | *Reticulate Reef* | *Coral Outcrops* | *Lagoon Reef*

Also known as Terumbu serpihan | Parche arrecifal | Massif corallien | رقعي شعب

Small Reef

Small Reef refers to any detached (stand-alone) reef, surrounded by Deep Water and too small (generally less than approx. 1 sq km) to show a central depression and/or other clear geomorphic zonation (e.g. crest, flat, backreef) besides a Reef Slope.

Definition and examples

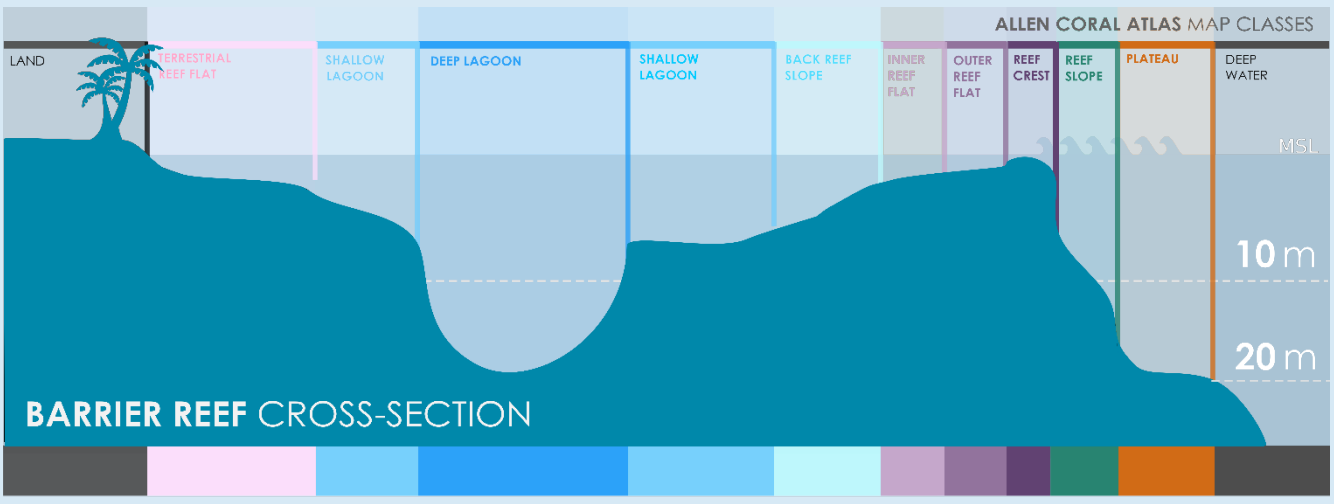


Other terms *Coral Knoll* | *Pinnacle Reef* | *Patch Reef* | *Marginal Structure*

Also known as *Terumbu karang kecil* | *Arrecifes pequeños* | *Petit récif corallien* | صغير شعب

Unknown

The 'Unknown' class is assigned to any location where a Global Geomorphic Class cannot be defined due to some factor that made classification difficult or impossible (e.g., depth too shallow, depth too deep, cloud interference, turbid water).



As with any classification, the classes mapped are an approximation of reality and can never fully represent the full diversity of natural features presented by coral reefs. This twelve-zone classification represents a first step in supporting development and use of a new breed of dynamic habitat map, and will hopefully be further refined with input from the community and as technological advances allow for expansion of finer-scale mapping methodologies.

For more detailed information on creation of classes
and guidance on how to interpret **Allen Coral Atlas** Global Geomorphic Map classes, please see:

Kennedy, E.; Roelfsema, C.; Lyons, M.; Kovacs, E.; Borrego-Acevedo, R.; Roe, M.; Phinn, S.; Larsen, K.; Murray, N.; Yuwono, D., et al. (2020) **Reef Cover: a coral reef classification to guide global habitat mapping from remote sensing**. bioRxiv 2020, doi:10.1101/2020.09.10.292243

Remote Sensing Research Centre | The University of Queensland Australia | planet. | ASU Center for Global Discovery and Conservation Science Arizona State University | National Geographic | Vulcan

BENTHIC MAP CLASSES

ALLEN CORAL ATLAS

Description of the shallow coral reef benthic mapping categories for **Allen Coral Atlas** global benthic habitat maps

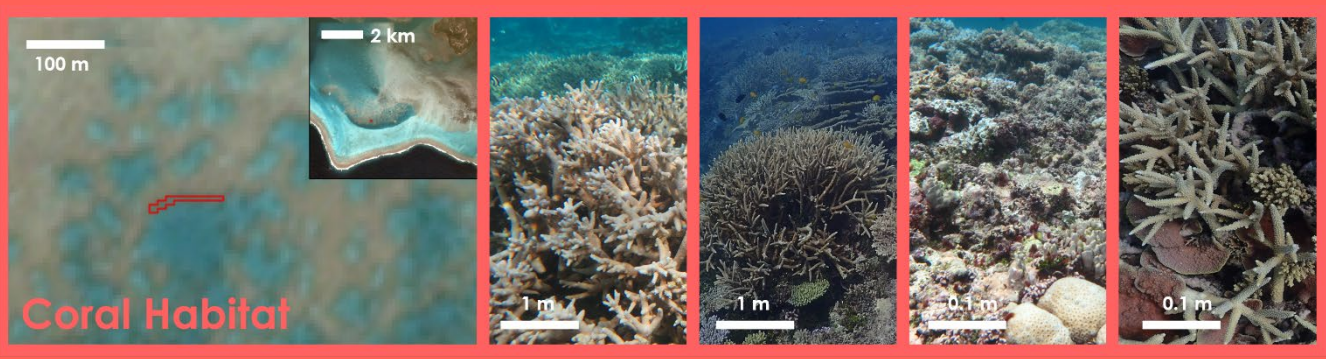
The *Allen Coral Atlas* is a global-scale coral reef habitat mapping project that uses Planet Dove 3.7 m resolution daily satellite imagery (in combination with wave models and ecological data) to create consistent and high-detail global habitat maps to support reef-related science and conservation.

Global Benthic Habitat Maps characterise different coral reef bottom types. These bottom types include communities of living organisms attached to the reef (benthos), as well as sediments and underlying substrate.

The six *Allen Coral Atlas* Global Benthic Habitat Map classes described below were developed by Roelfsema *et al* 2013* with input from other coral reef benthic classifications. This classification maximizes the breadth of information available from Planet Dove remote sensing data to create the best set of classes we can to support users. Benthic classification for global scale reef mapping is still constrained by spatial resolution, quality and accessibility of biophysical earth observation data. The satellites we use are still fundamentally unable to distinguish some of the key measures that ecologists prefer to assess reef health (e.g., cover of living coral, cover of dead coral, cover of bleached corals and functional forms of algae) but broad classes like *Coral Habitat* and *Rubble* can still be informative for characterising the local ecology.

CORAL HABITAT (CORAL/ALGAE)

Coral Habitat is any hardbottom area supporting living coral and/or algae.

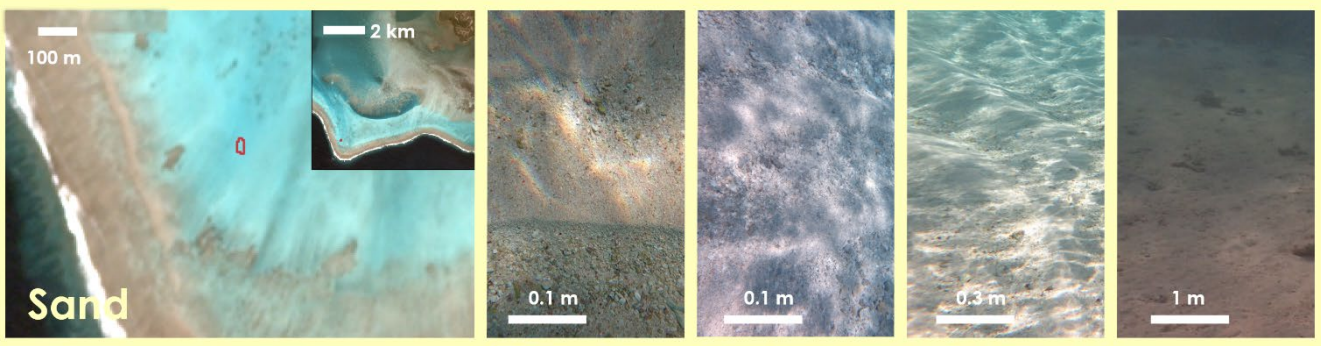


Habitat karang • Hábitats coralinos • Habitat corallien • مرجاني موطن

Main features	**Coral/Algae or Coral Habitat describes a benthic map class characterised by a hard underlying framework (usually coral-derived limestone framework, but may be non-carbonate) with a benthic covering of coral (including soft coral) and/or seaweeds (including macroalgae and turf algae). Benthic cover of coral or algae should be at least 1%, normally more than 5% and sometimes exceeding 40%, but does not necessarily have a dominance of any of these groups over non-living substrate. With average coral cover 10-20% globally, most reef habitats - even those supporting extensive coral growth - are unlikely to be quantitatively dominated by coral.**
Where is it found?	This benthic habitat is commonly associated with Reef Front and Slope, Sheltered Reef Front and Slope, Patch Reefs and Outer Reef Flat classes.
Why do we care?	Coral Habitat is generally the most topographically complex class (sand, seagrass, rubble and rock are comparatively flat), supports the greatest amount of animal diversity and biomass. Coral abundance is a widely used proxy for reef health and a key metric for ecological monitoring. Most benthic classifications distinguish coral and algae and many move beyond this to classify coral morphology (e.g. branching, sheet, massive, encrusting), identify dominant taxa (e.g., Palmata zone, Cervicornis zone), or estimate proportional cover (<10% cover, >50% cover) – something that is still hard to achieve at the global scale. The photosynthetic nature of corals and seaweeds mean they are spectrally similar making them challenging to distinguish though remote sensing. The epilithic algal turf or film that quickly covers corals following death creates similar spectral signatures, meaning dead coral matrix cannot be reliably distinguished either, because of the speed at which it becomes covered.
Also goes by	*Coral / Algae • Coral dominated • Coral framework • Hardbottom • Hard Coral • Stony Coral • Live Coral • Coral Reef • Mixed coral • Coral • Coral field • Carbonate framework*

SAND

Sand includes any soft-bottom area dominated by fine unconsolidated sediments.



Pasir • Arena • Le Sable • رمال

Main features	**Sand class describes soft-bottomed reef areas where fine unconsolidated granular material (finer than coral rubble but coarser than muds) dominate, thickly obscuring any underlying bedrock. Sparse algae, scattered rocks or small, isolated coral heads may also occur in the Sand class, but these features do not exceed 10% of the area.**
Where is it found?	Sand class is associated with Back Reef zones such as Inner Reef Flat, Back Reef Slope and Lagoon classes in particular, where it can occupy 80% of the area.
Why do we care?	Sand can tell us a lot about the age of the reef and biological activity. Most reef-associated sands are largely comprised of aragonite (50-80%) and magnesium calcite, although the size and source of the grain (including corals, coralline algae, molluscs, benthic foraminifers and Halimeda, among others) will vary and often shows strong cross reef zonation reflecting biogeographic and hydrodynamic factors.
Also goes by	*Sand dominated • Bioclastic Sand • Sand and sparse algae • Coral Sand • Fine Sediment • Detrital Sand • Sand with Scattered Coral and Rock • Biogenic sand*

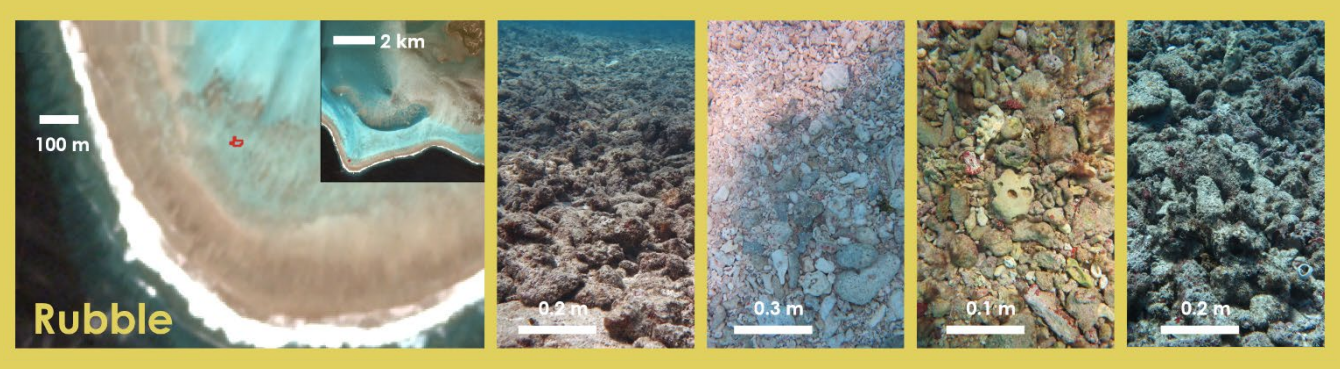
UNKNOWN

Unknown may be assigned to an area on the map if a data constraint means it is not allocated a Global Benthic Class. This happens most commonly in the Global Benthic Habitat Map where a class has been assigned a Global Geomorphic Zone (up to 15 m), but the benthos is beyond the depth detection limit (10 m).

