Centre for Earth Science Studies, Thiruvananthapuram

CZMP of Mira Bhayandar Municipal Corporation in 1:25000 scale

1. Introduction

The preparation of the CZMP for Mira Bhayandar Municipal Corporation has been undertaken as part of the CZMP preparation for the coastal zone of Thane and Sindhudurg districts. The approach and methodology followed are the same for all the Municipal Corporations, Municipal Councils and rural areas in the above districts.

The damages to the coastal zone and the impact of coastal hazards to communities and properties, to a certain extent, can be controlled by regulating high impact activities in the coastal zone. It was with this objective the Coastal Regulation Zone (CRZ) Notification (MoEF, 2011; 1991) was introduced in the country.

1. 1 Coastal Zone Management Plans

The CRZ provides a spatial planning framework for Coastal Zone Management Plans which provide setbacks around sensitive eco-zones restricting development and other activities close to it. Setbacks require specific reference lines and boundaries for its meaningful implementation. The High Tide Line (HTL) forms the cardinal reference line for determining the setbacks for CRZ. The 100, 200 and 500m CRZ lines landward from the HTL are the landward setback lines. The Low Tide Line (LTL) and the Territorial water boundary (12 NM) form the setback lines towards the sea. The Coastal Zone Management Plans are prepared in 2 scales:

1. CZMP consisting of CRZ maps in 1:25000 scale with Survey of toposheets as base maps
2. CZMP consisting of CRZ maps in 1:4000 scale with cadastral maps as base maps

The major work components are:

i. Generation of data in 1:4000 scale on HTL, LTL and eco-morphological systems relevant for CRZ

ii. Demarcation of HTL, LTL, ecosystems and morphology relevant for CRZ in 1:25,000

iii. Demarcation of HTL, LTL, ecosystems and morphology relevant for CRZ in 1:4,000 scale.

iv. Preparation of CZMP maps consisting of CRZ maps in 1:25000 scale

v. Preparation of Local level CZMP maps in 1:4000 cadastral scale.

The CZM/ CRZ maps in 1:25000 scale with Survey of toposheets as base maps which are required for policy decisions. These are to be submitted to MoEF, Govt of India for approval after stakeholder/

public consultations. The local level CRZ/ CZMP are prepared in 1:4000 with cadastral base maps and based on the approved CZMP. Local level data in cadastral scale was generated initially which is being used for preparing the 1;25000 CZMP on toposheet base maps. The same is used for local level CRZ/CZMP maps.

1.2 CZMP in1:25000 scale

The present study and report provide the CZMP in 1:25000 scale.

2. High Tide Line

Different tide levels like Mean High Water Springs, Mean Low Water Springs, Lowest Astronomical Tide, etc are defined and successfully used for navigational purposes and sea surveying. The High Tide Level is dependent on lunar cycles. It is normally taken as the water level at which the high tide intersects with the vertical plane.

The above definition is not in commensurate with the objectives of demarcating the HTL which is to regulate the activities on the land. The experience of Naval Hydrographer while demarcating the HTL in Goa way back in 1992-93 brought out the limitations in assigning the usual definitions for the HTL (Menon, 1993). The HTL demarcated in this case for Goa was found to be in the sea during the next monsoon.

A functional HTL is defined in the CRZ notification with the sole objective of protecting a given stretch of coastal strip from environmental degradation. Hence an approach different from the ones followed for navigational purpose, is necessary for demarcating HTL, in tune with the definition given in the Notification.

The HTL is defined 'for the purpose of the notification' as *"the line on the land upto which the highest waterline reaches during the spring tide"* which is different from the well known and widely accepted definition of High Tide Level. The above definition of HTL takes into consideration not only the level of inundation due to maximum tide (spring tide) but also the wave set up (having a seasonal periodicity). The sea level thus formed due to the combined effect of spring tide and wave set up gives the line of maximum reach of water on the land.

There is a similarity between the HTL thus defined and the High Water Line (HWL) given in Survey of India (SoI) toposheets. Both are lines drawn on the land. But the HWL and HTL are different that the former gives the fair season shoreline (because SoI field mapping is conducted during non-rainy season) during spring tide while the latter accommodates the rough season (monsoon) shoreline oscillations due to monsoon wave set up in addition to spring tide inundation.

