Mumbai Trans Harbor Link Project

Supplemental Environmental Impact Assessment

(Final, 24th of November 2015 2015)

Mumbai Metropolitan Region Development Authority (MMRDA)

Executive Summary

As of 24th November 2015 Final (based on 9th October version viewed by JICA)

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1.1 Project Description

The project outline and location is shown in the table and figure.

All specifications are still tentative due to under review and inspection based on the Final Feasibility Report in 2012.

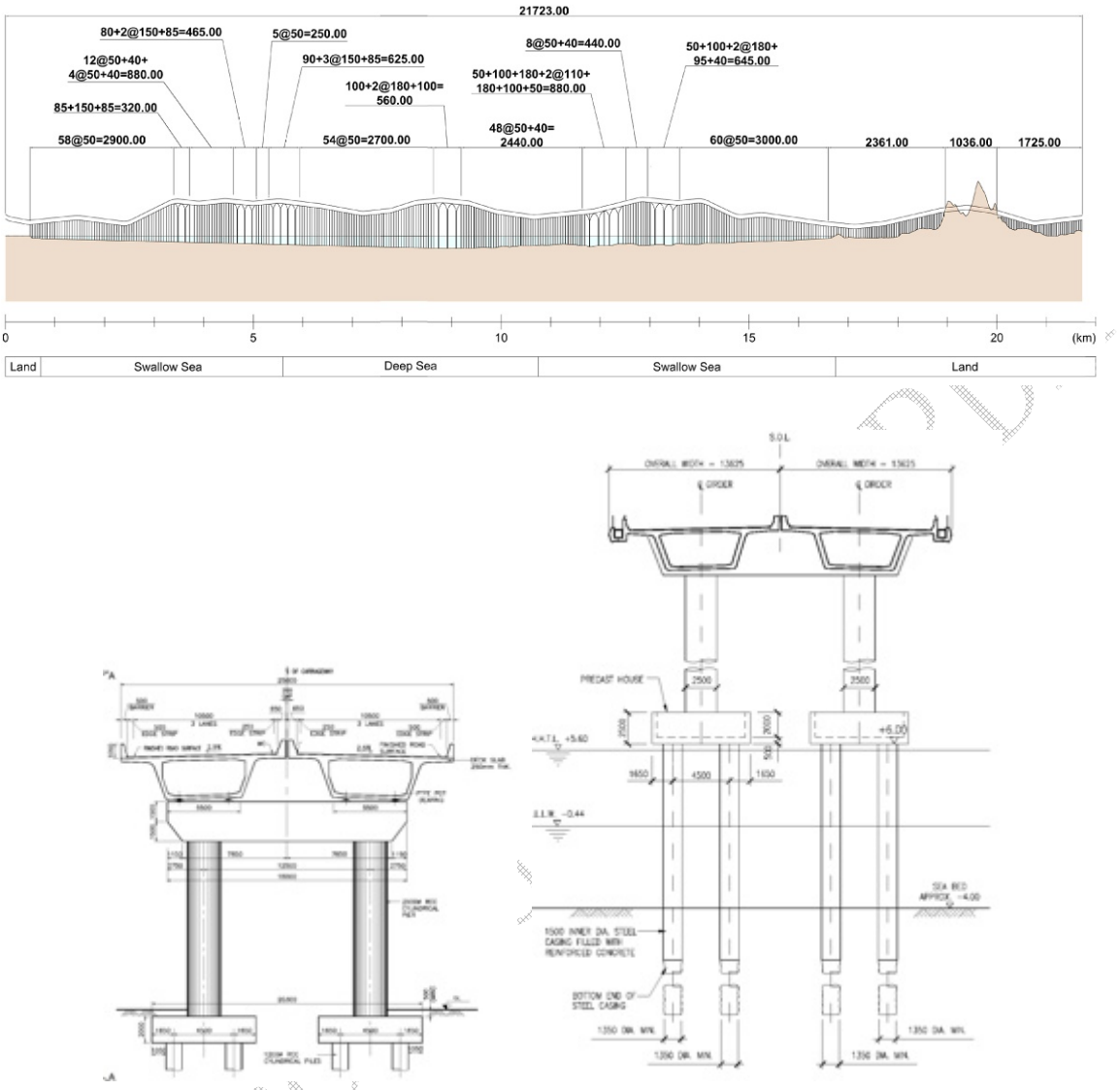
Table 1.1.1 Project Outline

Item	Description	Remarks
Project Name	Construction of Mumbai Trans Harbour Link	MTHL alignment was scrutinized and affirmed by an Expert Committee constituted by Prime Minister's Office, 1984
Type of construction Structure	- Road Type: Sealink under MMRDA (City Road under Mumbai City) - Type of Structure : Mainly bridge and viaduct road - Length: 22.5 km (App.17 km bridge on the sea) - Number of lanes: 6 lanes	-
Location	-Starting point(Western side): Sewri in Mumbai City -End Point: Chirle area in Raigad Division	-
Road Width	Road width (Typical Cross Section): app. 25m Right of Way (in Navi Mumbai side) : app. 120m	-

Source: JICA Study Team

Source: JICA Study Team

Figure 1.1.1 Project Location Map



Typical Cross Section (On the Land) Typical Cross Section (On the Sea)

Source: JICA Study Team

Figure 1.1.2 Typical Structure of the Bridge and Road

1.2 Current Natural and Social Environmental Condition

1.2.1 Topography, Geography and Hydrology

The elevation form the sea level is around 5 m from ST 0km Sewri side in Mumbai to ST 16km at the east side Navi Mumbai, and then the elevation increase up to approximately 40m gradually at the end point Chirle area. The area is classified in 5 sections based on topographic feature on site.

Table 1.2.1 Topographic and Geographic Features

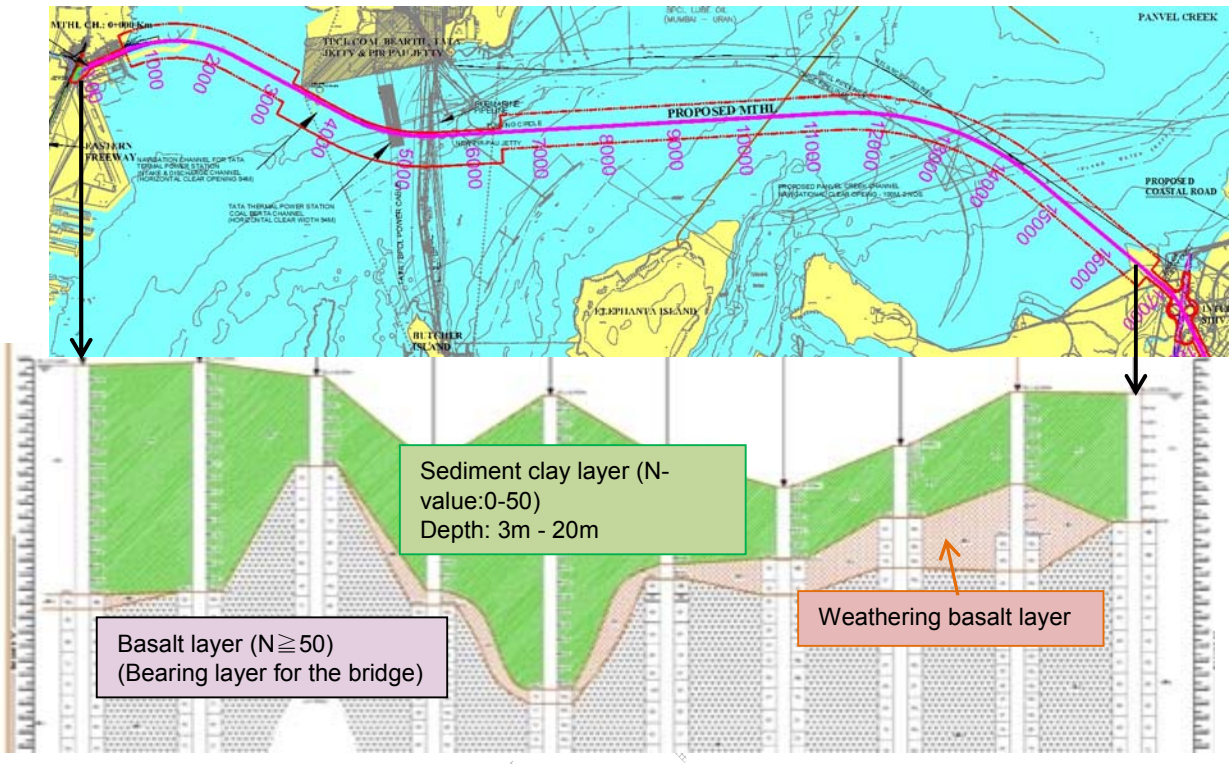
Section	Topographic Classification	Depth of the Sea	Topographic Feature
Section-1 （ST 0 - 0.72km）	Land (Partially Tidal Area)	-	Flat
Section-2 （ST 0.72 - 5.60km）	Tidal area	0.0m～3.0m	Flat (Partially mangrove area)
Section-3 （ST 5.60 - 10.75km）	Sea area	4.5m～7.0m	Most deepest area in the sea along the alignment (passing some wharfs)
Section-4 （ST 10.75 - 16.75km）	Sea area (Partially Tidal Area)	0.0m～4.0m	Flat (Partially mangrove area)
Section-5 （ST 16.75 - 21.84km）	Land	-	Hill and rock mountainous area (basaltic layer)

Source: JICA Study Team

Source: JICA Study Team

Figure 1.2.1 Topographic and Hydrological Feature

With regard to geographic feature, a sediment clay layer with 3 to 20 m depth on the basalt layer is located in the sea section in Sewri and the sea section. The basalt layer is exposed in the Navi Mumbai Section.



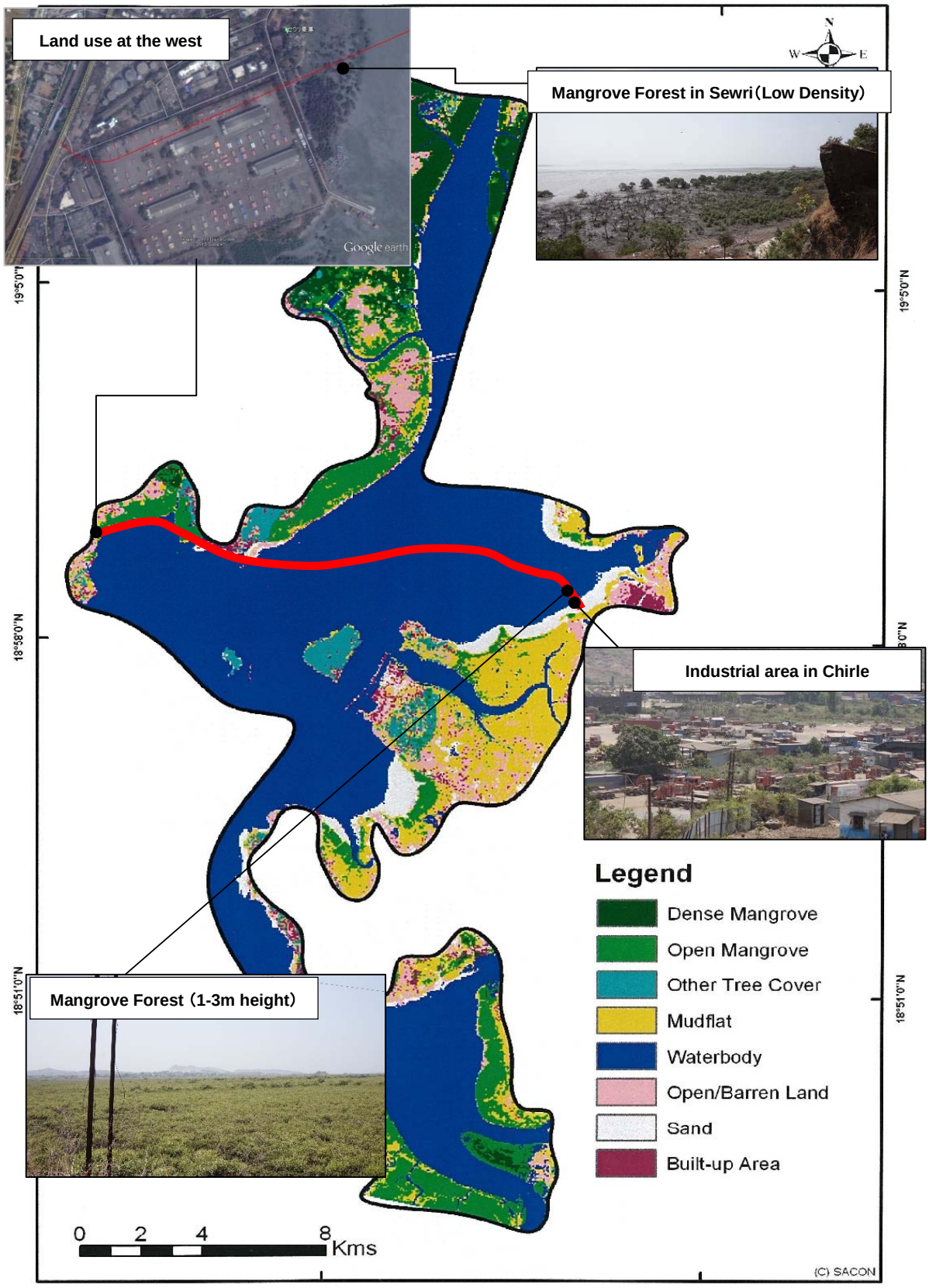
Source: JICA Study Team

Figure **1.2.2 Geographic Feature**

1.2.2 Land Use

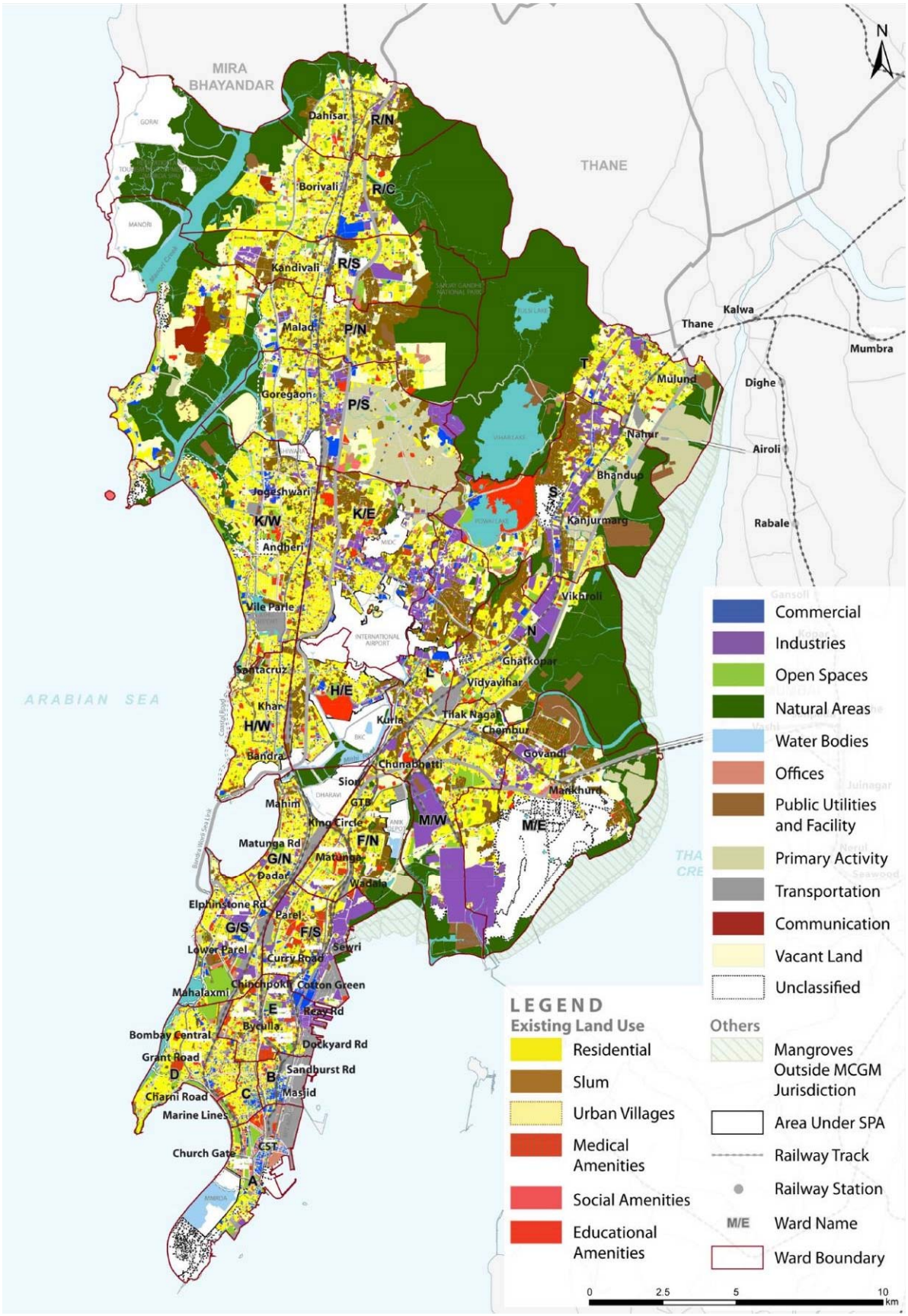
The organization management for development plan is in the scope of the Municipal Corporation of Greater Mumbai (MCGM) for Mumbai side and the City and Industrial Development Corporation (CIDCO) in Navi Mumbai side, respectively. Current land use as of 2008 in the project area is shown in the Figure 1.2.3, and future's land use is shown in Figure 1.2.4 & Figure 1.2.5 respectively.

The proposed MTHL starting point of the planned alignment is connected with the Eastern Freeway, and then the alignment is passing through the private land of the Mumbai Port Trust (MPT) which is affected by the Coastal Regulation Zone (CRZ). The stretch passing through the MPT area is approximately 2km on Mumbai side. On the other hand, the alignment in Navi Mumbai side is passing through CRZ in 0.65km, small residential area, quarry area, container yard and then connect with Mumbai – JNPT highway.



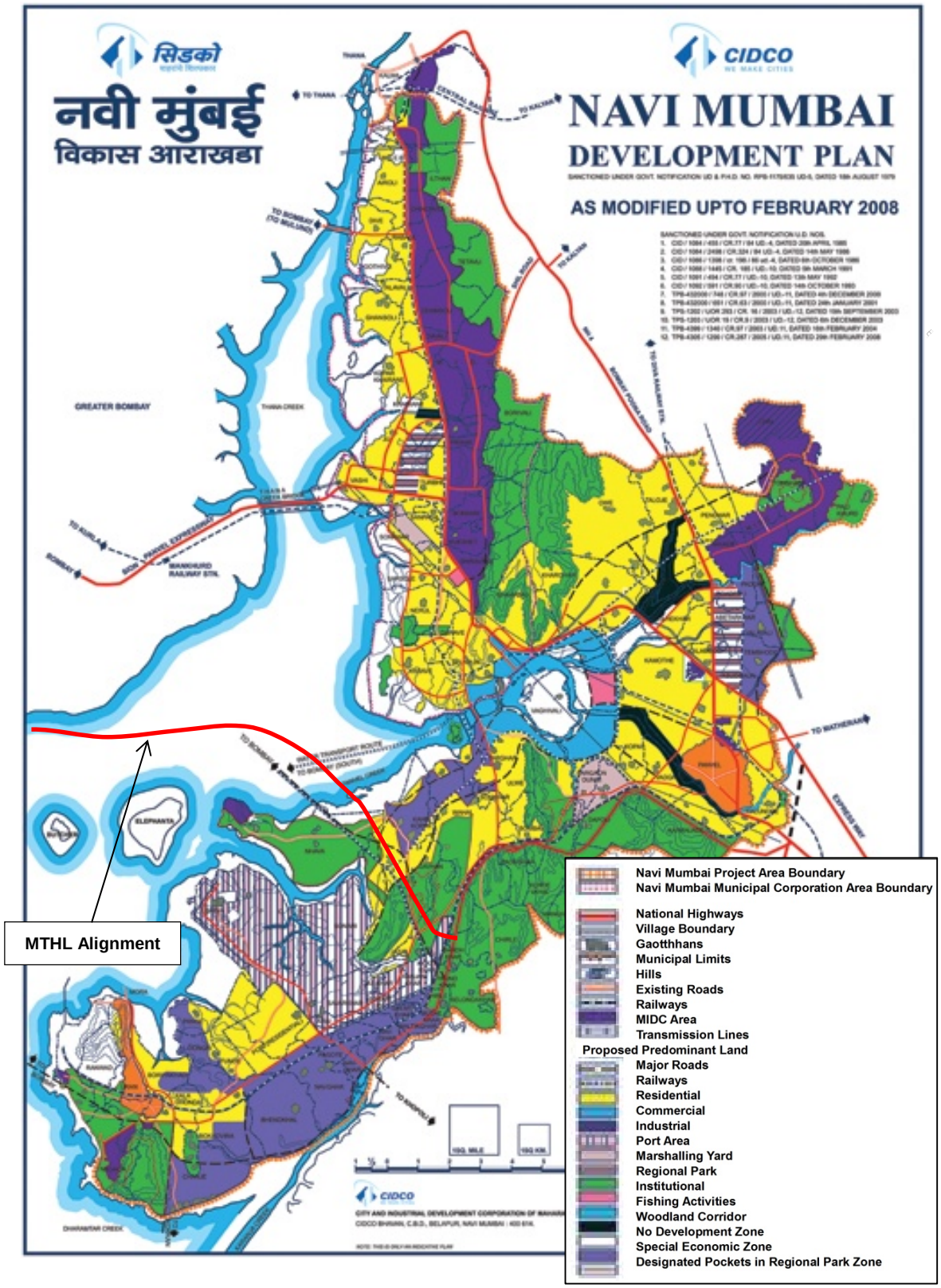
Source：Mumbai Trans Harbour Link Project Study of Flamingo and Migratory Birds Final Report 2008 December (Salim Ali Centre for Ornithology and Natural History)

Figure 1.2.3 Current Land Use in the Project Area (2008)



Source: Land Use Plan (draft: 2014－2034)

Figure 1.2.4 Land Use in Mumbai 2014-2034

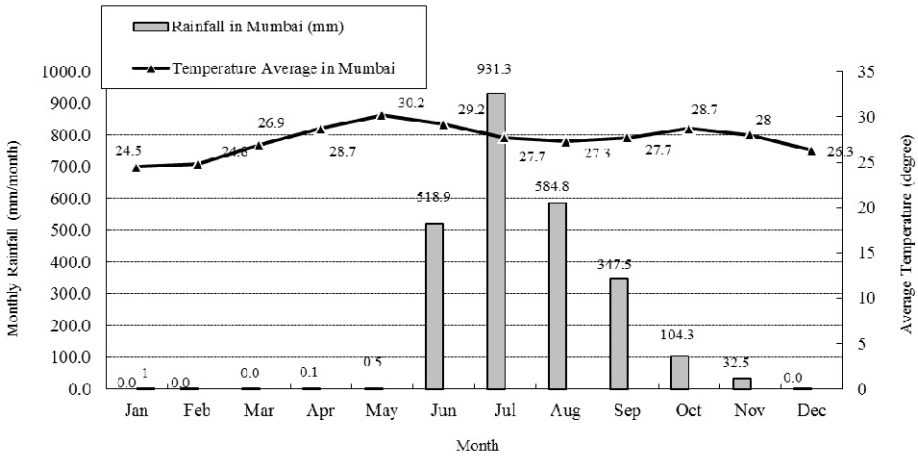


Source: Navi Mumbai Land Use Plan (CIDOCO 2008/Website)

Figure 1.2.5 Landuse in Navi Mumbai 2008.

1.2.3 Climate

The climate in the project area is categorized as the tropical monsoon climate. Daily average temperature in dry season ranges from 24^0 C in January to 30^0 C in May. On the other hand, rainy season starts from June and lasts till October. Average monthly rainfall and temperature is shown in Figure 1.2.6.



Source: India Metrological Department, Ministry of Earth Sciences (website)

Figure 1.2.6 Annual Rainfall in Mumbai (2008-2013 average)

1.2.4 Protected Area

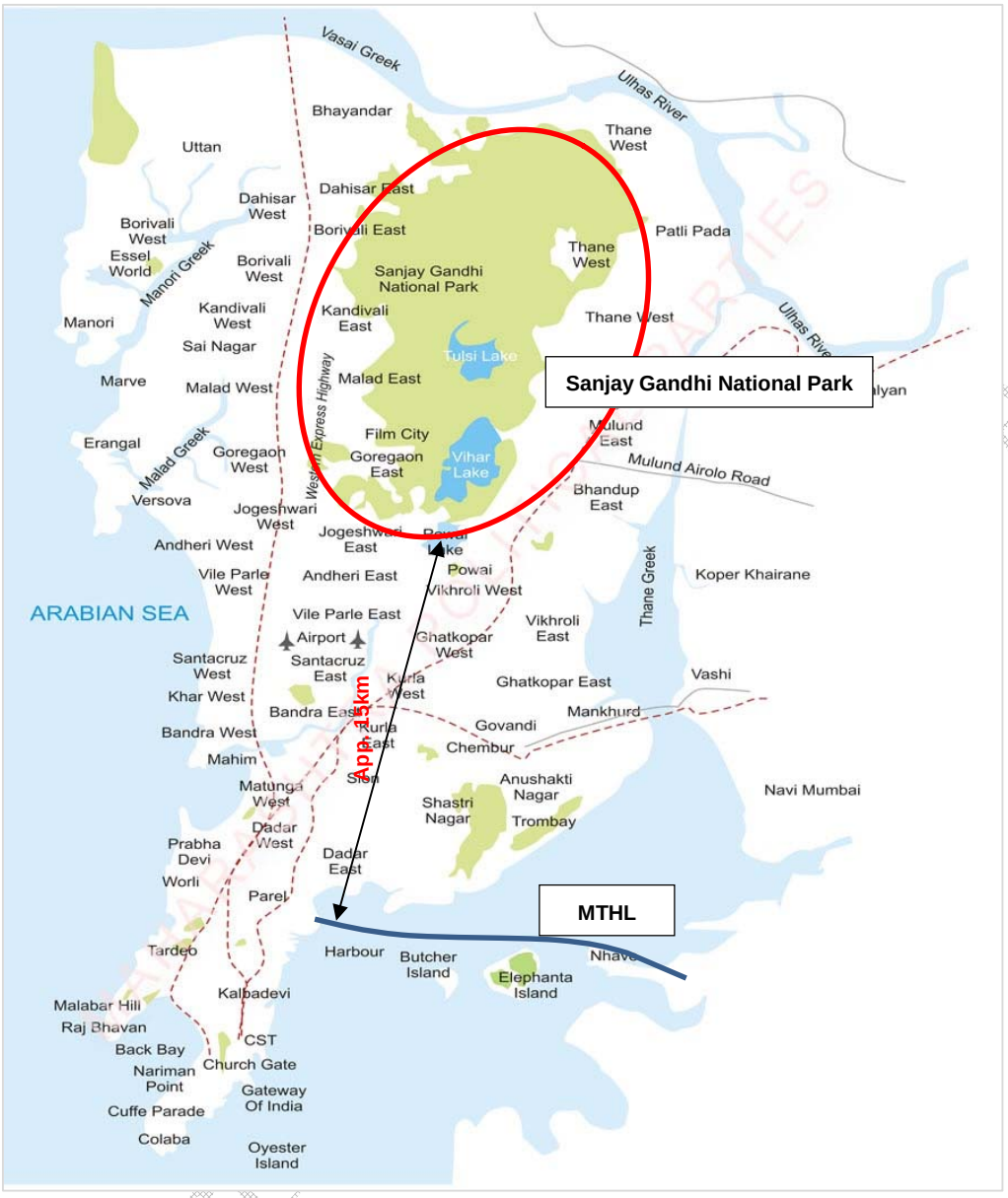
(1) National Park

The Sanjay Gandhi National park is located in the northern area of Mumbai shared with Thane district and is approximately 15km away from the project area. The location of the national park is shown in Figure 1.2.7.

(2) Coastal Regulation Zone (CRZ)

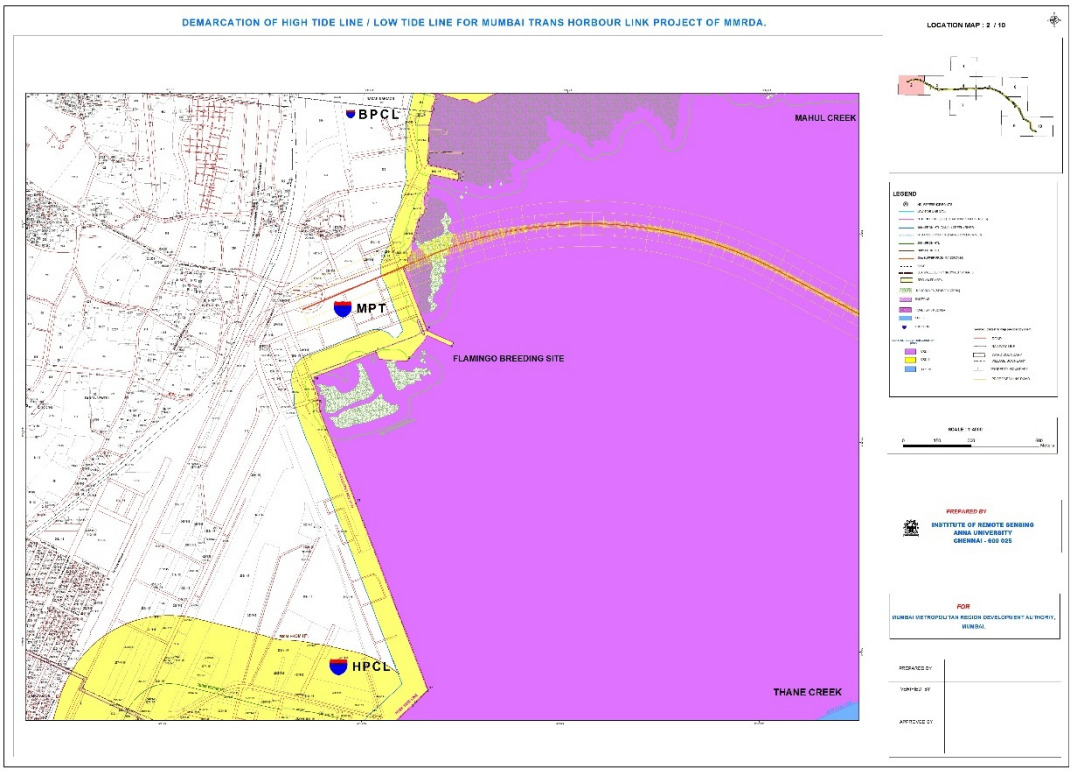
The alignment is passing through a part of the Coastal Regulation Zone (CRZ) in total 2.25 km.2013 from Ministry of Environment and Forests (MOEF). The location of the zone is shown in Figure 1.2.8 and Figure 1.2.9. The Environmental Clearance for CRZ has been issued with 5 years validity in July 19th

The matter subsequently was challenged in the National green tribunal and the Tribunal has suspended the clearance for 6 months. MCZMA has appraised the matter again and suggested minor changes in the



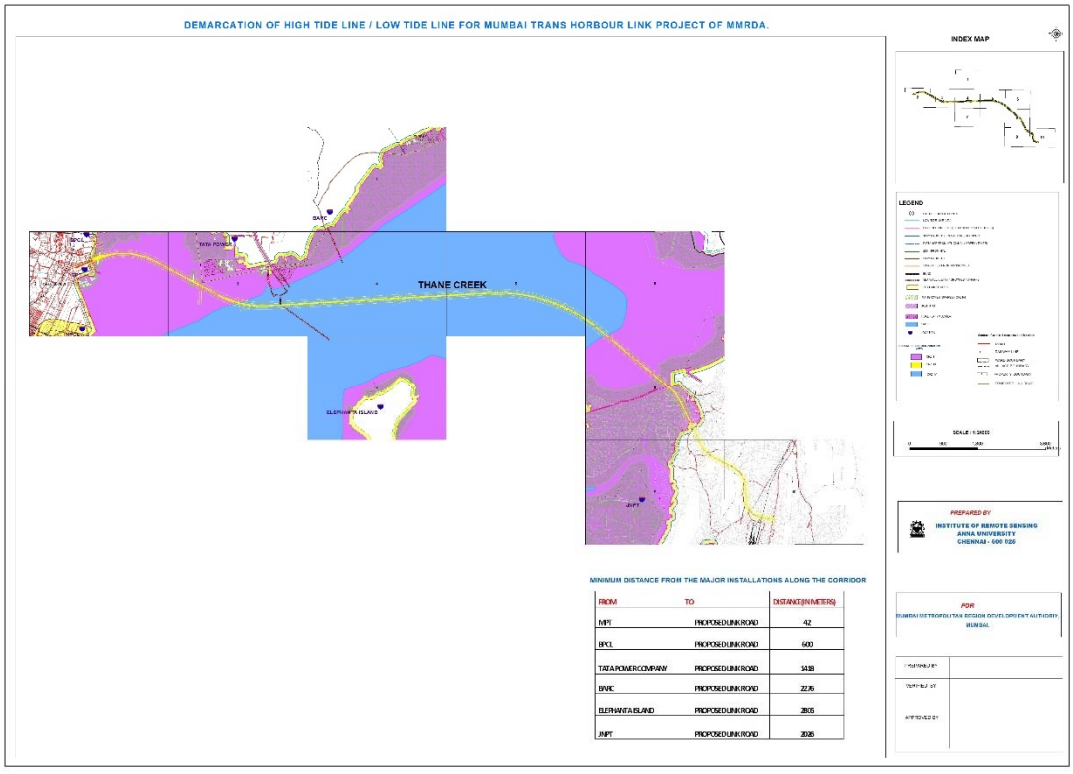
Source: JICA Study Team

Figure 1.2.7 Location of Sanjay National Park



Source: IRS Map

Figure 1.2.8 CRZ Section in Mumbai Side (Sewri)



Source: IRS Map

Figure 1.2.9 CZMP entire length of the Project

1.2.5 Fauna and Flora

The Sewri Mudflats along with entire Thane creek is identified as an Important Bird Area by Birdlife International in 2004. Considering the ornithological value of this area, The Forest Department notified Thane Creek area as Flamingo Sanctuary which excludes the alignment of the proposed sea link.

A detailed plan is suggested to be designed and implemented for monitoring the impacts of construction and operations phase on Birds in this region.

According to the study carried out during the Environmental past survey, 17 bird species has been observed in the project area. Most of observed species are categorized as the Least Concern (LC) class, but 2 species such as Black Headed Ibis and Lessor Flamingo are categorized as Near Threatened (NT).

Sewri are in Mumbai side is widely known as industrial area, however Lessor Flamingos and Greater Flamingos have been coming from the Gulf of Kutch in November since 1994 and staying there until June. A small non breeding population remains in the monsoon but scatters and moves inland.

According to the study report conducted by MMRDA in 2008, counted number of the flamingos is approximately 10,000 to 15,000 a day. These flamingos eat algae and/or plankton during low tidal.

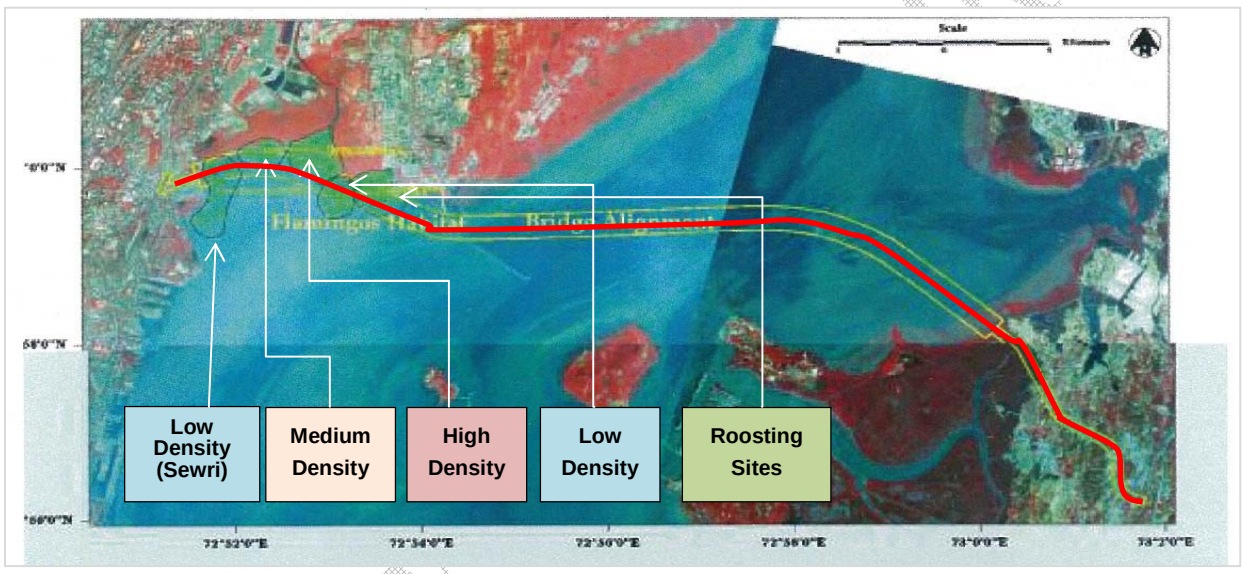
With regard to mangrove in Sewri and Navi Mumbai side, although the dominant specie is *Avicennia marina*, the plant height is low and especially on the Sewari mudflats, they are sparse.

Source: JICA Study Team

Figure 1.2.10 Vegetation at Sewri and Navi Mumbai Site (April 2015)

Source: JICA Study Team

Figure 1.2.11 Observed Migratory Bird (Lessor Flamingo) in Sewri Mudflat Site



Source: Mumbai Trans Harbour Link Project Study of Flamingo and Migratory Birds Final Report 2008 December (Salim Ali Centre for Ornithology and Natural History)

Figure 1.2.12 Surveyed Flamingo Distribution (2008)

1.2.6 Cultural Heritage

The Sewri Fort is located at about 180m away towards north of the alignment Other two World Cultural Heritage Sites named Gate Way of India and Elephanta Island is away from the proposed route app. 9km and 3km respectively. The project has received No Objection Certificate from Archeological Survey of India.

Source: JICA Study Team

Figure 1.2.13 Location of Registered Cultural Heritages

1.2.7 Socio-Economic

(1) Population

The project area is located between Mumbai and Navi Mumbai in North Konkan in the State of Maharashtra. The starting point of the Mumbai Trans Harbour Link is in Sewri area Mumbai City, and the route is crossing Mumbai Bay and connects with Mumbai-JNPT Highway in Raigad District.

Total area of Mumbai and Raigad District is approximately 7,750 km^2 and its total population is app. 5.8 million on the census in 2011. Population increase for 10 years from 2001 to 2011 is 4.56 % in Mumbai and app. 19% in Raigad District.

Table 1.2.2 Socio-Economic Situation in the Project Area

Name of Area	Area (km^2)	Rate	Population (2011) (Person)	Increase Rate (for 10 years)	Population Density (Person/km^2)
India	3,287,263	100.00%	1,210,193,422	14.99%	368
Maharashtra State	307,713	9.36%	112,372,972	15.99%	365
Konkan Division	30,746	0.94%	28,739,397	-	935
Mumbai City	603.4	0.02%	3,145,966	4.56%	25,851
Raigad District	7,152	0.22%	2,635,200	19.36%	368

Source: Indian Statistical Census (2011)

Source: JICA Study Team

Figure 1.2.14 Project Location on District Map

(2) Economy

GDP in India by state is indicated in Table 1.2.3. The GDP of Maharashtra is ranked the top state in India, and the GDP indicates 4,155 billion INR about 1.5 times of Uttar Pradesh, the largest State in the Country.

On the other hand, GDP per capita in Maharashtra is 114,000 INR and ranked 7th in India as shown in Table 1.2.4 . Additionally GDP and GDP per capita in Mumbai, Raigad and Thane are shown in Table 1.2.5.

