Initial Environmental Examination

Project Number: 40156-033
May 2016

India: Sustainable Coastal Protection and Management Investment Program – Tranche 2 Karnataka

Prepared by Karnataka Public Works, Ports & Inland Water Transport Department for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 7 April 2016)

Currency Unit	–	Indian rupee/rupees (Re/Rs)
Rs1.00	=	$ 0.015033
$1.00	=	Rs66.5224

ABBREVIATIONS

ADB	Asian Development Bank
CBO	community based organization
CMFRI	Central Marine Fisheries Research Institute
COMAPS	coastal ocean monitoring and prediction systems
CPCB	Central Pollution Control Board
CRZ	coastal regulation zone
CWC	Central Water Commission
CWPRS	Central Water and Power Research Station
CZMP	coastal zone management plan
EIA	environmental impact assessment
EMP	environmental management plan
GOI	Government of India
GP	Gram Panchayat (local government)
FFA	framework financing agreement
IEE	initial environmental examinations
EMC	environmental management committee
EMP	environmental management plan
ICMAM	Integrated Coastal and Marine Area Management
ISPRL	Indian Strategic Petroleum Reserves Limited
IUCN	International Union for Conservation of Nature
KSCZMA	Karnataka State Coastal Zone Management Authorities
MFF	multitranche financing facility
MOEFCC	Ministry of Environment, Forest and Climate Change
MOWR	Ministry of Water Resources
NCA	National Coordinating Agency
NCPP	National Coastal Protection Project
NMPT	New Mangalore Port Trust
NGO	nongovernmental organization
PMU	program management unit
PPMS	Project Performance and Management System
PPTA	project Preparatory technical assistance
PWD	Public Works Department
PWPIWTD	Public Works, Ports and Inland Water Transport Department
TMC	Town Municipal Council
WHO	World Health Organization
WRD	Water Resources Department

NOTES

(i) The fiscal year (FY) of the Government of India ends on 31 March. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2016 ends on 31 March 2016.

(ii) In this report, "$" refers to US dollars.

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I. INTRODUCTION

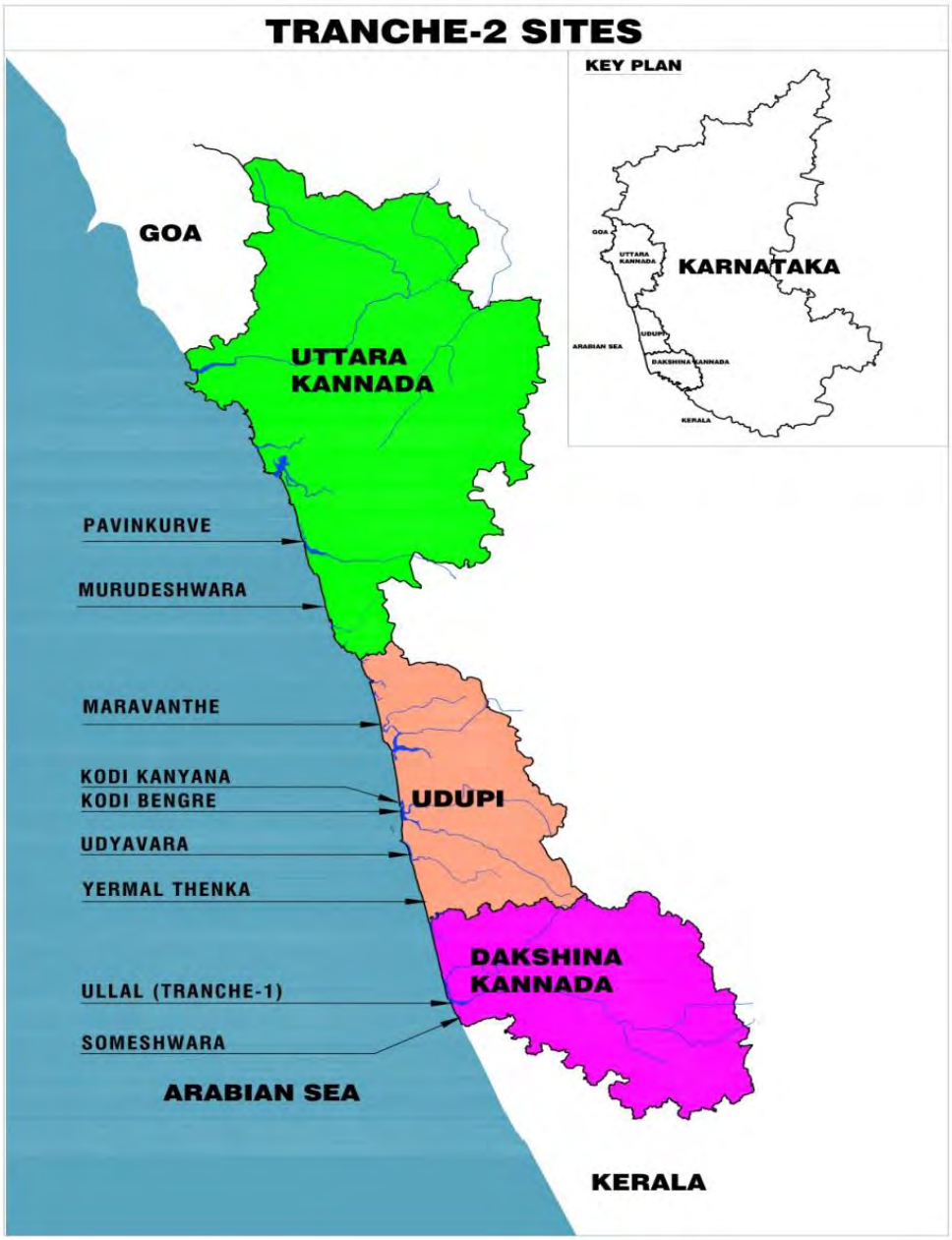
A. Project Background

1. The proposed investment - Project 2 of the Sustainable Coastal Protection and Management Investment Program will be funded by Asian Development Bank (ADB) as part of the multitranche finance facility (MFF) that was approved in September 2010. The MFF addresses immediate coastal protection needs and coastal instability through implementation of economically viable protection works using environmentally and socially appropriate solutions in the state of Karnataka. An integral part of the investment program is the provision of Shoreline Management Plans (SMPs) for the three coastal districts in Karnataka State. These SMPs have been completed, and provide the structure and context for the implementation of project 2. In essence, the provision of any coastal management projects in Karnataka should be implemented in order to meet the SMP Policy requirements, this provides for a more sustainable management approach to the management and protection of the whole of the Karnataka State coastline.

2. As part of project 2, severe coastal erosion prone sites were selected based on policies laid down in the Karnataka SMP, site visits with the project management unit (PMU) and stakeholders meetings conducted. The investment under project 2 involves the development of 9 subprojects to reduce erosion and improve beach stability, the subproject locations are shown in Figure 1. The project 2 has two components: (i) Coastal Erosion and instability reduced, and (ii) Capacity for integrated shoreline planning and development enhanced.

3. The Ministry of Water Resources (MOWR) through the Central Water Commission (CWC) will be the national coordinating agency (NCA) and will be responsible for the project to the national government. The executing agency will be Karnataka Public Works, Ports & Inland Water Transport Department (PWPIWTD).

Figure 1: Map of Project Area showing locations of subproject sites



Note: Does not include Stage 2 Community Protection Subprojects

B. Policy and Legal Framework

4. When proposing construction works in the coastal areas it is necessary to comply with the applicable legislation and administrative procedures in order to obtain the appropriate environmental approvals. In projects proposed within 500 meters (m) of mean low water level the relevant legislation and administrative arrangements relate to the Coastal Zone Management Authority.

1. The Environment (Protection) Act, 1986 and amendments.

5. The Environmental (Protection) Act, 1986 and amendments, is an umbrella act and many sub acts and rules exist. Amongst other items the act sets out the procedures for:

(i) Obtaining Environmental Approval, and
(ii) Submission of Environmental Statement.

6. The main rules pertinent here are indicated below:

(i) Environmental Impact Assessment (EIA) Notification
(ii) Coastal Regulation Zone (CRZ) Notification.

2. S.O.19 (E) Coastal Regulation Zone Notification 6th Jan 2011

7. The CRZ Notification, 2011 of the Ministry of Environment, Forests & Climate Change (MoEFCC) under section 3 (iv) (b), states that the following is exempt from the list of prohibited activities along the coastline - 'Measures for control of Erosion based on Scientific including the Environment Impact Assessment (EIA) studies'. The said project however does not attract the provisions of the Environmental Impact Assessment Notification, 2006 and its subsequent amendments. Also, as per section 4(i)(f), erosion control measures are listed as permissible activity. Further, as per section 4 (ii)(c), CRZ clearance from the Karnataka State Coastal Zone Management Authorities (KSCZMA) is required for all permissible projects in the CRZ area, not attracting provisions of EIA Notification, 2006 and subsequent amendments.

8. This notification repeals the earlier 1991 CRZ notification, adjusts the definitions of the CRZ, the prohibited activities and the regulations and grants powers for implementing the provision of the CRZ requirements to the State Coastal Zone Management Authorities (SCZMA).

9. CRZ clearance has been obtained for all the six Coastal Protection Subprojects from KSCZMA. Although the clearance does not contain any specific or general set of condition to be followed after obtaining approval, it is assumed that the conditions mentioned in the EIA reports submitted for clearance have to be followed and as usual six monthly monitoring data has to be submitted to KSCZMA by the PMU. The copy of project 2 CRZ clearance is attached in Appendix 2 of this report.

3. Noise Pollution (Regulation and Control) Rules, 2000

10. This legislation defines the levels of noise permitted in each area, including from vehicular traffic generators, construction activities and mechanical devices. This rule would be important especially during the construction period of the project. These levels need to be adhered to for all project activities.

4. Air (Prevention and Control of Pollution) Act, 1981, its Rules and Amendments

11. Under this act, Pollution Control Boards (Central and State) for the prevention and control of air pollution have been set up to monitor and manage activities that would lead to air pollution, declare air pollution control areas. The act also sets ambient air quality standards for industrial, residential and ecologically sensitive areas.

12. This will be important during the construction phase, where there is likely to be use of diesel generators for provision of energy and other activities that may result in air pollution. Also, based upon the area the project activities are underway, the standards, as defined by the act are to be adhered to.

5. The Water (Prevention and Control of Pollution) Acts

13. This law is to control and prevent water pollution. This legislation also defines discharge standards and permit needs for any effluent/wastewater discharged. It includes surface and ground water and marine discharges. This act also discusses possible water pollution, prevention and control areas for the application of this act.

14. Presently, the project does not envisage undertaking any activity that would result in effluent discharges and therefore permission under this act is not required. Nonetheless, at the construction phase of the project, there may be a need to look at possible discharge from various activities to ensure that discharges do not result in the change in the quality of water bodies, whether temporarily or permanently. Water quality standards for different uses have been defined by the Central Pollution Control Board, Government of India.

15. Statutory permission that are applicable and required to be obtained during the course of project 2 subproject implementation is provided in **Table 1** along with the agency responsible for obtaining any such permissions.

Table 1: Statutory Permissions Requirement for the Project 2 Coastal Protection Subproject:

S. No.	Clearances	Acts/Rules/Notifications/Guidelines and Application to Water Supply Projects	Concerned Agency	Applicable to Contract package	Responsibility	Applicable Sub Project site
	A. Pre-construction Stage					
1	CRZ Clearance	CRZ notification 2011 with amended promulgated under Environment (Protection) Act 1986 It delineates the steps required for obtaining CRZ clearance.	Karnataka State Coastal Zone Management Authority	Yes	PMU	All 6 Coastal Protection Subprojects
	B. Implementation Stage					
2	Storage of fuel oil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Karnataka State Pollution Control Board	Yes	Contractor	All 6 Coastal Protection Subprojects
3	Pollution Under Control Certificate	Central Motor and Vehicle Act 1988 and Central Motor and Vehicle Rules,1989 amended till 2013	Department of Transport, Govt. of Karnataka	Yes	Contractor	All 6 Coastal Protection Subprojects
4	Installation of Generators	The Air (Prevention and Control of Pollution) Act, 1981 as Amended in 1987 and Air (Prevention and Control of Pollution) Rules, 1983	Karnataka State Pollution Control Board	Yes	Contractor	Maravanthe and Murudeshwara
5	Employing Labour/ workers	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service)	District Labour Commissioner	Yes	Contractor	All 6 Coastal Protection Sub Project

		Act, 1996 & The Building and Other Construction Workers Related Laws (Amendment) Bill, 2013				
6	Permission for extraction of Rocks	Mines & Minerals (Regulation and Development) Act, 1957 and its amendments in1958, 1972, 1986, 1994,1999 & 2010	Department of Mines and Geology. Government of Karnataka	Yes	Contractor	All Coastal Protection Sub Projects except Someshwara .
7	Permission for extraction of ground water for curing tetrapods	Ground Water Rules of 2002	Karnataka Ground Water Authority	Yes	Contractor	Maravanthe and Murudeshwara
8	Permission for use of surface water for curing tetrapods	-	Irrigation Department	Yes	Contractor	Maravanthe and Murudeshwara
9	Installation of batching plant	The Air (Prevention and Control of Pollution) Act, 1981 as Amended in 1987 and Air (Prevention and Control of Pollution) Rules, 1983	Karnataka State Pollution Control Board	Yes	Contractor	Maravanthe and Murudeshwara

6. ADB Environmental Guidelines

16. From ADB's perspective there is the Safeguard Policy Statement, 2009 (SPS). The SPS is a set of operational policies that seeks to avoid, minimize, or mitigate adverse environmental impacts of development activities where ADB is involved. To ensure this, impacts of project activities on the environment are to be identified early in the project cycle so that appropriate mitigation and management actions are undertaken.

17. In the case of an MFF, an environmental assessment and review framework (EARF) is also to be developed. The EARF will provide guidance to the assessments of the subprojects of the subsequent tranches which are prepared after Board approval.

18. ADB has also developed categorization of all projects according to the level and type of impacts and type of investments. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. Projects can be categorized into four depending upon their impacts. These are,

(i) Category A. A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.

(ii) Category B. A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.

(iii) Category C. A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
(iv) Category FI. A proposed project is classified as category FI if it involves investment of ADB funds to or through a FI (Financial Intermediary).

19. To ensure that people's concerns and needs are included in project design, consultation with those impacted by the project needs to be undertaken early in the project design cycle. Furthermore, there is a need for the client to identify an appropriate grievance redress system for project impacted stakeholders and to ensure transparency. Each tranche will be categorized once interventions and their locations are identified. If the identified project is categorized as a Category B project, an initial environmental examination (IEE) will be undertaken and if it is a Category A, an EIA.

C. Approaches and Method in Preparing the Environmental Assessment Study

20. The environmental assessment study was prepared under the framework of the EARF prepared for this MFF. The study was carried out from August to October 2015 and the assessment of environmental impacts was based on activities identified at the stage of feasibility study. Since the subprojects will be constructed using a loan from ADB, it has been necessary to carry out studies in order to satisfy both the State of Karnataka, Government of India and ADB requirements.

21. This IEE report is based on EIA report submitted to the Karnataka State Coastal Zone Management Authority (KSCZMA), Government of Karnataka, for obtaining CRZ clearance for Tranche 2 sub projects. All the prediction of impacts and proposed mitigation measures that form the Environmental Management Plan, Environmental Monitoring Plan from EIA submitted for KSCZMA, have been taken into account in this IEE report to comply with ADB requirements. Therefore, the Project will have only one EMP and monitoring plan to be implemented and the report on implementing EMP and undertaking environmental monitoring will be submitted to the Government of Karnataka to comply with CRZ clearance and to ADB to comply with ADB SPS 2009. In addition, a number of environmental studies, of increasing complexity and rigor have been carried out at each of the subproject sites that are explained in the following paragraphs.

22. A baseline environmental data set has been established for each of the subprojects based on primary and secondary data collection. These studies include: (i) field work to collect ambient air quality, noise levels, ground water samples at seven locations along with marine water quality and marine ecology, marine water quality and sediment samples; and (ii) analysis in the vicinity of each subproject site. The above samples were collected in October 2015 (Post-Monsoon season) as per CPCB/MOEFCC guidelines.

23. In addition, a micrometeorological station to obtain local meteorological data was installed near Kambadakone, Kundapura. Secondary data such as weather details, marine ecology related peer reviewed papers, etc., were collected from various sources such as India Meteorological Department (IMD), National Hydrographic Office (NHO), Dehradun, Department of Fisheries, Karnataka, College of Fisheries, Mangalore, Central Marine Fisheries Research Institute (CMFRI), Mangalore, Works, PWPIWTD Government of Karnataka, and other authorized government and research institutions.

24. Anticipated environmental impacts due to each subproject as well as cumulative impacts due to the whole SCPMIP-K program have been reviewed including the impacts on marine and

terrestrial environmental, physical resource, socioeconomic impacts, local traffic, tourism, human health, fishing activities and necessary mitigation measures were suggested.

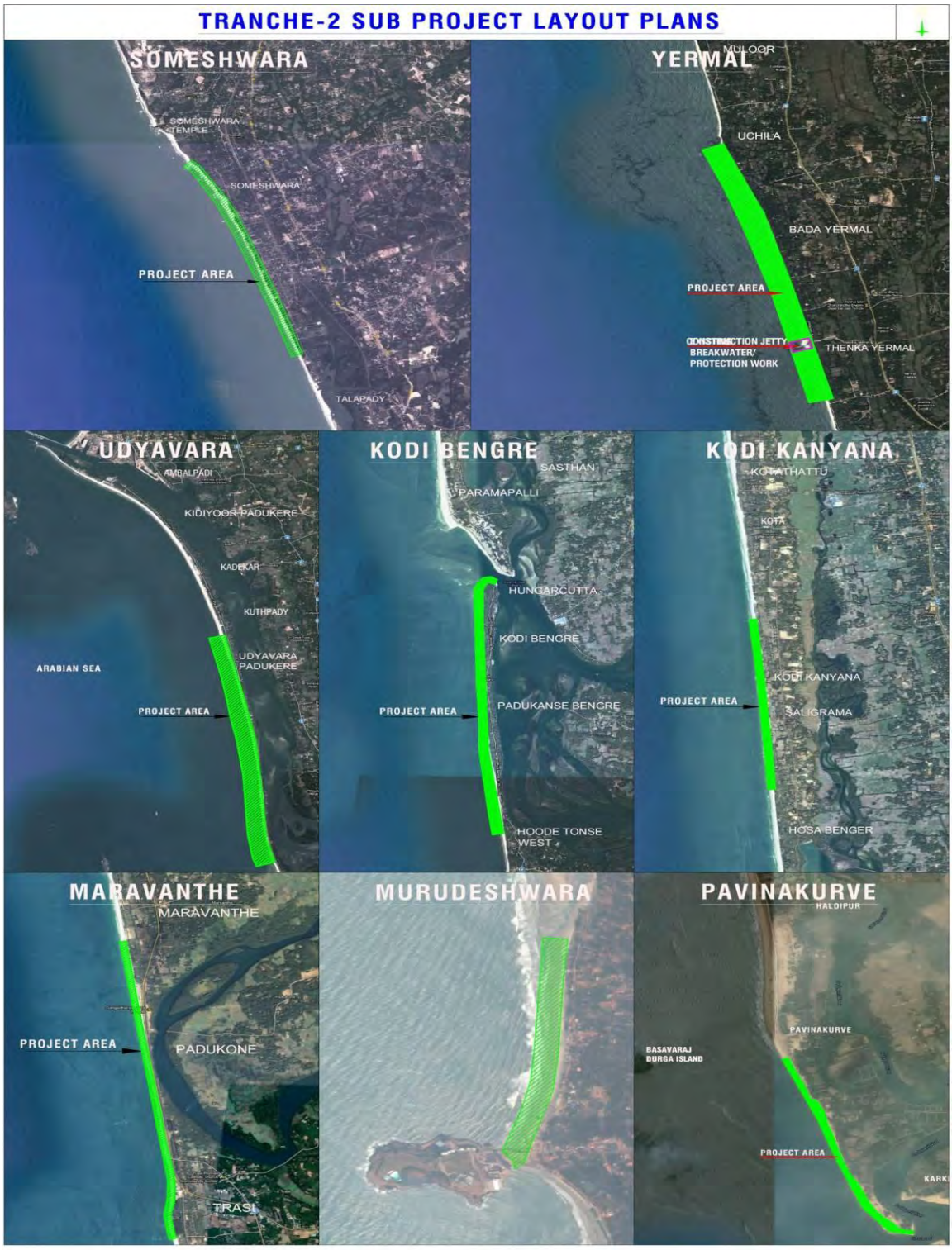
II. PROJECT LOCATION AND THE NEED FOR THE PROJECT

A. Location and Need

25. The subproject sites are located along the shorelines of the three coastal districts Dakshina Kannada, Udupi and Uttara Kannada of Karnataka on the west coast of India. These sites are shown in Figure 1. From south to north, these locations are Someshwara, Yermal Thenka, Udyavara, Kodi Bengre, Kodi Kanyana, Maravanthe, Murudeshwar and Pavinakurve. Many of these sites are located on barrier spits as a large part of coastal Karnataka is formed by spits. The subproject sites are shown individually in Figure 2. Full information on the coastal conditions and issues are given in the pre-feasibility, feasibility and final project reports of the sites prepared by the Project Management and Design and Consultant Consultant PMDCK (Euroconsult Mott MacDonald, 2014 and 2015).

26. These sites have suffered from erosion over several decades, and now local communities are under severe attack from waves. Due to the depleted beaches, waves cause serious loss of property, agricultural field and damages to infrastructure such as adjacent roads. These effects are more prominent during monsoon when consistently large waves carry huge amount of sand offshore. Although much of the beach builds back slowly as the monsoon recedes, wave run-up and overtopping during the monsoon have become a serious threat creating significant economic loss at these sites.

Figure 2: Project 2 Subproject Layout Plans



Note: Figure 2 does not include Stage 2 Community Protection Subprojects

27. Many of the coastal protection schemes in Karnataka, where they exist, were built within the last 30 years. In the context of the nine subprojects, rubble mound revetments exist in parts

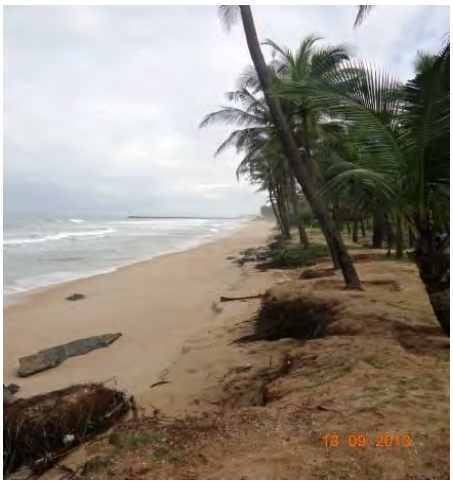
at Yermal Thenka, Udyavara, Kodi Bengre, Maravanthe and Murudeshwar. Parts of these revetments were taken up as temporary emergency measure just before the monsoon and were therefore built without a proper design. As a result, the revetments at the selected sites are in damaged conditions. Additionally, because of loss in the beach width over the years the existing revetments are also not fully effective against flooding due to wave overtopping. Erosion at Udyavara and Maravanthe is a very serious threat with the possibility of breach of the spit causing huge losses. Increased utilization of the coastal resources at Someshwara, Kodi Kanyana, Murudeshwar and Pavinakurve has brought issues arising from the erosion at those places under the limelight.

28. Direct victims of the erosion problems are fishermen, coconut farmers, agricultural land owners, house owners, road users and tourism industry. Two of the eight subproject sites, Someshwara and Murudeshwar, are presently among tourism priority locations in the state. Some of the other sites have good tourism potential which can be preserved and utilized only by properly planned sustainable shoreline management schemes.

Figure 3: Erosion pictures of Tranche 2 sites

Someshwara

Yermal Thenka



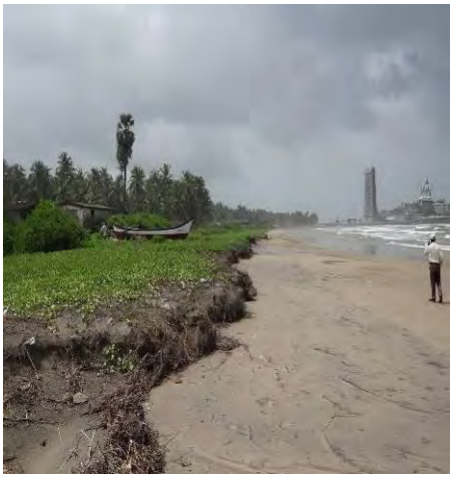
Udyavara

Kodi Bengre

Kodi Kanyana

Maravanthe

Murudeshwara **Pavinakurve**



Note: Figure 3 does not include Stage 2 Community Protection Subprojects

B. Type of Project

29. Project 2 involves implementation of measures to correct effects of severe erosion and protect the subject beach areas from further damage. The project incorporates nine subprojects. These nine subprojects are further categorized as

(i) Coastal Protection Subprojects, and
(ii) Community Protection Subprojects

1. Coastal Protection Subprojects

30. The coastal protection subprojects have been planned and designed to address the issues of medium to severe coastal erosion by means of civil construction at six locations, viz. Someshwara, Yermal Thenka, Udyavara, Kodi Bengre, Maravanthe and Murudeshwara.

2. Community Protection Subprojects

31. Community protection subprojects are proposed at three locations in two stages

(i) Stage 1: Two community subprojects Kodi Kanyana and Pavinakurve have been planned designed under project 1 and will be implemented in 2016/2017.
(ii) Stage 2: A further community subproject will be planned and designed by the project 2 consultants with implementation proposed for 2017/2018.

32. The community protection subprojects are designed for the long stretches of the coast which have no or only minor impacts of coastal erosion. Under climate change, it is estimated that erosion problems will gradually increase over time and many beaches which are currently stable would gradually become unstable.

33. The key objective is to develop lower cost preemptive actions that can help address or slow the erosion in these low erosion beaches. The projects would build on the use of the beach and dunes as natural defenses. The government does not have the resources to tackle the whole coast and there is good scope for the communities with external support could take on a role for locally based management and lower cost protection measures.

34. The community protection subprojects have been designed to demonstrate mechanisms on how the communities with some government support can be engaged in shoreline protection and management tasks including methods to create some local sources of financing that can be used to support the necessary long term management and maintenance activities.

35. The community protection subprojects would pilot new innovative approaches to coastal protection To develop and demonstrate methodologies and approaches to natural protection measures that can be taken up as complementary methods of coastal protection either as (i) standalone protection for lower erosion beaches, or (ii) as complementary actions to the higher investment protection projects.

36. The community pilot sub projects will focus on natural coastal protection measures focusing on reconstruction of the dunes through two key activities

(i) Reconstructing the natural dunes by scraping sand from lower beach above the low tide level or pumping sand from the near shore area in water less than 10 m depth; and
(ii) Planting of appropriate species of plants to help stabilize the dunes.

C. Summary of Subprojects

37. Designs of the project 2 subprojects have been developed through careful examination of the oceanographic, geo-morphological and anthropogenic features and methodology based on conceptual modeling, widely-accepted (semi-) empirical predictions and design guidelines. Designs considered in the feasibility studies of the (2014-15) subprojects were:

1. Coastal Protection Subprojects

38. Coastal Protection Subprojects have been planned and designed to address the issues of medium to severe coastal erosion by means of civil construction at 6 locations, viz. Someshwara, Yermal Thenka, Udyavara, Kodi Bengre, Maravanthe and Murudeshwara.

(i) Someshwara: The project site is located in Dakshina Kannada District, south of Mangalore. The proposed coastal protection scheme at Someshwara site is revetment using geotextile containers filled with sand, for a length of about 2 kilometers (km). The proposed scheme provides protection to the communities and infrastructure adjacent to the shoreline. The estimated cost of the proposed scheme at Someshwara is $4.69 million.
(ii) Yermal Thenka: The project site is located in Udupi District. The proposed coastal protection scheme at Yermal Thenka is to rehabilitate the existing rock revetment for a length of 3.8 km and constructing new rock revetment for a length of 700 m using large size armour rocks. The proposed scheme provides protection to the existing fisheries road running parallel to the shoreline for a length of 4 km and also to protect the land from erosion. The total estimated cost of the proposed scheme at Yermal Thenka is $11.62 million
(iii) Udyavara: The project site is located in Udupi District. The project site is a long narrow spit, surrounded by sea on the west and river on the east. A 9 km fisheries road which runs along the spit that connects Malpe fishing harbour to the nearby villages is under constant threat from erosion. The proposed coastal protection scheme at Udyavara includes protecting a shoreline length of 5 km by providing 35 numbers of shore normal rock groynes spaced at an interval of 120

m and nourishing the beach with a total volume 720,000 cubic meters (m^3**)** of sand. The total estimated cost of the proposed scheme at Udyavara is $14.57 million

(iv) Kodi Bengre[1]: The project site is located in Udupi District. The project site is a long narrow spit, surrounded by sea on the west and river on the east. The spit, which is densely populated, is under constant threat from erosion and wave flooding. The proposed coastal protection scheme at Kodi Bengre is to rehabilitate the existing rock revetment that has been accepted by the community as effective protection and to construct new rock revetment over a length of 4.5 km. The total estimated cost of the proposed scheme at Kodi Bengre is $11.07 million.

(v) Maravanthe: The project site is located in Udupi District. Maravanthe project site is surrounded by Arabian Sea on the west and Souparnika River on the east forming a narrow isthmus on which the National Highway 66 (NH-66) running that, connects Mumbai in the north to Kochi in Kerala towards the south. The proposed scheme involves protecting a shoreline length of 3.5 km by 15 numbers of shore normal groynes on south and northern ends of project site and 9 numbers of T-groynes at middle section where NH-66 runs close to the sea and river. Sand redistribution is proposed to enhance the beach width at critical sections. The total estimated cost of the proposed scheme at Maravanthe is $13.47 million.

(vi) Murudeshwara: The project site is located in Uttara Kannada District. Murudeshwara is one of the prime tourist destinations within Karnataka State. The shore protection scheme here is a combination of offshore reef, sand nourishment of 900,00m^3 and dune stabilization by vetiver grass for northern stretch of 1.5 km. The main rational of this scheme is to protect the beach located on the leeside of the reef by reducing the wave energy, increasing the beach width by sand nourishment. The total estimated cost of the proposed scheme at Murudeshwara is $3.93 million.

2. Community Protection Subprojects - Stage 1

39. Two community protection subprojects, Kodi Kanyana and Pavinkurve, have been planned designed under project 1 and will be implemented in 2016/2017.

(i) Kodi Kanyana: The project site is located in Udupi District. Three-layered vegetation planting scheme along a 1.5 km stretch is proposed in order to reduce wave up rush into the cultivable lands located behind the proposed site and also to hold the beach. This scheme is proposed to protect a length of 1.5 km stretch. Implementation and maintenance of this scheme is proposed to be carried out by involving local community. The total estimated cost of the proposed scheme at Kodi Kanyana is $ 0.14 Million.

(ii) Pavinakurve: The project site is located in Uttara Kannada district. The project area is divided into three sectors, where plantation scheme is proposed with a combination of different species of plants. This scheme is proposed to protect a length of 1.5 km stretch. Implementation and maintenance of this scheme is

[1] Long term risks or induced impacts from the project such as possible increased development in the spit area once the protection measures are completed will be addressed as part of the capacity building components of Output 2.

proposed to be carried out by involving local community. The total estimated cost of the proposed scheme at Pavinakurve is $ 0.14 million.

3. Community Protection Subprojects - Stage 2

40. A further community subproject will be planned and designed by the project 2 consultants with implementation proposed for 2017/2018.

41. The stage 2 community protection subprojects will involve dune construction with the nourishment of about 800,000 m^3 sand and planting for an area of 180 hectares (ha). This will cover approximately 30 km of shoreline. Minor infrastructure facilities in the form of access and water drainage will be provided wherever appropriate. The potential sites will be identified and the designs will be finalized by the project 2 consultants. The community protection subprojects - stage 2 will incorporate the design guidelines to be prepared by the Climate Resilient Coastal Protection Project (CRCPMP). The total estimated cost of the proposed scheme under community protection sub project - stage 2 is $10.31 million.

Table 2: Summa2ry of Proposed Interventions at Tranche 2 Subproject Sites

Sl.No	Sub Project	Protection Length (Km)	Revetment (km)	Groynes (nr)	T Groynes(nr)	Off shore reef (nr)	Planting (ha)	Sand (m^3)	Total rock (m^3)
Coastal Protection Subprojects									
1	Someshwara	2	2	-	-	-	-	30,000	
2	Yermal Thenka	4.5	4.5	-	-	-	-	-	230,329
3	Udyavara	5	-	35	-	-	-	720,000	121,800
4	Kodi Bengre	4.5	4.5	-	-	-	-	-	207,251
5	Maravanthe	3.5	-	15	9	-	-	225,000	178,926
6	Murudeshwara	1.5	-	-	-	1	0.45	90,000	10,020
Community Protection Subprojects - Stage 1									
1	Kodi Kanyana	1.5	-	-	-	-	0.3	-	-
2	Pavinakurve	1.5	-	-	-	-	0.7	-	-
Community Protection Subprojects - Stage 2									
1	Location to be decided	30	-	-	-	-	180	800,000	-

D. Detailed Description of Coastal Protection

42. Following section describes the coastal management interventions proposed at each of the project 2 sites.

1. Someshwara Subproject

43. The proposed coastal protection scheme at Someshwara site is geotextile revetment for a length of about 2 km, layout of proposed geotextile revetment is given in Figure 4.

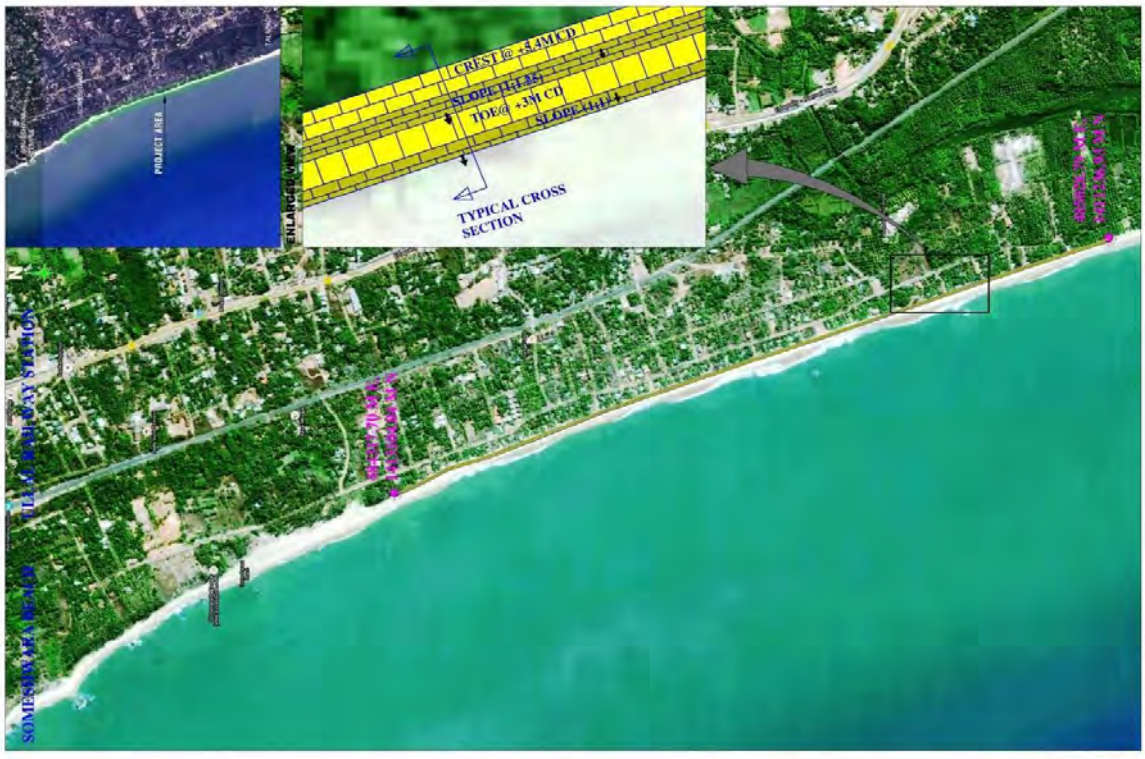
44. The primary features of the revetment geometry are as follows:

(i) The crest height is fixed at +5.4 mCD;
(ii) The crest width is fixed at a minimum of 3.0 m;
(iii) Seaward, the revetment has a fore slope of 1:1.25;
(iv) Seaward face of the revetment comes down to a level of +3.0mCD which is below the pre-monsoon level; and
(v) A wide toe of 3m width is provided which goes down to a level of 1.0 mCD. Although, no direct measurement of beach profile is available during the monsoon, observations indicate that the backshore beach level drops by 1.5 m going down to 0.0 mCD near the end of the toe.

45. It should be noted the toe design has the following key considerations:

(i) The wide toe provides additional safety by adaptation to the sea bed, if the monsoon beach erosion and local scour cause unforeseen sand piping from underneath;
(ii) The wide toe also helps reducing overtopping rate and volume for the same crest height and for sloping rate and volume for the same crest height and fore slope.

Figure 4: Layout of Proposed Geotextile Revetment at Someshwara



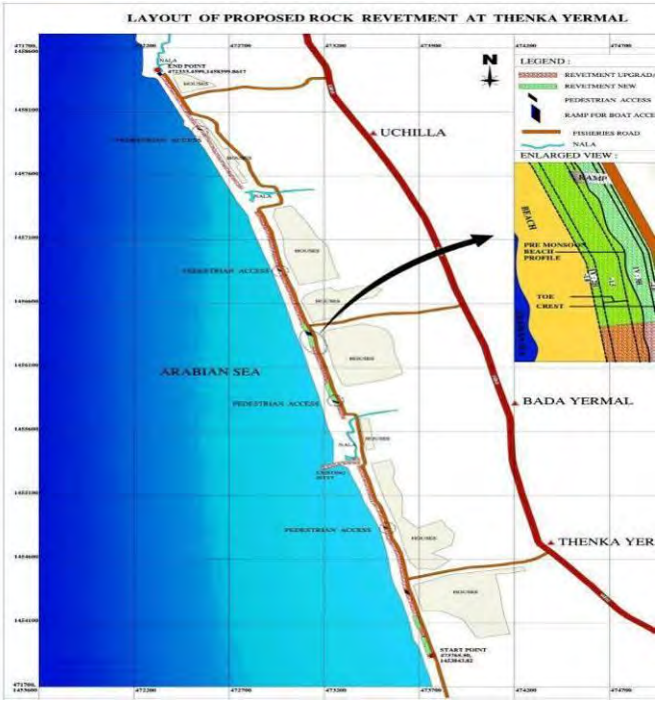
2. Yermal Thenka Subproject

46. The proposed option for the site is a rock revetment with the following key features:

(i) A wide toe of 4 m width to extend below the minimum expected beach level;
(ii) A geotextile filter layer over the underlying sand to prevent escape of the sediment through the armour layer and consequent settlement, lowering of the crest and collapse of the structure;
(iii) Crest height at 4.0 mCD with a fore slope of 1:3; and
(iv) The revetment will cover approximately 4,500 m along the shoreline with multiple gaps for the monsoon-flood rivers, ramps for fishing boats and access paths to the beach by pedestrians.

47. The details of the design conditions and calculations specifying the design cross-section, armour sizes and crest height are described in the Final Project Report prepared for the Yermal Thenka subproject site. Figure 5 shows the layout of the proposed rock revetment at Yermal Thenka. The revetment cross-section is designed to be made of rocks on the natural base material of the beach sand. The foundation level has been selected so as to be below the minimum expected annual beach level during the monsoon.

Figure 5: Layout of Proposed Rock Revetment at Yermal Thenka



3. Udyavara Subproject

48. The proposed option for the site is construction of 35 rock groynes and sand nourishment of 720,000m^3. The key features of the proposed interventions are as follows:

(i) 35 rock groynes shall be straight and normal to the shoreline and located at an approximately uniform spacing of 120 m between consecutive groynes;

(ii) Each groyne will tie up with the existing revetment at the back of the beach berm to prevent sediment drift behind and shall be approximately 67 m in length and extend to the low tide line.

(iii) If no revetment exists at the location, the baseline of the groyne will start from the existing vegetation line or the fore-dune.

49. The layout of the groyne field is shown in Figure 6. The groyne field covers a critical stretch of 5 km along the spit. Each groyne has a length of 50 m at the crest level, except for the two groynes in the transition zone at the north end. In the transition zone, the crest length of the groyne is reduced successively to 37 m and 23 m.

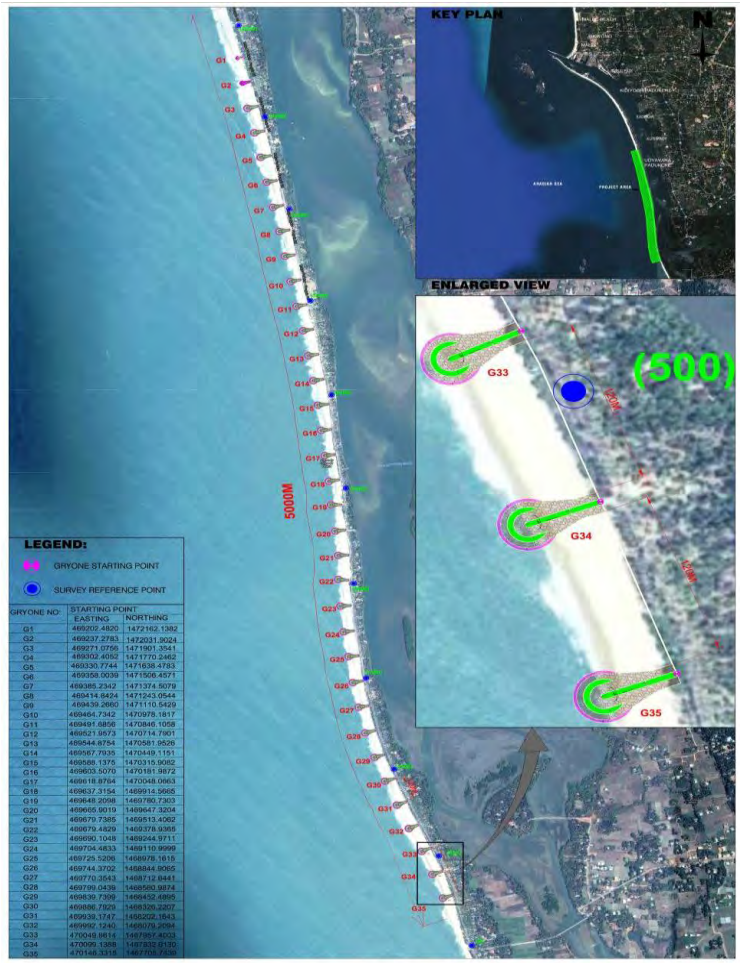
50. The existing beach width is not sufficient against overtopping during extreme monsoon events. Therefore, it is recommended to carry out a beach refill, where required, to achieve the minimum beach width.

51. The required sand volume is calculated on the assumption that the fill material has similar median diameter as that of the native sand. The volume of sand will have to be changed if the median diameter of the fill material is different from the native sand.

52. Fill material will be sourced from places with supply of dredged sand. Other likely sources are by proper management of the regular dredging taking place near the inlets and ports. Both physical and chemical characteristics of the fill material should be tested for deciding on the suitability of usage.

53. Spacing between the groynes was calculated using the Hsu and Evans parabolic model. The selected combination of 65 m groyne length and 137 m center to center spacing was therefore selected to provide the required minimum beach width at minimum cost.

Figure 6: Groyne Layout Plan at Udyavara



4. Kodi Bengre Subproject

54. The proposed option for Kodi Bengre site is rock revetment, the layout of proposed rock revetment is given in Figure 7.