3. Low Tide Line

Unlike the HTL the Low Tide Line (LTL) has not been defined for CRZ. The HTL required specific definition since the 100, 200 and 500m setback lines are defined with respect to the HTL. The conventional definition of lowest low water level and the resultant low water line during spring tide may be taken as the LTL.

4. Setback lines

The 100, 200 and 500m setback lines are drawn landward of the HTL. Once the HTL is well defined and demarcated, the above 3 setback lines could be drawn without any ambiguity following planimetric methods.

4.1 Setback line for CRZ II in MBMC

For urban areas like MBMC in which developed areas are eligible to be categorized as CRZ II, the setback lines are different. Those prohibited activities listed in the CRZ notification (2011: under para 3) are applicable for the entire CRZ. Other construction activities are permitted in CRZ II landward of 'existing' buildings or 'existing' or 'approved' roads. The word 'existing' and 'approved' are specifically defined in the notification.

5. Influence of Tidal action

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

6. Different approaches to demarcate HTL

The highest level horizontal positional and spatial accuracy in mapping and presenting the HTL becomes necessary for field uses by CRZ implementing agencies. The agencies are looking for a planimetric accuracy approaching zero error.

The different approaches now practiced in the country to demarcate the HTL are:

- tide level projection
- using morphological signatures
    - field methods
    - satellite data

The CESS follows the approach using morphological signatures (CESS, 1995)

6.1 HTL using morphological signatures

Morphological signatures are good indicators of shoreline oscillation and inundation of coastal waters, which could be used for identifying the HTL. The inundation of coastal waters on to the land and seasonal shoreline oscillations are dependent on coastal

morphology. Shoreline remains stable and would not retreat significantly along cliffy coasts. The shoreline retreats up to the cliff base along pocket beaches. Artificial morphologies like seawalls confine the oscillation of shoreline along the line of the structure itself. Sandy beaches are prone to seasonal and long term shoreline oscillation. Long term stability of the beach and the position of the stable part of the beach would be evident from morphological signatures such as berm and berm crest.

This could be done by field methods and using satellite data.

6.1.1 Field method

The HTL has to be fixed with respect to certain reference points on the land. These reference points at sufficiently close intervals (preferably at least 1 km alongshore) have to be marked with respect to lat-long and known points in the base map. Geomorphologic features like berm crest, cliff, headland, line of permanent vegetation, etc are indicators of the reach of sea water into the land. Stable coastal protective structures like seawall also limit the intrusion of seawater. Hence High Tide Line (line of maximum reach of seawater into the land during spring tide) can be fixed in the field, with respect to these features and tied to the reference points, as detailed below.

***Landward (monsoonal) berm crest for beach*es**

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

Seawall/revetments/embankments

In highly erosion-prone areas, there are no landward second berms. Such locations will be protected mostly by seawalls. During monsoon season majority of these are devoid of beaches. The waves impinge upon the seawall during the monsoon season, especially during the high tide. Thus they are the artificial barriers stopping the waves/tides at the coast. Since the seaward part of the seawall in most cases is defaced due to erosion, the landward toe is taken as the HTL boundary in such locations. There are some locations with two or three lines of seawall, particularly in the accreting areas. The seaward seawall is considered here for the purpose. On the other extreme, in the case of continuously eroding sites there are lines of sea wall which are now in the sea. In such cases the landward seawall is taken. In order to facilitate the demarcation of HTL at seawall locations, the latter has to be clearly marked in the beach profile during coastal surveys.

Permanent Vegetation Line

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

Tidal flats and mudflats

Tidal flats and mud flats are formed by fine-grained silts and clays in a medium to large tidal environment. They have a fairly large intertidal zone fringed by vegetation. In such cases the landward limit of HTL can be demarcated as the line of permanent vegetation other than salt marsh vegetation and mangroves of intertidal habitat. Other geomorphic signatures like changes in land forms & sediment characteristics can also be used.

Rocks, Headlands, Cliffs

At the rock outcrops, headlands and cliffs the water is quite deep that there is virtually no spatial displacement in the waterline. Hence, the High Water Line available in the topographical maps (transferred to the base map) can be taken as such (Fig.4). However, at the eroding laterite cliffs (e.g. Varkala, Paravoor, Thalassery in Kerala), the latest position of the toe is taken from the cross section measured at the respective sites. This is to be verified against the satellite imagery and transferred to the base map.