Table 1.2.3 GDP in India (FY2013-2014)

	Unit: Billion INR.	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
1	Maharashtra	4,155	4,868	5,845	6,848	7,540	8,558	10,492	11,754	13,238	14,762
2	Uttar Pradesh	2,608	2,932	3,363	3,830	4,447	5,234	6,003	6,855	7,804	8,627
3	Tamil Nadu	2,190	2,578	3,105	3,508	4,013	4,797	5,849	6,672	7,449	8,542
4	Gujarat	2,034	2,447	2,837	3,293	3,679	4,313	5,215	5,988	6,585	7,656
5	West Bengal	2,087	2,302	2,617	2,995	3,419	3,989	4,610	5,283	6,033	7,066
29	Manipur	51	57	61	68	74	83	91	111	127	143
30	Arunachal Pradesh	35	38	41	48	57	75	90	108	118	135
31	Sikkim	17	20	22	25	32	61	74	89	105	124
32	Mizoram	27	30	33	38	46	53	64	69	84	103
33	Andaman & Nicobar Islands	18	20	25	30	35	41	43	50	56	62

Source: Census of India (2015)

Table 1.2.4 GDP PER CAPITA in India (FY2013-2014)

Unit: x 1,000 INR	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
1 Goa	77	85	95	109	136	149	168	212	201	224
2 Delhi	64	72	83	95	112	126	145	167	193	220
3 Sikkim	27	30	32	36	47	91	109	130	151	176
4 Chandigarh	74	85	98	103	108	117	127	137	142	157
5 Puducherry	48	67	69	74	79	97	101	103	114	144
6 Haryana	38	42	49	57	67	82	94	106	120	133
7 Maharashtra	36	42	50	58	62	70	85	94	104	114
8 Tamil Nadu	30	35	42	48	54	64	78	89	99	113
9 Andaman & Nicobar Islands	41	45	54	61	69	79	81	90	98	107
10 Gujarat	32	38	43	50	55	64	77	86	93	107
31 Jharkhand	19	18	20	25	25	28	35	37	40	46
32 Assam	17	18	20	21	24	28	33	36	39	44
33 Manipur	19	20	21	23	24	27	28	34	38	42

Source: Census of India (2015)

Table 1.2.5 GDP PER CAPITA in the Project Area (FY2013-2014)

	GDP (billion INR)		GDP per capita (1,000 INR)	
	2012-2013	2013-2014	2012-2013	2013-2014
1 Mumbai	28.8	33.4	166	189
2 Thane	17.8	20.0	156	173
3 Raigad	3.5	3.8	120	132

Source: Maharashtra state plan division (2015)

(3) Industry

The key industries and sectors top three are shown in Table 1.2.6. The major industry in Maharashtra state is a service industry and it indicates around 63% and has been increasing.

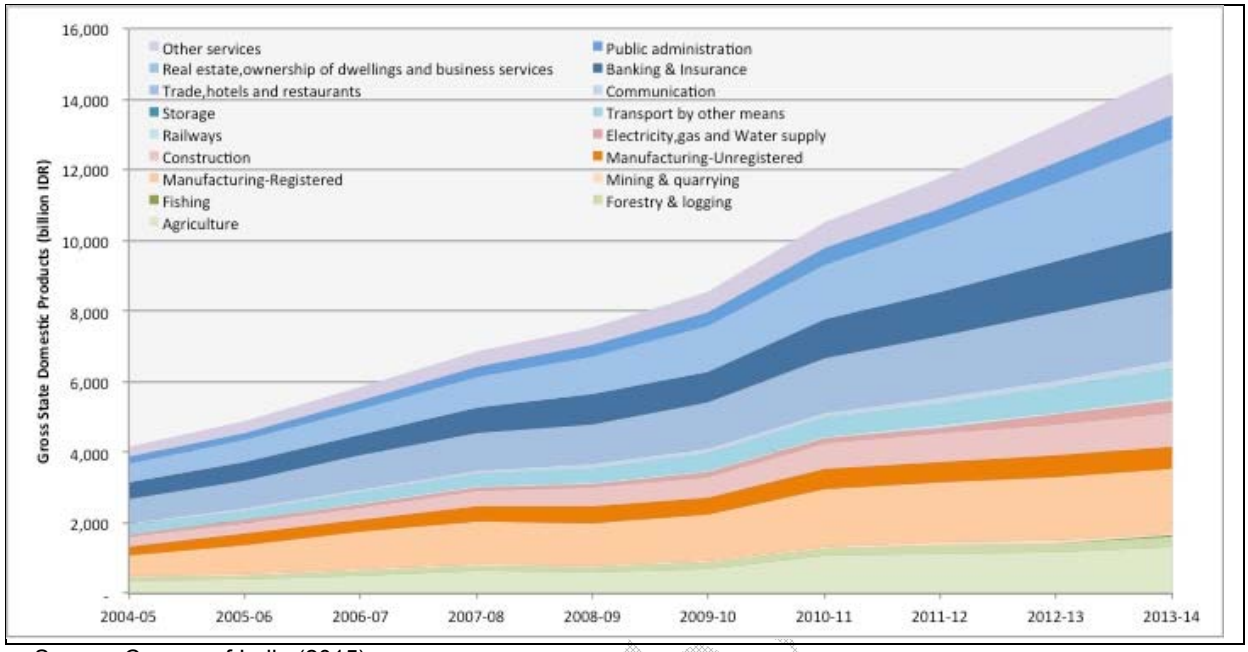
On the other hand, the industrial production is about 26% in 2013-2014, and it has been decreasing. The agricultural production is stabilized around 11-12 %.

Table 1.2.6 GDP on Major Industry in Maharashtra State

Unit: % (Billion INR)	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Primary Industry	10.8 (449)	10.8 (528)	11.5 (672)	11.8 (807)	10.1 (758)	10.4 (886)	12.3 (1,293)	11.8 (1,387)	10.9 (1,442)	11.1 (1,636)
1 Agriculture	8.3	8.2	8.7	9.4	7.9	8.0	10.2	9.6	8.7	8.8
2 Forestry	2.2	2.3	2.5	2.1	2.0	2.1	1.9	1.9	1.9	2.0
3 Fishery	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.3
Secondary Industry	29.6 (1,230)	31.8 (1,547)	32.0 (1,869)	32.4 (2,216)	31.3 (2,361)	29.8 (2,551)	29.7 (3,116)	28.2 (3,317)	27.4 (3,622)	26.0 (3,845)
1 Registered manufacturing	14.1	16.8	17.7	17.3	16.0	15.1	15.4	14.3	13.5	12.4
2 Construction	6.3	6.2	5.9	6.5	7.0	6.5	6.5	6.8	6.5	6.5
3 Not registered manufacturing	6.5	6.4	6.3	6.4	6.2	6.0	5.7	5.1	4.8	4.3
Tertiary industries	59.6 (2,475)	57.4 (2,793)	56.5 (3,303)	55.9 (3,826)	58.6 (4,420)	59.8 (5,121)	58.0 (6,082)	60.0 (7,050)	61.7 (8,173)	62.9 (9,282)
1 Real Estate	12.8	12.9	12.7	13.0	14.1	14.9	14.9	15.9	16.7	17.8
2 Trading/Hotel/Restaurant	16.2	15.6	15.9	15.4	15.0	15.1	14.6	14.6	14.6	13.8
3 Insurance and	11.4	10.5	10.2	10.2	11.1	10.4	10.4	10.8	10.8	11.0

Unit: % (Billion INR)	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
financial										

Source: Census of India (2015)



Source: Census of India (2015)

Figure 1.2.15 GDP by Industry in Maharashtra State

(4) Poverty Line

The criteria for poverty have been revising by the central government non-periodically. Thus the poverty line and the number under the poverty line are not accurate under the same criteria. According to poverty line in 2011-2012 based on the criteria determined by the India Planning Committee in 2014, the poverty line in Maharashtra is 1,078 INR in agricultural areas and 1,560 INR in urban areas.

Table 1.2.7 Poverty Line in Maharashtra State

	Poverty Line (INR/month-capita)		Poverty Ratio (%)			Number of Poor (million)		
	Rural	Urban	Rural	Urban	Total	Rural	Urban	Total
Lakdawala Methodology								
1973-74	50.47	59.48	57.71	43.87	53.24	21.1	7.7	28.7
1977-78	58.07	73.99	63.97	40.09	55.88	25.0	8.0	33.0
1983-84	88.24	126.47	45.23	40.26	43.44	19.4	9.7	29.1
1987-88	115.61	189.17	40.78	39.78	40.41	18.6	10.9	29.6
1993-94	194.94	328.56	37.93	35.15	36.86	19.3	11.2	30.5
1999-00	318.63	539.71	23.72	26.81	25.02	12.5	10.3	22.8
2004-05	362.25	665.90	29.6	32.2	30.7	17.1	14.6	31.7
Tendulkar Methodology								
2004-05	485	632	47.9	25.6	38.1	27.7	11.6	39.3
2009-10	744	961	29.5	18.3	24.5	18.0	9.1	27.1
2011-12	967	1,126	24.2	9.1	17.4	15.1	4.7	19.8
C.Rangarajan Methodology								
2011-12	1,078.34	1,560.38	22.5	17.0	20.0	14.0	8.8	22.8

Source: India Planning Committee (2014)

1.3 Environmental Legislation

1.3.1 Environmental Impact Assessment (EIA Notification 2006)

The necessity of environmental impact assessment is stipulated on the Environmental Protection Law in 1986, and concrete rules are described on the Environmental Impact Assessment Notification in 2006 (EIA Notification). According to the notification, prescript projects are required to obtain an Environmental Clearance before implementation of the actual construction.

Category A projects in accordance with EIA notification are required to obtain the Environmental Clearance from Ministry of Environment and Forests (MOEF) of the central government, on the other hand, Category B project shall have the clearance from State Government.

The mandatory list regarding road sector is shown in Table 1.3.1. MTHL is not required to conduct comprehensive EIA because this road is city road, neither national highway nor state highway.

Table 1.3.1 Mandatory List for EIA

Project Activity		Category C		Other Condition
		Category A (Central Government)	Category B (State Government)	
7f	Highway	i) New National Highways; and ii) Expansion of National High ways greater than 30 KM, involving additional right of way greater than 20m involving land acquisition and passing through more than one State.	i) New State High ways; and ii) Expansion of National / State Highways greater than 30 km involving additional right of way greater than 20m involving land acquisition.	General Condition shall apply

Source: EIA Notification (MOEF 2006)

1.3.2 Coastal Regulation Zone (CRZ Notification 2011)

According to CRZ notification 2011, following objectives for establishment of regulation are described;

"Now, therefore, in exercise of the powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government, with a view to ensure livelihood security to the fisher communities and other local communities, living in the coastal areas, to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in

the coastal areas, sea level rise due to global warming, does hereby, declare the coastal stretches of the country and the water area up to its territorial water limit, excluding the islands of Andaman and Nicobar and Lakshadweep and the marine areas surrounding these islands up to its territorial limit, as Coastal Regulation Zone (hereinafter referred to as the CRZ) and restricts the setting up and expansion of any industry, operations or processes and manufacture or handling or storage or disposal of hazardous substances as specified in the Hazardous Substances (Handling, Management and Transboundary Movement) Rules, 2009 in the aforesaid CRZ."

In the designated CRZ, "allowed" and "Not allowed" activities are categorized and stipulated. With regard to the Mumbai Harbor Trans Link, it is categorized as "Sealink" and it is a permissible activity. and CRZ clearance with 5 years validity has been obtained by MMRDA from MOEF in July 2013.

Relevant description regarding MHTL project on CRZ notification 2011 is show below.

Table 1.3.2 Relevant Description on CRZ Notification 2011

No.	Name of Article	Contents
Clause "3 (iv) (Page 2).	Prohibited activities within CRZ	The activities such as Land reclamation, bunding or disturbing the natural course of seawater are declared as prohibited activities within the CRZ except those,- (a) required for setting up, construction or modernisation or expansion of foreshore facilities like ports, harbours, jetties, wharves, quays, slipways, bridges, sealink, road on stilts, and such as meant for defence and security purpose and for other facilities that are essential for activities permissible under the notification;"
Clause "7 (Pg 8)	Classification of the CRZ	- For the purpose of conserving and protecting the coastal areas and marine waters, the CRZ area shall be classified as follows, namely:- (i) CRZ-I,– A. The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast,- (a) Mangroves, in case mangrove area is more than 1000 sq mts, a buffer of 50meters along the mangroves shall be provided; (b) Corals and coral reefs and associated biodiversity; (c) Sand Dunes; (d) Mudflats which are biologically active; (e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), the Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 of 1986); including Biosphere Reserves; (f) Salt Marshes; (g) Turtle nesting grounds; (h) Horse shoe crabs habitats; (i) Sea grass beds; (j) Nesting grounds of birds; (k) Areas or structures of archaeological importance and heritage sites. B. The area between Low Tide Line and High Tide Line; (ii) CRZ-II,- The areas that have been developed up to or close to the shoreline.
Clause "8 (Pg 9)	Norms for regulation of activities permissible under this notification,-	(i) The development or construction activities in different categories of CRZ shall be regulated by the concerned CZMA in accordance with the following norms, namely:- I. CRZ-I,- (i) no new construction shall be permitted in CRZ-I except,- (e) Construction of trans harbour sea link and without affecting the tidal flow of water, between LTL and HTL." "(ii) Areas between LTL and HTL which are not ecologically sensitive, necessary safety measures will be incorporated while permitting the following, namely:- (g) Construction of trans harbour sea links, roads on stilts or pillars without affecting the tidal flow of water."

Source: Coastal Regulation Zone Notification (MOEF 2011)

CRZ Area affected by the Bridge

Sr No	Zone	Area of Bridge in CRZ in Sqm	No of Piers	Size of Pier	Total area of pier in CRZ in sqm
SEWRI SIDE					
1	CRZ I	45000	62	3mX4m	744
2	CRZ II	4500	8	3mX4m	96
	Total	**49500**	**70**		**840**
CHIRLE SIDE					
1	CRZ I	15000	22	3mX4m	264
2	CRZ II	3000	6	3mX4m	72
	Total	**18000**	**28**		**336**
	Grand Total	**67500**	**98**		**1176**

Table 1.3.3 Special Conditions on CRZ Clearance for MTHL

No.	Conditions
1	As per the CRZ notification, 2011, at least five times the number of mangroves destroyed/cut during the construction process shall be replanted. Mangrove plantation in an area of 30 ha shall be carried out as committed against loss of 0.1776 ha of mudflats/mangroves. Permission from the High Court of Bombay shall be obtained before cutting of mangrove trees.
2	Proponent shallconsider suggestions from Bombay Natural History Society for provide lighting so as to minimize the likely impacts on the migratory birds
3	All the construction equipments shall be provided with exhaust silencers as committed
4	Noise containment barriers shall be provided on both sides of the bridge in mudflat areas (CRZ-IA) so as to minimize the likely impacts to the migratory birds
5	There shall be no dredging and reclamation for the project
6	Pre-fabricated super structure shall be used in the mud flat area for construction as committed
7	The muck materials shall be analyzed prior to dumping / disposal in the identified locations with the approval of competent authority to ensure that it does not cause any impact on the environment
8	Navigation channel is provided with 25m for ships and 9.1 m for fishing boats.
9	All the recommendations of the MCZMA & MOEF shall be strictly compiled with.
10	There shall be no building construction beyond 20,000 sqm.
11	There shall be no water drawal in CRZ area
12	There shall be no disposal of solid or liquid wastes on coastal area. Solid waste Management shall be as per Municipal Solid (Management and Handling) Rules, 2000.
13	Sewage shall be treated and the Treatment Facility shall be provided in accordance with the Coastal Regulation Zone Notification, 2011. The disposal of treated water shall conform to the regulations of State Pollution Control Board.
14	The project proponent shall set up a separate environmental management cell for effective implementation of the stipulated environmental safeguard under the supervision of a Senior Executive.
15	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.

Source: CRZ Environmental Clearance (MOEF 19th July 2013)

1.3.3 Other Relevant Environmental Laws and Regulations

Other relevant environmental laws and regulations are shown in the next table.

Table 1.3.4 Other Relevant Environmental Laws and Regulations

No.	Name	Year
1	Environmental（Protection）Act	1986
2	Environment Impact Assessment Notification	2006, 2009, 2012
3	Forest Conservation Act	1927, 1980
4	National Forest Policy	1952, 1988
5	Coastal Regulation Zone Notification	1991,2011
6	Wildlife（Protection）Act	1972
7	Land Acquisition Act	1894, 1989
8	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act	2013
9	Air（Prevention and Control of Pollution）Act）	1981
10	Hazardous Waste(Management and Handling) Rules）	1989, 2003
11	Municipal Solid Waste （Management and Handling） Rules）	2000
12	Noise Pollution Regulation and Control Rule）	2000
13	Water(Prevention and Control of Pollution) Act）	1974

Source: JICA Study Team

Table 1.3.5 Other Relevant Environmental Ratification Treaty

No.	Name	Effected Year
1	United Nations Framework Convention on Climate Change	1994
2	Kyoto Protocol	2001
3	Convention on Biological Diversity	1993
4	Cartagena Protocol on Biosafety	2003
5	Vienna Convention for the Protection of the Ozone Layer	1988
6	Montreal Protocol on Substances that Deplete the Ozone Layer	2002
7	Basel Convention	1992
8	The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	2004
9	Stockholm Convention on Persistent Organic Pollutants	2004
10	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	1996
11	Convention on International Trade in Endangered Species of Wild Fauna and Flora(CITES)	1975
12	The Convention on Wetlands of International Importance especially as Waterfowl Habitat	1975
13	Antarctic Treaty / Protocol on Environmental Protection to the Antarctic Treaty	1961
14	Protocol on Environmental Protection to the Antarctic Treaty （Madrid Protocol）	1998

Source: Ministry of Foreign Affairs in Japan (website)

Table 1.3.6 Various other environmental clearances required for the project

Clearance Required	Approving Authority	Responsibility	Obtained by when
Mangrove cutting	Bombay High Court	MMRDA	Before start of the project
Tree Cutting	Respective Tree Authorities	MMRDA/Contractor	6-7 days before cutting trees
Consent to Establish	Maharashtra Pollution Control Board	MMRDA/Contractor	When the contractor develops new quarry, borrow pits and camp site, if required.
Environmental Clearance under EIA notification 2006*	State SEIAA and/or MOEF	MMRDA	Before Start of the Project

*If applicable

1.3.4 Gaps between Existing EIA and JICA's Guideline

The project is categorized as Category A (as per JICA guidelines) which is required EIA level based on JICA Guidelines, thus following preliminary comparative analysis has been conducted between JICA Guidelines and "Rapid EIA in 2012" prepared by MMRDA for obtaining of Environmental Clearance for CRZ from MOEF.

According to the gap analysis, the identified gaps are "NOT-Implementation" of Social Impact Survey, Vibration Survey and Holding Public Consultation.

Table 1.3.6 Result of Preliminary Gap Analysis between JICA Guidelines and Rapid EIA

JICA Guideline (Appendix 2. EIA Reports for Category A Projects)	Rapid EIA (2012 prepared by MMRDA)	Gaps	Policy to fill up gaps in this Study
When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents etc. must officially finish those procedures and obtain the approval of the government of the host country.	At first, the project is not required to prepare the EIA in accordance with EIA Notification 2006. However necessary clearance for CRZ is obtained from MOEF by MMRDA in 2013.	- (no difference)	Not required
EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	Current Rapid EIA has been prepared in only English.	At least English and Hindi version shall be prepared. Marathi is also considered.	Summarry of Supplemental EIA shall be prepared in Marathi as well.
EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	Rapid EIA in 2012 has not been disclosed	Rapid EIA shall be disclosed	Supplemental EIA in English (in full) and Summary in Marathi shall be disclosed after preparation of Final Supplemental EIA.
In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared.	A public consultation has not been conducted on the process of Rapid EIA	Either local Stakeholder meeting and public consultation has been conducted	Twice public consultation is held at scoping and draft supplemental EIA stage respectively
Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.	Any consultation has not been conducted on the process of Rapid EIA 2012	Ditto	Ditto

Source: The Survey Team

1.4 Environmental and Social Impact Assessment

In this article, alternative analysis, scoping and expected mitigation measures are described for the MTHL project.

1.4.1 Analysis of Alternatives

The first recommended draft plan of MTHL dates backs to 1970s. Thereafter, a Committee constituted in 1972 and 1978 studied possible two alternative routes; a northern route linking Sewri with Nhava and southern route linking Colaba with Uran. Thereafter, Steering group constituted in 1981 reviewed previous studies and recommended that priority should be given to the construction of northern route. Further in 1982, Peter frankael and partners, had identified and studied alternative alignment between Sewri on Mumbai island and Nhava on the mainland.

In order to assess tidal impacts on the alignment, the Central Water and Power research station,s recommendation to provide opening in the embankment sectionon Seweri side to cater for non tidal inflow has been considered. Also on the recommendation of Bhabha Atomic Research Centre an Expert group has recommended to shift the northern alignment to the south of Jetty head and this alignment was approved in 1984 by the Prime Minister's office of India.Subsequently, this northern alignment so finalised based on hydrological and techno-economic feasibility was further studied by Consulting Engineering Services(CES) in 1996 with closed interaction with Mumbai Port trust and suggested modifications considering mitigation of following hydrological and environmental impacts:

- The alignment should be constructed on Viaducts instead of embankments in order to minimise disturbance to mudflats, existing hydro-logical conditions and minimizing the social impacts

- underpass interchange at sewri was proposed in view of complex elevated interchange, unavailability of road and difficulty in land acquisition from Mumbai Port Trust

- Nhava approach has considered less costly alternative II by reducing length of link having end point at Chirle on NH4B on the recommendation of CIDCO.

Also in order to consider security concerns, the alignment has been shifted so that it does not cross Tata Thermal Power station, the alignment does not invade oil

company or oil tanks and the alignment is shifted such that separation of 1600 m distance is secured from Bhabha Atomic Research Centre. Also the alignment is finalised considering minimal volume of cutting soil and minimising the impact on mangroves and maintaining minimum distance of 900 m from the Elephanta Island. Also the care has been taken that the alignment would not interfere the navigation channel for large vessels of JNPT.

(1) Alternative Analysis

As explained from main text of Supplemental EIA article 5.1.1 to 5.1.4, the route and fundamental structure have concluded and approved by central government from the view of natural & social environment, security and adjustment with other projects. Thus factor on alternative analysis is limited as follows. As shown in below table, the Span length and location of IC is listed up as factor of alternative analysis, however, in general, the location of IC is planned at actual connected trunk road, and hence, there are not any options to shift other area so long as the connected road plan does not change.

Table 1.4.1 Selected Factors on Alternative Analysis

Factor/ Condition	Reason for adoption
Location of Interchange	It is expected that changing of IC location may give positive impacts from the view of natural and social consideration. However since the location shall be set up at cross point with connected road, the location of IC cannot be shifted to other points. Thus "location of IC" is not appropriate factor on the analysis.
Span length (steel girder bridge)	It is expected that changing span length reduce excavated area in mudflat and mangrove cutting area. Adoption of steel girder for superstructure provides long span and reduction of number of piers and piles. Thus this factor is selected as an appropriate factor on the analysis

Source: JICA Study Team

"Span length" is selected as a factor on the alternative analysis and evaluated from the view of natural & social environment and economy & cost as shown in Table 1.4.2.

According to the result of analysis, option-2 with 80m span length has advantage slightly on the all items on natural environment such as negative impacts on mudflat, mangrove, Flamingo habitat, benthos, CRZ and tidal flow except land acquisition & resettlement. Although differences of impacts between Option 1 and 2 are not significant from the view of impacts on natural environment, Option-2 (80m) has extremely disadvantage from the view of construction cost. Additionally, it is supposed the adverse impacts are minimized by mitigation measures on management plan. Thus Option-1 (50m) should be selected from comprehensive point of view.

Table 1.4.2 Alternative Analysis (Span Length)

Factor/ Condition (analyzed area)	Option-1 50m span with PC girder	Option-2 80m span with steel girder	Differences between options, Evaluation and mitigation measure

Factor/ Condition (analyzed area)	Option-1 50m span with PC girder	Option-2 80m span with steel girder	Differences between options, Evaluation and mitigation measure
1. Area of Cutting mangrove (ST0.6-0.8km and 16.5-17.9km)	App. 2,100m2	App. 1,300m2	800m2 5 times of cutting mangrove area shall be replanted in the designated area by MoEF
2. Impacts on Flamingo (ST0.6-5.6km)	Width of flying course under bridge is 50m	Width of flying course under bridge is 80m	It is supposed Flamingo fly over bridge not under bridge. Thus there are no significant differences.
3. Impacts on Benthos in Mudflat area (ST0.6-5.6km and 15-17.9km note1)	Excavated impacts area is App. 2,100m2	Excavated impacts area is app. 1,300m2	800m2 5 times of cutting mangrove area shall be replanted and created new habitat in the designated area by MoEF
4. Impact on CRZ (0.6-2.1km and 16.5-17.1km) note2)	Excavated and cutting mangrove area is App. 1,100 m2	Excavated and cutting mangrove area is App. 690 m2	410m Mitigation measures are committed on CRZ clearance.
6. Tidal flow note3)	Few impacts (note3)	Few impacts (note3)	Same impacts and negligible
7. Land acquisition (ST0-0.6km and 16-22km)	Land acquisition area is same as Option-2	Land acquisition area is same as Option-1	Same impacts and compensation policy under Indian laws and JICA Guidelines
8. Construction Cost(entire of alignment) (Considered mudflat and mangrove area ST0.6-5.6km and 15-17.9km)	Approx. 1.640 crore INR	Approx. 2,490 crore INR	850 crore INR (= 15 billion yen)

Note 1) Mudflat and mangrove area is ST0.6km – 5.6km in Sewri side and 15.0 km – 17.9 km in Shivaji Nagar side
Note 2) CRZ is located in the sea section from ST0.6-2.1km (CRZ-1) and 16.48 – 17.08km (CRZ I and II)
Note 3) Adverse Impacts on tidal flow by construction of MTHL in case of 50m span length has been analyzed and concluded as "negligible level" by The Central Water and Power Research Station (CWPRS). Thus degree of impacts in both case of 50m and 80m are evaluated as same level.
Source: JICA Study Team

(2) Zero Option

In case of "Zero Option" which does not implement the project, following adverse negative and positive impacts are expected. Some positive impacts are expected, however, since the expected negative impacts are serious from the view of economic and environment, "With project case" is desirable comprehensively;

[Negative Impacts]

- The congested situation must be accelerated and prevent from sound urban development. Furthermore, this "without case" will not give a synergy effect on other development plan such as a construction of Navi Mumbai Air Port.
- The accelerated congestion must make all of vehicles decrease travelling speed, and then volume of greenhouse gases increase from vehicles.

[Positive Impacts]

- Mangrove and mud flat is conserved
- Resettlement and land acquisition is not caused

1.4.2 Screening

As described in previous chapter, obtaining of EC for EIA is not required in accordance with EIA Notification 2006, however Clearance for CRZ in accordance with CRZ Notification 2011

is required, and MMRDA has obtained this CRZ Clearance in 2013 by preparation of Rapid EIA in 2012. On the other hand, JICA HQ has judged that some significant impacts on natural and social environment are predicted on the MTHL project, thus the project has been classified as “Category A” which is required to conduct EIA level study.

1.4.3 Scoping

Scope of the EIA study for the project is discussed in this section. The environmental scoping is conducted based on an environmental reconnaissance by the JICA Study Team in April 2015.

The result of scoping is indicated on the Leopold scoping matrix and reason tables. First of all, impact factors, impacted item and impact degree are shown on the following scoping matrix based on JICA’s Guidelines.

(1) Scoping Matrix for MTHL

As the result of Scoping Analysis, 15 items such as Air, Water, Waste, Noise & Vibration, Biology & protected area, Hydrology, Topography and Geography, Existing Infrastructures, Misdistribution of benefit and damage, land scape, infectious diseases and accident are selected as item of the Rating B which has some negative impacts.

Additionally mainly social items such as “involuntary resettlement” are evaluated as “Rating C” which has unknown impacts.

Table 1.4.3 Draft Scoping Matrix for MTHL

	No	Affected Activities / Impacted Item (JICA Guidelines)	(Items of the Rapid EIA 2012)	During Construction	Pre/ During Construction Phase: Land acquisition and Loss of properties and Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation(including Mangrove)	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	After Construction	Operation Phase: Increase of Through Traffic and traveling speed	Appearance/ Occupancy of Roads and related building structures including tunnel and embankment	Increasing influx of settlers
Pollution	1	Air Pollution	Air quality/ Siting of borrow and quarry material areas	B-	D-	D-	D-	D-	B-	D-	D-	D-	B-	B-	D-	D-
	2	Water pollution	Water Quality/ Construction of labor camp/ Siting of borrow and quarry material areas	B-	D-	B-	D-	B-	D-	D-	D-	B-	D-	D-	D-	D-
	3	Waste	Solid waste management/ Construction of labor camp/ Topography, Soil and Geology	B-	D-	D-	B-	B-	D-	D-	D-	B-	D-	D-	D-	D-
	4	Soil contamination	Topography, Soil and Geology/ Siting of borrow and quarry material areas	C-	D-	D-	D-	B-	D-	D-	D-	D-	D-	D-	D-	D-
	5	Noise and Vibration	Ambient Noise	B-	D-	D-	D-	D-	B-	D-	D-	D-	B-	B-	D-	D-
	6	Ground Subsidence		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	7	Odour		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	8	Sediment quality	Topography, Soil and Geology(No.4)	C-	D-	D-	D-	C-	D-	D-	D-	D-	D-	D-	D-	D-
Natural Environment	9	Protected Area	Reserved Forest and Fauna	B-	D-	D-	B-	B-	B-	D-	D-	C-	B-	B-	B-	D-
	10	Ecosystem	Ecology and Biodiversity/ Ecology/Construction of labour camp	B-	D-	D-	B-	B-	B-	D-	D-	C-	B-	B-	B-	D-

	No	Affected Activities / Impacted Item (JICA Guidelines)	(Items of the Rapid EIA 2012)	During Construction	Pre/ During Construction Phase: Land acquisition and Loss of properties and Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation(including Mangrove)	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	After Construction	Operation Phase: Increase of Through Traffic and traveling speed	Appearance/ Occupancy of Roads and related building structures including tunnel and embankment	Increasing influx of settlers
	11	Hydrology		B-	D-	D-	D-	B-	D-	D-	D-	D-	B-	D-	B-	D-
	12	Topography and geology	Topography, Soil and Geology	B-	D-	D-	D-	B-	D-	D-	D-	D-	B-	D-	B-	D-
Social	13	Involuntary resettlement		B-	B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	14	The poor		C-	C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	15	Indigenous and ethnic people		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	16	Local economy such as employment and livelihood	Quality of Life/Fisheries	C-	C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	17	Land use and utilization of local resources	Land use/Fisheries	C-	C-	D-	C-	D-	D-	D-	D-	D-	C-	D-	C-	D-
	18	Waste Usage	Water Quality	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	19	Existing social infrastructures and services	Utility services and community severance	B-	B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
Social Environment	20	Social institutions such as local decision making institutions		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	21	Misdistribution of benefit and damage	Quality of life	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	22	Local		B-	D-	D-	D-	D-	D-	D-	D-	B-	D-	D-	D-	D-

	No	Affected Activities / Impacted Item (JICA Guidelines)	(Items of the Rapid EIA 2012)	During Construction	Pre/ During Construction Phase: Land acquisition and Loss of properties and Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation(including Mangrove)	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	After Construction	Operation Phase: Increase of Through Traffic and traveling speed	Appearance/ Occupancy of Roads and related building structures including tunnel and embankment	Increasing influx of settlers
		conflict of interests														
	23	Cultural Heritage	Archaeological /Heritage	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	24	Landscape	Aesthetics and landscape	B-	D-	D-	D-	D-	D-	B-	D-	D-	B-	D-	B-	D-
	25	Gender		C-	C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	26	Right of Children		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	27	Infectious diseases such as HIV/AIDS		B-	D-	D-	D-	D-	D-	D-	D-	B	D-	D-	D-	D-
	28	Labour environment (including work safety)		B-	D-	D-	D-	D-	D-	D-	D-	B-	D-	D-	D-	D-
Other	29	Accidents	Accident hazards and safety	B-	D-	D-	D-	D-	B-	D-	D-	D-	B-	B-	D-	D-
	30	Cross Boundary impacts and climate change		B-	D-	D-	B-	D-	B-	B-	D-	D-	C-	C-	D-	D-

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary. (+: Positive impacts, - : Negative impacts)
Source: JICA Study Team

Table 1.4.4 Reasons for Draft Scoping on MTHL

Area	No.	Impacted Item (Item on the Rapid EIA)	Rating		Reasons of the Rating
			Pre/During Const	After Const	
Pollution	1	Air Pollution (Air quality/ Siting of borrow and quarry material areas)	B-	B-	**Construction phase:** Temporary negative impacts are expected on air quality due to construction machines and equipment. **Operation phase:** Negative impact is expected due to the increase in traffic number.
	2	Water Pollution (Water Quality/ Construction of labour camp/ Siting of borrow and quarry material areas)	B-	D-	**Construction phase:** Turbid water may be generated by earth works and excavation in the water where bridges are planned. Additionally Organic polluted water may be discharged from base camp. **Operation phase:** No serious impacts are expected(The service area is not planned on this project)
	3	Waste (Solid waste management/ Construction of labour camp/ Topography, Soil and Geology)	B-	D-	**Construction phase:** Construction waste such as waste soil and cutting trees are expected. Additionally domestic waste and night soil may be generated from construction base camp. **Operation phase:** No serious impacts are expected(The service area is not planned on this project)
	4	Soil Contamination (Topography, Soil and Geology/ Siting of borrow and quarry material areas)	C-	D-	**Construction phase:** Excavated soil in the mudflat and mining area may contain polluted soil such as heavy metals. **Operation phase:** No impacts are expected
	5	Noise and Vibration (Ambient Noise)	B-	B-	**Construction phase:** Noise generation is expected due to works of construction machines and equipment. **Operation phase:** Traffic Noise and Vibration is expected because of the increase in traffic number and travelling speed.
	6	Ground subsidence	D-	D-	**Construction and operation phase:** No impacts are expected since activities which cause ground subsidence not expected.
	7	Odour	D-	D-	**Construction and operation phase:** No impacts are expected since activities which cause odour are not expected.
	8	Sediment quality (Topography, Soil and Geology(No.4))	C-	D-	**Construction phase:** Excavated soil in the mudflat and may contain polluted soil such as heavy metals. **Operation phase:** No impacts are expected
Natural Environment	9	Protected Area (Reserved Forest and Fauna)	B-	B-	**Construction and operation phase:** There are not any national parks on the alignment, however, the alignment is passing through a part of coastal regulation zone (CRZ). Although an environmental clearance (EC) of CRZ has been given from MOEF in 2013, the degree of impact should be confirmed.
	10	Ecosystem (Ecology and Biodiversity/ Ecology/Construction of labor camp)	B-	B-	**Construction and Operation phase:** Some considerable species are observed in the project area. The degree of impacts will be evaluated based on literature surveys and interview survey with specialists.
	11	Hydrology	B-	B-	**Construction and Operation phase:** Construction of bridge may change hydrological situation of the rivers.
	12	Topography and geology (Topography, Soil and Geology)	B-	B-	**Construction and operation phase:** Considerable topography and geological sites are not located in the project area, thus no impact is expected. However embankment section may have risks of land slide.
Social Environment	13	Involuntary resettlement	B-	D-	**Pre-Construction phase:** Illegal occupants are observed in Sewri area, and number of affected persons will be identified on the SIA Survey. **Operation phase:** No impact is expected
	14	The Poor	C-	D-	**Pre-Construction phase:** Impacts will be assessed based on the SIA Survey. **Operation phase:** No impact is expected

Area	No.	Impacted Item (Item on the Rapid EIA)	Rating		Reasons of the Rating
			Pre/During Const	After Const	
	15	Indigenous and ethnic people	D-	D-	**Pre-Construction and Operation phase:** Few impacts are expected
	16	Local economy such as employment and livelihood	C-	D-	**Pre-construction phase:** Livelihood of residents and shopkeepers may be affected by land clearance. The degree of impacts will be assessed on the SIA Surveys. **Operation phase:** Few impacts are expected
	17	Land use and utilization of local resources (Quality of Life/Fisheries)	C-	C-	**Pre-construction phase:** No agriculture land is observed, but quarry sites are located on Navi Mumbai side. Additionally construction of bridge may affect to fishermen in the sea. Thus the degree of impacts to fishermen will be assessed by the SIA Surveys. **Operation phase:** It is not likely to give adverse impacts since appropriate land management along the road in Navi Mumbai side is planned by CIDCO. w impacts are expected However construction of bridge may affect to fishermen in the sea. Thus the degree of impacts to fishermen will be assessed by the SIA Surveys.
	18	Water Usage (Water Quality)	D-	D-	**Construction phase:** Few impacts are expected since major structure is viaduct and earthwork is limited in the project area. Furthermore, there are any residential area in the earth work area, thus it is not likely to give any impacts on this item. **Operation phase:** Few impacts are expected.
	19	Existing social infrastructures and services	B-	D-	**Pre-Construction and Construction phase:** Some schools, temples and public facilities may be affected by land acquisition for the road construction. Thus the degree of impacts will be assessed on the SIA Surveys. **Operation phase:** Few impacts are expected because major structure is viaduct.
	20	Social institutions such as local decision making institutions	D-	D-	**Construction and operation phase:** Impacts are not expected, since local decision making institute will continue after the road construction.
	21	Misdistribution of benefit and damage (Quality of life)	D-	D-	**Construction and operation phase:** Misdistribution of benefit and damage caused by the road & bridge construction is not expected.
	22	Local conflict of interests	B-	D-	**Construction phase:** Local inhabitants and local authorities may request to ensure job opportunities as construction workers. **Operation phase:** No impact is expected
	23	Cultural Heritage (Archaeological /Heritage)	D-	D-	**Pre-Construction and Construction Phase:** No registered cultural heritage on the alignment. **Operation phase:** No impact is expected
	24	Landscape (Aesthetics and landscape)	B-	B-	**Construction and operation phase:** Sewri Fort and Elephanta Island (World Cultural Heritage) is located near the alignment, thus landscape from each site may change after construction of bridges and road.
	25	Gender	C-	D-	**Pre-Construction and Construction phase:** Male head of the household may seize the initiative in India, thus actual situation should be confirmed on SIA Survey. **Operation phase:** Few impact is expected
	26	Right of children	D-	D-	**Construction and operation phase:** Few impact is expected
	27	Infectious diseases such as HIV/AIDS	B-	D-	**Construction phase:** Infectious diseases such as STD are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provoke to provide habitats of mosquito that possibly transmits dengue fever. **Operation phase:** Road operation which causes infectious diseases is not expected.
	28	Labor environment	B-	D-	**Construction phase:** Construction work environment needs to be considered in accordance with relevant laws and regulations. **Operation phase:** No impact is expected.

Area	No.	Impacted Item (Item on the Rapid EIA)	Rating		Reasons of the Rating
			Pre/During Const	After Const	
Other	29	Accidents (Accident hazards and safety)	B-	B-	**Construction phase:** Construction vehicles may use existing local road near residential areas, thus number of traffic accident may increase. **Operation phase:** Risks of traffic accidents on the new road is expected due to increase of traveling speed.
	30	Cross boundary impacts and climate change	B-	C-	**Construction phase:** Deforestation and operation of construction machines may increase greenhouse gases such as CO2. **Operation phase:** Reduction of distance between Navi Mumbai and Mumbai area will cut amount of greenhouse gases such as CO2. Furthermore, replantation 5 times of cutting tree will be done, thus such replantation will give positive impacts. However construction of the sealink may generate additional traffic flow from developed area, thus the impact should be estimated by quantitative forecast.

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary. (+: Positive impacts, - : Negative impacts)
Source: JICA Study Team

1.4.4 Baseline Survey and Analysis Methodology

The expected baseline and survey and analysis methodologies are listed below.