*Roelfsema, Phinn, Jupiter, Comley and Albert. 2013. International Journal of Remote Sensing 34(18): 6367-6388.
Also see: Kennedy, Roelfsema, Lyons, Kovacs, Borrego-Acevedo, Roe, Phinn, Larsen, Murray, Yuwono *et al*. 2020. bioRxiv.

RUBBLE

Rubble is any habitat featuring loose, rough fragments of broken reef material.

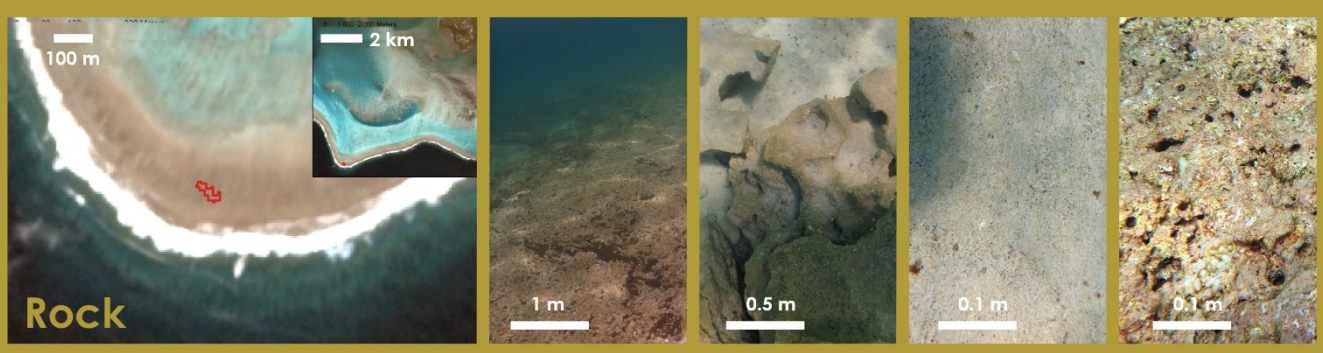


Dominan puing / pecahan karang • Substrato dominado por escombros de arrecifes
Débris dominants • مرجانية بحطام ساند نطاق

Main features	**Rubble class describes any area featuring loose, cylindrical to irregularly shaped fragments of bedrock or clasts of corals, bivalves and coralline algae.**
Where is it found?	This important habitat often occurs landward of well-developed reef formations in the Reef Crest, Back Reef or Reef Flat zones, and may be associated with some fringing reefs, and also rubble-dominated reef flats.
Why do we care?	Rubble pieces - while themselves are non-living - can be heavily encrusted by foraminifers, bryozoans or coralline algae, and contain boring organisms.
Also goes by	*Rubble-Dominated • Skeletal Rubble • Coral Gravel • Coral Rudstone • Reef Rubble • Rhodoliths • Unconsolidated substrate*

ROCK

Rock is any exposed hardbottom area with uncommon to scarce corals and fleshy macroalgae.

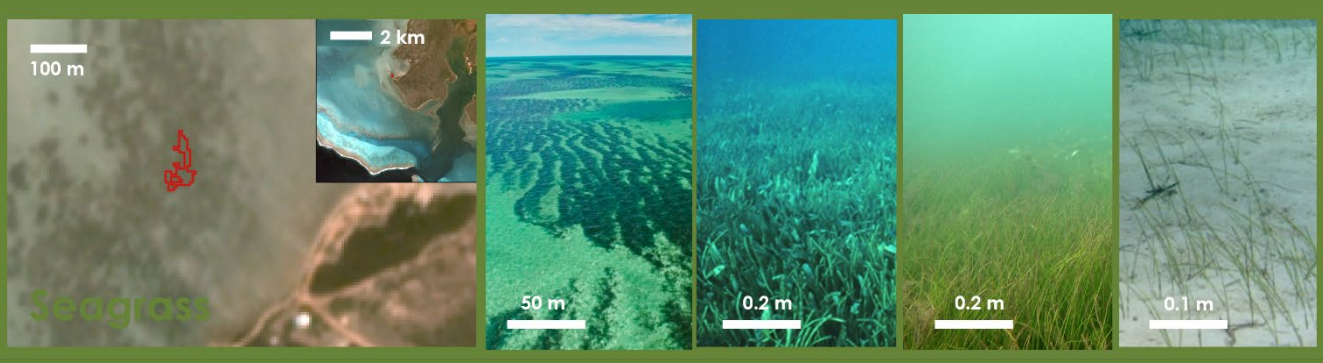


Batuan • Roca • Roches • صخر

Main features	**Rock class describes any habitat dominated by "exposed areas of hard bare substratum without visible corallite structure". This habitat often has a near horizontal, pavement-like appearance and is usually associated with areas of high energy (e.g. Reef Crest) where the cover of living organisms is low (< 10%) - although it may have high coverage of crustose coralline algae. The class encompasses limestone reef matrix, but also underlying non-reefal bedrock and "beach rock" (calcarerite) - areas of coral sand cemented together which are difficult to distinguish by earth observations.**
Also goes by	*Rock dominated • Bedrock • Pavement • Rock Outcrop • Boulder • Beach Rock • Uncolonised hardbottom*

SEAGRASS

Seagrass is any habitat where seagrass is the dominant biota.

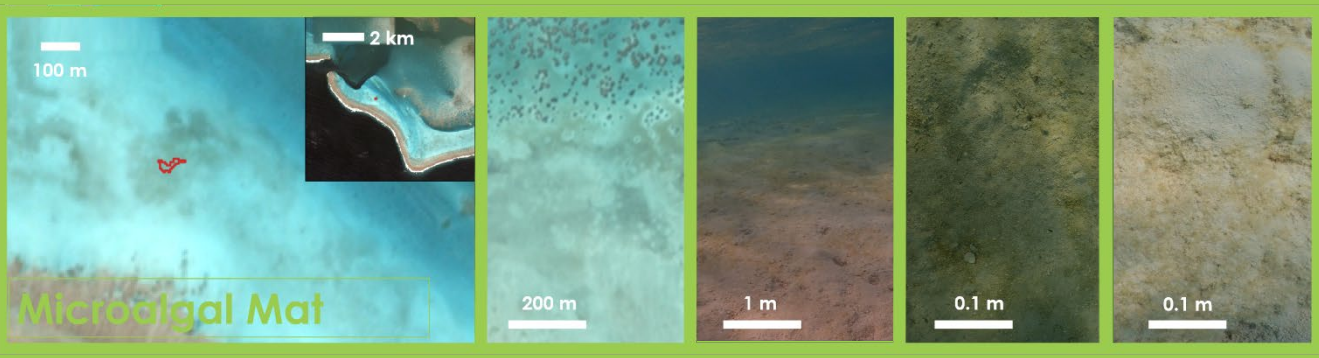


Padang/ hamparan lamun • Pastos marinos / ceibadales
Herbiers marins / gazons algaux • البحرية الأعشاب مرج

Main features	**Seagrass class describes a soft-bottomed habitat dominated by any single species of seagrass from the order Alismatales (e.g. *Syringodium* sp., *Thalassia* sp., and *Halophila* sp.) or any combination of species. This class also includes sparser or more spatially restricted seagrasses, as long as it is the dominant biota, and/or has a total cover >10%.**
Where is it found?	Seagrass habitats are most commonly associated with *Shallow Lagoon* and *Back Reef Slope*.
Why do we care?	Seagrasses can form extensive beds, called meadows, which shelter abundant diverse species (epiphytes, small invertebrates and juvenile fish), support herbivory (e.g. of turtles and dugongs) and play an important role in trapping sediment, as well as biogeochemical cycling.
Also goes by	*Seagrass Meadow • Seagrass Bed • Seagrass Dominated • Phanerogam Beds*

MICROALGAL MAT

Microalgal Mats are visible accumulations of microscopic algae in sandy sediments.



Ganggang mikro bentik • Microalgas bénticas • Micro-algues benthiques • المجهرية القاعية الطحالب.

Main features	**The Microalgal Mat class describes microscopic communities - abundant and spatially extensive enough to be visible as mats - growing on or in the top few centimetres of shallow, sandy sediments. The benthic microalgae that comprise these mats, also known as microphytobenthos, are primarily diatoms, but include cyanobacteria, chlorophytes, and other microscopic organisms that grow on sand, silts and muds in both marine and freshwater habitats.**
Where is it found?	In shallow, sandy and sheltered reef areas, such as the leeside of islands and in Lagoons, benthic microalgae aggregate into mats which can be geographically extensive (up to several kilometers), and penetrate up to 15 cm into the sediment (although most biomass occurs in the upper centimetres).
Why do we care?	Benthic microalgal mats are productive habitats that play important roles in sediment stabilisation, trophodynamics and biogeochemical cycling. They may promote benthic recovery by rapidly re-oxygenating the sediment surface. In ecology, patterns of herbivory can create grazing halos in the mats, the size and number of which can indicate ecosystem health. These habitats are most often associated with sheltered Back Reef areas and Shallow Lagoons.
Also goes by	*Benthic Microalgae • BMA • Cyanobacterial Mats • Filamentous Algal Mat*

Remote Sensing Research Centre · The University Of Queensland Australia · planet. · ASU Center for Global Discovery and Conservation Science Arizona State University · National Geographic · Vulcan

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Srikumar Chattopadhyay *Editor*

Marine and Coastal Resources of India

Selected Case Studies

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Srikumar Chattopadhyay
Editor

Marine and Coastal Resources of India

Selected Case Studies

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Editor
Srikumar Chattopadhyay
(Retired) Centre for Earth Science Studies
Thiruvananthapuram, Kerala, India

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Contents

27 Exploring India's Coral Reefs: A Comprehensive Analysis of Biodiversity, Threats, Conservation, Restoration, and Monitoring

C. Sivaperuman, J. S. Yogesh Kumar, R. Uma Maheswari, S. Balamurugan, V. Balaji, K. Balasubramani, and K. Sivakumar

Abstract

Coral reefs represent some vital unique marine ecosystems globally. Apart from providing several ecologic services and food and economic benefits, coral reefs are stunning underwater scenes that offer a variety of leisure opportunities and raise the nation's appeal to both domestic and foreign tourists. Global environmental degradation and climate change are placing enormous strain on coral reef ecosystems. The exclusive economic zone (EEZ) of Indian coastal waters covers 2.02 million km^2 and a coastline spanning over 8000 km. However, the reef formation is found only across the Gulf of Mannar (GoM), the Andaman and Nicobar Islands (ANI), the Gulf of Kachchh (GoK), and the Lakshadweep Islands (LaI). Patchy reefs are reported from Ratnagiri and Malvan coasts. Coral reefs of each of these areas have a unique form or structure. The estimated area under coral reef in India is 2375 km^2. The Indian Coastal Regulation Zone (CRZ) Notification of 1991 safeguards all coral reefs in India. The CRZ1 category encompasses all coral reef habitats. Additionally, national, state, and non-governmental organizations in India have started taking steps towards artificial reef deployment, reef transplantation and restoration. This chapter discusses the state of coral reefs in India and the emerging concerns primarily based on satellite remotely sensed observations, supplemented by data from other sources. Besides, there is an attempt to deliberate on some of the management issues to preserve and restore coral reefs in India. This includes the successful application of the novel eDNA metabarcoding in coral reef

C. Sivaperuman
Zoological Survey of India, ANRC,
Port Blair, Andaman & Nicobar Islands, India

J. S. Y. Kumar
Zoological Survey of India, SbRC,
Canning, West Bengal, India

R. U. Maheswari · K. Sivakumar (✉)
CAS in Marine Biology, Faculty of Marine Sciences,
Annamalai University,
Portonovo, Tamil Nadu, India

S. Balamurugan
Khalifa Center for Genetic Engineering and Biotechnology, United Arab Emirates University,
AI Ain, UAE

V. Balaji
OMCAR Foundation, Velivayal, Tamil Nadu, India

K. Balasubramani
Department of Geography, School of Earth Sciences,
Central University of Tamil Nadu, Thiruvarur, Tamil Nadu, India

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restoration activities, which would support the creation of programs for fair conservation and data-driven coastal zone management.