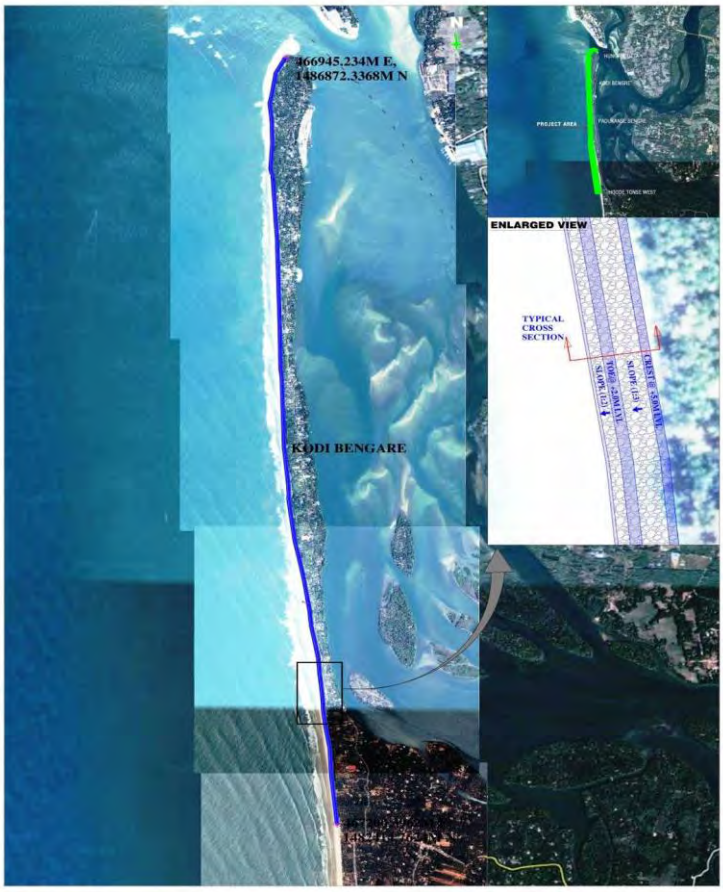
55. The primary features of the revetment geometry are as follows:

(i) The crest height is fixed at +5.0 mCD;
(ii) Tthe crest width is fixed at a minimum of 3.0m;
(iii) Seaward, the revetment has a fore slope of 1:
(iv) Seaward face of the revetment comes down to a level of 2.0 mCD which is slightly above the pre-monsoon level;
(v) A wide toe of 4m width is provided which goes down to a level of 0.0 mCD. Although, no direct measurement of beach profile is available during the monsoon, observations indicate that the backshore beach level drops by 1.5m going down to 0.0 mCD near the end of the toe;
(vi) Together with the core, the base goes down to -0.5 mCD to provide adequate protection against local scour at the end of the toe.

56. It should be noted the toe design has the following key considerations:

(i) The design bed profile, i.e.; the eroded bed profile during monsoon, intersects the toe nearly at +0.0 to -0.5 mCD;
(ii) The wide toe provides additional safety by adaptation to the sea bed, if the monsoon beach erosion and local scour cause unforeseen sand piping from underneath; and
(iii) The wide toe also helps reducing overtopping rate and volume for the same crest height and fore slope.

Figure 7: Layout of Proposed Rock Revetment at Kodi Bengre



5. Maravanthe Subproject

57. The proposed scheme at Maravanthe consists of:

(i) 7 straight groynes in the northern section with 120m spacing center to center;
(ii) 9 T-Head groynes in the middle section 150 m spacing center to center;
(iii) 8 straight groynes in the southern section 150 m spacing center to center; and
(iv) Redistribution of 225,000m^3 volume of sand from the north section to the middle section.

58. These groynes shall be normal to the shoreline and within each section located at an approximately uniform spacing between consecutive groynes.

59. Each groyne will tie up with the existing revetment at the back of the beach berm to prevent sediment drift behind and shall be approximately 65 m in length and extend to the low tide line.

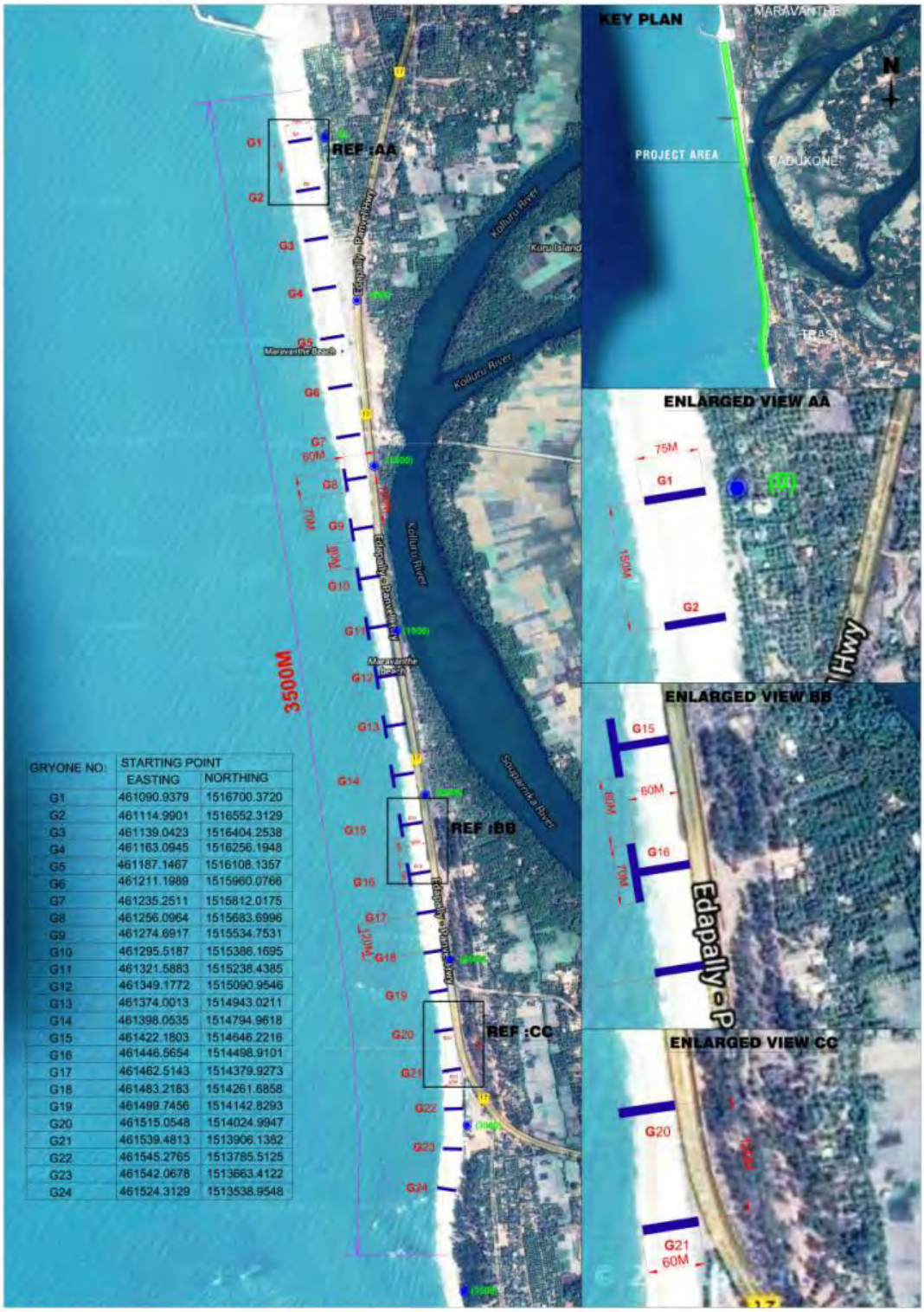
60. If no revetment exists at the location, the baseline of the groyne will start from the existing vegetation line or the fore-dune.

61. All the straight groynes in the scheme shall be constructed of rock.

62. The T-Head Groynes shall be constructed of rock, with Tetrapods used as the primary armour on the seawards slope and round heads of the T-section.

63. The scheme includes sand redistribution to advance the shoreline in the critical middle section, fronting the national highway.

Figure 8: Layout Plan of Maravanthe Subproject



GRYONE NO.	STARTING POINT	
	EASTING	NORTHING
G1	461090.9379	1516700.3720
G2	461114.9901	1516552.3129
G3	461139.0423	1516404.2538
G4	461163.0945	1516256.1948
G5	461187.1467	1516108.1357
G6	461211.1989	1515960.0766
G7	461235.2511	1515812.0175
G8	461256.0964	1515683.6996
G9	461274.6917	1515534.7531
G10	461295.5187	1515386.1695
G11	461321.5883	1515238.4385
G12	461349.1772	1515090.9546
G13	461374.0013	1514943.0211
G14	461398.0535	1514794.9618
G15	461422.1803	1514646.2216
G16	461446.5654	1514498.9101
G17	461462.5143	1514379.9273
G18	461483.2183	1514261.6858
G19	461499.7456	1514142.8293
G20	461515.0548	1514024.9947
G21	461539.4813	1513906.1382
G22	461545.2765	1513785.5125
G23	461542.0678	1513663.4122
G24	461524.3129	1513538.9548

6. Murudeshwara Subproject

64. Key features of the project area Murudeshwar are:

(i) There is an existing revetment on the southern side. The revetment is in fairly good condition and there is no immediate need of shore protection for this stretch.

(ii) The beach immediately north of the causeway gets almost completely submerged during the monsoon under action of high tide and wave run-up. Beach sand is fine. This beach is visited by many tourists during the non-monsoon time and becomes very active for recreational activities. This part of the beach is about 500m long and has undergone a mild curvature in the form of a bay.

(iii) Still further north, the shoreline is more or less straight. The beach is wide, but a vertical cut (beach scarp) of 30 to 50 centimeter (cm) is present all along the vegetation line (field visit on 6th August 2015).

65. Therefore, the shore protection scheme considered involves the following components:

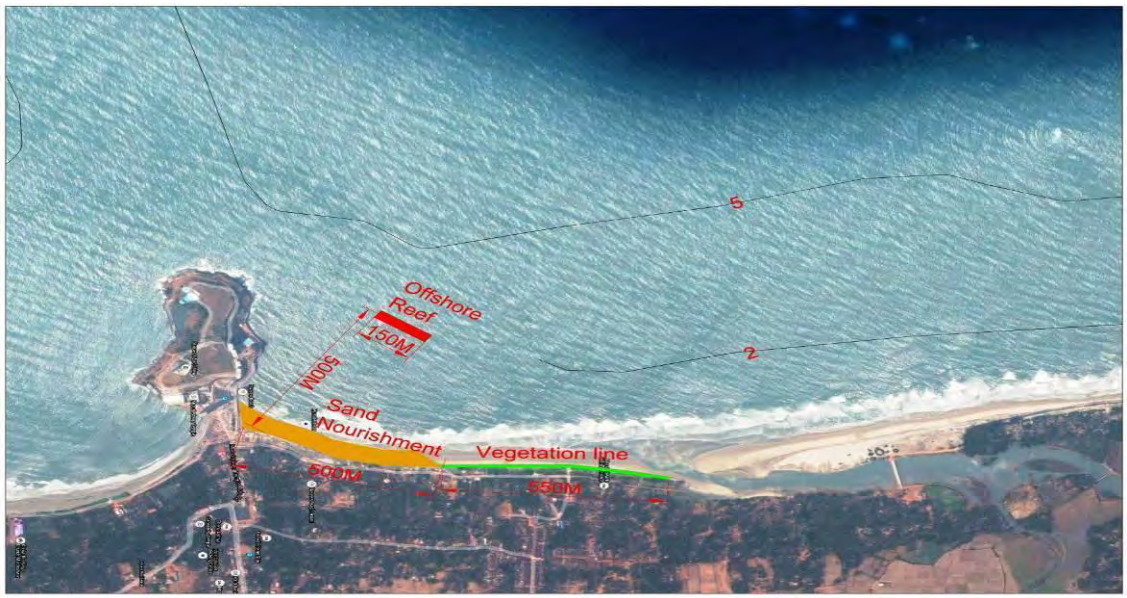
(i) Offshore structure between -3 mCD and -4 mCD providing shelter to the beach from direct wave attack in the lee side and creating conditions for the salient formation thereby, increasing the beach width along a significant part of the shoreline in the tourist-active part.

(ii) Beach nourishment with relatively coarser sand to create a more amenable beach for the tourists, while providing protection against wave overtopping to the road and wave attack to the peripheral wall.

(iii) Dune stabilization by suitable planting along the entire length of approximately 0.5 km north of the tourist beach.

66. These options address two primary functional aspects: (i) protection of the shoreline, and (ii) limiting overtopping to acceptable limit. As an important addition, they are designed to improve the tourism potential of the community. The layout of proposed coastal management strategy at Murudeshwara is as shown in Figure 9

Figure 9 Layout of Proposed interventions at Murudeshwara



E. Detailed Description of Community Protection Subproject – Stage 1

1. Kodi Kanyana Subproject

67. The three key features of the proposed shoreline management scheme are:

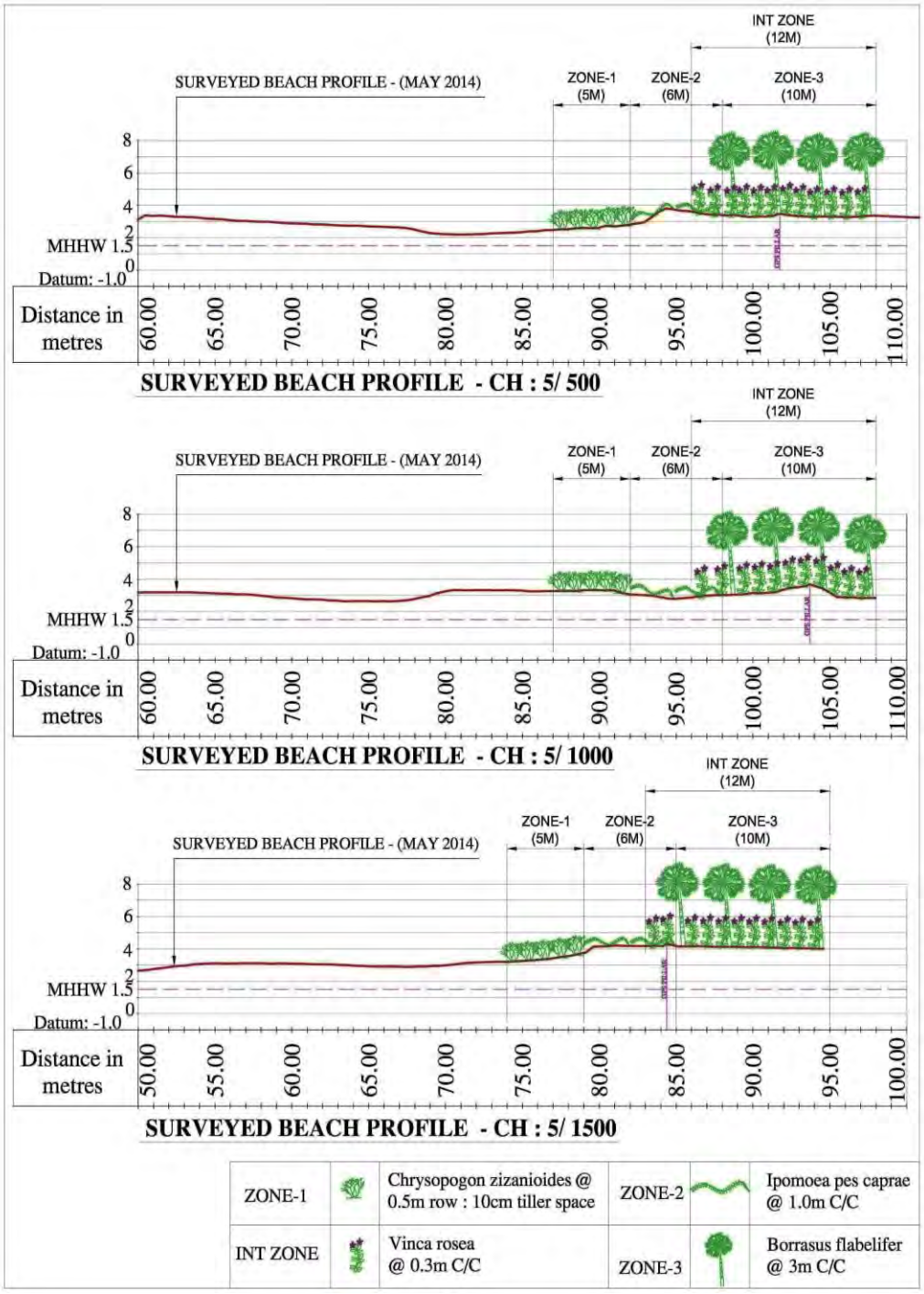
(i) Three-layered vegetation planting scheme along a 1,500-m stretch;
(ii) Implementation and maintenance of the scheme through community participation; and
(iii) Training and awareness campaign for the community.

68. It is proposed that the Shoreline Management Organisation (SMO) will be the nodal point for the implementation. The SMO also will be responsible for the operation and maintenance of the scheme The SMO will be provided with active support during the initial stage for technical know-how, management and spreading awareness across the wider community. Over a period of time, the support may be calibrated to meet need based requirements. It is also proposed to maintain a nursery close to the subproject area to meet replacement and replanting needs to achieve sustainability. It should be noted that this subproject will be one of the first such schemes to be undertaken in Karnataka and there is no prior experience of actual implementation, cost efficacy or effectiveness of a “soft shore protection project” of this nature. The majorr benefit, of this pilot plantation scheme, are the data, knowledge and experience that will flow to the local community and other stakeholders including the PMU / Public Works Department (PWD) engineers.

69. If successful, this pilot scheme will form the basis for many future shoreline management schemes in Karnataka and India that are cost-effective, community-based and eco- friendly.

Figure 10: Plan Showing Proposed Plantation Scheme at Kodi Kanyana Subproject Site

Figure 11: Proposed Plantation Scheme at Kodi Kanyana Sub-Project Site



2. Pavinakurve Subproject

70. Three key features of the proposed shore management scheme are

(i) An appropriate planting scheme for the subproject area;

(ii) Implementation and maintenance of the scheme through community participation; and
(iii) A training and awareness campaign for the community.

71. The adaptability of the plant species to the local environment is the main criteria to be employed to select species to be used in planting scheme. The types of plants to be used in the planting scheme were based on the following criteria: (i) Survival rates in the coastal environment and the functionality of retaining sand; (ii) conformity with native plants and; (iii) Commercial utilization of the plants. Because of the differences in the land usage and coverage from one segment to another, the planting area is divided into three sectors.

72. **Sector 1,** the northernmost section, is 500 m long. In this stretch, 20-m wide beach space at the upper end is utilized for planting. *Vetiver*, a grass variety, is proposed for this primary layer.

73. **Sector 2** is a 500 m stretch of sandy beach south of sector 1. A 30-m wide belt of primary (Vetiver), secondary (Ipomoea pes caprae) and tertiary (*Cocos nucifera*) zones makes up the planting scheme in this sector. Two inter layers of *Vinca rosea* and *Anacardium occidentale* (cashew nuts) are also included in this sector overlapping the second and third zones.

74. **Sector 3** is the southernmost zone of the spit flanked by the Arabian Sea on the western side and the Sharavathi-Badagani River on the eastern side. This is largely a barren strip with an elevated crest and has a much wider space of 80 m available for planting. The proposed planting in this sector consists of a four-zone planting of Vetiver (first zone of 10 m), *Ipomoea pes caprae* (second zone of 15 m), *Vinca rosea* (third zone of 10 m) and *Cocos nucifera* (final zone of 45 m). *Anacardium occidentale* (cashew) is proposed as an interlayer overlapping the third and final zones.

75. It is proposed that the SMO will be the nodal point for the implementation and subsequent operational management and maintenance of the scheme. The SMO must be provided technical know-how and active support during the initial stage of the scheme through experts and nongovernment organization (NGO). In addition, training on caring for the ecological protection and general awareness of the scheme should spread through the wider community. It is also proposed to maintain a nursery close to the subproject area to meet the needs of continuous transplanting and growth of the vegetation.

76. It should be noted that this subproject will be one of the first such schemes to be undertaken in Karnataka. The executing agency has no prior experience of actual implementation, cost or effectiveness of a “soft shore protection project” of this nature in Karnataka. Success of this pilot plantation scheme will demonstrate mechanisms of how the communities with some government support can be engaged in shoreline protection and management tasks including methods to create some local sources of financing that can be used to support the necessary long term management and maintenance activities. Besides the direct benefits the scheme will generate for the sub-project area, it will generate data, knowledge and experience that will flow to the local community and other stakeholders including the PMU/PWD engineers.

77. If successful this pilot scheme will form the basis for many future shoreline management schemes in Karnataka and India that are cost-effective, community based and eco- friendly.

Figure 12: Layout Plan Showing Proposed Plantation Scheme Pavinakurve

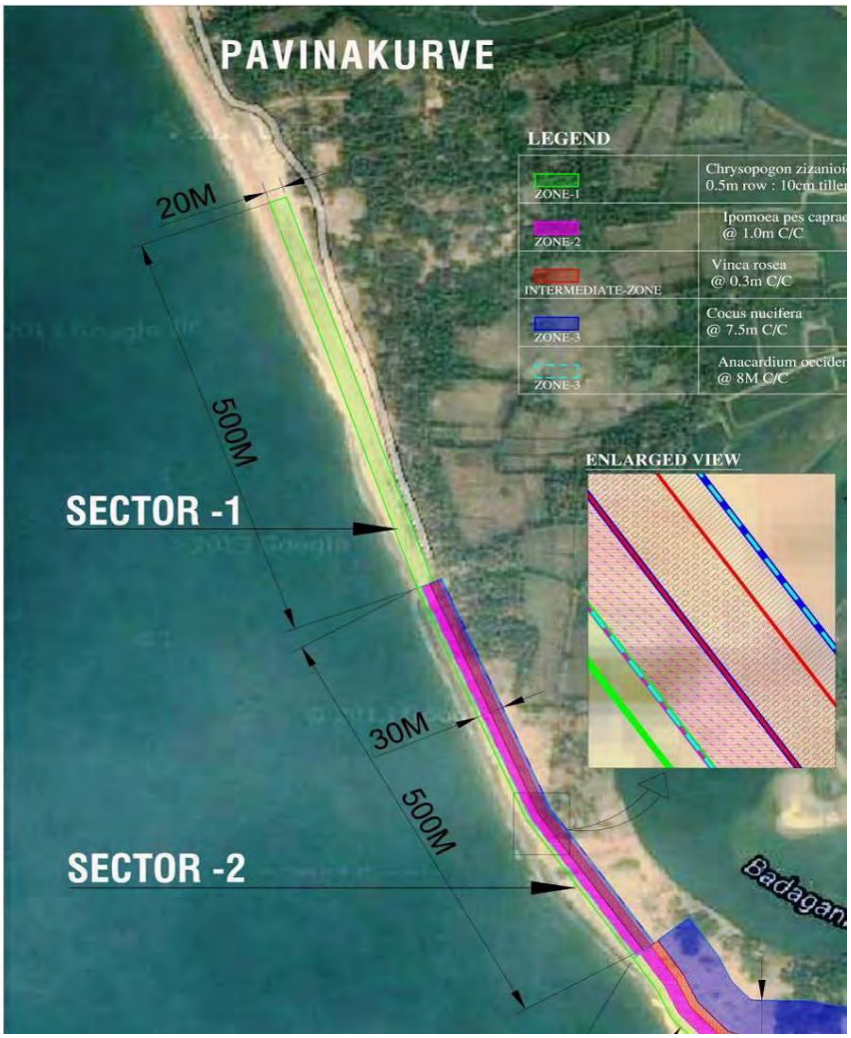


Figure 13: Sector -1 Plantation Scheme at Pavinakurve

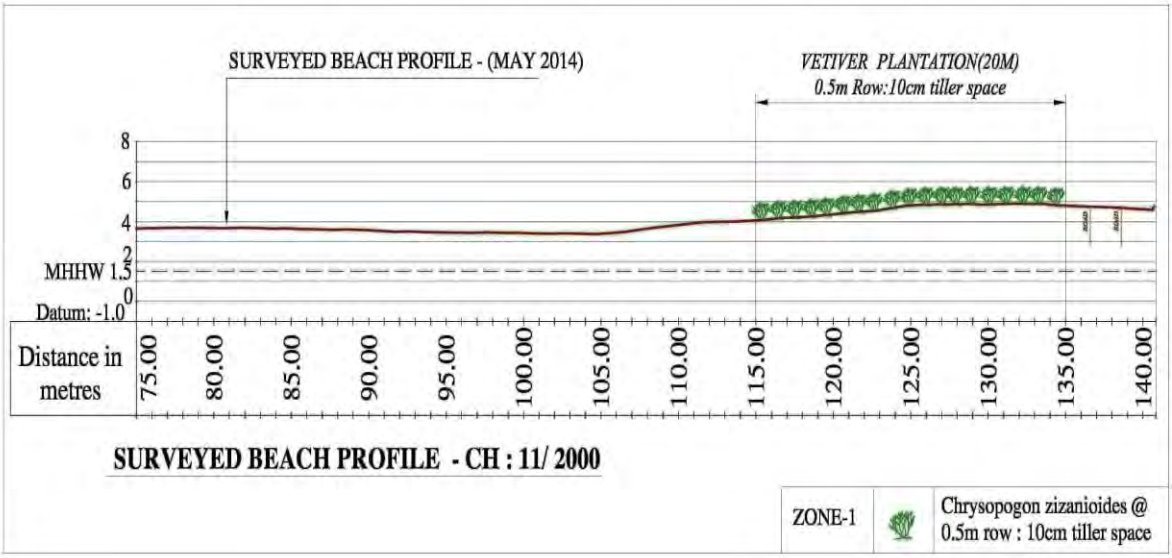


Figure 14: Sector -2 Plantation Scheme at Pavinakurve

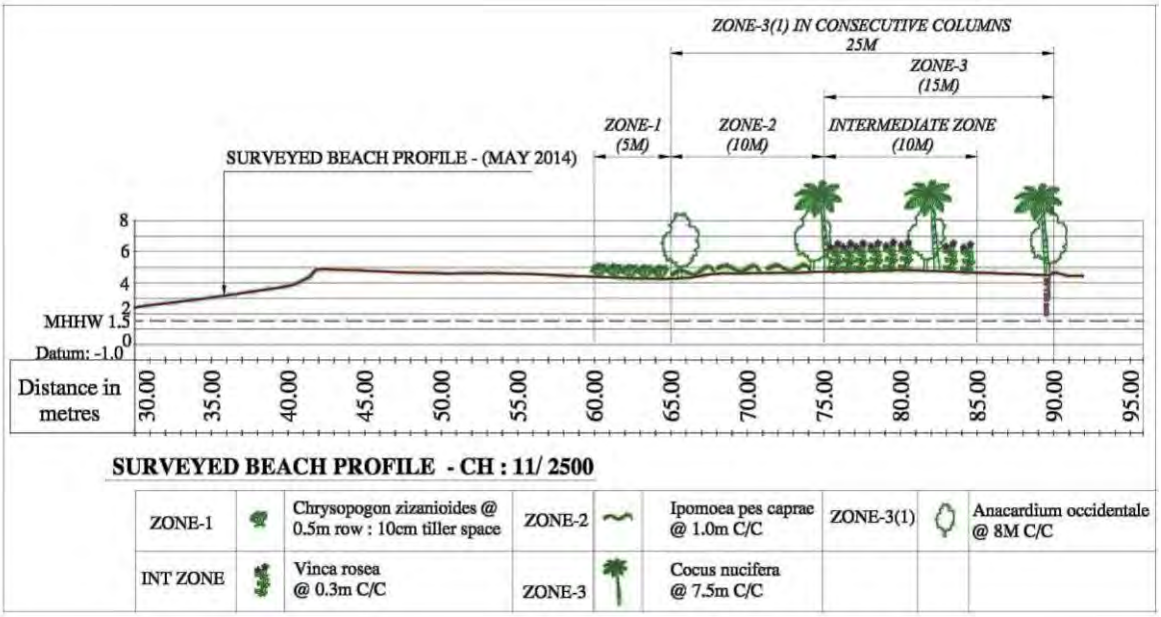
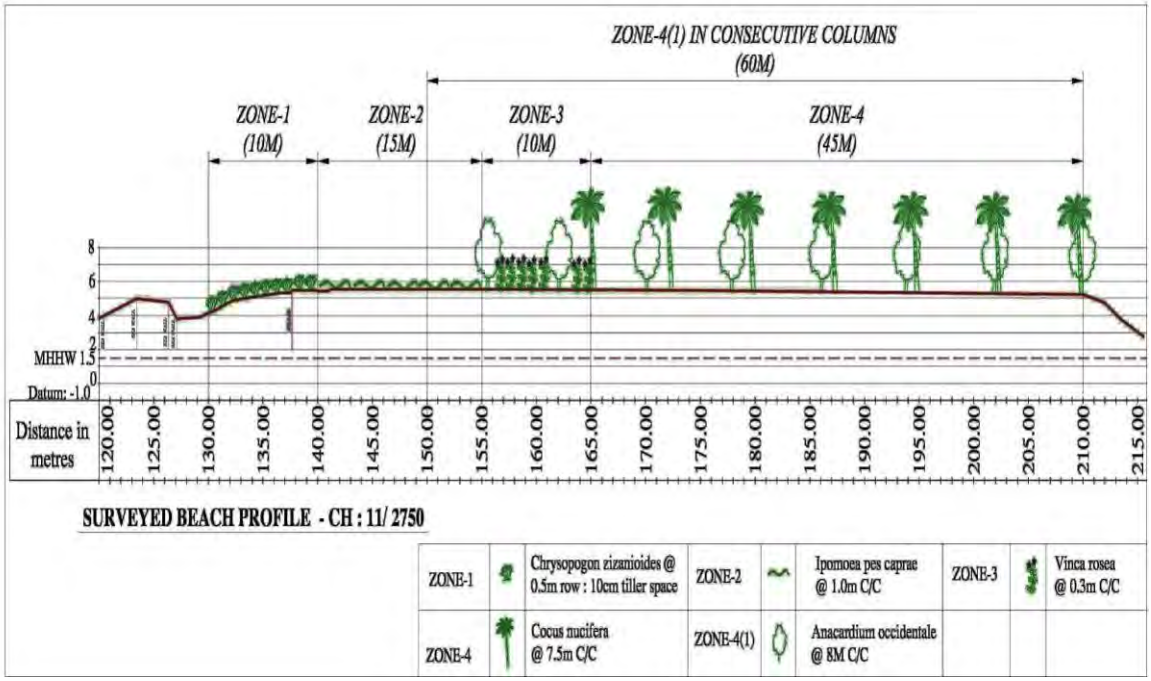


Figure 15: Sector-3 Plantation Scheme at Pavinakurve



F. Detailed Description of Community Protection Subproject – Stage 2

1. Introduction

78. The community protection subprojects - stage 2 will be implemented at one or two locations to be selected; a list of the possible locations have been prepared and is shown in

Table 3: Possible Locations of Stage 2 Community Protection Sub Projects

Site no.	Focal State & Site	Location	Coordinates (approx.)	Set up of the coast	Erosion status
	KARNATAKA				
Site 1	Talappady	Someshwara (DK)	12°45'37.27"N 74°51'51.16"E	inlet-dune-beach	low
Site 2	Nadikudru	Hijamadi (U)	13°5'19.63"N 74°46'19.94"E	beach	low
Site 3	Gujjadi	South of Maravanthe (U)	13°40'26.19"N 74°38'56.08"E	beach near inlet	low
Site 4	Kirimanjeswara	(U)	13°46'12.78"N 74°37'49.97"E	beach	low
Site 5	Uppunda	In Udupi (UK border)	13°49'16.12"N 74°37'10.96"E	beach-dune north of breakwater	low
Site 6	Majali-Devbagh	Karwar (UK)	14°52'17.59"N 74° 6'23.37"E	beach	low

2. Linkage with the ADB/GEF Sustainable Climate Resilient Coastal Protection and Management Project (CRCPMP)

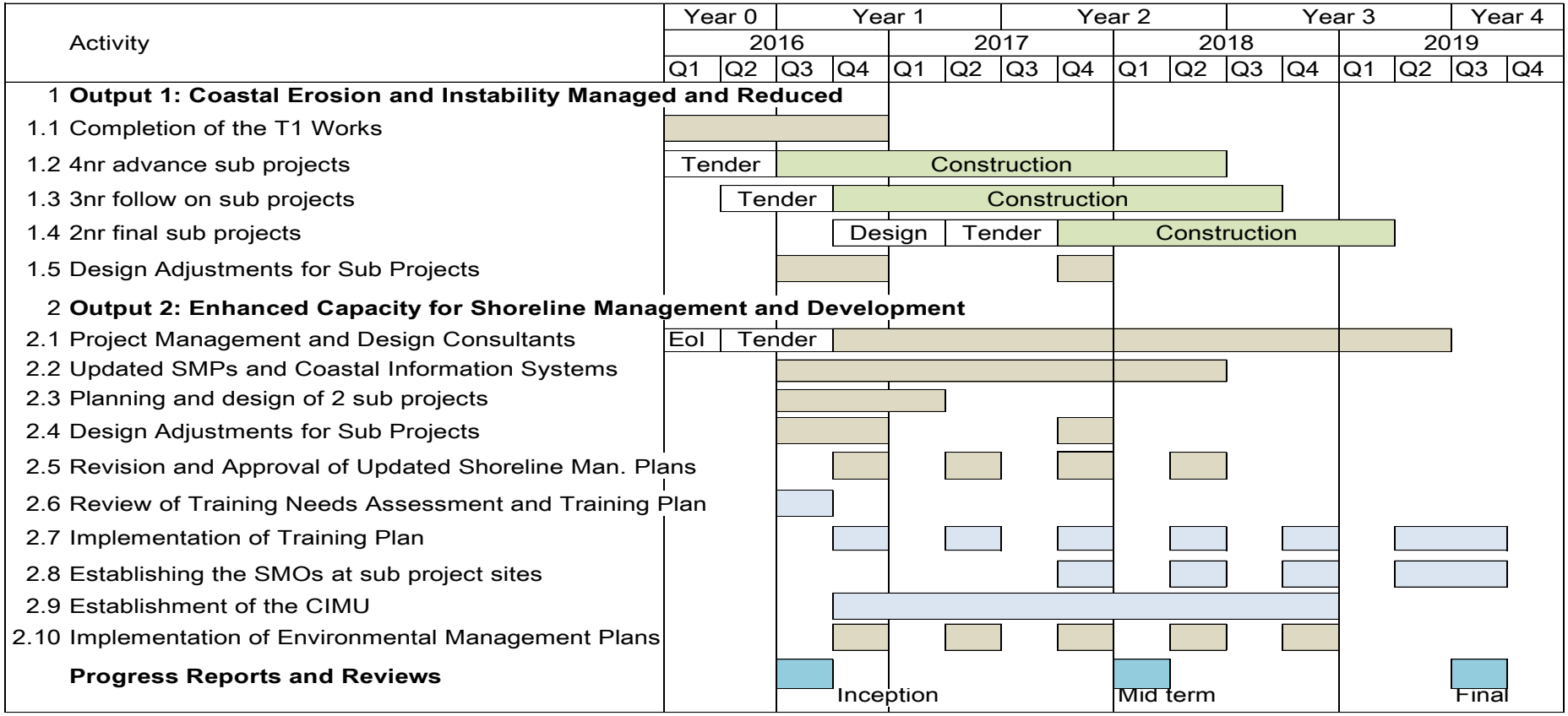
79. The community protection subprojects - stage 2 will be developed based on the key outputs of the CRCPMP as shown below.

Climate Resilient Coastal Protection Project (CRCPMP)		**Karnataka Project 2 Sustainable Coastal Protection and Management Project 2**	
Studies	**Pilot Community Protection Projects**	**Studies Planning and Design**	**Implementation**
1. Coastal Climate Change Impacts Report which brings together an in-depth knowledge of the latest research on the impacts of climate change on the India Coast . 2. Guidelines for Climate Change Adaptation for the Indian Coast which will provide technical guidance for climate resilient coastal protection adaptation decision-making and implementation. The guidelines will provide specific recommendations climate change adaptation for shoreline planning and design of sub projects for the two focal states of Maharashtra and Karnataka.	Implementation of up to four small pilot community protection projects in the two focal states of Maharashtra and Karnataka to test and demonstrate The initiatives are designed to address the requirements of climate resilience for beaches with currently low levels of instability. The outputs and lessons learnt from the pilot projects will form a part of the climate adaptation guidelines	Project 2 will undertake studies to assess the impacts of coastal. These will include : 1. Wave and sediment modelling of a selected stretch of the Karnataka coast to assess the impacts of climate change. 2. Beach nourishment studies to assess potential sources of sand to support beach nourishment and dune reconstruction. 3. Planning and design of the stage 2 Community Protection projects	Under project dune reconstruction and planting will be implemented up to 30 km beach. The activities would include. 1. Up to 650,000 m^3 of dune reconstruction using sand sourced from the lower beach and shallow water up to 10metrres in depth. 2. Up to 130 ha of dune planting to stabilize the dunes 3. Other activities to include zoning of the dune area, provision of small geotextile bags, improvement in the alignment of drains. 4. Community engagement, strengthening and training.

G. Project Implementation Schedule

80. Implementation of the project 2 subproject is shown in Figure 16.

Figure 16: Proposed Implementation Schedule



Notes: Compliled by the PMU and the Project Management Consultants.
1/ Advance subprojects are Udyavara, Maravanthe and Kodikanyana/ Pavinkurve (4 sub projects, 3 contracts)
2/ Follow on sub projects are Kodi Bengre, Murudeshwara and Someshwara (3 sub projects)
3/ Final sub projects; (i) Yermal Thenka (based on revised design) and (ii) Community Protection Subproject nr 3. (2 sub projects)
4/ Shoreline Management Plans (SMP) will incorporate the impacts of climate change
5/ Subprojects to be designed are (i) Yermal Thenka (design revision) and (ii) community sub project number 3, includes sand resource surveys and coastal modelling
6/ Design adjustments incorporates preparation of detailed design drawings based on the actual beach profile at the time of construction.

III. DESCRIPTION OF THE ENVIRONMENT

A. Introduction

81. This IEE gives an assessment of the various environmental impacts due to the subprojects likely to be caused on the surrounding environment during the construction and operational phase. It will also help in delineation of the environmental management plan (EMP) to minimize the impacts.

82. The environmental study has to first delineate and define the existing environmental factors in and around the project on the existing environmental scenario which will include various environs like physio-chemical and biological and social environment. The baseline environmental sampling has been carried out at all the subproject locations where the civil construction activities have been proposed. The baseline data has been established for air, water- both marine and ground water, and noise. The test results and discussions of these data are given in Appendix 1.

83. The project 2 includes nine subprojects of which six subprojects are civil construction projects proposed at Someshwara, Yermal Thenka, Udyavara, Maravanthe, Kodi Bengre and Murudeshwara, while the other three subprojects at Kodi Kanyana, Pavinakurve and Community Protection Subproject - Stage 2, are soft solutions by plantation for coastal management. The primary environmental data has been established only for the six subproject sites having hard engineering structures, while the socioeconomic and secondary data has been collected for the eight subprojects except for the Community Protection Subproject - Stage 2.

B. Physical Resources

84. Information in this section has been extracted from annexes to the project 2 detailed project report (July 2015) specifically, information on physical and ecological resources and economic development is from the EIAs prepared for obtaining CRZ clearance from the Government of Karnataka for the project 2 subprojects and information on the social and cultural environment is from the social impact assessment (SIA).

1. Geo-morphology of Karnataka Coast

a. Coastal Geology

85. The west coast is characterized by flat sea bed slopes (1:100 to 1:500) and a wide continental shelf of approximately about 250 km (ranging from 60 to 340 km). The coastal area of Karnataka is composed of various litho units. Mangalore area is mainly covered by tertiary and quaternary sediments. Further north, Gneissic complexes extend to coastal areas along with Schist belts of Dharwar group (both Chitradurga and Bababuddan group). At places, outcrops of granites extend to beach as is found along Someshwara.

b. Sediment Characteristics and Transport

86. Beach surface sediment samples were collected for all the subproject sites during monsoon season. The surface samples for each subproject were collected from three locations along the beach width from back of the beach, beach berm and at swash zone. The surface samples were collected at three locations for each subproject with minimum one set of sample

at 1,000 m interval along each subproject location. The collected sand samples in its natural state was sent to laboratory for obtaining the sediment characteristics like grain size distribution, bulk density (loose and dense state), specific gravity and shear parameters cohesion and angle of internal friction.

87. The grain size distribution of sediment is mostly between medium to fine sand over the subproject sites and with the average specific gravity of sand being 2.64 kilokg/m^3.

88. The sediment transport along the coast have been studied earlier and reported; relevant data from locations in south Karnataka and north Kerala are depicted in Table 4.

Table 4: Gross Sediment Transport Rate per Year, South Karnataka

Location	Net Transport (m3/yr)	Direction	Gross Transport (m3/yr)
Maravanthe	25,372	North	29,836
Malpe	14,169	South	106,641
Padubidri	89,358	South	385,469
Ullal	36,165	South	38,273
Kasargod	736,772	South	958,478

Source: PPTA,2009

c. Beach and Coastal Profile

89. A high level of geo-morphological diversity exists along the nearly 300 km coastline of Karnataka. It is one of the most indented shorelines with numerous river mouths, bays, creeks, headlands, promontories, rocky shores, sandy spits, barrier beaches, open beaches, embayment, estuaries, and offshore islands. In general the Karnataka coastline has about 75% sandy beach, 11% rocky coast, and 14% mud flats.

90. The shelf off Karnataka has an average width of 80 km and the depth of the shelf break is between 90 and 120 meters. Fourteen rivers empty into the Arabian Sea along Karnataka coast. The important estuaries are Netravati-Gurupur, Gangoli, Hangarakatta, Sharavati, Aganashini, Gangavali and Kalinadi.

91. Sandbars have developed in most of the estuaries. There are a number of barrier spits formed due to migration of coastal rivers. There are also 90 beaches of varying aesthetic potential, including the beaches at Someshwara-Ullal, Malpe, St. Mary's Island, Belekeri and Karwar. Of these, 22 are classified as unfit for use due to coastal erosion and other anthropogenic activities.

92. Erosion along the beaches near river mouths has been commonly noticed along Karnataka coast. Coastal erosion and submergence of land have been reported at Ankola, Bhatkal, Malpe, Mulur, Mangalore, Honnavar, Maravanthe and Gokarn in Karnataka. About 60 km of beach (19% of the total length of shoreline) is affected by erosion. The problem is relatively more severe in Dakshina Kannada and Udupi coasts, where about 28% of the total stretch is critical. In Uttara Kannada region, about 8% of the coast is subjected to erosion.

93. Beach topography surveys was carried out for all the subprojects during pre-monsoon (May-June, 2014) and post monsoon (December 2014–January 2015) seasons to know the variations in beach levels and widths. After establishing permanent marker points in each of the subprojects and establishing of X, Y, Z coordinates, the base line for profiling in each of the subproject was established. The base line was fixed on the landward side, i.e. near to the permanent structures like house, bitumen road, etc.

94. After establishing the base line parallel to the general trend of the shoreline and the permanent monument at every 500 m, the perpendicular direction to the base line at each pillar was established. The beach profiling was carried out in the perpendicular direction towards the shoreline. The UTM projected coordinates as easting and northing and elevation values with respect to that of the pillar were recorded at every 0.5 m distance on the ground along the profile line using the Total station.

95. The profiling was carried out to a distance of 10m beyond the permanent structure on the landward side. On the seaward side, the profiling was carried out up to the maximum possible extent in the inshore area where survey personnel could safely position with the pole prism. The data recorded on the seaward side in each sector was well beyond the MLLW and up to or below the Chart Datum (CD). All the vertical levels recorded were finally presented with respect to the Chart Datum Oceanographic Processes.

d. Regional Wave Modeling

96. A regional wave model was set up for the entire coast of Karnataka, extending over 300 km from north to south. The model has been built using the Simulating Waves Nearshore (SWAN) spectral wave model.

97. In order to derive wave climates along the entire coastline of Karnataka, the available offshore wind and wave climate data (taken from the Climate Forecast System Reanalysis/ CFSR for 1979-2009 data set) were discretized into a set of conditions covering the full range of possible combinations of wind and wave conditions (several thousand). The SWAN model was then run for each combination to derive look-up tables at each near-shore point of interest. Over 4000 model runs were undertaken. In order to complete all these runs in the very-short timescale, HR Wallingford made use of their cluster of powerful computer servers.

98. The model was validated for the inshore wave climate data available, off-shore of Mangalore and is considered to be suitable for use in computing the expected wave climates and extreme wave conditions at inshore locations along the coast of Karnataka.

99. Offshore wave data were analyzed to evaluate off-shore extreme wave conditions using a Weibull extreme-wave analysis. The return periods considered were 1, 5, 10, 20, 50 and 100 years. The Karnataka regional wave model was then run for these offshore extreme wave cases to derive near-shore extreme wave data.

100. The locations considered for near-shore wave extremes lie along -10 m and -5 m contours over the full 300 km of the Karnataka coast. These points are at about 200m spacing. The predicted wave extremes obtained are also presented in contour plots that show the distribution of extreme waves along the coast.