Mainly 1) measurement of vibration, 2) updating of statistical data and current secondly data and 3) quantitative forecast on air, noise, vibration and water quality based on the latest traffic condition will be done based on the Rapid EIA 2012, and then the EIA will be modified and approved by MMRDA.

Methodologies of baseline survey and analysis are shown in the following table.

Table 1.4.5 Draft Baseline Survey and Analysis Methodology on MTHL

Area	No.	Item (on Rapid EIA 2013)	Rating		Survey Methodology	Forecast Methodology
			Pre and during Const.	Operation		
Pollution	1	Air pollution (Air quality/ Siting of borrow and quarry material areas)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction Phase:** Qualitative analysis **Operation Phase:** - Quantitative analysis (Puf model : calm wind model)
	2	Water pollution (Water Quality/ Construction of labour camp/ Siting of borrow and quarry material areas)	B-	D-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction Phase:** Qualitative analysis and quantitative analysis based on other cases
	3	Waste (Solid waste management/ Construction of labour camp/ Topography, Soil and Geology)	B-	D-	Refer to Rapid EIA in 2012 and the preparatory survey by JICA	**During Construction Phase:** Quantitative forecast of cutting trees and excavated soil based on construction plan
	4	Soil Contamination (Topography, Soil and Geology/ Siting of borrow and quarry material areas)	C-	D-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction Phase:** Qualitative forecast based on the Rapid EIA 2012
	5	Noise and Vibration (Ambient Noise)	B-	B-	-Site Survey: Noise : Not conducted Vibration: measurement at 2 points for 24 hours -Literature Survey: Refer to Rapid EIA in 2012 and the latest monitoring data	**During Construction Phase:** Quantitative or qualitative analysis based on other cases. **Operation Phase:** - Quantitative analysis (ASJ CN-Model 2008)
	6	Ground Subsidence (Topography, Soil and Geology(No.4))	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	7	Odour	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	8	Sediment Quality (Topography, Soil and Geology(No.4))	C-	D-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction:** Qualitative analysis based on the Rapid EIA in 2012
Natural Environment	9	Protected Area (Reserved Forest and Fauna)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction and Operation Phase:** Qualitative analysis based on the Rapid EIA in 2012 and relevant monitoring data, if any
	10	Ecosystem (Ecology and Biodiversity/ Ecology/Construction of labour camp)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any Interview survey with specialist and other project study cases in Japan is referred.	**During Construction and Operation Phase:** Qualitative analysis based on the Rapid EIA in 2012, interview survey with specialists and relevant monitoring data, if any
	11	Hydrology	B-	B-	- Site Survey: Not conducted - Literature Survey: Refer to secondary data the latest monitoring data and results on this JICA Survey, if any	**During construction and operation phase:** Refer to other quantitative analysis

Area	No.	Item (on Rapid EIA 2013)	Rating		Survey Methodology	Forecast Methodology
			Pre and during Const.	Operation		
	12	Topography and geology (Topography, Soil and Geology)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012, the latest monitoring data and topo. & geo. survey result on this JICA Survey	**During construction and operation phase:** Qualittive analysis
Social Environment	13	Involuntary resettlement	B-	D-	Refer to SIA survey	**During construction phase:** Quantitative analysis based on SIA surveys
	14	The poor	C-	D-	Refer to SIA survey	**During construction phase:** Quantitative analysis based on SIA surveys
	15	Indigenous and ethnic people	C-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	16	Local economy such as employment and livelihood (Quality of Life/Fisheries)	C-	D-	Refer to SIA survey	**During construction phase:** Quantitative or qualitative analysis based on SIA surveys
	17	Land use and utilization of local resources (Land use/Fisheries)	C-	C-	Refer to SIA survey	**During construction phase:** Quantitative or qualitative analysis based on SIA surveys
	18	Water Usage (Water Quality)	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	19	Existing social infrastructures and services (Utility services and community severance)	B-	D-	Refer to SIA survey	**During construction phase:** Qualitative analysis based on SIA surveys
	20	Social institutions such as local decision making institutions	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	21	Misdistribution of benefit and damage (Quality of life)	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	22	Local conflict of interests	B-	D-	Refer to SIA survey	**During construction phase:** Qualitative analysis based on SIA surveys
	23	Cultural Heritage (Archeological /Heritage)	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	24	Landscape (Aesthetics and landscape)	B-	B-	-Site Survey: Visual Survey at Sewri and Elphanta Island (April 2015)	**During Construction and Operation Phase:** Qualitative analysis or preparation of Photo montage
	25	Gender	C-	D-	Refer to SIA survey	**During construction phase:** Quantitative or qualitative analysis based on SIA surveys
	26	Right of Children	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	27	Infectious diseases such as HIV/AIDS	B-	D-	Refer to SIA survey	**During construction phase:** Qualitative analysis based on SIA surveys
	28	Labour environment including work safety	B-	D-	Legal framework regarding labour environment and safety shall be clarified and the safety shall be	Qualitative and quantitative analysis based on the construction plan

Area	No.	Item (on Rapid EIA 2013)	Rating		Survey Methodology	Forecast Methodology
			Pre and during Const.	Operation		
					secured. Relevant laws and actual situation shall be interviewed with relevant organizations.	
Other	29	Accident (Accident hazards and safety)	B-	B-	Literature Survey: Statistical data from police department, if any	**During Construction and Operation Phase:** Quantitative analysis based on statistical data
	30	Cross Boundary impacts and climate change	B-	C-	Site Survey: Not conducted Literature Survey: Refer to the drawing and SIA survey results (number of cut trees)	**During Construction and Operation Phase:** Quantitative analysis based on generation of CO_2

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary. (+: Positive impacts, - : Negative impacts)
Source: JICA Study Team

1.4.5 Summary of Baseline Survey and Forecast

The Result of Baseline and Forecast are shown below.

Table 1.4.6 Result of Baseline and Forecast on Main Items

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
Pollution	1	Air pollution (Air quality/ Siting of borrow and quarry material areas)	B-	B-	The value of SPM is high and above the Indian standards and IFC standards. Other items such as CO, NO2 and SO2 are low and below the standards. Note) SPM is between 92 (Elephanta Island) to 393 µg/m3 (Sewri) on Rapid EIA 2012 (monitored in 2011)	[During construction] Exhaust gases including CO, NO2, SO2 and SPM are discharged from construction machines and may impact to the near residential area. However this adverse impact is not serious because operation time is limited and most of the construction area is on the ocean, not adjacent to residential area. [After Construction] Forecasted impacts with background density meet Indian standard and IFC.	[During const.] Exhaust gases and dusts are produced by the construction activities. However the adverse impact is not serious because of far distance from residential area, bridge structure, underwater construction etc., and the impacts can be minimized by mitigation measures such as water sprinkling. [After const.] Air quality such as PM10, CO, NO2 and SO2 density increases along the road during operation phase. However the density-increasing area is very limited, and road-contributed density is very small, and the total density at roadside point is below standard values, thus it is not likely to give significant impacts on air quality.
	2	Water pollution (Water Quality/ Construction of labor camp/ Siting of borrow and quarry material areas)	B-	D-	DO at all Zone in high tide Zone II and III in low tide is exceeding standard values. pH range and BOD values are within the range of the standard. The highest COD value was found to be 105mg/L and within acceptable limits of 250mg/L.	[During const.] Turbid water is generated by earth works and excavation. Spillage of oil and grease from machines and storage is avoided or mitigated by appropriate management and maintenance.	[During const.] The impacted time, duration and area is limited. And the impacts are minimized by planned mitigation measures such as sedimentation pond, the casing. Thus, the degree of impacts is acceptable level.
	3	Waste (Solid waste management/ Construction of	B-	D-	Domestic waste from household is disposed to designated dumping site. Night soil in the city area is treated in	[During const.] Excavated muck soil from the sea section is estimated around 99,000 m^3. General waste soil on the land section is	[During const.] All generated construction waste and domestic waste are reused and/or disposed under adequate mitigation measures, thus it is not likely to give significant impacts on this item.

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
		labour camp/ Topography, Soil and Geology)			sewerage plant. Construction waste such as concrete and cutting trees are used for construction material. Muck soil is tested, treated and disposed at designated site.	2,400m^3. Cutting mangrove volume is approximately 13.9m^3. Domestic waste and night soil is generated at base camp for workers, estimated volume is around 760kg/day.	
	4	Soil Contamination (Topography, Soil and Geology/ Siting of borrow and quarry material areas)	C-	D-	According to Rapid EIA 2012, only density of Lead is exceeding standard level.	[During const.] Excavated muck soil from the sea section is estimated around 99,000 m^3. General waste soil on the land section is 2,400m^3.	[During const.] All generated construction waste soil are reused and/or disposed after soil analysis under adequate mitigation measures, thus it is not likely to give significant impacts on this item.
	5	Noise and Vibration (Ambient Noise)	B-	B-	The existing noise levels are exceeding the permissible limit excepting Mahul near power plant industrial area. All vibration level meets traffic vibration standard of Japan. Note) daytime : Night time Noise dB(A) Leq Sewri: 75-76 : 60-62 Shivaji Nagar: 62-65 : 54-60 Vibration: dB Sewri: 48-49 : 48-49 Shivaji Nagar: 48-49 : 48-49	[During const.] Estimated construction noise is less than 85dB(A). With regard to construction vibration, it is estimated less than 75dB. The noise and vibration during the construction of MTHL can be expected to be less than the Japanese standard. [After const.] The all forecasted noise and vibration level meet Indian standard and Japanese standard respectively. Note) Noise Standard along road: 75 dB(A) for daytime and 70 dB(A) for night time, Vibration Standard : 65dB for daytime and 60 dB for night time along the road	[During const.] In the daytime, it is expected that impacts from construction activities is reduced by mitigation measures such as selecting low-noise equipment, informing the construction schedule and meet standard values, thus it is not likely to give serious impacts to surrounding area. In the night time, the construction activities will give a degree of impacts to the nearest residential area, however, implementation of the mitigation measures minimize the impacts and the degree of impacts will be acceptable level for inhabitants. [After const.] The forecasted noise and vibration level meets standard values, thus it is not likely significant impact on this item. Since the noise-reducing effect of noise barrier is not very high, it is not necessary to build a noise barrier.
	8	Sediment Quality	C-	D-	According to Rapid EIA 2012, only density of Lead is	[During const.] Excavated muck soil from the sea section	[During const.] All generated construction waste soil are reused and/or disposed

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
		(Topography, Soil and Geology(No.4))			exceeding standard level.	is estimated around 99,000 m^3.	after soil analysis under adequate mitigation measures, thus it is not likely to give significant impacts.
Natural Environment	9	Protected Area (Reserved Forest and Fauna)	B-	C-	The proposed alignment passes through Coastal Regulation Zone.	Totally 2.25km of the alignment has been classified as CRZ. CRZ-I : 2.0km CRZ-II: 0.25km	It is not likely to give serious impacts under implementation of appropriate mitigation measures.
	10	Ecosystem (Ecology and Biodiversity/ Ecology/ Construction of labor camp)	B-	C-	On Rapid EIA 2012, 17 bird species, 4 butterflies, 7 fauna species in benthos have been recorded. On migratory birds survey in 2008, totally 78 bird species have been observed. Out of 78 bird species in the survey 2008 and 2012, 15 species are categorized as migratory birds, only 1 species Lessor Flamingo is categorized as NT level (Nearly Threatened). In other 66 species, 5 species are categorized as NT and VU (Vulnerable) However it is supposed that such 6 species are using the project area as feeding area, not nesting area. Note) NT: 1) Black Headed Ibis, 2) Painted Stork, 3) Black Tailed Godwit and 4) Eurasian Curlew	[During const.] <u>Fauna</u> Turbid water due to activities in the river and inflowing from construction area may impact on aquatic fauna. Part of the mudflat ecosystem is lost by the implementation of development projects. The drying of the mudflat may impact on food resources of migratory birds. If the base camp and construction yard are installed near the feeding grounds of migratory birds, migratory birds may avoid and fly away to other mudflat in Mumbai harbour temporarily. However, in general, such birds may come back same place throughout a period of time. <u>Flora</u> Deforestation may impact on mangrove area. However, the drying of the mudflat may increase the mangrove area in some limited area around piles. [After const.] <u>Fauna</u>	[During const.] Construction activities of MTHL may cause noise during construction stage, thus some group of migratory birds may avoid the adjacent area and flyaway to other area in Mumbai basin temporarily. However since several mitigation measures will be conducted, the migratory birds may get back again gradually. Additionally turbidity from excavated area in the sea and cutting mangrove area will be minimized by appropriate mitigation measures. [After const.] Vehicle travelling, making noise and existence of viaduct may give adverse impacts for migratory birds. For minimization of these impacts, not only CRZ specification conditions, but also additional measures such as consideration of lighting system not to give impacts on Flamingo's roosting area are planned. When unexpected events and phenomena has been confirmed after construction and during construction, appropriate to take action in consultation with relevant organizations. Thus, it is not likely to give serious impacts on project including mudflat ecosystem under implementation of appropriate mitigation measures.

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
					VU: Greater Spotted Eagle	Some migratory birds are accidentally killed on the road and bridge due to increase of traffic volume. The presence of elevated road, there is a risk of inhibiting the flight path of the Flamingo. Impact on the Flamingo roost is concerned by the irradiation of road lighting. According to the result of forecast on hydrology, existence of piers does not give significant impacts on entire of tidal flow and physical condition of mudflat, thus it is expected that such insignificant impacts on tidal flow and physical condition of mudflat does not give adverse impacts on ecosystem in the mudflat. <u>Flora</u> The drying of the mudflat may be caused by existence of bridge piers, however, such area is limited around piers and may provide possible environment which mangrove grows.	
	11	Hydrology	B-	B-	The project area belongs to Savana Climate and dry-rainy seasons are distinguished clearly. Mumbai basin has 1,358 ha with some rivers and Thane creek. Tidal flow varies with location, time and depth. Nautical chart indicates near MTHL alignment from 1.03 to 1.54 m/s.	According to hydraulic analysis by using FEM (Finite Element Method) on the report of the Central Water and Power Research Station (CWPRS), at the nearest point of the project alignment No.3 named Pir-Pau, there is negligible increase and decrease in current strength during ebb and flood tide. It was also reported that it will not have any hydraulic impact on functioning of other points.	Although Hydraulic impacts are negligible, the monitoring of the tidal level and current should be conducted at the bridge sites by installing water alarm system during and after the construction of the bridge. Furthermore, the bathymetric survey around the MTHL should be conducted periodically, and will be confirmed that the sea bed level is higher than the design scour depth. When the sea bed gets closer to the design scour depth, the surrounding of pier around the sea bed will be protected by appropriate material such as the riprap or geobag.

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
	12	Topography and geology (Topography, Soil and Geology)	B-	B-	The area is classified in 5 sections based on topographic feature on site. 1: flat land 2: tidal area (partially mangrove area) 3: sea area 4: sea and tidal area (partially mangrove area) 5: hills and rock mountainous area	Any considerable topography and geological sites are not located in the project area, thus no impact is expected. However embankment section may have risks of land slide.	Implementation of appropriate designing and mitigation measures such as slope protection and periodical monitoring & maintenance will mitigate the expected impacts. Thus it is not likely to give significant impacts on stability of earthwork section.
Social Environment	13	Involuntary resettlement	B-	D-	A total of 282 project affected families and 1,272 project affected persons are recorded.	[During const.] Total Number of PAFs and relocated persons is 282 and 1,272 to be displaced are identified based on SIA survey.	[During const.] Implementation of appropriate compensation, resettlement and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item.
	14	The poor	C-	D-	In the Sewri area, 146 (58.9 %) of PAHs earn income ranging from 50,000 to 100,000 INR while yearly expenditure less than 300,000 INR indicates 96.3%. 4 PAPs are categorized as under-poverty line in the survey area Sewri Section.	[During const.] 4 PAPs under poverty line to be displaced are identified. Such displaced PAPs may have income reduction due to increase of commuting time and loss of job temporarily.	[During const.] Although the displaced house heads may have risks of income reduction, implementation of appropriate compensation and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item.
	16	Local economy such as employment and livelihood (Quality of Life/Fisheries)	C-	D-	More than half of household heads are private service workers, and approximately 23.7% belongs to business and trade activities.	[During const.] According to census and economic surrey on SIA, loss of income is expected on private sector workers and Non fishing labours mainly.	[During const.] Although 447 PAPs and their properties are impacted by the project, implementation of appropriate compensation and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item.
	17	Land use and utilization of	C-	C-	Some areas are used for residential and commercial	[During const.] Approximately 8.6 ha commercial and	[During const.] Although totally 8.6ha compound in Sewri area, and customary

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
		local resources (Land use/Fisheries)			shops. Some house heads and shop owners have a lease contract with MPT in Sewri Section. Additionally, in the sea section, traditional fishermen have own customary fishing ground. Detailed data is shown in SIA report.	housing land will be used for construction site and yard. In the sea section, customary fishing ground will be reduced by the construction. [After const.] Surrounding area of the MTHL may be used for commercial area and small factory compound without any permission from authorities.	fishing area in sea section is affected by the project, implementation of appropriate compensation and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item. [After const.] Appropriate land use management will give positive impacts in the affected area from the view of economic and natural environment considerations.
	19	Existing social infrastructures and services (Utility services and community severance)	B-	D-	According to SIA survey, no sensitive receptors such as school and hospital and local meeting places are observed in the affected area. However community level temple, mosques and women's group accommodation are recorded in the project area.	[During const.] Traffic restriction area in the project area, inhabitants and commuting people including students will spend much time than usual for passing such construction area. Additionally displacement of community level temples & mosques and women's group facilities may give adverse impacts on prayers and group members.	[During const.] Construction activities will give adverse impact on access to public facilities and commuting time, additionally displacement of community level temples and mosque will be caused. However implementation of mitigation measures will minimize the impacts. Thus it is not likely to give serious impacts on this item.
	22	Local conflict of interests	B-	D-	According to comments in the local level stakeholder meetings and socialization meetings on SIA, local inhabitants and local authorities requested to ensure job opportunities as construction workers.	[During const.] Conflicts or disputes between communities may be raised if imbalance in hiring workers is caused.	[During const.] The hired workers from other areas may have conflicts with inhabitants however implementation of mitigation measures will minimize the impacts. Thus it is not likely to give serious impacts on this item.
	24	Landscape (Aesthetics and landscape)	B-	B-	Sewri fort as registered heritage and Elephant Caves designated as the World Cultural Heritage is located within 5 km from the project area. However entrance of	The landscape elements are mainly mangrove trees, mudflat and skyline of opposite hilly area. A part of mangrove and mudflat are obstructed by the construction of MTHL.	The changes before and after construction of sealink are unavoidable. However the structure does not give serious impact on skyline of opposite hilly area. Additionally, Non Objection Certificate regarding passing through near heritage sites had been issued from relevant authority in 2003.

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
					Elephanta cave cannot see project area, thus Sewri Fort is selected as main view point.		Thus it is evaluated that the project does not give serious impacts on this item.
	25	Gender	C-	D-	--	[During const.] According to result of basic economic survey on SIA, any gender gaps and risks caused by the project on this item are not identified.	--
	27	Infectious diseases such as HIV/AIDS	B-	D-	According to interview survey with inhabitants, major infection diseases are dengue fever, malaria and diarrhea. However such statistical data is not recorded in this area.	[During const.] Hired construction workers and skilled equipment operators may contact with inhabitants and spread infection diseases. Additionally puddles in the construction area and insufficient drainage will provide a habitat of carrier mosquito for dengue fever and malaria. [After const.] Insufficient maintenance of drainage and bridges may provide some puddles and small pond, such environment may be habitat of mosquito larva.	Inflow of workers during construction may provide opportunity for spreading infection disease. Additionally insufficient and inappropriate drainage and maintenance during and after construction may also provide habitats of mosquito larvae. However implementation of mitigation must prevent and minimize these adverse impacts. Thus it is not likely to give serious impacts on this item.

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
	28	Labour environment including work safety	B-	D-	-	[During const.] Working without considering labor laws and regulations in the construction area may cause accident. For instance, working without out helmet and working boots have risks to injure head and foot.	[During const.] The labour environment is secured when the contractor under observation of general consultant follows Indian laws and international standards.
Other	29	Accident (Accident hazards and safety)	B-	B-	According to statistical Mumbai Police Department, number of fatal and injured case in 2014 is 350 and 14,684 persons respectively.	[During const.] Construction machines and trucks will be operated for 4.5 years. Thus risks of traffic accident increase on the commuting roads. [After const.] Number of traffic accident may increase due to increase of traffic number and travelling speed after construction of MTHL.	Traffic volume must increase during and after construction of MTHL, hence, number of accident increase in conjunction with traffic volume. However implementation of mitigation must prevent and minimize these adverse impacts. Thus it is not likely to give serious impacts.
	30	Cross Boundary impacts and climate change	B-	C-	--	Total generated CO2 volume is analysed with and without MTHL respectively. 1. Current Condition in 2015 With Project: ---- Without Project: 454,386 t/year 2. During Construction in 2018 With Project: 602,173 t/y Without Project: 591,914 t/year 3. During Operation Phase in 2032 With Project: 984,813 t/y	[During const.] Compensatory mangrove replanting is required in accordance with CRZ clearance on 19th July 2013. [After const.] Not required

Area	No.	Item (on Rapid EIA 2013)	Rating		Summary of Result		
			Pre and during Const.	Operation	Baseline	Forecast	Mitigation Measures and Evaluation
						Without Project: 986,574 t/year With project case, CO2 volume during construction is higher than without project case, however, this volume during operation in 2032 and 2042 gives positive impacts.	

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary. (+: Positive impacts, - : Negative impacts)
Source: JICA Study Team

1.4.6 General Environmental Management Plan

An Environmental Management Plan (EMP) has been recommended in this chapter. This EMP takes into account all the environmental impacts identified for MTHL and the corresponding mitigation measures to ameliorate the same. The EMP presented below includes:

- Specific actions to be taken vis-à-vis site-specific issues;
- Mitigation measures for abatement of the undesirable impacts caused during construction and operation stages
- Agencies responsible for its implementation & supervision;
- Post project Environmental Monitoring Program to be undertaken after commissioning of the project
- Environmental status reporting frequency; and
- Institutional arrangement, Strengthening of their capabilities, and role.
- Mitigation measure and monitoring plan is merged from Rapid EIA 2012 prepared by MMRDA, CRZ clearance specific condition and JICA Scoping report commented by JICA Advisory Committee.
- The cost for all mitigation measures is including a part of construction cost except replanting mangrove. The cost of replanting mangrove in accordance with CRZ clearance is estimated 60 Lakh INR on Rapid EIA 2012
- Detailed mitigation measures and monitoring plan should be establish in the future under MMRDA and General Consultant

Environmental management plan during construction phase and operation phase is listed below.

Table 1.4.7 Draft Major Environmental Management Plan on MTHL

Area	No.	Item (on Rapid EIA 2013)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
Pollution	1	Air pollution (Air quality/ Siting of borrow and quarry material areas)	☐ All vehicles and machineries shall obtain & maintain the 'Pollution under Control Certificate (PUC)'. These vehicles will be maintained so that emissions conform to the standards prescribed in the certificate. ☐ Vehicles carrying construction material shall be covered to avoid spilling ☐ Asphalt mixing plant (Hot mix and batching plants) shall be over 500 m away from any communities and 300 m from the road as far as possible to avoid any air emissions from these plants. ☐ Water sprinkling shall be carried out twice or thrice each day on earth road/unpaved sections of road and construction yard near residential area to avoid dust generation ☐ The exhaust of DG set will be released at the height prescribed by MPCB (Maharashtra Pollution Control Board) so that it does not affect nearby population.	☐ Appropriate land use management along the road (commercial and industrial area) ☐ Monitor periodically ambient air quality at suggested locations ☐ Enforcing different control measures to minimize the air pollution	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	2	Water pollution (Water Quality/ Construction of labor camp/ Siting of borrow and quarry material areas)	☐ Turbid waste water from construction area shall be mitigated and treated in sedimentation pond, if required. ☐ In the sea section, the casing and excavation methodology shall be adopted not to generate significant turbid water. ☐ There shall be no water drawl in CRZ area ☐ Waste oil shall be stored and disposed to designated site ☐ Provision of sanitation facilities at the labor camps, also the location of camps will be at least 200 m away from any water sources. ☐ Domestic waste water and night soil from base camp shall be treated and discharged. ☐ Septic tanks will be provided in accordance with Coastal Regulation Zone Notification, 2011. The disposal of treated water shall conform to the regulations of MPCB (Maharashtra Pollution Control Board). ☐ Uncontrolled digging of borrow pits will be avoided to prevent water accumulation, which results in breeding of vector disease. ☐ Providing adequate drainage structure ☐ Avoiding obstruction of existing drainage during filling	☐ Turbid water from road surface shall be collected through drainage and treated by sedimentation trench ☐ In the mudflat section, storm water should be collected by every pier and discharged on pile caps not to excavate mudflat area by the falling water.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)

Area	No.	Item (on Rapid EIA 2013)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
	3	Waste (Solid waste management/ Construction of labor camp/ Topography, Soil and Geology)	☐ After considering the possibility of reuse, construction waste shall be disposed at designated disposal site with the approval of competent authority to ensure that it do not cause any impact to the environment ☐ Proper sanitation facilities such as septic tank shall be provided at construction workers camp. Garbage/muck materials generated will be analyzed prior to dumping / disposal in the identified locations with the approval of competent authority to ensure that it do not cause any impact to the environment ☐ There will be no disposal of solid or liquid wastes on coastal area. Solid waste Management will be as per Municipal Solid (Management and Handling) Rules, 2000	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	4	Soil Contamination (Topography, Soil and Geology/ Siting of borrow and quarry material areas)	☐ Polluted excavated soil including muck soil shall be disposed at designated site with the approval of competent authority to ensure that it do not cause any impact to the environment	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	5	Noise and Vibration (Ambient Noise)	☐ Adoption of low-noise equipment ☐ All the construction equipment's shall be provided with exhaust silencers as committed. ☐ Noise containment barriers shall be provided on both sides of the bridge in mudflat areas (CRZ-IA) so as to minimize the likely impacts to the migratory birds ☐ Avoiding works of heavy equipment during night time. ☐ Provision of using ear plugs by workers exposed to high noise levels ☐ Informing the construction schedule to surrounding communities to obtain their consensus.	☐ Proponent will propose appropriate land use plan such as commercial area along the road ☐ Noise barrier shall be installed as required ☐ Periodic monitoring of ambient noise levels at suggested locations ☐ Erecting signboards at sensitive and residential locations prohibiting use of horns ☐ Growing road side plantation to prevent the noise levels.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	8	Sediment Quality (Topography, Soil and Geology(No.4))	☐ Polluted excavated soil including muck soil shall be treated, and then reused and/or disposed at designated site in accordance relevant laws and regulations.	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Natural	9	Protected Area (Reserved	☐ Adoption of excavation methodology for the turbid water prevention (i.e. bore casing and excavation)	☐ Installation of noise barrier for not to cause "Fly-Kill" on the viaduct as	MMRDA & Contractor	MMRDA & General Consultant (PMC &

Area	No.	Item (on Rapid EIA 2013)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
Environment		Forest and Fauna)	☐ Temporary jetty would be constructed in the mudflats for movement of vehicles and machinery to avoid the disturbance to mudflats/mangroves. ☐ Establishment of construction plan in consideration with lifecycle of migratory birds such as Flamingos. ☐ Installation of silencer with construction machines in accordance with CRZ clearance. ☐ Implementation of monitoring for migratory birds such as Flamingos in accordance with CRZ clearance general condition on July 2013. ☐ Implementation of the compensatory mangrove plantation in accordance with CRZ clearance specific condition (5 times of cutting mangrove: 0.1776 ha x 5 = 0.888 ha) where MoEF appoints. ☐ It is recommended that implementation of detailed baseline survey for fauna & flora and preparation of monitoring plan in the project area before design-build stage.	required ☐ Sound barriers shall be installed on both sides of the road in CRZ area and Flamingo's distributed area in accordance with CRZ clearance specific conditions. ☐ Adoption of bridge type which does not give significant impacts on migratory bird flying course in mudflat area. note) Distribution area and flying course should be identified through baseline survey prior to construction stage. ☐ Pre-stressed super structure shall be used in the mud flat area for construction as committed on CRZ clearance ☐ Lighting which does not give significant adverse impacts to roosting area of Flamingos should be installed in accordance with CRZ clearance specific condition. ☐ Prohibit using vehicle horn in mudflat section (Installation of sign boards). ☐ Implementation of monitoring for migratory birds such as Flamingos in accordance with CRZ clearance general condition on July 2013. ☐ Implementation of appropriate management and maintenance of mangrove plantation area	(Construction Company)	EC)
	10	Ecosystem (Ecology and Biodiversity/ Ecology/ Construction of labor camp)				
	11	Hydrology	☐ The monitoring of the tidal level and current should be conducted at the bridge sites by installing water alarm system during and after the construction. ☐ The bathymetric survey around the MTHL should be conducted periodically, and will be confirmed that the sea bed level is higher than the design scour depth. Designing of bridges with sufficient capacity not to give impacts on tidal conditions. ☐ There shall be no water drawl in CRZ area.	Same monitoring and mitigation measures during construction shall be done	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)

Area	No.	Item (on Rapid EIA 2013)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
	12	Topography and geology (Topography, Soil and Geology)	☐ Installation of slope and stabilizing embankment with appropriate measures	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Social Environment	13	Involuntary resettlement	☐ Implementation of SIA; ・ Holding consultation meetings for understanding of compensation policy. ・ Implementation of adequate compensation on JICA Guidelines. ・ Implementation of livelihood restoration program based on SIA.	Monitoring based on SIA	MMRDA	MMRDA
	14	The poor	☐ Implementation of SIA	Monitoring based on SIA	MMRDA	MMRDA
	16	Local economy such as employment and livelihood (Quality of Life/Fisheries)	☐ Implementation of SIA	Monitoring based on SIA	MMRDA	MMRDA
	17	Land use and utilization of local resources (Land use/Fisheries)	☐ Holding consultation meetings for understanding of compensation policy and livelihood restoration programs for affected persons including fishermen. ☐ Implementation of adequate compensation for affected properties based on JICA's Guidelines. ☐ Implementation of livelihood restoration program for income loss for fishermen based on JICA's Guidelines.	☐ Management of appropriate land use in accordance with approved land use plan along the road.	MMRDA	MMRDA (propose to MCGM and CIDCO)
	19	Existing social infrastructures and services (Utility services and community severance)	☐ Implementation of SIA	Monitoring as required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	22	Local conflict of interests	☐ Local workforce is prioritized for construction of MTHL ☐ Implementation of appropriate education for hired workers from other area and countries.	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	24	Landscape (Aesthetics and	☐ Adoption of appropriate design and color harmonized with surrounding current landscape ☐ Landscaping of borrow pits	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)

Area	No.	Item (on Rapid EIA 2013)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
		landscape)				
	27	Infectious diseases such as HIV/AIDS	☐ Installation of sufficient drainage facilities not to provide habitat for vector mosquito. ☐ Provision of adequate temporary sanitation facilities. ☐ Enforcement of medical screening and periodical medical check-up. ☐ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness of the labors and local inhabitants is promoted.	☐ Installation of sufficient drainage facilities not to provide habitat for vector mosquito. ☐ Implementation of periodical maintenance for drainages and bridges.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	28		☐ Implementation and follow relevant laws and regulations "Building And Other Construction Workers (Regulation of Employment and Conditions of Service) Act,1996" and "The building and other construction worker's welfare cess Act, 1996" and IFC Performance Standard 2 Labor and Working Conditions	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Other	29	Accident (Accident hazards and safety)	☐ Secure assistance from local police for traffic control during construction phase. ☐ Safety measures will also be undertaken by installing road signs and marking for safe and smooth movement of traffic. ☐ Setting up of appropriate detours. ☐ Restricting mobilization speed in the construction site. ☐ Installation of parking for idling construction machines. ☐ Installing gate structure at the entrance of the construction site to set up restricted area ☐ Deploying flagman at the gate and crossing points of the construction vehicles. ☐ Installing fence around the construction site to keep out local people such as children. ☐ Installation of lightning in the night time near construction area. ☐ Labourers will be equipped with proper safety gears like helmets gloves and gumboot. ☐ Periodic health check-up of construction worker. ☐ Safety training for the workers and safety patrol at the construction site by supervisors. ☐ Monthly safety meeting	☐ Implementation of advertisement for traffic safety campaign. ☐ Prepare and administer a monitoring system on road accidents. ☐ Installation of sign board and road making for speed limit. ☐ Enforcement of traffic controls by police.	Contractor (Construction Company) in consultation with Traffic Police Department	MMRDA
	30	Cross Boundary impacts and climate change	☐ Replanting mangrove and street trees same amount of cutting trees (Replanting of mangrove shall be done 5 times of cutting trees in CRZ as per specific condition on CRZ clearance)	☐ Maintenance of planted trees and mangroves through periodical inspection	MMRDA	MMRDA

Source: JICA Study Team

Additionally all committed specific conditions on CRZ clearance on 2013 will be conducted by MMRDA as shown in the next table.

Table 1.4.8 Mitigation Measures on CRZ Clearance for MTHL

No	Conditions	Response on Mitigation Measures
1	As per the CRZ notification, 2011, at least five times the number of mangroves destroyed/cut during the construction process shall be replanted. Mangrove plantation in an area of 30 ha shall be carried out as committed against loss of 0.1776 ha of mudflats/mangroves. Permission from the High Court of Bombay shall be obtained with respect to mangrove cutting.	MMRDA will replant 5 times of cutting mangrove in the appointed area by MoEF.
2	Proponent shall provide lighting in consulting in consulting with the Bombay Natural History Society so as to minimize the likely impacts to the migratory birds.	MMRDA will setup traffic light inside of bridge handrail especially in CRZ and flamingo roosting area.
3	All the construction equipment's shall be provided with exhaust silencers as committed.	Low noise construction machines and with exhaust silencer is installed during construction.
4	Noise containment barriers shall be provided on both sides of the bridge in mudflat areas (CRZ-IA) so as to minimize the likely impacts to the migratory birds.	Noise barrier is installed in CRZ and roosting /feeding are of migratory birds such as flamingo.
5	There shall be no dreading and reclamation for the project.	Dreading and reclamation is not planned on this project in the CRZ.
6	Pre-stressed super structure shall be used in the mud flat area for construction as committed.	Pre-stressed super structure will be used in the mud flat area CRZ.
7	The muck materials shall be analyzed prior to dumping / disposal in the identified locations with the approval of competent authority to ensure that it do not cause any impact to the environment.	The muck soil is generated from excavated points of piles. The excavated soil is analyzed and disposed at designated and authorized dumping site.
8	Proponent informed that there is no fishing activity in the area since it is a navigation channel for the nearby ports. However, navigation channel is provided with 25m for ships and 9.1 m for fishing boats.	Sufficient prescript vertical clearance under discussion with relevant authorities.
9	All the recommendations of the MCZMA shall be strictly compiled with.	All recommendation of the Maharashtra Coastal Zone Management Authority will be reflected to mitigation measures, if any.
10	There shall be no building construction beyond 20,000 sqm.	No building is planned in CRZ. Only toll gate is planned out of CRZ in Navi Mumbai side.
11	There shall be no water drawal in CRZ area.	No polluted water from project in CRZ. However storm water will be flow down from the road in monsoon season.
12	There shall be no disposal of solid or liquid wastes on coastal area. Solid waste Management shall be as per Municipal Solid (Management and Handling) Rules, 2000.	There is no activities to discharge and dispose solid and liquid waste from project activities in CRZ.
13	Sewage shall be treated and the Treatment Facility shall be provided in accordance with the Coastal Regulation Zone Notification, 2011. The disposal of treated water shall conform to the regulations of State Pollution Control Board.	Sewage including polluted water and night soil does not generate from project activities in CRZ.
14	The project proponent shall set up a separate environmental management cell for effective implementation of the stipulated environmental safeguard under the supervision of a Senior Executive.	MMRDA will setup environmental management cell for MTHLin MMRDA.
15	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	MMRDA will secure budge for MTHL.

Source: CRZ Environmental Clearance (MOEF 19th July 2913)

1.4.7 Environmental Monitoring Plan

Environmental Monitoring shall be done by the construction contractor under PW. The contractor shall conduct prescript monitoring and report to the construction supervision consultant monthly.

The expected environmental monitoring plans are shown below.