6.2 100, 200 & 500 m lines

Once the reference points and the HTL are available, it is not difficult to draw 100, 200 and 500 m line on the map as required in the Notification.

The distance of 100, 200 and 500 m from the HTL is converted to the map scale at each reference point and demarcated. The above lines are drawn parallel to the HTL uniformly all along the coast.

For the use in the field, the distance of LWL, 100, 200 and 500 m line from HTL from all the reference points can be given as a table. The location details, including place names, latitude, longitude etc can also be given in these tables.

7. HTL demarcation in the field and CRZ map generation

Since CRZ is applicable to inland water bodies, the influence of tidal action upstream of the water bodies is determined by verifying the salinity of the water body during the driest month of the year. If the salinity is 5 ppt or more, then the water body is considered to be influenced by tidal action. This is assessed from field measurements and indicators like the limit of tidal influence given in the CZMP (1996) and presence of mangroves.

Field studies are undertaken for fixing ground control points for georeferencing and referring the position of the HTL. A hybrid approach of field studies supported through information extracted from satellite imageries and existing maps are relied upon for CRZ mapping to

identify the HTL, LTL, eco-geomorphic systems and land use relevant for CRZ. The eco-geomorphic systems include mangroves, intertidal zone, mudflats, salt pans, etc.

7.1 CRZ/ CZM map in 1:25000

The CRZ map in 1:25000 is prepared with Survey of India topsheets as base maps. These toposheets being of the coastal area, are restricted and hence have to be procured through proper channel following specified procedures and after giving statutory undertakings to ensure authorized use and safe custody. Toposheets of the area of study are georefernced and the High Water Line (HWL) in the toposheets have been extracted along with other coastal features like waterbodies, inter tidal zones, mudflats, beaches, mangroves, slat pans, prawn aqua farms, etc. The HWL is updated with current field measurements and satellite imageries to get the present HTL. Field measurements were made in 1:4000 scale for better accuracy and compatibility with large scale local level CZMP.

The variations of present HTL from that of CZMP (1996) is verified and documented. The probable reasons for the variations are looked into and the details are given wherever possible.

7.2 CRZ/ CZM map in 1:4000

The base map on which HTL and LTL are demarcated have to be familiar for officials of local bodies and the public. These have to be of sufficiently large scale with sufficient number of reference points identifiable on the ground for facilitating field applications.

7.3 Base maps

Cadastral maps available with Revenue/ Survey and Land Records Dept are in 1:4000 or 1:5000 scale. Survey plots and plot boundaries are locatable on the ground. 'Plot boundary junction points' are taken as the reference points. The Centre for earth Science Studies has successfully used cadastral maps for preparing Panchayat resource maps which are being widely used by local bodies for local level planning (CESS 2000).

7.4 Field mapping and map generation

Initially cadastral maps of the required area are obtained from the concerned departments (Revenue/ Survey and Land Records Dept). These are checked for its scale accuracy through comparing the distance of 2 known points from the map and from the ground. Toposheets and imageries of the area for which HTL is to be demarcated, are referred to know the features and available morphological signatures. Information derived from toposheets and satellite imageries of different coastal ecosystems in the given area is used as baseline

information for planning the field investigations. Cadastral maps are rectified with coordinates of known ground control points (GCP) taken from the field. The datum used is WGS 84 and the projection is UTM.

Ground features that can be clearly identified both on the ground and on the cadastral map are used as ground control points (GCP). With precise planimetry of the identified GCPs, the cadastral maps are geo-referenced with GPS/ DGPS measured geo coordinates. GCPs used are survey plot boundary junctions or survey stones established at the time of field survey for the preparation of cadastral maps. These are identified in the field. At least one control point is identified within 1 km of alongshore length. The coordinates (Latitude; Longitude) of the identified control points are taken using GPS/DGPS. The signature for the nearest HTL is identified and distance to the HTL from the control point is measured with distometer (usually laser distometer). The GPS/ DGPS is moved along the HTL identified through signatures and the readings are recorded. Wherever possible these are linked to the control points identified earlier and distance to HTL measured with distometer. The data thus collected is transferred to cadastral maps and superimposed in GIS platform. Information from satellite imageries are used to verify the data collected and also to supplement the data wherever the area is not approachable. Cadastral maps and satellite images are rectified in the same geographical coordinate system and projection.