101. The wave extremes for the project 2 locations were extracted from the model and were used in the design calculations. It is intended that these predicted inshore wave data shall be included in the Coastal Information Management System.

e. Waves

102. Waves play the most important role in eroding the coastal land. Coastal erosion along the west coast of India is caused during south-west monsoon when the sea is very rough resulting in high waves. Wave statistics show persistent west-southwest (WSW) wave approach with a predominant wave period of 10 second during south-west monsoon season. Refraction function values are higher for such wave characteristics, indicating higher wave energy along the entire coast.

103. India's west coast receives two storms per year on average. Unlike the east coast which experiences two distinct monsoons, the west coast experiences only the southwest monsoon (May to September). The wave height is insignificant during summer months due to the calmer meteorological conditions. The wave direction and energy during the monsoon season propagate at shore-normal / perpendicular to the coast.

104. The wave characteristics at 13 m depth off Mangalore reported significant wave height (Hs) for 100 year return period as 4.1 m. While high wave activity prevails during the southwest monsoon (June-September) relatively calm sea conditions prevail during the rest of the year.

105. The swell direction on the west coast of India is mainly from the north-west and is considered less severe than that witnessed on the south coast. Depending on the season, the angle of wave direction, and therefore of wave approach is variable.

f. Tides

106. The west coast of India has a tidal range varying from less than 1 m in the southern extent to more than 6 m in the north. The tide exhibits diurnal and semi-diurnal bands. The tidal amplitude along the Indian coast ranges from 8.5 m at Bhavanagar, Gulf of Khambhat to 0.5 m along the peninsular tip of India.

107. Udupi coast experiences mixed semidiurnal micro tides with a mean tidal range of 1.2 m and spring tidal range of 1.8 m (SOI 2007). Unlike the northwest coast of India, the southwest coast does not show much variation in water levels during spring and neap periods. The mean sea level off Mangalore is about 1.0 m; the mean low water spring is between 0.5 and 1.0 m; high water level in spring tide is in the range from 1.5 m to 2.0 m. During neap period, the low and high water levels range from 0.5 m to 1.0 m and from 1.0 to 1.5 m, respectively (Sanil Kumar et al. 2006).

108. The tides in this region are mixed semi-diurnal dominant, the range of which increases towards the north (Kumar et al 2011a). The monthly-mean sea level along the west coast of India exhibits a seasonal oscillation that is related to reversal of geostrophic currents along the coast (Shankar 2000). The monthly mean sea level at Karwar varies from 1.06 m in September to 1.3 m in January. The average tidal range at Karwar is 1.58 m during springs and 0.72 m during neaps.

109. Normal tides are thought not to have as large an impact on the coastline as the local current and wave climate influenced by the Monsoon. High tides during storm or large wave events may have a more significant effect on the shoreline.

g. Currents

110. South-west monsoon conditions cause the waters off the west coast of India to experience a wind stress which is strongly time dependent. Data on monthly mean wind shows that the longshore component of the wind stress, which is equator-ward throughout the year, is weak in March. It begins to increase in April, reaches a peak value of around 0.5 dyne/square centimeter (cm^2) in July and again declines to about 0.1 dyne/cm^2 by November.

111. Climatic ship drift data indicate that from April to October the longshore surface current is equator-ward along the west coast. There is also evidence of upwelling along the west coast, especially along the southern part. From November to January, during the inversion period, the equator-ward longshore wind stress is very weak (0.1 meter per second [m/s]). The northward coastal intrusion of the Bay of Bengal water occurs during this time.

112. Strong tidal currents exist in the northern west coast of India. The measured current speed is found to vary from 1.4 m/s in the open ocean to 3.2 m/s in the Gulf of Khambhat. There is a significant difference in the dominating current direction during the two seasons. The majority of local currents are bound by varying physical and geological conditions such as bathymetry. Local meteorological conditions will also drive variable current cells. The current speeds observed and reported off Mangalore coast during May at 9 m depth was 0.05 to 0.4 m/s and the direction was 180-360 degrees.

2. Meteorology

113. The climatic conditions of the state of Karnataka are given in Table 5.

Table 5: Karnataka state meteorological conditions

Month	Features
December – February	Cool, most pleasant weather
March – May	Warm summer, hot and humid
June – September	Heavy rains, 3,000-4,000 mm, high humidity
October – November	Relatively warm, very little rain

114. Most of the rain is received during the four months of June to September. Monthly rainfall pattern during the past 10 years indicate that the maximum rainfall occurs during July.

115. Besides the regular monsoon, the Arabian Sea and the West coast of India is also exposed to occasional cyclones.

116. Coastal Karnataka has common climatic pattern of the other west coast states of India. It is characterized by excessive humidity (78%) during the greater part of the year. There are four seasons: (i) four wet months of June to September, when the district encounters strong winds, high humidity, heavy showers and a slight fall in temperature; (ii) two warm and damp months of

October and November when south west monsoon is retreating; (iii) three cool months of December to February when generally dry conditions prevail; and (iv) three hot months of March to May when temperatures are increasing.

117. Generally, the average temperatures over the three districts of coastal karnataka vary from approximately 20°C to 35°C with highest summer temperature going beyond 40°C. The mean monthly temperature is usually the highest in May and the lowest in January - February. Moderate tropical weather prevails during rest of the year. While coastal areas are warmer, the interior places are cooler.

C. Ecological Resources

1. Marine Fisheries

118. Total estimated marine fish landing in Karnataka was estimated at 473630t. Total fishery during 2014 was valued at an estimated Rs 2734 crore.(Central Marine Fisheries Research Institute (CMFRI) Annual Report 2014-15)

119. An estimated 29233 t of crustaceans were landed forming 6.2% of total catch in Karnataka. Major share of the landings were contributed by trawls. Multiday trawls contributed major share of shrimps and crabs whereas stomatopods were landed only by single day trawls. Total shrimp landing of Karnataka during the year was 12484 t of which 10839 t was landed by trawlers. Compared to annual average of previous 3 years, crustacean landings of Karnataka in 2014 showed an increase of 10.3% and among crustaceans crabs showed an increase of 48.8%, stomatopods 11.8% and penaeid shrimps 2.6%(CMFRI Annual Report 2014-15)

120. Pelagic fisheries of Karnataka coast mainly comprise mackerel and oil sardine, traditionally harvested using the “Rampani” technique. The traditional rampani is around 800-1,000 m long, made by joining together pieces of netting. Both ends of the net are narrower and feature a larger mess size. Towards the centre, the height of the net increases, while its mesh size decreases. Generally, the net is divided into three parts: karal (around 16 pieces), modan (around 8 pieces) and ghol (around 8 pieces). The karal and modan are at the ends of the net, while the ghol is the central portion.

121. The rampani net is collectively owned by 30 to 40 fishermen, who become owners according to their contributions in the form of pieces of net or monetary input. This method is now less favored compared to purse seines and trawlers. Thirty to forty foot trawlers are used for the exploitation of inshore demersal fisheries and shrimping, extending the fishing operation offshore into new waters.

122. The subproject area contains ice plants, cold stores, freezing plants, canning plants and fishmeal plants for the processing of this important resource.

123. The major species landed are oil sardine, mollusks, perch, Indian mackerel, white sardines, sharks, cephlapods (squid, octopus and cuttlefish) and crustaceans (crabs and prawns).

Breeding Grounds in India

"The monsoon season is closed for fisheries in almost all maritime states as most fish species breed in this season"[1]

"Most of the maritime states have declared closed seasons at different times of the year for conservation of resources. Kerala and Tamil Nadu observe ban on fishing operations for 45 days from 15th June to 29th July every year. In West Bengal, March to June is observed as closed season which is extended up to August for trawl fishing. Andaman and Nicobar Islands have declared 15th April to 31st May every year as closed season for bottom trawlers and those vessels engaged in shark fishing and 1st May to 30th September for fishing sea shells. In Gujarat, no fishing can be carried out in the territorial waters from 10th June to 15th August. Maharashtra has banned fishing from 10th June to Nariyal Poornima day, which falls around 15th August. In Goa, mechanized fishing by means of trawl nets and purse seines nets is banned during the period 1st June to 24th July every year" (Shenoy and Biradar, 2005)[2].

124. It must be mentioned that ceteaceans (whales and dolphins) and Elasmobranchs (sharks and rays) were not mentioned in the assessment of exploitation. However, it was noted that *S. laticaudus* and *S. lewni* were regularly caught shark species with a majority of juvenile landings observed at fishing harbors of Karnataka eg Gangolli.

2.

3. Marine Ecosystem

125. Baseline information has not been collected to characterize plankton, benthic fish and invertebrate seasonal use of the proposed project areas for breeding or other purposes. However, It is suggested to establish the baseline data for benthos before the start of the construction activities as part of EMP in **Error! Reference source not found.** and accordingly the monitoring budget has been kept aside for benthos during pre-construction and is given in Table 18.

126. Effects of benthic smothering are expected to be short lived considering the short generation times of these organisms and the prevailing littoral transport of larvae of these organisms; re-colonization of the benthic fauna is expected within 1–2 months. Fish and invertebrate taxa using the sub project beaches are not known; characterization of the fish/invertebrate communities, especially mobile species, would enable types and timing of likely use which could be used to refine the timing of construction activity in order to minimize possible effects. Records indicate that the Phytoplankton maximum in the central west-coast including the Karnataka border occurs, normally, during February – April. In other periods, its occurrence is not so in recognizable prominence. The group, when studies were carried-out, represented by members of Myxophyceae, Chlorophyceae and Bacillariophyceae. So is the case with the Zooplankton concentrate constituted by members belonging to Copepoda, Lammelibranchs, Kucifera, Polycheata, Stomatapod larvae and fish larvae. In effect, the plankton biomass had a poor representation as described in para 125.

[1] Varkey D., Pramod G. and Pitcher T.J. (Supplied by CMFRI, 2009) An Estimation of Compliance of the Fisheries of India with Article 7 Fisheries Management) of the UN Code of Conduct for Responsible Fishing

[2] Shenoy, L. and Biradar, R.S. (2005) Marine Fishing Regulation Acts of Coastal States of India – A Compendium. Central Institute of Fisheries Education, Mumbai, India. 73pp.

127. The constituents of the Phyto and the Zooplankton, in the centers studied in both the surface and sub-surface zones, had almost similar (poor) representation – could be because of very heavy wave-action impact at each place where sampling was done. Qualitative composition of the Plankton of the coastal waters of Karnataka is given in Appendix 6

4. Beach Vegetation

128. At the subproject sites, strips of sandy land forms above mean water level to just beyond the reach of the storm waves are characterized by a maritime climate, exposure to air-borne salts and sand blast and a shifting substrate with a low water holding capacity and low organic content. Beach plants are *Psammophytes, facultative Halophytes or salt tolerant Glycophytes. Species Spinifex littoreus, Cyperus pedunculatus, C.arenarius, Hydrophylax maritima, Ipomoea pes-caparae, Canavalia lineata and Launaea sannentosa.* Major species observed all along the shoreline are *Cocos nucifera, Scaveola taccada* is extensively found in the shore line & *Clerodendrum inerme* is also present and contribute significantly to the floral patterns

5. Protected Areas, Endangered Species and Mangroves

129. Neither terrestrial nor marine protected areas are included within the boundary of the subprojects. Protected areas and mangroves are not present at sub project sites nor those in the surrounding project area. Endangered species listed in the IUCN Red Data (*IUCN, 2008*) are not reported to exist in these subproject beaches.

130. Besides a large number of fish, India is home to 5 out of 7 species of marine turtles in the world. All the five species of sea turtles along with marine mammals are severely threatened and endangered.

131. Sea turtles are reported to nest at the southern extent of Maravanthe beach. Since the proposed project interventions are further north it is unlikely these beaches would be affected. The resultant improved beach and dune area would provide a potentially improved habitat for breeding of turtles.

132. Seven out of nine species in the Karnataka region are under threat according to the endangered species list produced by the WWF[3] mainly due to intensive overfishing.

Protection of Endangered Species

India signed the 1979 Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention), covering turtles and sharks in Indian waters, belongs to CITES, and has ratified the1992 Convention on Biological Diversity (CBD), which has a marine biological diversity component (the Jakarta Mandate). The Ministry of Environment, Forest and Climate Change (MOEFCC) have a mandate to protect endangered marine species under the Indian Wildlife Protection Act 1972. In 1991 MOEFCC introduced in situ wildlife protection and fisheries management measures for ten species of shark and ray, nine species of molluscs, all sea horses, giant grouper, five species each of coral and sea cucumbers, sponges and mollusks (Mathew, 2003)[4]. India has indicated high priority to Marine and Coastal Biological diversity, started an All India Co-ordinated Project for Conservation and Management of Coastal and Marine Biodiversity in

[3] 2009 http://wwf.com/india

[4] Mathew, S. (2003) Technical Support Document (TSD) on Fisheries: India. Asia Pacific Regional Initiative on Trade, Economic Governance and Human Development, UNDP, 41pp.

1999, and has begun a coral reef monitoring programme. There is a well-planned, large olive ridley turtle sanctuary in Orissa, where TEDs are mandatory, but compliance is a problem (Das, 2003[5])

D. Ecological Sensitivity

133. None of the subproject areas are currently identified as Important Coastal and Marine Biodiversity Areas (ICMBA) /protected/ conservation reserve/community reserve.

E. Heritage

134. None of the subproject areas are currently have identified archaeological or ethnographical sites registered with the Archeological Survey of India(ASI).

F. Resources for Construction Materials

1. Rock Source

135. The project 2 subprojects presented involve the construction of groynes, offshore reefs and revetments at all project 2 subproject sites. The other three projects are small scale plantation schemes. The main material required for the schemes is rock for fill and armour. The combined volume of rock required to be sourced from quarries for all Tranche 2 projects is substantial and is 716,208m^3.

136. The project 1 subproject site at Ullal is ongoing and involves the construction of two offshore reefs and refurbishment of the north and south breakwaters. The volume of rock required for project 1 subproject is 225,999 m^3. A total volume of 942,207 m^3 of rock is required for project 1 and project 2 subprojects under SCPMIP-K.

137. Apart from SCPMIP-K, there is the National Cyclone Risk Mitigation Project Phase II, (NCRMP-II) which is funded by the World Bank, through the International Development Association (IDA), is designed to reduce vulnerability to cyclone and other hydro-meteorological hazards of coastal communities in project States, and increase the capacity of the State entities to effectively plan for and respond to disasters. It is understood that a number of project designs have been and are being progressed under this program and that designs for a number of cyclone shelters, concrete roads, bridges and culverts are being finalized, ready for submission through the approvals process. It is clear that this project will involve the construction of infrastructure in coastal Karnataka and that significant quantities of rock may be required for use as concrete aggregate and for saline embankments within the river estuaries. A conservative estimate for the needs of the NCRMP-II in coastal Karnataka is of the order of 600,000 m^3 of rock.

138. Based on the information presented in the previous section it is clear that the SCPMIP-K and NCRMP projects together will require up to 942,207 m^3 + 600,000 m^3 = 1,542,207 m^3 of rock between mid-2015 and end 2021.

139. Construction of the two projects for underground storage of crude oil commenced in 2009 in Udupi District and is now mainly complete. Approximately 7 million (70 lakh) m^3 of excavated rocks have been stockpiled at these two sites. These rocks are available for a

[5] Das, P. (2003) Nesting of Olive Ridleys unlikely along Orissa coast, Fishing Methods Blamed for Massive Indian Turtle Deaths. The Hindu, New Delhi, India, February 17, (2003).

number of beneficial uses, including rock armour, fill and concrete aggregate. The rock is good quality granite, which is suitable for a wide range of uses, including rock armour, under layer and core for the construction of marine structures and as aggregate for concrete. The third source near Saibarkatte, Kota in Kundapura is also used for producing the rock for construction of Breakwater at Shiruru. This rock source can also be augment if required for the project 2 subproject construction works.

140. Several agencies are involved in marketing the rock from the stockpiles and they have furnished the details of various laboratory tests to confirm the quality of the rock. As part of the due diligence carried out by the project team rock samples were collected from both stock piles and independent laboratory tests were carried out to confirm the suitability of the rock for use in marine structures. The ISPRL stockpile at Mangalore is being used as the rock source for the project 1, which involves construction of two offshore reefs and rehabilitation of the two breakwaters at Ullal.

141. The volume of rock required for the SCPMIP Tranche 1, SCPMIP Tranche 2 and NCRMP between 2015 and 2021 is 1,542,207m^3. As can be seen the existing stock piles total of 8.85 million metric tonnes at the two ISPRL sites. This gives sufficient head room for other uses and the overall availability of rock to carry out the SCPMIP in Karnataka is considered to be good.

142. The rock at the two ISPRL sites is stockpiled as it was excavated and must be sorted into the appropriate size grades for use as armour stone. This process has been started and an indication from the quarry/stockpile operators is that sufficient quantities of the smaller rocks are available up to the 1t-3t range.

143. However, due to the nature of the rock and the blasting operations carried out to excavate the tunnels only a relatively small quantity of rock in the 2t-4t range is likely to be available. Consequently although some of the designs prepared use 2t-4t rock an alternative design replacing that grade with 2.5t concrete Tetrapods at the Maravanthe site has been prepared. Thus the risk of lack of availability of the critical large sizes has been mitigated.

144. Considering the distance from source of construction materials to the project site, strict requirements for transportation will be implemented. The road distances from the stockpiles to the sites are as follows:

(i)	Someshwara	30 km
(ii)	Yermal Thenka	30 km
(iii)	Udyavara	16 km
(iv)	Kodi Bengre	35 km
(v)	Maravanthe	70 km
(vi)	Murudeshwara	70 to 80 km

2. Sand Source

145. Identified sand sources for Tranche 2 sub projects are as follows:

(i) Udyavara – Possible sand sources for sand nourishment at Udyavara are off shore areas of Udyavara up to a distance of 10 km from the shore, navigational channel of Malpe port located near to the project area within in 5 km reach, navigational channel of Hungaracutta Port located at a distance of 15 km and from navigational channel of Gangolli port located at a distance of 40 km;

(ii) Maravanthe – The sand from the adjacent beach towards north of project area will be used for redistribution
(iii) Murudeshwara- Sand from off shore area of Murudeshwara up to a distance of 10 km; and
(iv) Other possible sand sources are the new Mangalore Port Dump ground is a possible sediment source-indications at the surface and depths of 1 m is the level of silts and clays are too high, although there are indications that the % of sand increases with depth, the sand bar at the Netravathi river mouth contains good quality sediments, inside the Netravathi river mouth there are also good quality sand.

G. Economic Development

1. Land Use

146. The major land uses in and around the sub project beaches and adjoining nearshore and foreshore areas are: (i) traditional fishing; (ii) housing, homestead agriculture, coconut orchards and animal husbandry (iii) guest houses (iv) fish landing and associated activities.

147. Anthropogenic activities like construction of ports and harbour, sand and clay mining, construction of dams are partly responsible for erosion, reduction in width of beaches and receding shorelines. Due to construction of dams sediment supply to the coast has been dramatically reduced as rainwater is retained for various purposes, including irrigation and drinking water, especially towards the end of the monsoon months.

148. Other human activities include deforestation, urbanisation and infrastructure development, all of which put pressure on the environment and alter the natural sediment dynamics of the region.

2. Someshwara

149. Someshwara, falls under the jurisdiction of Someshwara Gram Panchayat, Mangalore Taluk of Dakshina Kannada District.

150. The project site is a linear stretch along the coast, stretching from 12°45'39.25"N, 74°51'49.70"E in the South to 12°47'9.89"N, 74°51'13.53"E in the North, a distance of about 2km. Majority of the people are mainly depending on fishing, agriculture, daily wage workers etc. there are no medium or large land holdings. Sea erosion is becoming more problematic since last decade and more specifically during the past 4–5 years.

151. The village of Someshwara runs parallel to the project site along the coast. Railway line is situated about 200 m away from the coast whereas the main National highway 66 is situated about 500 m to the east of the project site. The district headquarters of Mangalore city is about 20 km from the project site.

152. This Gram Panchayath is relatively sparsely populated, though residences run parallel with the shoreline. There are few private guest houses along the coastline of Someshwara.

153. There is an existing fisheries road that runs parallel to the proposed project site at Someshwara. The road is wide and in good condition.

a. Yermal Thenka

154. Yermal Thenka is located in Udupi taluk of Udupi district in Karnataka state. The two villages are surrounded by Uchila in the north and Padubidri in the south. These villages fall under two different gram Panchayat - one under Thenka Gram Panchayat towards the south and the other under Bada gram Panchayat in the north.

155. The project area is part of a straight coastal strip of length 17 km extending from Mulki & Pavanje river estuary on the southern end to Kaup lighthouse on the northern end. This coastal strip is characterized with large open sandy beaches towards the south. Large to small emerged and submerged rock outcrop areas are visible at near shore and offshore areas. The project site is a linear stretch along the coast, stretching from 13°9'25.35"N, 74°45'22.19"E to 13°11'31.22"N, 74°44'39.98" for a distance of about 4.5 km.

156. A rock revetment seawall exists on the southern side from the existing breakwater structure, and extends to the south for a length of about 1km. This is constructed to protect the existing fisheries road which runs parallel to the coast and connect Mulur, Kaup and Malpe fishing port located north from Hejamadi village towards the south.

157. The village of Yermal Thenka runs parallel to the project site along the coast. Railway line is situated about 2,100 m away from the coast whereas the main National highway 66 is situated about 818 m to the East of the project site.

158. There is an existing fisheries road that runs parallel to the proposed project site at Yermal Thenka. The road is wide and in good condition.

b. Udyavara

159. Udyavara spit is located 50 km north of New Mangalore port and south of Malpe fishing port. It is a long narrow simple, curved and sword shaped spit formed by deflection of Udyavara & Pangala rivers towards the North and runs parallel to the coast for a length of 7.5km and deflects towards Northwest direction and empties into the Arabian Sea on the West. This is one of the longest spits in Karnataka state. It is a long narrow spit extending from Mattu village in the south to the entrance of Malpe fishing harbour in the north and has a total length of approximately 10.57 km. The spit is open on the north and tied to the mainland on the southern end. The spit is surrounded by Udyavara and Pangala rivers to the east and the Arabian Sea on the west.

160. Malpe fishing harbour is one of the largest fishing ports within Karnataka state and lies within the Udyavara river estuary on the north bank, just within the entrance. The port entrance was constructed in the year 1980 and consists of two protruding breakwaters or training groynes constructed at the mouth of the Udyavara River of the entire 10.57 km long Udyavara spit, it is proposed to undertake erosion control measures along a length of 4.5 km, which is suffering the greatest impact of erosion.

161. The project site is located between coordinates 13°16'24.56"N; 74°43'30.25"E and 13°18'48.31"N; 74°42'58.77"E. The village of Udyavara- Padukere runs parallel to the project site along the coast. Fisheries road is the only road access to the village and the project site, which connects at the South end of the spit to the National Highway 66 and Udupi. A bridge at the northern end to connect the spit to Malpe is under progress. Railway line is situated about

3.5 km away from the coast whereas the main National Highway 66, State Highway 67 is situated about 2.7 km to the east of the project site.

162. Mostly residential with plenty of coconut orchards along the spit. Fisheries road runs parallel to the coast with either side populated with residential houses.

163. There is an existing fisheries road that runs parallel to the proposed project site at Udyavara. The road is wide and in good condition.

c. Kodi Bengre

164. Kodi Bengre is located in Udupi taluk of Udupi District in Karnataka State. The village is situated in Kodi Gram Panchayath and is a long spit with Swarna River along the east and Arabian Sea along the west. The Swarna River meets the Sea at the Northern end of the spit. The spit is about 4 km in length and varies in width from about 100-250 m. many mangrove islands dot the Swarna river estuary.

165. The project area is part of a straight coastal strip of length 11.5 km extending from Malpe Harbour in the south to the Swarna river mouth in the North. This coastal strip is characterized with large open sandy beaches towards the south. Large to small emerged and submerged rock outcrop areas are visible at near shore and offshore areas. The project site is a linear stretch along the coast, stretching from 13°24'23.93"N, 74°41'49.25"E to 13°26'56.92"N, 74°41'44.84"E for a distance of about 4.5 km. A rock revetment seawall exists along the stretch, with many parts in dilapidated state. This is constructed to protect the existing fisheries road which runs parallel to the coast

166. The village of Kodi Bengre runs parallel to the project site along the coast. Railway line is situated about 8 km away from the coast whereas the main National highway 66 is situated about 5 km to the East of the project site.

167. There is an existing fisheries road that runs parallel to the proposed project site at Kodi Bengre. The road is wide and in good condition.

d. Kodi Kanyana

168. Kodi Kanyana village, part of Kodi Gram Panchayath, is located in Udupi Taluk, Udupi District on the central west coast of Karnataka. The study area extends for about a length of 1.5km along the shoreline. Width of the beach backshore within the study area is about 70m. This coastal lowland area is associated with long and straight open sandy beaches that are relatively stable, surrounded by paddy fields, coconut orchards and low density fishing communities. The project area extends from (466236.63m E, 1491262.77m N) to (466095.51m E, 1492764.27m N).

169. Land use and land cover of the project location is characterized by open beaches, wetlands and rocky island towards south west. The beaches at this location are sparingly used by floating tourists and fishermen to park the boats. Mostly the land use at this location is characterized by beaches towards west and separated by wetland parallel to the coast. Upland located towards east with good vegetation along the coastline, coastal plain, sparsely populated residential, religious, fishing and allied activities are other features present in the area.

170. There is an existing fisheries road that runs parallel to the proposed project site at Kodi Kanyana. The road is wide and in good condition.

e. Maravanthe

171. The project site is Located in the Kundapur taluk of Udupi district, Karnataka state extending from Trasi village on south to Maravanthe village on north. and forms a narrow strip of land in between Kollur River flowing on eastern side and Arabian Sea on western side. The river Kollur, which almost touches the Arabian Sea at this location, takes south east direction and flows for about 10km and takes south west direction, confluence with two other rivers Chakra and Haladi forming Gangolli estuary.

172. The project site stretches from 13°41'14.44"N 74°38'39.76"E to 13°43'7.05"N, 74°38'24.29"E in the North, a distance of 4.5km. The village of Maravanthe runs parallel to the project site along the coast. Railway line is situated about 3887 m away from the coast whereas the main National highway 66 is situated about 205 m to the East of the project site.

173. Land use and land cover of the project location is characterized by open beaches, barrier spits, wetlands and rocky island towards south west. River's running parallel to the coast forming a narrow strip of land. The beaches at this location are widely used by floating tourists and fishermen to park the boats. The water front at this location is mostly used as fishing grounds by the local fishermen.

174. National Highway-66 runs parallel to the proposed project site at Maravanthe. The road is wide and in good condition.

f. Murudeshwara

175. Murudeshwar beach town lies on the coast of the Arabian Sea and is also famous for the Murudeshwar Temple. It is located 14 km distance from Bhatkal town and 2.1 kms from National Highway 66 (NH66). This sacred place presents some beautiful carvings and statues, which has a history that dates back to a few centuries. The sea is an intrinsic part of the temple scape at Murudeshwar. The sea on three sides surrounds the temple towering on the small hill called Kanduka Giri on three sides. The potential for sensitive improvements in the amenity and tourism value of such beaches can be harnessed to both increases local economic and coast protection benefits.

176. Majority of land use is primarily a commercial area with resorts and hotels catering to the tourists. The beach along Murudeshwar is also used as a fish landing area with small and medium sized mechanized and manual boats bringing as well as parking the boats along the shore. The boats also are used for recreational purposes by tourists, for rides along the shoreline.

177. The proposed project site is a linear stretch along the coast, stretching from 14° 5'4.05"N, 74°29'20.49"E in the south to 14° 6'3.80"N, 74°29'11.62"E in the north, along the edge of the Murudeshwar hillock.

178. Access road to the Murudeshwara project site is well connected to the nearby National Highway 66. The road is wide and in good condition.

g. Pavinakurve

179. Pavinakurve village, part of Karki Gram Panchayath, is located in Honnavar taluk, Uttara Kannada district on the North west coast of Karnataka. The coastline at Pavinakurve is inclined 17° to the west with the depth contours aligned approximately parallel to the coastline. The study area extends for about a length of 3 km in the coastal zone and the width of the beach varies from 20 m to 90 m. An island called Basavaraja Durga is located towards the West of Pavinakurve village, about 1 km offshore. Due to the presence of this island, a salient has been formed, the beaches towards North are sufficiently wide, and the island provides enough wave shadow to defend the existing coastal road.

180. The mouth of the Sharavathi and Badagani estuary located south of the project site is very dynamic, shifting towards the North. One possible reason for this Northward shift may be the reduction in flows from the Sharavathi River, due to the construction of a dam at Gerusoppa village located about 25km upstream. Moreover the river mouth, which was situated near the Kasarkod hamlet as per the Admiralty chart of 1963 has shifted about 2.5km towards the North at the Pavinakurve hamlet with the formation of a sandbar in between having width in the range of 150m to 450m. Fishing boats launching from Honnavar port face considerable difficulties due to the narrow entrance of 30m to 40m width and shallow depths at the mouth.

181. Land use and land cover of the project location is characterized by a coast featuring cliffs, beaches, wetlands and rocky island towards south west. The beaches at this location are rarely used by tourists and fishermen to park the boats. Mostly the land use at this location is characterized by beaches towards the west and separated by wetland parallel to the coast with Upland located towards east with good vegetation cover along the coastline. This area of the coastal plain has very low density populated residential areas and is home to a fishing community.

182. There is an existing fisheries road that runs parallel to the proposed project site at Pavinakurve. The road is wide and in good condition.

3. Socioeconomic Profile of Subproject Sites

183. Following section describes the socio economic profile of all the sub project sites.

a. Someshwara

184. Someshwara Gram Panchayath has 16 wards in total of which 4 are coast facing wards. These four wards are most affected by erosion; socioeconomic data of these severely affected wards and the Someshwara Gram Panchayath are given in Table 27 in Appendix 5.

185. About a decade ago, fishery was the most dominant occupation among coastal households. However, it was observed during the survey that people prefer to take up alternate occupation as against fisheries, which are risk free and fetch better returns. Farming is also pursued by some fisher folks as a secondary occupation. Nevertheless, most people living across the shores are conversant with fishing practices and carry out fishing in the sea to meet household consumption Beedi(a type of cigarette made of unprocessed tobacco wrapped in leaves) rolling is another very common occupation, specifically with women and men pitching in during their free time. About 40% of the people are engaged in beedi rolling as primary or secondary source of income. With about 1125 females per 1000 population, male: female ratio is positively in favor of females. Illiteracy is around 10% who predominantly belong to older age

group, while total working population accounts for around 47%. In many households, working population mostly lives off shore while only women take care of the routine domestic chores. In the coastal wards of Someshwara Gram Panchayat, the household size ranges from a minimum of two to a maximum of 10. A large majority of the households (54%) have family size of about 4. The average size in the coastal wards works out to be around 6. This is slightly more than the average family size of households of the Gram Panchayat.

b. Yermal Thenka

186. The project area falls under two Gram Panchayaths (GPs) viz., Bada and Thenka. There are seven wards in total of which five are coast facing wards. These five wards are worst affected by erosion.

187. The socio-economic profile of the two GPs and the combined profile of five coastal wards (2 in Thenka and 3 in Bada) are presented in Table 28 in Appendix 5. About one fourth of the total households in both the GPs live along the coastal wards. The average household size is in the coastal wards is about 5.2, which is a little above the average size in the total GP (4.6). Fisheries is the most dominant occupation followed by farming. Farming is also pursed by some fisher folks as a secondary occupation. Beedi rolling is a household industry that engages about 15% of the households in the two GPs. However, this is estimated to be lower (about 12%) along the coastal wards. With about 529 females per 1000 population, male: female ratio is positively in favour of females. About 28% of the population are in the working age group People living below poverty line are insignificantt in both the GPs.

188. The education levels of families in the coastal wards better the overall average GP literacy level of over 85%. There are only 2.4% of illiterates; where as 9.1% of the hhs have at least one member who has acquired a graduation degree. Close to two third (74.7%) hhs have at least one member with secondary school education and 13.8% of the hhs have one member with at least primary education.

c. Udyavara

189. The entire project area falls under the Gram Panchayath of Udyavara. There are 8 wards in total of which only 1 is a coast facing ward. The entire length of this ward is affected by erosion; socioeconomic data of this severely affected ward and the total of Udyavara Gram Panchayaths are given in Table 29 in Appendix 5.

190. Over two third (78%) of the households have 3 to 5 members, where as 13% have up to 2 and 8% have between 6 to 10. The overall average household size works out to be 4.8.

191. The education levels of families in the coastal wards are well comparable with the overall average GP literacy level of over 90%. More than 10% of the households have at least one member who has acquired a graduation degree. About 76% hhs have at least one member with secondary school education and of the hhs have one member with at least primary education. About 13% have one member with primary school qualification and only 1% has illiterates in the household.

192. Fishing dominates as a primary occupation, with about 68% of the households depending on it, followed by manual labour (14%) and private service (5%) in that order. Not many households count on back-up livelihood options, with about 72% reporting that they do not having any secondary occupation.

d. Kodi Bengre

193. The project area is spread between two Gram Panchayaths viz., Kemmanu and Kodi. There are 12 wards in total of which 7 are coast facing wards. These seven wards are most affected by erosion; socio-economic data of these severely affected wards and the total of Kemmanu and Kodi gram Panchayath's are given in Table 30 in Appendix 5.

194. About 26% of the total households in the Kemmanu Gram Panchayat live along the coastal wards. Fishery is the most dominant occupation followed by coconut farming. Farming is also pursed by some fisher folks as a secondary occupation. Males to female ratio is in favor of females with 1144 females for every 1000 males in the entire Gram Panchayat and 1106 females to males in the coastal wards. Number of people below poverty line is 47% in the entire Gram Panchayat whereas, in the coastal wards it is about 25%. Total working population ratio is significantly lower with just about 21% as compared to the entire Gram Panchayat which stands at about 60%.

195. About 55% of the total households in the Kodi Gram Panchayat live along the coastal wards. The average household size is in the coastal wards is about 3.72, which is a little less the average size in the total Gram Panchayat (3.85). Fisheries are the most dominant occupation followed by farming. Farming is also pursed by some fisher folks as a secondary occupation.

196. In the coastal wards of Kemmannu Gram Panchayat, the household size ranges from a minimum of two to a maximum of 10. A large majority of the households (57.10%) have family members between three and five. About 38.10% of households have larger number family members between six and 10. The average size works out to be around 4. 7.

197. In the coastal wards of Kodi Gram Panchayat, the household size ranges from a minimum of two to a maximum of 13. A large majority of the households (54.19%) have family members between three and five. About 36.77% of household surveys conducted reveala larger number of family members between 6 and 10. The average size works out to be around 3.84. This is slightly more than the average family size of household survey in the Gram Panchayat.

198. The literacy levels of families in the coastal wards better the overall average Kemmanu Gram Panchayat of over 90%. There are only 9.53% of illiterates, where as 5.95% of the households have at least one member who has acquired a graduation degree. Close to two third 52.38%) households have at least one member with secondary school education and 32.14% of the households have one member with at least primary education.

e. Kodi Kanyana

199. The project area falls under Kodi Gram Panchayath. Of the total four wards in the GP, two are coast facing wards. Both the wards are most affected by erosion; socio-economic data of this severely affected wards and the total of Kodi Gram Panchayaths are given in Table 31 in Appendix 5.

200. The Table 31 in Appendix 5above presents the overall socio-economic profile of Kodi Kanyana and the two coastal wards. Of the total number of four wards in Kodi Kanyana, two are coastal wards (ward number 6 and 7), which is home for 650 households. The total population of the two coastal wards is 2420, taking the average household size to about 4. Among all the coastal wards, Kodi Kanyana has the lowest household size. The male female ratio is negatively

skewed towards females. While it is a universal feature in the coastal wards that gender ratio is in favour of women, Kodi Kanyana stands as an exception to this phenomenon.

201. About 5% of the population in the coastal wards are children in the below 6 years age group and 65% are in the working age group. About 15% of the population (297+71=368) belong to socially backward categories (i.e. scheduled caste and scheduled tribe). About 8% (200) of the population belong to the vulnerable group; either physically challenged or elders beyond working age group.

202. Fisheries as an occupation pursued by about 22% of the population. Beedi rolling is a cottage industry that is pursued by about 5% of the population; primarily women. They earn their wages on a piecemeal basis. Cultivators are in a minority with only about 2% of the population depending on farming as an occupation.

203. The average household size in Kodi Kanyana is about 4.5 with a large majority (54%) of the households having between three to five family members. About 36.8% of households have family members between 6 to 10. Just one family among the surveyed households is found to be larger in size, with 11 members.

204. The household survey data indicates that illiteracy levels in Kodi Kanyana is slightly higher than the other project areas. About 9% (14hh) have all illiterate family members and an equal number of households (14hh) have at least one member in the family who has attained graduation degree. Those who attended primary schools is significantly higher (45%), as compared to secondary school attainments (37%) amongst surveyed households.

f. Maravanthe

205. The project area is spread across two Gram Panchayaths viz., Trasi and Maravanthe. There are nine wards in total in the two GPs, of which four are coast facing wards. These four wards are most affected by erosion; socio-economic data of these severely affected wards and the total of Trasi and Maravanthe Gram Panchayaths are given in Table 32 in Appendix 5.

206. The socio-economic profile of the two GPs and the combined profile of four coastal wards (2 each in Maravanthe and Trasi) are presented in Table 32 in Appendix 5. Close to 43% (1108 of 2570) of the total households in both the GPs live along the coastal wards, underpinning the high dependence of households on fishing and other coastal resources. The household survey also indicates that over 94% of coastal households depend on fishing as a livelihood option. The average household size is in the coastal wards is 6.9, which is substantially higher than the average household size of the overall GP (5.8).

207. Subsistence farming is also pursed by some fisher folks, to supplement income from fisheries. Beedi rolling is a household industry that engages about 15% of the households in the four coastal wards, mainly by women. . The beedi rolling population is higher (about 25%) in the non-coastal wards. With about 534 females per 1000 population, male: female ratio is positively in favour of females in the four coastal wards. About 59% of the total population is in the working age group. The population living below the poverty line stands at 24%. It is reported that about 20 members are physically challenged at varying degrees across four coastal wards.

208. The literacy level in the coastal wards as evident from the household survey stands close to 93% which is 8% higher than the secondary level information collected from the GP records. The main reason for this is that the GP records indicate the 2001 data and not updated

to reflect the change in literacy trends over the past decade. About 7% of the households have all illiterate members, whereas about 9% of the households have at least one graduate in the family. A little more than half of the households (53%) have at least one member with secondary school education and about 30% of the households have at least one member who has completed primary school education.

g. Murudeshwara

209. The project area falls under the Gram Panchayath of Mavalli . In total, Mavalli GP has 14 wards of which 8 are coast facing. These coast facing wards are most affected by erosion. The socio-economic data of the severely affected wards and the total of Mavalli Gram Panchayath are given in

210. Table 33 in Appendix 5.

211. The socio-economic profile highlights many of the salient features like the number of households in the coastal area and the prime occupation of the households. . Eight of the total 14 wards are coastal wards, with 31% of the households and 40% of the population depending on coastal resources for their livelihood. About 34% of the population belong to the working population group in the coastal area. About 54% are pensioners and 44% are physically challenged persons. These two are the high risk-prone categories of the population. What is more striking is that for 80% of the people fishing is the only occupation. Only about 11% of the households are cultivators and about 36% are engaged in Beedi-rolling. In the coastal wards, the household size ranges from a minimum of two to a maximum of 10. A large majority of the households (50.59%) have family members between three to five members. And about 42.35% of household survey have family members between six and ten. The average size works out to be around 7.06%. From this it is evident that there are more small families in the area.

212. About 9.41% are illiterates, whereas 1.18% of the household have at least one member who has acquired a graduation degree. Close to one third (14.12%) of the households have at least one member with secondary school education and 75.29% have one member with at least primary education

h. Pavinakurve

213. The project area falls under the Gram Panchayath of Karki . Of the 7 wards of Karki GP, 3 are coast facing wards. These three wards are frequently affected by erosion. The socio-economic data of this severely affected wards and that of Karki Gram Panchayaths are given in Table 34 in Appendix 5.

214. About 11% of the total Karki GP population lives in the three coastal wards of Pavinakurve; their main occupation being fisheries, supplemented by subsistence agriculture. Only about 6% of the fisher folks own boats. The literacy rate of the coastal wards is 77%, close to the overall GP literacy rate and higher than the overall state average (75.36%).

215. A large majority of the households (76%) have family members between 3 to 5, whereas about 11% have up to 2 and about 13% have between 6 to 10 members. The overall average household size works out to be 5.1.

216. The literacy levels of families in Pavinakurve (77%) is slightly lower than the average Karki GP literacy of over 82%. Nevertheless, it stands higher than the state average. About 16%

of the households have at least one member who has acquired a graduation degree. Almost equal percentage (41% and 40%) of the households have at least one member with secondary school and primary school education respectively. About 3% of the households are considered as illiterate.

4. Impact of Beach Erosion

217. The following section describes the impact of erosion on each of the sub project sites.

a. Someshwara

218. Even though, the number of people depending on fishing is dwindling because of diversification of occupation, the cause and effects of sea erosion is known by most in their own traditional way, although they may lack full technical and scientific understanding of the coastal processes. On various aspects of the sea such behavior of the waves, direction of the wind currents, tidal waves etc., and in such other behavior of the sea, the people have conventional wisdom.

219. The coastal communities by virtue of the nature of their occupation hold privy to the traditional knowledge of predicting tides, wave patterns, wind speed and direction etc. just by observing the sea on an hourly basis. Their coping mechanism is mainly determined by this wisdom. During the discussions, villagers expressed that the behavior of the sea has changed in the recent times, as against the earlier fixed patterns of movements. Coastal erosion affects the communities in multiple ways. Loss of shore land, loss of crops, damage to roads, and damage to other infrastructure are some of the physical manifestations, besides the psychological trauma of hardships, especially during three monsoon months beginning in June ending sometime in August.

220. Loss of beach width (30 meters in 2013), loss of coconut trees along the shorelines (over 150), loss of cropped area 25 acres and damage to public infrastructure (5 electric poles) are the major losses During the household surveys, it was observed the damage caused to the houses, post erosion residuals of structures cracks developed in the walls, portion of retained walls remaining with almost hollow base have left deepest trauma in the minds of the residents in this area.

b. Yermal Thenka

221. The cause and effects of sea erosion is understood by most villagers in their own traditional way, although they may lack full understanding of the coastal processes. On various aspects of the sea such behaviour of the waves, direction of the wind currents, tidal waves etc, the fishing community has conventional wisdom. Fishing community by virtue of the nature of their occupation, hold privy to the traditional knowledge of predicting tides, wave patterns, wind speed and direction etc. just by observing the sea on an hourly basis. Their coping mechanism (e.g. when not to set sail, how high will be the waves) is mainly determined by this wisdom.

222. Coastal erosion affects the communities in multiple ways. Loss of shore land, loss of crops, damage to roads, and damage to other infrastructure are some of the physical manifestations, besides the psychological trauma of hardships, especially during three monsoon months beginning in June ending sometime in August.

223. The following presents the asset loss encountered by the communities as expressed by them during the survey. Loss of beach width (50 m in 2013) , loss of coconut trees along the shorelines (over 350), loss of cropped area (26 acres) and damage to public infrastructure (10 electric poles) are the major problems. One caveat is in order here. These figures may not represent an accurate picture as they are based on "memory recall" by prominent residents, during FGDs. The memory recall suffers from long term memory lapses and therefore it carries the risk of some over estimation or under estimation.

224. Increase in water level is being observed since the past ten years. Villagers attribute this to the break water construction by Nagarjuna Power Corporation Limited. Because of this apprehension, villagers protested and succeeded in getting the breakwater removed. Sea erosion problems are attended by the authorities as a reactive response only during monsoons by providing resorting to emergency measures. Communities are aware that the state government (not the GP) is responsible for shoreline management, but they are ignorant of the agencies involved in protecting the shores.

225. The GP officials and community members are unanimous in their opinion that the temporary mitigation measures (rubble mounds) provide no guarantee of protection, although they protect shorelines as an emergency measure. Such emergency actions give rise to more problems than solutions. They insist that more long term options must be considered. However, they have very limited idea on what such actions could be. For them, the long-term option is to construct well designed sea walls using hard rocks. In their understanding, coast lining with tetrapods provide sound protection. This perception is arising out of the fact that many residents of Yermal Thenka and Bada have migrated to Mumbai in search of jobs and the trend continues. This has exposed them to alternate coastal protection measures other than rock dumping solutions.

c. Udyavara

226. Udyavara suffers from coastal erosion every monsoon, inflicting heavy damage on private properties and public infrastructure. The villagers have learnt to live with this reality. On various aspects of the sea such behaviour of the waves, direction of the wind currents, tidal waves etc. the fishing community has conventional wisdom. Just like other fishing communities living by the sea side, Udyavara fisher folks also hold traditional knowledge of predicting tides, wave patterns, wind speed and direction etc. just by watching the sea on an hourly basis. Their coping mechanism (e.g. when not to set sail, how high will be the waves) is mainly determined by this wisdom.