Table 1.4.9 Environmental Monitoring Plan Pre and During Construction Phase

Area	No.	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
Pollution	1	Air pollution	SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, Pb, CO, NH_3, C_6H_6, BaP, As, Ni, CH_4 and CO_2 (14 Items)	Same method as baseline survey Or Establis fixed monitoring station at 2 locations	**2 Locations** where baseline monitoring was carried out. (2 locations: Sewri and Shivaji Nagar)	**4 times / year x 4.5 years** (Once every quarter –Summer, Winter, post-monsoon) (24 hr/day for 2 consecutive working days per week for 2 weeks except CO which is 8 hr/day)	1800,000	National Ambient Air Quality Standards (NAAQS) by Central Pollution Control Board (CPCB) (Standard for 24hrs: Industrial and Residential/ Ecological Sensitive area) • SO_2: 80 / 80µg/m^3 • NO_2: 80 / 80µg/m^3 • PM_{10}: 100 / 100µg/m^3 • $PM_{2.5}$: 60 / 60µg/m^3 • O_3: 180 / 180µg/m^3 • Pb: 1.0 / 1.0µg/m^3 • CO: 0.4 / 0.4mg/m^3 • NH_3: 400 / 400µg/m^3 • C_6H_6: 0.5 / 0.5µg/$m^{3(anual)}$ • BaP: 0.1 / 0.1µg/$m^{3(anual)}$ • As: 0.6 / 0.6mg/$m^{3(anual)}$ • Ni: 20 / 20mg/$m^{3(anual)}$
	2	Water pollution	pH, BOD, DO, Turbidity and O&G	Same method as baseline survey	3 Locations Near excavated area in Zone II (Sewri mudflat), Zone III and Zone IV where baseline monitoring was carried out.	4 times / year x 4.5 years Once every quarter – Summer, Winter and post-monsoon	810,000	**Marine water quality Standards – Class SW-IV Harbour Waters (MPCB)** pH : 6.5-9 DO: 3 mg/l Turbidity: 30 NTU BOD: 5 mg/l O & G: 10 mg/l
	3	Waste	Volume of waste soil, cutting tree and domestic garbage	Record volume of generated waste	3 Locations (1. Sewri camp site 2. Mangrove cutting area 3. Navi Mumbai camp site))	4 times / year x 4.5 years	324,000	**Municipal Soild Waste Management Rules, 2013** Generated waste shall be reused or disposed at designated site. (The construction waste can be dumped in legally authorized dumping grounds in Navi Mumbai by CIDCO with association of Navi Mumbai Municipal Corporation (NMMC) which is located in Taloja. Remaining i.e. from Mumbai side, MMRDA can be taken care of and dumped the construction waste in association with Municipal

Area	No.	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
								Corporation of Greater Mumbai (MCGM) on authorised sites i.e. Deonar, Mulund and Gorai.
	4 And 8	Soil Contamination/sedimentation	Heavy Metals & Oil & Grease (5-10 items shall be selected from Soil pollution standards)	Same method as baseline survey	2 Locations 1. Excavated muck soil and 2. stocked soil in the yard from cutting area	1 times / year x 4.5 years	108,000	**Soil Pollution Standard in India (MOEF)** Cd: 0.01mg/l Lead: 0.01mg/l Chromium (VI): 0.05mg/l Arsenic: 0.01mg/l T-Mercury: 0.0005mg/l Copper: 125mg/kg (some items shall be selected from totally 25 standards items)
	5	Noise and vibration	Ambient and road side noise (dB(A)LAeq)	Same method as baseline survey (continuous 24 hrs)	3 Locations (1. Sewri, 2. ST migratory bird distribution area ST500-5500, 3. Shivaji Ngagar) Note) No2 and 3 locations where baseline monitoring was carried out.	2 times / year x 4.5 years	108,000	-Construction Noise; 85dB(A) -**Ambient Noise Standards in India (dB (A) Leq)** 1.Industrial Area Day Time: 75 (6-22hr) Night Time: 70 (22-6hr) 2.Commercial Area: Day Time: 65 (6-22hr) Night Time: 55 (22-6hr) 3.Residential Area: Day Time: 55 (6-22hr) Night Time: 45 (22-6hr) 4.Silence Zone Day Time: 50 (6-22hr) Night Time: 40 (22-6hr)
			Vibration (dB L10 or mm/sec)	Same method as baseline survey (continuous 24 hrs)	↑ ditto	2 times / year x 4.5 years	54,000	- Construction vibration 75dB -**Vibration Standards** roadside 1. Commercial /Industrial Area Day Time: 70 (7-20hr) Night Time: 65 (20-7hr) 2. Residential Area: Day Time: 65 (7-20hr) Night Time: 60 (20-7hr)
al Envir	9	Protected Area	1.Monitoring of mudflat conditions	Ocular inspection and	Along MTHL alignment and mangrove replant area	4 times / year x 4.5 years	6,480,000	Significant impacts are not caused by the project Note) Detailed monitoring plan will be setup during basic
	10	Ecosystem						

Area	No.	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
			including fauna-flora 2. Monitoring of Cutting Tree and replantation/ transplanting area 3.Monitoring of Mangrove Plantation area appointed by MoEF 4. Monitoring of sedimentation soil and ecological parameter (18items on main text Table 6.1.15 for soil and 7 items such as 1)Netprimary productive, 2)Chlorophyll-a, 3)Phosphate, 4)Nitrate, 5)Nitrite, 6)Particulate Organic Carbon, 7) SiO2)	quantitative survey 1-1. Fauna-Flora Line-Point census and record number and appeared species 1-2: Mangrove density and community survey 1-3: Benthos Survey 2-1: Cutting trees confirmation 3-1: Mangrove survey in the replanted area				design stage Standard for Soil; main text エラー! 参照元が見つかりません。 Standards for Ecological Parameter: • Netprimary Productivity <1,500 mgC/m3/day at surface • Chlorophyll-a:<4mg/m3 • Phosphate: 0.1-90µg/l • Nitrate: 1.0-500µg/l • Nitrite: <125µg/l • Particulate Organic Carbon: 10-100mg/m^3 • SiO2: 10-5,000µg/l
	11	Hydrology	Flooding situation	Flood level measurement during high precipitation	2 Locations (CRZ at Sewri and Shivaji Nagar)	4 times / year x 4.5 years	540,000	Project activities and structures does not cause flooding and impacts on tidal conditions

Area	No.	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
				periods				
	12	Topography and Geology	Conditions in embankment area	Visual survey about Stability of embankment	2 Locations (1. Embankment of Inter Change in Shibaji Nagar and 2 Cutting area at toll gate in Chirle)	4 times / year x 4.5 years	The cost is including with No 17 Land use	Embankment shall be stabilized without any landslide and cracks
Social Environment	13	Involuntary resettlement	Payment and implementation of social assistance in accordance with SIA	Consultation Meeting and/or Survey with the project affected persons (PAPs)	Affected area	Refer to SIA monitoring plan	Refer to SIA monitoring plan	Compensation shall be completed prior to actual construction activities and secure livelihood standards
	14	The poor						
	16	Local economy such as employment and livelihood						
	17	Land use and utilization of local resources	Situation of establishment of land use map	Confirmation of land use map	2 Locations (Sewri and Navi Mumbai side in the Affected area)	2 times / year x 4.5 years	180,000	Designated land use shall be secured without any unplanned development by local people and developers
	19	Existing social infrastructures and services	Condition of facilities to be displaced	Ocular inspection	Affected area	Refer to SIA monitoring plan	Refer to SIA monitoring plan	Compensation shall be completed prior to actual construction activities and secure livelihood standards
	22	Local conflict of interests	Construction worker's township	Confirmation of workers list from contractor	2 Locations (camp site in Sewri and Shivaji Nagar)	4 times / year x 4.5 years	180,000	Employment opportunity shall be provided fairly
	24	Landscape	Condition of landscape	Visual inspection	1 Location (View from Sewri Fort)	1 time / year x 4.5 year (Dry season)	22,500	Color of structure shall be adopted monotone color harmonized with surrounding landscape
	27	Infectious diseases such as HIV/AIDS	Number of infected patient	Confirmation of health check list from contractor	2 Locations (camp site in Sewri and Shivaji Nagar)	4 times / year x 4.5 years	180,000	Infection disease rate shall not be caused by the project
	28	Labour	Construction	Confirmation	2 Location	2 times / year x 4.5 years	90,000	"Building And Other Construction Workers (Regulation of

Area	No.	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
		Environment	worker's condition	of safety devices and conditions via interviews	(camp site in Sewri and Shivaji Nagar)			Emloyment and Conditions of Service) Act,1996", "The building and other construction worker's welfare cess Act, 1996" and international standards such as "IFC Performance Standard 2 Labor and Working Conditions"
Other	29	Accident	Number of accidents	Confirmation of accidents list from local government and State Traffic Police Department	2 Locations (camp site in Sewri and Shivaji Nagar)	4 times / year x 4.5 years	180,000	Any accidents are not caused by construction
	30	Cross Boundary impacts and climate change	Monitoring of replanting and transplanting trees and mangrove	Refer to No.9 and 10				
Total Cost during Construction : *8,140,500 INR* for 4.5 years (during construction)								

Source: JICA Study Team

Environmental monitoring survey plan for operation phase is proposed as follows. Proposed monitoring period is at least three (3) years.

Table 1.4.10 Environmental Monitoring Plan during Operation Phase

Area	No	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
Pollution	1	Air pollution	SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, Pb, CO, NH_3, C_6H_6, BaP, As, Ni, CH_4 and CO_2 (14 Items)	Same method as baseline survey Or Establis fixed monitoring station at 2 locations	**2 Locations** (1. Embankment of Inter Change in Shibaji Nagar and 2 Cutting area at toll gate in Chirle)	**2 times / year x 3 years** (Once every quarter –Summer, Winter, post-monsoon) (24 hr/day for 2 consecutive working days per week for 2 weeks except CO which is 8 hr/day)	600,000	National Ambient Air Quality Standards (NAAQS) by Central Pollution Control Board (CPCB) (Standard for 24hrs: Industrial and Residential/ Ecological Sensitive area) • SO_2: 80 / 80μg/m^3 • NO_2: 80 / 80μg/m^3 • PM_{10}: 100 / 100μg/m^3 • $PM_{2.5}$: 60 / 60μg/m^3 • O_3: 180 / 180μg/m^3 • Pb: 1.0 / 1.0μg/m^3 • CO: 0.4 / 0.4mg/m^3 • NH_3: 400 / 400μg/m^3 • C_6H_6: 0.5 / 0.5μg/$m^{3(anual)}$ • BaP: 0.1 / 0.1μg/$m^{3(anual)}$ • As: 0.6 / 0.6mg/$m^{3(anual)}$ • Ni: 20 / 20mg/$m^{3(anual)}$
	2	Water pollution	pH, BOD, DO, Turbidity and O&G	Same method as baseline survey	3 Locations Zone II (Sewri mudflat), Zone III and Zone IV where baseline monitoring was carried out.	4 times / year x 3 years Once every quarter – Summer, Winter and post-monsoon	540,000	Marine water quality Standards – Class SW-IV Harbour Waters (MPCB) pH : 6.5-9 DO: 3 mg/l Turbidity: 30 NTU BOD: 5 mg/l O & G: 10 mg/l
	4 & 8	Soil Contamination/ sedimentation	Heavy Metals & Oil & Grease (5-10 items shall be selected from Soil pollution standards)	Same method as baseline survey	3 Locations (Zone II, III and III)	1 time / year x 3 years	108,000	Soil Pollution Standard in India (MOEF) Cd: 0.01mg/l Lead: 0.01mg/l Chromium (VI): 0.05mg/l Arsenic: 0.01mg/l T-Mercury: 0.0005mg/l Copper: 125mg/kg (some items shall be selected from totally 25 standards

Area	No	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
								items)
	5	Noise and vibration	Ambient and road side noise (dB(A)LAeq)	Same method as baseline survey	2 Locations Sewri and Shivaji Nagar where baseline monitoring was carried out.	2 times / year x 3 years	48,000	Ambient Noise Standards in India (dB (A) Leq) 1.Industrial Area Day Time: 75 (6-22hr) Night Time: 70 (22-6hr) 2.Commercial Area: Day Time: 65 (6-22hr) Night Time: 55 (22-6hr) 3.Residential Area: Day Time: 55 (6-22hr) Night Time: 45 (22-6hr) 4.Silence Zone Day Time: 50 (6-22hr) Night Time: 40 (22-6hr) Vibration Standards (refer to Japanese standards along the road) 1. Commercial /Industrial Area Day Time: 70 (7-20hr) Night Time: 65 (20-7hr) 2. Residential Area: Day Time: 65 (7-20hr) Night Time: 60 (20-7hr)
			Vibration (dB L10 or mm/sec)	Same method as baseline survey		2 times / year x 3 years	24,000	
Natural Environment	9 & 10	Protected Area / Ecosystem	1.Monitoring of mudflat conditions including fauna-flora 2. Monitoring of Cutting Tree and replantation/ transplanting area 3.Monitoring of Mangrove Plantation area appointed by	Ocular inspection and quantitative survey 1-1. Fauna-Flora Line-Point census and record number and appeared species 1-2:	Along MTHL alignment and mangrove replant area	**2 times / year x 3 years**	2,160,000	Significant impacts are not caused by the project **Note) Detailed monitoring plan will be setup during basic design stage** Standard for Soil; main text エラー! 参照元が見つかりません。 Sandar for Ecological Parameter: • Netprimary Productivity <1,500 mgC/m3/day at surface • Chlorophyll-a: <4mg/m3 • Phosphate: 0.1-90µg/l • Nitrate: 1.0-500µg/l • Nitrite: <125µg/l • Particulate Organic Carbon: 10-100mg/m^3

Area	No	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
			MoEF 4. Monitoring of sedimentation soil and ecological parameter (18items on main text エラー! 参照元が見つかりません。 for soil and 7 items such as 1)Netprimary productivitye, 2)Chlorophyll-a, 3)Phosphate, 4)Nitrate, 5)Nitrite, 6)Particulate Organic Carbon, 7) SiO_2)	Mangrove density and community survey 1-3: Benthos Survey 2-1: Cutting trees confirmation 3-1: Mangrove survey in the replanted area				• SiO2: 10-5,000µg/l
	11	Hydrology	Flooding situation	Flood level measurement during high precipitation periods	2 Locations (CRZ at Sewri and Shivaji Nagar)	4 times / year x 3 years	360,000	Project activities and structures does not cause flooding and impacts on tidal conditions
	12	Topography and Geology	Conditions in embankment area	Visual survey about Stability of embankment	2 Locations (1. Embankment of Inter Change in Shibaji Nagar and 2 Cutting area at toll gate in Chirle)	2 times / year x 3 years	Refer to item No17	Embankment shall be stabilized without any landslide and cracks
Environ	13	Involuntary resettlement	Payment and implementation	Consultation Meeting	Affected area	Refer to SIA Monitoring plan	Refer to SIA monitoring	Compensation shall be completed prior to actual construction activities and secure livelihood standards

Area	No	Item (on Rapid EIA 2012)	Parameter	Method	Location	Frequency a year	Cost (INR)	Standard
	14	The poor	of social assistance in accordance with SIA	and/or Survey with the project affected persons (PAPs)			plan	
	16	Local economy such as employment and livelihood						
	17	Land use and utilization of local resources	Situation of establishment of land use map	Confirmation of land use map	2 Locations (Sewri and Navi Mumbai side in the Affected area)	2 times / year x 3 years	60,000	Designated land use shall be secured without any unplanned development by local people and developers
	24	Landscape	Condition of landscape	Visual inspection	1 Location (View from Sewri Fort)	1 time / year x 3 year (Dry season)	15,000	Color of structure shall be adopted monotone color harmonized with surrounding landscape
Other	29	Accident	Number of traffic accidents	Confirmation of accidents list from local government and State Traffic Police Department	On Mumbai Trans Harbour Link	2 times / year x 3 years	30,000	Any accidents are not caused by construction
	30	Cross Boundary impacts and climate change	Monitoring of replanting and transplanting trees and mangrove	Refer to No.9 and 10				
Total Cost: *3,945,000* INR for 3 years (after construction)								

Source: JICA Study Team

1.4.8 Monitoring Organization

The objectives and design of the EMP and Environmental Monitoring Plan was described in earlier sections of this chapter. There is a necessity to form a proper 'Institutional Framework' for the effective implementation of the formulated environmental management & monitoring plan. The elements of this 'Institutional Framework' will co-ordinate and work with each other throughout the project, i.e. during pre-construction, construction & operation stage. The implementation of formulated environmental mitigation measures comes with a cost so the budgeting of EMP is necessary and also the financial source that will provide this budget, are discussed in this section.

The suggested elements of 'Institutional Framework' for implementing EMP of MTHL project will be as follows:

a) MMRDA - Project Implementing Agency (PIA) and Environmental Cell
b) Financial Source – JICA & MMRDA
c) Project Contractor – Construction Company (PC)
d) General Consultant
   - Project Management Consultant (PMC)
   - Environmental Consultant (EC)
e) Environmental Authorized Agency - Statutory Bodies (Authorities)
   - Maharashtra State Pollution Control Board (MPCB)
   - MoEF

The Environmental Authorized Agency will not be a direct part of 'Institutional framework' but it will hold controlling authorities on it. It will review and approve the reports submitted by the PIA and can take necessary further actions, if any.

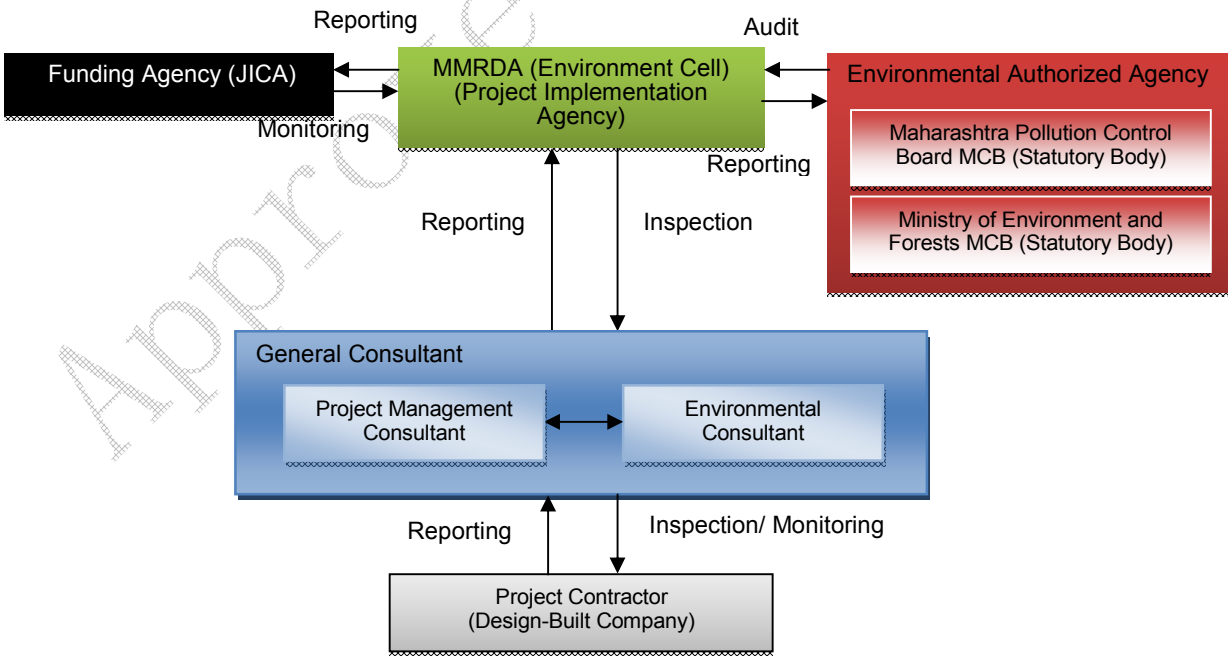
The above stated elements are part of the 'Institutional Framework' who will work together to effectively implement the formulated 'Environmental Management Plan'. The roles & responsibilities of these elements are given in Table 1.4.10 Roles & Responsibilities of Institutional Framework.

Table 1.4.11 Environmental Management and Monitoring Organization

Stage	Name of Organization	Roles and Responsibilities
Pre- Construction & Construction	Project Implementing Agency and Environmental cell - PIA	
	MMRDA	Initiate the co-ordinate process among the concerned organizations (Elements of Institutional Framework) for EMP implementation. Overseeing the implementation of the EMP by the PMC Approval of '6 monthly - Environmental Compliance Report' submitted by the EC and respond necessary action. After Approval sending the report to the MPCB. Finalization of the SIA during detailed design. Facilitate relocation of people & monitoring actual payments of compensation to affected stakeholders such as landowners, Structure owners etc.
	General Consultant	
	Project Management	PIA will get the EMP implanted through PMC.

Stage	Name of Organization	Roles and Responsibilities
	Consultant (PMC)	PMC will work in association with Project Contractor (Construction Company) & the Environmental Consultant (EC) on a full time basis at the project site office. PMC will mainly look after managing engineering & construction related activities.
	Environmental Consultant (EC)	EC will look after implementation of approved environment measures on site. EC will be in constant touch with PMC & Project Contractor. EC will facilitate PIA to obtain mandatory 'Consent to Establish' certificate from Maharashtra State Pollution Control Board (MPCB) before start of the Construction on site. EC will get the 6 monthly environmental monitoring done from the MoEF approved laboratory. EC will prepare an 'Environmental Compliance Report (ECR)' describing Status of approved Environmental Mitigation measures on site (submitted by PC) and Monitoring of Environmental Attributes (submitted by MoEF Approved Laboratory) on a six monthly basis and will submit it to the PIA for their approval. PIA will then submit the approved ECR to the MPCB.
	Project Contractor - PC	
	Construction Company	PC will implement approved EMP (mitigation measures) as directed by PMC & Environmental Consultant. The PC will submit the report for all conducted mitigation measures on site to the EC on a six monthly basis.
Operation (Twice in a year x 3 years)	Project Implementing Agency – PIA	
	MMRDA	PIA will oversee the compliance status of all environmental measures through their appointed consultants.
	Appointed Consultant by MMRDA	Periodical inspection & maintenance of the MTHL. EC will facilitate PIA to obtain mandatory 'Consent to Operate' certificate from Maharashtra State Pollution Control Board (MPCB) before start of operation of the project. EC will prepare annual 'Environmental Statement (Form V)' as mandated in CRZ clearance and submit to PIA for their approval. PIA after reviewing the same will submit to the MPCB.

Source: JICA Study Team



Source: JICA Study Team

Figure 1.4.1 Proposed Environmental Management and Monitoring Implementation Organization

All cost for environmental management plan such as mitigation measures are including in the physical contingency of project construction cost. On the other hands, cost for project management such as Environmental Cell in MMRDA will be secured on MMRDA annual budget.

1.5 Stakeholder Meeting

1.5.1 Objectives of the Meeting

It is mandatory to conduct local level stakeholder meeting twice for this EIA based on draft EIA process as per JICA Guidelines for Environmental and Social Consideration (2010).

Main objectives for holding local stakeholder meeting are shown below;

- ✓ To make aware stakeholders about the proposed MTHL project and project related proposed actions both before and after development decisions are made.
- ✓ To understand the concerns of local project affected people and others who have plausible stake in the environmental impacts of the project.
- ✓ To inform stakeholders about the environmental and social adverse and positive impacts of the project.
- ✓ To exchange opinions regarding project and environmental issues.
- ✓ To minimize probable adverse impacts of the project and to achieve speedy implementation of the project through bringing in awareness among the stakeholders about the benefits of the project.

1.5.2 Schedule of the meeting

Following local stakeholder meetings were conducted in July & August-September 2015. A schedule and agenda for stakeholder meetings are shown below;
And major opinions exchanged with participants are shown in main text of this report.

Table 1.5.1 Schedule Stakeholder Meetings on EIA and SIA

Date & Venue	Objectives of the meeting	Major Agenda	Participants
7th July, 2015 Shakha office, Near Shri Krishna Hindu Hotel, Sewri Gadi Adda, Haji-bundar road, Sewri (E), Mumbai - 400 015	To discuss the social impacts of the project with the key Stakeholders (Project affected people)	Project outline, necessity of social survey and survey items, basic compensation policy and declaration of cut off data	MMRDA JICA Team Project Affected Persons
29th July, 2015 Committee Room, 6th Floor, MMRDA Office, B.K.C, Mumbai	To inform stakeholders about the proposed MTHL project & Explanation of draft modified Rapid EIA and	Project outline, Benefits of the project, Predicted environmental impacts, practical mitigation measures, monitoring plan	MMRDA JICA Team Relevant local government (CIDCO, MPT & JNPT, ASI, NEERI)

Date & Venue	Objectives of the meeting	Major Agenda	Participants
	formulation of basic consensus	and project schedule	Project affected persons Experts from various fields as per JICA requirement
25th August (SIA 2nd PC) Sewri Koli Samaj Hall, 22/1 Koli Samaj Co.Op.Society, Sewri, Koliwada (E), Mumbai - 400015	To intimate to the stakeholders about the result of BSES and Resettlement & Rehabilitation Policy of MTHL.	Background, 1st SIA Stakeholder meeting (SSM), Result of BSES, Resettlement & Rehabilitation Policy of MTHL, Resettlement Site, Requesting opinions from PAPs.	MMRDA JICA Team Project Affected Persons
15th September, 2015 Sewri Koli Samaj Hall, 22/1 Koli Samaj Co.Op.Society, Sewri, Koliwada (E), Mumbai - 400015	To inform/communicate to the stakeholders and public at large about the findings of the draft supplemental EIA. To discuss about the mitigation measures as suggested in the draft EIA.	Opening Remarks, Project in Brief, Objectives & schedule of public consultation meetings, details of first public consultation of EIA, result of reformed studies, Environmental Management Plan, Environment Monitoring Plan, Project Implementation Schedule, Exchange Opinions, Remarks	MMRDA Team JICA Team Relevant local government (CIDCO, MPT & JNPT) Experts from various fields as per JICA requirement NGOs Project affected persons

Source: JICA Study Team

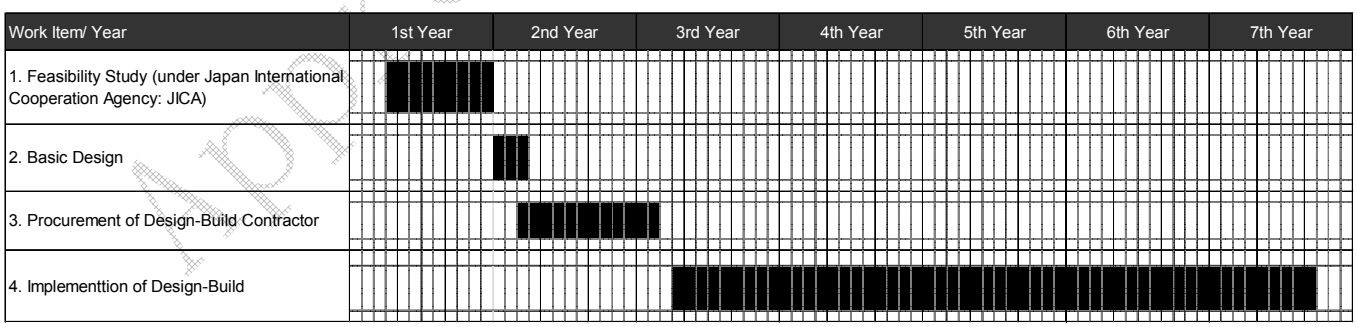
1.6 Schedule for the Project Process

It is expected that “the design-build system” is adopted from the view of saving cost and time for this project after feasibility study and basic study.

Almost 1 year is required for bidding and selection of contractor, and 4.5 years are necessary for detailed design and construction period.

The tentative construction schedule is shown as of March 2015 is given in Table 1.6.1.

Table 1.6.1 Construction Schedule (as of Sep, 2015)



Source: JICA Study Team

Main Text

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CHAPTER 1 PROJECT BACKGROUND

1.1. Preface

Mumbai's peculiar geographical spread imposes constraints on expansion; its great job potential has nevertheless attracted migrants from many parts of the country. The result has been severe housing shortages, lack of open spaces and civic amenities and transport bottlenecks. As per the 2011 census, the population of Mumbai is 12.25 Million.

The port, market, industries, offices and above all increasing population has considerably overloaded the rail and road transportation infrastructure of the city, causing innumerable commuting hardships as well as severe strain on the city's civic services resulting in extremely poor living conditions for the majority of residents.

The northern & north eastern parts of Greater Mumbai are likely to be saturated in the near future. In that event, the only location for expansion (apart from Navi Mumbai) will be in areas to the north of Greater Mumbai up to Virar at the northern limit of the Mumbai Metropolitan Region. This northwards expansion however is aggravating problems of its own. With the augmentation of the north-south commuter movement it would not only keep increasing commuting time to the heart of the island city but also traffic congestion on the transport network.

The pressure on the rail and road network can be relieved only by redirecting part of the movement into an east-west (towards Navi Mumbai) orientation. Having known the geography of the city, this can only be achieved by taking positive steps to encourage the development of residential areas on the mainland on the coast.

1.2. Need of the Project

The need for the project arises from the undisputed fact that Greater Mumbai is already overcrowded and congested. The only solution to prevent the existing conditions from worsening is to expand on to the mainland, which to a limited extent, has already occurred in the northern half of Navi Mumbai. This is however, insufficient, and a major push to the development of the rest of Navi Mumbai can be given only by providing quick access to the southern half of Navi Mumbai.

The southern half of Navi Mumbai is having 2,500 hectares of land for housing, which will benefit most in terms of commuting time by the construction of the Link between mainland and south of Mumbai. When completed, MTHL will reduce the distance between the island and the mainland by 17km viz-a-viz the existing road link and will help save approximately an hour in travel time. Moreover, the MTHL is going to be main connectivity between Mumbai and the proposed International Airport at Navi Mumbai. In addition to the MTHL, the proposed Coastal Road in Mumbai is likely to resolve the traffic congestion for the islanders.

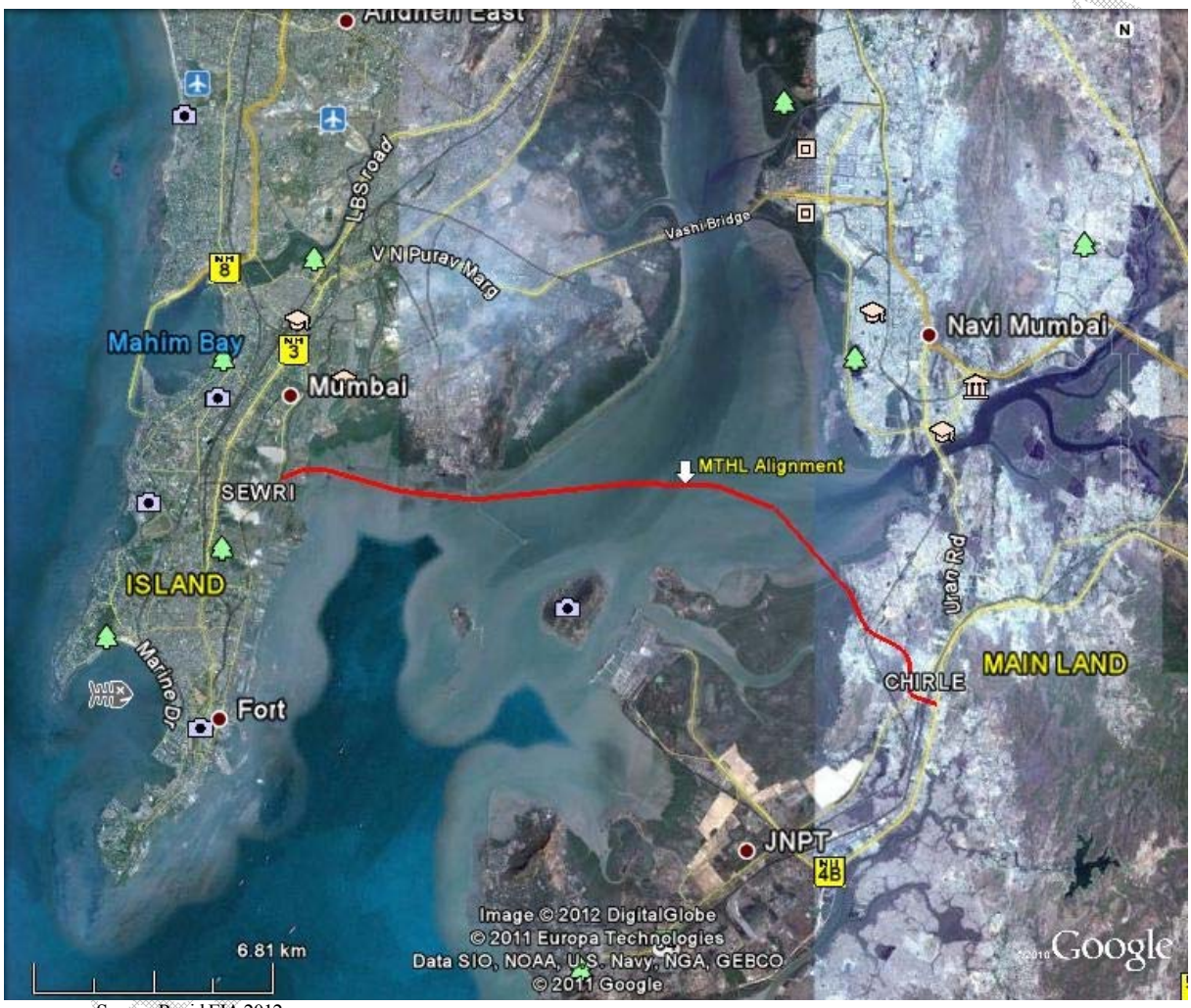
At present, there are two road links connecting Mumbai to Navi Mumbai:

- ✓ The Thane Creek Bridge
- ✓ Airoli Bridge

Both these links together are near saturation and are not equipped to meet the combined future projected traffic, thereby necessitating creation of additional links to meet traffic growth. In this context, the proposed Mumbai Trans Harbour Link has become a necessity for the state government.

The proposed Mumbai Trans Harbour Link will, therefore, serve not only as an economic gateway to Navi Mumbai but also a panacea for the problems being faced by Mumbai. The link would also further strengthen the economic integration of island of Mumbai and the mainland. Navi Mumbai would therefore emerge as a vibrant satellite city to Mumbai in the same way as Gurgaon and Noida have emerged as satellites to New Delhi.

From this perspective, the MTHL project will not merely provide the most efficient solution to Mumbai's acute accommodation problem, but will provide the most viable solution open to the city for its survival. The location of the MTHL alignment is shown in Figure 1.2.1



Source: Rapid EIA 2012

Figure 1.2.1 Project Location Map

1.3. Need and Objective of EIA study

The necessity of environmental impact assessment is stipulated on the Environmental Protection Law in 1986, and concrete rules are described on the Environmental Impact Assessment Notification in 2006 (EIA Notification). According to the notification, prescript projects are required to obtain an Environmental Clearance before implementation of the actual construction.

Category A projects in accordance with EIA notification are required to obtain the Environmental Clearance from Ministry of Environment and Forests (MOEF) of the central

government, on the other hand, Category B project shall have the clearance from State Government.

Since the mandatory projects which require environmental clearance in road sector prescript only National and State Highway, MTHL is not required to conduct comprehensive EIA because this road is city road, neither national highway nor state highway.

However MMRDA has prepared Rapid EIA 2012 based on Comprehensive EIA 2005 prepared by MSRDC for obtaining a CRZ Clearance in accordance with CRZ (Coastal Regulation Zone) Notification 2011. This Rapid EIA 2012 has been approved and issued CRZ Clearance in July 2013 by MOEF (Ministry of Environment and Forests). The matter subsequently was challenged in the National green tribunal and the Tribunal has suspended the clearance for 6 months. MMRDA has approached the MCZMA for fresh clearance and the appraisal has been carried out by MCZMA with minor changes in the Rapid EIA 2012.

In 2015, JICA (Japan International Cooperation Agency) is supporting of implementation of feasibility study. MTHL project is classified as Category A which requires full-scale EIA in accordance with JICA Guidelines for Environmental and Social Considerations (2010), thus MMRDA in association with JICA carries out EIA base on approved Rapid EIA 2012 in this feasibility study.

History regarding environmental and social considerations is shown below;

Table 1.3.1 History of Environment and Social Considerations on MTHL

Year	Item	Remarks
1984	MTHL alignment was scrutinized and affirmed by an Expert Committee constituted by Prime Minister's Office.	-
1999/April and December	Public Hearing for MTHL was conducted and used as a base for Comprehensive EIA 2005	Based on EIA Notification 1994
2005/ March 11	Comprehensive EIA has approved by MOEF CRZ Clearance was issued	Based on EIA Notification 1994 and CRZ Notification 1991
2013 July 19	Rapid EIA has been approved by MOEF CRZ Clearance was issued (with 5 years validity)	Based on EIA Notification 2006 and CRZ Notification 2011
2015	Preparation of Supplemental EIA based on Rapid EIA 2012 approved by MOEF	Based on JICA Guidelines for Environmental and Social Considerations (2010)

1.4. Purpose of Study

The purpose of modification Rapid EIA (REIA) study is to adjust with requirements on JICA Guidelines for Environmental and Social Considerations 2010, and to ensure that the project option under consideration is environmentally sustainable and sound. EIA identifies ways and means for improving the project environmentally friendly by preventing, minimizing, mitigating or compensating for adverse impact, so as to achieve a sustainable development.

1.5. Project Benefits

MTHL will directly and indirectly lead to the betterment of MMR, both from an economic and social perspective.

(1) Direct Benefits from MTHL

- ✓ Savings in travel times for commuters.
- ✓ Improved comfort and accessibility between the island and the mainland.
- ✓ Reduced operating costs of vehicles due to lesser congestion.

- ✓ Accelerated growth of Navi Mumbai.
- ✓ Smooth traffic flow from Navi Mumbai airport to Mumbai Island.
- ✓ Decrease generation of greenhouse gases such as CO2

(2) Indirect Benefits from MTHL

- ✓ Rationalization of real estate prices in Greater Mumbai
- ✓ Increased demand for land in Navi Mumbai and consequent improvement of land prices.
- ✓ Accelerated economic development of Navi Mumbai and nearby regions
- ✓ Greater economic integration of Mumbai island with Navi Mumbai and extended regions of Pune, Goa, Panvel and Alibaug
- ✓ Decongestion of Mumbai Island and dispersal of population to Navi Mumbai region and beyond
- ✓ Environmental improvement and reduced pollution levels
- ✓ Improved safety due to reduction in accidents
- ✓ Improvement in trade and trade competitiveness through faster and improved logistics
- ✓ Facilitation for Coastal Road.

The proposed Mumbai Trans Harbour Link will therefore serve not only as an economic gateway to Navi Mumbai but also a panacea for the problems being faced by Mumbai. The link would also further strengthen the economic integration of Mumbai Island and Mainland Mumbai.

Navi Mumbai would therefore emerge as a vibrant satellite city to Mumbai in the same way as Gurgaon and Noida have emerged as satellites to New Delhi. Both Thane Creek Bridge and Airoli Bridge are near saturation, thereby necessitating creation of additional links to meet traffic growth. In this context, the proposed Mumbai Trans Harbour Link has become a necessity for the state government.

A number of developmental initiatives have been proposed in the Navi Mumbai region that will not only give rise to additional traffic movement, but also accentuate the need for greater economic integration of Mumbai Island with Mainland Mumbai. Some of the key infrastructures facilities proposed and / or already developed include:

- ✓ Navi Mumbai Integrated Special Economic Zone (SEZ)
- ✓ International airport at Navi Mumbai
- ✓ New container terminals at Jawaharlal Nehru Port Trust at Nhava Sheva
- ✓ Thane Vashi, Thane-Nerul and Nerul-Uran Rail link
- ✓ CBD – Taloja-Khandeshwar-ring metro
- ✓ Trans Thane Creek Industrial Area

Navi Mumbai is also well connected through rail and road links with Pune, Nasik and Thane, indicating the potential for the region to develop into a satellite city.

In this context, the proposed Mumbai Trans Harbour Link (MTHL) connecting Sewri to Nhava Sheva is expected to be a key driver in the development of the city by promoting horizontal growth as against vertical growth that has been experienced over the past few years. The link would help reduce the problems of congestion and pollution in Mumbai Island.

1.6. Structure of the Report

The structure of the report is as follows:

Executive Summary
Chapter 1 Project Background
Chapter 2 Project Description

CHAPTER 2 PROJECT DESCRIPTION

2.1. Project Description

The outline of the Mumbai Trans Harbor Link (MTHL) project is given in Table 2.1.1.

Table 2.1.1 Project Outline

Item	Description	Remarks
Project Name	Construction of Mumbai Trans Harbour Link	The project was approved by a technical committee constituted by the PMO
Type of construction Structure	Road Type: Sea link under MMRDA (City Road under Mumbai City) Type of Structure : Mainly viaduct road and bridge Length: 21.85 km (App.16 km bridge on the sea) Number of lanes: 6 lanes	-
Location	Starting point(Western side): Sewri in Mumbai City End Point: Chirle area in Raigad District	-
Road width and Right of Way	Road width (typical cross section) : app. 25m Secured Right of Way (Navi Mumbai side): app. 120m	-

Source: JICA Study Team

The Mumbai Trans Harbor Link (MTHL) project's recommended alignment is given in Table 2.1.2.

Table 2.1.2 Elements of the Recommended Alignment

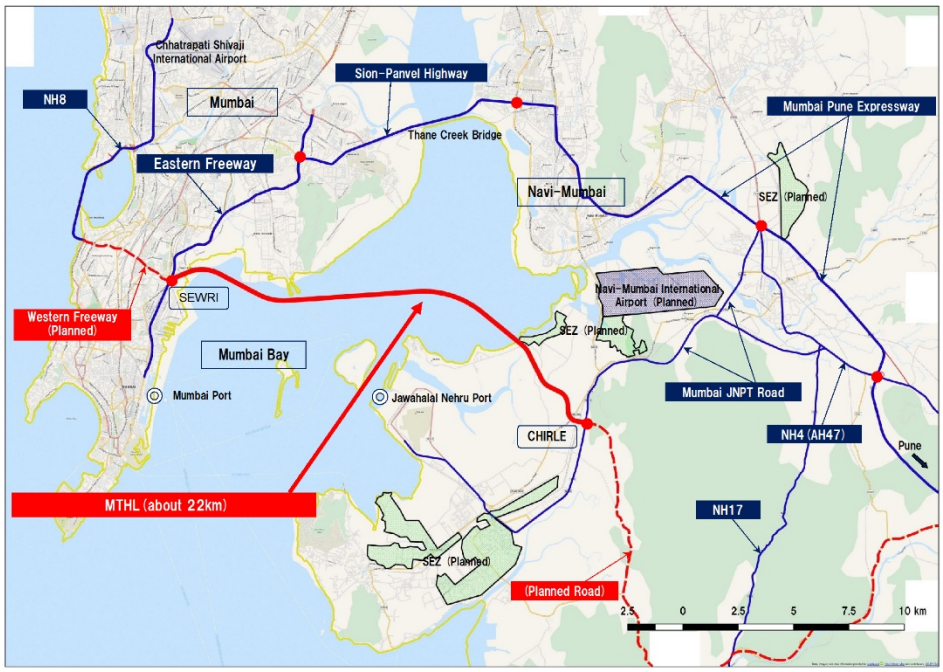
Approaches at Sewri : Approach Ramps to MTHL and connection to Messant Road & local network	0.72 km
Main Structures :	
Viaduct across Sewri Intertidal zone	4.650 km
Bridge across Pier Pau Jetty	0.740 km
Viaduct up to Central Channel (Thane Creek)	2.550 km
Bridge across Central Channel (Thane Creek)	0.540 km
Viaduct up to ONG Pipelines	2.650 km
Bridge across ONG Pipelines I	0.270 km
Viaduct between ONG Pipelines	0.650 km
Bridge across ONG Pipelines II	0.430 km
Viaduct up to Panvel Creek	1.600 km
Bridge across Panvel Creek	0.320 km
Viaduct across Nhava Intertidal zone	3.000 km
Road on Embankment up to Interchange at Chirle	3.730 km
Total Length	**21.85 km**

Source: Rapid EIA 2012

In this EIA, natural, social and pollution items on construction of "MTHL" project are discussed and concluded from the view of environmental and social considerations.