Keywords

India's coral reefs · Biodiversity · Satellite observation · Coastal regulation zone · Metabarcoding

27.1 Introduction

The ocean supports life on Earth and plays a crucial role in regulating the global climate. Among the most remarkable marine ecosystems worldwide are coral reefs, characterized by colonies of coral polyps intertwined through calcium carbonate structures in surface or shallow waters. The ability of reefs to build corals engages in a synergetic relationship with photosynthetic algae known as zooxanthellae, residing in their tissues and facilitating mutualistic interactions. Coral reefs' substantial role is absorbing significant amounts of wave energy, providing essential protection against flood events and hurricanes for coastal communities, lives, and properties. Moreover, these ecosystems contribute significantly to fisheries, acting as crucial nurseries and habitats that support the livelihoods of fishermen and related industries by supplying food and income. Beyond their economic importance, coral reefs enhance the aesthetic appeal of marine environments, offering captivating seascapes that facilitate various recreational events. Additionally, the presence of vibrant coral reefs enhances the allure of a country for international tourism markets, showcasing the ecological and aesthetic value of these marine wonders.

According to the International Union for Conservation of Nature (IUCN), globally, among all ecosystems, coral reefs host the greatest biodiversity and also offer direct support to over 500 million people worldwide, predominantly in economically challenged nations. These reefs are astounding, visually stunning, biologically diverse, invaluable and most productive ecosystems on Earth. The UN Environment Report 2018 estimated that the global coral reef value is 375 billion US$ per year considering goods and services.

India boasts a coastline spanning approximately 8000 km and features diverse types of reefs, with an average area of 2375 km^2, with a primary concentration in four key regions: the Gulf of Mannar (GoM), Andaman and Nicobar Islands (ANI) in the Bay of Bengal, Gulf of Kachchh (GoK) and Lakshadweep Islands (LaI) in the Arabian Sea (Baswapoor and Irfan 2018). Based on remote sensing data, the total area under coral reefs has been estimated as 841 km^2, 2384 km^2, and 1420 km^2 during the periods 1992–1993 (Garg et al. 1998), 2004–2007, and 2007–2008, respectively (SAC 2011; Bahuguna et al. 2013). Also, the estimation by Spalding et al. (2001) revealed a total coral reef coverage of 5790 km^2, which accounts for 2.04% of global coral coverage. Subsequent estimations of coral reef coverage in 2009 (SoE 2009) and early 2010 (Venkataraman 2011; Bahuguna et al. 2013) indicated a significant decline in coral reefs, with coverage reduced to approximately 2375–2383 km^2, equal to 0.92% of global coral coverage (Souter et al. 2021). Bahuguna et al. (2013) estimate the coral coverage in India, with significant area observed in the Andaman and Nicobar Islands (~1021 km^2) and the Lakshadweep Islands (~934 km^2). The Gulf of Kachchh has approximately 352 km^2 of coral coverage, while the Gulf of Mannar/Palk Bay has about 76 km^2. The Andaman and Nicobar Islands and the Lakshadweep, together, account for around 40% of India's total reef area (Saroj et al. 2016).

Four major types of coral reefs found in Indian sub-continents are:

27.1.1 Platform Reefs

These reefs have no lagoon and are almost flat. They are found between a shore and a barrier reef or near atolls, usually on the shallower parts of the continental shelf. Platform reefs are very common in the Indian Gulf of Kachchh.

27.1.2 Fringing Reefs

In India, the fringing reefs are dominating in the ANI, covering an expanse of 1021.46 km^2. Such reefs adhere directly to a shore or border in shallow waterways or lagoons. Moreover, some fringing reefs are found in the GoM and the GoK, with respective areas of 352.50 km^2 and 75.93 km^2 (De et al. 2017).

27.1.3 Barrier Reefs

Barrier reefs are observed mostly in the ANI of India. They are formed when a deep canal or lagoon divides an island's shoreline from that of a mainland. Notably, the best example of a barrier reef outside India is the Great Barrier Reef in Australia, which is distinguished by its separation from the mainland by vast stretches of water while paralleling the coastline. In India, barrier reefs can be found in the GoM and the ANI (Saroj et al. 2016; De et al. 2017).

27.1.4 Atolls

An atoll is a circular coral formation that often supports low-lying islands and surrounds a lagoon. In India, atolls are chiefly found in the Lakshadweep Islands, with an area of 933.7 km^2, characterized by an unevenly circular ring of reefs encircling a lagoon and a low-lying island is typical. This reef type is common in the Indian and South Pacific Oceans (Saroj et al. 2016).

27.1.5 Patchy Reefs

Patchy reefs are often encountered on the continental shelf between Vengurla and Vijaydurg along the Maharashtra coast, as well as in intertidal zones like Ratnagiri, Malvan, and Redi. Additionally, submerged patchy reefs may be found adjacent to the western coast, like the Angria Bank off Sindhudurg in Maharashtra, Grande Island in Goa, Netrani Island on the Karnataka coast, Gaveshana Bank off the Malpe coast, Kachchh's of Gujarat (most northerly coral reefs), and near Quilon and Vizhinjam along the Kerala coast. Additionally, Enayem along the Tamil Nadu coast hosts these reefs. Mesophotic coral ecosystems are situated off the Puducherry coast (Jasmine et al. 2009; De et al. 2017; Kumar et al. 2019; Laxmilatha et al. 2019).

These coral reefs not only provide support to biodiversity but also hold immense value to humankind. They play a crucial role both ecologically and economically (Table 27.1).

Table 27.1 Economic importance of coral reefs besides their ecosystem function

Type of services	Function	Description
Provisional services	Medicinal properties	Coral reefs have the potential to cure diseases such as ulcers, leukaemia, and lymphoma (Baswapoor and Irfan 2018). Some genera of corals such as *Sinularia*, *Echinomuricea*, *Paraminabea*, etc. have anti-inflammatory properties (Cooper et al. 2014)
	Food	Coral reefs are crucial fish nurseries, supporting 25% of ocean fish and providing essential protein, which attracts national and international fishing companies, significantly contributing to revenue (Baswapoor and Irfan 2018)
	Rich in minerals	Abundant in limestone and calcium-rich coral sand (Baswapoor and Irfan 2018).
Regulating services	Protects coastline	The worldwide coral ecosystem protects the shoreline by absorbing 97% of the energy from incoming waves. This protection benefits around 197 million individuals residing within 50 km of reefs and below 10 m in elevation (Ferrario et al. 2014)
	Water quality	Corals and marine sponges are filter feeders, consuming suspended particles in the water. Thus improving the quality and clarity of our coastal waters (UNEP 2020)
Cultural services	Tourism	Research indicates that, on average nations with coral reef industries generate over 50% of their Gross National Product (GNP) from these ecosystems. Additionally, the reefs themselves attract tourists, fostering water sports economies centred around snorkelling and Scuba diving fees (Baswapoor and Irfan 2018)

27.2 Coral Diversity

India is home to approximately 585 coral species, categorized into 23 families and 108 genera, within an area of about 2383 km^2 (De et al. 2020; Venkataraman 2007). The highest species richness is documented in the ANI, with 523 species belonging to 95 genera and 23 families, followed by 169 species belonging to 46 genera and 16 families from the GoM; 165 species belonging to 54 genera and 17 families from LaI; 76 species of 30 genera and 12 families from Gulf of Kachchh (De et al. 2020). In addition to these reefs, smaller reefs on India's west coast, such as the Malvan Marine Sanctuary, Angria Bank, Grande Island, and Netrani Island, are also known to include Scleractinian fauna (De et al. 2020) (Figs. 27.1 and 27.2, Table 27.2).

The largest island in the Nicobar group and the southernmost island in the Andaman and Nicobar group, the Great Nicobar Island is part of the UNESCO-MAB-Network of biosphere reserve. Here, the Simpson's density index for coral reefs goes from 0.93 to 0.99, the Shannon-Weiner diversity index ranges from 2.84 to 4.45 and Laxman beach was found to be with most diversified coral reefs. The presence of 29.98% of *Scleractinian* coral species found in Great Nicobar Island denotes the sense of ecological attributes behind the sustainable support towards the coral settlement, growth, and development (Mondal et al. 2016).

Fig. 27.1 Coral reef site at Andaman and Nicobar Island. (Photo Credit @ Author Yogesh Kumar, J.S. ZSI "Coral reef site at ANI". 2015)

Fig. 27.2 Coral reef site at Lakshadweep Island. (Photo Credit @ Author Yogesh Kumar, J.S. ZSI. "Coral reef site at Lakshadweep Islands")

Table 27.2 Location and list of coral family and species observed in Indian sub-continent

Key areas	No of species	Coral family	List of common coral species	List of coral species (Ref)
Andaman and Nicobar Islands (A&N Islands)	523	Acroporidae Pocilloporidae Poritidae Faviidae Milleporidae	*Acropora*, *Montipora*, *Pocillopora, Porites*, *Goniopora, Favia* *Millepora, Sarcophyton* sp., *Lobophytum* sp., and *Sinularia* sp.	Venkataraman (2006)
Lakshadweep Islands	165	Acroporidae Pocilloporidae Euphyllidae Oculinidae Siderastraidae Agariciidae Fungidae	*Acropora humilis*, *A. muricata (formerly A. formosa)*, *A. intermedia*, *A. hyacinthus*, *Pocillopora verrucosa*, *Euphyllia glabrescens*, *Galaxea fascicularis*, *Psammocora contigua*, *P. haimeana*, *Pavona maldivensis*, *P. clavus*, *Fungia danai*, and *Podobacia crustacea*	Venkataraman (2006)
Gulf of Mannar (GoM)	169	Acroporidae Pacilloporidae Poritidae	*Montipora monasteriata*, *M. informis*, *M. spumosa*, *M. turgescens*, *M. venosa*, *M. verrucosa*, *M. digitata*, *M. millepora*, *M. manauliensis*, *Acropora digitifera*, *A. secale*, *A. intermedia*, *Pocillopora verrucosa*, *Porites mannarensis*, *P. exserta*, and *Goniopora stutchburyi*. Species like *Montipora millepora*, *M. jonesi*, *M. manauliensis*, *M. edwardsi*, *M. exserta*, *Acropora rudis*, *A. valenciennesi*, *A. microphthalma*, *Porites exserta*, and *Porites mannarensis*	Venkataraman (2006)
Gulf of Kachchh (GoK)	76	Anacropora Merulinidae Poritidae Siderastraidae	*Montipora venosa*, *Cosinaria monile*, *Hydnophora excesa*, *Turninaria petata*, *Goniastrea pectinata*, *Platygyra sinensis*, *Cyphastrea serialia*, *Porites compressa*, *Goniopora stutchburyi*, *Siderastrea savignayana, and Acanthastrea hillae*	Venkataraman (2006)

27.3 Threats to Coral Reefs of India

Among the ecosystems that face the greatest threat on Earth are coral reefs. Since the 1980s, there has been a decline in the health of coral reefs in all of the major tropical oceans, with a global average decline in coral cover of 30–50%. Local and regional stresses like pollution, overfishing, and habitat destruction are the main reasons for these decreases. It is generally accepted that the reef's geographical expanse has decreased in recent decades as a result of rising human pressures, even if the entire reef area cannot be accurately assessed (Ramadas and Rajeswari 2011; Rebekah and Inamdar 2018). Especially, severe bleaching can lead to coral mortality, and accordingly it is important to determine how the Sea Surface Temperature (SST) affects the coral reefs (Arora et al. 2019). Global climate change (prolonged and intense El Nino) is recognized as a major factor for the coral reef decline, associated with ocean acidification, outbreak of disease, and bleaching events. Whereas uncontrolled fishing practices and mining of lime and coral were previously considered the primary threats to corals (Edward 2002), additional threats such as nitrogen pollution and seawater warming have emerged as significant factors affecting coral reefs (Painter et al. 2023). The frequency of coral damage brought on by pollution and sewage discharge, damage from bottom trawling, siltation from coastal development, the invasion of exotic species, and increased coral mortality due to increasing algal blooms (Chandrasekaran et al. 2008; Machendiranathan et al. 2016; Asir et al. 2020; Raj et al. 2020). The reef's ecological dynamics have been impacted by the growing amount of physical damage caused by tourists and recreational divers (Purvaja et al. 2019). The coral reefs of Andaman and Nicobar face a range of threats, including natural disasters such as the 2004 tsunami and the 2011 tropical storm. Human activities, particularly tourism and poaching, also pose significant risks (Jeyabaskaran et al. 2007). Climate change-induced events (El Nino), such as the 2010 mass coral bleaching, further exacerbate these threats (Majumdar et al. 2018). Notwithstanding these challenges, the diverse and dynamic coral reefs in the region possess the capacity to act as a refuge in the midst of global warming. Further, rising levels of turbidity, sedimentation, and discharges from cities and industries have been the results of anthropogenic shoreline alteration, heavy industry, and rapid coastal expansion in recent years (MoEF 2014; Magesh and Krishnakumar 2019; Jinoj et al. 2021).