227. Coastal erosion affects the communities in Udyavara multiple ways. Loss of shore land, loss of crops, heavy damage to roads, and damage to other infrastructure are some of the physical manifestations, besides the psychological trauma of hardships, especially during three monsoon months beginning in June ending sometime in August.

228. Loss of beach width (100 m between 2010 to 2014), loss of coconut trees along the shorelines (over 200), roads becoming inaccessible (length of about 2.5 km), partial damage to community assets (prayer halls) and public infrastructure (electric poles, water supply taps) are the major problems. In 2013, a large number of households had to be temporarily relocated due to erosion and extreme floods.

229. Currently, sea erosion problems are addressed by the Ports Department as a reactive response during monsoons, providing only temporary measures. Communities are aware that

the state government (not the GP) is responsible for shoreline management, but they are ignorant of the agencies involved in protecting the shores. Nevertheless, the GP has been actively involved in taking up the issue of coastal erosion i) with the District Collector and ii) with the political representatives (MP and MLA) and continues to do so.

230. The GP officials and community members are unanimous in their opinion that the temporary mitigation measures (rubble mounds) provide no guarantee of protection, although they protect shorelines as an emergency measure. Such emergency actions give rise to more problems than solutions. They insist that more long term options must be considered. However, they have very limited idea on what such actions could be. For them, the long-term option is to construct well designed sea walls using hard rocks. In their understanding, coast lining with stones provide sound protection. However, they also articulate that such a protection measure should not restrict their access to the sea.

d. Kodi Bengre

231. The impact of beach erosion has been felt acutely in this region. Unable to bear the consequences of a wild sea and its devastating actions in every rainy season, many fishermen have shifted their activities to the nearby Malpe fishing harbor. The houses near the seashores are affected and the people live in fear during the rainy season. They do not know when their house will be washed away due to the fury of the sea. Loss of beach width (20 meters in 2013), loss of coconut trees along the shorelines (over 1000), loss of cropped area (50 acres) and damage to public infrastructure are the major problems. Many families were dependant on coir making cottage industry, which has been washed away due to sea erosion.

e. Kodi Kanyana

232. The impact of beach erosion on the lives of people in Kodi Kanyana is immense, although seasonal. The Swarna river flows parallel to the sea with a narrow patch of about 150 m between the sea and the river. The trauma that about three fourth's of the land area between the sea and the river in Kodi Bengre has been lost due to sea erosion about 10 years ago has been deeply etched in the memory of people. People also feel that the depth of the river is becoming shallower with sea bringing in silt and sand each time it overtops. This is making the river of no productive valuevalue to the residents. Fisher folks understand and interpret sea erosion in their own way and it affects their social behaviour significantly and influences the way they live and respond to the coastal phenomenon called erosion. The presence of prayer halls along the coastlines is a reflection of their collective coping mechanism, which is perceived to be beyond human control.

233. Loss of beach width (200 m over 5 years), loss of coconut trees along the shorelines (about 150), loss of cropped area (500 meters in width over five years) and damage to 4 buildings are some of the major issues of concern to the communities. However, on a relative scale the loss estimates are far lower in Kodi Kanyana as compared to other coastal wards. Some respondents reported that some of them received compensation at the rate of Rs 80 per coconut tree to offset their losses. This could not be verified by government sources, because no recorded data are available.

f. Maravanthe

234. Coastal erosion affects the communities in multiple ways. Loss of beach width, damage to roads, damage to public infrastructure(NH 66), seasonal loss of crops are some of the

physical manifestations, besides the psychological trauma of hardships, especially during three monsoon months beginning in June ending sometime in August. Close to 150 households are chronically vulnerable to coastal erosion.

235. Seasonal loss of beach width (varying from 15 to 500 m) is a common phenomenon. The seasonal loss is also reported to be recovering normally after monsoon. Complete washing away of coconut trees along the shorelines (135 to 140), loss of cropped area (about 300 acres; one of the largest in the coastal belt) and damage to public infrastructure (450 meters of road length; 1 km of GP road, 4 km of fisheries road, 6 electric poles, water supply pipeline) are some of the major quantified losses. These figures do not necessarily represent an accurate picture as they are best estimates by prominent residents, during FGDs. The figures are also coloured by the interpretation of multiple data sources, which are influenced by varied understanding. Nevertheless, it is the best assessment based on which the loss figures could be arrive at with more or less verifiable numbers.

g. Murudeshwara

236. Over the years, the effect of sea erosion has been very acute and has changed the very lifestyle of the fishermen. Many of them have even gone to the extent of changing their vocation and have re-skilled themselves to pursue other business activities in the nearby towns. They have undergone so much pain and suffering and realized that survival is going to be very difficult in the future if they rely on fishing as their only occupation.

237. Loss of beach width (200 meters in 2013) in the river estuary, loss of coconut trees along the shorelines (over 20), and marginal loss of cropped area (01 acres) and damage to public infrastructure (compound wall) are the major problems apart from a couple of households and roads partly or fully damaged. These figures may not represent an accurate picture as they are based on "memory recall" by prominent residents, during Focus Group Discussions.

h. Pavinakurve

238. During the household survey, about 38% of the households reported that they did not face any problem due to coastal erosion till now. About 13.7% expressed that they had lost their property due to coastal erosion, whereas 8.8% of the households had experienced temporary change of house, 7.9% lost livelihood in some form, and 6.1% were affected by loss of basic services. About 25% of the respondents stated that they have faced all the above problems in one form or the other due to coastal erosion. Since no recorded data is available on losses, household survey data becomes the most authentic source of information to visualize the impact of coastal erosion on communities.

239. The complete length of the narrow coastal stretch in Pavinakurve suffers from heavy coastal erosion mainly during monsoons. The major impact of the erosion is on the roads and houses. Coastal erosion affects the households in Pavinakurve in multiple ways, although the stretch is not so densely populated.

240. About eight families have lost some landed properties (extent and value could not be assessed), one family has lost its boat (only source of livelihood), 11 acres of cropped area have been damaged, unspecified length of beach width has been lost (2010 to 2013), number of coconut trees have been uprooted, and about 2 km length of black topped roads collapsed in small stretches. In 2011, four families have voluntarily relocated (temporarily) due to erosion.

5. Other Issues

a. Resettlement and Rehabilitation

241. The technical mitigation measures for erosion control of the sub project beaches will not require any land acquisition. Loss of income is not anticipated as a result of project implementation. There will not be any loss of land or other form of property and hence resettlement of affected persons will not be required.

b. Indigenous People's Development Plan

242. As there are no indigenous people at any of the proposed sub project sites; a plan to address loss due to project impact is not required.

c. Gender Profile

243. Although the primary focus of the Investment Program is on addressing the coastal erosion and coastal management, a significant number of poor including women are also likely to be the beneficiaries of the sub-projects because of protection from losses and damages to their lands and houses and restoration of their livelihood and incomes. The Investment Program will promote community participation and income generation opportunities including some gender benefits. These initiatives will enhance the livelihood of the people directly affected by the shoreline erosion and promote sustainable social development. Coastal protection and management programs will create a number of economic opportunities (tourism, fish trading, beedi rolling etc) some of which would have direct and indirect benefits to women. The major gender related covenant is that SMOs will constitute up to 30% of women members.

244. The executing agency will follow the principles of the ADB's gender development policy during Tranche 2 project implementation. They monitor each project's effects on men and women through, where relevant, sex-disaggregated data collected pursuant to the monitoring and evaluation system referred to in the PPMS.

245. The executing agency shall take all reasonable and necessary steps to encourage women living in the Project areas to participate in planning and implementation of the Project, including: (i) providing gender-responsive information, education and communication (IEC) materials integrating women's issues and needs and disseminating these through channels accessed by women; and (ii) ensuring that all project reports, including project completion reports (PCRs), include analysis and reporting on progress against targets and indicators in each Gender Action Plan (GAP).

246. In the proposed project areas, women make up more than 25% of stakeholders. The project preparatory social assessments reveal that, with some exceptions, women within households have greater responsibility for coastal living than men, yet women have poor representation in terms of employment in the coastal sector as well as less ability to participate in decision-making on public issues in general and, therefore, less voice in coastal zone management in particular.

247. The Project has been categorized under category iii i.e. some gender elements (SGE) and therefore, no GAP is required.

IV. ALTERNATIVES

A. Proposed Project Site

248. Project 1 and the follow on agreements for the Sustainable Coastal Protection and Management Program form the basis for preparing the project 2 investment program for sustainable coastal protection and management in the state Karnataka

249. The terms of reference of the PMDCK required that a few subprojects be selected for detailed studies and design works. The planning and selection processes went through a multi-level process of short-listing. The decision tree included a range of issues covering aspects such as socio-economic, state preferences, erosion status, data availability, ability to demonstrate alternative coastal protection solutions and inter-departmental aspirations.

250. PMDCK developed a long list of 78 sites based on the list of Tranche 2 subprojects developed by the PPTA, ICMAM report (Report to MOEFCC, October 2009), numerous site visits and a series of stakeholder consultations. From this long list of 78 sites, PMDC-K shortlisted 9 sites as shown in Figure 1 on the basis of Shoreline Management Plan (SMP) prepared for each of the three districts, site visits, discussion with stakeholders, community level discussions, geomorphology at and around the sites and review of the available literature. It was decided to spread these eight subprojects across the three coastal districts Dakshina Kannada, Udupi and Uttara Kannada. The executing agency was involved at all stages of the shortlisting.

251. These eight sites were finalized after discussion with other state agencies and approval from the PSC. The State has high priority for these subprojects. The subprojects are located at Someshwara, Yermal Thenka, Udyavara, Kodi Bengre, Kodi Kanyana, Maravanthe, Murudeshwar and Pavinakurve from the south to the north. The primary goal is to solve coastal erosion and the consequences such as wave overtopping resulting there from.

252. The local conditions have been studied studied in detail and several alternative options were considered during the feasibility study for each subproject. Consultations with local communities in the selected sites were carried out to take into account the communities' experiences and preference.

B. Technology

253. The transition to softer solutions is relatively new to India but has been applied worldwide. In many areas hard rock protection has been replaced or modified with softer options such as beach nourishments, dune management or submerged structures below mean sea level. More recently, multi-functional coastal protection options, have been gaining greater acceptance. This is best illustrated by examples on the Gold Coast (Australia) and at Mount Maunganui (New Zealand) where artificial offshore submerged reefs have been constructed for coastal protection, recreation and marine ecology enhancement. Beach nourishment projects are most often undertaken in conjunction with some form of sand retention device such as groynes (Poole Bay, England), submerged reefs (e.g. Narrowneck on the Gold Coast in Australia), or detached breakwaters (e.g. East Anglia, England). This combination of coastal protection methodologies is undertaken to lower costs of nourishment (since the material remains in place for a greater period of time) and address the restraints of sufficient source materials and sustainability. All these options are kept in mind. Offshore reefs and sand-filled geotextile containers were introduced to designs for Tranche 1 projects. Experience gained from project implementation during Tranche 1 has shown that offshore reefs located around -7 mCD

in areas close to river mouth are associated with high risk of significant settlement due to the presence of thick clay layer on the bed. Thus, solution based on offshore reefs will be at high risk of settlement and may incur much higher cost in dredging and stabilizing the bed. Beach nourishment, on its own, has certain demerits: loss of sand from the system, mapping of adequate sand sources for project life period. In India, a few more aspects come into play: sand mining, lack of institutional capacity for pro-active management of nourished beaches. Thus, unless beach tourism is to the level that it will support expensive and pro-active management of nourished beaches, sand retaining structures are preferred. Shore-normal groynes are an option against local loss of sand due to non-uniform longshore transport of sediment. However, these structures need to be properly designed to minimize downstream erosion. Groynes are used for this purpose at many places all over the world. In the present context, shore normal groynes and its variations, the T-Head groynes, are designed relatively short up to the low-water line. This ensures that a good percentage of the longshore drift continues uninterrupted. Revetments are also among the options considered. Fishing method used by the local fishermen at Yermal Thenka makes any intervention in the form of reefs or groynes unacceptable. Dune build-up and stabilization through ecological schemes are other options considered. Many of the sites along the Karnataka coastline are severely constrained with respect to space. Available beach width at many of the selected sites is already narrow. Ecological or planting schemes are not suitable at these sites where the erosion is already moderate to severe of the available beach width is narrow. Dune planting schemes are considered at sites with mild erosion and relatively wider beaches.. Combination schemes are also considered, e.g. beach nourishment with offshore structure along part of the shoreline and ecological stabilization along the rest of the same stretch of shoreline at Murudeshwar. In short, various options are considered and recommended depending on the assessed effectiveness and sustainability at each local site. In short, the various options that have been used in this project, consisting of 8 subprojects are:

(i) Sand nourishment or redistribution with retaining structures;
(v) Rock groynes and concrete tetrapods as retaining structures;
(vi) Rock Revetment with wide toe;
(vii) Geotextile Revetment;
(viii) Nearshore reef;
(ix) Dune stabilization through planting.

C. Materials

254. Material used for the structural interventions varies. Final selection of the material is made after considering the technical suitability of the material, local site conditions, ease of construction, availability of the material close to the construction site and cost. In general, there is as yet no domestic manufacturer for high-quality, nonwoven geotextile fabric although the use of geotextile material for marine applications is increasing. This makes procurement of right kind of geotextile material both expensive and time-taking in India. Another point for consideration is that risk of failure of geotextile is higher in India due to vandalism especially when located outside water.

255. **Options of Materials for the Revetments.** The use of geotextiles in marine structures is expanding and there is quite significant debate amongst the coastal engineers on the use of geotextiles against rock. Both sand-filled geotextile bags/tubes and rocks are considered as alternative material during design considerations. Along many parts of the Karnataka shoreline, where rock revetments exist although in damaged conditions, rock becomes a preferred option. This is because a portion of the rock requirement for the new revetment can come from the

rocks lying in the area. At site, where there is no rock revetment yet (e.g., Someshwara) sand-filled geotextile bag is recommended as a viable alternative for some of the future constructions. Rock from designated quarries is presently available within a reasonable distance for most coastal sites in Karnataka. At the present standing, rock revetment in Karnataka is also somewhat cheaper.

256. **Option of Materials for the Groynes.** The option to construct groynes from rocks is technically viable in most cases. If the groyne heads are exposed to higher waves, rock size required for stability becomes large. Rocks weighing close to 4 ton and larger become difficult to get. If large rocks of the required size are not available, concrete tetrapods provide an option. At Maravanthe, the armour layers of the T-Heads are made of concrete tetrapods to avoid uncertainty of getting large rocks. Geotextile bags are technically viable as well in many cases. However, as groynes made of geotextile bags behave like impermeable walls experience has shown that the distance between two consecutive geotextile groynes has to be much smaller than for rocks or concrete. This makes using geotextile a less attractive option for a groyne field.

257. **Sand for Beach Nourishment.** Beach nourishment is proposed at three subproject sites, namely Udyavara, Maravanthe and Murudeshwar. It has been shown that the sand used for nourishment at the critical sections of Maravanthe will be met by redistribution of sand within the same littoral cell. It will be like one time sand bypassing. At Udyavara and Murudeshwara, sand has to be supplied from outside sources. The sand volumes required at these two places are 720,000 m^3 and 90,000 m^3. Several sand sources have been identified during the PPTA study as well as project 1 planning and design phase. Confirmatory chemical analysis of the sand is yet to be done before definite mapping of the sand source. This exercise needs to be completed before the final contract award for the beach nourishment work at Udyavara and Murudeshwara.

(i) The new Mangalore Port Dump ground is a possible sediment source – data indicate that at the surface and depths of 1 meter the levels of silts and clays are too high, although there are indications that the percent of sand increases with depth. Tests have been carried out during the PPTA to assess the level of contaminants. There is evidence of some contamination however levels are within international standards.
(ii) The sand bar at the river mouth contains good quality sediments; care is required to assess the safe quantity of sand available from this area due to environmental issues and possible scour along the breakwaters. It is estimated that this source could provide adequate sand for the geotextile sand filled reefs.
(iii) Inside the Netravathi River mouth there is also good quality sand. The safe volume of sand to be extracted however has to be assessed.
(iv) There is also huge sand trapped by the Ullal north breakwater and Gangolli inlet breakwater.

D. Study of Alternative Options

258. The design finalization for the recommended option has followed a 3-stage process. During the pre-feasibility study level, which constitutes the first stage, nature of the problem along with a basic shore protection scheme and ball-park cost are estimated. During the feasibility study, a Multi Criteria Analysis (MCA) is used to short-list three or four options from a wider list. These three or four options are then evaluated to in-depth conceptual design basis including social, environmental and economic issues.

259. A Multi Criteria Analysis (MCA) is a quick method of ranking the options among a whole list of alternative options. A variety of assessment criteria were used including cost, sustainability and societal impacts. Each option was assessed under the different criteria and given a score to determine the total score for each option. The highest scoring options are considered the most suitable to be taken forwards for more detailed analysis. Each option is scored based on its positive or negative impact under each criterion. This is identified as either 'Low', 'Medium' or 'High' based on the collective decision of the group. An option is available for 'N/A', though this should be avoided where possible to show full consideration (Figure 17).

260. Often this approach rejects certain proposed options where one or two criteria are not acceptable. For example placing a major concrete sea wall in a very environmentally sensitive location where natural dune frontages exist in front of dispersed communities, will most likely generate high negative value scores, which ultimately would deem such an option unsuitable for that location – probably on the basis of environmental impact and cost.

261. The basis behind the approach is that for each criterion along the top of the table then there must be at least one score of -5 and at least one score of +5 against each option. In this way the full range of relative impacts and benefits can be assessed for each of the options provided. And when combined the overall potential for any option to move forwards to more detailed assessment can be achieved.

262. The alternative options taken forward for detailed analysis after MCA are discussed in the feasibility study reports of each sub project. The final proposed option at each site and its key features are given in this report under Section II- Project Description.

Figure 17: The Values Given to Each Assessment

Based on the Positive and Negative Impact

High +	5
Medium +	3
Low +	1
N/A	0
Low -	-1
Medium -	-3
High -	-5

E. Options Considered at Subproject Sites

263. For the subproject at Someshwara, two options considered during the feasibility level are:

(i) geotextile Sand Container revetment for providing shelter from direct wave attack in the lee side and holding the shoreline in position; and
(ii) rock revetment.

264. These two options have been assessed in more detail at the feasibility stage. The concept revetment sections, crest heights and the size of the structural elements are developed along with realistic costs. The final option proposed at Someshwara is a revetment made of sand-filled geotextile bags. Its key features are given in this report under Section II- Project Description. During the discussion on the option, the CWPRS suggested keeping the rock option for the revetment open. A final decision on this could be taken at the time of detailed design by December 2015.

265. For the subproject Yermal Thenka, three options considered for further feasibility analysis are:

(i) Rock Groynes;
(ii) Geotextile Groynes and;
(iii) Rock Revetment.

266. These three options have been assessed in more detail at the feasibility stage. The concept revetment sections, crest heights and the size of the structural elements are developed along with realistic costs

267. Shore protection schemes based on groynes have been discarded following the rejection of any intervention structure in the water by the local fishermen. At the same time, demobilization of the 200m long construction jetty north of Yermal Thenka has also obviated the need for groynes. The final option proposed at Yermal Thenka is based on rock revetment along 5 km long shoreline. Its key features are given in this report under Section II- Project Description.

268. For the subproject at Udyavara, the three options that are carried forward for in-depth feasibility analysis are:

(i) Beach nourishment without any structure
(ii) Groynes and partial beach nourishment
(iii) Offshore reef and partial beach nourishment

269. These options have been assessed in more detail at the feasibility stage to arrive at the layout for each scheme, dimensions of the individual structural elements and the cost figures. Beach nourishment without any structure did not receive much favour from the side of Administrative Management and was perceived as too risky. Reef option was removed from technical consideration of higher risk of the bed settlement under the reef.

270. The final option adopted at Udyavara comprises of a groyne field and sand nourishment. Its key features are given in this report under Section II- Project Description

271. For this subproject at Kodi Bengre, planting scores a low, unsustainable option due to lack of space and inadequacy to protect against direct attack of the waves on to the revetment fronting the highway. The primary concern here is the reduced beach width during the monsoon and flooding due to wave overtopping. Because of the existence of a rock revetment at the site, rock is the preferred material for the rehabilitation of the revetment here. The options adopted for further analysis is Rock revetment providing shelter from direct wave attack in the lee side and protecting the infrastructure behind the existing seawall.

272. This option has been assessed in more detail at this feasibility stage, to design the concept cross-section as well as the cost figure.

273. The final option proposed at Kodi Bengre and its key features are given in this report under Section II- Project Description.

274. For the subproject at Maravanthe, planting turns out to be a low, unsustainable option due to lack of space and inadequacy to protect against direct attack of the waves on to the revetment fronting the highway. Option based on offshore reef scores high due to its effectiveness in reducing the wave height reaching the shore and advancing the shoreline through salient formation. In all, four options have been adopted for further analysis. These are:

(i) Two offshore reefs providing shelter from direct wave attack in the lee side and creating the conditions for the salient formation thereby, increasing the beach width along a significant part of the shoreline.
(ii) One offshore reef, creating a salient in the most vulnerable place and shore normal groynes made of rocks.
(iii) Same as above except that the groynes are made of geotextile bags. A smaller spacing is recommended for the geotextile groynes, resulting in a larger number of groynes.
(iv) T-Head groynes fronting the most vulnerable stretch in the middle of the site and shore normal straight groynes on both sides.
(v) In all cases above, sand is redistributed along the shoreline and the underlying philosophy is that the structures help retain the sand in the right place after the redistribution.

275. These options have been assessed in more detail at the feasibility stage. All the four schemes have been studied in depth to their design basis. For each scheme, the layout, spacing between the groynes and the structural dimensions are evaluated along with the cost figures. Reef option is not recommended because of the potential risk of unacceptable bed settlement offshore.

276. The final option proposed at Maravanthe is a combination of straight and T-Head groynes along with sand redistribution. Key features of the scheme are given in this report under Section II- Project Description

277. The subproject at Murudeshwar is uniquely marked by a short causeway connecting to what was earlier a nearshore island. North of the causeway is a popular tourist attraction and shows evidence of erosion. A combination scheme is proposed here which integrates shoreline protection with tourism potential in a sustainable way. The shoreline management option consists of an offshore structure, beach nourishment along half of the shoreline and dune stabilization through planting along the remaining half. The options considered for the offshore structure are:

(i) Rock and tetrapod reef
(ii) Geotextile-tube reef
(iii) Concrete reefballs

278. These options for the offshore structure have been looked at during the feasibility option. At the present, the offshore reef is located at a water depth of 4m w.r.t CD. At this depth, earlier experience has shown that risk of failure increases for sand-filled-containers (geotextile tubes).

Reefballs may not be very efficient unless they could be placed closer to the shore. Therefore, the present recommendation for the reef is a design based on concrete tetrapods on the sea-side and the round head, and rocks on the leeside. The feasibility study provides an in-depth design basis of the shore protection scheme with concrete tetrapod-rock reef as the offshore structure.

279. The final option proposed at Murudeshwar is a rock-tetrapod reef, beach nourishment along 500m shoreline and dune stabilization at adjacent 500m of the shoreline. Its key features are given in this report under Section II- Project Description.

F. Without Project

Table 6 Shoreline Recession Rate at Tranche 2 Sub Project Sites

Sl.no	Site	Shoreline Recession rate m/year
1	Udyavara	1.28 to 1.47
2	Kodi Bengre	0.5 to 2.5
3	Maravanthe	0.5 to 1.0
4	Murudeshwara	0.64

280. As described before, many of the coastal sites in Karnataka experience severe erosion. There are no systematic survey data available at any site to access the recession rate accurately, Table 6 gives an indication of the erosion rates available from the literature at some of the sites for few of the tranche 2 sites. Shoreline recession data is not available for the rest of the sites except for the sites mentioned in Table 6. The erosion rates may increase further due to projected sea level rise.

281. Without the project, the coastline will continue to erode, damaging infrastructure, land and houses and other buildings.

282. Road which the coast is a vital supporting infrastructure for fisheries activities. In absence coastal protection measures, the road will erode. Construction of new road in current present price will cost nearly Rs 1590 lakh.

283. Owning land in a coastal area is an important asset for the people. Proposed measure will protect land from erosion. Another important aspect is that reduced overtopping of saline water will also protect productivity. Presently nearly 334.77 acres is at risk. As per prevailing market price of agriculture land in the surrounding area, the rate is Rs 7,000,000 per acre. Total cost of land at risk is Rs 18751.2 lakh.

284. Avoidance of resettlement costs that may arise if land and buildings are eroded. Resettlement of family living in high area will cost Rs 10850 Lakh in current prices.

285. Nearly 1,352 acres of land in these areas are under coconut plantation. Families owning these land are cumulative able to earn Rs 391 Lakh per year.

286. Cashew plantation is another major economic activity in Maravanthe and Karki gram Panchayaths, according to biodiversity document prepared by Environmental Management and Policy Research Institute (EMPRI). Approximately 32 acres of land in these areas are under

cashew plantation. Families owning these lands are cumulatively able to earn Rs 12.12 Lakhs per year from cashew plantation.

287. According to socioeconomic survey carried out in December 2014, nearly 1746 persons depend on fishing as their primary occupation. Average cumulative household income of these families is nearly Rs 2874 lakh/year. Loss of beach or resettlement in the event of breach of the spit will lead to loss of livelihood of these families. The proposed sub-project will protect livelihood of the fishing families in the subproject area.

288. In Udyavara nearly 250 acre of land is under Mattu Gulla (GI Brinjal) cultivation. Mattu Gulla is a specially variety of Brinjal grown in this area only. Farmers growing Mattu Gulla earn nearly Rs 1.50 lakh per acre per year.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Potential Adverse Effects

289. Project activities will take place in 12 locations split into 9 subprojects namely, Someshwara, Yermal Thenka, Udyavara, Maravanthe, Kodi Bengre, Kodi Kanyana, Murudeshwara and Pavinakurve, the 9th sub project will be identified during the implementation of project 2 subprojects.

290. The nine locations are spread across the three coastal districts of Karnataka State and exhibit similar ecological and resource values so scope of activities and potential effects are considered below. However, no impacts are expected due to the proposed plantation scheme in subprojects at Kodi Kanyana and Pavinakurve as these are small scale plantation schemes involving local community for planting and maintenance. No EMP is required for these 2 sites however certain degree of monitoring with respect to near shore marine water, ground water and sediment quality is required at these 2 sites. Details of monitoring of all the sub projects under Tranche 2 are provided in **Error! Reference source not found.**.

291. The Community Protection Sub Projects Stage 2, i.e. the 9th sub project is expected to have a similar impacts already covered under tranche 2 project, i.e. impacts due to Sand Nourishment and Plantation. However, once the 9th Sub Project sites becomes clearer, more site specific Environmental Assessment will be carried out by PMDCK2 and this IEE and EMP will be updated. The Updated IEE and EMP will be submitted to the PMU for review and finally the report has to be submitted to ADB for information and disclosure.

292. Following Table 7 shows the subproject locations proposed under project 2 along with the proposed solution to mitigate coastal erosion.

Table 7: Sustainable Coastal Protection and Management Investment Programme Karnataka - Tranche 2 subprojects

Sl. No	Sub-project Site	Problem	Protection Length (m)	Solution
Protection Project				
1	Someshwara	Erosion, Wave Overtopping	2,000	Geotextile revetment
2	Yermal Thenka	Erosion, Wave Overtopping	4,500	Rock revetment

3	Udyavara	Severe Erosion, Wave Overtopping	5,000	Straight Groynes, Partial Sand Nourishment
4	Maravanthe	Severe Erosion	3,500	Straight & T-Head Groynes, Sand Redistribution within Sediment Cell
5	Kodi Bengre	Severe Erosion	4,500	Rock revetment
6	Murudeshwara	Severe Erosion	1,500	1 Off shore reef, Partial Sand Nourishment and Dune Planting
Stage 1 Community Protection Sub Projects				
1	Kodi Kanyana	Mild Erosion	1,500	Dune Planting
2	Pavinakurve	Mild Erosion	1,500	Dune Planting
Stage 2 Community Protection Sub Projects				
1	Will be selected during project implementation	Mild Erosion	30,000	Sand Nourishment and Dune Planting
Total Protection Length (m)			**54,000**	

293. This section identifies and predicts the potential impacts on different environmental components during the pre-construction, construction and operational phase of sub projects. It details all the potential impacts on biophysical and socio-economic components of the local environment due to the activities and sub-activities. Prediction of impacts is the most important component in the Environmental Impact Assessment studies. The prediction of impacts helps to minimize the adverse impacts and maximize the beneficial impacts on environmental quality during post project completion. The screening of environmental impact and its mitigation measures are given below.

B. Screening of Environmental Impacts

Table 8: Screening of Environmental Impacts of Project 2

Environmental Attributes		**Project Aspects and interventions**	**Impact**	**Mitigation Hierarchy**	**Mitigation Measures**
Biological Environment	Mangroves	Project Location	Insignificant and Reversible (since work will not involve the Mangrove area so the impact will be insignificant)	Avoided (the project locations are so selected that avoids the designated areas of Mangroves planted.)	No mitigation measures required
	Turtle nesting	Project Location	Significant and Irreversible (if the turtle	Avoided (The turtle nesting	No mitigation required as the selected project

Environmental Attributes		Project Aspects and interventions	Impact	Mitigation Hierarchy	Mitigation Measures
			nesting area is not avoided, the nesting areas will be lost.)	locations have been excluded after consultation with Local Forest Department and NGOs from this project, these locations are identified by the forest department and NGOs)	sites is not within previously spotted sporadic nesting site. If turtle nesting found closer/within the construction site, works should be halted and alert the concerned authorities and work site should be shifted away and take all necessary actions to protect the nests.
	Marine Ecosystem	Project Location and construction activity near shore and offshore	Insignificant and reversible (the impact on marine ecosystem will be limited to beach area and length as proposed)	Minimized (minimized by selecting project measures to limit to the shoreline and already having anthropogenic activity)	No disposal of waste into sea and storage of excavated sand on land side.
			Increase turbidity and sunlight penetration as well as change in sediment pattern and flows at dredging site	Minimized (Certain degree of turbidity is expected during dredging operation, which is temporary)	No mitigation required
			Removal and disturbance to aquatic flora and fauna	Minimized (Most of the construction are near shore and disturbance to aquatic	No mitigation required

Environmental Attributes		Project Aspects and interventions	Impact	Mitigation Hierarchy	Mitigation Measures
				flora and fauna is not expected to be significant)	
			Alteration of bottom surface and modification to bathymetry, causing change in tidal bore, river circulation, species diversity and salinity	Avoided(none of the sub project structures will have impact on the tidal bore, river circulation, species diversity and salinity)	No mitigation required
			Change in sediment pattern and littoral drift that may cause beach/coastal erosion of neighboring areas	All sub project coastal protection structures are designed to stabilize the entire vulnerable stretch of the shoreline in such a way as to minimize adverse effects on downstrea m.	No mitigation required as the mitigation measure is included in the design stage
	Residential area	Project Location and transportation of construction material	Significant and reversible (if transportation of construction vehicles and material are not appropriate the impact due to operation of vehicle may	Project location avoids residential area while transportati on. Constructio n materials will be	Construction materials should be covered while transportation

Environmental Attributes		Project Aspects and interventions	Impact	Mitigation Hierarchy	Mitigation Measures
			create negative impact and causing public protest and hindrance to the project)	transported through National Highway No 66	
Ambient Air Quality and Ambient Noise level	Open area	Batching Plant location, construction equipment, movement of barges and vessels	Insignificant and reversible (since the construction work is located away from the residential area the impact will be limited due to operation of construction vehicles only)	Avoid the residential area and any sensitive area while selecting the site for batching plant.	Follow manufacturer's guidelines for batching plant and mitigation measures proposed in EMP
	Construction camps and Construction site	Use of oil and lubricants	Insignificant and reversible (the construction camps will mainly be storage of material and parking of construction vehicles and not having off situ casting so impact would be limited and once the construction camp is closed, it will be revert back to original condition)	Reduced (reduced by adopting mitigative measures)	Handling and storage of oil and lubricants on impermeable platform to prevent any leakage on ground
Surface and Ground Water	At the beach nourishment area, Groynes , revetment and reef	Sand redistribution which may cause turbidity	Significant	Minimize (minimize by selecting coarse sand so that it settles quickly)	Select coarse sand so that it settles quickly.

Environmental Attributes		Project Aspects and interventions	Impact	Mitigation Hierarchy	Mitigation Measures
	Sea	Disposal of construction waste	Significant Reversible (if the breeding season which is monsoon season is not avoided, the impact will be significant)	Avoided (construction in breeding season and disposal of waste into sea will also be avoided by managing waste.)	No waste will be disposed in the sea.
Socio-economic	Fishing activity – Access of local fisher man to launching boats	Construction site of Groynes	insignificant and reversible (the impact on fishery will be insignificant because it will not obstruct the movement of fisher man and its facility)	Minimize	20-25 meter of beach will be barricaded at each location at the interval of about 100-120 meters
Land Use	Sea Beach	Construction of reef, Groynes and sand redistribution	No Impact	Avoided	No change in land use
Natural Resources	Use of quarry material	Construction of Groynes, reef and revetment	Significant impact and irreversible (use of quarry material is significant and opening of new quarry will have significant impact and irreversible)	Avoided (this will be avoided by use excavated rock out of tunneling project)	Rock will be procured from a tunneling project or other designated quarries. No new quarry will be opened for the purpose of this project
Health and safety	Community	Construction site	Significant (movement of local people on the construction site will have risk of drowning)	Avoided (this will be avoided by providing barricading)	Barricade and signage at the construction site and prohibit movement of local people within the construction site.
		Movement of local people on	Significant (movement of	Avoided this will be	Warning Signage and emergency

Environmental Attributes		Project Aspects and interventions	Impact	Mitigation Hierarchy	Mitigation Measures
		Groynes and revetment post construction stage.	local people and tourist on the Groynes will have risk of drowning)	avoided by providing signage and emergency number display.	number will be provided.
	Workers	Construction activity	Significant (accident during construction)	Avoided/ minimize (by providing PPEs and safety measures)	Provide Personal Protective equipment

Table 9: Mitigation Hierarchy of Environmental Impacts

Impacts	Significant Adverse Impact	The impacts are widespread and some or the impact are irreversible. Which is defined as the ecosystem cannot be brought to the original condition
	Insignificant adverse impact	Less impact and limited to the construction site and most of them are reversible. Which is defined as the ecosystem can be brought to the original condition.
Mitigation Hierarchy	Avoid	The first step of the mitigation hierarchy comprises measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of infrastructure or disturbance.
	Minimise	Measures taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided. Effective minimization can eliminate some negative impacts.
	Restoration / Rehabilitation	Measures taken to improve degraded or removed ecosystems following exposure to impacts that cannot be completely avoided or minimised. Restoration tries to return an area to the original ecosystem that occurred before impacts, whereas rehabilitation only aims to restore basic ecological functions and/or ecosystem services. Rehabilitation and restoration are frequently needed towards the end of a project's life-cycle, but may be possible in some areas

		during operation.

The detailed impact and mitigation measures are given for various parameters below-

294. **Pre-Construction Stage Impact Assessment.** The pre-construction phase will comprise all preparation works required for construction to commence. This will include preparing DPR, obtaining CRZ clearance, CWC approval, preparation of tender documents awarding contracts, preparation of a construction management plan, liaison with key regulatory parties and finalisation of documents supporting the EMP (Example – Pollution Under Control Certificate etc) prior to commencement of works.

295. This IEE and EMP have to be included as part of the bidding and contract document for project 2 civil works.

296. **Construction Phase.** Majority of the impacts are confined to construction phase and these impacts are expected to be short term and reversible. Following section discusses the impacts expected on environment of the sub project sites due to project activity. The anticipated impacts of project activity are given in below table.

Table 10: Anticipated Impacts due to Project 2 Subprojects

Sl No.	Project Activity	Anticipated impact	Mitigation Measures
1.	Transportation of Rock	Noise due to operation of vehicles in residential area, Change of land use of the area where quarry is operated Safety risk of handling of rock.	Noise level mitigation measures will be avoided by proper maintenance of machineries and equipment. Work will be limited to day time. New Quarry Operation will be avoided by use of excavated rocks form identified tunnel project or from designated legal quarry.
2.	Preparation of site	Clearance of vegetation including some risk species like Mangroves	Location of Mangroves has been avoided. Tree cutting will be avoided.
3.	Transportation of geotextile material for revetment	No Impact	
5.	Construction Camp	Leakage and spill over of stored material like fuel, lubricants and adhesives. Safety risk of workers in	Provide impermeable layer for storage of lubricants, fuel and adhesives.

		the construction camp Safety risk of movement outside people to the construction camp.	Provide PPEs to workers, safety awareness training and safety inspections, identification of hazardous places, activity and equipment. Provide mitigation measures.
6.	Labour Camp	Competing use of resources with local community like power, water, space. Conflict with local community if the construction site is near the local community. Solid waste generated from the labour camp Health and hygiene of workers living in the construction camp if facility is not sufficient. Compliance of labour laws.	Select location of labour camp away from community and community facility where interventions are expected. Provide solid waste management, disposal of sewage. Provide facilities like safe drinking water, clean fuel, safe dwelling. Take labour license form labour commissioner.
7.	The construction of Groynes extends some distance in the sea	Increased turbidity in sea water Damage to flora fauna during breeding season which is Monsoon. Safety Risk – since the construction of Groynes give access to dangerous depth where drowning can happen.	Use coarse sand so it settles quickly. Avoid monsoon season for construction at in the sea. Provide sign board and warning sign. Also provide emergency numbers displayed at the construction site.
8.	Construction of Offshore structure.	This requires geotechnical investigation for suitability of seabed to sustain the load of offshore structure/reef. This may require removal of upper layer of seabed and disposal at suitable	Select site based on the suitable geotechnical requirements. If unavoidable, prepare muck disposal plan based on quality and quantity of muck.

		location which has minimum environmental/ ecological impact and these disposal locations are not hindrance to the movement of sea transport.	
9.	Sand nourishment – Movement of sand from source location with sea to target location where nourishment is required.	Sand nourishment may cause turbidity in water at localised area.	Minimise the disturbance after nourishment so that sand can settle.
10.	Dune Plantation	Community may protest if species of plantation are not suitable. Use of chemical pesticide may cause its impact.	Select species in consultation with local community. Avoid chemical pesticide. If required use herbal pesticide.

297. Based on the above understanding, impact assessment and its mitigation measures are provided in the following section. The impacts and mitigation measures are not limited to the above table but assessment has been done in details in the following sections.

1. Ambient Air Quality

a. Potential Effects

298. Air quality potentially will be affected during the construction stage from the activities like vessels and equipment installing the reef at Murudeshwara, excavation of beach for construction of under layer of Groynes, rock revetment; transportation of construction material; from the batching plant for casting tetrapod at Maravanthe; the use of earthmovers and heavy duty trucks at all civil construction sub project sits will lead to increase in dust emission, which will increase further in presence of dry winds blowing landwards, along with emissions from the engines of the vehicles. Vessels and equipment are expected to emit small amounts of particulates and green-house gases during operation over these seasonal construction windows. This will cause a small but definite increase in presence of particulate matter as well as marginal increase in concentrations of SOx and NOx and hydrocarbons.

299. Land vehicles that deliver construction materials/personnel and equipment to construction sites and from construction site to land access locations for transfer to installation sites will periodically emit small amounts exhaust fumes.

300. Effects on air quality during operation and maintenance of the reef, groynes, rock revetment and beach nourishment areas are not expected, apart from short inspection visits by responsible authorities and/or repairs if damage occurs. These visits are expected to be of relatively short duration compared to initial construction activities.

b. Subproject Specific Impact Assessment

301. Someshwara subproject will be provided with geotextile revetment. No air pollution impact is expected except operation of construction vehicle but it is expected it will be within permissible limits. The operation of construction vehicles involves transportation of rock from the selected area.

302. Yermal Thenka Subproject will be provided with rock revetment. No air pollution impact is expected except operation of construction vehicle but it is expected it will be within permissible limits. The operation of construction vehicles involves transportation of rock from the selected area.

303. Udyavara subproject will be provided with 35 number of rock groynes at an interval of 120 meters and its length will be about 65-70 meters. Since the groynes will be constructed of rocks. So this will also not cause air pollution.

304. Kodi Bengre Subproject will be provided with rock revetment. No air pollution impact is expected except operation of construction vehicle but it is expected it will be within permissible limits. The operation of construction vehicles involves transportation of rock from the selected area.

305. Kodi Kanyana involves three layered plantation of 1,500 m stretch implementation through participation community. This will not have impact on ambient air quality.

306. Maravanthe subproject will have five straight groynes at spacing of 120 m, nine T-Head groynes at spacing of 150 meters and redistribution of 225,000 m^3 sand. Groynes will be constructed of rock with Tetrapod. Sand redistribution will be done within sea. So construction work in this project will not generate dust or air pollution except exhaust of construction vehicles but it is expected it will be within permissible limits.

307. Murudeshwara involves offshore structure between -3 mCD and -4 mCD providing shelter to the beach from direct wave attack in the lee side and creating conditions for the salient formation thereby, increasing the beach width along a significant part of the shoreline in the tourist-active part, Beach nourishment with relatively coarser sand to create a more amenable beach for the tourists, while providing protection against wave overtopping to the road and wave attack to the peripheral wall and Dune stabilization by suitable planting along the entire length of approximately 0.5 km north of the tourist beach. These activities do not generate air pollutant. But operation of construction vehicles and machine will generate pollutants but this will be within permissible limit.

308. Pavinakurve involves three layered plantation of 500 m stretch implementation through participation community. This will not have an impact on ambient air quality.

c. Mitigation Measures

309. Possible mitigation measures include: turning off engines and generators when not in use; equipment conformity to international standards; regular/routine servicing of all construction vehicles and machinery; and immediate replacement of defective equipment and removal from work sites.

310. Measures to control dust emissions from construction sites or other locations include dust suppression by regular sprinkling, i.e. morning and evening, of water; halting work during excessive onshore winds; and addressing verbal social complaints immediately.

d. Subproject Specific Mitigation Measures

i. Someshwara Subproject

311. Transportation of material required of geotextile revetment does not generate dust but the exhaust of vehicles generate air pollutants like RPM, SO2, NOx etc. this will be monitored through pollution under control certificates. It this is non-compliant, the vehicle will be removed from the construction for maintenance or replacement.

ii. Yermal Thenka Subproject

312. Transportation of material rock does not generate dust but the exhaust of vehicles generate air pollutants like RPM, SO2, NOx etc. this will be monitored through pollution under control certificates. It this is non-compliant, the vehicle will be removed from the construction for maintenance or replacement.

iii. Udyavara Subproject

313. Transportation of material rock does not generate dust but the exhaust of vehicles generate air pollutants like RPM, SO2, NOx etc. this will be monitored through pollution under control certificates. It this is non-compliant, the vehicle will be removed from the construction for maintenance or replacement.

iv. Kodi Bengre

314. Transportation of material rock does not generate dust but the exhaust of vehicles generate air pollutants like RPM, SO2, NOx etc. this will be monitored through pollution under control certificates. It this is non-compliant, the vehicle will be removed from the construction for maintenance or replacement.

v. Maravanthe

315. Transportation of material rock does not generate dust but the exhaust of vehicles generate air pollutants like RPM, SO2, NOx etc. this will be monitored through pollution under control certificates. It this is non-compliant, the vehicle will be removed from the construction for maintenance or replacement.

vi. Murudeshwara

316. Transportation of material rock does not generate dust but the exhaust of vehicles generate air pollutants like RPM, SO2, NOx etc. this will be monitored through pollution under control certificates. It this is non-compliant, the vehicle will be removed from the construction for maintenance or replacement.

e. Significance of Residual Effects

317. Air quality effects are expected to be small in volume and geographical area. Emissions will occur during most of each seasonal construction window though duration in any one location will be relatively short. Potential effects can be minimized through use of standard mitigation measures. Concentrations of particulates and gases rapidly will return to pre-construction conditions once activity ceases. Significant effects on air quality are not anticipated.