The most difficult part is the transferring of information from imageries to unprojected cadastral maps on which CRZ maps are prepared. This is overcome by using sufficient number of precise reference/control points spread over the entire study area for georeferencing and compartmentalizing the maps. One of the major contributors to errors is those occurring while reproducing the cadastral map from original map through photocopying and scanning. While photocopying the enlargement or reduction produce the scale error; also the shrinkage/folding of paper during the process. Another is the scale error during geo-referencing the map. It may be noted that cadastral maps have no projection while the images are projected. When overlying cadastral map on image by applying a common coordinate system, some distortions do occur at edges and in the shape of features such as road network, plot boundary, etc. The errors in reproduction of cadastral maps can be minimized by taking proper precautions. The errors in georeferencing could be controlled by taking precautions through selection of proper field Gorund Control Points (GCPs) and identifying the field GCPs in the cadastral as well as satellite images precisely. And by making some finer adjustments, the ecosystem boundaries delineated from satellite images could be matched with real cadastral boundaries on the ground.

The use of satellite imageries in combination with field mapping provides better results in cadastral level mapping. At the same time, various location and spatial errors that could get magnified in large scale maps like cadastral maps require to be contained through appropriate approach.

7.5 Use of Remote sensing data for HTL

With the availability of precision GPS and high resolution satellite data like Quick Bird, IKONOS, Resource Sat (P 6) and Cartosat, it is now possible to get a mapping accuracy of less than one meter for the demarcation of HTL / LTL. It requires georeferencing using accurate GPS data at precisely locatable Ground Control Points (GCPs) in satellite images to

have improved accuracy level in the identification and demarcation of HTL/LTL. Accurately identifying the positions for HTL with respect to signatures may become difficult when vegetation like coconuts cover the signatures. PAN merged IRS-1C/1D LISS III, IRS P6 LISS IV and Cartosat 1 (PAN) are mostly used. PAN has a resolution of 5.8 m, whereas LISS III has 23 m resolution. The IRS P6 LISS IV has a resolution of 5.8 m. Cartosat-1 (PAN) has a spatial resolution of 2.5 m.

8 LTL delineation

The LTL also depends on lunar cycle. The seaward/waterside limit will depend on the width of tidal flat and beach. An initial assessment of LTL could be made from Hydrographical charts. While mapping HTL the signatures of LTL could be noted and the distance from HTL to LTL may be assessed. This is further verified and corrected with the information from Hydrographical charts and satellite imageries. Information on LTL is derived from satellite imagery by identifying the seaward limit of beach/ tidal flat during fair season when the beaches/ intertidal zone have maximum width. The imageries could be selected for a spring tide low.

9 CZMP/ CRZ map of Mira Bhayandar in 1:25000 scale

The MBMC area is shown in two 1:2500 toposheets:

- Sheet No. 47 A15 SW
- Sheet No. 47 A15 SE

In addition to MBMC, part of Vasai Virar Municipal Corporation is seen in toposheet No. 47 A15 SW and part of Thane Municipal Corporation and Bhiwandi taluka in toposheet No. 47 A15 SE.

The CRZ field mapping was carried out during March-December 2013. As already discussed High Water Line (HWL) has been extracted from geo-referenced SOI toposheets following standard procedures. Field data was generated in 1:4000 scale from 18 villages that comprises MBMC such as Chowk, Tarandi, Raimrdhe, Murdhe, Uttan, Morva, Dongri, Bhayandar, Khari, Ghoddev, Ghodbundar, Versave, Chene, Kashi, Mira, Mahajanwadi, Penkarpada and Pali

The HWL has been appropriately modified with the HTL obtained from field observations and satellite imageries for preparing the CZMP as per CRZ 2011.

The CZMP (1996) is superimposed on to the above CZMP and the variations of present HTL from that of CZMP is verified and the reasons for the variations are discussed.