27.4 Impact of Climate Change on Corals of India

Coral reefs are the utmost imperil ecological system on Earth, facing significant threats from unprecedented global warming and climate changes, compounded by escalated local pressures. Coral reef ecosystems are highly susceptible to changes in the physical environment brought about by climate change. Since the 1980s, the process known as "bleaching" of coral reefs, which is caused by unusually high water temperatures, has had a hugely negative impact on the entire world (Baker et al. 2008). UNESCO warns if current levels of greenhouse gas emissions persist, World Heritage coral reef sites may disappear by the end of this century.

27.4.1 Bleaching Events

Corals undergo stress when ocean temperatures change, leading them to expel the algae they host. These algae are responsible for the vibrant colour of the reef, and without them, only the white coral skeletons are visible, resulting in a "bleached" appearance. As corals depend on algae for nutrition, the absence of algae weakens the coral polyp (WWF 2023). In the Gulf of Kachchh and Gulf of Mannar, the coral covering declined by 20–40%, in the Lakshadweep Islands by 20–30%, and in the Andaman and Nicobar Islands by less than 10% as a result of widespread coral bleaching in 1998 (Venkataraman 2011). Venkataraman et al. (2004) reported that only 25% of live corals remained in the Gulf of

Mannar, with branching corals like Acropora and Pocillopora spp. being the most affected, along with Montipora.Marimuthu et al. (2013) and Krishnan et al. (2013) stated that the 2010 bleaching event in the Andaman Islands caused severe bleaching occurrences that were linked to high sea surface temperature. Another catastrophic bout of bleaching struck the coral reefs in GoM and Palk Bay in April and May of 2010, with 85.1% and 87.2%, respectively. The GoK experienced bleaching in 2014–2015, according to Adhavan et al. (2014). This was probably caused by a mix of high sea surface temperature, sedimentation, and a delayed monsoon. High sea surface temperatures of 34.0°C in 2016 prompted bleaching of almost 70% of the corals in Palk Bay and 46% of the corals in the coastal Thoothukkudi Islands in the Gulf of Mannar (Krishnan et al. 2018). The bleaching resulted in a substantial increase in dead coral cover, ranging from 60% to 80%.

Arthur et al. (2005) found that the majority of Lakshadweep's atolls had a consistently low living coral cover. In April–May 2002, Harithsa et al. (2005) measured temperatures in the Kavaratti atoll that were above the bleaching threshold causing coral bleaching. From May to June 2010 an average coral bleaching of 76.5% on Agatti reefs was recorded (Ajith Kumar and Balasubramanian 2012).

27.4.2 Ocean Acidification and Calcification Challenges

Another consequence of climate change is ocean acidification, a process driven by the absorption of excess carbon dioxide by the oceans. Acidification poses a direct threat to the ability of corals to build their exoskeletons through calcification. As the oceans become more acidic, it becomes increasingly challenging for corals to maintain their structural integrity, making them susceptible to physical damage and erosion. The reduced resilience makes them more susceptible to additional stressors, intensifying the overall risk to coral health. In India, the impact of carbon dioxide (CO_2) emissions has led to the warming and increased acidity of surface waters (Pendleton et al. 2016). A research investigation carried out in the Andaman Sea revealed that ocean acidification has an impact on the growth of coral by diminishing skeletal density. The study emphasized the correlation between the skeletal growth of *Porites* corals concentrating with the surrounding saltwater environment which affects the chemistry of the coral calcifying fluid by connecting skeletal density to it (Mollica et al. 2018).

27.4.3 Extreme Weather Events and Habitat Destruction

Extreme weather occurrences' frequency and severity, such as cyclones and storms, have been amplified by climate change. These events can cause physical damage to coral reefs, breaking apart delicate structures that have been formed over centuries. The Lakshadweep Islands, during cyclones in 1847, 1891, 1922, 1941, and in subsequent occurrences, have witnessed significant coral damage. This has disrupted the fragile equilibrium of the marine ecology. The combined impact of climate change and cyclonic events has had a profound and detrimental effect on these systems, causing impairment of the centuries-old biological structure of coral reefs. As these events increase in frequency, the recovery period for coral reefs is shortened, rendering them more vulnerable to subsequent disturbances (Riyas et al. 2020).

27.5 Restoration and Monitoring

United Nations Environment Programme (UNEP) proposed the term "Coral reef restoration" refers to a series of proactive actions intended to increase the numbers of significant species in addition to strengthening the reef ecosystem's composition and abilities. Coral restoration methods include proceeding coral gardening, moving coral fragments without a transitional nursery phase, larval enhancement, sexually derived coral larvae at a restoration site, adding artificial structures such as shipwrecks for

the purpose of restoring coral reefs and stabilizing the substratum to aid in coral recruitment or recovery. The report says that the restoration methods are not equivalent to more traditional approaches such as threat reduction and marine protection. On the other hand, long-term success with restoration might depend on its combination with vigorous local conservation initiatives and measures to alleviate the impact of climate change.

Coral restoration sceptics contend that it is unproductive unless it can rebuild reefs at the ecosystem level and diverts priority from resolving climate change and other problems to the marine environment. In response, proponents of coral restoration argue that although large-scale problems like coastal pollution and climate change are being mitigated, short-term interventions can help preserve coral biodiversity.

27.5.1 India in Reef Restoration

The Ministry of Environment Forest and Climate Change (Government of India), the Forest Department(Government of Tamil Nadu)partnered with Suganthi Devadason Marine Research Institute (SDMRI) in 2002 to start coral regeneration programme along the Tuticorin coast of the Gulf of Mannar (CORDIO). The affordable, low-tech and low-cost transplantation technique that the SDMRI researchers used to continue coral restoration using artificial substrates was successfully standardized and field tested in the region. The Tuticorin coast has restored more than 1 km^2 of deteriorated reef area, with an overall survival rate of over 80%.

Due to increased temperatures and other reasons, the GoM coral reef colonies experienced significant bleaching during 2005, 2010, and 2016. So the National Centre for Coastal Research (NCCR), the Ministry of Earth Sciences, Government of India started a coral restoration project which resulted in the recovery of live coral cover in dead coral reef areas in the Gulf of Mannar islands. NCCR was also successful in restoring Lakshadweep region corals, viz. Agatti and Kavaratti in an area, approximately of one acre size. The activity covered transplantation with branching corals, massive corals, and folic corals. Department of Science and Technology (DST), Lakshadweep Islands, helped in this activity. DST also actively supports the research related to the discovery that shipwrecks at the Vembar (Gulf of Mannar), Zusis (Goa), North Bay (Port Blair, South Andaman), Peel (Havelock, South Andaman), and Japan (Car Nicobar) sites produced new, productive ecosystems with higher biodiversity (Yogeshkumar et al. 2015).

The Central Marine Fisheries Research Institute (CMFRI, Government of India) provided technical support to the Government of India for the installation of artificial reefs offshore in Chennai and nearby regions. In a record of 45 days, 6000 artificial reef units totalling about 5250 metric tonnes were transported in fishing vessels and put into place; this effort has begun ushering marine life. Similar work of deployment of the artificial reef has been undertaken by Temple Adventure in Puducherry waters and found positive outcomes.

With assistance from Tata Chemicals Limited, the Gujarat Forest Department and Wildlife Trust of India collaborated to launch the 2008 Coral Reef Recovery Project. A portion of a marine region is being actively maintained by a community for the first time in India. Situated 12 km south of the Gulf of Kachchh in Gujarat, it aims to create and carry out suitable plans for the preservation of the Mithapur Reef (Fig. 27.3).

Further, a dead coral reef was found by Indian marine scientists from the Zoological Survey of India (ZSI) which ages to thousands of years old in the Gulf of Kachchh and decided to take an attempt to revive it. In addition, ZSI is implementing a first-time technique for revitalizing coral reefs utilizing mineral accretion technology, or biorock, with assistance from Gujarat's Forest department. In 2019, the installation of a biorock structure was done in the Gulf of Kachchh, one nautical mile off the shore of Mithapur. Because of the large tidal amplitude in GoK, 4-m biorock was installed at the site where

Fig. 27.3 Coral reef restoration in the GoK, west coast of India. (Photo Credit @ Venkatraman, K., ZSI "Restoring Coral Reefs at GoK". 2015)

the region has low tide depth at high tide. A total of 1000 m^2 coral transplantation was successfully completed by ZSI in three different places in the GoK, i.e., Mithapur reef, Narara reef, Pirotan Island, at Gulf of Kachchh from 2013 to 2015 and found Acroporidae (*Acropora* sp. and *Montipora* sp.) to be suitable for large-scale transplantations (Yogeshkumar et al. 2016). The programme was funded by the Society of Integrated Coastal Management, Ministry of Environment Forest and Climate Change (MoEFCC) through the World Bank-Integrated Coastal Zone Management Project (ICZMP), Gujarat Ecology Commission (GEC) in this region.

Additionally, Reef Watch launched the RE (EF) Generate programme in 2018 to restore coral in the Andaman Islands through the use of Mineral Accretion Technology. A restored reef patch can be adopted through the Reef Guardian Programme with the objective to promote a personal link between mankind and the reef.

The Intergovernmental Panel on Climate Change (IPCC) warns that coral reefs are at serious risk as global temperatures rise. If the planet warms by 1.5 °C, an estimated 70–90% of coral reefs could disappear. At 2 °C of warming, over 99% are expected to be lost. The global temperature is currently 1 °C higher than it was before industrialization. If we do not take coordinated action to reduce emissions and encourage adaptation and faster recovery from injury, we face the very real prospect that the world's coral reefs as we know them could disappear within a generation. This issue will be made worse by the growing frequency of disturbances that affect coral reefs since there is insufficient recuperation time between the distressing occurrences. In this context, protecting coral reefs necessitates effective reef restoration efforts.

27.5.2 Monitoring Techniques

Monitoring coral reefs is crucial for understanding their health and resilience. Growing recognition of the extensive threats confronting coral reef ecosystems has underscored the importance of monitoring activities in evaluating the repercussions of disturbances on reefs and monitoring subsequent recovery or degradation. Numerous coral reef monitoring initiatives relying on field surveys have been established to gauge the global coral reefs' health condition.