2. Ambient Noise Level

a. Potential Effects

318. Noise will occur when vessels and/or barges bring sand to the beach nourishment area at Udyavara and Maravanthe project area and equipment/pumps distribute sand along the shore, and when equipment are engaged in reef, Groyne and rock revetment construction activities along the civil construction sub project sites. Additional though smaller noise sources will include land vehicles used to move material and equipment between staging areas and work-area access points. Noise will occur periodically over the three non-monsoon construction seasons.

319. Transportation and handling of rock at subproject Someshwara, Yermal Thenka, Udyavara, Kodibegre and Marvanthe will create noise and vibration. Since the construction site is away from habitation and construction work will be allowed in day time only so no impact due to noise is anticipated.

b. Mitigation Measures

320. Possible mitigation measures include identification of work timing windows and/or appropriate hours of equipment operation acceptable to the community through consultation; maintaining minimum noise levels in locations near dwellings and businesses; daily checks to improve potential sources of excessive noise especially out of daylight hours; addressing complaints regarding noise immediately.

321. Noise will be minimized by turning off engines and generators when not in use; equipment conformity to international standards; fitting all vehicles used in construction with silencers; and immediate replacement of defective equipment and removal from the site.

322. Residents expressed during feasibility study consultation desire to have the erosion problem dealt with as rapidly as possible to prevent further damage to dwellings and may wish to have longer work hours in order to shorten the overall construction period.

c. Significance of Residual Effects

323. Noise will occur at reef, groyne, and beach nourishment locations and associated on-land work areas during seasonal (non-monsoon) construction periods. Noise will not be sustained at any single work location and will shift as work is initiated and completed at each location. Noise levels can be minimized through use of standard mitigation measures; effects on communities can be minimized through public consultation regarding appropriate hours of construction activity. Noise levels will return to pre-construction conditions once activity ceases. Significant effects of project-related noise levels are not anticipated.

3. Longshore Currents and Beach Erosion

a. Potential Impacts

324. Coastal structures may have potential to alter the local current and wave patterns which may have some negative impacts on the adjacent shoreline.

325. Revetments may interfere with the longshore currents if not constructed away from the wave run-up line.

326. Groynes will also affect the longshore current and the sediment movement. The adverse effects downstream can be significant if groynes are extended further into the sea.

327. Reflection of waves from the reef may reach the adjacent shoreline, if the shoreline is curved or islands are in the vicinity offshore of the reef. Reef also induces longshore current to the leeside of the reef from the adjacent shoreline. For shorter length of the reef, the influence zone is limited to a shorter length of the adjacent beach behind the reef.

b. Mitigation Measures

328. The proposed groynes are short in length, normal to the shore. They are designed with appropriate spacing, length and height for the primary purpose of stabilising the beach between two consecutive groynes. A field of groynes is designed to stabilise the entire vulnerable stretch of the shoreline with transition at the end to minimise adverse effects downstream.

329. Rock/geotextile revetment have been designed as far as back from the mean high water level depending on the site conditions and will have no impact on longshore currents during most period of the year and might have very minimal impact during the monsoon at some sites due to the drop in beach level itself.

330. In case of Murudeshwara, wave are nearly normal to the reef, therefore the reflected waves will travel back offshore without affecting the shoreline . Some reflected waves may hit the adjacent island but the island is rocky. Since the island is rocky, there will be no adverse effect. In the shadow area of the reef, sand nourishment is proposed, this will extend the baseline by 20m, therefore small movement of small volume of sediment from the adjacent beach towards the leeside of the beach will be compensated by the nourished beach.

c. Significance of Residual Effects

331. Proposed designs and locations of reef, Groynes and revetment are expected to avoid changes to currents that would induce rip currents or beach erosion. Significant adverse effects

on currents are not expected but changes in current patterns are to be monitored and evaluated for several years after reef, Groyne and revetments are installed. Appropriate measures will be considered and taken if significant adverse effects are observed.

4. Water quality

a. Potential Effects

332. Water quality along sub project sites could be affected by:

(i) Turbidity during sediment placement in target areas at Udyavara, Maravanthe and Murudeshwara along the sub project sites at Udyavara, Maravanthe and Murudeshwara beaches as fine sediments are flushed from the coarser sand material;
(ii) Turbidity during possible spills of sediment near the beach nourishment area or during filling of geotextile containers used for revetment at Someshwara;
(iii) Contaminants that flush from sediment after placement at target locations on the beach, reef, geotextile revetment or from sediment spills; and
(iv) Leaks or spills of operational material such as fuels, oils or hydraulic fluids.

333. Turbidity has potential to impair photosynthesis of phytoplankton and other flora, feeding and migratory behavior of fish and invertebrates, and aesthetic attributes potentially important to tourist activity that takes place mainly in the southern portion of the beach area. By design, the project will be selecting bottom sediments that are largely coarser sand material. High turbidity is expected after initial sand placement and possibly after the first period of heavy waves as fine sediment is removed from coarser fractions. High turbidity is expected to be of short duration with concentrations of fine material declining as those particles settle out of the water column in lower energy areas away from the immediate shoreline. The impact is insignificant since nourishment will be mainly on the beaches of Udyavara, Maravanthe and Murudeshwara and not having sensitive ecosystem. The construction work will avoid fish breeding season of Monsoon. This will also reduce the significance of impact.

334. Sediments having concentrations of potential contaminants will not be used for sediment placement on the beach or in geotextile containers used for revetment at Someshwara. Currently, types of contaminants that may be present in bottom sediments to be used for beach nourishment are not known. In general, contaminants have potential to be toxic to organisms, interrupt food webs and migration of fish and other organisms, and affect human health. If present in sediment placed on the beach likely such compounds will be rapidly flushed from the sand material together with fine sediments.

335. Fuels, oils and hydraulic fluids also have potential to affect ecological resources and human health; effects would be determined by amount of material released and degree of exposure by organisms and humans. There is no activity which involves release of fuel, oil or hydraulic fluids at construction site. These will be handled at the construction camp set for the sub-project of Someshwara, Udyavara, Yermal Thenka, Murudeshwara, Kodi Bengre and Maravanthe. Kodi Kanyana and Pavinakurve will be required to set up construction camp so no impact is envisaged.

b. Mitigation Measures

336. Potential contaminants - Sediments to be used for beach nourishment and filling geotextile containers will be selected in part based on identification of potential contaminants and acceptable limits for allowing use of sediments containing those contaminants.

337. Turbidity - Sediments to be used for beach nourishment and filling geotextile containers will be selected in part based on presence of mainly larger particle sizes and small proportions of fine material such as fine sand, silts and clays, so that the sediments will settle relatively quickly .

338. Sediment spills – equipment inspection and repair will be undertaken and documented routinely before and during sediment transfer from transport containers/vessels to beach or geotextile revetment.

339. Fuels, oils, hydraulic fluids – Protocols for routine equipment inspection and repair/maintenance, and fueling will be required before work commences and practices during work must be documented. Contingency plans to be used in the event of spills will also be required beforehand and spill containment and clean-up equipment must be present during all fueling and fluid replacement/top-up activities. Fuelling of vessels and equipment should take place at shore mooring locations with spill containment equipment present prior to commencement of fueling.

340. Routine discharges are unlikely to be made due to the nature of the proposal. If there are accidental spills contingency plans should be initiated immediately.

c. Significance of Residual Effects

341. Water will be temporarily turbid along the shoreline after placement of sediment in beach nourishment areas and in geotextile containers and in the vicinity of revetment also when geotextile containers are filled. Periods of high turbidity are expected to be of relatively short duration and geographical extent, with a return to background levels dependent on the amount of fine material in sediments and prevailing water/climate conditions. Periods of high wave energy along the shoreline could induce additional flushing of fine material at that time.

342. Possible contaminants in sediments are to be identified prior to sourcing the sand and effects should not be evident if sediments having contaminants are avoided during dredging. A chemical analysis of sediment for beach nourishment will be undertaken. Standard measures to prevent, contain and clean up possible leaks or accidental spills of fuels, oils, hydraulic fluids are available (Section e Accidents and Malfunctions, below) and should be in place before start of construction.

343. Significant effects on water quality are not anticipated if proposed mitigation measures are used.

5. Accidents/malfunctions

a. Potential Adverse Effects

344. Possible accidents and malfunctions that could have adverse environmental effects during construction include fuel, oil, lubricant spills, and fires/explosions, spills of sand and

vessel collisions or rock vessel collision at construction site of Someswara, Udyavara, Yermal Thenka, Kodi Bengre, Maravanthe and Murudeshwara . Fuel, oil or lubricant spills could affect water quality, ecological resources and human health. Fires/explosions could affect air quality and human health. Spills of sediment could affect water quality mainly in the form of high levels of turbidity along the shore. Vessel collisions could lead to economic losses and human injury or fatality.

b. Mitigation Measures

345. Measures can be taken to prevent these accidents and malfunctions. In addition, contingency plans can be prepared to contain and clean-up spills of fuels, oils and lubricants and sediment if an event occurs.

c. Significance of Residual Effects

346. Significant adverse effects of accidents or malfunctions are not anticipated as long as preventative safeguards are in place and contingency plans prepared and implemented if found necessary.

6. 6. Effects on Ecological Resources - Marine Biota and Habitat

a. Potential Adverse Effects

347. Placement of sediment for beach nourishment, construction of reef, groynes and revetment will smother benthic biota and temporarily impair food web relationships and possibly local production of food used by harvestable species. The effect on beach nourishment areas will be short-lived as the re-establishment of benthic population will begin with cessation of sediment placement as work progresses to new areas along the stretch of beach targeted for nourishment.

b. Effects of water quality changes

348. Temporary increase in turbidity has potential to reduce photosynthetic activity and impair plankton production, feeding activity, migration and behaviour patterns. Potentially these effects could cause short term reduction in production of harvestable species. Alongshore and cross-shore currents will carry sediment disturbed from the site to the surrounding region. Littoral transport of sediment is minimal in the area during the non-monsoon period; the zone of high turbidity is expected to extend less than one to two kilometers at that time before sediment settles out of the water column.

349. Project activities could cause chemicals to be released along the beach including contaminants brought in sediment from dredging locations, fuels, oils, and hydraulic fluids. Measures to minimize potential release of these compounds are described in Section e, Accidents and Malfunctions. These materials have potential to be directly toxic to organisms and interfere with food webs, migration and behavior patterns and catch of harvestable species.

c. Mitigation Measures

350. **Construction**. Measures to minimize release of sediment, and chemical compounds during placement of sediment in the beach nourishment area and during construction and filling

of the geotextile containers for revetment at Someshwara are described in Section d, water quality above.

351. Project activities are planned to be completed within as short a period of time as possible. At reef and berm locations, sand-bottom habitat will be replaced by potential reef-like habitat and new fish/invertebrate assemblages.

352. Fish and invertebrate taxa using the sub project area are not known; characterization of the fish/invertebrate communities, especially mobile species, would enable types and timing of likely use which could be used to refine the timing of construction activity in order to minimize possible effects.

353. Project activities are planned to be completed within as short a period of time as possible. At groyne and revetment locations, sand-bottom habitat will be replaced by potential reef-like habitat and new fish/invertebrate assemblages.

354. In the event that the geotextile revetment are deemed no longer necessary they lend themselves to decommissioning by splitting open geotextile containers, releasing sand contained therein, and removal of fabric, suggesting that benthic smothering effects would be reversible if bags are removed.

d. Significance of Residual Effects

355. The project will likely cause localized reduction of benthic and planktonic production in the target area of beach nourishment sites during the construction period with effects lasting for several months after which the benthic biological conditions typical of sand habitat are anticipated to be reestablished. Benthic habitat in relatively small areas under the proposed reef will be replaced by reef-like habitat as biological colonization of the reef takes place. Follow-up studies to verify that reef are providing expected habitat, fish/invertebrate assemblages and possible fisheries enhancement will require collection of pre-construction baseline data with regard to benthos, fisheries and invertebrates at all civil construction sub project sites

356. If measures to prevent release of potentially harmful chemicals are implemented adverse effects on marine life are not likely. Adverse effects on marine life in the sub project beach areas are expected to be limited to the duration of construction activities and occur over the relatively small construction area with turbidity temporarily affecting a broader area.

357. Significant adverse effects on marine life are not anticipated.

7. Effects on Ecological Resources - Terrestrial Habitats

a. Potential Effects

358. Small areas of land likely will be needed during the construction phase for constructing geotextile/ rock revetment, groyne and possible equipment access points, and material/equipment storage/staging. Project needs are uncertain and will be identified based on contractor proposals during the tendering process. The project area is mainly an area of human habitation and activity including light industry and tourism; adverse effects on terrestrial habitat are unlikely.

b. Mitigation Measures

359. If clearing of vegetated areas is needed area conditions indicate that disturbance to local habitats likely can be rectified. Replanting and therefore stabilization of the environment including replacement of any native plant species should be possible.

c. Significance of Residual Effects

360. Although land needs are uncertain likely there will be little effect on terrestrial habitat and, if needed, effects can be mitigated. No significant adverse effects are anticipated.

8. Waste Management

361. Throughout construction, the workforce will generate general refuse comprising food scraps, waste paper, empty containers etc. The storage, handling and disposal of general refuse have the potential to give rise to some environmental impacts if not properly managed. These include odour if waste is not collected frequently, windblown litter, water quality impacts if waste enters water bodies, and visual impact. Rapid and effective collection of site wastes will therefore be required. With the implementation of good site practices and the recommended mitigation measures on disposal arrangements, adverse environmental impacts are not expected to arise during the construction works.

9. 9. Natural resources

362. Construction of rock groynes and rock revetment across all the civil construction projects require about 716,208m^3 of rock and the source of rock is to be approved by the Government of Karnataka. The nearest sources of construction material are within 70km radius from the project site. The responsibility of rehabilitation of quarry lies with the operator of the quarry since the government approval given to the operator based on the conditions of the rehabilitation.

363. About 1,035,000 m^3 of sand is required for beach fill within the T groynes, and shore normal groynes at Udyavara, Maravanthe and Murudeshwara which will be sourced by redistribution of sand from northern beaches and within the same sediment cell from the excavated beach material obtained due to construction of groynes. About 29,870 m^3 sand is required for filling of geotextile containers for the construction of revetment at Someshwara, the sand excavated for the construction of revetment will be used for filing the bags.

10. Local Land Traffic

a. Potential Adverse Effects

364. During construction there will be periodic movement of equipment, material and supplies by land and from work areas. The main material to be used during these activities, sediment for beach nourishment and geotextile revetment and rock for revetment and groyne, will be transported by vessels/barges. The amount of vehicles and trips required during the construction phase will be identified during the tendering project; however these requirements and their effect on land traffic is not expected to be large.

b. Mitigation Measures

365. Construction related activities including movement of equipment and supplies will be discussed with stakeholders during consultations before construction begins. Project needs related to access points, staging/construction areas and land traffic will be discussed at that time together with community input regarding activity timing and possible local traffic control needs.

c. Significance of Residual Effects

366. Significant adverse effects on local traffic are not anticipated.

11. Tourism

a. Potential Adverse Effects

367. During construction, local tourist entities may be periodically affected by air quality changes, noise, local traffic, and water quality changes (high turbidity) along the shoreline. These effects will be temporary; high turbidity may extend for several kilometers and persist for a number of days after activity ceases depending on the amount of fine material contained in the sediment used for beach nourishment.

368. During operation Groynes and revetment will be visible along the shore changes in wave patterns will be visible offshore where the submerged reef is situated. The Groynes will eventually blend with the beach as areas in the cups formed by the Groyne fill and the beach extends seaward.

b. Mitigation Measures

369. Consultation meetings are planned prior to construction to inform stakeholders of planned activities and discuss activity types and scheduling.

370. Measures to mitigate possible effects of contaminants in sand and degraded water quality are described in Section d, water quality.

c. Significance of Residual Effects

371. The main residual effect on tourism will be periods during construction when high turbidity will be visible in water along the beach. Turbidity may extend for several kilometers and last for a number of days once work activity ceases. Significant adverse effects on tourism along the beach are not anticipated.

12. Safety and Human Health

a. Potential Adverse Effects

372. Factors that could affect human health during construction include air quality, noise, accidents/malfunctions, mishaps and sand and water quality. Factors that could affect safety are accidents/malfunctions, increased land/traffic, navigational mishaps and equipment activities at the beach nourishment and reef, groynes and revetment work areas.

b. Mitigation Measures

373. Measures to mitigate possible effects on air quality, noise, sand and water quality, increased land traffic and navigational mishaps are described in preceding subsections.

374. Measures to mitigate safety concerns relate mainly to equipment operation and construction activities in each work area; some areas will have to be restricted to ensure the safety of the local people and site workers.

c. Significance of Residual Effects

375. Measures must be implemented to protect human safety and health. Significant adverse effects are not anticipated if those measures are adhered to.

13. Health and safety of worker

376. The civil work contractor is responsible for providing safety equipment for the workers and the contractors will be enforced to comply with the requirement to provide Personal protective equipment (PPEs) for the workers as part of the health and safety measures. The health and safety of the workers will be taken care by providing safe working condition and personal protective equipment. The contractor will assess the detailed requirement of PPE before commencement of the work. The construction of groynes requires handling of rocks. Falling of heavy rock on labours can cause serious damage. This will be the responsibility of the contractor and under the supervision of PMU to provide suitable safety boots to the workers. The contractor will provide safe drinking water and hygienic condition for boarding and lodging.

14. Health and Safety of Community

377. The construction site of groynes and revetment shall be fenced and proper sign board will be displayed to avoid accidents.

15. Livelihoods and Fishing Activity

a. Potential Adverse Effects

378. The sub projects are not expected to adversely affect livelihood during or after construction. Possible local effects during construction on fishing vessel movement or equipment use, fish production (short-term reduction in benthic and planktonic food organisms likely would not be detectable in catches), and tourism likely will not be manifested in loss of livelihood.

b. Mitigation Measures

379. The subproject components are not expected to have any adverse impact on livelihood of the local community. The construction of groyne and revetment may have temporary impact on access to fishing beaches and loading places of fish during construction period. This will be mitigated by providing alternate access in consultation with the fishermen.

380. And most importantly none of the subprojects are not located in estuaries thus there will be no impact of Navigation due to the sub projects.

16. Significance of Residual Effects

381. Significant adverse effects on livelihoods are not anticipated.

17. Cumulative Effects of the Project

382. The subprojects are located at substantial distance from each other. The various activities during construction and operation are not expected to cumulatively affect valued resource components as long as planned mitigation measures are adhered to. The project activities are likely to add incrementally to effects from other sources in their respective areas over the construction period (such as local increases in noise and exhaust fumes) but are not expected to have adverse effects on valued resource components within their respective regions once construction ends.

18. Unanticipated Impacts

383. Unanticipated impacts are always possible in a project of this size and complexity. Such impacts are more likely to result from natural or man-made disasters. Therefore, the PMU, contractors and other relevant stakeholders should be prepared for any contingencies arising from unanticipated impacts.

384. **Operational Phase.** The post-construction phase will comprise carrying out rehabilitation of site before contractor leaves the site. Planting and stabilization of site, including replacement of any native plant species, if any.

385. All areas used for temporary construction operations must be completely restored to their former condition with appropriate rehabilitation procedures as per the rehabilitation plan prepared by the contractor and approved by the Engineer/Environmental Officer.

386. While it is not envisaged that there will be any substantial environmental impacts resulting from works carried out in this phase, the EMP has allowed for additional monitoring works to be completed.

C. Cumulative Effects of Project

387. Multiple activities during the construction and operation phases are not expected to cumulatively affect valued resource components as long as planned mitigation measures are adhered to. Subproject activities likely will add incrementally to effects from other sources over the construction period (such as local increases in noise and exhaust fumes) but are not expected to have significant adverse cumulative effects on valued resource components once construction activities cease.

D. Climate Change Implications

388. The historical sea level rise rate (S1) is 1.31mm/year. This is calculated by taking the average of trend analyses for Marmagoa (0.91mm/yr) to the North of Maravanthe and Cochin (1.71mm/yr) to the South (NOAA, 2013).

389. There are varied approaches to projecting the expected Sea Level Rise (SLR). It is deemed most appropriate to adopt the Physical Science basis in the IPCC Fifth Assessment Report (IPCC, 2013) for the future sea level rise rate (S2). Projected global average of SLR

during the 21st Century is considered to range between 3.9mm/year to 9.7mm/year across the six scenarios developed for the 21st century. For the purposes of this report Scenario RCP 6.0 has been used as this is the medium stabilisation scenario. The future rates of Sea Level rise pertinent to Karnataka coastline are outlined in Table 11

Table 11: The Annual Rates of sea Level Rise. The Rates have been Calculated in 20 Year Intervals according to Scenario RCP 6.0 of IPCC, 2013.

Year	Annual rate of sea level rise (m)
2000	0.0013
2020	0.0037
2040	0.0048
2060	0.0050
2080	0.0065
2100	0.0075

390. Using this, the increase in SLR over the next 25 years is calculated to be 97.5mm.

391. This has been taken in the design water level and resulting in design of height of structural element of proposed coastal protection schemes under Tranche 2 including plantation schemes.

E. Beneficial Effects

392. The project activity will rectify the present long term trend of degradation of the beach. The short-run net result will be arresting adverse changes by balancing the material cycle, and thereby enhancing the system in the long-run.

393. Further, the submerged reef at Murudeshwara may enhance fishery productivity by establishing the foundation of an additional food web and encourage an assemblage of reef organisms.

394. Previous successful beach nourishment schemes in Europe, US and Australia have improved overall biodiversity, stabilized the coastline and increased tourism due to more aesthetically pleasing surroundings.

F. Irreversible and Irretrievable Impacts

395. The rock to be used for the Tranche 2 project is an outcome of a tunneling project and thus there will be no new quarry is expected to source rock for the Tranche 2; fossil fuels will be used by vessels, vehicles and equipment. The subproject is expected to have a negligible irreversible effect on the natural resources.

VI. PUBLIC INVOLVEMENT AND DISCLOSURE

A. Public Consultation Methodology

396. Consulting stakeholders, right from the project design phase was considered as an important activity. Soon after the preparation of project pre Feasibility Report, discussions were held at grassroots level, involving the officials, elected representatives and officials of GPs and general public from the coastal wards of the villages.

397. Public consultations were carried out in several stages at three levels on a multi-stakeholder format. The three levels include i) community level ii) GP level and iii) district level. The initial consultation process involved preliminary presentations at the community level, listening to their concerns and apprehensions, seeking their ideas and incorporating them in the final design, where feasible. This was followed by a meeting at the GP level, where meetings were held with the elected body members and officials. Some prominent citizens such as members of the fisher folks association, retired school teachers were also present in these meetings by invitation. The ward-specific elected body members and some GP officials were familiar with the proposed structures by virtue of their attendance in the community level consultations. This was followed by a common meeting (sometimes two or more) convened by the District Collector. These meetings were generally large with as many as 50 to 60 participants attending in each meeting.

398. Gram Panchayath (GP) was considered as the rallying point for all the sub project consultations. Initially, the project team met the local GP president, vice president and Panchayath Development Officer(PDO) to collect the information related to the particular sub project for e.g – demographic details, number of coastal wards, impact of beach erosion on the local people etc.

399. The project team requests the local GP for providing date and also to invite the people from the village/villages falling under the proposed sub project site. After the confirmation of the date and place of meeting the project team including social, technical and environmental specialists presented the information regarding the Tranche 2 proposal.

400. During public consultation at each of the sub project sites, the distribution of project brochure in local language has been a standard practice. (refer Appendix 4 for a copy of the brochure) The brochure describes the components of SCPMIP-K, aims and objectives of SCPMIP-K and the sites selected for Tranche 2.

401. At the outset of the meeting, following procedures were adopted i) introduction of the project team ii) brief explanation about SCPMIP, iii) discussion on the current practices of coastal protection and their environmental consequences iv) need for permanent sustainable solution for coastal protection at the sub project sites. Project details were explained to them in the meetings including the possible interventions proposed and their suggestion were noted down and logical suggestions were considered into the design. These consultations provided inputs to the various sector specialists in identification of the felt needs of the communities, and the relevant stakeholders.

402. In each meeting the project team emphasised the importance of local and affected persons participation in decision making and requested the participants to share their problem related to coastal erosion.

403. The team used sketches and drawings to visually demonstrate the designs, and sought people's opinions of the local people, especially the fisher folks.

404. During the discussion the project team also suggested to contact the PMU and PMDC-K's office for any further information, suggestion or for grievance, if any. The brochure contained the complete address with contact information of PMU and PMDC-K.

405. The minutes of the meeting held at each of the sub project sites are given in Appendix 4.

406. Most of the main stakeholders have already been identified and consulted during preparation the feasibility report any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders are

(i) Public Works, Ports and Inland Water Transport Deparment
(ii) Fisheries Departement
(iii) National Highways Authority of India
(iv) Gram Panchayaths of Sub Project sites
(v) Local fishermen association
(vi) Community Prayer Assemblies (Bhajana Mandirs)
(vii) The beneficiary community in general
(viii) ADB as the funding agency

407. Secondary stakeholders are:

(i) Other concerned government institutions
(ii) NGOs and CBOs working in the affected communities;
(iii) Other community representatives (prominent citizens, religious leaders, elders, women's groups)

1. Future Consultation and Disclosure

408. The public consultation and disclosure program will remain a continuous process throughout the subprojects implementation and shall include the following

2. Consultation During Detailed Design

409. Focus-group discussions with villagers from coastal wards of each gram Panchayath and other stakeholders to were held to consider their views and concerns, so that these can be addressed in proposed project wherever necessary. Regular updates on the environmental component of the project will be kept available at the PMU of Public Works, Ports and Inland Water Transport Department.

3. Consultation During Construction

410. Public meetings with affected communities (if any) to discuss and plan work programs and allow issues to be raised and addressed once construction commences

411. Micro-level, field meetings to discuss and plan construction work with local communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation. An attempt will be made to address their grievances (if any) at the first level where they occur.

412. PMU will conduct information dissemination sessions at major habitations and solicit the help of the local community leaders/fisherman association, prominent citizens to encourage the participation of the people to discuss various environmental issues.

413. The PMU will conduct information dissemination sessions in the project area. During EMP implementation PMU shall organize public meetings and will apprise the communities about the progress on the implementation of EMP in the subproject works.

4. Disclosure of Environmental Impact Assessment

414. Local communities will be continuously consulted and their consent will be sought regarding location of construction camps, access and hauling routes and other likely disturbances during construction. For the benefit of the community the IEE will be disclosed to the community and other stakeholders and the summary IEE in local language(s) will be made available in an accessible place in a timely manner. In addition, it will be made available at: (i) PMU office; (ii) District Commissioner Office ;.(iii) District Pollution Control Board; (iv) Office of the Regional Director (Environment). It will be ensured that the hard copies of IEE are kept at such places which are conveniently accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE will be placed in the official website of the PMU and official website of ADB after approval of the IEE by ADB.

B. Major Comments Received and Addressed

415. The summary of major environmental concerns raised during consultations at each of the sub project sites were closely linked with livelihoods issue and loss of livelihood dependant assets. Concerns were raised by the stakeholders on the pace of erosion and the imminent environmental threat and loss of livelihoods caused by it. The main environmental concerns raised by the local businessmen engaged in fishing and other trades were over the construction of groynes where they wanted clarification on the effect of the same on movement of fishing vessels and nets. Sub project wise people's views are discussed in section 3 – Impact of Beach Erosion and the minutes of these meetings are given in Appendix 4.

C. Compliance with Regulatory Requirements for Public Participation

416. Public participation activities are in compliance with requirements of GOI and ADB guidelines. Additional consultations will take place on findings of the IEE and during the implementation stage.

D. Summary of Public Acceptance

417. There has always been a high level of support for the coastal protection works at sub project sites. In general the stakeholders were very supportive of the design proposals and there appeared to be no reason from the stakeholder why the project could not proceed. In all the proposed construction sites, assurance of full co-operation by the communities has been exemplary. There are requirements for further dialogue and it is recommended that the shoreline management organization should be established as soon as possible.

VII. GRIEVANCE REDRESSAL MECHANISM

418. Although there has been no grievance received during the implementation of tranche 1, the grievance redress mechanism under tranche 1 will be employed for tranche 2. The GRM will aim to provide a time bound and transparent mechanism to voice and resolve social and environmental concerns linked with the project. The project specific GRM is not intended to bypass the government's own redress process, rather it is intended to address project affected people's concerns and complaints promptly, making it readily accessible to all segments of affected persons and is scaled to the risks and impacts of the project. The set at three levels i.e. i) sub-project and PMU level ii) local GRC level and iii) district administration level, as shown in figure 19 below.. The Assistant Executive Engineer(AEE)/ Assistant Engineer (AE)of the

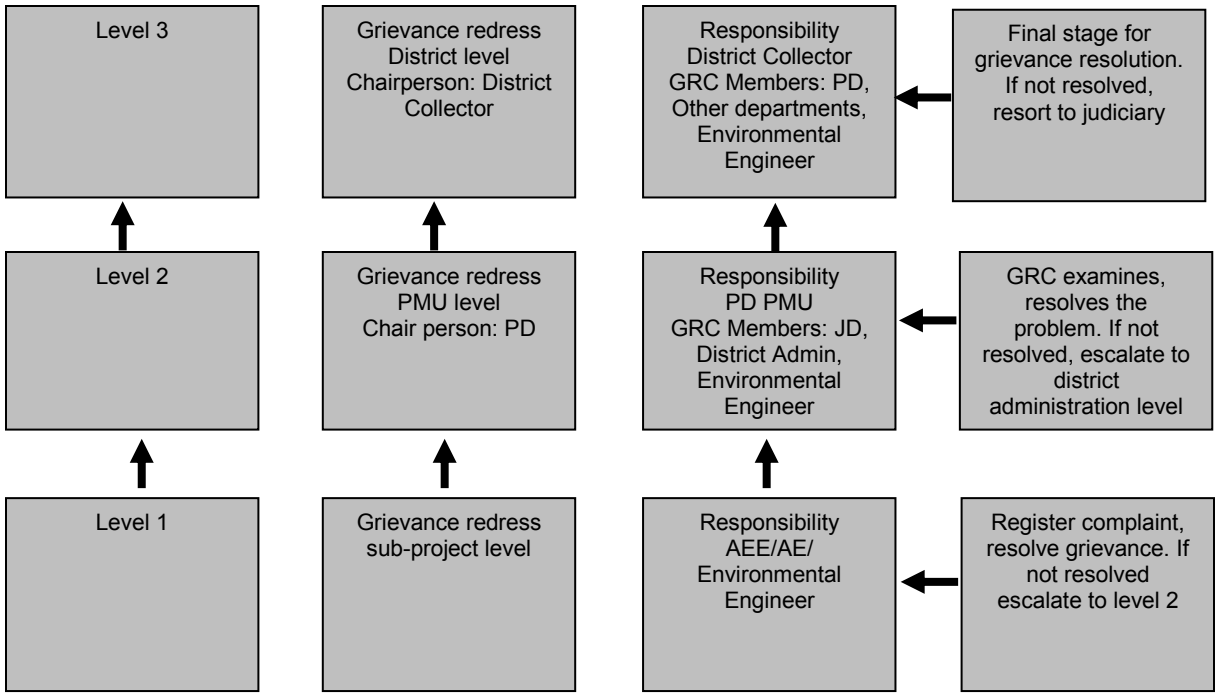
respective project sites will be the first recipient of the grievance of the Affected Persons (APs). The grievance will be recorded at PMU by Environmental Engineer. The AE and environmental engineer will make an attempt to address the grievances (pertaining to contractors or to the project design and construction aspects) and resolve issues at the point of origin itself. At this level, the grievance team will consist of the AEE/AE, others sub-project team member, and representative of affected people.

419. If the redress mechanism fails to resolve the issue at this level, the Affected People assisted by the AEE/AE can escalate the grievances to the second level i.e. Grievance Redressal Committee (GRC) level. The Project Director, PMU will try and resolve the grievance by forming a GRC with appropriate department based on the type of grievances, by convening a meeting of the GRC and the Affected Persons. He is fully empowered to address the grievances by taking up appropriate remedial measures so that the grievances are fully addressed. The Project Director, PMU will consult the expert members to find acceptable solutions.

420. If the grievance is not resolved either at level 1 or at level 2 to the full satisfaction of the Affected Persons, they can further escalate it to the district administration level of their respective districts (level 3). The district collector of the respective districts will act as the chairperson of the GRCC at level 3. The district collector can call for a common meeting of the PMU, contractor, respective GPs and the affected people depending on the nature of the grievance.

421. The GRC at this level will determine the merit of each grievance, and resolve grievances within a month of receiving the grievance by the Affected People or the project implementing agency. If grievances are not addressed to the full satisfaction of the affected people even at level 3, further grievances by the Affected People can be raised to the appropriate judiciary levels or to ADB. Records will be kept of all grievances received including: contact details of complainant, date of the complaint received, nature of grievance, agreed corrective actions and the date of these were effected, and final outcome.

Figure 18 : Grievance Redressal Mechanism



VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. MItigation

422. Potential adverse effects during the construction stage include temporary and localized effects on air quality, noise levels, beach sand quality, water quality, marine biota and habitat, terrestrial biota and habitat, nearshore fishing activity, vehicle traffic, tourist activity and safety of beach users. Measures are identified to prevent or minimize these effects. Potential adverse effects during operation and maintenance stage include erosion of beaches if structures do not perform as planned or unexpected events occur (with associated effects on land, buildings and economic activity), marine habitat and biota, fishing activity. These possible effects were important considerations during the design stage and have been mitigated mainly through site-specific design features such as placement locations, depths, size and shape.

423. An environmental management plan (EMP) is presented in Appendix 3. The EMP identifies potential impacts to be mitigated, monitoring plan, and institutional measures to be taken during key subproject activity stages. The EMP identifies the parties responsible for implementing each action.

424. The EMP is proposed for the sub project sites where civil construction activities have been proposed and EMP is not required for the 2 sub projects viz., Pavinakurve and Kodi Kanyana where only a small scale plantation scheme will be taken up and only environmental monitoring related to near shore marine water, ground water and sediment quality has been proposed for these 2 sites.

425. As outlined in the EMP additional information to support development of the EMP includes:

(i) Additional data on possible contaminants in the planned sediment sources to be used for beach nourishment and filling geotextile containers; This sediment analysis will be carried out by PMU and the data will be analysed by PMDCK2 and report will be sent to PMU regarding the suitability of sediment for nourishment and filling geotextile container.
(ii) Establishment of baseline data(water and sediment) as per this report at Kodi Kanyana and Pavinakurve. This data will be established by PMU and the test results will reviewed and recommended by PMDCK2.
(iii) Characterization of the fish and invertebrate communities in the sub project beach area using existing published/unpublished information to aid identification of possible refinements to work activities and schedules; this review of literature will be reviewed by PMDCK2 and report will be submitted to PMU.

B. Monitoring

426. Environmental Monitoring Plan is provided in **Error! Reference source not found.** as part of the EMP in Appendix 3. Monitoring is planned for the construction period to monitor pre-construction and construction activities and post-construction to monitor effectiveness of structure designs and locations for preventing impacts on relevant environmental features such as erosion of beaches and impairment of fishing activity and navigation. The monitoring plan

includes all locations where subproject activities will take place and identifies parameters to be measured, measurements to be made, measurement locations and frequency, and institutional responsibilities.

427. Environmental monitoring will be organized through an Environmental Management Committee (EMC) to be convened by the executing agency. The executing agency shall be key as an intermediary of matters between the EMC, stakeholders, local community and the contractor

1. Environmental Audit of Tranche 2 subprojects

428. Aside from internal monitoring, the PMU will engage a third party environmental auditor to conduct an annual environmental audit for all the project 2 subprojects. To review the IEE and the EMPs and identify the key mitigation measures and monitoring requirements during the construction phase. The cost of environmental audit is included in the environmental budget and presented in Table 18 in Appendix 3. Some of the key outputs from the Environmental Auditor is as follows:

(i) To conduct an annual environmental audit for all the Tranche 2 sub projects.
(ii) To review the IEE and the EMPs and identify the key mitigation measures and monitoring requirements during the construction phase.
(iii) To examine the records and documentation relating to impacts, actions taken to manage them and aspects of performance i.e. more specifically to review the reports prepared by the Consultant teams environmental specialists for the coastal protection works, reports of the PMU and ADB's aide memoires during each proceeding audit period of one year.
(iv) To conduct site observations at locations where construction activities are underway and at contractor facilities to check that environmental measures and controls are operating as described and intended.
(v) To conduct interviews with management and line staff of PMU, Contractors' personnel dealing with the implementation of EMP and the relevant personnel of the PMDCK-2 to corroborate factual information and probe areas of concern.
(vi) To review implementation status of recommendations/mitigation measures regarding design aspects of the civil works against safety, adequate location, arrangements for proper ventilation, lighting, provision of basic facilities for the use of workers/disabled staff etc.
(vii) To assess the efficacy of monitoring of implementation of EMP and identify shortcomings, if any and areas for improvement, if any and areas for improvement.
(viii) To identify constraints if any in ensuring compliance to the measures outlined in the EMP
(ix) To prepare and present the findings (draft report) to PMU. The report shall highlight constraints, if any during implementation of mitigation measures indicated in the EMPs and the extent of effective monitoring by the PMUs etc, and suggest measures for effective implementation and monitoring of EMPs. The audit report will be prepared based on review of the above document, site observations, compliance of the statutory requirements and interviews with stake holders.
(x) Preparation of final report with suitable appendices etc after approval of the findings of the Draft report by the PMU.

C. Institutional Arrangements

1. Project Management Unit

429. The PWPIWTD is the executing agency for Tranche 2. There is already an existing Project Management Unit (PMU) which is undertaking the implementation of ADB loan for Tranche 1. During project implementation of both Tranche 1 and Tranche 2, the PMU will be responsible for supervising the implementation of this IEE and EMP prepared for Tranche 2.

430. Currently, the technical staff at PMU includes a Project Director- responsible for overall project implementation but not full time at site, a full time Joint Director(JD) who is available at site all the time, 2 numbers of Assistant Executive Engineers (AEE), 2 numbers of Assistant Engineers (AE), a environmental engineer and a GIS specialist.

431. Under project 2 it is proposed to strengthen the existing PMU by adding technical and administrative staff. The proposed additional technical staff for tranche 2, including the existing ones are 1 Project Director, 1 Joint Director, 2 Executive Engineers(EE), 4 Assistant Executive Engineers(AEE), 12 Assistant Engineers of (AE), 2 Environmental Engineer, 1 Health and Safety Engineer and 1 Social/ institutional Expert.

432. The PMU is responsible for overall environmental management of the proposed subprojects. The regular monitoring of environmental compliance audits shall be undertaken to make sure that the mitigation measures in the EMP are properly implemented by the PMU headed by an Environmental Specialist. The PMU is assisted by PMDC-K2 consultant and by designated site engineers who will be responsible for the field activities. The EA will ensure that key institutions including local governments are involved in updating the EMP (if necessary due to change in future design). The duties and responsibilities of the PMU include:

(i) To ensure that the detail design will take into account recommendations from the Environmental Assessment
(ii) Ensure that the bidding and contract document for civil work will include section for requirement to implement EMP during construction
(iii) Ensure that the bidders for the civil work will be evaluated also on their capacity to implement EMP
(iv) To monitor the implementation of EMP and to prepare and submit Environmental Monitoring Report to relevant parties including ADB for semiannual monitoring report.
(v) To recruit an accredited environmental monitoring agency for environmental monitoring and field surveys at sub project sites as recommended in the IEE and EMP.
(vi) To recruit a third party environmental auditor to audit for the compliance with respect to implementation of EMP.
(vii) To host Project Grievance Redressal Mechanism and resolve in coordination with local authorities, any grievance received from affected people.
(viii) Review the updated IEE and EMP report submitted for the Community Protection Subproject–Stage 2 by PMDCK2. Once reviewed and finalized, the report has to be submitted to ADB for information and disclosure.

a. Responsibilities of Environmental Engineer, PMU

433. The environmental engineer, PMU will take responsibility to assist PMU in implementing overall EMP and also to monitor implementation of EMP by contractor and supervise consultant. The brief responsibility of environmental engineer, PMU is as follows.

(i) Establish additional information required with respect to benthos at each of the sub project sites before the start of the construction works. At Murudeshwara the baseline data has to be established at the proposed reef location. Submit the result of benthic analysis to PMDCK2 for review and recommendation. Review the updated EMP submitted by PMDCK2 if required based on the benthos study.
(ii) Review the recommendation of PMDCK2 with respect to suitability of sediment to be used for sand nourishment and take necessary action.
(iii) Review the updated EMP submitted by PMDCK2, if any based on the construction methodology submitted by the contractor. Ensure that the updated EMP is included in the contract documents for the civil works.
(iv) Inform the local and regional environmental authorities regarding the start date of the sub project construction activities.
(v) Review the environmental monitoring locations suggested by PMDCK2, based on the contractor's construction methodology. If the locations suggested are accepted, invite accredited environmental monitoring agencies for collection of environmental data as per monitoring plan.
(vi) Review the environmental monitoring report submitted by the PMDCK and if it is found that the environmental parameters are above threshold levels, inform contractor to take appropriate corrective measures.
(vii) Supervise the implementation of the IEE and EMP clauses mentioned in the civil construction contract documents and take corrective action based on the non compliance by contractor, if any.
(viii) Liaison with the Karnataka State Pollution Control Board (KSPCB), and in seeking their assistance to resolve environment-related issues during project implementation
(ix) Review the environmental management along with monitoring data reports every 6 months and submission of the report to ADB, PWPIWTD and Karnataka State Coastal Zone Management Authority (KSCZMA).
(x) To ensure that the copy of CRZ clearance, environmental monitoring data and environmental compliance reports of each sub project sites are disclosed on PMU's website.
(xi) In coordination with health and safety engineer and make sure that the contractor's workers are using PPEs during construction.
(xii) Environmental engineer will be the focal point in grievance redressal mechanism. He/she will receive and record the grievance and progress in resolving the grievance.

D. Project Management and Design and Consultant Consultant 2 (PMDCK2)

434. PMDCK2 will be responsible for providing overall technical assistance in the implementation of project 2 subprojects. The duties and responsibilities of PMDCK2 include as far as the implementation of IEE and EMP include:

(i) Advise PMU and ensure that the detail design will take into account recommendations from the Environmental Assessment

(ii) Advise PMU and ensure that the bidding and contract document for civil work will include section for requirement to implement EMP during construction
(iii) Advise PMU and ensure that the bidders for the civil work will be evaluated also on their capacity to implement EMP
(iv) Assist PMU in preparing necessary sub consultancy agreement document for hiring environmental and survey agencies.
(v) Assist PMU in preparing necessary agreement document to hire a third party environmental auditor to audit for the compliance with respect to implementation of EMP.
(vi) Conduct public consultation meetings at Tranche 2 sub project locations.
(vii) Train the PMU and Tranche 2 sub project contractors on ADB safeguards requirement and EMP implementation as mentioned in this IEE and contract document.
(viii) Carryout environmental assessment of the Community Protection Sub Project – Stage 2, once the sites are confirmed. Update this IEE and EMP and submit the updated document to PMU and ensure that the report will be submitted to ADB.
(ix) Check and verify contractor claim for implementing EMP
(x) Advice the contractor in implementing EMP
(xi) Maintain data on contractor claim for implementing EMP

435. The responsibilities of Environmentalist, PMDCK2 are:

(i) Assist PMU in establishing the additional information required with respect to benthos at each of the sub project sites before the start of the construction works. Review and update the EMP if required based on the results of benthos study and submit the updated EMP to PMU.
(ii) Review the test results of sediments to be used for sand nourishment and filling geotextile containers and make recommendations to PMU.
(iii) Review the construction methodology submitted by the contractor and make appropriate changes to the EMP, if any to suite the construction methodology. Submit the updated EMP to PMU for review and ensure that the updated EMP is included in the contract document of the civil construction.
(iv) Based on the contractor's construction methodology identify the environmental monitoring locations in coordination with Environmental engineer, PMU for each sub project locations and submit a report. The environmental monitoring has to be carried out from an MoEFCC/ NABL accredited laboratory.
(v) Analyze the environmental monitoring data collected at each of the sub project sites and submit a report to PMU.
(vi) Monitoring of EMP clauses included in the bid documents in coordination with Environmental engineer, and suggest PMU in case of shortcomings.
(vii) Advising and coordinating effective environment management
(viii) Liaison with the Karnataka State Pollution Control Board (KSPCB) in coordination with Environmental Engineer, PMU and in seeking their assistance to resolve environment related issues during project implementation.
(ix) Providing training and safety updates with on environmental issues related to implementation of coastal protection structures to project staff, PMU staff and employees of contractor and also execute capacity building activities
(x) Prepare environmental management plan along with monitoring data reports every 6 months and submission of the report to PMU.