2.2. Project Location

The project location Google map is shown in Figure 2.2.1 and the recommended alignment of MTHL is shown in Figure 2.2.2.



Source: JICA Study Team

Figure 2.2.1 Project Location Map

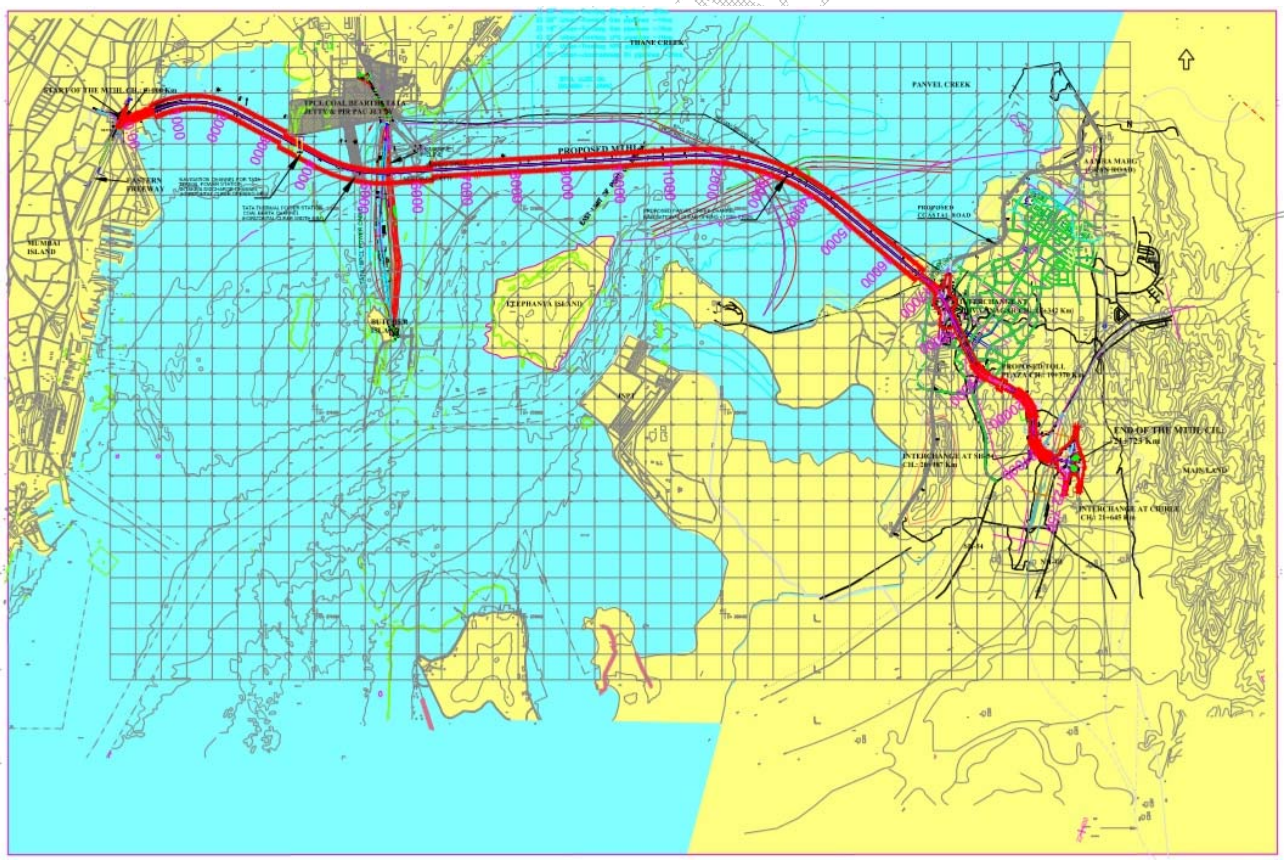
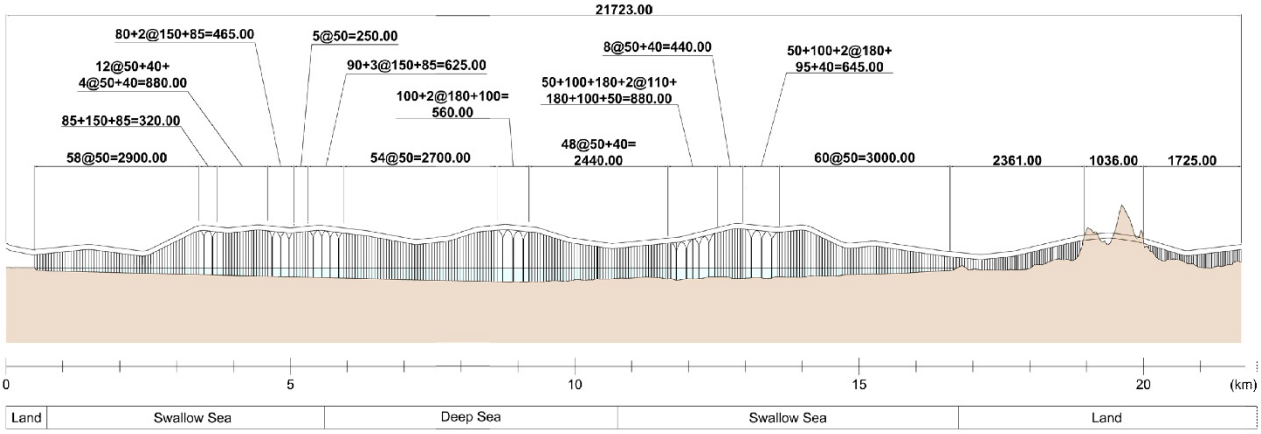


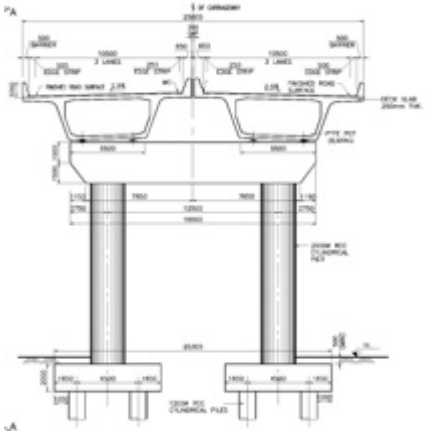
Figure 2.2.2 Detailed Alignment of MTHL

2.3. Structural Details of the Bridge and Road

The typical structure and cross-section of the bridge and road is shown in Figure 2.3.1 below:



Land section



Sea section

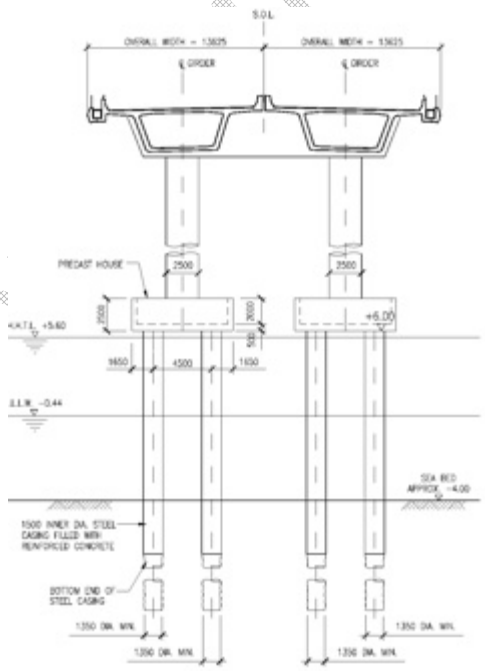


Figure 2.3.1 Typical Structure of the Bridge and Road

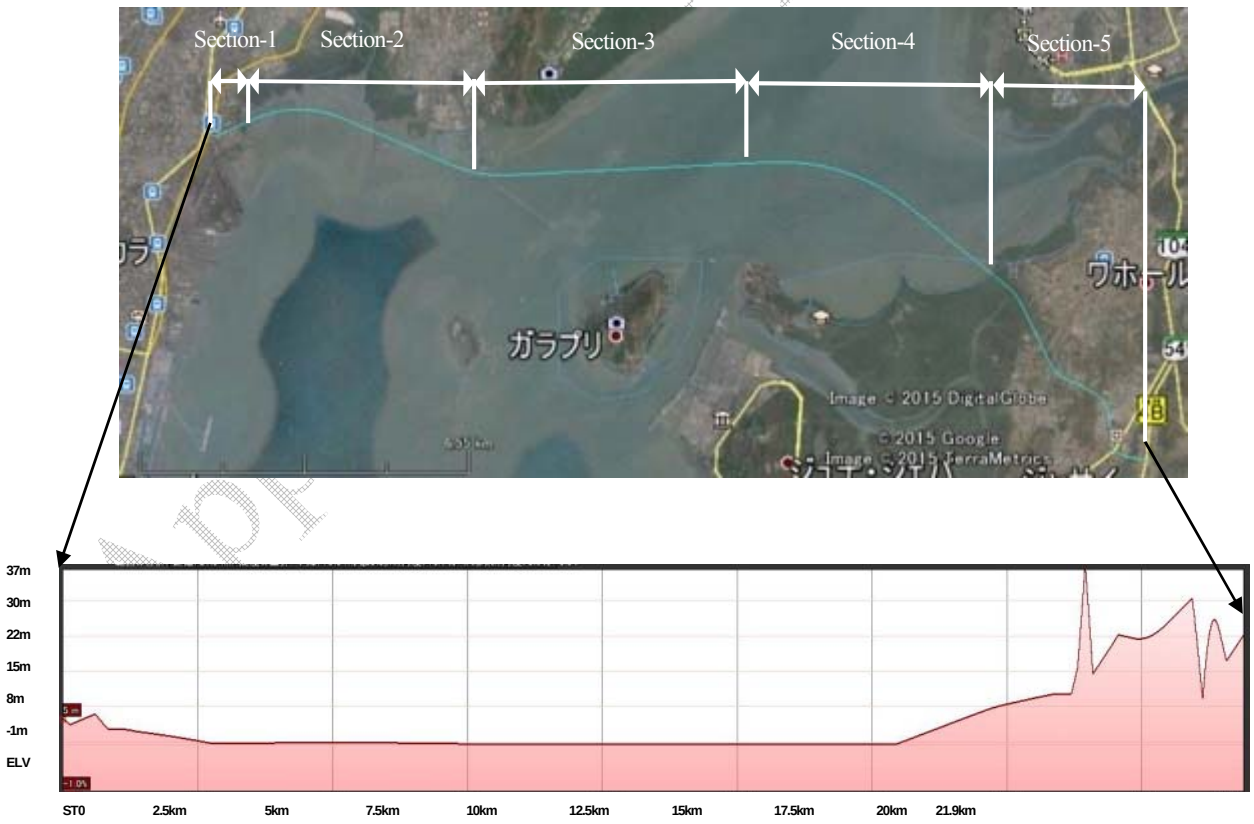
CHAPTER 3 CURRENT NATURAL AND SOCIAL ENVIRONMENT CONDITIONS

3.1. Topography, Geography and Hydrology

The elevation form the sea level is around 5 m from ST 0km Sewri side in Mumbai to ST 16km at the east side Navi Mumbai, and then the elevation increase up to approximately 40m gradually at the end point Chirle area. The area is classified in 5 sections based on topographic feature on site.

Table 3.1.1 Topography Features by Section

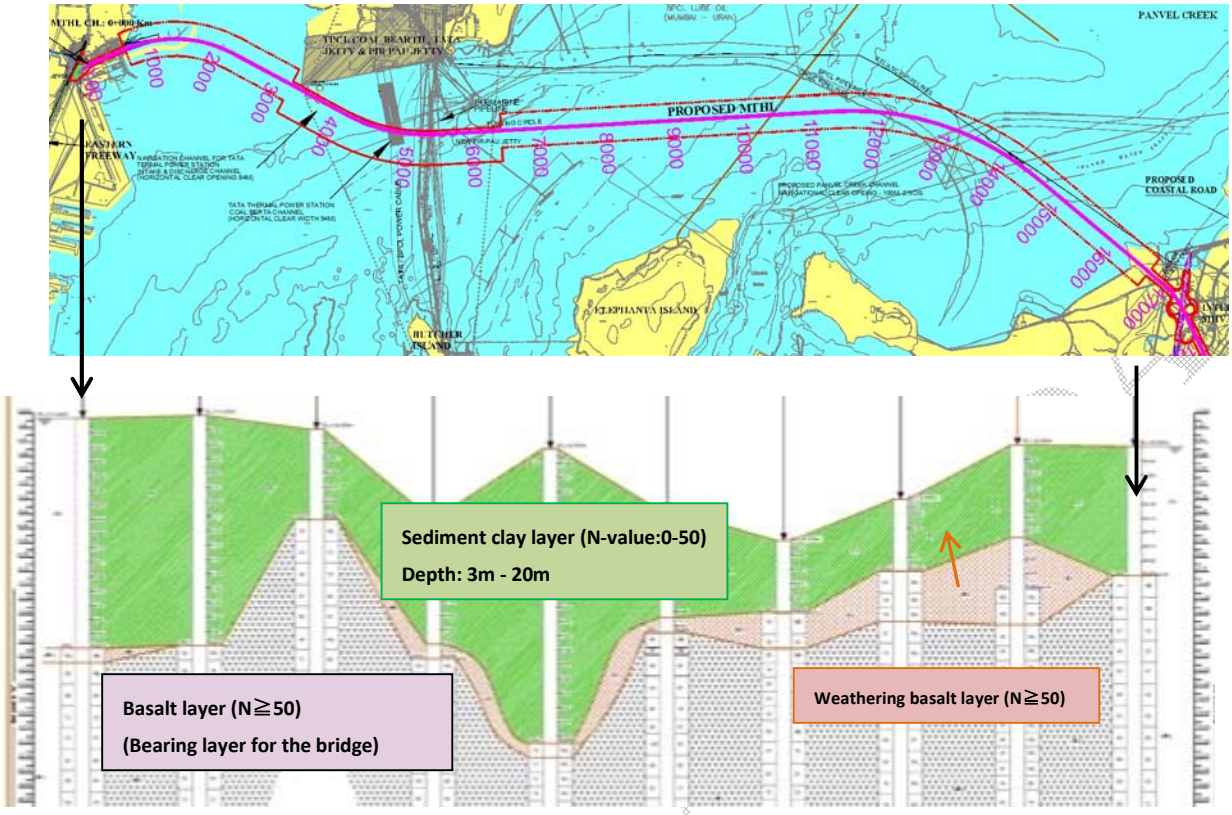
Section	Topographic Classification	Depth of the Sea	Topographic Feature
Section-1 (ST 0 - 0.72km)	Land (Partially Tidal Area)	-	Flat
Section-2 (ST 0.72 - 5.60km)	Tidal area	0.0m～3.0m	Flat (Partially mangrove area)
Section-3 (ST 5.60 - 10.75km)	Sea area	4.5m～7.0m	Most deepest area in the sea (passing some wharfs)
Section-4 (ST 10.75 - 16.75km)	Sea area (Partially Tidal Area)	0.0m～4.0m	Flat (Partially mangrove area)
Section-5 (ST 16.75 - 21.84km)	Land	-	Hill and rock mountainous area (basaltic layer)



Source: JICA Study Team

Figure 3.1.1 Topographic and Hydrological Feature

With regard to geographic feature, a sediment clay layer with 3 to 20 m depth on the basalt layer is located in the sea section in Sewri and the sea section. The basalt layer is exposed in the Navi Mumbai Section.



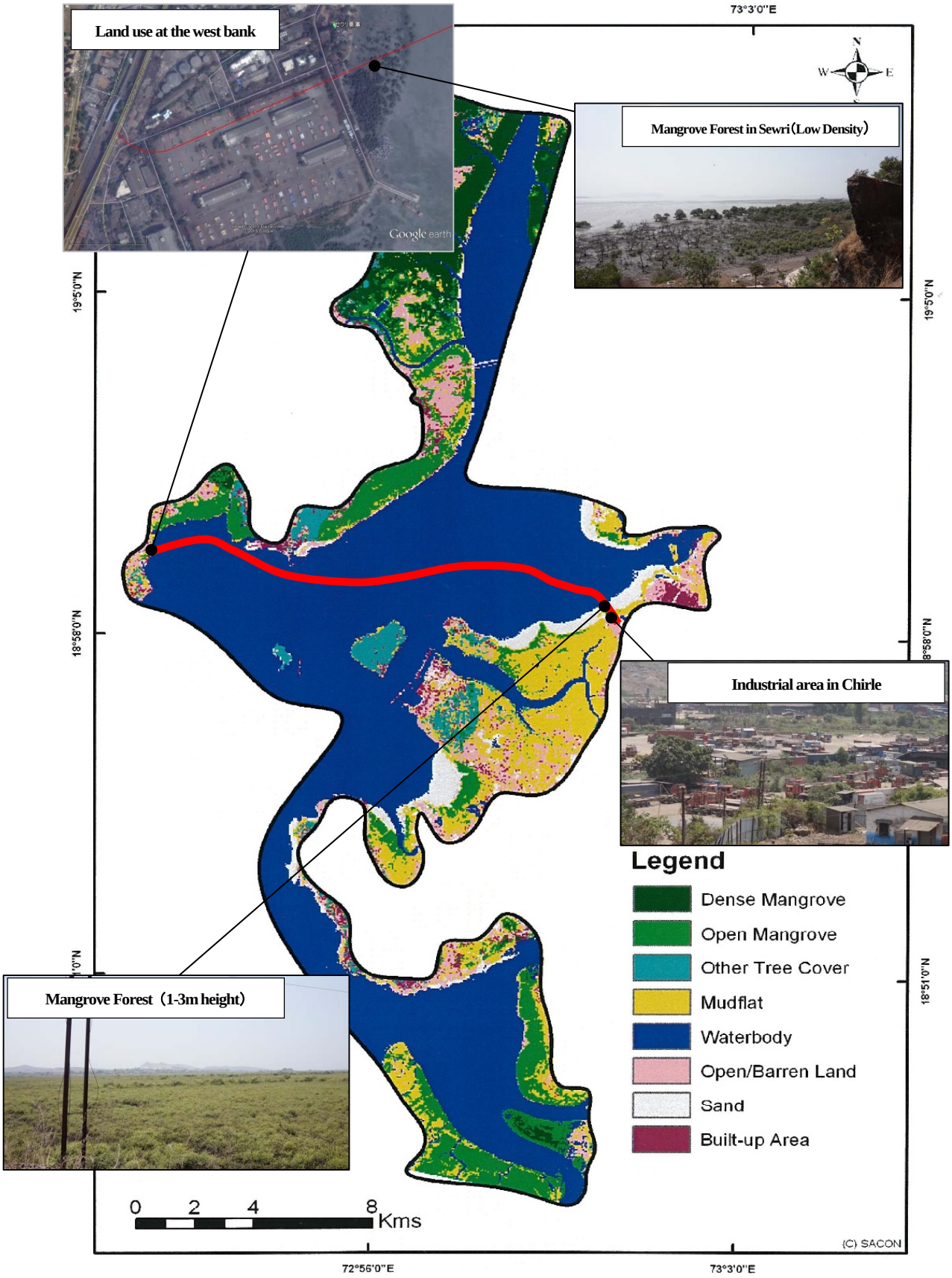
Source: JICA Study Team

Figure 3.1.2 Geographical Feature

3.2. Land Use

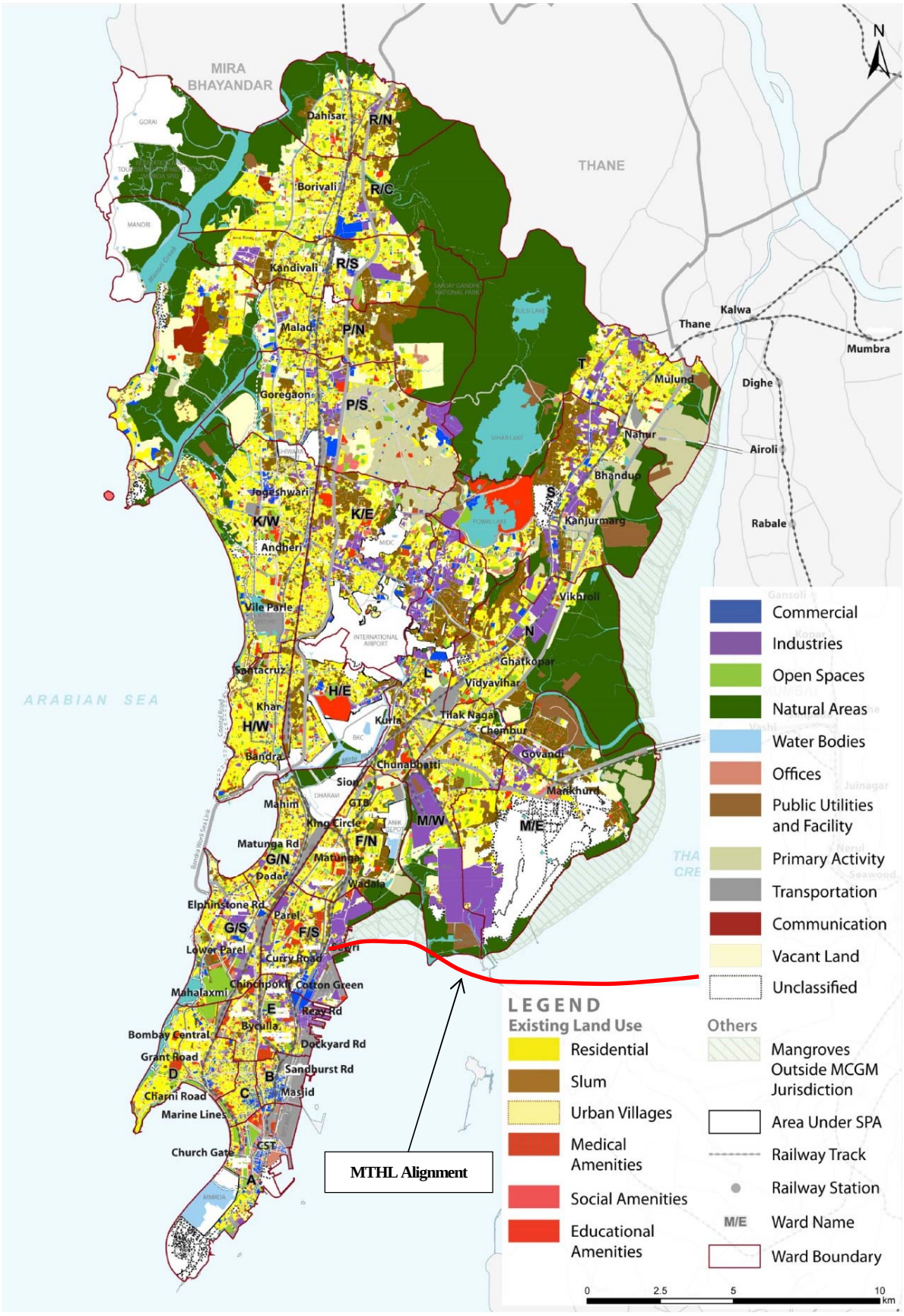
The management organization for development plan is the Municipal Corporation of Greater Mumbai (MCGM) for Mumbai side and the City and Industrial Development Corporation (CIDCO) in Navi Mumbai side respectively. Current land use as of 2008 in the project area is shown in the Figure 3.2.1, and future's land use is shown in Figure 3.2.2 & Figure 3.2.3 respectively.

The starting point of the planned alignment is connected point with the Eastern Highway, and then the alignment is passing through back yard in Mumbai Port Trust (MPT) and Coastal Regulation Zone (CRZ) in 1.65km in Mumbai side. On the other hand, the alignment in Navi Mumbai side is passing through CRZ in 0.6km, small residential area, quarry area, container yard and then connect with Mumbai – JNPT highway.



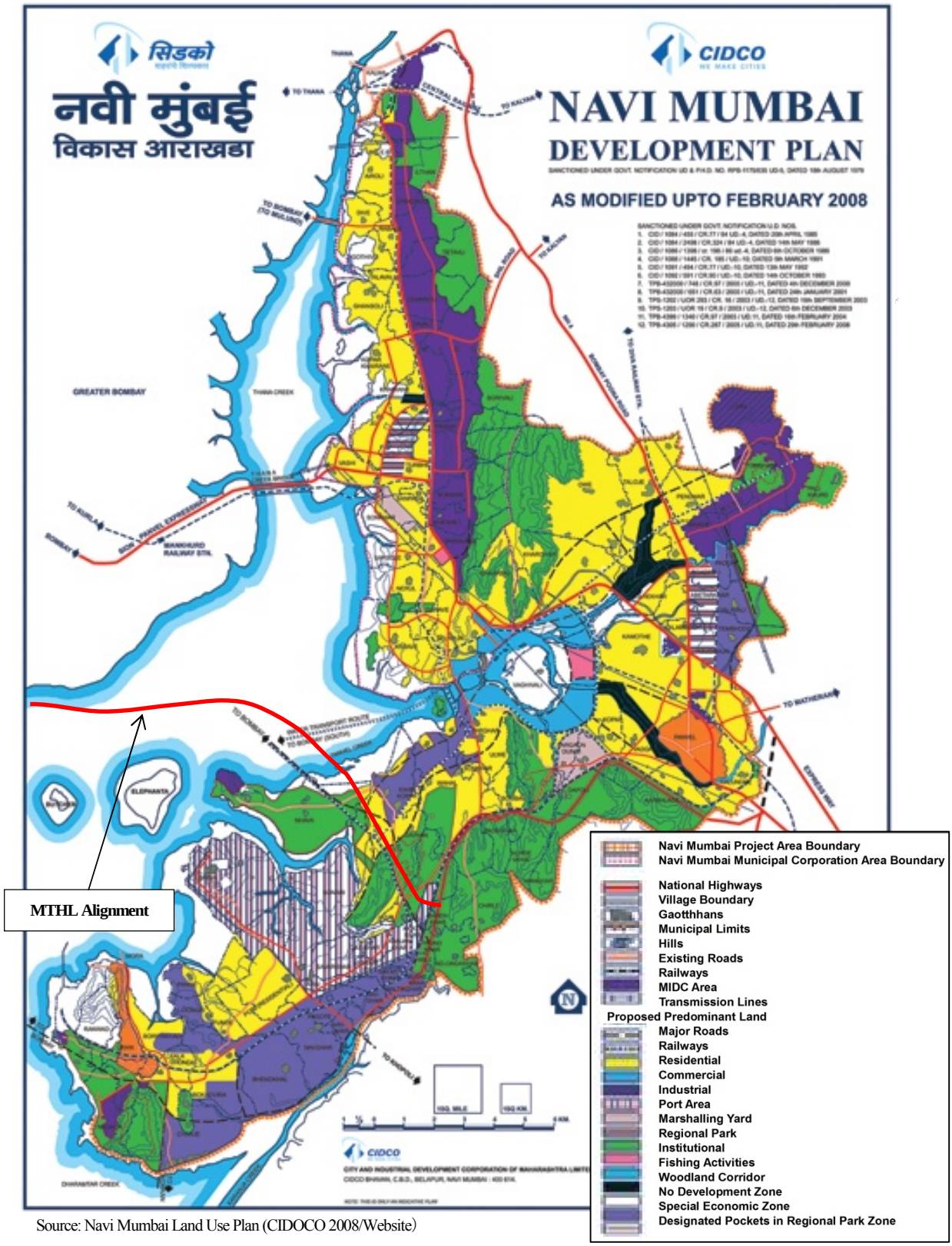
Source : Mumbai Trans Harbour Link Project Study of Flamingo and Migratory Birds Final Report 2008 December (Salim Ali Centre for Ornithology and Natural History)

Figure 3.2.1 Current Land Use in the Project Area (2008)



Source: Land Use Plan (draft: 2014－2034)

Figure 3.2.2 Land Use Plan in the Project Area (Mumbai Area 2014-2034)

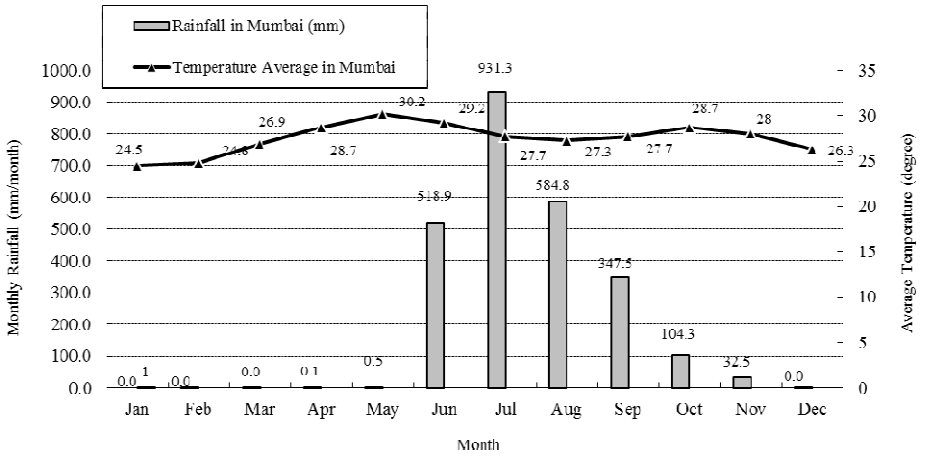


Source: Navi Mumbai Land Use Plan (CIDOCO 2008/Website)

Figure 3.2.3 Current Land in the Project Area (Mumbai Area 2008)

3.3. Climate

The project area is categorized as the tropical monsoon climate. Daily average temperature is from 24 in January to 30 degree in May, dry season. On the other hand, rainy season starts from June and lasts in October. Average monthly rainfall and temperature is shown in Figure 3.3.1.



Source: India Metrological Department, Ministry of Earth Sciences (website)

Figure 3.3.1 Annual Rainfall in Mumbai (2008-2013 average)

3.4. Protected area

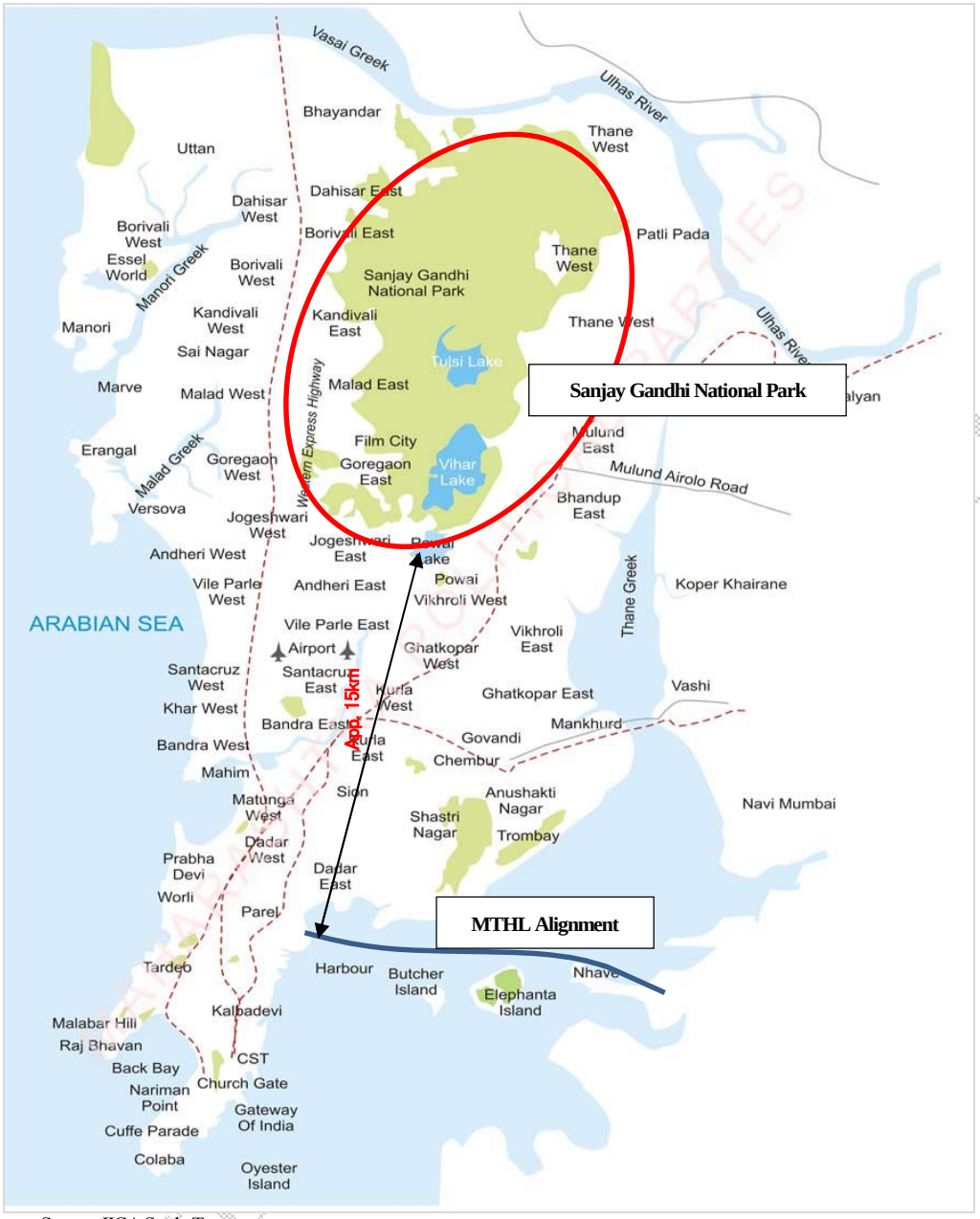
(1) National Park

The Sanjay Gandhi National park is located in the northern area, approximately 15km away from the project area. The location of the national park is shown in Figure 3.4.1.

(2) Coastal Regulation Zone (CRZ)

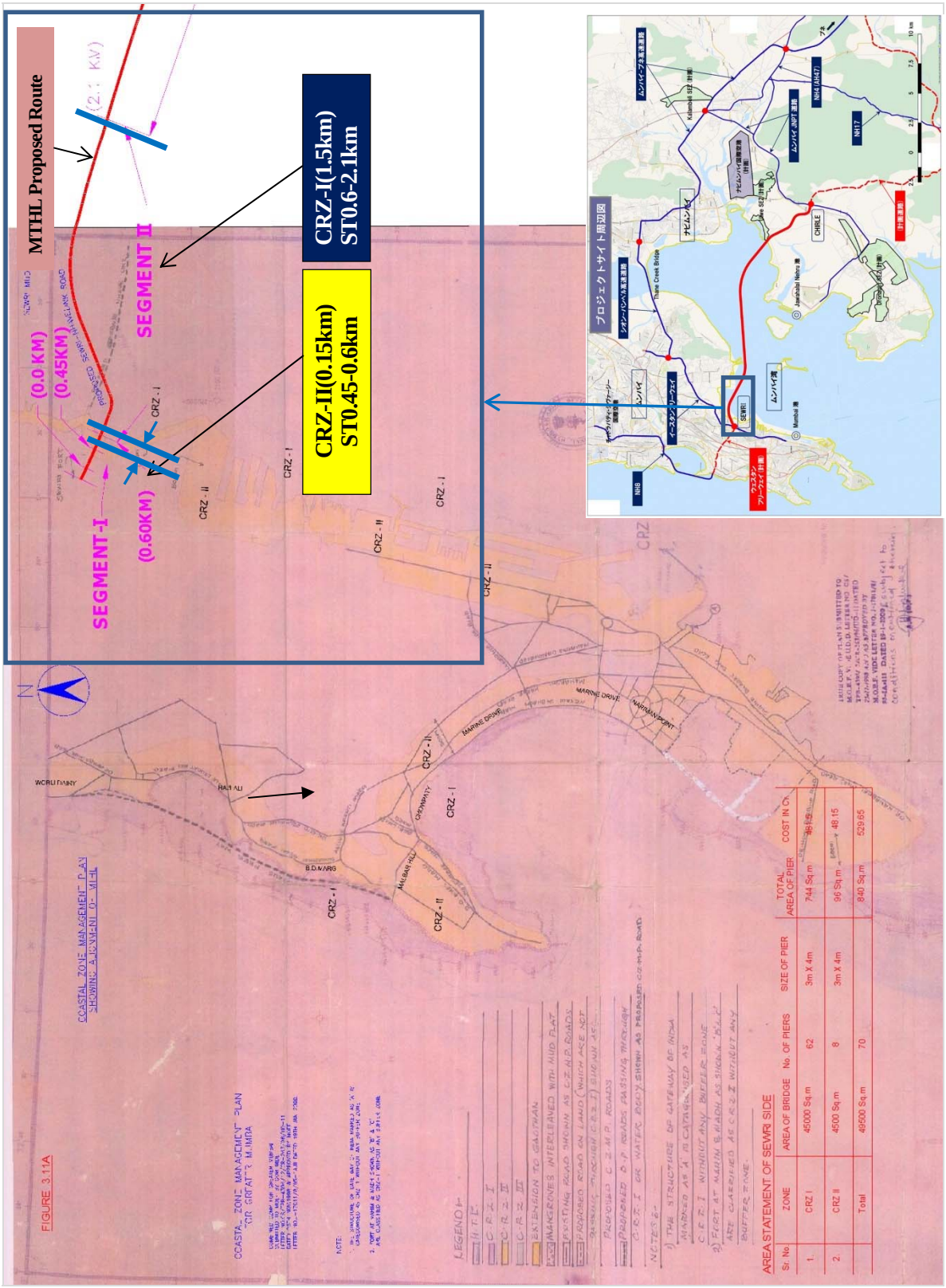
The alignment is passing through a part of the Coastal Regulation Zone (CRZ) in total 2.25 km.