27.5.2.1 Implications of Geospatial Technology to Study the Coral Reefs of India

Satellite earth observations and geographic information system (GIS) based analytical capabilities have revolutionized the mapping and monitoring of coral reefs. Traditionally, coral reef classification has been attempted, involving grouping coral reefs into different classes based on field observations. In the last few decades, technological advancements in geospatial techniques improved the mapping and monitoring of coral reefs (Kennedy et al. 2021). Remote sensing offers synoptic coverage for inferring large-scale patterns in coral reefs and complements field surveys for studying the reefs' spatial, spectral, and temporal dynamics (Hedley et al. 2016). Initially, reefs were merely interpreted using satellite images in the 1980s, just like identifying the reefs from field photographs (Fig. 27.4), and it has been extended to mapping habitats that are conducive to reef development (Fig. 27.5). In the early 2000s, the accessibility to higher spatial-spectral resolution images and computer-based processing techniques enabled a detailed mapping of reefs with physical attributes. Optical sensors that function within the visible range of the electromagnetic spectrum (400–700 nm) can penetrate up to 25 m deep in clear waters and provide valuable information about shallow reef platforms (Hamylton 2017). In addition, the near-infrared (NIR) band of various satellite sensors is potentially helpful for coral reef researchers (Andréfouët et al. 2003). Indexes like the Normalized Differential Vegetation Index (NDVI) are constructed using various combinations of visible and NIR bands, which provide valuable signatures for identifying environmental conditions that affect reef development. To strengthen coral reef resilience in the face of global warming, NOAA launched the Coral Reef Watch programme in 2000, utilizing near real-time satellite-derived products on a global scale (Fig. 27.6). However, the satellite-based approaches are limited by the data availability and resolution trade-offs. Obtaining remote sensing data for a coastal region with high spatial and spectral resolutions is difficult under cloud-free conditions and repeated coverage (Kennedy et al. 2021).

The remote sensing data with comprehensive information on reef systems is the first World Atlas of Coral Reefs published by UNEP World Conservation Monitoring Centre (Spalding et al. 2001; Hamylton 2017). In recent years, geospatial scientists have overcome these shortcomings by developing automated methods for mapping the coral reefs in conjunction with spectral reflectance and bathymetry information. The emerging technologies, including 3D mapping, autonomous underwater vehicles (AUVs), drones, and machine learning tools, have revolutionized mapping and modelling capabilities and helped coral reef conservation communities (Madin et al. 2019). For instance, scientists, universities, NGOs working in coral reefs, and private entities published the Allen Coral Atlas which consists of mapping of the world's coral reefs and their threats in unprecedented detail using high-resolution satellite imagery and advanced analytics (Fig. 27.7).

Similar to these world scientific trends, in India, the coral reefs were studied scientifically, from traditional field-based classification to modern, robust methods, by a diverse group of scientists. All major coral reef areas in India, including the ANI, LoI, GoK, and GoM, were studied using a convergence of geospatial techniques which revealed the current status of coral reefs, changes in their spatial extent and coverage, and life-threatening aspects/events (Fig. 27.4). The stud-

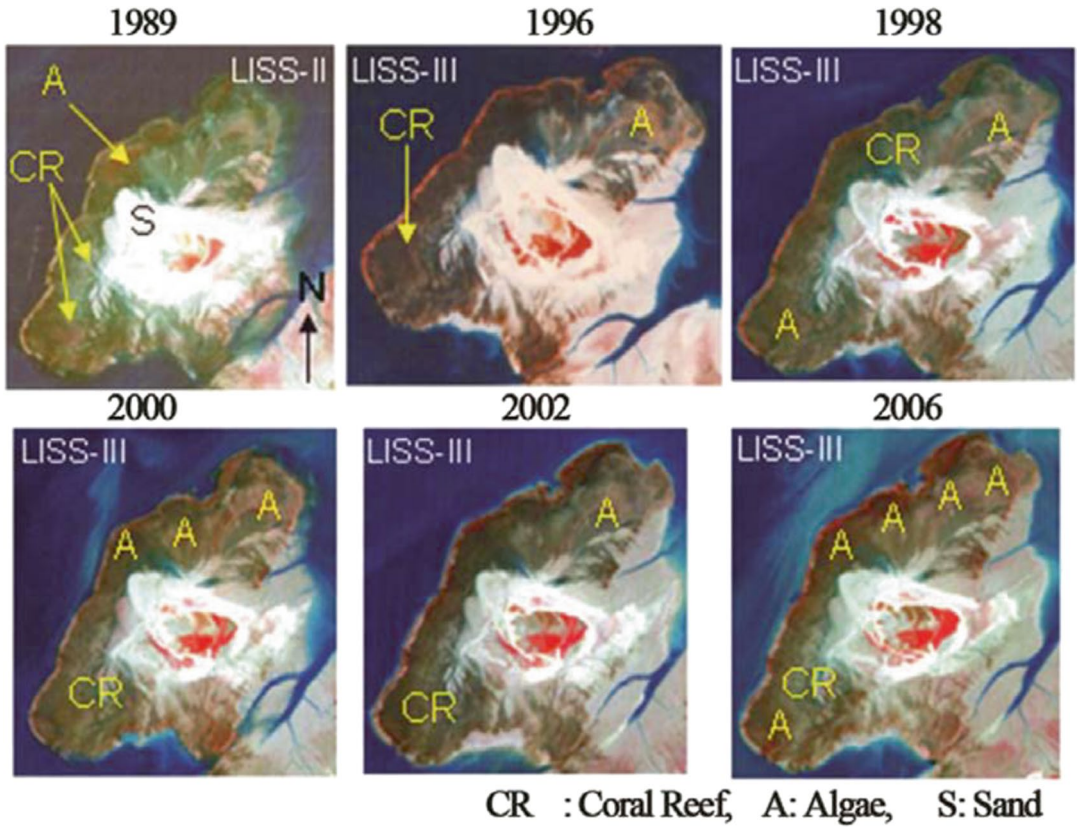

Fig. 27.4 Images from the IRS satellite series LISS-II and LISS-III sensors reveal the successive degradation of Pirotan Reef, Gulf of Kachchh, which covers both coral and macroalgae-dominated regions during 1989–2006. (Source: https://nopr.niscpr.res.in/handle/123456789/24796)

ies are also extended to document various natural and anthropogenic stresses that harm the development and sustenance of coral reefs in India.

The recent availability of multi-spectral datasets and developments in digital image classification methods of coral reef monitoring significantly improved in India. The ongoing free provision of Landsat and IRS-Resourcesat, satellite datasets for Indian regions, helps scholars and agencies study diverse threats the coral habitats face (Bahuguna et al. 2013). Nimalan et al. (2021) study in the GoM region found that spectral peaks around 485 nm and 590 nm wavelengths easily distinguished live coral species from dead or bleached corals; they found that bleached and dead coral reefs do not have peaks in these spectral wavelengths. Many studies attempted in India link remote sensing-derived environmental factors with reef distribution, allowing the scientists to characterize site-specific features of the Indian coral reefs and perform physical and biological linkages of them at local, regional, and global scales.

Bahuguna et al. (2013) inventorised the coral reef habitats of the Central Indian Ocean using multi-temporal satellite datasets (2004–2007) and found that GoK and GoM reefs are in degraded condition due to coral bleaching due to anomalous rise in SST, the effect of sedimentation and anthropogenic pressures. This revealed the coral reefs in the LoI enjoy pristine ecological status to some extent, while the coral reefs in the ANI were in pristine ecological conditions before the 2004 Indian Ocean Tsunami. The deadly waves damage about 54% of Andaman reefs. The modern assessments show that LoI and ANI reefs

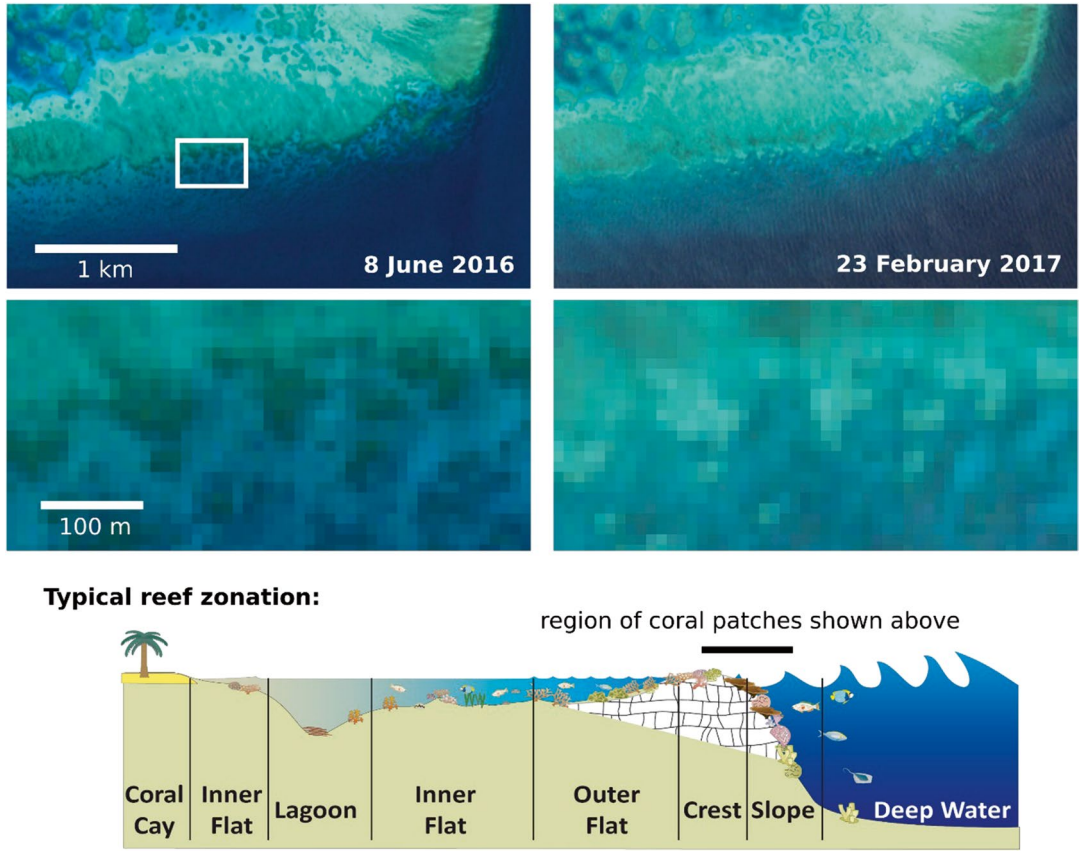

Fig. 27.5 Image of coral turning bright white in Adelaide Reef, Central Great Barrier Reef generated from the Copernicus Sentinel-2A satellite on 8 June 2016 and 23 February 2017. (Source: https://www.esa.int/ESA_Multimedia/Images/2017/05/Sentinel-2_captures_coral_bleaching)

are vulnerable. The satellite images also reported the coral bleaching events between 1998 and 2016, with severe impacts in 2010 in Andaman Island reefs. Also, Majumdar et al. (2018) recently used SENTINEL-2A data to report the distribution of coral reefs in the Andaman Islands. With the help of knowledge-based classification algorithms, they found that the Andaman Islands' coral reefs are affected by natural hazard events, including earthquakes, land subsidence, and tsunamis. Their study also reported the coupling mechanism of elevated SSTs and El Niño that cause coral damage in the Andaman Islands.

In addition to satellite images, GIS provides a promising tool for analysing environmental factors to characterize coral reef habitats along the Indian coasts. Databases such as MARSPEC and Bio-ORACLE (Sbrocco and Barber 2013; Assis et al. 2017) provide pelagic and benthic marine layers to model the present and future conditions of the reefs using GIS. Using these datasets, Ellepola et al. (2021) modelled in a GIS environment and found that a higher coral depletion is expected in the GoM. GIS-based modelling studies help to understand the ecological settings for conserving unique reef habitats around the country. Implementing geospatial technologies with optical, microwave, hyper-spectral, and acoustic sensor datasets through GIS is essential for monitoring and managing coral reefs in India.