(xi) Review the monthly report submitted by the contractor with respect to implementation of EMP mentioned in the contractor clause. Inform PMU in case of shortcomings.
(xii) To ensure that the copy of CRZ clearance, environmental monitoring data and environmental compliance reports of each sub project sites are disclosed on PMU's website.
(xiii) Assist Environmental engineer, PMU in resolving grievances, if any.
(xiv) Assist in the preparation of relevant project output reports.
(xv) Review the bills submitted by the contractors with respect to implementation of EMP.

E. Contractor

436. As part of the employer's requirement, it is mandatory for the civil contractor to have a Environmental and safety inspector. The Contractor shall employ an Environmental and Safety Inspector with full time presence at the site. The Inspector shall prepare the site environmental management plan and safety action plan summarizing the Contractor's arrangements in sufficient detail to ensure compliance with all environmental and safety measures as per applicable stipulations, such as Indian Government rules and regulations, ADB environmental requirements as described also in the EMP of the IEE report of the project. The Contractor shall prepare monthly reports summarizing the Contractor's compliance with EMP and all environmental and safety regulations, as well as reporting any incident occurring at the site and the Contractor's follow-on precautionary measures to reduce the risk of future incidences of similar type.

437. The Contractor shall comply with all applicable environmental legislation, rules and regulations and international good practices to minimize, as far as is practically possible, the effects of all his and his subcontractors' activities upon the environment and shall implement and monitor measures to prevent:

(i) contamination of surfaces, ground, groundwater, surface water and rivers, sea water;
(ii) Emissions to air, including smells, gases, smoke, and dust;
(iii) Unsanitary or unsafe storage or discharge to drain, sewer and surface waters;
(iv) Unsanitary or unsafe storage or discharge of solid wastes;
(v) Noise;
(vi) Visual intrusion, and
(vii) Excessive energy and water consumption.

438. These requirements shall be met through the constant and careful attention of the Contractor's management of all site and off-site activities, and by instruction to all staff and labour in these matters. The contractors will be strictly required to implement the requirements pertaining to worker's health and safety. The safety equipment and procedure to handle emergency should be in place, and workers have to be trained in fire drills, and other drills for other emergency situations should be routinely carried out.

439. Contractor shall indicate all claims submitted for payment or reimbursement that specifically to implement EMP.

F. Third Party Environmental Auditor

440. Aside from internal monitoring, the PMU will engage a third party environmental auditor to conduct an annual environmental audit for all the Tranche 2 sub projects. The input of the environmental auditor is not more than 2 months per year.

G. Reporting

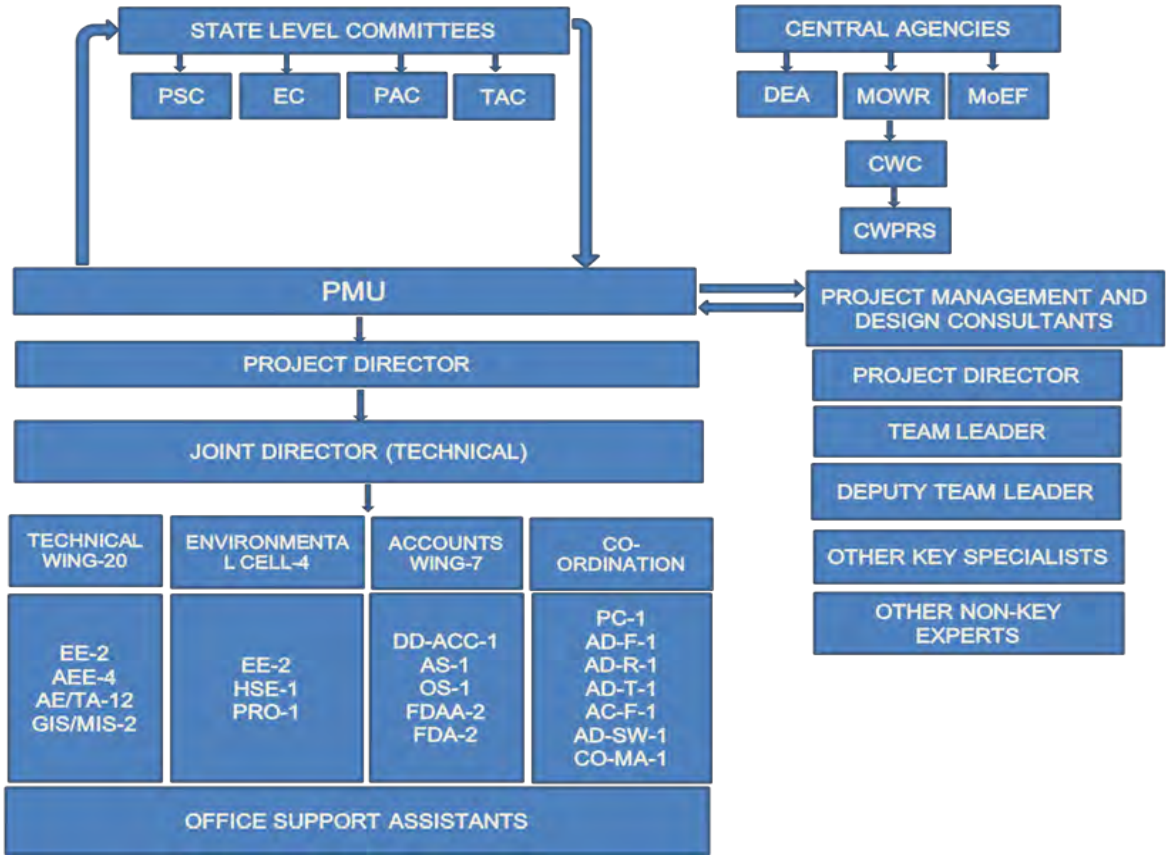
441. The PMDCK2 will regularly review and report the status of implementation of IEE and EMP by the contractor during the project implementation period of Tranche 2 sub project to PMU. This report will include the monitoring of (i) compliance with conditions obtained from KSCZMA for the applicable sub projects; (iii) compliance of environmental management plan, and iv) good environmental practice and standards at an international level for all sub project sites. The results of monitoring will be included in the regular project progress report. Reporting to PWPIWTD, KSCZMA and the ADB will be carried out in keeping with agreed operational guidelines.

442. The contractor will also prepare and submit monthly report for implementation of EMP and any other incident reporting to PMDCK2 and PMU.

443. PMU to review the reports submitted by the PMDCK2 and contractors and take corrective actions as required and submit the report to concerned state departments and to ADB after finalization.

444. The semiannual environmental monitoring report will need to be submitted by PMU to ADB on regular basis starting 6 months after the loan effectiveness.

H. Project 2 Organogram



Notes:
DEA-Dept.of Economic Affairs
MoWR-Ministry of Water Resources
MoEFCC - Ministry of Environment, Forest and Climate Change
CWC-Central Water Commission
CWPRS-Central Water and Power Research Station

PSC-Project Steering Committee
EC-Empowered Committee
PAC-Procurement Approval Committee
TAC-Technical Approval Committee

EE-Executive Engineer
AEE-Assistant Executive Engineer
AE-Assistant Engineer
EE-Environmental Engineer
HSE-Health & Safety Engineer
PRO-Public Relations Officer
DD-ACC-Accounts.

IX. CONCLUSIONS ANS RECOMMENDATIONS

A. Gains which Justify Project Implementation

445. The subproject designs are intended to prevent further degradation at the coastline, keep wave overtopping to an acceptable level. The shore protection measure adopted at some of the sites will help beach restoration to appreciable level.

446. As described before, many of the coastal sites in Karnataka experience severe erosion. Table 6 gives an indication of the erosion rates available from the literature at some of the sites. The erosion rates may increase further due to projected sea level rise.

447. Benefits of the proposed interventions on the beach will accrue from prevention of erosion by providing sustainable coastal protection interventions. The economy will benefit from prevention of loss of property and saving on the recurring cost of coastal protection. The enhanced beach will help regain the traditional fisheries operations and also create opportunities for beach tourism. Additional benefits could include possible enhancement of fisheries and turtle nesting. While these general benefits will be gained at almost all the project sites, there are several significant specific benefits at some of the sites:

(i) Udyavara: prevention of a possible breach of the spit, increased beach area potentially adding to increased number of tourists and convenience of fishermen.
(ii) Maravanthe: Prevention of a possible breach of an important National Highway, increased beach area potentially adding to increased number of tourists and convenience of fishermen.
(iii) Murudeshwar: Increase potential for tourism while controlling erosion, the offshore reef will in addition enhance ecological habitat
(iv) Kodi Kanyana and Pavinakurve: The dune stabilization by planting integrating community participation is the first of its kind in Karnataka and relatively new in India. It will promote cost-effective, local solutions in an eco-friendly manner, where applicable.

448. Erosion related problems at subproject beaches precipitate significant loss of opportunities to society as well as irrevocable loss of beachfront properties. Substantial amounts of resources may be needed to recover loss at a future date if the current trend is allowed to continue.

B. Minimization of Adverse Effects

449. Potential adverse effects during the construction phase, which will take place over several non-monsoon seasons, can be mitigated and significant residual effects are not anticipated.

450. Revetment at Someshwara, Yermal Thenka and Kodi Bengre are designed to be constructed as far as back towards the landward side and there will be impact on longshore currents for a short period during monsoon.

451. Groynes are Udyavara and Maravanthe are short groynes, going upto Low Water Level and there will be impact on longshore currents for a short period during monsoon.

452. Potential long-term adverse effects at sub project beaches on current and wave conditions and erosion of adjacent beaches were considered during the design stage; 1D modeling was used to aid selection of designs/locations to avoid effects. Risk management measures were considered for unexpected and undesirable impacts on coastal erosion due to new technologies applied and complex nature of coastal processes.

453. An environmental management plan (EMP) has been developed to address possible effects during construction and operation phases. Additional information to be obtained during early stage of implementation to support development of the EMP includes:

(i) Additional data on possible contaminants in the planned sediment sources to be used for beach nourishment and filling geotextile containers;
(ii) Establishment of baseline data (air, water and noise) as per this report at Kodi Kanyana and Pavinakurve.
(iii) Characterization of the benthos, fish and invertebrate communities in the sub project beaches using existing published/unpublished information to aid identification of possible refinements to work activities and schedules; and
(iv) Design of a follow-up study to confirm expected reef habitat benefits and possible enhancement of nearby fisheries, and if necessary collection of pre-construction baseline data.
(v) However, no impacts are expected due to the proposed plantation scheme in subprojects at Kodi Kanyana and Pavinakurve as these are small scale plantation schemes involving local community for planting and maintenance. No EMP is required for these 2 sites, however certain degree of monitoring with respect to near shore marine water, ground water and sediment quality is required project Tranche 2 are provided in

C. Use of Irreplaceable Resources

454. The rock to be used for the Tranche 2 project is will be procured from a tunneling project or other designated quarries. No new quarry will be opened for the purpose of this project; fossil fuels will be used by vessels, vehicles and equipment. The subproject is expected to have a negligible irreversible effect on the natural resources

D. Provision for Follow-up Surveillance, Monitoring and Reporting

455. All proposed mitigation measures, to address environmental impacts submitted to the Government of Karnataka to obtain CRZ clearance, have been incorporated into this IEE report submitted to the ADB. Therefore, the reporting on monitoring the implementation of EMP and monitoring the environmental quality will be prepared in biannual basis and submitted to the Government of Karnataka to comply with the CRZ clearance requirement and to ADB to comply with loan agreement.

456. Monitoring programs will be implemented during the construction and post construction phases. Long term follow-up surveillance and monitoring is expected to include examination of Long term effects on beach formation;Change in effectiveness of retention structures; and effectiveness of reef as new habitat for fisheries enhancement.

457. The location of one of the Community Protection Subproject, that will be designed by involving the communities, has not been selected, and therefore, the specific environmental impacts for this sub-project have not being assessed and have not been included in this report.

Prior to executing this sub-project, the environmental impact assessment will be prepared by following the guidance described in the Environmental Assessment Review Framework and by taking into account the environmental impacts from the similar subprojects implemented in Kodi Kanyana and Pavinakurve.

Appendix 1: Baseline Data Collection

1. The project 2 includes nine subprojects of which six subprojects are civil construction projects proposed at Someshwara, Yermal Thenka, Udyavara, Maravanthe, Kodi Bengre and Murudeshwara, while the other three subprojects at Kodi Kanyana, Pavinakurve, and Community Project Subproject – Stage 2 are soft solution by plantation for coastal management. The primary environmental data has been established focused on the 6 sub project sites having hard engineering structures, while the socio economic and secondary data has been collected for all 8 sub projects. The following Table 12 below shows the sampling locations for different parameters along with the coordinates of the samples taken. The test certificates are not shared here in this report but are available on request.

Table 12: Sampling Location for different Parameters with Coordinates of Sample Collected

Site	Ambient Air Quality Monitoring	Noise Level Monitoring	Ground Water	Marine Water					
				Surface Water-I	Surface Water-II	Sub-Surface Water -I	Surface Water -III	Sub-Surface Water - II	Sub Surface -III
Someshwara	12°47'43.53"N 74°51'12.88"E	12°47'43.53"N 74°51'12.88"E	12°46'47.76"N 74°51'25.34"E	12°46'29.89"N 74°51'30.12"E	-	12°46'27.73"N 74°51'29.46"E	12°46'29.93"N 74°51'23.99"E	12°46'29.93"N 74°51'23.99"E	-
Yermal Thenka	13°10'27.75"N 74°45'16.72"E	13°10'27.75"N 74°45'16.72"E	13°10'27.75"N 74°45'16.72"E	13°10'25.63"N 74°45'4.91"E	13°10'48.00"N 74°44'37.50"E	-	13°10'23.40"N 74°44'37.50"E	-	13°10'23.40"N 74°44'37.50"E
Udyavara	13°16'33.17"N 74°43'29.30"E	13°16'33.17"N 74°43'29.30"E	13°16'33.78"N 74°43'30.15"E	13°16'32.40"N 74°43'27.10"E	13°16'45.10"N 74°43'12.90"E	-	13°16'37.90"N 74°43'13.60"E	13°16'45.10"N 74°43'12.90"E	13°16'37.90"N 74°43'13.60"E
Maravanthe	13°41'57.94"N 74°38'40.65"E	13°41'57.94"N 74°38'40.65"E	13°41'50.07"N 74°38'41.10"E	13°41'33.08"N 74°38'38.12"E	13°41'24.30"N 74°38'24.60"E	13°41'24.30"N 74°38'24.60"E	13°41'28.30"N 74°38'10.50"E	13°41'28.30"N 74°38'10.50"E	-
Kodi Bengre	13°24'31.13"N 74°42'0.16"E	13°24'31.13"N 74°42'0.16"E	13°24'32.48"N 74°41'54.25"E	13°24'30.70"N 74°41'49.10"E	13°24'31.20"N 74°41'35.30"E	-	13°25'2.60"N 74°40'57.30"E	13°24'31.20"N 74°41'35.30"E	13°25'2.60"N 74°40'57.30"E
Murudeshwara	14° 5'48.05"N 74°29'14.05"E	14° 5'48.05"N 74°29'14.05"E	14° 5'53.54"N 74°29'14.86"E	14° 5'53.84"N 74°29'10.47"E	14° 5'48.19"N 74°29'1.36"E	14° 5'48.13"N 74°28'50.11"E	-	-	-

BASELINE ENVIRONMENTAL SAMPLING

Ambient Air Quality

2. One sampling location at each of the proposed civil construction sites has been selected for Ambient Air Quality. The coordinates where the AAQM was carried out are shown in Table 12 above. The main sources of air pollution in this area are house hold emission, agricultural activity and traffic of local road and nearby Nation Highway 66. The main recipients of the pollution are the local habitant of the nearby village.

3. Ambient air quality along the proposed alignment was measured at each of the proposed civil construction sites by setting up Ambient Air Quality Monitoring (AAQM) station. Pre calibrated Respirable Dust Sampler (RDS) and Fine Particulate Matter Sampler of Envirotech Instruments was used for monitoring. The parameters measured and method of measurement of ambient air quality monitoring is presented below along with the CPCB National Ambient Air Quality (NAAQ) Standards. The result of the air quality reveals that all of the ambient air quality parameters are well within the NAAQ Standards at all locations. As the project site lies along the busy National Highway, the values of pollutants are moderately high, but well within the statutory limits.

Table 13: Air Quality Parameters Measured

#	Parameters	Unit	NAAQ Standards	Methods
1.	Period of sampling	Hrs		--
2.	Particulate Matter (PM_{10})	µg/ m^3	100	IS: 5182 (P 23)-2006
3.	Particulate Matter ($PM_{2.5}$)	µg/ m^3	60	USEPA 40 CFR (P 53)
4.	Sulphur dioxide	µg/ m^3	80	IS: 5182 (P2)-2001
5.	Nitrogen dioxide	µg/ m^3	80	IS: 5182 (P6)-2006
6.	Lead (Pb)	µg/m^3	1.0 (24 hr Average)	Lab-SOP No. EHSRDC/SOP/ICP-OES/001 based on - CPCB Guidelines for the Measurement of Ambient Air Pollutants Volume-I ,2011
7.	Nickel (Ni)	ng/m^3	20.0 (Annual Average)	
8.	Arsenic (As)	ng/m^3	6.0 (Annual Average)	
9.	Carbon Monoxide (CO)	mg/m^3	4.0 (1 hr Average)	IS: 5182 (P 10)-1999
10.	Ozone (O_3)	µg/m^3	180 (1 hr Average)	Instrument method
11.	Ammonia (NH_3)	µg/m^3	400.0 (24 hr Average)	Air Sampling and Analysis Book, method 401
12.	Benzene (C_6H_6)	µg/m^3	5.0 (Annual Average)	IS: 5182 (P 11)-2006
13.	Benzo (a) pyrene (BaP)	ng/m^3	1.0 (Annual Average)	IS:5182 (P 12)-2004

Noise Level Monitoring

4. One sampling location at each of the proposed civil construction sites has been selected for Noise Level monitoring. The coordinates where the noise level monitoring was carried out are shown in Table 12 above.

5. Noise sampling was done only during the day as the entire area is residential in nature with no sources with high noise generating potential except traffic. The sampling was done during the day using 'Sound Level Meter EQ-8852'. The results of the noise level reveal that, the measured values are slightly higher than the CPCB standards at few sub project sites, the main reason being the nearby National Highway and the fisheries road that run parallel to the sub project sites, eg: Yermal Thenka, Maravanthe, Udyavara.

Water Sampling

6. Water sampling has been conducted for testing of ground water as well as marine water (surface and subsurface). Ground water and marine water samples have been collected from each of the proposed civil construction sites. These samples were tested for 41 parameters including physical, chemical, biological parameters and heavy metals. Saline water samples were collected from three locations this includes two offshore and one near shore. The offshore location includes the sea surface water and sub-surface water sampling. The subsurface water samples were collected at different depths. The locations of samples collected are shown in the Table 12 above.

7. Ground water sample were collected from open well of a residence very close to the project site. Climate influenced physical parameters such as Temperature, DO and pH were recorded at site itself. Adequate parameter wise preservatives were added to the samples and collected samples were brought to the laboratory by maintaining 4^0C in the insulated ice boxes. Separate sterilized bottles were used for collection of water samples for microbial analysis. The results are as shown below and the results of ground water quality reveal that, the sample analyzed confirms to IS 10500 standards.

Table 14: Ground Water Parameters Measured

Sl.No	Parameters	Test Methods	Unit
1.	pH	IS 4500H^+ B	--
2.	Colour	--	Hazen
3.	Odour	--	--
4.	Taste	--	--
5.	Total Dissolved Solids	IS 2540 C	mg/L
6.	Total Hardness	IS 2340 C	mg/L
7.	Calcium as Ca	IS 3500-Ca	mg/L
8.	Magnesium as Mg	IS 3500 Mg B	mg/L
9.	Sulphide	IS 4500-SO32	mg/L
10.	Sulphate as SO_4	IS 4500-SO_4^{2-}	mg/L
11.	Fluoride as F	IS 4500F D	mg/L
12.	Nitrate as NO_3	IS 4500-NO_3 E	mg/L
13.	Chloride as Cl	IS 4500-Cl B	mg/L
14.	Iron as Fe	IS 3500-Fe B	mg/L

15.	Anionic Detergents	IS 5540 C	mg/L
16.	Residual Free Chlorine	IS 4500-Cl B	mg/L
17.	Phenolic Compounds	IS 5530 C	mg/L
18.	Aluminum as Al	IS 3111 C	mg/L
19.	Alkalinity	IS 2320 B	mg/L
20.	Boron as B	IS 4500-B B	mg/L
21.	Barium	IS 3111D	mg/L
22.	Polynuclear hydrocarbons	APHA 6440	mg/L
23.	Polychlorinated Biphenyl(PCB)	IS 13428:2005 (Annex M)	mg/L
24.	Trihalomethanes	GCMS Method	mg/L
25.	Pesticides	GCMS Method	mg/L
26.	Mineral Oil	IS:3025	mg/L
27.	Silver as Ag	IS 3111B	mg/L
28.	Total Chromium	IS 3111B	mg/L
29.	Nickel as Ni	IS 3111B	mg/L
30.	Mercury as Hg	IS 3112 B	mg/L
31.	Lead as Pb	IS 3111 B	mg/L
32.	Cadmium as Cd	IS 3111 B	mg/L
33.	Selenium as Se	IS 3114 B	mg/L
34.	Arsenic as As	IS 3114 B	mg/L
35.	Cyanide as CN	IS 4500-CN D	mg/L
36.	Zinc as Zn	IS 3111 B	mg/L
37.	Copper as Cu	IS 3111 B	mg/L
38.	Manganese a Mn	IS 3111 B	mg/L
39.	E-Coli	IS:15185	CFU/100ml
40.	Total Coliform	IS 9222 B	CFU/100ml
41.	Feacal Coliform	IS 9222 D	CFU/100ml

8. Marine studies were conducted to assess the baseline status of the marine environment as a part of required studies for the EIA required for CRZ clearance. As a part of which, sea water quality was assessed at different distances from the shore as well as at different depths at off shore distance of 250 m and 600 m respectively. Water from shore was collected by grab sampling whereas sub-surface sea water was collected using a Kemmerer water sampler.

Table 15: Marine Water Parameters Measured

Sl no	Parameters	Unit
1	pH	--
2	Temperature	^{0}C
3	Salinity	mg/L
4	Dissolved Oxygen	mg/L
5	B.O.D, (3 days in 27^{o}C)	mg/L
6	Iron as Fe	mg/L
7	Phosphate as Po_4	mg/L
8	Total Nitrogen	mg/L

9	Ammonia	mg/L
10	Nitrite - Nitrogen	mg/L
11	Nitrate as NO_3	mg/L
12	Copper as Cu	mg/L
13	Zinc as Zn	mg/L
14	Nickel as Ni	mg/L
15	Cadmium as Cd	mg/L
16	Total Chromium	mg/L
17	Lead as Pb	mg/L
18	Mercury as Hg	mg/L
19	Phenolic Compounds	mg/L

Appendix 2: Government of India Coastal Regulation Zone Compliance

ENVIRONMENTAL MONITORING AND MITIGATION

1. The overall assessment from IEE is that the environmental impacts identified are manageable and that certain basic and easy to implement mitigation measures recorded in IEE should be followed. Hence Environmental Management Plans (EMP) and Monitoring Plans (MPs) have been prepared for each sub project site. These plans make provision for the inclusion of an environmental budget to carry out the necessary monitoring and mitigation work in the context of the suggested institutional arrangements including roles and responsibilities of organization and individual officers. The plans also suggest appropriate levels of (and mechanisms for) public consultation, information disclosure and grievance redress.

2. Responsibility for carrying out the requirements set out in the EMP shall be part of the construction contracts and the construction contractor must ensure that the project will be implemented in compliance with the plan. The Project Authorities will have responsibility for oversight and review of adherence to the EMPs and MPs by the contractor at each sub-project site.

CRZ APPROVAL

3. Environmental Impact Assessments for each sub-project site have been carried out as per the guidelines of CRZ notification 2011. The outcome of these EIA studies, which were conducted in parallel with the detailed design is the receipt of state CRZ approvals for the programme of work at the sub-project sites. The proposed soft solution (dune and planting) at Kodi Kanyana and Pavinakurve does not involve construction and consequently these two sites do not require CRZ or EIA clearance.

Summary of Tranche 2 CRZ Clearance

4. M/s Environmental Health and Safety Consultants (EHSC) Pvt Ltd, Bangalore, an NABL/QCI accredited consultant were employed to process the CRZ clearances from KSCZMA for the Tranche 2 sites.

5. The Form-1, CRZ maps showing HTL and LTL and EIA report including Environmental Management and Monitoring Plan was submitted to KSCZMA in January 2015 and to Regional Director’s office of each coastal district during February 2015.

6. Following the submission of the documents to all three Regional Directors offices, joint site inspections were held during March 2015 and April 2015 with officials from Regional Directors office, PMU and PMDC-K.

7. The proposals were then presented to the District CRZ committees headed by the District Commissioners of each coastal district during the month of March 2015 and April 2015. The proposals were accepted at District CRZ committees and were further recommended to KSCZMA.

8. A KSCZMA meeting was then convened under the chairmanship of Additional Chief Secretary to Govt, Department of Forest, Ecology and Environment on 28th May 2015 and the proposals were accorded with CRZ clearance and a NoC issued. The copy of CRZ clearance is attached as follows.

R.P.A.D

No. FEE 40 CRZ 2015

GOVERNMENT OF KARNATAKA

Karnataka Government Secretariat
M. S. Building,
Bangalore, dated: 27.06.2015.

From:

Secretary to Government,
(Ecology and Environment)
Forest, Ecology & Environment Department.

To:

The Project Director,
Project Management Unit,
SCPMIP, PWD Department,
Old Mangalore Port Office Building,
Bunder, Mangalore-575001

Sir,

Sub: - CRZ clearance for Coastal erosion protection works at Someshwara, Mangalore Taluk, Dakshina Kannada District - reg.

******

With reference above subject, the proposal submitted for CRZ clearance for coastal erosion protection works proposed to be undertaken at Someshwara, Mangalore Taluk under the ADB assistance, the details of which are as follows:

The project site is a linear stretch along the coast, stretching from 12°45'39.25"N, 74°51'49.70"E in the South to 12°47'9.89"N, 74°51'13.53"E in the North, a distance of about 2km. It is reported that the investigations have revealed that the, the erosion rate at Someshwara has significantly increased posing threat to nearby houses and plantations. It is therefore proposed to use Geobags/Geocontainers with 1:3 slope with a toe level of 0 mtr and crust level of 3.5 mtr AMSL. Long term monitoring and maintenance of the project site is also proposed. Thus, providing a long term solution to the issue of coastal erosion at this site.

The proposal was considered in the Karnataka State Coastal Zone Management Authority (KSCZMA) meeting held on 28.05.2015.

The proposed work at at Someshwara beach is likely to enhance the area's natural ecology, both flora and fauna in the near shore and benefits local people. The total cost of the project proposed is Rs. 25.41 crores.

The proposal was recommended by the DCZMC, meeting held on 12.03.2015, for CRZ clearance.

R.P.A.D

As per para 4(i) (f) and 8 (i) I (ii)(b) of the CRZ Notification 2011, Erosion Control Measures are permissible.

The KSCZMA has decided to issue NOC for proposed erosion control measures .

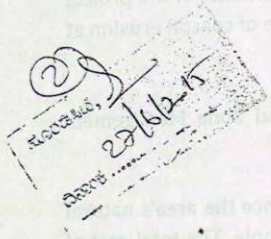
The above NOC is issued and do not contravene the provisions of CRZ Notification, 2011.

Yours faithfully,

(O. Palaiah)
Special Director (Technical Cell) and
Secretary, KSCZMA
Forest, Ecology & Environment Department.

Copy to:

Regional Director (Environment), Forest, Ecology & Environment Department, Mahanagara Palike Complex, Lalbagh, Mangalore for information.



GOVERNMENT OF KARNATAKA

No. FEE 109 CRZ 2015

Karnataka Government Secretariat
M. S. Building,
Bangalore, dated: 24.06.2015.

From:

Secretary to Government,
(Ecology and Environment)
Forest, Ecology & Environment Department.

To:

The Project Director,
Project Management Unit,
SCPMIP, PWD Department,
Old Mangalore Port Office Building,
Bunder, Mangalore-575001.

Sir,

Sub: - CRZ clearance for Coastal Erosion Protection Works at Yermal Thenka, Udupi Taluk, Udupi District - reg.

******

With reference to the above subject, the proposal submitted for CRZ clearance for coastal erosion protection works proposed to be undertaken at Yermal Thenka in Udupi under the ADB assistance, the details of which are as follows:

The project site is a linear stretch along the coast, stretching from 13°9'25.35"N, 74°45'22.19"E to 13°11'31.22"N, 74°44'39.98" for a distance of about 4.5 km. It is reported that the investigations have revealed that the, beach berm front and width at this location has reduced by approximately 28m-30m from 2003-2014. The average rate of retreat/ narrowing of the beach is estimated to be 3m/year. In these situations the beach width reduces to zero and severe steepening of the upper beach occurs during the monsoon, with direct attack on the coastal structures implemented. Such pressure on the coastline takes the form of coastal squeeze which negates the effectiveness of the natural beaches and coastal processes to manage wave impacts and associated overtopping inundation.

The proposal was considered in the Karnataka State Coastal Zone Management Authority (KSCZMA) meeting held on 28.05.2015.

It is proposed to install upgraded and formally designed coastal rock revetments with a crest level of +3.5m, a toe level of 0CD, and a slope of 1:3 using 1 tonne armour stone, and to monitor the beach changes monthly to ascertain how the beach evolution continues. If net sediment losses, continued reduction over the next 3 years then implement a beach recharge programme. The proposed work at Yermal Thenka beach is likely to enhance the area's natural ecology near shore and benefits local people. The total cost of the project proposed is Rs.60 crores.

The proposal was discussed in the Udupi District Coastal Management Committee Meeting held on 22.04.2015 and has been recommended for CRZ clearance.

As per para 4(i) (f) of the CRZ Notification 2011, Erosion Control Measures are permissible.

The KSCZMA has decided to issue NOC for proposed erosion control measures.

The above NOC is issued and do not contravene the provisions of CRZ Notification, 2011.

Yours faithfully,

(O. Palaiah)
Special Director (Technical Cell) and
Secretary, KSCZMA
Forest, Ecology & Environment Department.

Copy to:

Regional Director (Environment), Forest, Environment & Ecology Department, 1st Floor, C Block, Rajathadri, District Administrative Centre, Manipal, Udupi - 576104 for information.

GOVERNMENT OF KARNATAKA

No. FEE 111 CRZ 2015

Karnataka Government Secretariat
M. S. Building,
Bangalore, dated: 24.06.2015.

From:

Secretary to Government,
(Ecology and Environment)
Forest, Ecology & Environment Department.

To:

The Project Director,
Project Management Unit,
SCPMIP, PWD Department,
Old Mangalore Port Office Building,
Bunder, Mangalore-575001.

Sir,

Sub: - CRZ clearance for Coastal Erosion Protection Works at Udyavara, Udupi Taluk, Udupi District - reg.

******

With reference to the above subject, the proposal submitted for CRZ clearance for coastal erosion protection works proposed to be undertaken at Udyavara in Udupi under the ADB assistance, the details of which are as follows:

The project site is located between coordinates 13°16'24.56"N; 74°43'30.25"E and 13°18'48.31"N; 74°42'58.77"E. the village of Udyavara- Padukere. It is proposed to undertake erosion control measures along a length of 4.5 km. It is reported that the investigations have revealed that the, Udyavara Beach is eroding due to changes in river course.

The proposal was considered in the Karnataka State Coastal Zone Management Authority (KSCZMA) meeting held on 28.05.2015.

Construction of three, 200m long, shore parallel, offshore reefs to provide shore protection to a vulnerable stretch of 4,500 m length between the southern rocky outcrop and the northern outcrop and jetty. The three offshore reefs shall be constructed on the -5mCD bed contour, approximately 500m from the shoreline. The crests of the reefs will be at 0.5mCD level. In addition to the reefs, partial recharge of sand may be necessary to supply sand to the salient's expected to be formed in the shadow of the reefs. The proposed work at Udyavara beach is likely to enhance the area's natural ecology, both flora and fauna in the near shore and benefits local people. The total cost of the project proposed is Rs.80 crores.

The proposal was discussed in the Udupi District Coastal Management Committee Meeting held on 22.04.2015 and has been recommended for CRZ clearance.

As per para 4(i) (f) of the CRZ Notification 2011, Erosion Control Measures are permissible.

The KSCZMA has decided to issue NOC for proposed erosion control measures.

The above NOC is issued and do not contravene the provisions of CRZ Notification, 2011.

Yours faithfully,

(O. Palaiah)
Special Director (Technical Cell) and
Secretary, KSCZMA
Forest, Ecology & Environment Department.

Copy to:

Regional Director (Environment), Forest, Environment & Ecology Department, 1st Floor, C Block, Rajathadri, District Administrative Centre, Manipal, Udupi - 576104 for information.

GOVERNMENT OF KARNATAKA

No. FEE 108 CRZ 2015

Karnataka Government Secretariat
M. S. Building,
Bangalore, dated: 24.06.2015.

From:

Secretary to Government,
(Ecology and Environment)
Forest, Ecology & Environment Department.

To:

The Project Director,
Project Management Unit,
SCPMIP, PWD Department,
Old Mangalore Port Office Building,
Bunder, Mangalore-575001.

Sir,

Sub: - CRZ clearance for Coastal Erosion Protection Works at Kodi Bengre, Udupi Taluk, Udupi District - reg.

******

With reference to the above subject, the proposal submitted for CRZ clearance for coastal erosion protection works proposed to be undertaken at Kodi Bengre in Udupi under the ADB assistance, the details of which are as follows:

The project site is a linear stretch along the coast, stretching from 13°24'23.93"N, 74°41'49.25"E to 13°26'56.92"N, 74°41'44.84"E for a distance of about 4.5 km. It is reported that the investigations have revealed that the, morphological changes in Swarna and Sita Rivers causes Kodi Bengre spit to grow southerly and Oddu Bengre spit receding southwards. From Topographic map and satellite imageries, it is found that the Kodi Bengre spit is continued with its southerly growth whereas Oddu Bengre spit shows erosion. The width of Kodi Bengre spit has considerably increased and no changes in Oddu Bengre spit. The changes do show that the southerly drift is predominant over northerly drift. The coastal road experiences wave overtopping during monsoon season.

The proposal was considered in the Karnataka State Coastal Zone Management Authority (KSCZMA) meeting held on 28.05.2015.

It is proposed to construct rock revetment which will work as a barrier to check erosion and loss of infrastructure existing on the landward side. The project, regularly monitored and maintained will have a positive impact in terms of protection of existing infrastructure and houses. The proposed work at Kodi bengre beach is likely to enhance the area's natural ecology near shore and benefits local people. The total cost of the project proposed is Rs.49 crores.

The proposal was discussed in the Udupi District Coastal Management Committee Meeting held on 22.04.2015 and has been recommended for CRZ clearance.

As per para 4(i) (f) of the CRZ Notification 2011, Erosion Control Measures are permissible.

The KSCZMA has decided to issue NOC for proposed erosion control measures.

The above NOC is issued and do not contravene the provisions of CRZ Notification, 2011.

Yours faithfully,

(O. Palaiah)
Special Director (Technical Cell) and
Secretary, KSCZMA
Forest, Ecology & Environment Department.

Copy to:

Regional Director (Environment), Forest, Environment & Ecology Department, 1st Floor, C Block, Rajathadri, District Administrative Centre, Manipal, Udupi - 576104 for information.

Inward no. 1434
Recd. by email from DHSC email on 04-07-2015

GOVERNMENT OF KARNATAKA

No. FEE 115 CRZ 2015

Karnataka Government Secretariat
M. S. Building,
Bangalore, dated: 02.07.2015.

From:

Secretary to Government,
(Ecology and Environment)
Forest, Ecology & Environment Department.

To:

The Project Director,
Project Management Unit,
SCPMIP, PWD Department,
Old Mangalore Port Office Building,
Bunder, Mangalore-575001.

Sir,

Sub: - CRZ clearance for Coastal erosion protection works at Murudeshwara, Bhatkal Taluk, Uttara Kannada District - reg.

******

With reference above subject, the proposal submitted for CRZ clearance for coastal erosion protection works proposed to be undertaken at Murudeshwara, Bhatkal Taluk in Uttara Kannada District under the ADB assistance, the details of which are as follows:

The proposed project site is a linear stretch along the coast, stretching from 14° 5'4.05"N, 74°29'20.49"E in the south to 14° 6'3.80"N, 74°29'11.62"E in the north, along the edge of the Murudeshwar hillock. It is reported that the investigations have revealed that the, beach area south of temple is proposed to be re-molded or recreated so as to provide a marina for fishing boats which helps to develop the livelihood for fishing communities. On the north side, the beach area shall be further developed for recreational activities for tourists. Construction of two offshore reefs or breakwaters, one of them 300m and the other with a boomerang shape of 300 m at a distance of 400 m offshore will provide shelter for marina from high waves.

The proposal was considered in the Karnataka State Coastal Zone Management Authority (KSCZMA) meeting held on 28.05.2015.

It is proposed to enhance the safety of tourists, economy of local fishermen and benefits local people. The total cost of the project proposed is Rs.47 crores.

The proposal was discussed in the Udupi District Coastal Management Committee Meeting held on 24.03.2015 and was recommended for CRZ clearance.

As per para 4(i) (f) of the CRZ Notification 2011, Erosion Control Measures are permissible.

The KSCZMA has decided to issue NOC for proposed erosion control measures.

The above NOC is issued under the provisions of CRZ Notification, 2011.

Yours faithfully,

(O. Palaiah)
Special Director (Technical Cell) and
Secretary, KSCZMA
Forest, Ecology & Environment Department.

Appendix 3: Tranche 2 Subprojects Environmental Management Plan

Table 16: Environmental Management Plan

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
Pre construction **a) Someshwara** **b)Yermal Thenka** **c) Udyavara** **d)Kodi Bengre** **e)Maravanthe** **e)Murudeshwara**	IEE and EMP included in the civil works bidding document and also as part of contract document of the civil works contractor.	Inclusion of IEE and EMP in the bidding and contractor document	All Tranche 2 sub projects with civil construction activities	Inspection before the bidding documents are finalised	Before finalizing the bidding documents for civil works	PMU, PMDCK-1
Construction **a) Someshwara** **b)Yermal Thenka** **c)Kodi Bengre** **e) construction of revetment**	***Physical Environment***					
	Air quality *Emission control* Adherence to national standards that apply to emissions and ambient air quality for the types of vessels, vehicles and equipment proposed by contractor for construction/installation Engines and generators turned off when not in use Equipment conforms to international standards. Verbal social complaints dealt with immediately and efficiently.	Exhaust emissions sources Ambient air quality	Near revetment, and other work areas	Visual inspection – emission sources; construction sites: vessel, equipment, and vehicles	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Dust control Dust suppression by regular sprinkling, i.e. morning and evening, or other means Halt work during excessive onshore winds. Verbal social complaints dealt with immediately and efficiently.	Dust levels	Near revetment, and other work areas	Visual inspection – dust emissions from construction sites	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Noise	Noise levels	Near revetment,	Visual inspection of	Daily	PMU, Contractor,

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Adherence to Central Pollution Control Board's (CPCB) noise standards Engines and generators turned off when not in use Equipment conforms to international standards. Vehicles/engines fitted with silencers Daily checks and remedy of potential sources of excessive noise especially out of daylight hours. Complaints regarding noise dealt with professionally and with respect		and other work areas	noise sources Regular monitoring of sound levels		PMDCK-2 Routine inspection by Project team
	Water and sediment quality Adherence to national water quality standards Supervision of all operation procedures to minimize spillage of sand and oil/fuel Soil erosion could is to be considered with all onshore activities. Accidental oil/fuel and sediment spills contingency plans should be initiated immediately Sediment is to be screened for potential contaminants and not used if present above thresholds identified in international standards.	Turbidity Sediment quality Fuel, oil, fluid leaks or spills Potential contaminants	Near revetment, and other work areas	Visual inspection Water and sediment sampling	Monthly water and trimonthly sediment quality measurement	PMU, Contractor, PMDCK-2 Contracted MoEFCC accredited labs
	Biological Environment					
	Marine Habitat and biota Benthic communities are expected to return to pre-construction condition within several months after construction of revetment	Epi-benthic and sediment in-fauna invertebrate species abundance	Near revetment structure (nearshore area)	Biological monitoring of benthos and visual inspection	yearly	PMU, Contractor, PMDCK-2
	Economic, Social and Cultural Environment					

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Beach safety Public consultation to identify locations, times and types of potential safety risks, and develop sites-specific advisories and safety measures All equipment, waste and construction materials debris must be removed from the site.	Usage and types Number and type of incidents Weather conditions Wave conditions	Beach work areas	Visual inspection Incident Reports including police complaints Weather statistics Wave buoy records	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Fishing Activity Consultation with to devise acceptable times	Conflicts with fishing activity	Marine work sites and transport routes	Incident Reports of complaints	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Vehicle Traffic Increased potential of road accidents, Public consultation to identify times/types of potential conflict, develop timing windows for truck traffic and measures to advise public and truck drivers regarding road safety requirements	Traffic disruption Traffic accidents	Assembly/staging and/or access areas and routes	Incident Reports of collisions, close-calls and complaints	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Community Health and Safety - Reduced safety of beach users. Install and maintain signage and barricading of construction site throughout the construction period. Identify any incidental health and safety risk by public consultation to identify locations, times, and types of potential safety risks, and develop site-specific advisories and safety measures. All equipment, waste, and construction material debris must be inspected and removed daily from site.	Installation of signage and barricades	Beach work areas	Visual inspection Incident Reports including police complaints	Daily	PMU, Contractor, PMDCK-2

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Display boards at critical locations along the groyne site giving emergency instructions.					
	Worker's health and Safety Contractor will identify the hazardous activity and its mitigation measures and also identify the personal protective equipment required for the project. Based on the above each contractor will prepare a Health and Safety Plan. The contractor will identify the drowning area and will provide caution signage and emergency information. Provide personal protective equipment. Provide safe drinking water Sanitation and hygiene Safe accommodation safety training and instruction awareness about HIV/ AIDS. Regular health check up	Use of PPE by workers, regular health checkups, signage and safety training.	Beach work areas	Visual inspection Incident Reports including police complaints	daily	PMU, Contractor, PMDCK-2
Construction **a) Udyavara** **b) Maravanthe** **i. Groyne construction** **ii. Sand redistribution** **iii. Dredging**	**Physical**					
	Air quality *Emission control* Adherence to national standards that apply to emissions for the types of vessels, vehicles and equipment proposed by contractor for construction/installation and ambient air quality standards Engines and generators turned off when not in use Equipment conforms to international standards. Verbal social complaints dealt with immediately and efficiently.	Exhaust emission sources	Near dredging , sand redistribution and groyne work areas	Visual inspection – emission sources; construction sites, vessels, equipment vehicles	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Noise Adherence to Central Pollution Control Board's (CPCB) noise standards Engines and generators turned off when not in use Equipment conforms to international standards. Vehicles/engines fitted with silencers Daily checks and remedy of potential sources of excessive noise especially out of daylight hours. Complaints regarding noise dealt with professionally and with respect	Noise levels	Near dredging , sand redistribution and groyne work areas	Visual inspection of noise sources Regular monitoring of sound levels	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Water quality and sediment quality Adherence to national water quality standards Supervision of all operation procedures to minimize spillage of sand and oil /fuels Accidental spills contingency plans should be initiated immediately Soil erosion is to be considered with all onshore activities.	Fuel/oil, turbidity and spills/leaks	Near dredging , sand redistribution and groyne work areas	Water and sediment sampling	Monthly water quality and trimonthly sediment quality measurement	PMU, Contractor, PMDCK-2 MoEFCC accredited labs
	Biological					
	Marine Habitat and biota Benthic communities are expected to return to pre-nourishment condition within several months of sediment placement	Epi-benthic and sediment in-fauna invertebrate species abundance	Beach nourishment area	Biological monitoring of benthos	yearly	PMU, Contractor, PMDCK-2