The Environmental Clearance for CRZ has been issued with 5 years validity in July 19th 2013 from Ministry of Environment and Forests (MOEF). The location of the zone is shown in Figure 3.4.2 and Figure 3.4.3. The matter subsequently was challenged in the National green tribunal and the Tribunal has suspended the clearance for 6 months. MCZMA has appraised the matter again and suggested minor changes in the



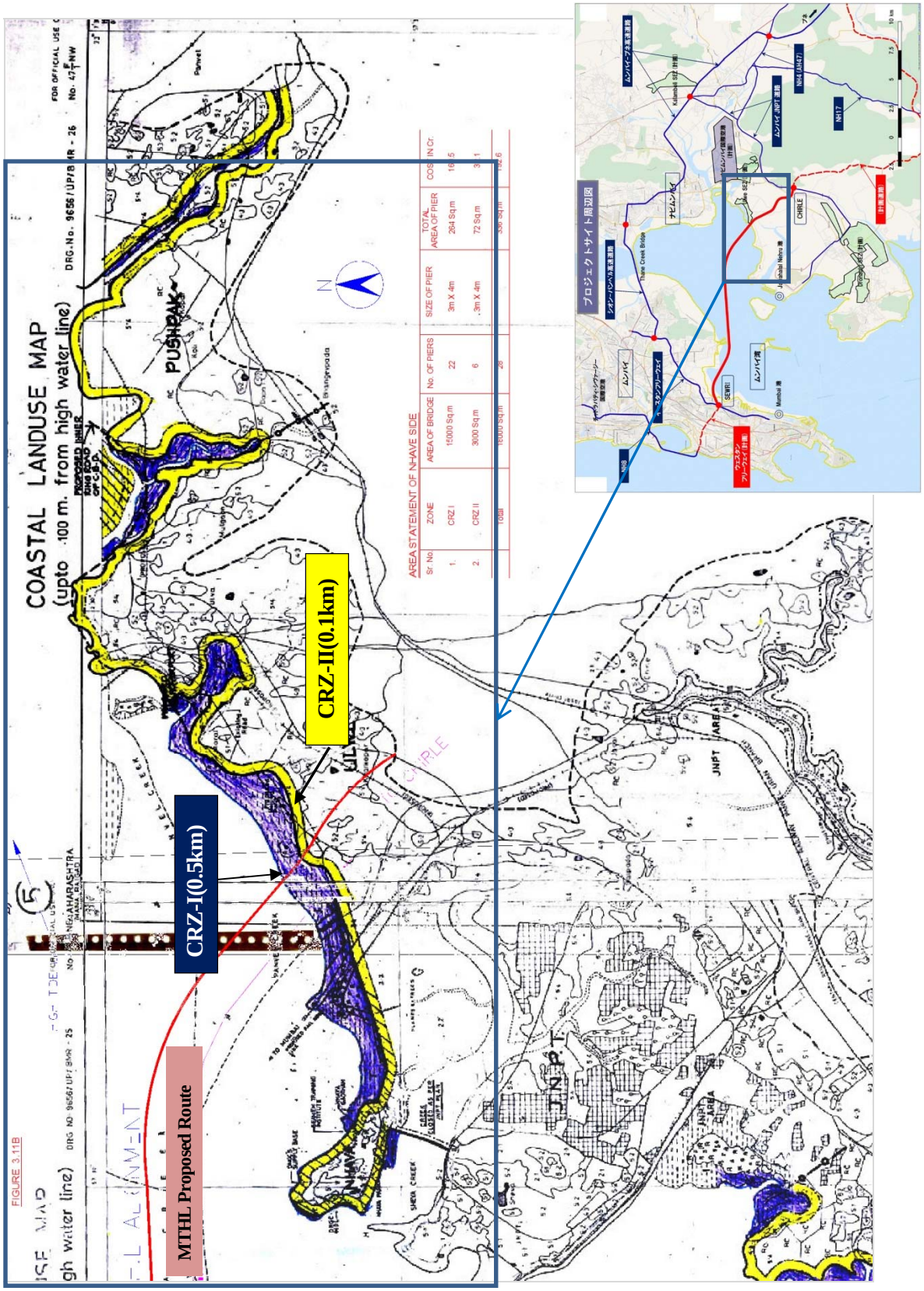
Source: JICA Study Team

Figure 3.4.1 Location of Sanjay National Park



Source: Rapid EIA (MMRDA 2013)

Figure 3.4.2 Location of CRZ in Mumbai Side (Sewri)



Source: Rapid EIA (MMRDA 2013)

Figure 3.4.3 Location of CRZ in Navi Mumbai Side

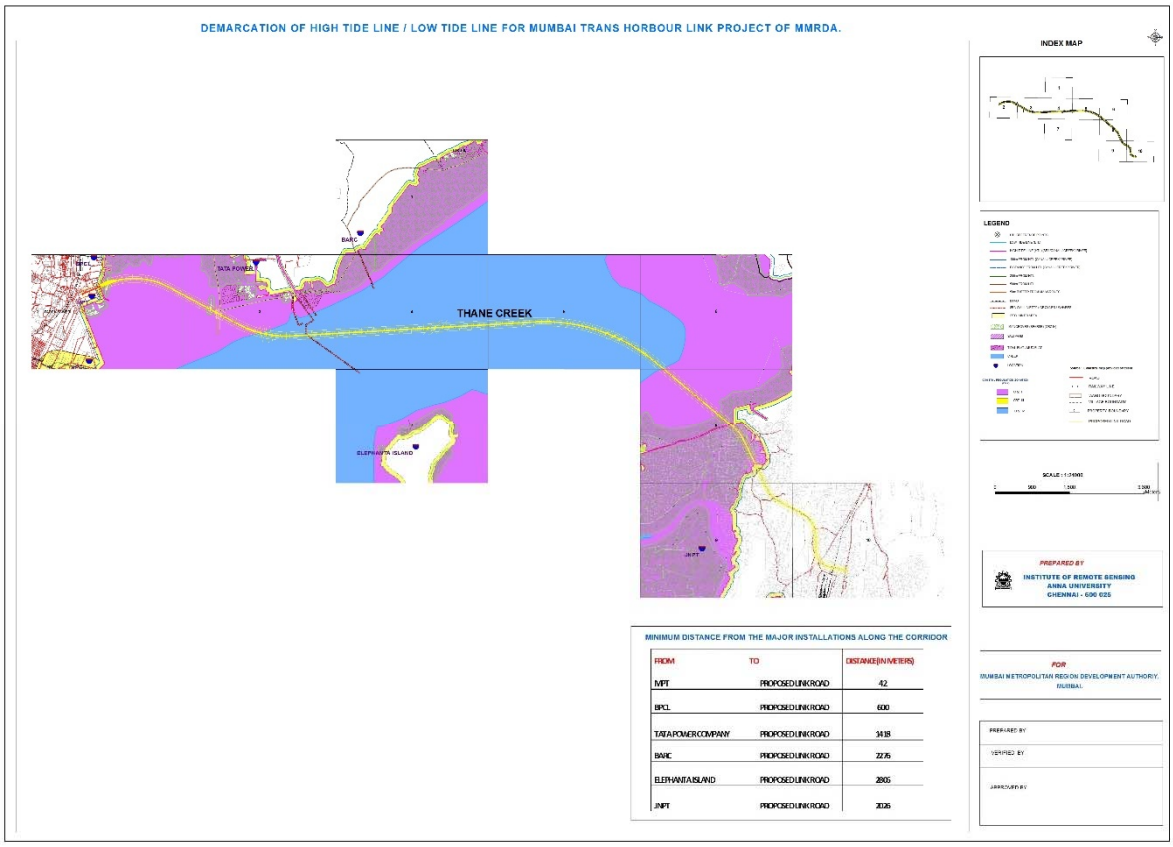


Figure 3.4.3a: CRZ Map prepared by IRS at 1:4000 scale

3.5. Fauna and Flora

The Coastal Regulation Zone is located in Sewri 1.65km and Navi Mumbai side 0.6 km in total 2.25km. According to the past survey, 17 bird species has been observed in the project area. Most of observed species are categorized as the Least Concern (LC) class, but 2 species such as Black Headed Ibis and Lesser Flamingo are categorized as Near Threatened (NT).

Sewri area in Mumbai side is widely known as industrial area, however Lesser Flamingos and Greater Flamingos have been coming from Europe and/or Eastern African countries in November since 1994 and staying there until June.

According to the study report conducted by MMRDA in 2008, counted number of the flamingos is approximately 10,000 to 15,000 a day. These flamingos eat algae and/or plankton during low tidal.

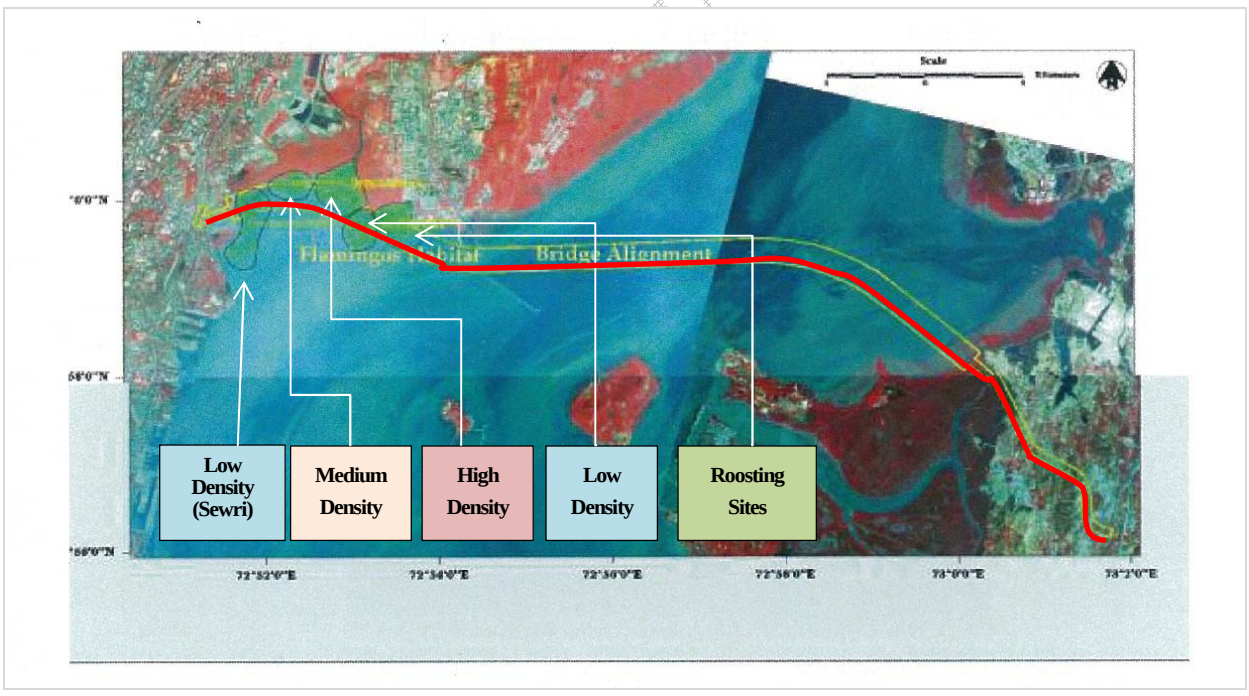
With regard to mangrove in Sewri and Navi Mumbai side, the dominant specie is Avicennia marina.

Source: JICA Study Team

Figure 3.5.1 Vegetation Community at Sewri and Navi Mumbai Site (April 2015)

Source: JICA Study Team

Figure 3.5.2 Observed Migratory Bird (Lesser Flamingo) in Sewri Mudflat Site



Source: Mumbai Trans Harbour Link Project Study of Flamingo and Migratory Birds Final Report 2008 December (Salim Ali Centre for Ornithology and Natural History)

Figure 3.5.3 Surveyed Flamingo's Distribution (2008)

3.6. Cultural Heritage

In Sewri area, Sewri Fort is located in the northern area app. 180m away from ST 700m. Other two World Cultural Heritage Sites named Gateway of India and Elephanta Cave is away from the proposed route app. 9km and 3km respectively. A No Objection Certificate

(NOC) was issued by the Archaeological Survey of India, Government of India regarding passing through nearest area of the Elephant Island.

Source: JICA Study Team

Figure 3.6.1 Location of Registered Cultural Heritages

3.7. Socio-Economic

(1) Population

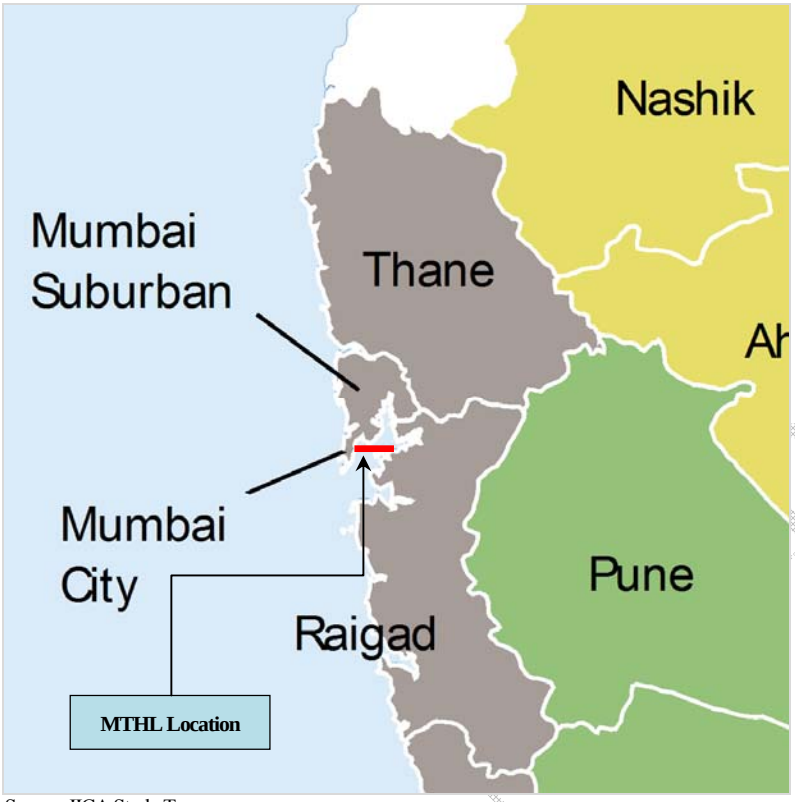
The project area is located in Konkan area, State of Maharashtra. The starting point of the Mumbai Harbor Trans Link is in Sewri area Mumbai City, and the route is crossing Mumbai Bay and connects with Mumbai-JNPT Highway in Raigad District.

Total area of Mumbai and Raigad District is approximately 7,750 km2 and its total population is app. 5.8 million on the census in 2011. Population increase for 10 years from 2001 to 2011 is 4.56 % in Mumbai and app. 19% in Raigad District.

Table 3.7.1 Socio-Economic Situation in the Project Area

Name of Area	Area (km^2)	Rate	Population (2011) (Person)	Increase Rate (for 10 years)	Population Density (Person/km2)
India	3,287,263	100.00%	1,210,193,422	14.99%	368
Maharashtra State	307,713	9.36%	112,372,972	15.99%	365
Konkan Division	30,746	0.94%	28,739,397	-	935
Mumbai City	603.4	0.02%	3,145,966	4.56%	25,851
Raigad District	7,152	0.22%	2,635,200	19.36%	368

Source: Indian Statistical Census (2011)



Source: JICA Study Team

Figure 3.7.1 Project Location on Division Map

(2) Economy

GDP in India by state is indicated in Table 3.7.2. The GDP in Maharashtra is ranked the top state in India, and the GDP indicates 4,155 billion INR about 1.5 times of Uttar Pradesh.

On the other hand, GDP per capita in Maharashtra is 114,000 INR and ranked 7th in India as shown in Table 3.7.3. Additionally GDP and GDP per capita in Mumbai, Raigad and Thane are shown in next tables

Table 3.7.2 GDP in India (FY2013-2014)

	Unit: Billion INR.	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
1	Maharashtra	4,155	4,868	5,845	6,848	7,540	8,558	10,492	11,754	13,238	14,762
2	Uttar Pradesh	2,608	2,932	3,363	3,830	4,447	5,234	6,003	6,855	7,804	8,627
3	Tamil Nadu	2,190	2,578	3,105	3,508	4,013	4,797	5,849	6,672	7,449	8,542
4	Gujarat	2,034	2,447	2,837	3,293	3,679	4,313	5,215	5,988	6,585	7,656
5	West Bengal	2,087	2,302	2,617	2,995	3,419	3,989	4,610	5,283	6,033	7,066
29	Manipur	51	57	61	68	74	83	91	111	127	143
30	Arunachal Pradesh	35	38	41	48	57	75	90	108	118	135
31	Sikkim	17	20	22	25	32	61	74	89	105	124
32	Mizoram	27	30	33	38	46	53	64	69	84	103
33	Andaman & Nicobar Islands	18	20	25	30	35	41	43	50	56	62

Source: Census of India (2015)

Table 3.7.3 GDP PER CAPITA in India (FY2013-2014)

	Unit: x 1,000 INR	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
1	Goa	77	85	95	109	136	149	168	212	201	224
2	Delhi	64	72	83	95	112	126	145	167	193	220
3	Sikkim	27	30	32	36	47	91	109	130	151	176
4	Chandigarh	74	85	98	103	108	117	127	137	142	157

5	Puducherry	48	67	69	74	79	97	101	103	114	144
6	Haryana	38	42	49	57	67	82	94	106	120	133
7	Maharashtra	36	42	50	58	62	70	85	94	104	114
8	Tamil Nadu	30	35	42	48	54	64	78	89	99	113
9	Andaman & Nicobar Islands	41	45	54	61	69	79	81	90	98	107
10	Gujarat	32	38	43	50	55	64	77	86	93	107
31	Jharkhand	19	18	20	25	25	28	35	37	40	46
32	Assam	17	18	20	21	24	28	33	36	39	44
33	Manipur	19	20	21	23	24	27	28	34	38	42

Source: Census of India (2015)

Table 3.7.4 GDP PER CAPITA in the Project Area (FY2013-2014)

	GDP (billion INR)		GDP per capita (1,000 INR)	
	2012-2013	2013-2014	2012-2013	2013-2014
1 Mumbai	28.8	33.4	166	189
2 Thane	17.8	20.0	156	173
3 Raigad	3.5	3.8	120	132

Source: Maharashtra state plan division (2015)

(3) Industry

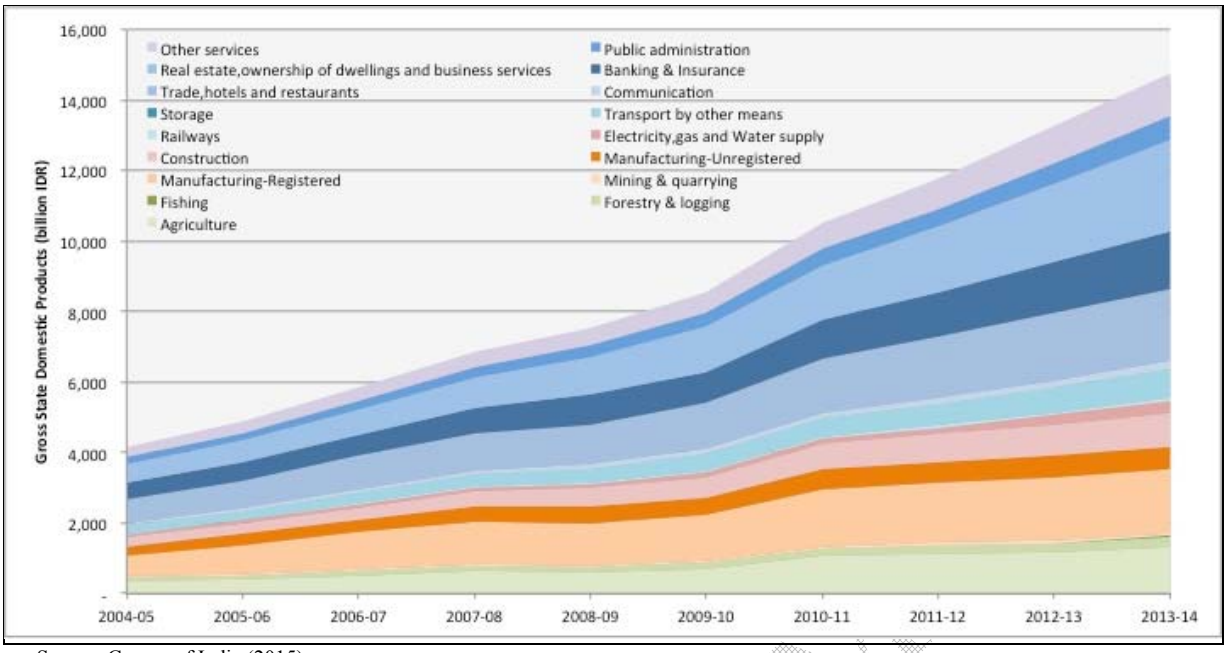
The key industries and sectors top three are shown in Table 3.7.5. The major industry in Maharashtra state is a service industry and it indicates around 63% and has been increasing.

On the other hand, the industrial production is about 26% in 2013-2014, and it has been decreasing. The agricultural production is stabilized around 11-12 %.

Table 3.7.5 GDP on Major Industry in Maharashtra State

Unit: % (Billion INR)	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Primary Industry	10.8 (449)	10.8 (528)	11.5 (672)	11.8 (807)	10.1 (758)	10.4 (886)	12.3 (1,293)	11.8 (1,387)	10.9 (1,442)	11.1 (1,636)
1 Agriculture	8.3	8.2	8.7	9.4	7.9	8.0	10.2	9.6	8.7	8.8
2 Forestry	2.2	2.3	2.5	2.1	2.0	2.1	1.9	1.9	1.9	2.0
3 Fishery	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.3
Secondary Industry	29.6 (1,230)	31.8 (1,547)	32.0 (1,869)	32.4 (2,216)	31.3 (2,361)	29.8 (2,551)	29.7 (3,116)	28.2 (3,317)	27.4 (3,622)	26.0 (3,845)
1 Registered manufacturing	14.1	16.8	17.7	17.3	16.0	15.1	15.4	14.3	13.5	12.4
2 Construction	6.3	6.2	5.9	6.5	7.0	6.5	6.5	6.8	6.5	6.5
3 Not registered manufacturing	6.5	6.4	6.3	6.4	6.2	6.0	5.7	5.1	4.8	4.3
Tertiary industries	59.6 (2,475)	57.4 (2,793)	56.5 (3,303)	55.9 (3,826)	58.6 (4,420)	59.8 (5,121)	58.0 (6,082)	60.0 (7,050)	61.7 (8,173)	62.9 (9,282)
1 Real Estate	12.8	12.9	12.7	13.0	14.1	14.9	14.9	15.9	16.7	17.8
2 Trading/Hotel/Restaurant	16.2	15.6	15.9	15.4	15.0	15.1	14.6	14.6	14.6	13.8
3 Insurance and financial	11.4	10.5	10.2	10.2	11.1	10.4	10.4	10.8	10.8	11.0

Source: Census of India (2015)



Source: Census of India (2015)

Figure 3.7.2 GDP by Industry in Maharashtra State

(4) Poverty Line

The criteria for poverty have been revising by the central government non-periodically. Thus the poverty line and the number under the poverty line are not accurate under the same criteria. According to poverty line in 2011-2012 based on the criteria determined by the India Planning Commission in 2014, the poverty line is 1,078 INR in agricultural area Maharashtra and 1,560 INR in urban area respectively.

Table 3.7.6 Poverty Line in Maharashtra State

	Poverty Line (INR/month-capita)		Poverty Ratio (%)			Number of Poor (million)		
	Rural	Urban	Rural	Urban	Total	Rural	Urban	Total
Lakdawala Methodology								
1973-74	50.47	59.48	57.71	43.87	53.24	21.1	7.7	28.7
1977-78	58.07	73.99	63.97	40.09	55.88	25.0	8.0	33.0
1983-84	88.24	126.47	45.23	40.26	43.44	19.4	9.7	29.1
1987-88	115.61	189.17	40.78	39.78	40.41	18.6	10.9	29.6
1993-94	194.94	328.56	37.93	35.15	36.86	19.3	11.2	30.5
1999-00	318.63	539.71	23.72	26.81	25.02	12.5	10.3	22.8
2004-05	362.25	665.90	29.6	32.2	30.7	17.1	14.6	31.7
Tendulkar Methodology								
2004-05	485	632	47.9	25.6	38.1	27.7	11.6	39.3
2009-10	744	961	29.5	18.3	24.5	18.0	9.1	27.1
2011-12	967	1,126	24.2	9.1	17.4	15.1	4.7	19.8
C.Rangarajan Methodology								
2011-12	1,078.34	1,560.38	22.5	17.0	20.0	14.0	8.8	22.8

Source: India Planning Commission (2014)

CHAPTER 4 ENVIRONMENTAL LEGISLATION IN INDIA

The principal Environment Regulatory Agency in our country is the Ministry of Environment & Forest (MoEF). The environment policies and environment clearance process for various projects are laid down by MoEF. The State Pollution Control Board (SPCB) grants No Objection Certificate (NOC) and consent for establishment and operation of the project.

4.1. EIA Notification 2006

The necessity of environmental impact assessment is stipulated on the Environmental Protection Law in 1986, and concrete rules are described on the Environmental Impact Assessment Notification in 2006 (EIA Notification). According to the notification, prescript projects are required to obtain an Environmental Clearance before implementation of the actual construction.

Category A projects in accordance with EIA notification are required to obtain the Environmental Clearance from Ministry of Environment and Forests (MOEF) of the central government, on the other hand, Category B project shall have the clearance from State Government.

As per the EIA Notification of MoEF issued on 14th September, 2006, a National or State highway development or expansion projects fall in either Category A or B of the schedule of the notification. The proposed project does not completely fulfill either of the criterions described for Category A or B, i.e. the proposed alignment is a sea link which is 22km (less than 30km) and it is not a national/state highway. Hence, there is no need of obtaining Environment Clearance from Ministry of Environment and Forests (MoEF) for which an EIA/EMP study is a primary requirement.

Table 4.1.1 Mandatory List for EIA

Project Activity		Category C		Other Condition
		Category A (Central Government)	Category B (State Government)	
7f	Highway	i) New National Highways; and ii) Expansion of National High ways greater than 30 KM, involving additional right of way greater than 20m involving land acquisition and passing through more than one State.	i) New State High ways; and ii) Expansion of National / State Highways greater than 30 km involving additional right of way greater than 20m involving land acquisition.	General Condition shall apply

Source: EIA Notification (MOEF 2006)

However, the proposed alignment passes through coastal regulation zone (CRZ) as per the Coastal Zone Management Plans (hereafter referred to as the CZMPs) of Mumbai and Navi Mumbai. Though construction of 'Sea link' is a permissible activity as per CRZ notification, approval from Maharashtra Coastal Regulation Zone Management Authority (MCZMA) is required as per the MoEF Notification of January 2011.

4.2. Coastal Regulation Zone (CRZ Notification 2011)

According to CRZ notification 2011, following objectives for establishment of regulation are described;

"Now, therefore, in exercise of the powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the

Central Government, with a view to ensure livelihood security to the fisher communities and other local communities, living in the coastal areas, to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in the coastal areas, sea level rise due to global warming, does hereby, declare the coastal stretches of the country and the water area upto its territorial water limit, excluding the islands of Andaman and Nicobar and Lakshadweep and the marine areas surrounding these islands upto its territorial limit, as Coastal Regulation Zone (hereinafter referred to as the CRZ) and restricts the setting up and expansion of any industry, operations or processes and manufacture or handling or storage or disposal of hazardous substances as specified in the Hazardous Substances (Handling, Management and Transboundary Movement) Rules, 2009 in the aforesaid CRZ."

In the designated CRZ, "allowed" and "Not allowed" activities are categorized and stipulated. With regard to the Mumbai Harbor Trans Link, it is categorized as "Sealink" and allowed to construct roads and bridges in CRZ, and an Environmental Clearance for CRZ with 5 years validity has been obtained by MMRDA from MOEF in July 2013.

Relevant description regarding MHTL project on CRZ notification 2011 is show below.

Table 4.2.1 Relevant Description on CRZ Notification 2011

No.	Name of Article	Description
Clause "3 (iv) (Page 2).	Prohibited activities within CRZ	The activities such as Land reclamation, bunding or disturbing the natural course of seawater are declared as prohibited activities within the CRZ except those,- (a) required for setting up, construction or modernisation or expansion of foreshore facilities like ports, harbours, jetties, wharves, quays, slipways, bridges, sealink, road on stilts, and such as meant for defence and security purpose and for other facilities that are essential for activities permissible under the notification;"
Clause "7 (Pg 8)	Classification of the CRZ	- For the purpose of conserving and protecting the coastal areas and marine waters, the CRZ area shall be classified as follows, namely:- (i) CRZ-I,– A. The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast,- (a) Mangroves, in case mangrove area is more than 1000 sq mts, a buffer of 50meters along the mangroves shall be provided; (b) Corals and coral reefs and associated biodiversity; (c) Sand Dunes; (d) Mudflats which are biologically active; (e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), the Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 of 1986); including Biosphere Reserves; (f) Salt Marshes; (g) Turtle nesting grounds; (h) Horse shoe crabs habitats; (i) Sea grass beds; (j) Nesting grounds of birds; (k) Areas or structures of archaeological importance and heritage sites. B. The area between Low Tide Line and High Tide Line; (ii) CRZ-II,- The areas that have been developed upto or close to the shoreline.
Clause "8 (Pg 9)	Norms for regulation of activities permissible under this notification,-	(i) The development or construction activities in different categories of CRZ shall be regulated by the concerned CZMA in accordance with the following norms, namely:- I. CRZ-I,- (i) no new construction shall be permitted in CRZ-I except,- (e) Construction of trans harbour sea link and without affecting the tidal flow of water, between LTL and HTL." "(ii) Areas between LTL and HTL which are not ecologically sensitive, necessary safety measures will be incorporated while permitting the following, namely:- (g) Construction of trans harbour sea links, roads on stilts or pillars without affecting the tidal flow of water."

Source: Coastal Regulation Zone Notification (MOEF 2011)

Table 4.2.2 Special Conditions on Environmental Clearance of CRZ for MTHL

No.	Conditions
1	As per the CRZ notification, 2011, at least five times the number of mangroves destroyed/cut during the construction process shall be replanted. Mangrove plantation in an area of 30 ha shall be carried out as committed against loss of 0.1776 ha of mudflats/mangroves. Permission from the High Court of Bombay shall be obtained with respect to mangrove cutting.
2	Proponent shall provide lighting in consulting in consulting with the Bombay Natural History Society so as to minimize the likely impacts to the migratory birds
3	All the construction equipment's shall be provided with exhaust silencers as committed
4	Noise containment barriers shall be provided on both sides of the bridge in mudflat areas (CRZ-IA) so as to minimize the likely impacts to the migratory birds
5	There shall be no dreading and reclamation for the project
6	Pre-stressed super structure shall be used in the mud flat area for construction as committed
7	The muck materials shall be analyzed prior to dumping / disposal in the identified locations with the approval of competent authority to ensure that it do not cause any impact to the environment
8	Proponent informed that there is no fishing activity in the area since it is a navigation channel for the nearby ports. However, navigation channel is provided with 25m for ships and 9.1 m for fishing boats.
9	All the recommendations of the MCZMA shall be strictly compiled with.
10	There shall be no building construction beyond 20,000 sqm.
11	There shall be no water drawal in CRZ area
12	There shall be no disposal of solid or liquid wastes on coastal area. Solid waste Management shall be as per Municipal Solid (Management and Handling) Rules, 2000.
13	Sewage shall be trated and the Treatment Facility shall be provided in accordance with the Coastal Regulation Zone Notification, 2011. The disposal of treated water shall conform to the regulations of State Pollution Control Board.
14	The project proponent shall set up a separate environmental management cell for effective implementation of the stipulated environmental safeguard under the supervision of a Senior Executive.
15	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.

Source: CRZ Environmental Clearance (MOEF 19th July 2913)

The CRZ clearance was challenged in the National green tribunal and the Tribunal has suspended the clearance for 6 months.

4.3. Other relevant Environmental Laws and Regulations

Other relevant environmental laws and regulations are shown in the next table.

Table 4.3.1 Other Relevant Environmental Laws and Regulations

No.	Name	Year
1	Environmental (Protection) Act	1986
2	Environment Impact Assessment Notification	2006, 2009, 2012
3	Forest Conservation Act	1927, 1980
4	National Forest Policy	1952, 1988
5	Coastal Regulation Zone Notification	2011
6	Wildlife (Protection) Act	1972
7	Land Acquisition Act	1894, 1989
8	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act	2013
9	Air (Prevention and Control of Pollution) Act)	1981
10	Hazardous Waste(Management and Handling) Rules)	1989, 2003
11	Municipal Solid Waste (Management and Handling) Rules)	2000
12	Noise Pollution Regulation and Control Rule)	2000
13	Water(Prevention and Control of Pollution) Act)	1974

Source: JICA Study Team

Table 4.3.2 Other Relevant Environmental Ratification Treaty

No.	Name	Effected Year
1	United Nations Framework Convention on Climate Change	1994
2	Kyoto Protocol	2001
3	Convention on Biological Diversity	1993
4	Cartagena Protocol on Biosafety	2003
5	Vienna Convention for the Protection of the Ozone Layer	1988
6	Montreal Protocol on Substances that Deplete the Ozone Layer	2002
7	Basel Convention	1992
8	The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	2004
9	Stockholm Convention on Persistent Organic Pollutants	2004
10	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	1996
11	Convention on International Trade in Endangered Species of Wild Fauna and Flora(CITES)	1975
12	The Convention on Wetlands of International Importance especially as Waterfowl Habitat	1975
13	Antarctic Treaty / Protocol on Environmental Protection to the Antarctic Treaty	1961
14	Protocol on Environmental Protection to the Antarctic Treaty （Madrid Protocol）	1998

Source: Ministry of Foreign Affairs in Japan (website)

4.4. Gaps between Rapid EIA 2012 and JICA's Guideline

The project is categorized as Category A which is required EIA level based on JICA Guidelines, thus following preliminary comparative analysis has been conducted between JICA Guidelines and "Rapid EIA in 2012" prepared by MMRDA for obtaining of Environmental Clearance for CRZ from MOEF.

According to the gap analysis, the identified gaps are "NOT-Implementation" of Social Impact Survey, Vibration Survey and Holding Public Consultation.

Thus vibration survey and implementation of public consultation has been carried out on this modified Rapid EIA.

Table 4.4.1 Result of Preliminary Gap Analysis between JICA Guidelines and Rapid EIA

JICA Guideline (Appendix 2. EIA Reports for Category A Projects)	**Rapid EIA** (2012 prepared by MMRDA)	**Gaps**	**Policy to fill up gaps in this Study**
1. When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents etc. must officially finish those procedures and obtain the approval of the government of the host country.	At first, the project is not required to prepare the EIA in accordance with EIA Notification 2006. However necessary environmental clearance for CRZ is obtained from MOEF by MMRDA in 2013.	- (no difference)	Not required
2. EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	Current Rapid EIA has been prepared in only English.	At least English and Hindi version shall be prepared	Supplemental EIA shall be prepared in English and Marathi (Syopsis)
3. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	Rapid EIA in 2012 has not been disclosed	Rapid EIA shall be disclosed	Supplemental EIA in English and Hindi shall be disclosed after preparation of Final modified Rapid EIA.
4. In preparing EIA reports, consultations with stakeholders, such as local residents, must take	A public consultation has not been conducted on the process of Rapid EIA	Either local Stakeholder meeting and public	Socialization prior to conducting a series of RAP survey and a public

JICA Guideline (Appendix 2. EIA Reports for Category A Projects)	**Rapid EIA** (2012 prepared by MMRDA)	**Gaps**	**Policy to fill up gaps in this Study**
place after sufficient information has been disclosed. Records of such consultations must be prepared.		consultation has been conducted	consultation after preparation of draft Supplemental EIA will be held.
5. Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.	Any consultation has not been conducted on the process of Rapid EIA 2012	ditto	ditto

Source: The Survey Team

CHAPTER 5 Alternative Analysis, Screening and Scoping

5.1. Alternative Analysis

5.1.1. Route Analysis

The first recommended draft plan of MTHL dates back to 1970s. Subsequently, committees were formed in 1972 and 1978 to study the possible alternatives for establishing the communication links across the Mumbai bay. The committees identified two alternative routes, a northern route linking Sewri with Nhava and a southern route linking Colaba (southern tip of Mumbai Island) with Uran, and suggested to carry out necessary engineering studies for the alternative routes.

A Steering Group was constituted in 1981 and reviewed the previous studies and recommended that Priority should be given to the construction of a northern route.

(1) Alignment by Peter Frankael and Partners (PFP), 1982

Five alternative alignments between Sewri on Mumbai Island and Nhava on the main land were identified and studied. All the alignments started from Sewri.

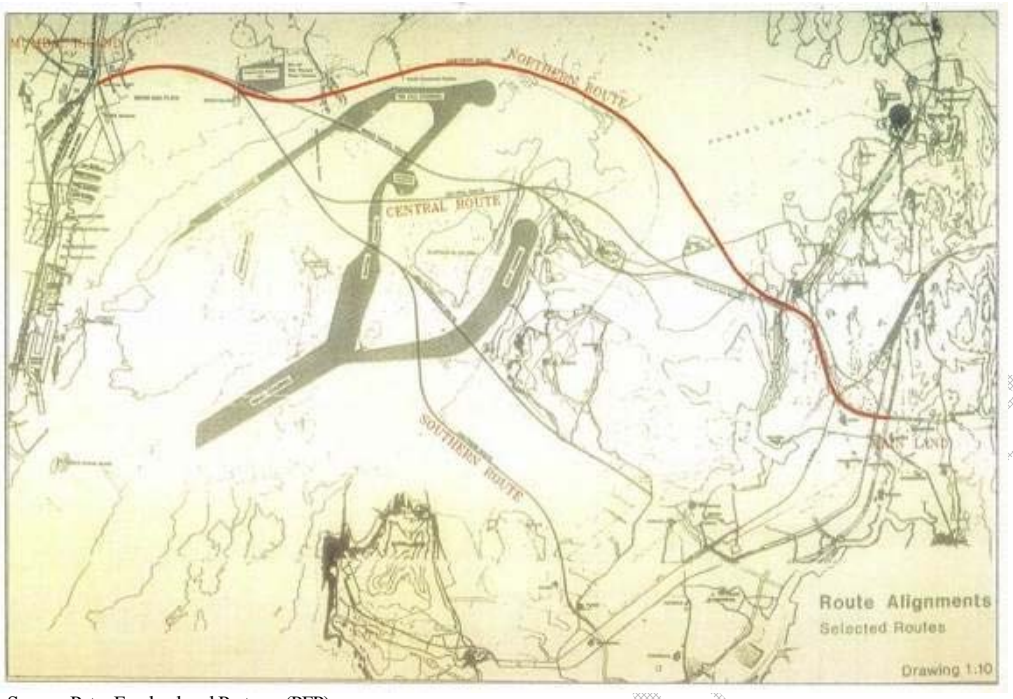
The study recommended the northern most alignment for the communication link Sewri with Nhava through a low level bridge skirting the harbour to the north.

Total length is 22.61km and it is comprised of the following sections (refer to Figure 3.1.1):

- ✓ **Section 1:** Sewri side Approach 0.7 km
- ✓ **Section 2:** Embankment over Sewri mudflats 2.32 km
- ✓ **Section 3:** Viaduct 13.19 km
- ✓ **Section 4:** Embankment on Nhava mudflats 2.20 km
- ✓ **Section 5:** Nhava side Approach 4.20 km

The embankment of Section 2 and 4 had a road level of +7.00m above Chart Datum (CD) considering run-up of wave approximately 1.0m above HHTL of 5.38m. The Central Water & Power Research Station (CWPRS) study had recommended that the embankment section shall be provided with an opening to cater for the non-tidal inflow. Accordingly, the embankment on Sewri side was proposed to terminate at 350m west of the Green Island.

Subsequently the recommended northern alignment was modified by Expert Group by shifting it to south of the jetty head in order to satisfy Bhabha Atomic Reserch Centre (BARC) requirements. This shifted alignment was approved by Prime Minister's Office (PMO) in 1984.



Source: Peter Frankael and Partners (PFP)

Figure 5.1.1 Alignment Recommended by PFP, 1982

(2) Alignment by Consulting Engineering Services (CES), 1996

CES were appointed to review and update the feasibility study for the recommended northern alignment in 1996 taking into account the subsequent developments after the 1982 study.

During the study, the Consultants held discussions and had interaction with concerned departments including Mumbai Port Trust (MbPT), and studied various parameters and suggested modifications. Among them the largest suggestion from the Consultants is as follows:

✓ **Mudflats and Mangroves**

With respect to the alignment traversing the mudflats, both at Sewri and Nhava, it was recommended the link should be constructed on viaducts instead of embankment in order to minimize the encroachment and the disturbance to the mudflats and the existing hydrological conditions.

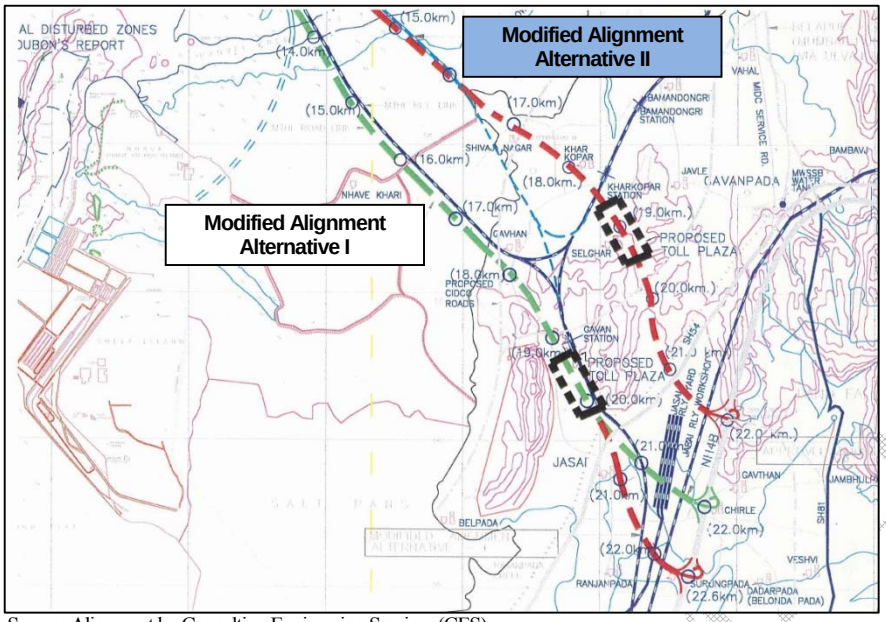
To this end, the Consultants suggested the following related to the alignment.