27.5.2.2 Environmental DNA (eDNA) and Its Role in Coral Biodiversity Monitoring

The utilization of eDNA gained interest in various biological disciplines, encompassing terres-

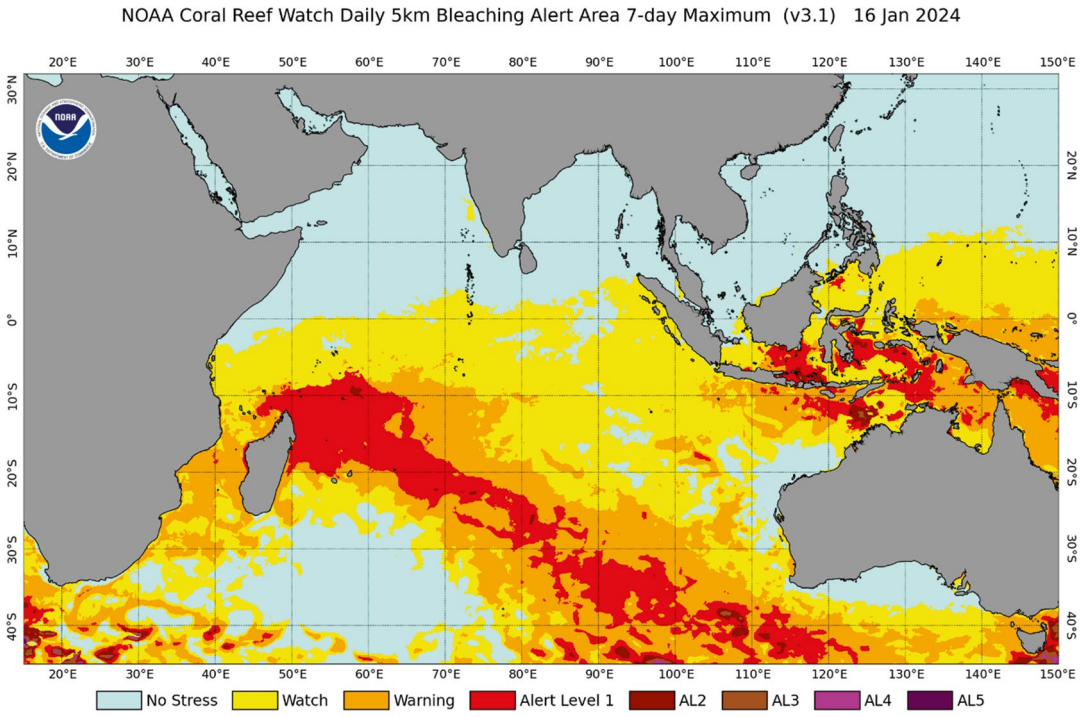

Fig. 27.6 NOAA coral reef bleaching alert product based on CRW's satellite SST monitoring during 10–16 January 2024 and updated daily at a 5 km satellite data grid. (Source: https://coralreefwatch.noaa.gov/product/5km/index.php)

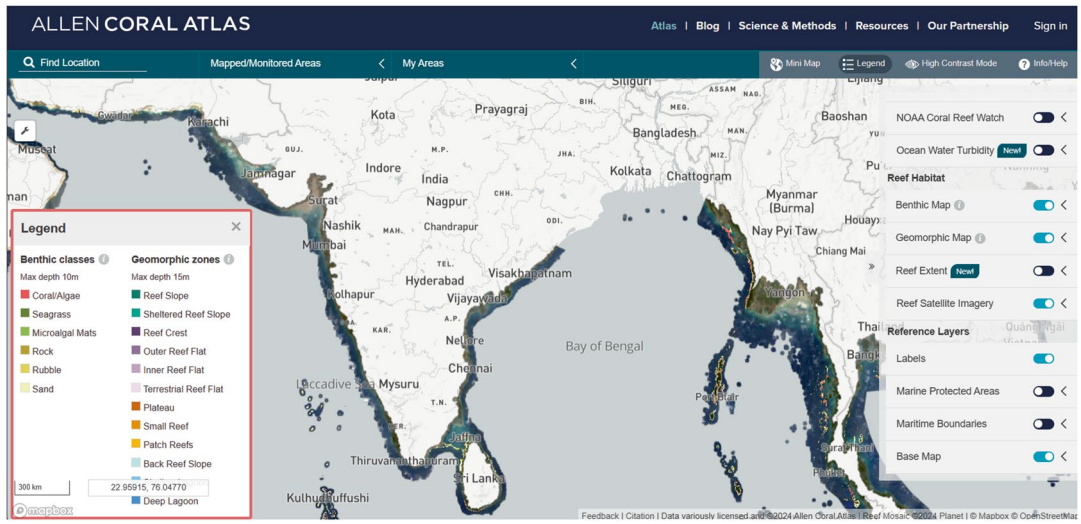

Fig. 27.7 The distribution of coral reefs and their geomorphic zones, Indian sub-continent by the Allen Coral Atlas, which maps and monitors coral threats using a high-quality (3.125 m) mosaic from Planet's Planet Scope satellite imagery. (Image credit: Allen Coral Atlas https://allencoralatlas.org/)

trial and aquatic ecology, conservation, public health, and ecosystem engineering. eDNA is based on the principle that the DNA of each individual organism can be retrieved from any given environment. This DNA is released through excretion, shedding of body parts, mucus, egg and sperm deposition, and decomposed tissue scraps after death (Ogden 2022). While the monitoring of fish species through eDNA is well-established, especially in invasive species monitoring, recent research, like that of Gelis et al. (2021), has successfully employed eDNA metabarcoding to accurately identify coral reef-associated fish species and reveal higher species diversity in specific reef zones. However, assessing coral distribution and health, which is vital in the ongoing climate change, remains a complex task. Nichols and Marko (2019) found a robust correlation between visual estimates of coral cover and eDNA abundance in Hawaii reefs, highlighting the potential of eDNA to monitor coral biomass. Additionally, the eDNA method detected more coral genera compared to visual surveys, with long reads proving more effective in detecting a broader range of coral genera (Nichols and Marko 2019). Coral species along with other 14 eukaryotic community members were detected using eDNA metabarcoding with 18S rRNA eukaryotic primer from the lagoon and reef slopes of Ningaloo coast of Australia (Fig. 27.8) (Dugal et al. 2023).

Alexander et al. (2020) developed a comprehensive eDNA toolkit designed for monitoring coral diversity and validated its performance against visual surveys. Everett and Park (2018) showed that eDNA sequencing can complement traditional surveys by identifying deep-sea octocorals that are challenging to visually identify.

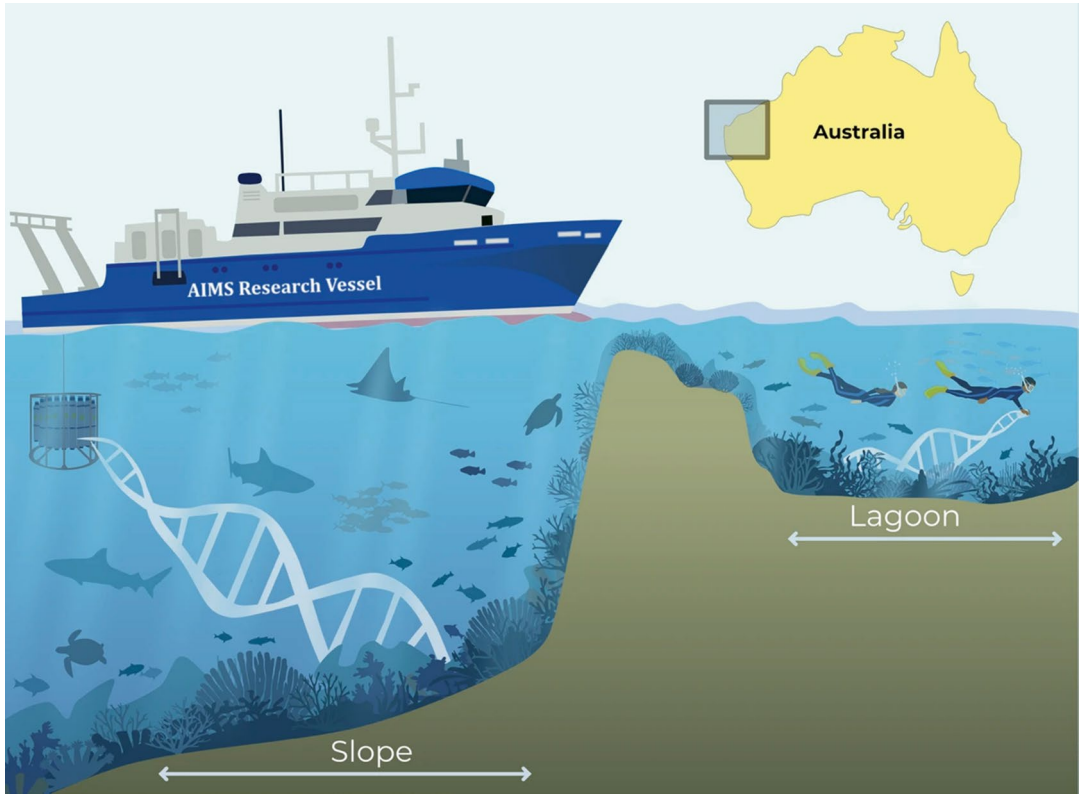

Fig 27.8 Dugal et al. (2023) use of eDNA to identify the coral community from the environments of the reef slopes and lagoons of Western Australia's Ningaloo Coast World Heritage Area. (© Dugal, L., Thomas, L., Meenakshisundaram, A. et al. Distinct coral reef habitat communities characterized by environmental DNA metabarcoding. *Coral Reefs* **42**, 17–30 (2023). https://doi.org/10.1007/s00338-022-02301-3

Overall, these findings highlight the potential of eDNA as a non-invasive and efficient method for coral assessment. Kutti et al. (2020) used eDNA, and primer targeting 178 bp of *Lophelia pertusa* (cold-water coral (CWC) reefs) mitochondrial DNA, and successfully detected elevated eDNA concentrations near large reefs in Norwegian fjords, particularly those on surface water. Kutti et al. (2020) successfully modelled eDNA disposal in the well-studied Norwegian fjords, including CWC reefs in the region. The model demonstrated high accuracy, in measuring eDNA concentrations in the water (Fig. 27.9). This cost-effective method offers a rapid way to locate challenging-to-detect "wall reefs," presenting a promising solution to supplement traditional mapping techniques (multibeam echosounders and ROVs), and costly surveys in identifying vulnerable marine ecosystems.

Beyond the well-recognized threats of climate change and rising water temperatures, another crucial facet of coral reef conservation involves addressing concerns related to coral predators. Sea stars, fish, marine worms, barnacles, crabs, and snails are among the predators that, during outbreaks, can inflict significant damage on coral reefs. In a study by Uthicke et al. (2018), environmental DNA (eDNA) and a PCR-based method were employed to identify crown-of-thorns sea stars in the Australian Great Barrier Reef. The droplet digital (dd) PCR method efficiently identified sea star DNA both in laboratory and field settings, with the identified sea star population through ddPCR showing correlation with visual surveys. This approach utilizing eDNA and ddPCR proves valuable in monitoring predator populations in reef areas.

The application of environmental DNA (eDNA) and metabarcoding, with targeted mitochondrial COI gene primers specific to marine biodiversity as demonstrated by Levy et al. (2023), proved effective in detecting a wide range of marine organisms. This initiative established a foundational biodiversity baseline, offering data on diversity, richness, and species abundance in the Gulf of Eilat/Aqaba. The study highlighted the capacity of eDNA to reveal cryptic organisms.

Beyond recording species richness and diversity at a high taxonomic level, eDNA was employed to identify corals at the genus level. In the work by Nishitsuji et al. (2023), over 43

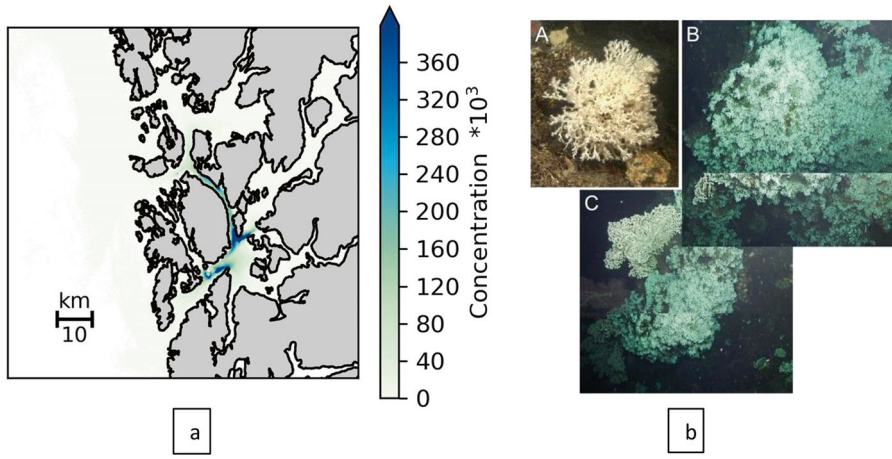

Fig. 27.9 (**a**) eDNA-based dispersal study was conducted in May 2018 from 200 m depth (Nakken CWC reef) using the ROV Aglantha. The simulation shows the dispersal of *Lophelia pertusa* genetic material was decreased with increase in distance from the coral reef. After 12–31 km from the reef only 5% of the coral genetic material is detectable. (**b**) *Lophelia pertusa* colonies in different sizes: (A) 25 cm in diameter, (B) 280 cm high and 350 cm wide, and (C) 300 cm high and 180 cm wide. (Kutti T, Johnsen IA, Skaar KS, Ray JL, Husa V and Dahlgren TG (2020) Quantification of eDNA to Map the Distribution of Cold-Water Coral Reefs. Front. Mar. Sci. 7:446. https://doi.org/10.3389/fmars.2020.00446)

Scleractinia genera were identified from surface seawater above reefs near Okinawa Island using the eDNA approach. The correlation between eDNA results and direct conformation by divers confirmed the presence of major genera, including *Acropora*, *Montipora*, *Pocillopora*, and *Porites* (Fig. 27.10). Notably, eDNA detected more coral genera than visual survey and revealed the undocumented species. This specific eDNA method for *Scleractinia* corals holds promise as a robust and powerful tool for comprehensive surveys of coral reefs.