9.1 Data Sources

In addition to field investigations including GPS/DGPS mapping, data sources such as topographic sheets, hydrographic charts and satellite images have been used. Field mappings were carried out during March to December 2013. An initial assessment of the morphology

and ecosystems is obtained from Google imageries which are mostly QuickBird images. Google imageries (QuickBird) of 2010 and 2011, available in the public domain, were down loaded as different scenes with resolution zoomed to the required level. These are then merged in photoshop and georeferenced.

PAN merged IRS-1C/1D LISS III and IRS P6 LISS IV data were also used wherever required (Fig. 2). PAN has a resolution of 5.8 m, whereas LISS III has 23 m resolution. The IRS P6 LISS IV has a resolution of 5.8 m.

10. CRZ categories

The CRZ of Mira Bhayandar consists of CRZ I, CRZ II, CRZ III and CRZ IV. The CRZ IA are those ecologically sensitive and the geomorphological features which play a role in maintaining the integrity of the coast as listed under para '7(i)A' such as mangroves, corals, sand dunes, etc. The CRZ IB is area between Low Tide Line and High Tide Line. The CRZ II is those developed areas (with more than 50% built up area) in legally designated urban areas. Mira Bhayandar being a Municipal area, the CRZ in Mira Bhayandar which have more than 50% built up area, is CRZ II. The CRZ III is undeveloped areas in the CRZ of Mira Bhayandar Municipal area. The CRZ IV is the nearshore waters, the inland water bodies and the bed. The details are given in the attached CRZ map (Fig 1) and Table 1 & 2.

Acanthus iliforus, Avicenia officinalis, Exocarria agallocha are the dominant variety of mangroves. Tidal influence in many low lying areas is regulated by bunds/ sluices to facilitate agriculture. These sluices/ bunds are constructed and maintained by the Khar Land Board. Many such sluices has become non-functional because of non maintenance due to decreasing agricultural uses. Many such areas now remain unused or reclaimed for construction related development activities. Mangrove vegetation has also spread in such areas. As suggested by MCZMA, wherever mangrove vegetations are present, those are shown as CRZ IA irrespective of whether these are landward of bunds or not. In some cases the bunds have been strengthened or reconstructed blocking or regulating the flow of tidal waters. These have been considered while demarcating the HTL. The scenario once the Khar Land Board gets the other bunds/ sluices repaired and made functional has not been considered.

Salt pans invariably occupy low lying tidal areas. But the continuous use of these low lying areas as salt pans has changed the terrain characteristics. Functional and ecological features no longer resemble intertidal zones. Some of the saltpans are completely separated from streams and creeks through bunds and the salt water required is pumped from adjoining streams/ creeks. Where bunds are breached and the saltpan remains unused, mangrove vegetation has come up. Those saltpan areas which have been converted to other development uses have been considered accordingly. At the same time the distinction between salt pans into which salt water is pumped and those dependant on natural tidal flow has not been considered since the details are not readily available. Otherwise saltpan is shown as an intertidal zone though functional and ecological features no longer resemble that of intertidal zones.

Mira Bhayandar Municipal Corporation being highly developed with a very high potential for further development, the Maharashtra Coastal Zone Management Authority took the

view that the CRZ in MBMC, other than CRZ I, CRZ IV and open spaces such as parks and play grounds have built up area more than 50% and hence could be considered as CRZ II. Accordingly the CRZ in MBMC, other than CRZ I, CRZ IV, are shown as CRZ II.

The MBMC has HTL for a length of 114.23 km. The total CRZ area is 65.41 km^2 which includes those areas outside the revenue boundaries in the intertidal zone. Mangrove area (CRZ IA) is 18.82 km^2 with a mangrove buffer zone of 20.89 km^2. The intertidal zone (which includes seasonal beach on the seacoast and mudflats on the banks of vreek/ river) is spread over 8.10 km^2 while saltpan area is 9.28 km^2.