✓ **Underpass Interchange at Sewri**

The Underpass IC at Sewri was proposed in view of complex elevated interchange, unavailability of road and difficulty in land acquisition from MbPT.

✓ **Modification of Nhava Approach**

The Consultants identified two alternatives as shown below. The Alternative II, which is the less costly of the two due to reduced length of the link and acceptable to CIDCO has been recommended.



Source: Alignment by Consulting Engineering Services (CES)

Figure 5.1.2 Alternative Alignments on Nhava Side, 1998

Table 5.1.1 Elements of Alternative Alignments on Nhava Side, 1998

Location	Route Terminating in Navi Mumbai at	
	Length in km Surungpada (Alt-I)	Length in km North of Chirle (Alt-II)
Sewri Interchange	0.850	0.850
• Embankment on Sewri mudflats with Eastern Freeway Interchange Ch. 0.600 km to Ch. 1.580 km	0.980 *	0.980 *
• Viaduct with transitions (ramp portion)		
Ch. 0.600 km to Ch. 18.42 km	17.82	-
Ch. 0.600 km to Ch. 17.58 km	-	16.98
• Embankment at Nhava		
Ch.18.42 km to Ch.18.76 km	0.34	0.34
Ch.17.58 km to Ch.17.92 km	-	-
• Road in Grade leading to toll plaza up to termination point		
Ch. 18.76 km to 22.60 km	3.84	-
Ch. 17.92 km to 22.00 km	-	4.08
• Rail link termination at Panvel-Uran link		
Ch. 18.76 km to 19.00 Ch.	0.24	-
Ch. 17.92 km to 19.00 ch.	-	1.08
Total Length of Alignment		
• For Road Link	22.85 km	22.25 km
• For Rail Link	20.40	20.40

* Not considered in calculating total length of MTHL

Source: Alignment by Consulting Engineering Services (CES)

(3) Alignment by Consulting Engineering Services (CES), 2004

The alignment proposed by the Consultants under Alternative II with end point on NH4B (north of Chirle) is finally accepted and proposed to be taken up for construction. This alignment satisfies various issue solved in previous study.

✓ **Sewri IC and Connection with Eastern Freeway**

Sewri IC is the starting point of the proposed MTHL link. The MTHL link will have to be

connected to Eastern Freeway and local road network. At that time, the alignment of Eastern Freeway and improvement of East-West corridor is taken up by MMRDA is under study. Therefore, only approach ramp is proposed to be constructed.

✓ **Viaduct over Sewri Mudflats**

PFP had proposed construction of embankment over Sewri mudflats. However, to satisfy the environmental requirements, it was suggested that the MTHL be provided with elevated viaducts across the mudflats. The mudflat section is approximately 5km long, and 50m spans were proposed along this section.

✓ **Main bridges in the marine section**

The main bridge extends 9.6km long. This consists of three obligatory spans crossing several jetties, the central channel and Panvel Creek and submarine pipelines.

✓ **Nhava Approaches and ending at north of Chirle**

The alignment suggested by CES (Alternative II) was inspected with CIDCO officials and was recommended as a better option.

The advantages of this alignment ending at north of Chirle include: reduced road/rail crossings, a shorter overall length, and avoidance of crossing about 2.7km of mangroves.

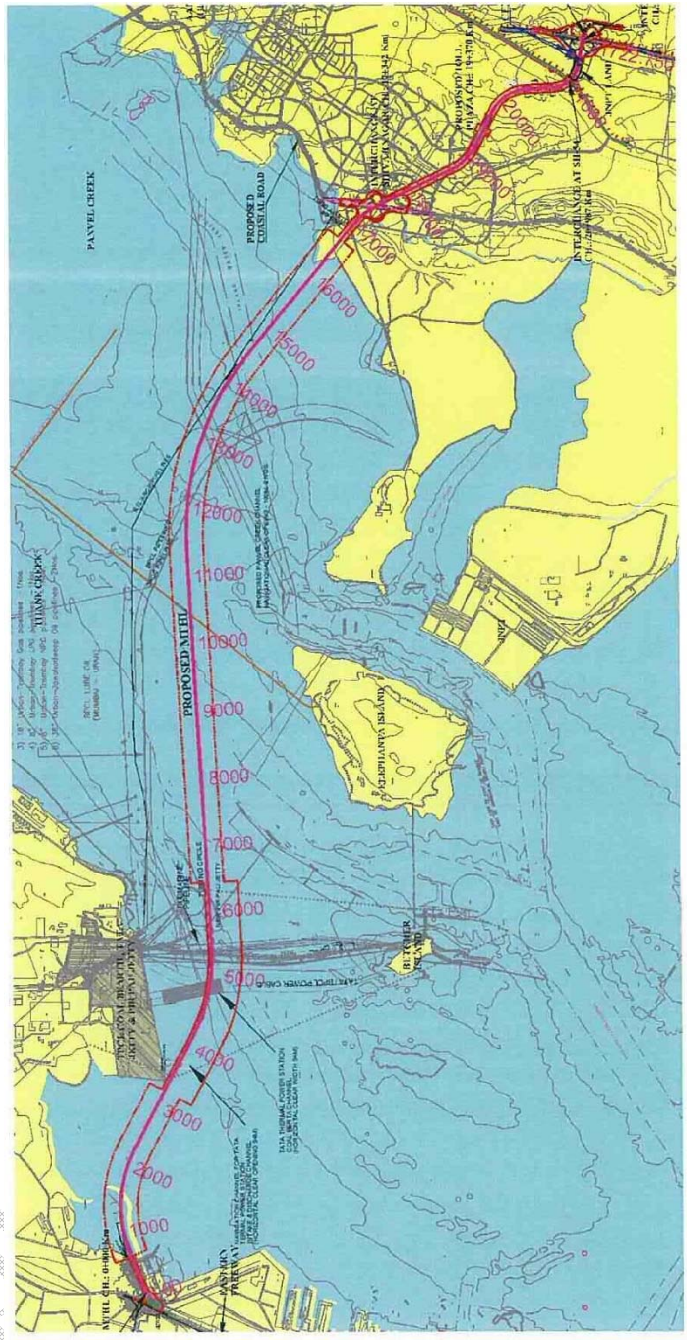
(4) Alignment by ARUP, CES and KPMG, 2012

The start of the alignment has been taken as Sewri IC (3-level IC) where the MTHL connects to the alignment of Eastern Freeway.

The alignment continues southeast to meet the NH4B by keeping Shivaji Nagar and Selghar villages to the south, and Kharkopar to the north, before crossing SH-54 and Panvel-Uran railway line.

The horizontal alignment has been shifted so that it does not cross the Tata Thermal Power Station land. The latest alignment of MTHL is shown in Figure 5.1.3.

As described above, the road alignment was fixed with extreme care after several studies in a long term.



Source: Final Feasibility Report (ARUP, CES and KPMG), 2012

Figure 5.1.3 MTHL Alignment on ARUP Report 2012

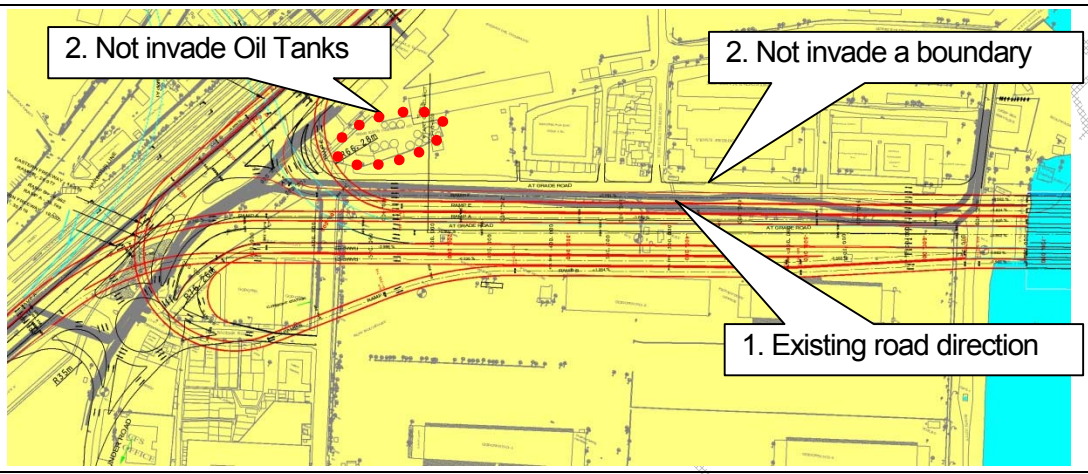
5.1.2. Control Points

(1) Control Points of Horizontal Alignment

Horizontal alignment is decided in consideration of the following control points.

1) Mumbai side

1. The Alignment matches the existing road direction
2. It does not invade Oil Company or Oil Tanks
3. Connect Eastern Freeway (Viaduct section)



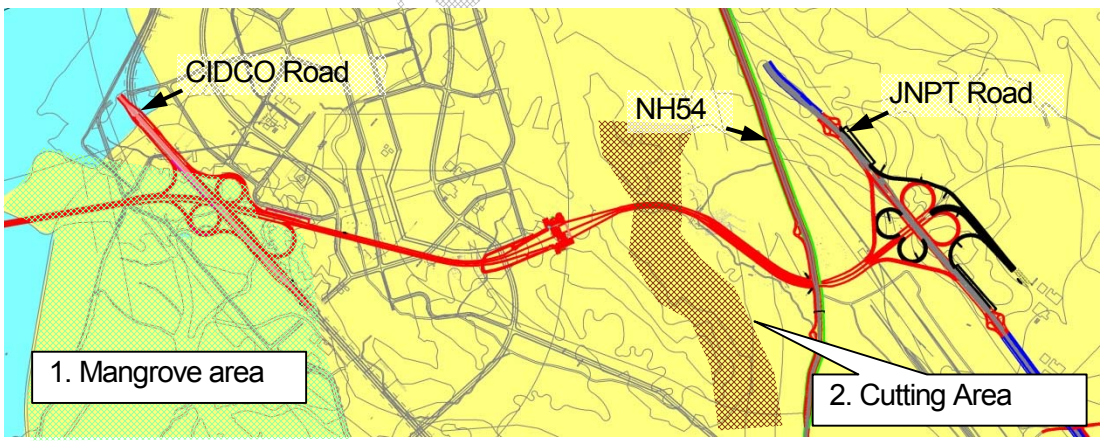
Source: JICA Study Team

Figure 5.1.4 Control Points at Mumbai Side

Horizontal alignment at the beginning point is decided by keeping the above control points.

2) Navi Munbai Side

1. The alignment passes through the edge of the mangrove area.
2. The alignment passes the area where cutting volume is reduced.
3. Connect CIDCO Road , NH54 and JNPT Road



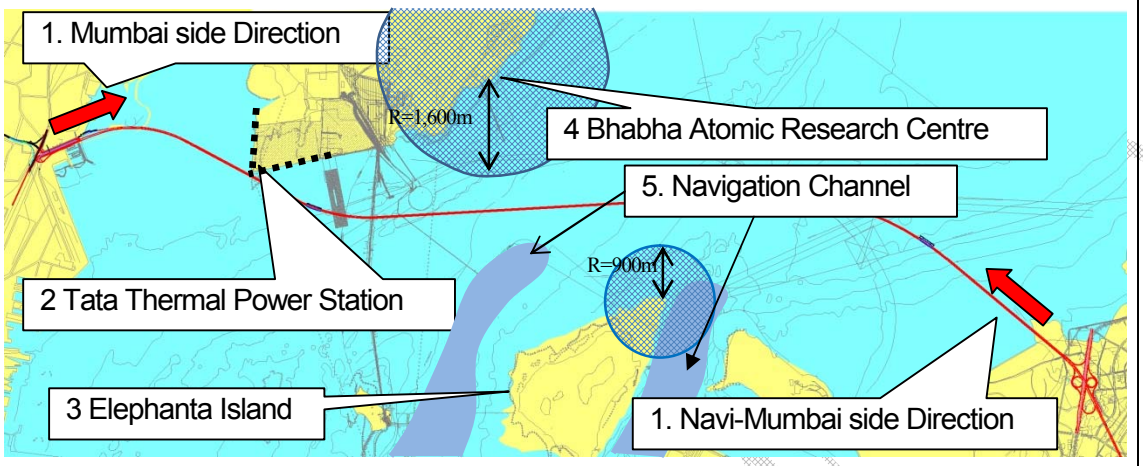
Source: JICA Study Team

Figure 5.1.5 Control Points at Navi-Mumbai Side

This alignment does not invade some control points. The curve radiuses are more than IRC standard.

3) On the Sea

1. Alignment direction of Mumbai and Navi Mumbai side shall be kept.
2. Not interfere to Tata Thermal Power Station
3. The separation more than 900m from Elephanta Island shall be secured.
4. The separation more than 1,600m from Bhabha Atomic Research Centre shall be secured.
5. Not interfere to navigation channel of large vessels



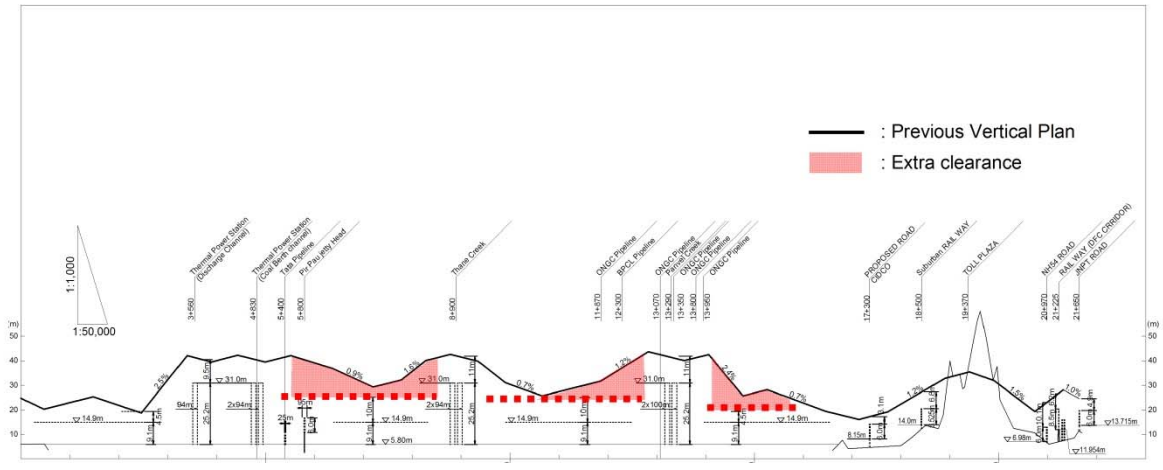
Source: JICA Study Team

Figure 5.1.6 Control Points on the Sea

The alignment is composed of three curves to avoid Tata Thermal Power Station and to keep the alignment direction of Mumbai and Navi-Mumbai side

(2) Control Points of Vertical Alignment

The control points of vertical alignment shows in Figure 5.1.7. It was clarified that there is an extra clearance in some sections for vertical alignment by securing the necessary vertical clearances.



Source: JICA Study Team

Figure 5.1.7 Control Points of Vertical Alignment

5.1.3. Summary of the Horizontal Alignment

Horizontal alignment of MTHL has been fixed by the following reasons:

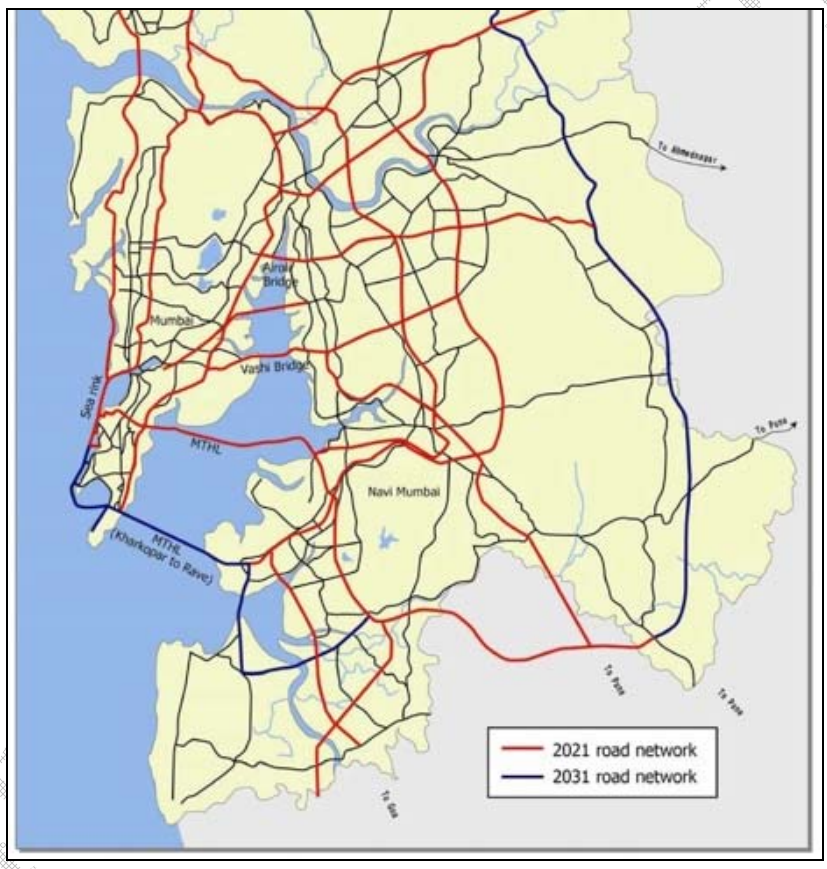
(1) Bay Crossing Route

1) Beginning points at Mumbai side

Northern route (connected at Sewri) was recommended in 1981 by a steering group, however, the details of the study documents was not able to find out. Therefore, review was carried out in a current viewpoint.

According to the master plan of the Mumbai Metropolitan Region that is the upper plan, the MTHL on Mumbai side starts from Sewri in a road network in the future. The followings are the reason:

- ✓ There is another plan on southern route linking Colaba (southern tip of Mumbai Island) with Uran in the master plan of the Mumbai Metropolitan Region.
- ✓ There is a plan linking western freeway via east-west corridor.
- ✓ There is a widening plan of Vashi Bridge on northern side of Sewri

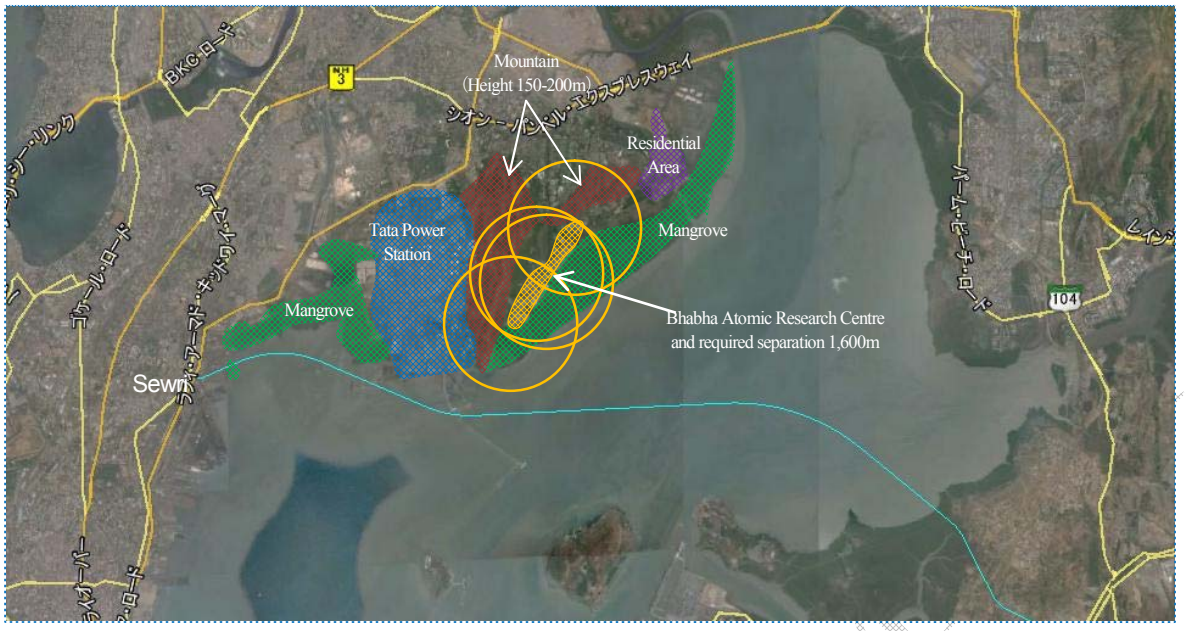


Source: Comprehensive Transport Study for Mumbai Metropolitan Region

Figure 5.1.8 Future Road Network

In addition, regarding the connection to the northern Sewri, an alignment which satisfy the followings is impossible since there is not have space to construction new road.

- ✓ Not interfere to Tata Thermal Power Station
- ✓ The separation more than 1,600m from Bhabha Atomic Research Centre shall be secured.
- ✓ Cutting mountain shall be avoided as much as possible.



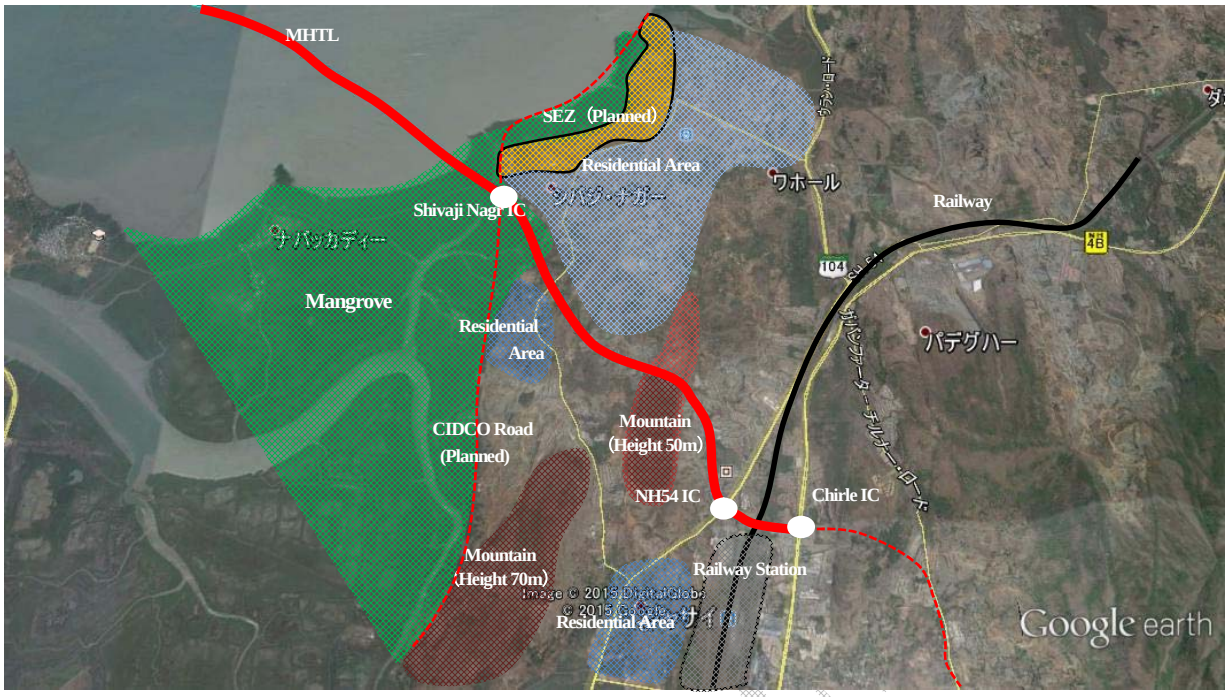
Source: JICA Study Team

Figure 5.1.9 Land Use Map on Northern Area of the Proposed Alignment

2) Ending points at Nhava (Navi-Mumbai) side

Regarding the alignment of Nhava side, the route comparison has been conducted in 1996 as described before. It is clear that the proposed alignment is fixed in consideration of the followings:

- ✓ The connection with CIDCO Road connected to Navi-Mumbai Airport, NH54, and JNPT Road connected to Jawaharlal Nehru Port.
- ✓ There is an upper plan of new road connected to Mumbai-Pune Expressway from Chirle (ending point of MTHL).
- ✓ Alignment of MTHL passes the side of Planned Special Economic Zone.
- ✓ Alignment of MTHL passes the side of residential area. In other words, the alignment is decided to minimize the resettlement.
- ✓ Alignment is considered to minimize the volume of cutting soil.
- ✓ Alignment is considered to minimize the impact on mangrove forest.



Source: JICA Study Team

Figure 5.1.10 Control Point of Alignment on Nhava (Navi-Mumbai) Side

3) Control of Alignment on Marine Section

As shown in Figure 5.1.9, alignment of marine section was decided in consideration of the following control points:

- ✓ Not interfere to Tata Thermal Power Station
- ✓ The separation more than 900m from Elephanta Island shall be secured.
- ✓ The separation more than 1,600m from Bhabha Atomic Research Centre shall be secured.
- ✓ Not interfere to navigation channel for large vessels of Jawaharlal Nehru Port

5.1.4. Structure Type

In general, there are 3 typical structures such as 1) viaduct bridges, 2) immersed tunnel and 3) shield tunnel are selected.

With regard to the tunnel, at least 1.5 to 2 times cost of bridge is expected since relevant utilities and facilities are required. Additionally construction period is longer than bridge, and maintenance cost is also higher than bridge. Thus bridge type is selected from the view of construction period and costs mainly.

5.1.5. Alternative Analysis

As explained from article 5.1.1 to 5.1.4, the route and fundamental structure have concluded and approved by central government from the view of natural & social environment, security and adjustment with other projects. Thus factor on alternative analysis is limited as follows. As shown in Table 5.1.2, Span length and location of IC is listed up as factor of alternative analysis, however, in general, the location of IC is planned at actual connected trunk road, and hence, there are not any options to shift other area so long as the connected road plan does not change.

Table 5.1.2 Selected Factors on Alternative Analysis

Factor/ Condition	Reason for adoption
Location of Interchange	It is expected that changing of IC location may give positive impacts from the view of natural and social consideration. However since the location shall be set up at cross point with connected road, the location of IC cannot be shifted to other points. Thus "location of IC" is not appropriate factor on the analysis.
Span length (steel girder bridge)	It is expected that changing span length reduce excavated area in mudflat and mangrove cutting area. Adoption of steel girder for superstructure provides long span and reduction of number of piers and piles. Thus this factor is selected as an appropriate factor on the analysis

Source: JICA Study Team

"Span length" is selected as a factor on the alternative analysis and evaluated from the view of natural & social environment and economy & cost as shown in Table 5.1.3.

According to the result of analysis, option-2 with 80m span length has advantage slightly on the all items on natural environment such as negative impacts on mudflat, mangrove, Flamingo habitat, benthos, CRZ and tidal flow except land acquisition & resettlement. Although differences of impacts between Option 1 and 2 are not significant from the view of impacts on natural environment, Option-2 (80m) has extremely disadvantage from the view of construction cost. Additionally, it is supposed the adverse impacts are minimized by mitigation measures on management plan. Thus Option-1 (50m) should be selected from comprehensive point of view.

Table 5.1.3 Alternative Analysis (Span Length)

Factor/ Condition (analyzed area)	Option-1 50m span with PC girder	Option-2 80m span with steel girder	Differences between options, Evaluation and mitigation measure
1. Area of Cutting mangrove (ST0.6-0.8km and 16.5-17.9km)	App. 2,100m2	App. 1,300m2	800m2 5 times of cutting mangrove area shall be replanted in the designated area by MoEF
2. Impacts on Flamingo (ST0.6-5.6km)	Width of flying course under bridge is 50m	Width of flying course under bridge is 80m	It is supposed Flamingo fly over bridge not under bridge. Thus there are no significant differences.
3. Impacts on Benthos in Mudflat area (ST0.6-5.6km and 15-17.9km note1)	Excavated impacts area is App. 2,100m2	Excavated impacts area is app. 1,300m2	800m2 5 times of cutting mangrove area shall be replanted and created new habitat in the designated area by MoEF
4. Impact on CRZ (0.6-2.1km and 16.5-17.1km) note2)	Excavated and cutting mangrove area is App. 1,100 m2	Excavated and cutting mangrove area is App. 690 m2	410m Mitigation measures are committed on CRZ clearance.
6. Tidal flow note3)	Few impacts (note3)	Few impacts (note3)	Same impacts and negligible
7. Land acquisition (ST0-0.6km and 16-22km)	Land acquisition area is same as Option-2	Land acquisition area is same as Option-1	Same impacts and compensation policy under Indian laws and JICA Guidelines
8. Construction Cost(entire of alignment) (Considered mudflat and mangrove area ST0.6-5.6km and 15-17.9km)	Approx. 1.640 crore INR	Approx. 2,490 crore INR	850 crore INR (= 15 billion yen)

Note 1) Mudflat and mangrove area is ST0.6km – 5.6km in Sewri side and 15.0 km – 17.9 km in Shivaji Nagar side

Note 2) CRZ is located in the sea section from ST0.6-2.1km (CRZ-1) and 16.48 – 17.08km (CRZ I and II)
Note 3) Adverse Impacts on tidal flow by construction of MTHL in case of 50-180m span length has been analyzed and concluded as "negligible level" by The Central Water and Power Research Station (CWPRS). Thus degree of impacts in both case of 50m and 80m are evaluated as same level.
Source: JICA Study Team

5.1.6. Zero Option

In case of "Zero Option" which does not implement the project, following adverse negative and positive impacts are expected. Some positive impacts are expected, however, since the expected negative impacts are serious from the view of economic and environment, "With project case" is desirable comprehensively;

Negative Impacts

- ✓ The congested situation must be accelerated and prevent from sound urban development. Furthermore, this "without case" will not give a synergy effect on other development plan such as a construction of Navi Mumbai Air Port.
- ✓ The accelerated congestion must make all of vehicles decrease travelling speed, and then volume of greenhouse gases increase from vehicles.

Positive Impacts

- ✓ Mangrove and mud flat is conserved
- ✓ Resettlement and land acquisition is not caused

5.2. Screening

As described in Chapter 4, obtaining of EC for EIA is not required in accordance with EIA Notification 2006, however EC for CRZ in accordance with CRZ Notification 2011 has been required, and MMRDA has obtained this EC in 2013 by preparation of Rapid EIA 2012. On the other hand, JICA HQ has judged that some significant impacts on natural and social environment are predicted on the MTHL project, thus the project has been classified as "Category A" which is required to conduct EIA level study.

5.3. Scoping

Scope of the EIA study for the project is discussed in this section. The environmental scoping is conducted based on an environmental reconnaissance by the JICA Study Team in April 2015.

The result of scoping is indicated on the Leopold scoping matrix and reason tables. First of all, impact factors, impacted item and impact degree are shown on the following scoping matrix based on JICA's Guidelines.

(1) Scoping Matrix for MTHL

As the result of Scoping Analysis, 13 items such as Air, Water, Waste, Noise & Vibration, Biology, Hydrology, Topography and Geography, Existing Infrastructures, Misdistribution of benefit and damage, land scape, infection diseases and accident are selected as item of the Rating B which has some negative impacts.

Additionally mainly social items such as "involuntary resettlement" are evaluated as "Rating C" which has unknown impacts.

Table 5.3.1 Draft Scoping Matrix for MTHL

	No	Affected Activities / Impacted Item (JICA Guidelines)	(Items of the Rapid EIA 2012)	During Construction	Pre/ During Construction Phase: Land acquisition and Loss of properties and Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation(including Mangrove)	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	After Construction	Operation Phase: Increase of Through Traffic and traveling speed	Appearance/ Occupancy of Roads and related building structures including tunnel and embankment	Increasing influx of settlers
Pollution	1	Air Pollution	Air quality/ Siting of borrow and quarry material areas	B-	D-	D-	D-	D-	B-	D-	D-	D-	B-	B-	D-	D-
	2	Water pollution	Water Quality/ Construction of labor camp/ Siting of borrow and quarry material areas	B-	D-	B-	D-	B-	D-	D-	D-	B-	D-	D-	D-	D-
	3	Waste	Solid waste management/ Construction of labor camp/ Topography, Soil and Geology	B-	D-	D-	B-	B-	D-	D-	D-	B-	D-	D-	D-	D-
	4	Soil contamination	Topography, Soil and Geology/ Siting of borrow and quarry material areas	C-	D-	D-	D-	B-	D-	D-	D-	D-	D-	D-	D-	D-
	5	Noise and Vibration	Ambient Noise	B-	D-	D-	D-	D-	B-	D-	D-	D-	B-	B-	D-	D-
	6	Ground Subsidence		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	7	Odor		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	8	Sediment quality	Topography, Soil and Geology(No.4)	C-	D-	D-	D-	C-	D-	D-	D-	D-	D-	D-	D-	D-
Natural Environment	9	Protected Area	Reserved Forest and Fauna	B-	D-	D-	B-	B-	B-	D-	D-	C-	B-	B-	B-	D-
	10	Ecosystem	Ecology and Biodiversity/ Ecology/Construction of labor camp	B-	D-	D-	B-	B-	B-	D-	D-	C-	B-	B-	B-	D-
	11	Hydrology		B-	D-	D-	D-	B-	D-	D-	D-	D-	B-	D-	B-	D-
	12	Topography and geology	Topography, Soil and Geology	B-	D-	D-	D-	B-	D-	D-	D-	D-	B-	D-	B-	D-
Social	13	Involuntary resettlement		B-	B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	14	The poor		C-	C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	15	Indigenous and ethnic people		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	16	Local economy such as employment and livelihood	Quality of Life/Fisheries	C-	C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	17	Land use and utilization of local resources	Land use/Fisheries	C-	C-	D-	C-	D-	D-	D-	D-	D-	C-	D-	C-	D-

	No	Affected Activities / Impacted Item (JICA Guidelines)	(Items of the Rapid EIA 2012)	During Construction	Pre/ During Construction Phase: Land acquisition and Loss of properties and Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation(including Mangrove)	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	After Construction	Operation Phase: Increase of Through Traffic and traveling speed	Appearance/ Occupancy of Roads and related building structures including tunnel and embankment	Increasing influx of settlers
	18	Waste Usage	Water Quality	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	19	Existing social infrastructures and services	Utility services and community severance	B-	B-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
Social Environment	20	Social institutions such as local decision making institutions		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	21	Misdistribution of benefit and damage	Quality of life	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	22	Local conflict of interests		B-	D-	D-	D-	D-	D-	D-	D-	B-	D-	D-	D-	D-
	23	Cultural Heritage	Archeological /Heritage	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	24	Landscape	Aesthetics and landscape	B-	D-	D-	D-	D-	D-	B-	D-	D-	B-	D-	B-	D-
	25	Gender		C-	C-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	26	Right of Children		D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-	D-
	27	Infectious diseases such as HIV/AIDS		B-	D-	D-	D-	D-	D-	D-	D-	B	D-	D-	D-	D-
	28	Labor environment (including work safety)		B-	D-	D-	D-	D-	D-	D-	D-	B-	D-	D-	D-	D-
Other	29	Accidents	Accident hazards and safety	B-	D-	D-	D-	D-	B-	D-	D-	D-	B-	B-	D-	D-
	30	Cross Boundary impacts and climate change		B-	D-	D-	B-	D-	B-	B-	D-	D-	C-	C-	D-	D-

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary. (+: Positive impacts, - : Negative impacts)
Source: JICA Study Team

Table 5.3.2 Reasons for Draft Scoping on MTHL

Area	No.	Impacted Item (Item on the Rapid EIA)	Rating		Reasons of the Rating
			Pre/During Const	After Const	
Pollution	1	Air Pollution (Air quality/ Siting of borrow and quarry material areas)	B-	B-	**Construction phase:** Temporary negative impacts are expected on air quality due to construction machines and equipment. **Operation phase:** Negative impact is expected due to the increase in traffic number.
	2	Water Pollution (Water Quality/ Construction of labor camp/ Siting of borrow and quarry material areas)	B-	D-	**Construction phase:** Turbid water may be generated by earth works and excavation in the water where bridges are planned. Additionally Organic polluted water may be discharged from base camp if mitigation not provided. **Operation phase:** No serious impacts are expected(The service area is not planned on this project)
	3	Waste (Solid waste management/ Construction of labor camp/ Topography, Soil and Geology)	B-	D-	**Construction phase:** Construction waste such as waste soil and cutting trees are expected. Additionally domestic waste and night soil may be generated from construction base camp. **Operation phase:** No serious impacts are expected(The service area is not planned on this project)
	4	Soil Contamination (Topography, Soil and Geology/ Siting of borrow and quarry material areas)	C-	D-	**Construction phase:** Excavated soil in the mudflat and mining area may contain polluted soil such as heavy metals. **Operation phase:** No impacts are expected
	5	Noise and Vibration (Ambient Noise)	B-	B-	**Construction phase:** Noise generation is expected due to works of construction machines and equipment. **Operation phase:** Traffic Noise and Vibration is expected because of the increase in traffic number and travelling speed.
	6	Ground subsidence	D-	D-	**Construction and operation phase:** No impacts are expected since activities which cause ground subsidence not expected.
	7	Odor	D-	D-	**Construction and operation phase:** No impacts are expected since activities which cause odor are not expected.
	8	Sediment quality (Topography, Soil and Geology(No.4))	C-	D-	**Construction phase:** Excavated soil in the mudflat and may contain polluted soil such as heavy metals. **Operation phase:** No impacts are expected
Natural Environment	9	Protected Area (Reserved Forest and Fauna)	B-	B-	**Construction and operation phase:** There are not any national parks on the alignment, however, the alignment is passing through a part of coastal regulation zone (CRZ). Although an environmental clearance (EC) of CRZ has been given from MOEF in 2013, the degree of impact should be confirmed.
	10	Ecosystem (Ecology and Biodiversity/ Ecology/Construction of labor camp)	B-	B-	**Construction and Operation phase:** Some considerable species are observed in the project area. The degree of impacts will be evaluated based on literature surveys and interview survey with specialists.
	11	Hydrology	B-	B-	**Construction and Operation phase:** Construction of bridge may change hydrological situation of the creek and sea.
	12	Topography and geology (Topography, Soil and Geology)	B-	B-	**Construction and operation phase:** Considerable topography and geological sites are not located in the project area, thus no impact is expected. However embankment section may have risks of land slide.
Social Environment	13	Involuntary resettlement	B-	D-	**Pre-Construction phase:** Illegal occupants are observed in Sewri area, and number of affected persons will be identified on the SIA survey. **Operation phase:** No impact is expected
	14	The Poor	C-	D-	**Pre-Construction phase:** Impacts will be assessed based on the SIA survey. **Operation phase:** No impact is expected
	15	Indigenous and ethnic people	D-	D-	**Pre-Construction and Operation phase:** Few impacts are expected
	16	Local economy such as employment and livelihood	C-	D-	**Pre-construction phase:** Livelihood of residents and shopkeepers may be affected by land clearance. The degree of impacts will be assessed on the SIA surveys. **Operation phase:** Few impacts are expected
	17	Land use and utilization of local resources (Quality of Life/Fisheries)	C-	C-	**Pre-construction phase:** No agriculture land is observed, but quarry sites are located on Navi Mumbai side. Additionally construction of bridge may affect to fishermen in the sea. Thus the degree of impacts to fishermen will be assessed by the SIA surveys. **Operation phase:** It is not likely to give adverse impacts since appropriate land management along the road in Navi Mumbai side is planned by CIDCO.