Similarly, with the use of in-house fusion primer, Gösser et al. (2022) identified 29 Scleractinian coral genera belonging to 14 families from the seawater of Koh Pha-ngan, Thailand. Similar to the findings from other studies, the eDNA survey indicates a log-linear correlation

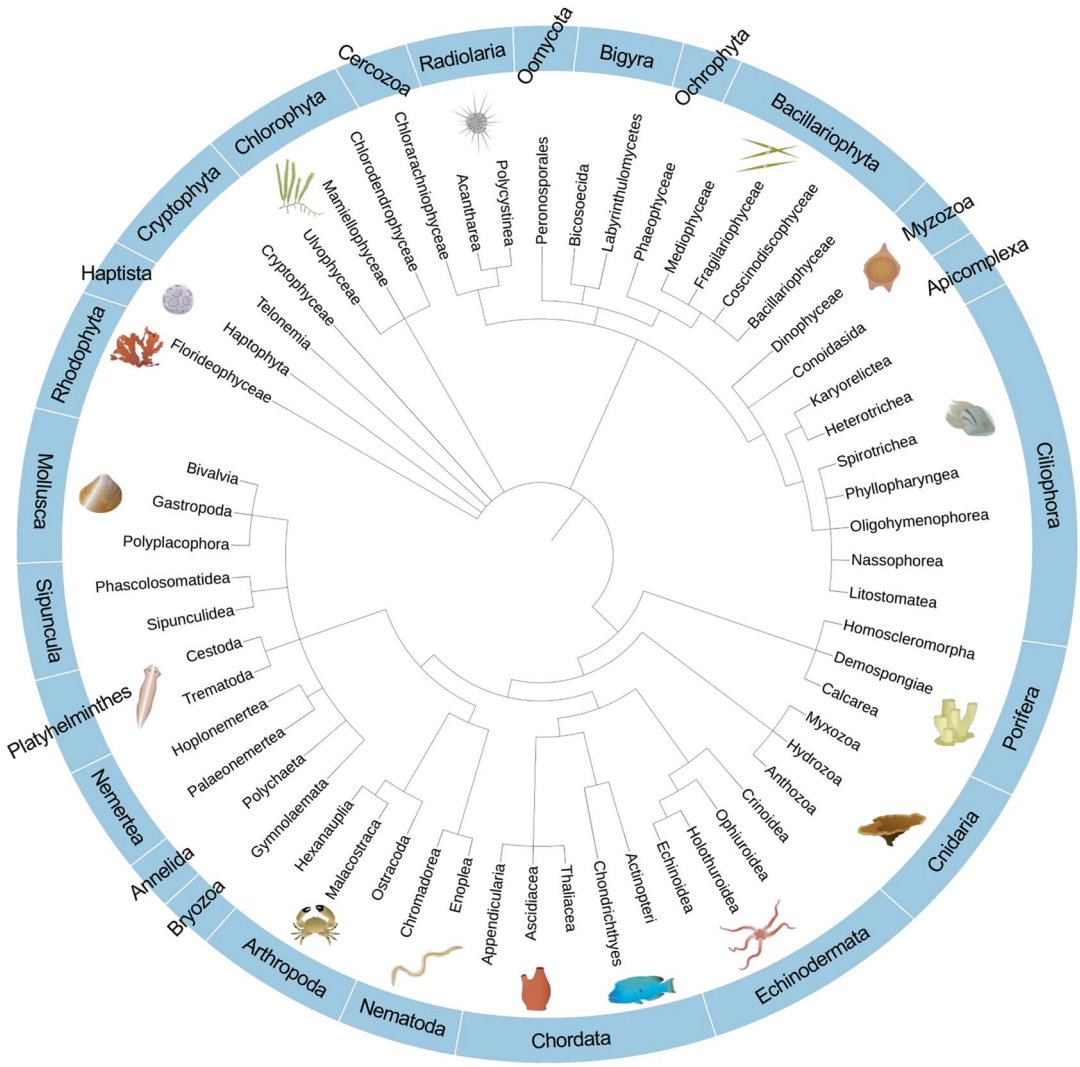

Fig. 27.10 Based on the eDNA, rRNA 18S Universal eukaryote and amplicon sequencing Dugal et al. (2022) identified the major eukaryote organisms like Protozoa, Cnidaria, Chromista, Apicomplexa, Radiolaria, Ciliophora, etc. (Dugal, L., Thomas, L., Meenakshisundaram, A. et al. Distinct coral reef habitat communities characterized by environmental DNA metabarcoding. *Coral Reefs* **42**, 17–30 (2023). https://doi.org/10.1007/s00338-022-02301-3)

between eDNA read abundance and visual estimation at the genus level suggesting a predictive correlation between eDNA reads and coral coverage. Besides, a variation in eDNA reads between diurnal and nocturnal samples was noted, which correlates with the activity of coral phases. Notably, the use of labelled fusion primers yielded similar results compared with commercial kits. This indicates that the utilization of different primers might enhance the large-scale study and help to increase the library which researchers may explore further. These findings are crucial to establish eDNA as a supplemental method alongside visual surveys for monitoring coral reefs.

27.6 Conservation Measures

The international community has committed to implementing coordinated policy measures to protect coral reef ecosystems. Various United Nations (UN) conventions play a significant role in restoration efforts, including the United Nations Convention on the Law of the Sea (UNCLOS) and the United Nations Framework Convention on Climate Change (UNFCCC), along with the Paris Agreement. Moreover, the United Nations Environment Programme (UNEP) supports coral restoration through four specific conventions: (1) the Conservation of Migratory Species of Wild Animals (CMS), (2) the Convention on Biological Diversity (CBD), (3) the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and (4) the Regional Seas Conventions and Action Plans. Additionally, the United Nations Educational, Scientific and Cultural Organization (UNESCO) oversees two conventions dedicated to these efforts: the Ramsar Convention on Wetlands and the World Heritage Convention (UNWHC).

The UN Resolution on the Decade on Ecosystem Restoration aims to "support and scale up efforts to prevent, halt, and reverse the degradation of ecosystems worldwide and raise awareness of the importance of successful ecosystem restoration." UNEP now extends support to compile a volume on best practices for coral reef restoration. Additionally, the UN Decade of Ocean Science for Sustainable Development (2021–2030) will enhance the Decade on Ecosystem Restoration, as scientific understanding is crucial for successful reef restoration.

Two significant global partnerships include the International Coral Reef Initiative (ICRI) and the International Union for Conservation of Nature (IUCN) through The Restoration Initiative (TRI), which work to identify and address the pressures on coral reefs. Furthermore, various prominent organizations such as the Coral Restoration Foundation and the NOAA Coral Reef Conservation Program are actively engaged in reef restoration activities worldwide. Approximately, 35 million people, in India, live within a distance of 30 km from the coral reef, and most of the coastal communities depend on reefs for their livelihoods and as a source of edible protein. Various legal frameworks have been enforced, including the Wild Life (Protection) Act (WLPA) 1972, Marine Fishing Regulation Act (MFRA) 1983, 2000, and the Coastal Regulation Zone (CRZ) Notification, 2011, to protect and conservation of Indian coral reefs. India has 31 Marine Protected Areas (MPAs), five of which have been surveyed and identified for coral reef protection. Recommendations have been made to halt all human activities that cause mechanical damage, coral removal, and the harvesting of marine organisms, except for scientific research (De et al. 2017). This includes the Marine National Park and Marine Sanctuary in the Gulf of Kachchh; the Malvan Marine Sanctuary in Maharashtra; the Gulf of Mannar Marine National Park in Tamil Nadu (part of the Gulf of Mannar Biosphere Reserve); various national parks, sanctuaries, and biosphere reserves in the Andaman and Nicobar Islands; and the Pitti Bird Sanctuary in the Lakshadweep Islands. These areas provide legal protection for coral reefs and their biodiversity, with some protections in place since the 1970s. Overall, coral reef ecosystems in India are granted the highest legal protection status to ensure their long-term preservation and conservation.

27.7 Conclusion

The detailed examination of India's coral reefs unveils their rich biodiversity and essential role in supporting coastal ecosystems and livelihoods. Despite their significance, these invaluable ecosystems confront a myriad of threats, encompassing the impacts of climate change, local stressors, and a consequential decline in reef health. Coral bleaching, ocean acidification, extreme weather events, and habitat destruction have resulted in substantial losses in live coral cover across diverse regions.

Addressing these challenges and conserving India's coral reefs involves a comprehensive strategy. International commitments, legal protection frameworks, conservation initiatives, artificial reef deployments, community-managed conservation, and government support all play crucial roles in safeguarding these fragile ecosystems. The integration of technologies such as geospatial tools and environmental DNA (eDNA) presents promising avenues for monitoring, assessing, and understanding coral reef status.

These collective efforts underscore the urgency of tackling both global and local stressors to ensure the survival and resilience of India's coral reefs. Conservation measures, community involvement, scientific research, and policy interventions are pivotal for the sustained protection and restoration of these diverse and economically significant ecosystems. In conclusion, coordinated endeavours, including international collaborations, the use of modern technological tools, and community engagement, are imperative to preserve India's rich coral biodiversity, mitigate threats, secure the future of these invaluable ecosystems for future generations, and contribute to sustainable marine resource management.

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Annexure A-40

BEFORE THE NATIONAL GREEN TRIBUNAL EASTERN ZONE AT KOLKATA

MEMORANDUM OF APPEAL

(Under Sections 16(h) read with 18(1) of the National Green Tribunal Act, 2010)

Appeal No. 32 of 2022

Ashish Kothari … Appellant

Vs

The Ministry of Environment, Forest and Climate Change

& Anr .. Respondents

Memo dated 05.04.2023 filed by the Appellant with photographs of the Turtle hatchery on the Eastern Flank of the Galathea bay

The appellant submits as follows:

1. It was contended during the course of submissions that the eastern flank of the Galathea Bay is not a turtle nesting ground. Contrary to the contention that the Galathea bay is rocky and there are no turtle nesting on these beaches, a turtle hatchery established by the forest department exists on the eastern flank – the boards are self-explanatory and also state the species, date of collection, number of eggs etc.
2. Photographs taken in March, 2023 of the eastern flank showing the turtle hatchery, of leatherback nesting pits on the eastern flank, Photographs of GPS device showing date and photographs of dead corals washed ashore on the beach (shows presence of corals in the bay, since corals will not wash ashore if there are one in the bay) are filed herewith.

Dated this the 5th day of April, 2023 at Chennai

Counsel for the Appellant

The Hatchery is seen (structure on the left – covered by a mesh). It can be seen that there is a wide beach and that it is not completely rocky as claimed.

Photos on the next page showing the hatchery and the boards describing the species, date etc make it evident that there is turtle nesting on this flank


SL - No - 08
SPECIES - OLIVE RIDLEY
TIME - 11:30PM
DATE - 30/1/23
EGGS - 120 Nos
SL No:09
SPECIES - O/R
DATE - 15/02/2023
TIME - 3:00AM

Photograph of GPS device showing date, time and GPS coordinates

Nesting pits of the Leatherback on the Eastern flank

Photograph of Dead coral with GPS coordinates

GREAT NICOBAR PROJECT

Why the Great Nicobar project could spell doom for the island's unique fauna

Experts say measures taken to mitigate harm to the animals represent only a "bare minimum".