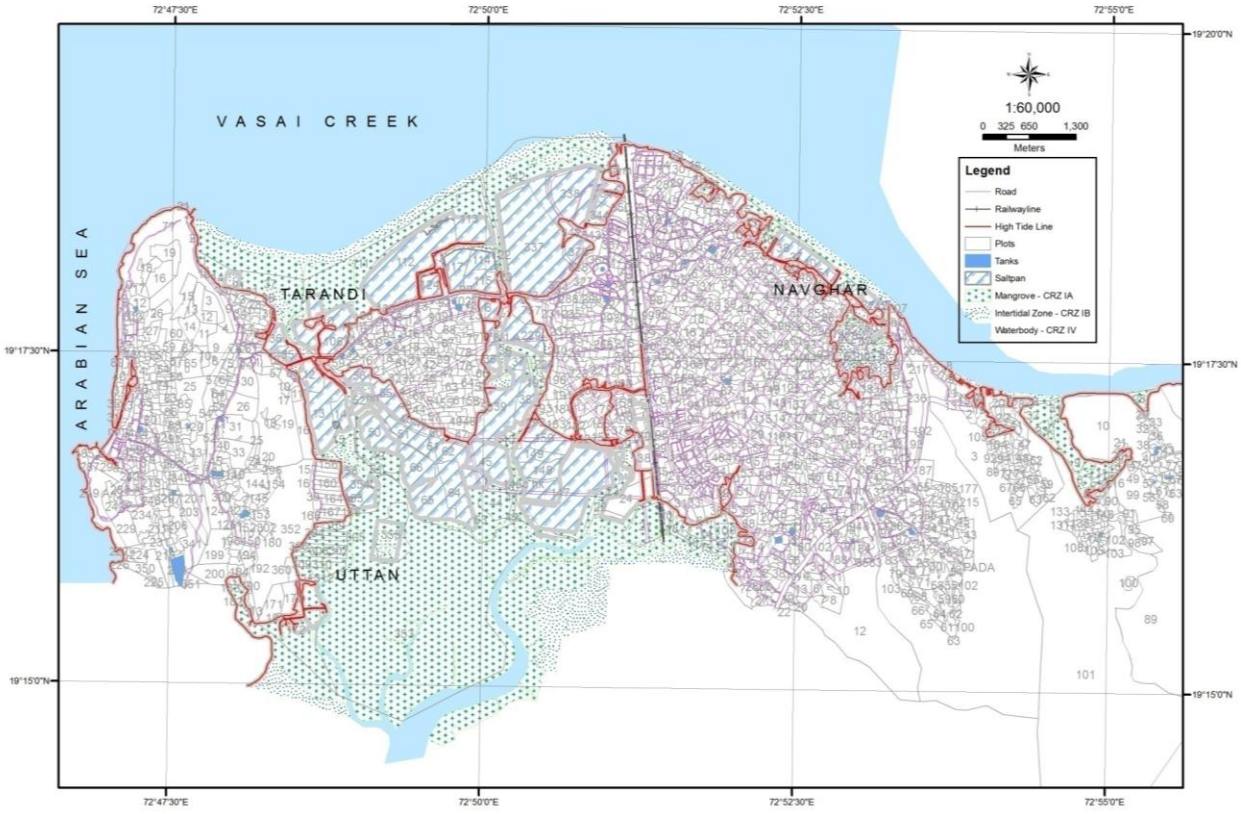


Fig.1. HTL and coastal ecosystems such as mangroves demarcated in cadastral scale for

Mira Bhayanadar

Table 1. CRZ details of Mira-Bhayandar Municipal Council

HTL Length (km)	Mangroves (CRZ IA) within Sy plot (km^2)	Mangroves (CRZ IA) within Sy plot and outside (immediately adjoining) (km^2)	ITZ (CRZ IB) within Sy plot (km^2)	ITZ (CRZ IB) within Sy plot and outside (immediately adjoining) (km^2)	Saltpan (km^2)	Mangrove buffer zone (CRZ I) (km^2)	CRZ II (km^2)
114.23	**14.33**	**18.82**	**5.96**	**8.10**	**9.28**	**20.89**	**8.32**

Table 2. CRZ details of Mira-Bhayandar Municipal Council (in each village)
(***mangroves and inter tidal zones given only for those within survey plots***)