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Terrestrial Habitat and Biota Disturbance to local habitats to be rectified before contractor leaves site. Planting and therefore stabilization of the environment, including replacement of any native plant species.	Area affected Area replanted Area successfully returned to pre-construction condition	Site access or staging areas	Visual inspection	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Social, Economic and Cultural					
	Navigation Local navigation and fishing Barge movement and dumping operation may be carried out in consultation with stakeholders to avoid interference with navigation.	Construction-related collisions, close-calls and complaints	Marine work sites and transport routes	Visual inspection Incident Reports of collisions, close-calls and complaints	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Beach safety Public consultation to identify locations, times and types of potential safety risks, and develop sites-specific advisories and safety measures All equipment, waste and construction materials debris must be removed from the site.	Usage and types Number and type of incidents Weather conditions Wave conditions	Beach work areas	Visual inspection Incident Reports including police complaints Weather statistics Wave buoy records	Daily	PMU Routine inspection by Project team
	Fishing Activity Consultation with to devise acceptable times	Conflicts with fishing activity	Marine work sites and transport routes	Incident Reports of complaints	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Vehicle Traffic Increased potential of road accidents, Public consultation to identify times/types of potential conflict, develop timing windows for truck traffic and measures to advise public and truck	Traffic disruption Traffic accidents	Assembly/staging and/or access areas and routes	Incident Reports of collisions, close-calls and complaints	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	drivers regarding road safety requirements					
	Community Health and Safety - Reduced safety of beach users. Install and maintain signage and barricading of construction site throughout the construction period. Identify any incidental health and safety risk by public consultation to identify locations, times, and types of potential safety risks, and develop site-specific advisories and safety measures. All equipment, waste, and construction material debris must be inspected and removed daily from site. Display boards at critical locations along the groyne site giving emergency instructions.	Installation of signage and barricades	Beach work areas	Visual inspection Incident Reports including police complaints	Daily	PMU, Contractor, PMDCK-2
	Worker's health and Safety Contractor will identify the hazardous activity and its mitigation measures and also identify the personal protective equipment required for the project. Based on the above each contractor will prepare a Health and Safety Plan. The contractor will identify the drowning area and will provide caution signage and emergency information. Provide personal protective equipment. Provide safe drinking water Sanitation and hygiene Safe accommodation safety training and instruction awareness about HIV/ AIDS. Regular health check up	Use of PPE by workers, regular health checkups, signage and safety training.	Beach work areas	Visual inspection Incident Reports including police complaints	daily	PMU, Contractor, PMDCK-2

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
Construction **a) Murudeshwara** **i) construction of reef** **ii)Sand Nourishment** **iii)dune plantation**	***Physical Environment***					
	Air quality *Emission control* Adherence to national standards that apply to emissions and ambient air quality for the types of vessels, vehicles and equipment proposed by contractor for construction/installation Engines and generators turned off when not in use Equipment conforms to international standards. Verbal social complaints dealt with immediately and efficiently.	Exhaust emissions sources Ambient air quality	Near reef and other work areas	Visual inspection – emission sources; construction sites: vessel, equipment, and vehicles	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Dust control Dust suppression by regular sprinkling, i.e. morning and evening, or other means Halt work during excessive onshore winds. Verbal social complaints dealt with immediately and efficiently.	Dust levels	Near reef and other work areas	Visual inspection – dust emissions from construction sites	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Noise Adherence to Central Pollution Control Board's (CPCB) noise standards Engines and generators turned off when not in use Equipment conforms to international standards. Vehicles/engines fitted with silencers Daily checks and remedy of potential sources of excessive noise especially out of daylight hours.	Noise levels	Near reef and other work areas	Visual inspection of noise sources Regular monitoring of sound levels	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Complaints regarding noise dealt with professionally and with respect					
	Water and sediment quality Adherence to national water quality standards Supervision of all operation procedures to minimize spillage of sand and oil/fuel Soil erosion could is to be considered with all onshore activities. Accidental oil/fuel and sediment spills contingency plans should be initiated immediately Sediment is to be screened for potential contaminants and not used if present above thresholds identified in international standards	Turbidity Sediment quality Fuel, oil, fluid leaks or spills Potential contaminants	Near reef and other work areas	Visual inspection, Water and sediment sampling	Monthly water quality and trimonthly sediment quality measurement	PMU, Contractor, PMDCK-2 Contracted MoEFCC accredited labs
	Biological Environment					
	Marine Habitat and biota Benthic communities are expected to return to pre-nourishment condition within several months of sediment placement. Benthic losses expected to be replaced by reef-induced enhanced biological production Reef structure is expected to serve as substrate for biological assemblages and production to replace initial loss of benthic production in sediment at reef locations	Epi-benthic and sediment in-fauna invertebrate species abundance. Presence and abundance of species/life-stages of flora, fish and invertebrates on and near reef Assemblages of fish and invertebrates	Beach nourishment area and reef location	Biological monitoring of benthos Reef-based biological surveys at reef location before and after reef placement	yearly	PMU, Contractor, PMDCK-2
	Economic, Social and Cultural Environment					

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Beach safety Public consultation to identify locations, times and types of potential safety risks, and develop sites-specific advisories and safety measures All equipment, waste and construction materials debris must be removed from the site.	Usage and types Number and type of incidents Weather conditions Wave conditions	Beach work areas	Visual inspection Incident Reports including police complaints Weather statistics Wave buoy records	Daily	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Fishing Activity Consultation with to devise acceptable times	Conflicts with fishing activity	Marine work sites and transport routes	Incident Reports of complaints	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Vehicle Traffic Increased potential of road accidents, Public consultation to identify times/types of potential conflict, develop timing windows for truck traffic and measures to advise public and truck drivers regarding road safety requirements	Traffic disruption Traffic accidents	Assembly/staging and/or access areas and routes	Incident Reports of collisions, close-calls and complaints	Weekly	PMU, Contractor, PMDCK-2 Routine inspection by Project team
	Community Health and Safety - Reduced safety of beach users. Install and maintain signage and barricading of construction site throughout the construction period. Identify any incidental health and safety risk by public consultation to identify locations, times, and types of potential safety risks, and develop site-specific advisories and safety measures. All equipment, waste, and construction material debris must be inspected and removed daily from site. Display boards at critical locations	Installation of signage and barricades	Beach work areas	Visual inspection Incident Reports including police complaints	Daily	PMU, Contractor, PMDCK-2

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	along the groyne site giving emergency instructions.					
	Worker's health and Safety Contractor will identify the hazardous activity and its mitigation measures and also identify the personal protective equipment required for the project. Based on the above each contractor will prepare a Health and Safety Plan. The contractor will identify the drowning area and will provide caution signage and emergency information. Provide personal protective equipment. Provide safe drinking water Sanitation and hygiene Safe accommodation safety training and instruction awareness about HIV/ AIDS. Regular health check up.	Use of PPE by workers, regular health checkups, signage and safety training.	Beach work areas	Visual inspection Incident Reports including police complaints	daily	PMU, Contractor, PMDCK-2
	Biological Environment					
	Marine Habitat and biota Benthic communities are expected to return to pre-nourishment condition within several months of sediment placement. Benthic losses expected to be replaced by reef-induced enhanced biological production Reef structure is expected to serve as substrate for biological assemblages and production to replace initial loss of benthic production in sediment at reef locations	Epi-benthic and sediment in-fauna invertebrate species abundance. Presence and abundance of species/life-stages of flora, fish and invertebrates on and near reef Assemblages of fish and invertebrates	Beach nourishment area and reef location	Biological monitoring of benthos Reef-based biological surveys at reef location before and after reef placement	yearly	PMU, Contractor, PMDCK-2
Operation and	***Physical Environment***					

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
<u>Maintenance</u> **Beaches and adjacent beach areas of** **a) Someshwara** **b)Yermal Thenka** **c)Kodi Bengre**	**Erosion of Beaches in front of revetment**	Beach profile Salient size, locations, migration Tide heights Weather conditions Wave conditions Current conditions	Beach areas in front of revetment	Beach survey – Total station surveys Land based topographic beach surveys	2 times per year for 3 years	PMU
				Hydrographic survey – Echo sounding Tide gauges – Current Profiler/ADCP Weather stats – local Met Office Wave buoy records	2 times per year for 3 years	PMU
	Social, Economic and Cultural Conditions					
	Fishing activity Project designs to ameliorate the deteriorated shoreline protection features encompass improvement to the beach profile, which currently impairs local beach-seine fishing and launching of traditional boats, are expected to improve beach fishing and boat-launching activities.	Species and numbers of fish, fishing methods and catch locations - catches from traditional fishing Value of catches Fish landings and value from commercial fishing	Fish capture activities near Someshwara, Yermal Thenka and Kodi Bengre beaches.	Fishermen interviews Fishery statistics including species composition	Once in a year for 3 years	PMU
	Biological Environment					

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Marine Habitat and biota Benthic communities are expected to return to pre-construction condition within several months after construction of revetment	Epi-benthic and sediment in-fauna invertebrate species abundance	Near rock revetment structure (nearshore area)	Biological monitoring of benthos	yearly	PMU
e) Udyavara f)Maravanthe **i. Groyne construction** **ii. Sand redistribution** **iii. Dredging**	**Physical**					
	Alteration of sediment transport from northern areas Groyne alignment is designed to enable southward passage of sediment	Beach accretion/profile change northern beach	Beach areas	Beach survey – Total station surveys Land based topographic beach surveys	2 times per year for 3 years	PMU
	Beach nourishment is planned to provide sufficient sediment to encourage beach formation at target location and longer term sediment passage from north to south	Beach profile Salient size, locations, migration Tide heights Weather conditions Wave conditions Current conditions	Beach areas	Beach survey – Total station surveys Land based topographic beach surveys	2 times per year for 3 years	PMU
	Social, Economic and Cultural Conditions					
	Fishing activity Project designs to ameliorate the deteriorated shoreline protection features encompass improvement to the beach profile, which currently impairs local beach-seine fishing and launching of traditional boats, are expected to improve beach fishing and boat-launching activities.	Species and numbers of fish, fishing methods and catch locations - catches from traditional fishing Value of catches Fish landings and value from commercial fishing	Fish capture activities near Udyavara and Maravanthe beach areas.	Fishermen interviews Fishery statistics including species composition	Once in a year for 3 years	PMU
	Biological Environment					

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Marine Habitat and biota Benthic communities are expected to return to pre-nourishment condition within several months of sediment placement	Epi-benthic and sediment in-fauna invertebrate species abundance	Beach nourishment area	Biological monitoring of benthos	yearly	PMU
Operation and Maintenance ***g) Murudeshwara***	***Physical Environment***					
	Erosion of Adjacent Beaches Beach nourishment is planned to provide sufficient sediment to encourage beach formation at target location and longer term sediment passage from north to south Detailed modeling was used to design and locate reef and berm retention structures and enable passage of sediment from north to south.	Beach profile Salient size, locations, migration Tide heights Weather conditions Wave conditions Current conditions	Beach areas	Beach survey – Total station surveys Land based topographic beach surveys	2 times per year for 3 years	PMU
	Change in effectiveness of retention structures (reef) Reef planned to be effective over time for improving conditions at target site without diminishing storm buffer along adjacent beaches	Reef levels Sea level Salient size	Reef	Hydrographic surveys	2 times in a year for 3 years	PMU
				Topographic survey of salient	2 times per year for 3 years	PMU
				Regular Visual Checks	Monthly for 1 year	PMU Routine inspection by Project team
	Biological Environment					

Project Stage	Mitigation Measures	Parameters to be Monitored	Location	Measurements	Frequency	Responsibilities
	Marine Habitat and biota Benthic communities are expected to return to pre-nourishment condition within several months of sediment placement. Benthic losses expected to be replaced by reef-induced enhanced biological production Reef structure is expected to serve as substrate for biological assemblages and production to replace initial loss of benthic production in sediment at reef locations	Epi-benthic and sediment in-fauna invertebrate species abundance. Presence and abundance of species/life-stages of flora, fish and invertebrates on and near reef Assemblages of fish and invertebrates	Beach nourishment area and reef location	Biological monitoring of benthos Reef-based biological surveys at reef location before and after reef placement	yearly	PMU
	Social, Economic and Cultural Conditions					
	Fishing activity Project designs to ameliorate the deteriorated shoreline protection features encompass improvement to the beach profile, which currently impairs local beach-seine fishing and launching of traditional boats, are expected to improve beach fishing and boat-launching activities. Reef placement is expected to create habitat diversity and enhance fish production.	Species and numbers of fish, fishing methods and catch locations - catches from traditional fishing Value of catches Fish landings and value from commercial fishing	Fish capture activities near Murudeshwara beach, reef	Fishermen interviews Fishery statistics including species composition	Once in a year for three years	PMU

1. The Community Protection Sub Projects Stage 2, i.e. the 9th sub project is expected to have a similar impacts already covered under tranche 2 project, i.e. Sand Nourishment and Plantation. However, once the 9th Sub Projects sites becomes clearer, more site specific Environmental Assessment will be carried out by PMDCK2 and this IEE and EMP will be updated. The Updated IEE and EMP will be submitted to the PMU for review and finally the report has to be submitted to ADB for information and disclosure.

2. Apart from the daily supervision of project activities and its implementation, the monitoring requirement for the standard parameters and the frequency of monitoring is given below.

Table 17: Summary of Monitoring Requirements

Project stage	Parameters to be Monitored	Location	Parameters/ Measurement	Frequency	Monitoring Responsibility
• **Pre-construction**	• Physical condition of site	• All Tranche 2 location	• Photographs and inventory if any.	• Before commencement of work at site	• PMDCK-2
	• Benthos study	• at all sub project site expect Kodi Kanyana and Pavinakurve)	• Assemblages of fish and invertebrates	• once before the start of the construction activities, to establish the baseline data of benthos. At Murudeshwar this data to be established at proposed reef location and nourishment area.	• PMDCK-2
Construction stage	Statutory and regulatory requirement	• At all civil construction sites	• NoC from KSPCB, PUC, Labour license and insurances for establishments and construction equipment. • Certificate for sourcing of material like royalty certificate and pollution control board clearance for quarrying • Storage of fuel oil, lubricants, diesel etc. at construction camp • Installation of Generators • Permission for extraction of Rocks	• before commencing construction activities • Before the rock is transported to the site	• Contractor / PMU / PMDCK-2
	• Ambient air	• 2 locations per	• PM_{10}, $PM_{2.5}$,	• Monthly	• PMDCK-2

Project stage	Parameters to be Monitored	Location	Parameters/ Measurement	Frequency	Monitoring Responsibility
	quality	sub project site (expect Kodi Kanyana and Pavinakurve) (including construction site, residential, commercial, construction camp)	NO_X, SO_2 and CO		
	• Noise	• 8 locations per sub project site(expect Kodi Kanyana and Pavinakurve (including construction site, residential, commercial, construction camp)	• Leq Day dB(A) • And Leq Night dB(A) • Leq Day and Night dB(A)	• Monthly	• PMDCK-2
	• Ground Water	• 1 location at all sub project site	• As per baseline data	• Monthly	• PMDCK-2
	• Marine Water Quality	• 4 location at all sub project site	• As per baseline data	• Monthly	• PMDCK-2
	• Sediments	• 1 sample at all sub project site	• arsenic, cadmium, lead, mercury, oil/grease, hydrocarbons such as PAHs, or pesticides	• Before sand nourishment at Udyavara, Maravanthe and Murudeshwara and before filling geotextile containers for the construction of revetment at Someshwara and Once every season except monsoon at remaining sites including above 3 sites.	• PMDCK-2
	• Beach topography and bathymetry survey	• Toposurvey at all sub project sites and bathysurvey at all sub project site expect Kodi Kanyana	• Beach levels of topography and bathymetry survey	• Twice in year	• PMDCK-2

Project stage	Parameters to be Monitored	Location	Parameters/ Measurement	Frequency	Monitoring Responsibility
		and Pavinakurve			
	• Benthos study	• at all sub project site expect Kodi Kanyana and Pavinakurve	• Assemblages of fish and invertebrates	• once during the peak construction period, to compare the effect of construction on benthos w.r.t baseline data of benthos. At Murudeshwar this data to be established at proposed reef location and nourishment area.	• PMDCK-2
	• Health and Safety	• Work site at all sub project site	• Workers safety and community safety as per the EMP	• Monthly	• Contractor/ PMU/ PMDCK 2
• Operation Stage	• Beach topography and bathymetry survey	• Toposurvey at all sub project sites and bathysurvey at all sub project site expect Kodi Kanyana and Pavinakurve	• Beach levels of topography and bathymetry survey	• Twice in year for three years	• PMU
	• Safety	• at all sub project site	• Signage and emergency information	• Twice in year for three years	• PMU
	• Benthic study	• at all sub project site (expect Kodi Kanyana and Pavinakurve)	• Assemblages of fish and invertebrates	• once after construction period, to compare the result w.r.t baseline data of benthos. At Murudeshwar this data to be established at reef location and nourishment area.	• PMU

Table 18: Budget for Environmental Monitoring

Sl. No.	Particulars	Stages	Unit	Total No.	Rate ($)	Cost ($)	Source of fund
A.	Legislation, permits and Agreements. Consent to Establish and Consent to Operate for plants and machinery of the contractor	Pre-Construction phase Construction phases -					The cost for clearances, permits and consents required by PMU & Contractors shall be borne by them respectively.
B.	Public consultations and information disclosure	Pre-Construction phase Construction phases	Lump sum	9	1,584	14,256	PMU, PMDCK-2
C.	Establishment of baseline data for benthos, fisheries and invertebrates	Pre Construction phase	Lump sum	12	1,584	19,008	PMDCK-2
D.	Environmental Audit	Construction	Lump sum	3	7,130	21,390	PMU
E.	**Environmental Monitoring**						
1	Air quality	Construction	Per sample	(2 No of Location/site X 1 sample per month X 16 months (excluding monsoon) = 32 sample x12sites=384	127	48,768	PMDCK-2
2	Water quality		Per sample	(5 No of Location(4 marine + 1 ground water)/site X 1 sample per month X 16 months (excluding monsoon) = 80 sample x 14 sites= 1120	40	44,800	
3	Noise Levels		Per sample	(8 No of Location X 1 sample per month X 16 months (excluding monsoon) = 128 sample per site. 128x12sites=1536	7	10,752	
4	Sediment			(4 No of Location X 1 sample per season X 5 seasons (excluding monsoon) = 20 sample x 14 sites= 280	135	37,800	

5	Collection of data for benthos, fisheries and invertebrates		Lump sum	12	1,584	19,008	
6	Public Consultation		Per season	1 time during construction stage. 1 times x 12 sites=12 times	792	8,784	PMU
7.	Dust Suppression at subproject sites	construction phases	lump sum		-	-	Civil Cost
8	Ambient Air Quality	Operation/ Defect Liability Period	Per Sample	(2 No of Location X 1 sample per month X 9 months (excluding monsoon) = 18 sample x 12 locations= 216	127	27,432	PMU
9	Water quality		Per sample	(5 No of Location(4 marine + 1 ground water) X 1 sample per month X 9 months (excluding monsoon) = 45 sample x 14 sites=630	40	25,200	
10	Ambient Noise Quality		Per Sample	(8 No of Location X 1 sample per month X 9 months (excluding monsoon) = 72 sample x 12 sites= 864	7	6,048	
5	Collection of data for benthos, fisheries and invertebrates		Lump sum	12	1,584	19,008	
F. Capacity Building							
1	Capacity Building expenses 2 sessions including all sites	EMP Training at Site Implementation of IEE/EMP for PMU and Engineer			PMDCK-2 budget		PMDCK-2
Total EMP cost in $					**302,254**		

A. Cost Estimates

3. Preliminary cost estimate for mitigation measures, monitoring and implementation is $ 302,254; $ 57,024 for establishment baseline, during and post construction dataset for benthos, fisheries and invertebrates at 6 civil sub project sites and 2 stage 2 community sub projects sites, $ 142,120 to support monitoring during construction and $ 58,680 for post-construction for implementation and $ 23,040 for public consultation capacity building and $ 21,390 for environmental audit for 3 years.

Appendix 4: Minutes of Tranche 2 Public Consultation

A. Subproject wise List of Public Consultations Held During Tranche 2 projects

1. Following are the minutes of the meeting held at each of the Tranche 2 sub project site, the Table 19 to **Table 25** summarises the place, date, name of stakeholder participated, issues and concerns raised and the inclusion of logical suggestion into the project design.

Table 19 Summary of Public Consultation held at Someshwara

Date of Meetings	Place of Meeting	Name of stakeholder	Issues and Concerns raised	Remarks
05/02/13 and 08/12/14	Someshwara Gram Panchayath Office and Uchila beach, Someshwara	Someshwara GP president, members, officials and people from Someshwara village, local fisher folks	Some of the participants said that since 2 years there has been increased evidence of erosion in Someshwara Uchila area even during non monsoon seasons. Participants said Ullal erosion got much attention by the authorities but not in Someshwara which is adjacent to Ullal town. Participants at the meeting demanded immediate protection works along the coast of Someshwara (Uchila). People mentioned that there has been loss of houses due to sea erosion and the compensation paid by the government is meagre. They cited the attention given by the Kerala government to mitigate impact of erosion and the higher amount of compensation paid. The grievance of people in this regard was so high that they articulated they were willing to consider the option of shifting their base to Kerala (Someshwara borders Kasaragod district of Kerala) They requested proper allocation of funds to maintain the lagoon which meets sea at Battapady.	The project team explained the background of SCPMIP and told that the increased erosion at Someshwara has been noticed by the authorities. Permanent coastal protection works will be taken up under Tranche 2 and requested people to have patience as this project is not like usual ad-hoc emergency protection works by dumping rocks. It looks at long-term solutions and therefore takes time to do justice to the project by conducting detailed studies and then taking up the design work. Once design is completed, approvals at the state and central government levels are needed. The project team explained that similar to Ullal, a coastal protection measure will be proposed by using geotextile revetment. For the flooding issues of the lagoon, the project team explained that this work can be taken up by setting up of an SMO and explained in detail about the role and responsibilities of SMO. The concept of SMO was highly appreciated by the locals and they offered support to set up of an SMO.

Table 20 Summary of Public Consultation held at Yermal Thenka

Date of Meeting	Place of Meeting	Name of stakeholder	Comments/Concerns	Remarks
27.06.14 24.12.14 31.12.14	Thenka and Bada Gram Panchayath Office	Thenka and Bada Gram Panchayath officials and people from Yermal Thenka and Bada village	There was erosion in Tenka Yermal from many years but the problem got worse after the construction of 200 m of UPCL breakwater in 2008-2009 leading to loss of land, damage to coastal road, uprooting of coconut plantation (around 200 in 2 years) and due to the loss of land, houses got close to the shore and the sea water gushes into the houses during monsoon.	These issues were already considered in project prefeasibility stage and suitable and sustainable intervention will be proposed.
			People mentioned that most of the population living on the coastline of Yermal Thenka are fishermen and depend on the sea for their livelihood. Due to the erosion and loss of land/property they are unwilling to relocate away from the coast.	The project does not involve relocating people but strive to enhance the livelihood of the coastal communities by providing sustainable coastal protection.
			The people are against the temporary emergency coastal protection works and are interested in permanent coastal protection.	The aim of the study under "SCPMIP" is also to address coastal protection needs through economically viable and long-term sustainable works
			Fisher folks at Yermal Thenka don't go for deep water fishing but use traditional large nets (Rompanni) and expressed their concern saying that construction of groynes might intervene/damage the nets if the space between the groynes are less and suggested to keep at least 500m offset between groynes.	The feasibility report on Thenka Yermal, had laid out three options and the Environmental, Social and Economic considerations for the site. A key issue from the engagement with the fisher folk community is that they cannot use their 500m long near shore nets

				within a groyne system. This has been demonstrated through field tests and observations of their fishing practices The community has a definite preference to not to have any obstructions on the beaches as well as within near shore waters. Therefore, options based on groynes were eliminated for this site in a bid not to interfere with the local fishing practices using drag nets, called 'Rompani'.

Table 21: Summary of public Consultation Held ar Udyavara

Date of Meeting	Place of Meeting	Name of Stakeholder	Comments/Concerns	Remarks
02/07/14	Near Project Site(Pandarinatha Bajana Mandir, Udyavara)	Udyavara Gram Panchayath officials, members of Pandarinatha Bajana Mandir and people of Udyavara village	Udyavara village has been under erosion threat in recent years, loosing beaches, roads and coconut plantations in quick succession. Udyavara is a narrow spit and when the road breaches , the community loses the only existing road connectivity .Most of the population living on this spit are fishermen and depend on the sea for their livelihood. Although there are losses of land/property due to erosion, they are not willing relocate away from the coast. They also mentioned that during the monsoon, at certain locations, the waves overtop and the seawater splashes into houses. They also informed that they face threat from both river side and sea side. Fisher folks mentioned that they face difficulty in parking their boats due to erosion and insufficient beach width. On explanation of proposal for construction of groynes and beach nourishment, people expressed that unlike Yermal Thenka, fishermen at Udyavara do not use traditional large nets (Rompanni) and expressed that construction of groynes and beach nourishment will not have any negative impact on their fishing activities.	These issues were already considered in project prefeasibility stage and suitable and sustainable intervention will be proposed. The project team confirmed that this project does not involve relocating people but strive to enhance the livelihood of the coastal community by providing sustainable coastal protection. Project team explained with the aid of sketch about the proposed groyne and sand nourishment scheme at Udyavara. The team urged the participants if they foresee any issues and concerns with it and asked if this intervention is acceptable to the local fishing community. Will it intervene in any manner in their fishing activity(like rompanni).Local fisher folks

				confirmed that they go for deep fishing and do not practice rompanni fishing and they have no objection for the construction of groynes and for sand nourishment.

Table 22 Summary of Public Consultation held at Kodi Bengre

Date of Meeting	Place of Meeting	Name of stakeholder	Comments/Concerns	Remarks
23.07.2014 23.12.2014	Kodi and Kemmanu GP office	Kodi and Kemmanu GP officials and people of Kodi and Kemmanu villages	People expressed their concerns about managing erosion by dumping stones in a haphazard manner, which only aggravated the problem. People mentioned that due to sea erosion there has been damages to water supply pipelines, electric poles and coconut plantations There is another peculiar problem in this area. There is river very close to the sea and the width is hardly 150 meters at present, between the sea and the river. About ¾ of the area in Kodi Bengre has been already lost to sea erosion about 10 years ago. The depth of the river is becoming shallower day by day with sea bringing in more sand each time it touches the river. The shallow river is of no use to the dwellers in the area. The authorities have been doing some work at the shores. The fishermen claim that the work is done only up to about 5 to 6 meters and they see an estimate of Rs. One Crore allotted for the work. This has irked the fishermen. Also the estimate says the work will be completed by 2016 and so far no visible work has been taken up at all in the area. If Bengre is lost to sea erosion and not protected at this stage, then the problem will escalate to a very large extent and even Bramhavara (a big inland settlement) will also get severely affected. They raised the concerns regarding flooding at the northern end of the spit during monsoon.	The project team explained the background of SCPMIP and told that the erosion at Kodi Bengre has been noticed by the authorities and the permanent coastal protection works will be taken up under Tranche 2 and requested people to have patience as this project focuses on long-term and sustainable solutions It takes time to study , prepare detailed designs and also to get clearances and approvals at state and national levels. The project team explained that similar to existing coastal defence will be rehabilitated where required and new rock revetment will be constructed by calculating the sea level rise and wave overtopping to avoid flooding and to counter sea erosion. It was also confirmed to the people that no relocation of people will be done because of the project.

Table 23 Summary of Public Consultation held at Kodi Kanyana

Date of Meeting	Place of Meeting	Name of stakeholder	Comments/Concerns	Remarks
23.07.2014 23.12.2014	Kodi GP office	Kodi GP officials and people of Kodi village	During the consultation meetings, people exhibited a reasonable level of awareness regarding environmental consciousness and shore line management. They mentioned that government has taken up some work of dumping stones and this has been done in the most haphazard manner, which only aggravated the problem of sea erosion. They also highlighted then fact that the width between the sea and the river is narrow; only about 150 meters at present. The depth of the river is becoming shallower day by day with sea bringing in more silt each time, thereby increasing the salinity of water. According to them the government claims to complete the work by 2016 but the work has not yet commenced. Two decades ago, one prominent citizen (Dayanand Survarna) had done a great service to the community by constructing a permanent sea wall in the north of Kodi Bengre. The structures put up by the authorities do not match this quality. People are readily willing to be involved in the environmental sustainability activities and they would voluntarily contribute to such actions by the authorities. Fisher folk representatives suggested that constructing a break water in Alivae area to the extent of at least 500 metres would help. One major grievance people expressed is that the GP office is located on the other side of the river (at a distance of 25 km) and the road accessibility is very restricted. They expect this need to be addressed, although this issue not directly connected to coastal protection works.	The project team explained the background of SCPMIP and told that the erosion at Kodi has been taken note of. The team also appreciated the sense of collaboration among residents. The team also explained the merits and demerits of breakwater structures and how wrong selection of coastal structures worsens the problem. This was supported by citing some examples closer to their area. The team assured that some sustainable coastal protection works will be taken for the total stretch, including Kodi Bengre, which would have a lasting impact on protecting the shorelines.

Table 24 Summary of Public Consultation held at Maravanthe

Date of Meeting	Place of Meeting	Name of stakeholder	Comments/Concerns	Remarks
24/07/14 30/07/14 30/12/14	GP office of Maravanthe and Trasi	Maravanthe and Trasi Gram Panchayath officials and people of Maravanthe and Trasi. Prominent residents and President of the Fishermen's Association of the area	Trasi GP has 2 coastal wards viz., Kachgod and Trasi and both of these wards face severe coastal erosion issues every year, including erosion at Trasi tourism park, flooding of houses and uprooting of coconut plantation. Around 4,000 fisher folks reside in this GP; fisher folks expressed their concerns over coastal defence by construction of seawall, as it obstructs the movement of boats in and out of the sea. Maravanthe has 1 coastal facing ward. The fisher folks are of the opinion that the outer harbour is one of the main causes for sea erosion in the area. They feel that after the construction, sea is more aggressive and the erosion is quite high. Also they are of the belief that sea erosion is more when people dump plastics and other waste indiscriminately along the shore. The sea takes it and throws it back at various places thus dirtying the area further.	These issues were already considered in project pre feasibility stage and suitable and sustainable intervention will be proposed. Project team explained with the aid of sketch about the proposed groyne and sand nourishment scheme at Maravanthe and requested the attendees if this intervention is acceptable to the local fishing community and will it intervene in any kind in fishing activity(like rompanni).Local fisher folks confirmed that they go for deep fishing and do not practice rompanni fishing and they have no objection for the construction of groynes and for sand nourishment. Project team explained the concept of SMO and informed the members that these issues can be managed through setting up of SMO. People appreciated the concept and offered their support.

Table 25 .Summary of Public Consultation held at Murudeshwara

Date of Meeting	Place of Meeting	Name of stakeholder	Comments/Concerns	Remarks
31.07.14 29.12.2014	Mavalli GP	Mavalli GP officials and people of Murudeshwara and Fisher Folks	People mentioned that in Murudeshwara shore is not severely affected by erosion over the years although there are certain issues with flooding at the Southren end where a rivulet meets the sea. People have complained sometimes water enters into their lands during rainy seasons. Apart from this, no significant erosion related problems were reported in the area. . The beach is one of the most beautiful beaches, but not maintained properly. Using the beaches as dumping grounds and for open defecation is a common problem in the area. This negatively impacts the image of the beach as a tourist spot.	Project team explained regarding the proposed scheme at Murudeshwara, which will include a combination of hard and soft solution such as building off shore reef and also planatation scheme.

Table 26 Summary of Public Consultation held at Pavinakurve

Date of Meeting	Place of Meeting	Name of stakeholder	Comments/Concerns	Remarks
31.07.14 02.08.2014	Karki GP	Karki GP officials and people of Pavinakurve villages Taluk Panchayath officials and prominent citizens One Non-resident Indian (NRI) investor	Pavinakurve village falls under Karki GP and has 3 coastal wards viz., Topplakeri, Rameshwarakambi and Pavinakurve. Around 100 houses in Kesarkodi have been relocated due to erosion issues around 30 years ago The GP officials and community members strongly feel that the temporary mitigation measures of rock dumping during emergencies give rise to more problems than solutions. They insist that more long term options must be considered.	The project team met with community members at several places in small groups. The team also consulted the taluka panchayat officials and some prominent citizens to obtain their opinion. Since the erosion prone beaches are sparsely populated, the team explained the cost-benefit analysis of the proposed project interventions. Several possible options for greening measures were explained to them. Some successful attempts earlier made by the forest department were also explained to them. The potential of attracting more number of tourists and the possibility of generating tourism related livelihood activities were presented. The precise selection of plant species

Date of Meeting	Place of Meeting	Name of stakeholder	Comments/Concerns	Remarks
				will be decided after studying various possibilities and the suitability of the species to the local environment.

District Level Meeting held at Udupi
Minutes of SMP and Tranche 2 workshop held at the Conference room of Zilla Panchayat Office, Udupi District, Manipal, December 23, 2013

Background

2. A consultative workshop was organized for Udupi district as per the following schedule, with two objectives.

(i) To present the draft Shoreline Management Policy (SMP) for the district and to seek feedback from the participants
(ii) To present the first draft proposals of tranche 2 technical options and to seek ideas from the Gram Panchayat officials and elected representatives.

3. The meeting was chaired by the Deputy Commissioner & District Magistrate, Udupi, Dr. M.T. Reju I.A.S; Mr. Jayaprakash Hegde, Member of Parliament, Udupi was the Guest of Honour.

Title of the Workshop	SMP, Tranche 2 and SMO for Udupi district
Date	December 23, 2013
Venue	Conference room of Zilla Panchayat Office
Participants	All line departments, local government officials and elected representatives

Workshop Proceedings

4. In his opening remark, Dr. Reju welcomed Mr. Jayaprakash Hegde and the SCPMIP-K team. He highlighted the problem of coastal erosion in Udupi district and emphasized the need for finding sustainable solutions. What is needed are long term, environmentally sound solutions, rather than ad-hoc measures. Therefore, the intervention of SCPMIP-K has come at the right time.

5. Mr. Jayaprakash Hegde recalled that the coastal erosion is a seasonal phenomenon and repeats itself every monsoon. However, the severity has reduced in the recent years as compared to the 1990s. The main problem with coastal assets is poor O&M. This is in contrast to Kerala where good emphasis is paid on O&M aspects. He welcomed the SCPMIP-K project intervention and assured his full support to the PWPIWTD. He also indicated that after the successful completion of Ullal project, it would be desirable to organize a site visit to participants from Udupi, which will give them good exposure. He also hoped that structures executed under tranche 2 will address O&M problems that are typical to government executed projects.

6. Following this, Hans Pos, Project Manager of PMDC-K explained the purpose of the meeting and detailed out the activities to be taken up under two different tranches i.e. tranche 1 and tranche 2. He explained the need for setting up CIMU and briefly touched upon the specific

features of SMP in Udupi and how CIMU will be evolved over a period of three years. He then briefly touched upon the roles and responsibilities of SMOs and the process of setting them up in each of the policy units. Mr. Jayapraksh Hegde requested Manoj Patel to translate the presentation in Kannada for the benefit of all participants. He also mentioned that since most of the participants are not familiar with tranche approach, it would be good if that is “decoded”.

7. Hans Pos took the participants through the presentation and various steps of SMP development for each of the districts and how they will lead to a state level Shoreline Management Policy for Karnataka State. He emphasized that tranche 2 construction activities will adhere to the policy parameters laid down in the SMP.

8. Mr. Shanth Kumar, Joint Director, and Executive Engineer from PMU touched upon the tranche one progress and process of site selection for tranche 2 to Mr. Jayapraksh Hegde.

9. Following the presentation, participants raised several interesting clarifications, which are listed below.

(i) What is the mechanism of co-ordination between various agencies, especially between the Ports department and other departments, including fisheries?
(ii) Many fisheries ports and fisheries road projects are planned. These need to be considered while implementing coastal protection measures
(iii) Sand mining is rampant and therefore, interface with Mines & Geology department is important. Mines & Geology department is the licensing agency for sand mining. It was suggested that PWPIWTD co-ordinates with Mines & Geology department in this regard.
(iv) Coastal protection measures are important and coastal residents would contribute to initiate sustainable measures and the local residents involvement is critical to the success.

10. The presentation of Hans Pos was followed by three presentations-i) SMP policy units and how they are delineated by Manoj Patel ii) Detailed selection of Tranche 2 projects by Deepak Jayachandran and iii) SMO formation and local residents involvement by Narayan Bhat. The important points raised and clarifications sought by the participants are listed below.

(i) The five options recommended in the SMP are good, but Do Nothing option should be explained in detail.
(ii) Photographic evidence of pre-monsoon and post-monsoon status of specific sites should be documented.
(iii) There are some flooding issues, locations of which needs to be mapped
(iv) Initially, Unit 6 was from Kaup lighthouse to Mattu and Unit 7 was Mattu to South breakwater of Malpe and during the workshop it was pointed out that the name of the location must be Uliyargoli Padukere instead of Mattu.
(v) Local residents would be interested in forming SMOs. Respective GPs will collaborate with the project.
(vi) New sites to be included as Tranche 2 sites are: i) Hoode (near Syndicate Bank ii) Kidiyor Padukere, Kodi Kanya, Kottathattu iii) flooding issues near Badanidiyur iv) New fisheries port is coming up in Hungaracutta, the impact of this to coastal erosion is to be considered.
(vii) An outer harbour in Policy Unit 14 is under construction. Effect of this on the adjacent coastline needs to be monitored.
(viii) Sand mining licensing is an issue that needs review.

(ix) The UPCL breakwater is causing erosion. There is a negative public opinion about its consequences. The impact of this should be studied and the structure removed, if needed.

(x) There is an excellent scope for soft solutions such as planting mangroves.

11. It was pointed out that the Minister for Urban Development and District In-charge Minister, Mr. Vinay Kumar Sorake has written a letter to the Ministry of Water Resources listing down 33 sites in Udupi district that need priority attention. The selection of tranche 2 sites needs to be verified with this list.

12. It was mentioned that similar stakeholder meetings will be held at each of the policy unit levels in the coming months.

13. The meeting ended with concluding remarks by Mr. Jayaprakash Hegde and thank you note by the SCPMIP-K team.

SCPMIP- K Brochure Distributed During Tranche -2 Public Consultation

Tranche 2 Sub-Projects

Tranche -2 Sub-projects pre-feasibility report was submitted to GOK in January 2014 and following sites were selected:

1. Pavinakurve, Uttar Kannada District.
2. Murudeshwara, Uttar Kannada District
3. Shiruru, Udupi District
4. Maravanthe, Udupi District
5. Kodi Kanyana, Udupi District
6. Kodi Bengre, Udupi District
7. Udyavara, Udupi District.
8. Yermal Thenka, Udupi District
9. Someshwara, Dakshina Kannada District

Regional wave modelling was carried out for entire Karnataka coast and extracted extreme wave data for entire coastline. Feasibility studies have been initiated for selected site mentioned above. The outcome of regional wave modelling will form a part of the feasibility studies. To support feasibility studies site surveys were carried out which includes beach survey, beach sand analysis and Socio-economic surveys. Based on these studies various alternatives of coastal protection and management options will be proposed against cost effectiveness, workability, environmental and acceptable socially. Stakeholder consultations shall be carried out at key stages of the project before finalisation of the coastal protection works.

Establishment of a Coastal Management Information System (CMIS)

The SCPMIP includes development of spatial information using Geographic Information System (GIS) and collating technical information within a Coastal Management Information System (CMIS). CMIS will be developed over the project period and will build up key information to support shoreline planning and management and helps in developing and implementing coastal infrastructure.

The CMIS will be established within the Coastal Infrastructure Management Unit (CIMU). On completion of SCPMIP, the CMIS will continue to operate within CIMU by frequently collecting, processing and updating the data and information

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SUSTAINABLE COASTAL PROTECTION AND MANAGEMENT INVESTMENT PROGRAMME – KARNATAKA

Sustainable Coastal Protection and Management Investment Programme

Public Works, Ports & Inland Water Transport Department, GoK, Bunder , Mangalore

Project Management & Design Consultants - Karnataka (PMDC-K)

Contact Information – PMU	Contact Information – PMDC
Project Management Unit : SCPMIP-Karnataka **Public Works, Ports & Inland Water Transport Department, Old Mangalore Port Office Building, Bunder, Mangalore - 575 001** **Tel: 0824 – 2441382, 0824 - 2441392** **Fax: 0824 - 2441382** **Email: adbpmu@gmail.com**	**Euroconsult Mott MacDonald BV** **Project Management & Design Consultants** **SCPMIP-Karnataka** **Near North Wharf Gate, Old Mangalore Port Office Premises, Bunder, Mangalore - 575 001** **Tel: 0824 - 2441274** **Email: pmdckar@gmail.com**

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SCPMIP-K addresses the sea erosion that occurs along large stretches of the 300 km Karnataka shoreline. Sustainable and environmentally friendly solutions are being sought to replace the unsustainable methods of dumping of rocks and construction of rock walls along the coast that was accepted and practice for decades.

The SCPMIP-K is an eight year programme that started in late 2011 and runs until mid-2019. The programme is financed through an ADB loan and during its first phase consists of four components:

1. Implementation of 1st Tranche sub-project
2. Set-up of CIMU and SMOs
3. Shoreline Management Planning(SMP)
4. Identification and preparation of 2nd Tranche sub-projects

Tranche 1 Sub - Project

Ullal Sub-Project

The 1st Tranche sub-project in Ullal consist of rehabilitation of Ullal breakwaters, construction of two off-shore reefs, construction of four in-shore berms and sand nourishment.

Inshore Berms - The construction of the four in-shore berms commenced in December 2013 with a construction period of 20 months. The construction materials used are geotextile mega-bags.

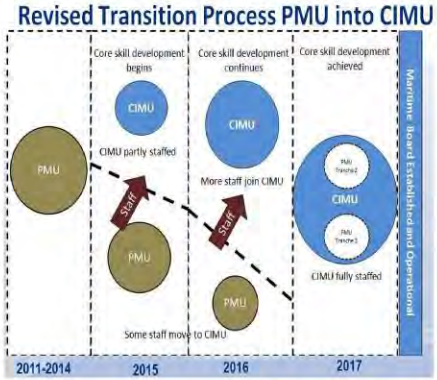
Breakwaters – The existing Ullal breakwaters are in dilapidated condition and requires immediate rehabilitation. With proposed rehabilitation, the structure will become more robust and adapted to future sea level rise. The southern breakwater will become slightly shorter to allow an increase of sand moving towards the Ullal frontage. Construction is expected to commence from October 2014.

Off-Shore Reefs – Central Water and Power Research Station (CWPRS) carried out the structural stability studies by flume tests in its laboratory. Tender was floated, bids were received and evaluation in progress. Construction is expected to commence late 2014.

Coastal Infrastructure Management Unit (CIMU)

The framework set-up of a CIMU within the Department of PW, P & IWT was accepted. In 2013 the unit will be established and its office will be located in Mangalore, the main coastal city of Karnataka.

CIMU will monitor the coast and provide long term sustainable solutions to protect and manage coastal assets, while interacting with stakeholders via the SMOs (Shoreline Management Organizations).



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Shoreline Management Planning (SMP), Shoreline Management Organizations (SMO) and Sustainable Emergency Response (SER)

PMDC-K developed SMP for Dakshina Kannada and Udupi districts which were approved in July 2013 and February 2014 respectively. Dakshina Kannada was divided into six coherent Policy Zones and Udupi was divided into 16 Policy Zones. PMDC-K provides understanding of coastal processes whereas local stakeholders provide local knowledge and concerns. Joint discussions lead to the first draft long term policy plans for coastal Karnataka.

PMDC-K continued developing the first draft SMPs for Uttar Kannada. These policy documents, after stakeholders meetings, will jointly lead to the development of the Karnataka State SMP in 2015.

The voluntary SMOs are the linkage between society and PMU / CIMU. They will have minor budgets to operate and in the future will contribute in monitoring coastal processes/changes and asset management along the coastal fringe.

Government, aware of the urgency of actions to combat damaging effects of monsoon storms, has allowed PMDC-K to develop a Sustainable Emergency Response (SER) plan.

SER will provide impulse response to emerging coastal hazards. These are sustainable solutions using smaller geo-textile bags filled with sand. These sand bags are stockpiled at a suitable location near to the coast. During emergency these bags shall placed by trained SMOs.