Vaishnavi Rathore
Dec 03, 2024 · 06:30 am

OTHERS ARE Reading

1  Why young Indians are not interested in the prime minister's ambitious internship scheme

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The Nicobar megapode is a mostly terrestrial bird. It has a black body and a bright red head. The Nicobar long-tailed macaque has greyish fur and a pinkish-brown face, and a tail that is longer than its height from head to rump. A newly discovered species of frog, *Chalcorana chozhai*, is yellowish green with blotches of faint brown.

These three sub-species of animals are only found on the Nicobar group of islands – that is, they are endemic to the region. While the megapode and macaque are classified as vulnerable by the International Union for Conservation of Nature, the wildlife biologists who discovered the frog have recommended that it be classified as endangered.

Before the Great Nicobar island began making headlines in connection with a massive Rs 72,000-crore development project planned on it, the region was well known for its diverse fauna. Now, ecologists warn that the megaproject could mean disaster for these animals.

The project has gained environment and forest clearances and looks set to receive other mandated permissions. Private companies have submitted expressions of interest to develop the project's various components – the transshipment port, power plant, township and airport. In response to a Lok Sabha question this November, the union environment minister stated that the decision to go ahead with the project had been taken "after due consideration of potential environmental impacts on island ecology" and "significant strategic, defence and national importance of the developmental projects".

About 166 sq km of the island's lush green rainforests are slated to be cut and be replaced by tarmacked roads and coastal infrastructure, like ports and jetties. The environmental impact assessment notes that this could entail work such as dredging, and coral and sand mining for construction. "Coastal marine ecosystems will be lost at alarming rates," noted a 2021 study by the Zoological Survey of India on the probable impacts of the project on wildlife, conducted as a part of the impact assessment. This loss, experts fear, will pose a colossal threat to the island's marine and terrestrial animals, and their habitats and food sources.

The environmental impact assessment report notes that construction of port infrastructure "might hinder the entry of the turtles in the area for breeding" and that the project may have "direct or indirect impacts on the habitats" of "iconic species" like the Nicobar megapode, macaque and giant leatherback turtle. It

then recommends a set of measures to mitigate these impacts. These include halting construction work at night, relocating species like crocodiles from project sites, and using lights that do not disturb turtles on the coast.

Such measures are insufficient, wildlife experts argued. They represent an "absolute bare minimum", said Ishika Ramakrishna, a doctoral fellow at the Centre for Wildlife Studies in Bengaluru, who is studying human and primate interactions. Ramakrishna noted that the suggested measures "focus on very marginally reducing the impacts during the construction of the infrastructure. It does not look at reducing the impacts of the project once it is actually standing and operating."

The threat to macaques

Apart from being classified as vulnerable by the IUCN, the Nicobar long-tailed macaque also has the highest degree of protection under India's Wildlife Protection Act, 1972. Great Nicobar is home to the largest population of the animal.

In January 2022, a group of primatologists and wildlife biologists wrote to the Andaman and Nicobar Pollution Control Committee, the coordinating agency for the environmental impact assessment, to provide feedback on the assessment. They expressed concerns grounded in the fact that, as Ramakrishna explained, the long-tailed macaque has adapted to live both on the coasts, where it depends on the pandanus fruit and coconuts for its subsistence, as well as further inland, where it uses the lush rainforests, surviving on fruits and insects. “Since the habitat of coastal groups will be altered completely and the inland groups will also become dependent on plantations for food, there will be more inter-group conflicts due to the limitation of resources following the clearing of forests,” the experts noted.

This, the experts noted, was likely to exacerbate problems that had begun to develop in the years after the 2004 tsunami. A 2016 study that examined the recovery of the island’s macaque population after the disaster found that in Great Nicobar, residents reported increased raiding of coconut and bananas by macaques in the years after it.

The upcoming project could further intensify such interactions, suggested Ramakrishna, who has worked on the long-tailed macaque in Great Nicobar. Last year, Ramakrishna wrote that "the approved construction work is likely to result in 70 per cent of the 36 troops of macaques on the island losing their territories".

In an interview with *Scroll*, she noted, "With the sheer number of trees that are marked to be cut down, their habitat is set to directly be impacted and the macaques are likely to spend more time in people's farms."

While in many cases, humans and the animals can coexist, such interactions may "not always be positive", she said. For instance, she noted, the species could be harmed if people begin setting traps on farms to protect their produce.

Ramakrishna also pointed out that the environmental impact assessment report suggests inaccurately that macaques are a species in conflict with humans on the island. "While there are issues, it's not a species that is in full blown conflict with humans yet," she said. She explained that the report's "labelling" of the species as such is also reflected in its failure to "include them properly" in measures to mitigate the project's harms on the island's fauna. "It gives a sense of disregarding them, since they are anyway a problem species," she said.

The biologists' and primatologists' letter also raised other problems with mitigation measures that the environmental impact assessment report had suggested for macaques, such as the relocation of animals encountered during construction of roads. The letter stated that studies on relocation of macaques had found such attempts "often unsuccessful as the entire social group is not successfully captured, there are many fatalities (especially of infants) during capture, they experience tremendous trauma during transportation and groups do not always survive after relocation due to unsuitability of habitat".

Diminishing turtle nesting ground

The beaches of the Great and Little Nicobar islands are crucial for turtle nesting in the region – they are home to 87% of the turtle nesting sites in the Nicobar group of islands, a 2016 study conducted by Dakshin Foundation found. The study identified around 770 nests of giant leatherbacks on Great Nicobar, along with 320 nests for green sea turtles, 470 for olive ridleys and 71 for hawksbill turtles.

According to the study, Galathea Bay, in the south of Great Nicobar, is among the Nicobar group's three "most important" nesting sites of the giant leatherback

turtle. A “rapid assessment” by the Wildlife Institute of India in 2021, which was also a part of the environmental impact assessment report, noted that the finer soils and gentle slope of three bays on the island, including Galathea, were probably “helping” the leatherbacks “reach shore and lay eggs here conveniently”.

“Galathea is an important site because it also has historical value from a research perspective,” said Kartik Shanker, professor at the Indian Institute of Science, Bengaluru. He explained that since Galathea Bay has been monitored since the 1990s, it offers baseline data of the population of the leatherback turtles and their nesting, allowing for further studies and population monitoring. “There are other beaches on the western coast of Great Nicobar and in the Little Nicobar where nesting occurs, but we have not monitored those beaches in the past.”

Galathea Bay has been selected for the construction of the international transshipment port – once operational, the coastal landscape will be replaced by shipping berths bustling with activities of ship docking, loading and unloading.

But Shanker is optimistic that leatherbacks will be able to find other nesting sites on the island, because they are well known to nest at different beaches. “They would not have survived for millions of years if they were completely rigid about their nesting beach,” he said. He added that his team had “tagged leatherback turtles in Little Andaman and found that they forage as far as western Australia in the east and Mozambique and Madagascar in the west”. But their studies showed that the animals migrated to these particular nesting grounds only every few years. Further, he cautioned that if development work reached the western coast of the island too, it could be a threat to the animal, since the only other known nesting sites on the island are situated there.

In an August 2020 webinar organised by the NGO Deccan Birders, Dr K Sivakmar, who led the Wildlife Institute of India’s rapid study, said that in an earlier interaction he had had with the NITI Aayog about the transshipment port, he had “begged” the chairman to consider the impact on the island’s leatherback turtles. He said that the chairman assured him that the beaches would not be touched for the project. But, “The government went ahead with the project,” Sivakumar said at the session. “I couldn’t convince, I am sorry for that.”

Several of the mitigation measures that the environmental impact assessment report suggests to offset the harm that could come to wildlife on the island are focused on turtles. These include halting construction activities “to the possible extent” during nights, as well as between November and February, which coincides with the nesting period of leatherback turtles.

“The port is expected to come up very close to the nesting beach, so it is hard to say if these measures, even though they should be taken, would really work for them to continue using this site for nesting,” Shanker said.

Megapodes and other birds

Apart from the megapode, which primarily inhabits the island’s coast, the development work is also likely to threaten other species of birds, such as the Nicobar pigeon and Nicobar jungle flycatcher, both classified as near threatened.

“Approximately 150 bird species, including endemic, resident, and migratory ones, have been recorded in the region,” said a local naturalist, who requested anonymity. “Among them is the Nicobar pigeon, a remarkable resident bird whose ancestors are traced back to the extinct dodo. Many of these species are endemic at the subspecies level, based on morphological differences, and require further scientific study.”

The population of megapodes has dropped steeply over the years – the zoological society report notes that in 1994, the island had between 1,100 and 1,800 breeding pairs, but that research conducted between 2015 and 2018 found only

between 97 and 104 such pairs.

In the webinar, Sivakumar noted that the population had undergone a “steep decline” and that the bird’s “habitat is under a lot of pressure”.

Megapodes have fascinated birders and wildlife biologists, in large part owing to their distinctive behaviour of building mounds on the ground to use as nests. They collect sand, loam, coral bits and vegetation to build these mounds, which can range in height from about 10 cm to two metres. Instead of using body heat to incubate their eggs, megapodes incubate them in these mounds.

The birds prefer coastal landscapes as the sites of these mounds, which makes them vulnerable to any changes on the coasts. A 1995 study by ornithologist R Sankaran, found that more than 90% of the mounds were built within 30 metres from the shore, some as close as five metres from it. “Typically, megapodes build their mounds in coastal forest areas where many deciduous trees shed their leaves yearly,” the naturalist said. “This leaf litter mixes with sandy loam soil, aiding megapodes in mound construction.”

Citing a 2000 research paper, the zoological society report described the plan to make Great Nicobar a “free port”, and to create a dock and refuelling base for international shipping on the mouth of Galathea River, as “the prime hazard hanging over the megapode population of the Nicobar”. The same report also highlighted an ongoing road construction project through Galathea, up to Indira Point, which it noted could lead to a loss of both micro and macro habitats in the area, and thus affect the micro climatic condition needed for the mounds.

Such effects have been observed earlier, even with less dramatic changes to the coast – a 1995 study found that a large number of abandoned mounds were found wherever primary forests along the coasts were converted into coconut plantations. The study observed that the birds needed sufficient ground cover as well as “middle-storey vegetation cover” for their mounds, and thus tended not to breed in forests that were changed to coconut plantations.

According to estimates of an expert appraisal committee, there are more than 50 active megapode nests in the area of the proposed megaproject, of which 30 will be permanently destroyed on account of construction activities.

To mitigate the harms to these birds, the environmental impact assessment report suggests “well organised plans” based on “internationally accepted mitigation measures for minimal impact”, but does not lay down any details. “The resident birds have evolved on these islands for thousands of years and migrate within the islands, and depend on availability of food,” the naturalist said. “An additional 12 to 20 hectares of mangroves are also set to be bulldozed, apart from the million trees cleared. How will the birds survive if their homes are destroyed?”

Research in the Great Nicobar is recent, and wildlife biologists have noted that there are likely many more species endemic to these islands than currently known. “Science takes time,” Ramakrishna said. “But the rapidity with which the project is moving forward also means that we are running out of time to understand species on the island better, and the impact that this project is costing them.”

We welcome your comments at letters@scroll.in.

Andaman And Nicobar Islands | Environment | Wildlife

Gmail

Raghunandan Sriram <raghunandan.sriram.adv@gmail.com>

Service of additional reply of Applicant in O.A. No. 93 of 2024

1 message

Raghunandan Sriram <raghunandan.sriram.adv@gmail.com> 16 September 2025 at 09:08
To: legumjure@gmail.com, lmc.moefcc@gov.in, aniidco@gmail.com, andaman@legaloptions.in, office@rschambers.net, suhasini@rschambers.net, rashmibothra24@gmail.com, Amrita Pandey <amritalegal@gmail.com>
Cc: Yogeshwaran Amarneethi <yogeshwaranadv@gmail.com>, Poongkhulali B <poongkhulali.b@gmail.com>

Respected Sir/Ma'am,

Please find attached the additional reply of the Applicant in the subject mentioned Original Application. Kindly treat this email as service of the additional reply.

Regards,
Raghunandan Sriram
On behalf of Yogeshwaran A
Counsel for Applicant
--
Raghunandan Sriram
Advocate
Chennai

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