Village Name	Length of HTL (km)	Mangroves (CRZ IA) (m^2)	ITZ (CRZ IB) (m^2)	Saltpan (m^2)	Mangrove Buffer zone (CRZ I) (m^2)	CRZ II along creek (m^2)	CRZ II along sea coast (m^2)
Chowk	2.90	10372.74	88296.33	0	55776.18	53379.31	739018.72
Tarandi	3.99	414262.32	367905.68	130795.98	646104.99	183792.95	0
Raimrdhe	12.38	1603843	1649524.8	2828283.94	2596018.53	313284.28	0
Murdhe	4.16	433297.92	353320.9	1013959.71	904107.61	351465	0
Uttan	17.39	6994269.85	540600.76	181816.18	7923659.48	481998.27	1529899.6
Morva	1.98	291975.98	62745.97	682207.49	615989.33	237411.66	0
Dongri	4.57	118694.81	126405.23	516613.28	274392.41	212317.68	0
Bhayandar	33.52	1621421.15	1652939.47	3833514.99	3257400.94	1528332.86	0
Khari	2.13	43814.83	29218.3	0	146697.4	224879.89	0
Ghoddev	0	0	0	0	0	0	0
Ghodbundar	8.20	125752.12	638456.39	53655.76	420918.85	425497	0
Versave	6.72	240736.78	60009.78	0	441688.93	378574.98	0
Chene	6.32	565654.113	92939.355	0	797920.33	565690.05	0
Kashi	0	0	0	0	0	0	0
Mira	0	0	0	0	0	0	0
Mahajanwadi	0	0	0	0	0	0	0
Penkarpada	8.45	1874768.19	282514.15	40684.04	2808098.6	624905.93	0
Pali	1.52	0.517627	11396.1	0	4314.3	0	473924.28
Total	**114.23**	**14.33 km^2**	**5.96 km^2**	**9.28 km^2**	**20893087.88**	**5.58 km^2**	**2.74 km^2**

11. Summary

- Mira Bhayandar Municipal Corporation (MBMC) is in Thane district in Maharashtra. It has Arabian Sea is on its west and Vasai Creek/ Ulhas River on its north

- The CZMP is prepared in 1:25000 scale based on field information collected in 1:4000 cadastral maps.

- MBMC is contained in toposheets No. 47 A15 SW and 47 A15 SE. Parts of Thane Municipal Corporation and Bhiwandi taluka are also seen in these toposheets.

- 1:25000 CZMP is prepared based on data collected on 1:4000 cadastral maps

- Acanthus iliforus, Avicenia officinalis, Exocarria agallocha are the dominant variety of mangroves

- Bunds and sluices which have been strengthened or reconstructed blocking or regulating the flow of tidal waters have been considered while demarcating the HTL. The scenario once the Khar Land Board gets the other bunds/ sluices repaired and made functional has not been considered.

- Saltpan is shown as an intertidal zone though functional and ecological features no longer resemble that of intertidal zones

- Those saltpan areas which have been converted to other development uses have been considered accordingly.

- Distinction between salt pans into which salt water is pumped and those dependant on natural tidal flow has not been considered since the details are not readily available.

- MBMC being highly developed with a very high potential for further development, the CRZ in MBMC, other than CRZ I, CRZ IV and open spaces such as parks and play grounds is considered to have built up area more than 50% and hence categorized as CRZ II as suggested by the Maharashtra Coastal Zone Management Authority.

- The MBMC has HTL for a length of 114.23 km.

- The CRZ of MBMC consists of CRZ I, CRZ II and CRZ IV. Parks, play grounds and similar open spaces are to be categorized as CRZ III. These are not shown in the present CZMP.

- The total CRZ area is 65.41 km^2 which includes those areas outside the revenue boundaries in the intertidal zone.

- Mangrove area (CRZ IA) is 18.82 km^2 with a mangrove buffer zone of 20.89 km^2.

- Intertidal zone (which includes seasonal beach on the seacoast and mudflats on the banks of vreek/ river) is is CRZ IB and is spread over 8.10 km^2. No distinction is made between biologically active and not biologically active mudflats.

- Saltpan area is 9.28 km^2.

(Dr K V Thomas, Centre for Earth Science Studies (CESS))