Policy Units of Dakshina Kannada District

Mott MacDonald

SUSTAINABLE COASTAL PROTECTION AND MANAGEMENT INVESTMENT PROGRAMME – KARNATAKA

ಹೂಳೆತ್ತುವಿಕೆ ಯಂತ್ರದ (dredger) ಅವಶ್ಯಕತೆ:

ಪಿಎಮ್‌ಡಿಸಿ–ಕೆ ಕರ್ನಾಟಕದ ಕರಾವಳಿ ತೀರದುದ್ದಕ್ಕೂ ಹೂಳೆತ್ತುವಿಕೆ ಯಂತ್ರದ ಅವಶ್ಯಕತೆ ಹಾಗೂ ಅದರ ಸವಿಸ್ತರ ವಿವರಣೆ (specifications) ಕುರಿತಾದ ತಪಶೀಲು ಪಟ್ಟಿ (inventory)ಯನ್ನು ಸಿದ್ಧಪಡಿಸಿದೆ. ಅಧ್ಯಯನದ ಮೂಲಕ ಹೂಳೆತ್ತುವಿಕೆ ಯಂತ್ರದ ಅವಶ್ಯಕತೆಯನ್ನು ದೃಢಪಡಿಸಿದ ಬಳಿಕ ಪಿಎಮ್‌ಡಿಸಿ–ಕೆ ಯೋಜನಾ ನಿರ್ವಹಣಾ ಘಟಕ (ಪಿಎಮ್‌ಯು), ಹಿತಾಸಕ್ತರು ಹಾಗೂ ಆಸಕ್ತ ಗುತ್ತಿಗೆದಾರರ ಸಹಯೋಗದಲ್ಲಿ ಮುಂದಿನ 6 ತಿಂಗಳಲ್ಲಿ ಈ ಯೋಜನೆಯ ಸಂಭಾವ್ಯತಾ ಅಧ್ಯಯನ (feasibility study) ವನ್ನು ಕೈಗೊಳ್ಳಲಿದೆ. ಹೂಳೆತ್ತುವಿಕೆ ಯಂತ್ರವನ್ನು ಖರೀದಿಸಿದ ಬಳಿಕ ಇದರ ಕಾರ್ಯಾಚರಣೆಯನ್ನು ಸಾರ್ವಜನಿಕ ಖಾಸಗಿ ಸಹಭಾಗಿತ್ವ (Public Private Partnership) ವಿಧಾನದ ಮೂಲಕ ಮಾಡುವ ಸಾಧ್ಯತೆಯ ಕುರಿತು ಅಧ್ಯಯನದ ಆಧಾರದ ಮೇಲೆ ನಿರ್ಧರಿಸಲಾಗುವುದು. ಈ ಹೂಳೆತ್ತುವಿಕೆ ಯಂತ್ರವನ್ನು ಹೂಳೆತ್ತುವಿಕೆಯ ನಿರ್ವಹಣೆ ಹಾಗೂ ಮರಳುಪೂರಣಕ್ಕಾಗಿ ಬಳಸಲಾಗುವುದು.

ಹಂತ 2ರ ಯೋಜನೆಗಳು

ಹಂತ 2ರಲ್ಲಿ 2 ಸಹ ಹಂತಗಳಿರುತ್ತವೆ.

ಹಂತ 2a ಯೋಜನೆಗಾಗಿ ಈ ಕೆಳಗಿನ ಸ್ಥಳಗಳನ್ನು ಗುರುತಿಸಲಾಗಿದೆ.

1) ಪಾವಿನಕುರುವೆ, ಉತ್ತರ ಕನ್ನಡ ಜಿಲ್ಲೆ
2) ಮುರುಡೇಶ್ವರ, ಉತ್ತರ ಕನ್ನಡ ಜಿಲ್ಲೆ
3) ಶಿರೂರು, ಉಡುಪಿ ಜಿಲ್ಲೆ
4) ಮರವಂತೆ, ಉಡುಪಿ ಜಿಲ್ಲೆ
5) ಕೋಡಿಕನ್ಯಾನ, ಉಡುಪಿ ಜಿಲ್ಲೆ
6) ಕೋಡಿ ಬೆಂಗ್ರೆ, ಉಡುಪಿ ಜಿಲ್ಲೆ
7) ಉದ್ಯಾವರ ಪಡುಕೆರೆ, ಉಡುಪಿ ಜಿಲ್ಲೆ
8) ಎರ್‌ಮಾಲ್ ತೆಂಕ, ಉಡುಪಿ ಜಿಲ್ಲೆ
9) ಉಳಿಯಾರಗೋಳಿ, ಉಡುಪಿ ಜಿಲ್ಲೆ
10) ಸೋಮೇಶ್ವರ ದಕ್ಷಿಣ ಕನ್ನಡ ಜಿಲ್ಲೆ

ಕರಾವಳಿ ನಿರ್ವಹಣಾ ಮಾಹಿತಿ ವ್ಯವಸ್ಥೆ (ಸಿಎಮ್‌ಐಎಸ್)ಯ ಸ್ಥಾಪನೆ:

ಸಿಎಮ್‌ಐಎಸ್ ಭೌಗೋಳಿಕ ಮಾಹಿತಿ ವ್ಯವಸ್ಥೆ (ಜಿಐಎಸ್)ಯ ಮೂಲಕ ಪ್ರಾದೇಶಿಕ ಮಾಹಿತಿಯನ್ನು ಅಭಿವೃದ್ಧಿಪಡಿಸುವುದು ಹಾಗೂ ಕರಾವಳಿ ನಿರ್ವಹಣಾ ಮಾಹಿತಿ ವ್ಯವಸ್ಥೆ (ಸಿಎಮ್ ಐಎಸ್) ಯೊಳಗೆ ತಾಂತ್ರಿಕ ಮಾಹಿತಿಯನ್ನು ತುಲನೆ ಮಾಡುವುದನ್ನು ಒಳಗೊಂಡಿದೆ. ಸಿಎಮ್‌ಐಎಸ್ ನ್ನು ಯೋಜನಾ ಅವಧಿಯಲ್ಲಿ ಅಭಿವೃದ್ಧಿಪಡಿಸಲಾಗುವುದು ಹಾಗೂ ಕರಾವಳಿ ತೀರದ ಯೋಜನೆ ಮತ್ತು ನಿರ್ವಹಣೆಗೆ ನೆರವಾಗುವಂಥಹ ಪ್ರಮುಖ ಮಾಹಿತಿಯನ್ನು ಈ ಅವಧಿಯಲ್ಲಿ ಸಂಗ್ರಹಿಸಲಾಗುವುದು.

ಕರಾವಳಿ ಮೂಲಸೌಕರ್ಯ ನಿರ್ವಹಣಾ ಘಟಕ (ಸಿಐಎಮ್ ಯು) ದೊಳಗೆ ಸಿಎಮ್‌ಐಎಸ್ ನ್ನು ಸ್ಥಾಪಿಸಲಾಗುವುದು. ಎಸ್ ಸಿ ಪಿ ಎಮ್ ಐ ಪೂರ್ಣಗೊಂಡ ನಂತರ ಸಿಐಎಮ್ ಯು ವ್ಯಾಪ್ತಿಯೊಳಗೆ ಕರ್ನಾಟಕದ ಕರಾವಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಮಾಹಿತಿ ಮತ್ತು ಅಂಕಿಅಂಶಗಳನ್ನು (data) ಆಗಾಗ ಸಂಗ್ರಹಿಸಿ, ಪರಿಷ್ಕರಿಸಿ, ಅಪ್‌ಡೇಟ್ ಮಾಡುವ ಕಾರ್ಯವನ್ನು ಸಿಎಮ್‌ಐಎಸ್ ಮುಂದುವರಿಸಲಿದೆ.

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SUSTAINABLE COASTAL PROTECTION AND MANAGEMENT INVESTMENT PROGRAMME – KARNATAKA

Sustainable Coastal Protection and Management Investment Program

Public Works, Inland & Water Transport Dept
Old Mangalore Port Office Building, Bunder

Project Management & Design Consultants
- Karnataka (PMDC-K)

ಸಂಪರ್ಕ ಮಾಹಿತಿ : ಪಿಎಮ್‌ಯು	ಸಂಪರ್ಕ ಮಾಹಿತಿ : ಪಿಎಮ್‌ಡಿಸಿ
ಯೋಜನಾ ನಿರ್ವಹಣಾ ಘಟಕ: ಎಸ್‌ಸಿಪಿಎಂಐಪಿ–ಕರ್ನಾಟಕ ಪಬ್ಲಿಕ್ ವರ್ಕ್ಸ್, ಪೋರ್ಟ್ಸ್ ಎಂಡ್ ಇನ್ ಲ್ಯಾಂಡ್ ವಾಟರ್ ಟ್ರಾನ್ಸ್ ಪೋರ್ಟ್ ಡಿಪಾರ್ಟ್ ಮೆಂಟ್, ಓಲ್ಡ್ ಮಂಗಳೂರು ಪೋರ್ಟ್ ಆಫೀಸ್ ಬಿಲ್ಡಿಂಗ್, ಬಂದರ್, ಮಂಗಳೂರು–575001 ದೂರವಾಣಿ ಸಂಖ್ಯೆ: : 0824–2441382, 0824–2441392 ಫ್ಯಾಕ್ಸ್ : 0824–2441382 ಇ–ಮೇಲ್ : adbpmu@gmail.com	**Euroconsult Mott MacDonald BV** ಯೋಜನಾ ನಿರ್ವಹಣಾ ಹಾಗೂ ವಿನ್ಯಾಸ ಸಮಾಲೋಚಕರು ಎಸ್‌ಸಿಪಿಎಂಐಪಿ –ಕರ್ನಾಟಕ ನಾರ್ತ್ ವಾರ್ಫ್ ಗೇಟ್ ಬಳಿ, ಹಳೆ ಮಂಗಳೂರು ಬಂದರು ಕಚೇರಿ ಆವರಣ, ಬಂದರು, ಮಂಗಳೂರು –575 001 ದೂರವಾಣಿ ಸಂಖ್ಯೆ: 0824–2441274 ಇ–ಮೇಲ್ : pmdckar@gmail.com

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ಎಸ್‌ಸಿಪಿಎಮ್‌ಐಪಿ–ಕೆ ಕರ್ನಾಟಕದ 320 ಕಿ.ಮೀ. ವ್ಯಾಪ್ತಿಯ ಕರಾವಳಿ ತೀರದಲ್ಲಿ ಉಂಟಾಗುವ ಕಡಲ್ಕೊರೆತದ ಸಮಸ್ಯೆಗೆ ಸ್ಪಂದಿಸಲಿದೆ. ಕಡಲ ತೀರಗಳಲ್ಲಿ ಕಡಲ್ಕೊರೆತ ತಡೆಗಾಗಿ ದಶಕಗಳಿಂದ ಜಾಲ್ತಿಯಲ್ಲಿರುವ ವಿಧಾನಗಳಾದ ಕಲ್ಲುಗಳ ಜೋಡಣೆ, ಕಲ್ಲಿನ ಗೋಡೆಗಳ ನಿರ್ಮಾಣ ಮುಂತಾದವುಗಳಿಗೆ ಪರ್ಯಾಯವಾಗಿ ಸುಸ್ಥಿರ ಹಾಗೂ ಪರಿಸರಸ್ನೇಹಿ ಪರಿಹಾರೋಪಾಯಗಳನ್ನು ಈ ಕಾರ್ಯಕ್ರಮದಲ್ಲಿ ಅಳವಡಿಸಲಾಗುವುದು.

2012ರ ಪ್ರಾರಂಭದಲ್ಲಿ ಆರಂಭವಾದ ಎಸ್‌ಸಿಪಿಎಮ್‌ಐಪಿ–ಕೆ ಎಂಟು ವರ್ಷಗಳ ಅವಧಿಯ ಕಾರ್ಯಕ್ರಮವಾಗಿದ್ದು 2015ರ ಮಧ್ಯದ ಅವಧಿವರೆಗೆ ಪ್ರಥಮ ಹಂತದಲ್ಲಿ ಕಾರ್ಯಾಚರಿಸಲಿದೆ. ಎಡಿಬಿ ಸಾಲದ ಹಣಕಾಸು ವ್ಯವಸ್ಥೆಯ ಮೂಲಕ ನಡೆಯುವ ಈ ಕಾರ್ಯಕ್ರಮ ಪ್ರಥಮ ಹಂತದಲ್ಲಿ ನಾಲ್ಕು ವಿಭಾಗಗಳನ್ನು ಹೊಂದಿದೆ.

1) ಮೊದಲನೇ ಹಂತದ ಸಹ–ಯೋಜನೆಗಳ ನಿರ್ಮಾಣ
2) ಎಸ್‌ಐಎಮ್‌ಯು ಹಾಗೂ ಎಸ್ ಎಮ್ ಒ ಗಳ ಸ್ಥಾಪನೆ
3) ಕರಾವಳಿ ತೀರ ನಿರ್ವಹಣಾ ಯೋಜನೆ
4) ದ್ವಿತೀಯ ಹಂತದ ಪ್ರಸಾವನೆಗಳ ಗುರುತಿಸುವಿಕೆ ಹಾಗೂ ತಯಾರಿಕೆ

ಉಳ್ಳಾಲ ಉಪಯೋಜನೆ

ಉಳ್ಳಾಲ ಉಪಯೋಜನೆ

ಉಳ್ಳಾಲದ ಪ್ರಥಮ ಹಂತದ ಉಪ ಯೋಜನೆ ಎರಡು ಬ್ರೇಕ್‌ವಾಟರ್‌ಗಳ ಪುನರ್‌ನಿರ್ಮಾಣ (breakwaters rehabilitation), ಆಳಸಮುದ್ರದಲ್ಲಿ ಎರಡು ಬಂಡೆ ಸಾಲುಗಳ (off-shore reefs) ನಿರ್ಮಾಣ, ಕಡಲ ತೀರದಲ್ಲಿ ನಾಲ್ಕು ತಡೆದಂಡೆಗಳ ನಿರ್ಮಾಣ (in-shore berms) ಹಾಗೂ ಎರಡು ಮರಳು ಪೂರಣ (sand nourishment events) ಕಾಮಗಾರಿಗಳನ್ನು ಒಳಗೊಂಡಿರುತ್ತದೆ.

ಕಡಲತೀರದಲ್ಲಿ ತಡೆದಂಡೆಗಳು (in-shore berms): ಕಡಲತೀರದಲ್ಲಿ ನಾಲ್ಕು ತಡೆದಂಡೆಗಳ ನಿರ್ಮಾಣದ ಗುತ್ತಿಗೆಗೆ 2013 ಫೆಬ್ರವರಿಯಲ್ಲಿ ಸಹಿ ಮಾಡಲಾಗಿದೆ. ಈ ನಾಲ್ಕು ತಡೆದಂಡೆಗಳನ್ನು 2014ರ ಮಳೆಗಾಲದೊಳಗೆ ನಿರ್ಮಿಸಲಾಗುವುದು. ಅವಿಷ್ಕಾರಾತ್ಮಕ ಪ್ರಯತ್ನವಾಗಿ ಜಿಯೋಟಿಕ್ಸ್ ಟ್ಯೂಬ್ ಮೆಗಾ ಬ್ಯಾಗ್‌ಗಳನ್ನು ನಿರ್ಮಾಣ ಕಾರ್ಯದಲ್ಲಿ ಬಳಸಲಾಗುವುದು.

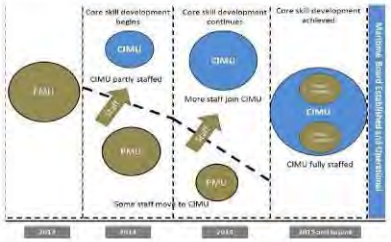
ಬ್ರೇಕ್‌ವಾಟರ್‌ಗಳು: ಪಿಎಮ್‌ಡಿಸಿ–ಕೆ ಈಗಾಗಲೇ ಬ್ರೇಕ್‌ವಾಟರ್‌ಗಳ ಪುನರ್ ನಿರ್ಮಾಣದ ವಿನ್ಯಾಸ ವರದಿಯನ್ನು ಅಂತಿಮಗೊಳಿಸಿದೆ. ಭವಿಷ್ಯದಲ್ಲಿನ ಸಮುದ್ರ ಮಟ್ಟದ ಏರಿಕೆಗೆ ಹೊಂದಿಕೊಳ್ಳುವಂಥಹ ಸುದೃಢವಾದ ನಿರ್ಮಾಣ ವ್ಯವಸ್ಥೆ ಇದಾಗಲಿದೆ.

ಆಳಸಮುದ್ರದಲ್ಲಿ ಬಂಡೆಸಾಲುಗಳ ನಿರ್ಮಾಣ: ಕೇಂದ್ರ ನೀರು ಹಾಗೂ ವಿದ್ಯುತ್ ಸಂಶೋಧನಾ ಕೇಂದ್ರ (ಸಿಡಬ್ಲ್ಯುಪಿಆರ್‌ಎಸ್) ತನ್ನ ಪ್ರಯೋಗಾಲಯದಲ್ಲಿ ಫ್ಲೂಮ್ ಟಿಸ್ಟ್ ಒಳಗೊಂಡಂತೆ ಆಳಸಮುದ್ರದಲ್ಲಿ ನಿರ್ಮಾಣ ಮಾಡಲಾಗುವ ಬಂಡೆಸಾಲುಗಳ ವಿನ್ಯಾಸವನ್ನು ಸಿದ್ಧಪಡಿಸುತ್ತಿದೆ.

ಪಿಎಮ್ ಯು ಹಾಗೂ ಎಮ್ ಡಿಸಿ–ಕೆ ಬ್ರೇಕ್‌ವಾಟರ್‌ಗಳ ಪುನರ್ ನಿರ್ಮಾಣ ಮತ್ತು ಆಳಸಮುದ್ರದಲ್ಲಿ ಬಂಡೆಸಾಲುಗಳ ನಿರ್ಮಾಣದ ಪ್ಯಾಕೇಜ್‌ಗೆ ಜಂಟಿ ಟೆಂಡರನ್ನು ಸಿದ್ಧಪಡಿಸುವ ಚಿಂತನೆಯಲ್ಲಿದೆ. ಈ ಮೂಲಕ ಅರ್ಹ ಹಾಗೂ ಬೃಹತ್ ನಿರ್ಮಾಣ ಸಂಸ್ಥೆಗಳನ್ನು ಟೆಂಡರ್‌ನಲ್ಲಿ ಭಾಗವಹಿಸಲು ಆಕರ್ಷಿಸಬಹುದಾಗಿದೆ

ಕರಾವಳಿ ಮೂಲಸೌಕರ್ಯ ನಿರ್ವಹಣಾ ಘಟಕ (ಸಿಐಎಮ್‌ಯು) : ಲೋಕೋಪಯೋಗಿ ಇಲಾಖೆ, ಪಿ ಎಂಡ್ ಐಡಬ್ಲ್ಯುಟಿ ಯೊಳಗೆ ಸಿಐಎಮ್‌ಯುನ ಸ್ಥಾಪನೆಯ ಚೌಕಟ್ಟು ಸ್ವೀಕೃತವಾಗಿದೆ. 2013ರಲ್ಲಿ ಈ ಘಟಕವನ್ನು ಸ್ಥಾಪಿಸಲಾಗುವುದು ಹಾಗೂ ಕರ್ನಾಟಕದ ಪ್ರಮುಖ ಕರಾವಳಿ ನಗರವಾದ ಮಂಗಳೂರಿನಲ್ಲಿ ಈ ಘಟಕದ ಕಚೇರಿ ಕಾರ್ಯಾಚರಿಸಲಿದೆ.

ಸಿಐಎಮ್‌ಯು ಕರಾವಳಿಯ ಮೇಲ್ವಿಚಾರಣೆ ಮಾಡುವುದರ ಜೊತೆಗೆ ಕರಾವಳಿ ತೀರ ನಿರ್ವಹಣಾ ಸಂಸ್ಥೆಗಳ (ಎಸ್ ಎಂ ಒ) ಮುಖಾಂತರ ಹಿತಾಸಕ್ತರೊಂದಿಗೆ ಸಮಾಲೋಚನೆ ನಡೆಸುವ ಮೂಲಕ ಕರಾವಳಿಯ ಆಸ್ತಿಪಾಸ್ತಿಗಳ ರಕ್ಷಣೆ ಹಾಗೂ ನಿರ್ವಹಣೆಗೆ ದೀರ್ಘಕಾಲಿಕ ಸುಸ್ಥಿರ ಪರಿಹಾರೋಪಾಯಗಳನ್ನು ಸೂಚಿಸಲಿದೆ.



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ಕರಾವಳಿ ತೀರ ನಿರ್ವಹಣಾ ಯೋಜನೆ (ಎಸ್‌ಎಂಪಿ), ಕರಾವಳಿ ತೀರ ನಿರ್ವಹಣಾ ಸಂಸ್ಥೆಗಳು (ಎಸ್ ಎಂ ಒ) ಹಾಗೂ ಸುಸ್ಥಿರ ತುರ್ತು ಸ್ಪಂದನೆ (ಎಸ್‌ಇಆರ್)

ಕರಾವಳಿ ತೀರ ನಿರ್ವಹಣಾ ಯೋಜನೆಯ ವಿಧಿವಿಧಾನಗಳ ಆಧಾರದಲ್ಲಿ ದಕ್ಷಿಣ ಕನ್ನಡ ಜಿಲ್ಲೆಗೆ ಕರಾವಳಿ ತೀರ ನಿರ್ವಹಣಾ ಯೋಜನೆಯ ಪ್ರಥಮ ಕರಡನ್ನು ಪಿಎಂಡಿಸಿ–ಕೆ ಒಂದು ವರ್ಷದ ಅವಧಿಯಲ್ಲಿ ಸಿದ್ಧಪಡಿಸಿದ್ದು ಇದನ್ನು 2012 ಜೂನ್‌ನಲ್ಲಿ ಅಂಗೀಕರಿಸಲಾಗಿದೆ. ದಕ್ಷಿಣ ಕನ್ನಡ ಜಿಲ್ಲೆಯನ್ನು ಪರಸ್ಪರ ಹೊಂದಿಕೊಳ್ಳುವ 6 ವಲಯಗಳನ್ನಾಗಿ ವಿಂಗಡಿಸಲಾಗಿದೆ. ಕರಾವಳಿ ಪ್ರಕ್ರಿಯೆಯ ಅರಿವನ್ನು ಪಿಎಚ್‌ಡಿಸಿ–ಕೆ ಪೂರೈಸುತ್ತಿದ್ದು, ಸ್ಥಳೀಯ ಆಗುಹೋಗುಗಳ ಅರಿವು ಹಾಗೂ ಕಾಳಜಿ ವಹಿಸಬೇಕಾದ ವಿಷಯಗಳ ಮಾಹಿತಿ ಸ್ಥಳೀಯ ಹಿತಾಸಕ್ತರ ನೆರವಿನಿಂದ ಎಸ್‌ಎಂಒಗಳ ಮೂಲಕ ಲಭಿಸುತ್ತದೆ. ಇವರೊಂದಿಗಿನ ಜಂಟಿ ಚರ್ಚೆಗಳು ಕರಾವಳಿ ಕರ್ನಾಟಕಕ್ಕೆ ಪೂರಕವಾಗಿ ದೀರ್ಘಕಾಲಿಕ ಕಾರ್ಯನೀತಿಯ ಪ್ರಥಮ ಕರಡನ್ನು ತಯಾರಿಸಲು ನೆರವಾಗುತ್ತದೆ.

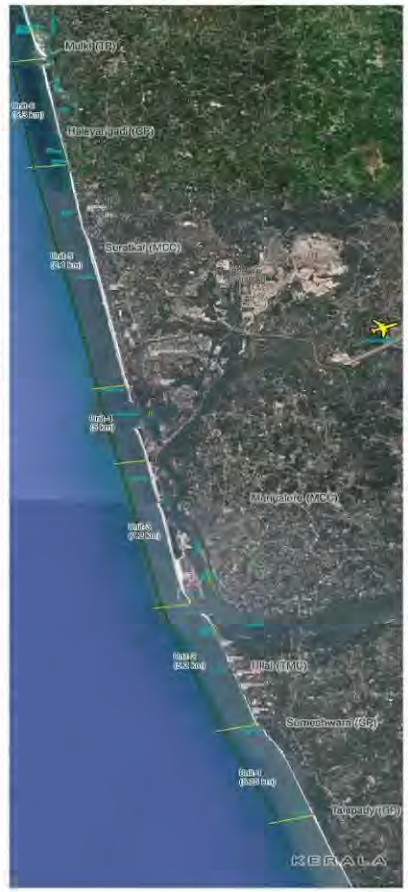
2013ರಲ್ಲಿ ಎಮ್‌ಡಿಸಿ–ಕೆ ಎಸ್‌ಎಂಒಗಳ ಸ್ಥಾಪನೆ ಹಾಗೂ ಉಡುಪಿ ಮತ್ತು ಉತ್ತರ ಕನ್ನಡ ಜಿಲ್ಲೆಗಳ ಎಸ್‌ಎಂಪಿಗಳ ರಚನೆಯ ಕಾರ್ಯವನ್ನು ಮುಂದುವರಿಸಲಿದೆ. ಎಸ್‌ಎಂಒ ಗಳ ಮೂಲಕ ಸಂಘಟಿತ ಹಿತಾಸಕ್ತರ ಭಾಗವಹಿಸುವಿಕೆಯೊಂದಿಗೆ ಈ ಕರಡು ಕಾರ್ಯನೀತಿಯ ದಾಖಲೆಗಳು, 2014ರಲ್ಲಿ ಕರ್ನಾಟಕ ರಾಜ್ಯದ ಎಸ್‌ಎಂಪಿಯನ್ನು ಅಭಿವೃದ್ಧಿಪಡಿಸಲು ನೆರವಾಗಲಿವೆ.

ಸ್ವಯಂಸೇವಾ ಎಸ್‌ಎಂಒಗಳು ಸಮಾಜ ಹಾಗೂ ಪಿಎಚಿಡಿಸಿ–ಕೆ/ಸಿಐಎಂಯು ನಡುವಣ ಕೊಂಡಿಯಾಗಿ ಕಾರ್ಯಾಚರಿಸಲಿವೆ ಇವುಗಳು ತಮ್ಮ ಕಾರ್ಯಾಚರಣೆಗಾಗಿ ಸಣ್ಣ ಪ್ರಮಾಣದ ಬಜೆಟ್‌ಗಳನ್ನು ಹೊಂದಿದ್ದು ಮುಂಬರುವ ದಿನಗಳಲ್ಲಿ ಕರಾವಳಿಯ ಅಂಚಿನುದ್ದಕ್ಕೂ ಇರುವ ಕರಾವಳಿ ಪ್ರಕ್ರಿಯೆಗಳ/ಬದಲಾವಣೆಗಳ ಮೇಲ್ವಿಚಾರಣೆ ಹಾಗೂ ಆಸ್ತಿ ನಿರ್ವಹಣೆಗೆ ನೆರವಾಗಲಿವೆ.

ಮಳೆಗಾಲದ ತೀವ್ರತೆಯಿಂದ ಉಂಟಾಗಬಹುದಾದ ಹಾನಿಕಾರಕ ಪರಿಣಾಮಗಳನ್ನು ತಡೆಗಟ್ಟುವುದಕ್ಕಾಗಿ ಅವಶ್ಯವಿರುವ ತುರ್ತು ಕ್ರಮಗಳ ಅಗತ್ಯತೆಯನ್ನು ಮನಗಂಡಿರುವ ಸರಕಾರ, ಸುಸ್ಥಿರ ತುರ್ತು ಸ್ಪಂದನಾ ಯೋಜನೆ (Sustainable Emergency Response Plan- ಎಸ್‌ಇಆರ್‌ಪಿ) ಯನ್ನು ಅಭಿವೃದ್ಧಿಪಡಿಸಲು ಎಮ್‌ಡಿಸಿ–ಕೆ ಗೆ ಅನುಮತಿ ನೀಡಿದೆ.

ಈ ಎಸ್‌ಇಆರ್ ಯೋಜನೆ ಅಂಗೀಕೃತಗೊಂಡ ಬಳಿಕ 2013ರ ಮಳೆಗಾಲದ ಅವಧಿಯೊಳಗಾಗಿ ಪ್ರಥಮ ಪ್ರಾಯೋಗಿಕ (ಪೈಲಟ್) ಯೋಜನೆಯಾಗಿ ಪರಿಚಯಿಸಲಾಗುವುದು. ಎಸ್‌ಇಆರ್ ಅನುಷ್ಠಾನಕ್ಕಾಗಿ ಪ್ರಸಕ್ತ ಸಾಲಿನಲ್ಲಿ ಗುತ್ತಿಗೆದಾರರನ್ನು ನೇಮಿಸಲಾಗಿದ್ದರೂ, 2014ರ ಮಳೆಗಾಲದ ಆರಂಭದಲ್ಲಿ ಗುತ್ತಿಗೆದಾರರ ಪಾತ್ರವನ್ನು ತರಬೇತಿ ಪಡೆದ ಎಸ್‌ಎಂಒ ಗಳು ನಿರ್ವಹಿಸಲಿವೆ.

Policy Units of Dakshina Kannada District



Mott MacDonald

Appendix 5: Socioeconomic Profile of Tranche 2 sub project sites

Table 27: Socioeconomic Profile of Someshwara

Socioeconomic Factors	Someshwara (Total)	Coastal Wards (Total)
Number of Wards	16	4
Number of Households	4752	525
Total Population	24066	3145
Males	11830	1,480
Females	12236	1,665
Below Poverty Line (BPL) (in numbers)	1287	328
Children below 6 years	2489	632
Scheduled Caste Population	1485	325
Scheduled Tribe population	857	452
Literacy Rate (%)	92	90
Total Working Population	13587	1488
Physically challenged (in numbers)	91	10
Pensioners/idlers (in numbers)	1589	375
Beedi rolling population	4548	1254
Cultivators (in numbers)	857	128
Petty shops (in numbers)	1365	125
Fishery (in numbers)	70	75
Fish meal factories (in numbers)	0	0

Source: Household Survey, December 2014 and Gram Panchayat Records, 2011

Table 28 : Socioeconomic Profile of Yermal Thenka and Bada

Socioeconomic Factors	Yermal Thenka and Bada (Total)	Coastal Wards (Total)
Number of Wards	7	5
Number of Households	2709	600 (estimated)
Total Population	12,570	3,145
Males	5822	1,480
Females	6748	1,665
Below Poverty Line (BPL) (nrs)	650	NA
Children below 6 years	3190	830
Scheduled Caste Population	Nil	Nil
Scheduled Tribe population	Nil	Nil
Literacy Rate (%)	85%	86%
Total Working Population	3244	890
Physically challenged (nrs)	47	NA
Pensioners/lders (nrs)	12	NA
Beedi rolling population	400	75 (estimated)
Cultivators (nrs)	838	250
Petty shops (nrs)	150	25
Fishery (nrs)	850	850
Fish meal factories (nrs)	7	7

Source: HH Survey, December 2014 and GP Records, 2011

Table 29: Socioeconomic Profile of Udyavara

Socioeconomic Factors	Udyavara (Total)	Coastal Ward
Number of Wards	8	1
Number of Households	2247	113
Total Population	11386	650
Males	5402	312 (estimated)
Females	5984	338 (estimated)
Below Poverty Line (BPL) (nrs)	51%	NA
Children below 6 years	3985	230
Scheduled Caste Population	Nil	Nil
Scheduled Tribe population	Nil	Nil
Literacy Rate (%)	91%	91%
Physically challenged (nrs)	Nil	Nil
Pensioners/elders (nrs)	NA	NA
Cultivators (nrs)	160	NA
Petty shops (nrs)	NA	3
Fishery (nrs)	9680	550 (estimated)
Fish meal factories (nrs)	3	3

Source: HH Survey, December 2014 and GP Records, 2011

Table 30: Socioeconomic Profile of Kodi Bengre

Socioeconomic Factors	Kemmannu and Kodi (Total)	Coastal Wards (Total)
Number of Wards	12	7
Number of Households	2706	1110
Total Population	12500	4661
Males	5996	2354
Females	6504	2547
Below Poverty Line (BPL) (in numbers)	1990	776
Children below 6 years	1109	302
Scheduled Caste Population	1613	342
Scheduled Tribe population	579	98
Literacy Rate (%)	90	92
Total Working Population	7319	2596
Physically challenged (in numbers)	52	5
Pensioners/ldlers (in numbers)	1441	439
Beedi rolling population	1704	481
Cultivators (in numbers)	718	72

Socioeconomic Factors	Kemmannu and Kodi (Total)	Coastal Wards (Total)
Petty shops (in numbers)	122	19
Fishery (in numbers)	904	544
Fish meal factories (numbers)	2	2

Source: HH Survey, December 2014 and GP Records, 2011

Table 31: Socioeconomic Profile of Kodi Kanyana

Socioeconomic Factors	Kodi Kanyana (Total)	Coastal Wards (Total)
Number of Wards	4	2
Number of Households	1166	650
Total Population	4490	2420
Males	2161	1410
Females	2329	1010
Below Poverty Line (BPL) (nrs)	1569	658
Children below 6 years	368	121
Scheduled Caste population	958	297
Scheduled Tribe population	258	71
Literacy Rate (%)	91	85
Total Working Population	2458	1585
Physically challenged (nrs)	16	2
Pensioners/Elders (nrs)	568	198
Beedi rolling population	450	127
Cultivators (nrs)	391	51
Petty shops (nrs)	71	6
Fishery (nrs)	900	540
Fish meal factories (nrs)	1	1

Source: HH Survey, December 2014 and GP Records, 2011

Table 32: Socioeconomic Profile of Maravanthe and Trasi

Socioeconomic Factors	Trasi and Maravanthe (Total)	Coastal Wards (Total)
Number of Wards	9	4
Number of Households	2570	1108
Total Population	14,991	7655
Males	6772	3565
Females	8219	4090
Below Poverty Line (BPL)	4443	1806

Socioeconomic Factors	Trasi and Maravanthe (Total)	Coastal Wards (Total)
(nrs)		
Children below 6 years	2172	763
Scheduled Caste Population	1283	306
Scheduled Tribe population	1669	608
Literacy Rate (%)	88%	85%
Total Working Population	9822	4544
Physically challenged (nrs)	73	20
Pensioners/Elders (nrs)	1906	912
Beedi rolling population	3670	1117
Cultivators (nrs)	883	172
Petty shops (nrs)	229	44
Fishery (nrs)	1525	1052
Fish meal factories/Ice factories (nrs)	9	9

Source: HH Survey, December 2014 and GP Records, 2011

Table 33: Socioeconomic Profile of Mavalli

Socioeconomic Factors	Mavalli (Total)	Coastal Wards (Total)
Number of Wards	14	8
Number of Households	3706	1200
Total Population	17062	6889
Males	8267	3343
Females	8795	3546
Below Poverty Line (BPL) (in numbers)	8412	4018
Children below 6 years	1857	951
Scheduled Caste Population	2368	1351
Scheduled Tribe population	2412	1547
Literacy Rate (%)	68	63
Total Working Population	12365	4214
Physically challenged (in numbers)	145	64
Pensioners/idlers (in numbers)	1587	859
Beedi rolling population	1258	457
Cultivators (in numbers)	1864	198
Petty shops (in numbers)	945	583
Fishery (in numbers)	351	283
Fish meal factories (in numbers)	0	0

Source: HH Survey, December 2014 and GP Records, 2011

Table 34: Socioeconomic Profile of Karki

Socioeconomic Factors	Karki (Total)	Coastal Wards (Total)
Number of Wards	7	3
Number of Households	1501	172
Total Population	7629	1031
Males	NA	510
Females	NA	521
Below Poverty Line (BPL) (nrs)	NA	85%
Children below 6 years	NA	6.13%
Scheduled Caste Population	Nil	Nil
Scheduled Tribe population	Nil	Nil
Literacy Rate (%)	82%	77%
Physically challenged (nrs)	Nil	Nil
Pensioners/elders (nrs)	Nil	Nil
Cultivators (nrs)	450	46
Petty shops (nrs)	135	37
Fishery (nrs)	NA	80
Fish meal factories (nrs)	Nil	Nil

Source: HH Survey, December 2014 and GP Records, 2011

Appendix 6: Qualitative composition of the Plankton of the Coastal Waters of Karnataka

Order	:	Myxophyceae
Family	:	NOSTACACEAE
Genus	:	Nostoc Vaucher
1.		*Nostoc app.*
	:	
Division	:	Chlorophyta
Class	:	Chlorophyceae
Order	:	Chlorococcales
Family	:	HYDRODICTYACEAE
Genus	:	Pediastrum Meyer
2.		*Pediastrum boryanum* (Turpin) Meneghini
	:	
Order	:	Zygnematales
Family	:	DESMIDIACEAE
Genus	:	Staurastrum Meyer
3.		*Staurastrum orbiculare* Ralfs.
	:	
Order	:	Gymnodiniales
Family	:	GYMNODINIACEAE
Genus	:	Gymnodinium Stein
4.		*Gymnodinium albulum* Lindemann
	:	
Order	:	Peridiniales
Family	:	PERIDINIACEAE
Genus	:	Peridinium Ehrenberg
5.		*Peridinium platinum* Lauterborn
	:	
Family	:	CERATIACEAE
Genus	:	Ceratium Schrank
6.		*Ceratium hirundinella* (O.F.M) Shrank
	:	
Division	:	Chrysophyta
Class	:	Bacillariophyceae
Order	:	Bacillariales
Suborder	:	Discineae
Family	:	COSCINODISCACEAE
Subfamily	:	Melosirodeae
Genus	:	Melosira
7.		*Melosira ambigua* (Grun.) Mull.
	:	
Subfamily	:	Coscinodiscoideae
Genus	:	Coscinodiscus Ehrenberg
8.		*Coscinodiscus rothii* (Her.) Grun.
	:	
Genus	:	Cyclotella Breb.

9.		*Cyclotella stelligera* (Cl. And Grun.)
	:	
Genus	:	Stephanodiscus Ehrenberg
10.		*Stephanodiscus niagarae* Ehrenberg
	:	
Suborder	:	Biddulphinineae
Family	:	BIDDULPHIACEAE
Subfamily	:	Biddulphioideae
Genus	:	Biddulphia Gray
11.		*Biddulphia laevis* Ehrenberg
	:	
Subfamily	:	Terpisinioideae
Genus	:	Terpisinoe
12.		*Terpisinoe musica* Ehrenberg
	:	
Genus	:	Hydrosera Wallich
13.		*Hydrosera triquetra* Wall.
	:	
Family	:	CHAETOCERACEAE
Subfamily	:	Chaetoceroideae
Genus	:	Chaetoceros Ehrenberg
14.		*Chaetoceros elmorei* Bonger
	:	
Suborder	:	Soleniineae
Family	:	RHIZOSOLENIACEAE
Subfamily	:	Rhizoselenioideae
Genus	:	Rhizoselenia Her. Emend. Brightw.
15.		*Rhizoselenia eriensis* H.L.Sm.
	:	
Genus	:	Attheya West
16.		*Attheya zachariasi* Brun.
	:	
Suborder	:	Araphidineae
Family	:	FRAGILARIACEAE
Subfamily	:	Tabellarioideae
Genus	:	Tetracyclus Ralfs.
17.		*Tetracyclus lacustris* Ralfs
	:	
Genus	:	Tabellaria Ehrenberg
18.		*Tabellaria fanastrata* (Lungb.) Kutz.
	:	
Subfamily	:	Meridionoideae
Genus	:	Meridion Ag.
19.		*Meridion circulare* (Greve) Ag.
	:	
Genus	:	Diatoma Grun.
20.		*Diatoma vulgare* Bory

	:	
Subfamily	:	Fragilarioideae
Genus	:	Asterionella Hass.
21.		*Asterionella formosa* Hass.
	:	
Genus	:	Ceratoneis Ehrenberg
22.		*Ceratoneis arcus* (Ehr.) Kutz.
	:	
Genus	:	Centronella Voigt.
23.		*Centronella reichetti* Voigt.
	:	
Genus	:	Fragilaria Lyngb.
24.		*Fragilaria capucina* Desmazieres
	:	
Genus	:	Opephora Petit
25.		*Opephora martyi* Herib.
	:	
Genus	:	Synedra Ehrenberg
26.		*Synedra ulna* (Nitzsch) Ehrenberg
	:	
Genus	:	Amphicampa Ehrenberg
27.		*Amphicampa eruca* Ehrenberg
	:	
Suborder	:	Raphidioideneae
Family	:	EUNOTIACEAE
Subfamily	:	Peronioideae
Genus	:	Peronia Breb. And Arn.
28.		*Peronia erinacea* Breb. And Arn.
	:	
Subfamily	:	Eunotiodeae
Genus	:	Eunotia Ehrenberg
29.		*Eunotia praerupta* var. nitens (Ehrenberg)
	:	
Genus	:	Actinella Lewis
30.		*Actinella punctat* lewis
	:	
Suborder	:	Monoraphidineae
Family	:	ACHNANTHACEAE
Subfamily	:	Cocconeioideae
Genus	:	Cocconeis Ehrenberg
31.		*Cocconeis placentula* var. euglypha(Ehrenberg)
	:	
Subfamily	:	Achnanthes Broy
32.		*Achnanthes lanceolata* (Breb.)
	:	
Genus	:	Rhoicosphenia Grun.

33.		*Rhoicosphenia currata* (Kutzing)
	:	
Genus	:	Eucocconeis Cl.
34.		*Eucocconeis flexella* (Kutzing) Cl.
	:	
Suborder	:	Biraphidineae
Family	:	NAVICULACEAE
Subfamily	:	Naviculoideae
Genus	:	Amphileura Kutzing
35.		*Amphileura pellucida* Kutzing
	:	
Genus	:	Anomoeoneis Pfitz.
36.		*Anomoeoneis sphaerophora* (Kutzing) Pfitz
	:	
Genus	:	Brebissonia Grun.
37.		*Brebissonia boeckii* (Ehr.) Grun.
	:	
Genus	:	Caloneis Cl.
38.		*Caloneis amphisbaena* (Bory) Cl.
	:	
Genus	:	Diatemella Grun.
39.		*Diatemella batfouriana* Grun.
	:	
Genus	:	Diploneis Ehr.
40.		*Diploneis elliptica* (Kutz.) Cl.
	:	
Genus	:	Frustulia Grun.
41.		*Frustulia rhomboides* (Ehr.) De T.
	:	
Genus	:	Gyrosigma Hass.
42.		*Gyrosigma kutzingii* (Grun.) Cl.
	:	
Genus	:	Mastogloia Thw.
43.		*Mastogloia denseii* (Thwaites) W.Sm.
	:	
Genus	:	Navicula Bory
44.		*Navicula radiosa* kutz
	:	
Genus	:	Neidium Pfitz
45.		*Neidium affinis* Cl.
	:	
Genus	:	Pinnularia Ehr.
46.		*Pinnularia nobilis* Ehr.
	:	
Genus	:	Stauroneis Ehr.
47.		*Stauroneis phoenicentron* (Nitzch) Ehr.
	:	

Subfamily	:	Amphiroideae
Genus	:	Amphiphora
48.		*Amphiphora alata* (Ehr.) Kutz.
	:	
Family	:	GOMPHONEMACEAE
Subfamily	:	Gomphonemoideae
Genus	:	Gomphonema Hust.
49.		*Gomphonema geminatum* (Lyngb.)
	:	
Genus	:	Gomphoneis Cl.
50.		*Gomphoneis herculeanum* (Ehr.) Cl.
	:	
Family	:	CYMBELLACEAE
Subfamily	:	Cymbelloideae
Genus	:	Cymbella Ag.
51.		*Cymbella cistula* (Hempr. And Ehr.)
	:	
Genus	:	Amphora Ehr. Emend kutz
52.		*Amphora ovalis* (Kutz.) kutz.
	:	
Family	:	EPITHEMIACEAE
Subfamily	:	Epithemeoideae
Genus	:	Epithemia Breb.
53.		*Epithemia turgida* (Ehr.) Kutz.
	:	
Genus	:	Denticula Kutz.
54.		*Denticula thermalis* Kutz.
	:	
Subfamily	:	Rhopalodioidea
Genus	:	Rhopalodia Mull
55.		*Rhopalodia gribba* (Ehr.) Mull
	:	
Family	:	NITZSCHIACEAE
Subfamily	:	Nitzschiaceae
Genus	:	Cylindrotheca Raben
56.		*Cylindrotheca gracilis* (Breb.) Grun.
	:	
Genus	:	Bacillaria Gmel.
57.		*Bacillaria paradoxa* Gmel.
	:	
Genus	:	Hantzschia Grun.
58.		*Hantzschia amphioxys* (Ehr.) Grun.
	:	
Genus	:	Nitzchia Grun.
59.		*Nitzchia sigmoides* (Nitzchia) W.Sm.
	:	
Family	:	SURIRELLACEAE

Subfamily	:	Surirelloideae
Genus	:	Surirella Turp.
60.		*Surirella striatula* Turp.
	:	
Genus	:	Cymatopleura W.Sm.
61.		*Cymatopleura solea* (Breb.) W.Sm.
	:	
Genus	:	Campylodiscus Ehr.
62.		*Campylodiscus clypeus* Ehr.
	:	
Genus	:	Navicula Broy
63.		*Navicula radiosa* Broy