47A/15SE

72°55'0"E

72°57'30"E

19°20'0"N

19°17'30"N

CHANDRAPADA

KOPRIPADA

SARJAMORI

JUCHANDRA

SASUNAVGHAR

BHAYANDAR

NAVGHAR

MIRA

KASHI

MAHJANWADI

VERSAVE

CHENA

OCTROLINAKA

GAIMUKH

MOGHARPADA

NAGALE

PAYE

KHARDI

PAYGAON

GANE

FIRANGEPADA

KHARBHAV

VADAVALI

KAVESAR

KOLSHET

BHIWANDI TALUK

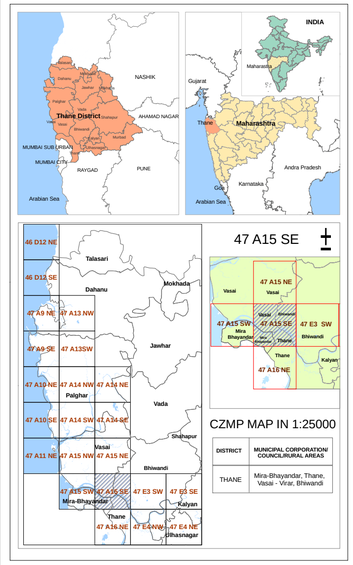
VASAI - VIRAR MUNICIPAL CORPORATION

MIRA-BHAYANDAR MUNICIPAL CORPORATION

THANE MUNICIPAL CORPORATION

VASAI CREEK

INDEX MAP



CZMP MAP IN 1:25000

DISTRICT	MUNICIPAL CORPORATION/ COUNCIL/RURAL AREAS
THANE	Mira-Bhayandar, Thane, Vasai - Virar, Bhiwandi

C Z M P M a p I n 1 : 2 5 0 0 0

Legend

- Road
- Railway line
- Seawall
- Municipal Boundary
- Taluk Boundary
- Village Boundary
- High Tide Line
- Low Tide Line
- CRZ Line for River or Backwater
- 100m CRZ Line
- 200m CRZ Line
- 500m CRZ Line
- Mangroves - CRZ IA
- Mangrove Buffer Zone - CRZ I
- Inter Tidal Zone - CRZ IB
- Saltpan - CRZ IB (inter tidal zone)
- CRZ II
- CRZ III
- Waterbody (sea) - CRZ IV A
- Waterbody (creek) - CRZ IV B
- Waterbody (non-tidal)
- Survey Plots

Coastal Zone Management Plan
Thane District, Maharashtra

Mapped During	Scale
October 2012 - December 2013	0 250 500 1,000 Meters 1:25,000
Checked by	Approved by
DRAFT MAP	

Refer CRZ report for details

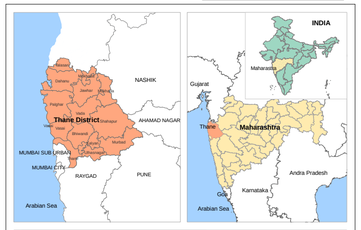
Centre for Eatrh Science Studies
Akkulam, Thuruvikkal P.O
Thiruvanathapuram - 11

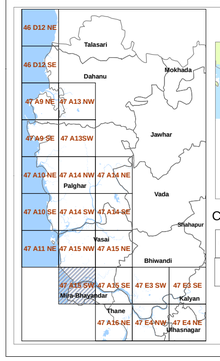
72°47'30"E
72°50'0"E
19°20'0"N
19°17'30"N

KAULAR BHUDRAK
SANDOR
CHIMNEY AGAR
MANIK AGAR
UMLEMAN
UMLE
JUCHANDRA
KAULAR KHURB
DHUVOLI
SANDOR
VASAI VIRAR MUNICIPAL CORPORATION
UMOLE
JUCHANDRA
MALONDA
PANCHU
VASAI FORT
CRZ 1A
C R E E K
V A S A I
KHARI
A R A B I A N S E A
CHOWK
TARANDI
GHODDEV
BHAYANDAR
RAIMURDHE
PALI
MURDHE
DONGRI
MORVA
BHAYANDAR
UTTAN
UTTAN
MIRA
PENKARPADA
DAHISAR
MAHAJANWADI
UTTAN

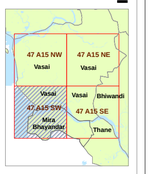
47A/15SW

INDEX MAP





47 A15 SW



CZMP MAP IN 1:25000

DISTRICT	MUNICIPAL CORPORATION/ COUNCIL/RURAL AREAS
THANE	Mira -Bhayandar, Vasai - Virar

C Z M P M a p I n 1 : 2 5 0 0 0

Legend

- Road
- Railway line
- Seawall
- Municipal Boundary
- Taluk Boundary
- Village Boundary
- High Tide Line
- Low Tide Line
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