Area	No.	Impacted Item (Item on the Rapid EIA)	Rating		Reasons of the Rating
			Pre/During Const	After Const	
					w impacts are expected However construction of bridge may affect to fishermen in the sea. Thus the degree of impacts to fishermen will be assessed by the SIA surveys.
	18	Water Usage (Water Quality)	D-	D-	**Construction phase:** Few impacts are expected since major structure is viaduct and earthwork is limited in the project area. Furthermore, there are any residential area in the earth work area, thus it is not likely to give any impacts on this item. **Operation phase:** Few impacts are expected.
	19	Existing social infrastructures and services	B-	D-	**Pre-Construction and Construction phase:** Some temples and public facilities may be affected by land acquisition for the road construction. Thus the degree of impacts will be assessed on the SIA surveys. **Operation phase:** Few impacts are expected because major structure is viaduct.
	20	Social institutions such as local decision making institutions	D-	D-	**Construction and operation phase:** Impacts are not expected, since local decision making institute will continue after the road construction.
	21	Misdistribution of benefit and damage (Quality of life)	D-	D-	**Construction and operation phase:** Misdistribution of benefit and damage caused by the road & bridge construction is not expected.
	22	Local conflict of interests	B-	D-	**Construction phase:** Local inhabitants and local authorities may request to ensure job opportunities as construction workers. **Operation phase:** No impact is expected
	23	Cultural Heritage (Archeological /Heritage)	D-	D-	**Pre-Construction and Construction Phase:** No registered cultural heritage on the alignment. **Operation phase:** No impact is expected
	24	Landscape (Aesthetics and landscape)	B-	B-	**Construction and operation phase:** Sewri Fort and Elephanta Island (World Cultural Heritage) is located near the alignment, thus landscape from each site may change after construction of bridges and road.
	25	Gender	C-	D-	**Pre-Construction and Construction phase:** Male head of the household may seize the initiative in India, thus actual situation should be confirmed on SIA survey. **Operation phase:** Few impact is expected
	26	Right of children	D-	D-	**Construction and operation phase:** Few impact is expected
	27	Infectious diseases such as HIV/AIDS	B-	D-	**Construction phase:** Infectious diseases such as STD are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provoke to provide habitats of mosquito that possibly transmits dengue fever. **Operation phase:** Road operation which causes infectious diseases is not expected.
	28	Labor environment	B-	D-	**Construction phase:** Construction work environment needs to be considered in accordance with relevant laws and regulations. **Operation phase:** No impact is expected.
Other	29	Accidents (Accident hazards and safety)	B-	B-	**Construction phase:** Construction vehicles may use existing local road near residential areas, thus risk of traffic accident may increase. **Operation phase:** Increased speed may increase gravity of accidents.
	30	Cross boundary impacts and climate change	B-	C-	**Construction phase:** Deforestation and operation of construction machines may increase greenhouse gases such as CO2. **Operation phase:** Reduction of distance between Navi Mumbai and Mumbai area will cut amount of greenhouse gases such as CO2. Furthermore, replantation 5 times of cutting tree will be done, thus such replantation will give positive impacts. However construction of the sealink may generate additional traffic flow from developed area, thus the impact should be estimated by quantitative forecast.

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary.
Source: JICA Study Team

5.4. Baseline Survey and Analysis Methodology

The expected baseline and survey and analysis methodologies are shown below.

Mainly,

1) Measurement of vibration base on Gap Analysis between Rapid EIA 2012 and JICA Guidelines,
2) Updating of statistical data and current secondly data and
3) Quantitative forecast on air, noise, vibration and water quality based on the latest traffic condition will be done based on the Rapid EIA 2012, and then the EIA will be modified and approved by MMRDA.

Methodologies of baseline survey and analysis are shown in the following Table 5.4.1

Table 5.4.1 Baseline Survey and Analysis Methodology

Area	No.	Item (on Rapid EIA 2012)	Rating		Survey Methodology	Forecast Methodology
			Pre and during Const.	Operation		
Pollution	1	Air pollution (Air quality/ Siting of borrow and quarry material areas)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction Phase:** Qualitative analysis **Operation Phase:** - Quantitative analysis (Puf model : calm wind model)
	2	Water pollution (Water Quality/ Construction of labor camp/ Siting of borrow and quarry material areas)	B-	D-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction Phase:** Qualitative analysis and quantitative analysis based on other cases
	3	Waste (Solid waste management/ Construction of labor camp/ Topography, Soil and Geology)	B-	D-	Refer to Rapid EIA in 2012 and the preparatory survey by JICA	**During Construction Phase:** Quantitative forecast of cutting trees and excavated soil based on construction plan
	4	Soil Contamination (Topography, Soil and Geology/ Siting of borrow and quarry material areas)	C-	D-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction Phase:** Qualitative forecast based on the Rapid EIA 2012
	5	Noise and Vibration (Ambient Noise)	B-	B-	-Site Survey: Noise : Not conducted Vibration: measurement at 2 points for 24 hours -Literature Survey: Refer to Rapid EIA in 2012 and the latest monitoring data	**During Construction Phase:** Quantitative or qualitative analysis based on other cases. **Operation Phase:** - Quantitative analysis (ASJ CN-Model 2008)
	6	Ground Subsidence (Topography, Soil and Geology(No.4))	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	7	Odor	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	8	Sediment Quality (Topography, Soil and Geology(No.4))	C-	D-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any	**During Construction:** Qualitative analysis based on the Rapid EIA in 2012
Environmental	9	Protected Area (Reserved Forest and Fauna)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest	**During Construction and Operation Phase:** Qualitative analysis based on the

Area	No.	Item (on Rapid EIA 2012)	Rating		Survey Methodology	Forecast Methodology
			Pre and during Const.	Operation		
					monitoring data, if any	Rapid EIA in 2012 and relevant monitoring data, if any
	10	Ecosystem (Ecology and Biodiversity/ Ecology/Construction of labor camp)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012 and the latest monitoring data, if any Interview survey with specialist and other project study cases in Japan is referred.	**During Construction and Operation Phase:** Qualitative analysis based on the Rapid EIA in 2012, interview survey with specialists and relevant monitoring data, if any
	11	Hydrology	B-	B-	- Site Survey: Not conducted - Literature Survey: Refer to secondary data the latest monitoring data and results on this JICA Survey, if any	**During construction and operation phase:** Refer to other quantitative analysis
	12	Topography and geology (Topography, Soil and Geology)	B-	B-	-Site Survey：Not conducted -Literature Survey： Refer to Rapid EIA in 2012, the latest monitoring data and topo. & geo. survey result on this JICA Survey	**During construction and operation phase:** Qualittive analysis
Social Environment	13	Involuntary resettlement	B-	D-	Refer to SIA survey	**During construction phase:** Quantitative analysis based on SIA surveys
	14	The poor	C-	D-	Refer to SIA survey	**During construction phase:** Quantitative analysis based on SIA surveys
	15	Indigenous and ethnic people	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	16	Local economy such as employment and livelihood (Quality of Life/Fisheries)	C-	D-	Refer to SIA survey	**During construction phase:** Quantitative or qualitative analysis based on SIA surveys
	17	Land use and utilization of local resources (Land use/Fisheries)	C-	C-	Refer to SIA survey	**During construction phase:** Quantitative or qualitative analysis based on SIA surveys
	18	Water Usage (Water Quality)	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	19	Existing social infrastructures and services (Utility services and community severance)	B-	D-	Refer to SIA survey	**During construction phase:** Qualitative analysis based on SIA surveys
	20	Social institutions such as local decision making institutions	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	21	Misdistribution of benefit and damage (Quality of life)	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	22	Local conflict of interests	B-	D-	Refer to SIA survey	**During construction phase:** Qualitative analysis based on SIA surveys
	23	Cultural Heritage (Archeological /Heritage)	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	24	Landscape (Aesthetics and landscape)	B-	B-	-Site Survey: Visual Survey at Sewri and Elphanta Island (April 2015)	**During Construction and Operation Phase:** Qualitative analysis or preparation of Photo montage
	25	Gender	C-	D-	Refer to SIA survey	**During construction phase:** Quantitative or qualitative analysis

Area	No.	Item (on Rapid EIA 2012)	Rating		Survey Methodology	Forecast Methodology
			Pre and during Const.	Operation		
						based on SIA surveys
	26	Right of Children	D-	D-	－(surveys on this item is not required due to no impacts)	Not required because few impacts are expected
	27	Infectious diseases such as HIV/AIDS	B-	D-	Refer to SIA survey	**During construction phase:** Qualitative analysis based on SIA surveys
	28	Labor environment including work safety	B-	D-	Legal framework regarding labor environment and safety shall be clarified and the safety shall be secured. Relevant laws and actual situation shall be interviewed with relevant organizations.	Qualitative and quantitative analysis based on the construction plan
Other	29	Accident (Accident hazards and safety)	B-	B-	Literature Survey: Statistical data from police department, if any	**During Construction and Operation Phase:** Quantitative analysis based on statistical data
	30	Cross Boundary impacts and climate change	B-	C-	Site Survey: Not conducted Literature Survey: Refer to the drawing and SIA survey results (number of cut trees)	**During Construction and Operation Phase:** Quantitative analysis based on generation of CO2

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary.
Source: JICA Study Team

CHAPTER 6 RESULT OF BASELINE SURVEY AND IMPACT ANALYSIS

6.1. Pollution

6.1.1. Air Pollution

(1) Result of Baseline Survey

1) Selection of Monitoring Stations

In order to know the ambient air quality status, air quality monitoring was carried out at six different locations in the influence zone of MTHL alignment as per CPCB guidelines. These locations are shown in Figure 6.1.1. The monitoring was carried out in post monsoon season during October to December 2011 for Rapid EIA study 2012 (REIA-2012).

The monitoring stations were selected considering the spatial relationship of various land use along the project road & wind direction in accordance with BIS guidelines [IS: 5182 (part-14)-1985].

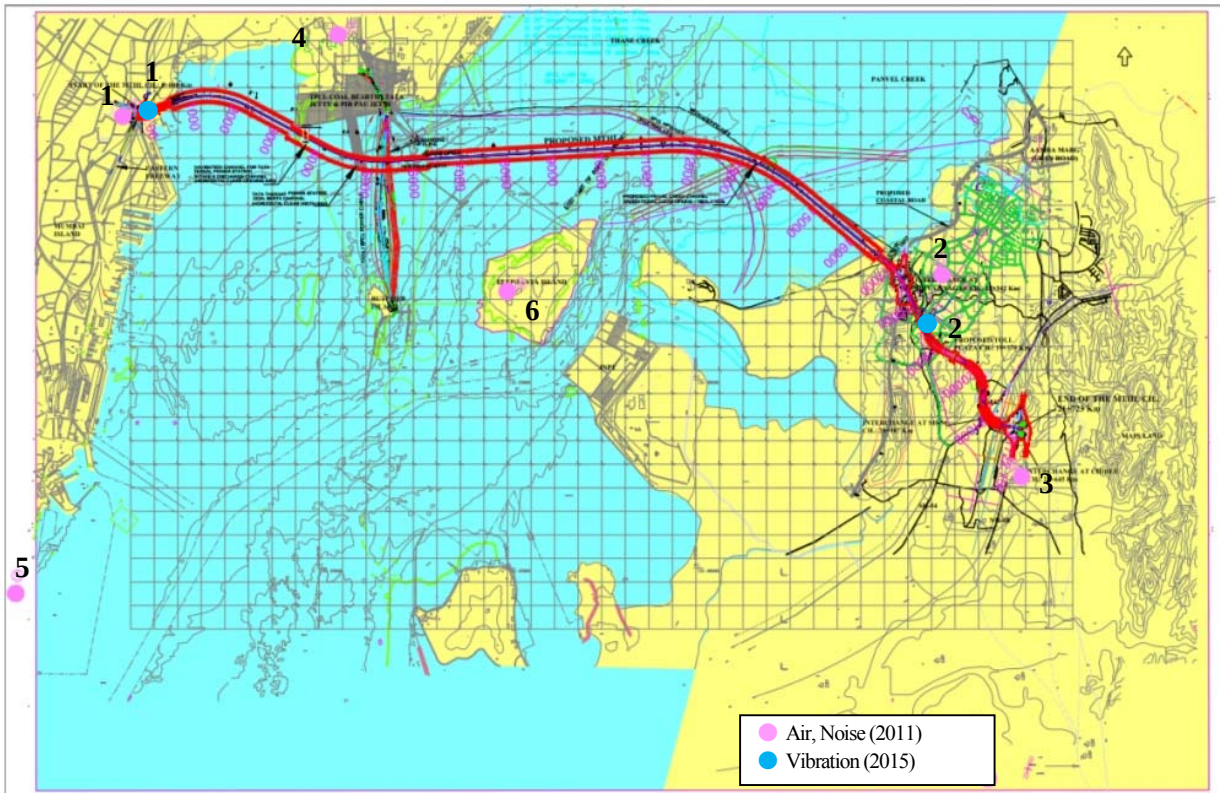


Figure 6.1.1 Air and Noise & Vibration Quality Monitoring Locations

2) Monitoring Methodology

Monitoring of ambient air quality was carried out as per CPCB (Central Pollution Control Board) guidelines. The concentration of ambient air is measured as per the methods given in MOEF notification at 18/11/2009 in respect of National Ambient Air Quality Standards. The value of most particles is low and below the Indian standard and IFC standard, but the value of SPM is high and above the standards.

Table 6.1.1 Monitored Ambient Air Quality (Average Values: 2011)

Location / Parameter	Chirle	Shivaji Nagar	Mahul	Sewri	Gate Way of India	Elephanta Island	UNIT	Indian Standard		(reference) IFC Standard	
								Industrial, Residential Rural and Other Areas	Sensitive Areas	Middle term objective	Guideline value
Particulate Matter (SPM)	266.33 (exceeding)	135.58 (exceeding)	153.33 (exceeding)	393.58 (exceeding)	220 (exceeding)	92	$\mu g/m^3$	60[1] 100[2]	60[1] 100[2]	70[1] 150[2]	20[1] 50[2]
Respirable Particulate Matter (RSPM)	79.92	42.83	48.42	141.00	48.5	24	$\mu g/m^3$				
Sulphur Dioxide (SO2)	53.67	31.33	32.02	66.85	37.1	12.6	$\mu g/m^3$	50[1] 80[2]	20[1] 80[2]	125[2]	20[2]
Nitrogen Dioxide (NO2)	61.83	39.25	38.18	74.82	53.4	13.8	$\mu g/m^3$	40[1] 80[2]	30[1] 80[2]		40[1] 200[2]
Ammonia (NH3)	21.97	10.15	16.70	31.32	26.2	28.5	$\mu g/m^3$	100[1] 400[2]	100[1] 400[2]		
Lead (Pb)	0.61	0.33	0.47	0.82	BDL	BDL	$\mu g/m^3$	0.5[1] 1.0[2]	0.5[1] 1.0[2]		
Carbon Monoxide (CO)	2.04	1.08	1.52	2.54	1.8	2.27	mg/m^3	2[3] 4[4]	2[3] 4[4]		
Hydrocarbon (HC)	1086.27	973.92	1090.42	1348.92	861	1083	$\mu g/m^3$				
Ozone (O3)	16.00	9.77	11.66	19.68	17.8	10.5	$\mu g/m^3$	100[3] 180[4]	100[3] 180[4]	160[3]	100[3]
Benzene (C6H6)	BDL	BDL	BDL	BDL	BDL	BDL	$\mu g/m^3$	5[1]	5[1]		
Benzopyrene (BaP)	BDL	BDL	BDL	BDL	BDL	BDL	ng/m^3	1[1]	1[1]		
Arsenic (As)	BDL	BDL	BDL	BDL	BDL	BDL	ng/m^3	6[1]	6[1]		
Nickel (Ni)	2.12	1.32	1.81	3.43	BDL	BDL	ng/m^3	20[1]	20[1]		

Source: Rapid EIA 2012 MMRDA, Surveyed by CES

Note: SPM: Suspended Particulate Matter RPM: Respirable Particulate Matter, NOx: Oxides of Nitrogen, SO2: Sulphur Dioxide, CO: Carbon monoxide
1)= Annual, 2)=24hours, 3)= 8hours, 4)=1hour, BDL: Below Detected Level

Table 6.1.2 Ambient Air Quality Monitoring Standards (CPCB)

Pollutant	Time Weighted Average	Industrial, Residential Rural and Other Areas	Sensitive Areas
Sulphur Dioxide (SO2) (μg/m3)	Annual * 24 hours**	50 80	20 80
Oxides of Nitrogen (NO2) (μg/m3)	Annual * 24 hours**	40 80	30 80
Particulate Matter (Size less than 10μm or PM10) (μg/m3)	Annual * 24 hours**	60 100	60 100
Particulate Matter (Size less than 2.5μm or PM2.5) (μg/m3)	Annual * 24 hours**	40 60	40 60
Ozone (O3) (μg/m3)	8 hours** 1 hour	100 180	100 180
Lead (Pb) (μg/m3)	Annual * 24 hours**	0.50 1.0	0.50 1.0
Carbon Monoxide (CO) (mg/m3)	8 hours** 1 hour**	2 4	2 4
Ammonia (NH3) (μg/m3)	Annual * 24 hours**	100 400	100 400
Benzene (C6H6) (μg/m3)	Annual *	05	05
Benzopyrene (BaP) (ng/m3)	Annual *	01	01
Arsenic (As) (ng/m3)	Annual *	06	06
Nickel (Ni) (ng/m3)	Annual *	20	20

Note) *Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 8 hourly or 1 hourly monitored values, applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Table 6.1.3 Air Quality Guideline (IFC Standard)

Pollutant	Time Weighted Average	Value	
Sulphur Dioxide (SO2) (μg/m3)	24 hours	Middle term objective-1	125
		Middle term objective-2	50
		Guideline value	20
	10 minutes	Guideline value	500
Nitrogen Dioxide (NO2) (μg/m3)	annual	Guideline value	40
	1 hour	Guideline value	200
Particulate Matter (Size less than 10μm or PM10) (μg/m3)	annual	Middle term objective-1	70
		Middle term objective-2	50
		Middle term objective-3	30
		Guideline value	20
	24 hours	Middle term objective-1	150
		Middle term objective-2	100
		Middle term objective-3	75
		Guideline value	50
Particulate Matter (Size less than 2.5μm or PM2.5) (μg/m3)	annual	Middle term objective-1	35
		Middle term objective-2	25
		Middle term objective-3	15
		Guideline value	10
	24 hours	Middle term objective-1	75
		Middle term objective-2	50
		Middle term objective-3	37.5
		Guideline value	25
Ozone (O3) (μg/m3)	8 hours	Middle term objective-1	160
		Guideline value	100

Source: Environmental, Health, and Safety Guidelines/GENERAL EHS GUIDELINES: ENVIRONMENTAL/ AIR EMISSIONS AND AMBIENT AIR QUALITY

The Ambient Air Quality Standards stipulated by CPCB (Central Pollution Control Board) are presented in Table 6.1.2 Ambient Air Quality Monitoring Standards (CPCB). At Chirle, PM concentrations are lower than the CPCB standards while SO2 and NOx concentrations are lower than the standards stipulated for 24 hours. The CO concentrations are below standard stipulated for residential areas. Whereas at Shivaji Nagar, the concentrations for all of the air parameters are lower than the ambient air CPCB standards. At Mahul it can be seen that except for SPM all other parameters are below the CPCB norms. At Sewri, the ambient concentrations of SPM, RSPM are above the CPCB standards whereas concentrations of SO2 and NOx are below the CPCB stipulations. Thus it can be seen from the above table that concentration of all the parameters are within the prescribed standard of MOEF except Sewri where the concentration of particulate matter is exceeding the standard. This may be due to the ongoing construction of Eastern Freeway at Sewri.

From the monitoring results of air quality, The background density, which must be the density of the area or point that do not be affected by any special pollution source, can be concluded. The monitoring of air quality was carried out at six points, but the results at five points are very high, and it can be concluded that those points are affected by some specific pollution sources, and they are not suitable as a background point. Therefore, the density at the point of Elephanta Island can be used as background density. This background density will be used later.

Table 6.1.4 Background Air Quality Density of the Project Area

Item	Particulate Matter (SPM)	Sulphur Dioxide (SO2)	Nitrogen Dioxide (NO2)	Carbon Monoxide (CO)
Background Density µg/m^3	92	12.6	13.8	2.27

Source: Rapid EIA 2012 (baseline data at Elephanta Island)

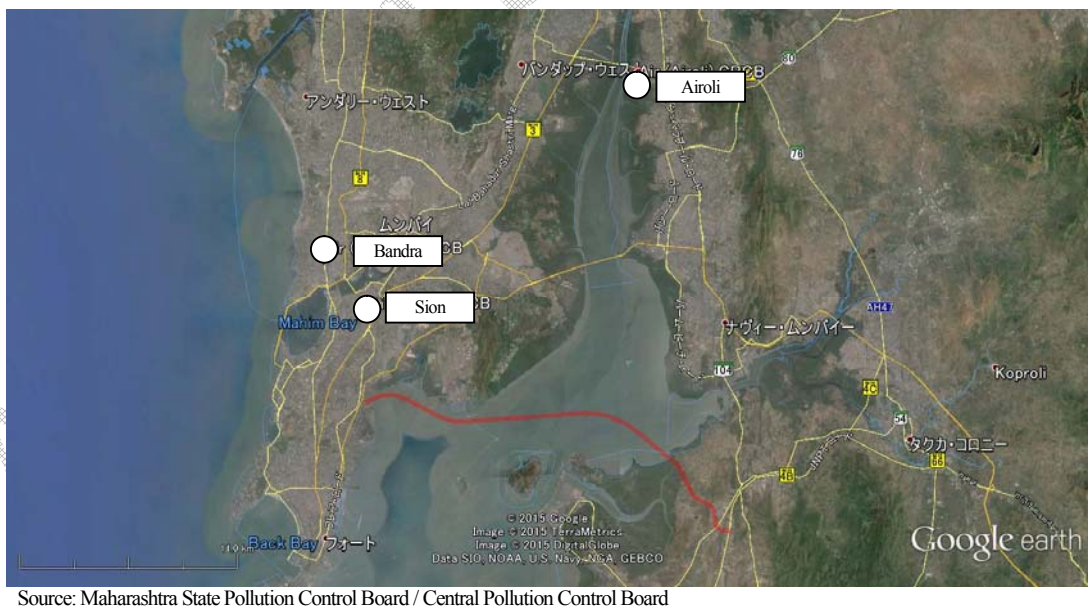
3) Secondly data

The air quality monitoring is conducting by Maharashtra state Pollution Control Board (MPCB) and Central Pollution Control Board (CPCB). The nearest monitoring locations and the latest data are monitored data is shown below. All monitored data indicated under standard level due to monsoon season.

Table 6.1.5 Monitored Ambient Air Quality by MPCB and CPCB (2015)

Location / Parameter	Mumbai side		Navi Mumbai Side	UNIT	Indian Standard		(reference) IFC Standard	
	Bandra 24hrs; 17th Aug. 2015 by CPCB	Sion 24hrs; 17th Aug. 2015 by MPCB	Airoli 24hrs; 17th Aug. 2015 by CPCB		Industrial, Residential Rural and Other Areas	Sensitive Areas	Middle term objective	Guideline value
Particulate Matter (SPM)	45.19 (meet standard)	-	50.88 (meet standard)	µg/m^3	100[2)]	100[2)]	150[2)]	50[2)]
Respirable Particulate Matter (RSPM)		135.0	-	µg/m^3				
Sulphur Dioxide (SO2)	16.33 (meet standard)	20.0 (meet standard)	14.37 (meet standard)	µg/m^3	80[2)]	80[2)]	125[2)]	20[2)]
Nitrogen Dioxide (NO2)	26.62	88.0	-	µg/m^3				200[2)]
Carbon Monoxide (CO)	BDL	-	0.50 (meet standard)	mg/m^3	4[4)]	4[4)]		

Source: Rapid EIA 2012 MMRDA, Survyed by CES
Note: SPM: Suspended Particulate MatterRPM: Respirable Particulate Matter, NOx: Oxides of Nitrogen, SO2: Sulphur Dioxide, CO: Carbon monoxide
1)= Annual, 2)=24hours, 3)= 8hours, 4)=1hour, BDL: Below Detected Level



Source: Maharashtra State Pollution Control Board / Central Pollution Control Board

Figure 6.1.2 Air Quality Monitoring Locations by MPCB and CPCB

(2) Potential Impacts

1) During Construction

Temporary negative impacts are expected on air quality due to construction machines and

equipment.

2) After Construction

Negative impact is expected due to the increase in traffic number.

(3) Impact Forecast

1) During Construction

Exhaust gases including CO, NO2, SO2 and SPM are discharged from construction machines and may impact to the near residential area. However this adverse impact is not serious because of the following reasons.

- Operation time is limited
- Most of the construction area is on the ocean, far from the residential area
- Most of the road is bridge structure, and therefore, earthworks is less than other structure.
- Most of the earthworks is underwater construction

2) After Construction

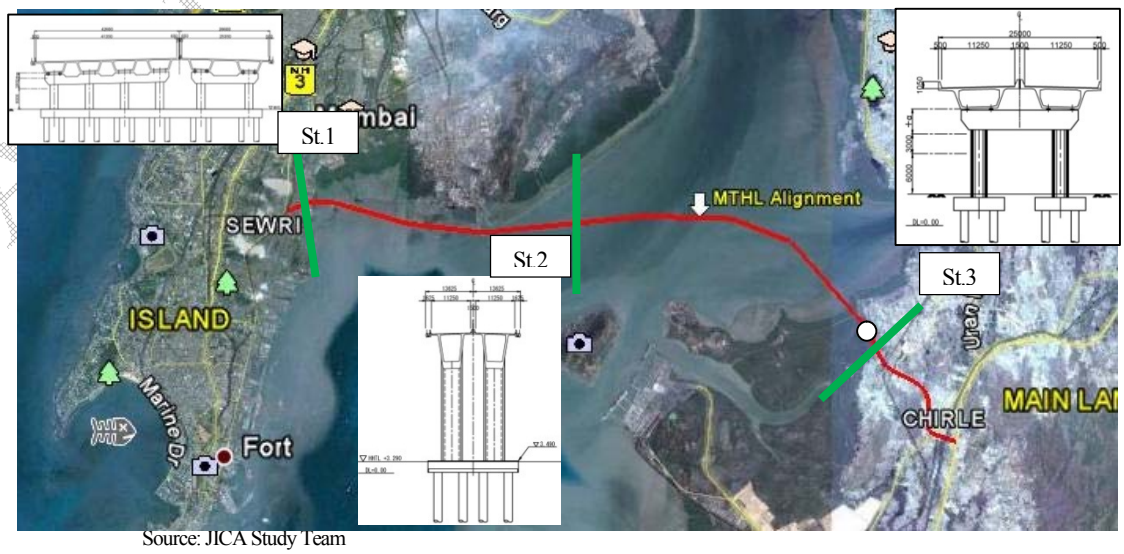
Increase of traffic volume will give a degree of adverse impacts on air quality.

The Puff model, which is widely used in the analysis of air pollution in Japan, is adopted for quantitative analysis in this case. Three points (sections) are selected for the prediction of air pollution, the traffic volumes at each section are shown in Table 6.1.6, the location and the road section of each points are shown in Figure 6.1.3.

Table 6.1.6 Traffic Volume at Forecasted Points at After Construction

Traffic Volume		Traffic Volume in 2032
MTHL	No.1 Sewri (ST500)	89,371
	No.2 Near Elephata (ST8800)	
	No.3 Shivaji Nagar (ST182000)	26,505

Source: JICA Study Team



Source: JICA Study Team

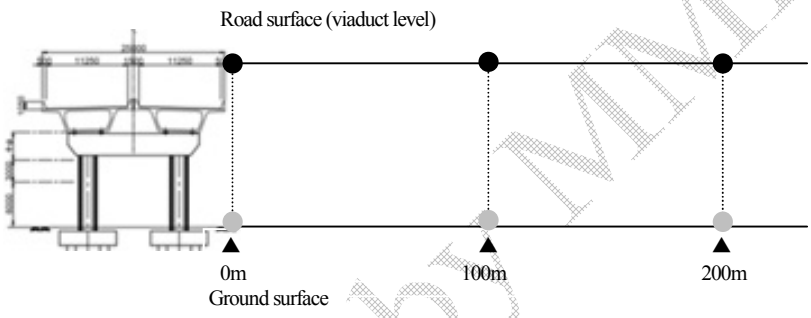
Figure 6.1.3 The prediction points of Air and Noise & Vibration

The Puff-model is used to predict the road-contributed density. Three (3) points at each cross section are selected as the prediction points at the distance of 0m, 10m and 200m, from road shoulder.

Table 6.1.7 Result of Quantitative Forecast on Air Quality by Road Traffic

	Point	ST-1			ST-2			ST-3		
	Distance from the road	0m	10m	200m	0m	10m	200m	0m	10m	200m
Indicator	Forecasted Point									
SPM	Road surface	0.26	0.23	0.03	0.55	0.40	0.04	0.21	0.16	0.01
(μg/m3)	Ground	0.26	0.24	0.03	0.22	0.21	0.04	0.16	0.13	0.01
SO2	Road surface	0.29	0.26	0.04	0.87	0.63	0.06	0.32	0.24	0.02
(μg/m3)	Ground	0.30	0.27	0.04	0.35	0.33	0.06	0.24	0.21	0.02
NO2	Road surface	2.60	2.35	0.35	5.62	4.09	0.37	2.21	1.66	0.14
(μg/m3)	Ground	2.69	2.43	0.36	2.27	2.13	0.38	1.64	1.40	0.14
CO	Road surface	0.09	0.08	0.01	0.20	0.14	0.01	0.07	0.05	0.00
(mg/m3)	Ground	0.09	0.09	0.01	0.08	0.07	0.01	0.05	0.04	0.00

Source: JICA Study Team



Source: JICA Study Team

Figure 6.1.4 Image of prediction points (Cross Section)

By adding the background density (reference as

Table 6.1.4) to the road-contributed density, the comprehensive density of each station points is obtained as following. The density at all three points is below Indian standard and IFC standard.

Table 6.1.8 Result of Comprehensive Quantitative Forecast on Air Quality

Point		ST-1			ST-2			ST-3			Standard
Distance from the road		0m	10m	200m	0m	10m	200m	0m	10m	200m	
Indicator	Forecasted Point										
SPM	Road surface	92.3	92.2	92.0	92.6	92.4	92.0	92.2	92.2	92.0	100[1)]
(μg/m3)	Ground	92.3	92.2	92.0	92.2	92.2	92.0	92.2	92.1	92.0	
SO2	Road surface	12.9	12.9	12.6	13.5	13.2	12.7	12.9	12.8	12.6	80[1)]
(μg/m3)	Ground	12.9	12.9	12.6	12.9	12.9	12.7	12.8	12.8	12.6	
NO2	Road surface	16.4	16.1	14.2	19.4	17.9	14.2	16.0	15.5	13.9	200[2)]
(μg/m3)	Ground	16.5	16.2	14.2	16.1	15.9	14.2	15.4	15.2	13.9	
CO	Road surface	2.36	2.35	2.28	2.47	2.41	2.28	2.34	2.32	2.27	10[3)]
(mg/m3)	Ground	2.36	2.36	2.28	2.35	2.34	2.28	2.32	2.31	2.27	

Note: 1)= Indian standard 2)=IFC standard, 3)= Japan Standard
Source: JICA Study Team

As a reference, the density of the monitoring points on Rapid EIA 2012 are also calculated, the results are shown below.

Table 6.1.9 Quantitative Forecasted Air Quality Values at Monitored Points

Location		Chirle	Shivaji Nagar	Mahul	Sewri	Gate Way of India	Elephanta Island
Parameter	composition						
Particulate Matter (SPM, μg/m3)	Observed(2011)	266.33	135.58	153.33	393.58	220	92
	Road-contributed	0.04	0.01	0.04	0.03	0.04	0.04
	Total	266.37	135.59	153.37	393.61	220.04	92.04
Sulphur Dioxide (SO2, μg/m3)	Observed(2011)	53.67	31.33	32.02	66.85	37.1	12.6
	Road-contributed	0.06	0.02	0.06	0.04	0.06	0.06
	Total	53.73	31.35	32.08	66.89	37.16	12.66
Nitrogen Dioxide (NO2, μg/m3)	Observed(2011)	61.83	39.25	38.18	74.82	53.4	13.8
	Road-contributed	0.38	0.14	0.38	0.36	0.38	0.38
	Total	62.21	39.39	38.56	75.18	53.78	14.18
Carbon Monoxide (CO, mg/m3))	Observed(2011)	2.04	1.08	1.52	2.54	1.8	2.27
	Road-contributed	0.01	0.00	0.01	0.01	0.01	0.01
	Total	2.05	1.08	1.53	2.55	1.81	2.28

Source: Baseline data is from Rapid EIA 2012, / Forecasted data : JICA Study Team

As shown above, the density at some observed points is higher than Indian standard since the current density (observed value on the Rapid EIA) is exceeding the standard values. However, the impact by the MTHL is negligible since the road-contributed density to the monitoring points is too low to be nearly zero.

(4) Mitigation Measures

1) During Construction

Water sprinkling shall be carried out on earth road and construction yard near residential area

2) After Construction

Appropriate land use management will be done along the road (commercial and industrial area)

(5) Evaluation

1) During Construction

Exhaust gases and dusts may be produced during construction. However the adverse impact is not serious because of far distance from residential area, bridge structure, underwater construction etc., and the impacts can be minimized further by mitigation measures.

2) After Construction

Air quality such as PM10, CO, NO2 and SO2 density increases along the road during operation phase. However the density-increasing area is very limited, and road-contributed density is very small, and the total density at roadside point is below standard values, thus it is not likely to give significant impacts on air quality in the future.

6.1.2. **Water Pollution**

(1) Result of Baseline Survey

1) Survey Area

The survey area of water quality includes Thane creek, flanked by Sewri mud-flats & Shivaji Nagar mud-flats on either side. For survey purpose, the area was divided into 3 zones:

- Zone II : Sewri mud- flat

- Zone III : Thane Creek (sea)
- Zone IV : Shivaji nagar mud- flat

The feature of each zone is summarized in the next table

Table 6.1.10 Summary of Zone Feature

Zone No	Zone Feature	Chainage	Length in km	CRZ areas
I	Land	0.45 to 1.0	0.5	0.15 km in CRZ-II
II	Mudflats and sparse Mangroves	1.0 to 2.5	1.5	CRZ-I
III	Sea	2.5 to 16.98	14.48	-
IV	Mudflats and sparse Mangroves	16.98 to 17.58	0.6	0.10 Km in CRZ II & 0.5km in CRZ-I
V	Land	17.58 to 22.00	4.42	-

Source: Rapid EIA 2012 (MMRDA)

The survey area and alignment of MTHL are shown in following figures.

Source: JICA Study Team

Figure 6.1.5 Surveyed Section

2) Survey Result

Water quality of Sea water was determined by the physical & chemical attributes, and those are given in Table 6.1.11. Only Dissolved Oxygen (DO) at Zone III and IV high-tide is exceeding standard values slightly.

Table 6.1.11 Physical & Chemical Attributes in Aquatic medium

Sites	Tide	pH [6.5-9]	Temp ℃	Salinity ‰	Alkalinity ppm	Hardness mg/L	DO (mg/L) [3.0]	BOD (mg/L) [3 or 5]	COD mg/L
Zone II	High	7.5	28	32.95	14	46	1.20 **(exceeding)**	0.97	100
	Low	7.5	24.5	32.95	14	47	1.48	1.32	105

							(exceeding)		
Zone III	High	7	23.5	32.95	12	32	3.10	0.42	105
	Low	7	28	32.95	14.5	34	2.40 (exceeding)	0.42	76
Zone IV	High	7	26	32.95	10	36	3.03	0.83	100
	Low	7	28	32.95	9.5	30	2.05 (exceeding)	0.12	85

Note) [*****] standard values for Primary Water Quality Criteria for Class SW-IV Waters (For Harbour Waters)
Source: Rapid EIA 2012 MMRDA, Survyed by CES

Table 6.1.12 Water Quality Standard for Harbour in India

No	Parameter	Standard Value	Unit	Remarks
1	pH	6.5-9.0	-	To minimize corrosive and scaling effect
2	DO (Dissolved Oxygen)	3.0	mg/l	
3	Colour and Odour	No noticeable colour or offensive odour.		
4	Floating Matters Oil, grease and scum (including Petroleum products)	10	mg/l	
5	Fecal Coliform	500	Num/100ml (PAN)	
6	BOD (Biochemical Oxygen Demand : 3 days at 27°C)	5	mg/l	To maintain water relatively free from pollution caused by sewage and other decomposable wastes
7	BOD (Biochemical Oxygen Demand : 3 days at 27°C)	3	mg/l	Restricted for bathing (aesthetic quality of water). Also prescribed by IS:2296 1974.

Source: EPA, 1986 [GSR 7, dated Dec. 22, 1998 / Table 1.4 Primary Water Quality Criteria for Class SW-IV Waters (For Harbour Waters)

✓ **Observations:**

- **pH**

The pH of the water samples was found to be between 7-7.5. There is no significant difference in high tide and low tide. Acidity is measured using the pH scale, where items are given a numerical value between 0 and 14. Historically, ocean pH has averaged around 8.17, meaning that ocean waters are slightly basic. But with the rising CO2 concentration causing acidification, today the pH levels are around 8.09, edging the waters closer to neutral.

- **Temperature**

Surface water temperature was found to be between 23 to 28 ºC. But the temperature was found to low at Zone III during high tide. However, considering the ambient temperature range for the west coast of India is in normal range. The study revealed the temperature was in a normal range but it was found that the temperature at low tide was found to be more than the high tide.

- **Salinity**

The salinity range of the surface waters around India shows great seasonal fluctuations owing to the influence of the monsoon rains as a result of river discharge. The salinity was found to be 32.95‰ at all the Zones.

- **Alkalinity**

Alkalinity in itself is not harmful to human being; still the water supplies with less than 100mg/L are desirable for domestic use. The alkalinity ranges from 9.5 to 14 ppm.

- **Hardness**

Hardness was found to be in the range of 30 to 47mg/L

- **DO**

DO values range between 1.2 to 3.1 mg/l. Only Dissolved Oxygen (DO) at Zone III and IV high-tide is exceeding standard values slightly.

- **BOD**

During the recent study the BOD1 varied from 0.12 mg/L to 1.32 mg/L. The BOD was found to be lowest at Zone III during low tide. The BOD values were found to be comparable to that of standard value. High BOD values results from high oxygen demanding substances disposed to coastal waters. It is suggested that the sewage contamination may be less in these areas.

- **COD**

The COD was found to be highest at low tide at Zone II and high tide at Zone III with values 105 mg/L; and within acceptable limits of 250 mg/L.

(2) Potential Impacts

1) During Construction

Turbid water may be generated by earth works and excavation in the sea where bridges are planned to be constructed. Additionally spillage of oil and grease from construction machines and storage in the construction yard may be caused when maintenance of machines and storage is not appropriate. Organic polluted water will be generated from labor camp site.

2) After Construction

No permanent impact is anticipated on water quality due to no construction of service area.

(3) Impact Forecast

1) During Construction

Turbid water may be generated by earth works and excavation.

- According to other cases[Note 1)], the impacted density of suspended solid (SS) in 250m from excavated point is around 4mg/l and 2mg/l out of 250m without any mitigation measures respectively.
- Thus this turbid water may give impacts on fauna-flora spceies within 250m range from the excavated point since Japanese standard of Fisheries Water indicates 2 mg/l.

  This standar value 2mg/l means additional impacted SS density, not absolute values in the water body.
- Therefore, the impact on water quality during construction may give impact within 250m from the excavated point, however it is insignificant out of 250m. Thus appropriate mitigation measures for reduction of SS within 250m from excavated area shall be prepared.

Note1) Environmental impact assessment report of island-city motorway, Fukuoka Prefecture, June 2013.

- With regard to impacts by labor campsite, leaking oil and grease from machines and storage, such adverse impacts will be avoided and/or mitigated by appropriate management and maintenance.

2) After Construction

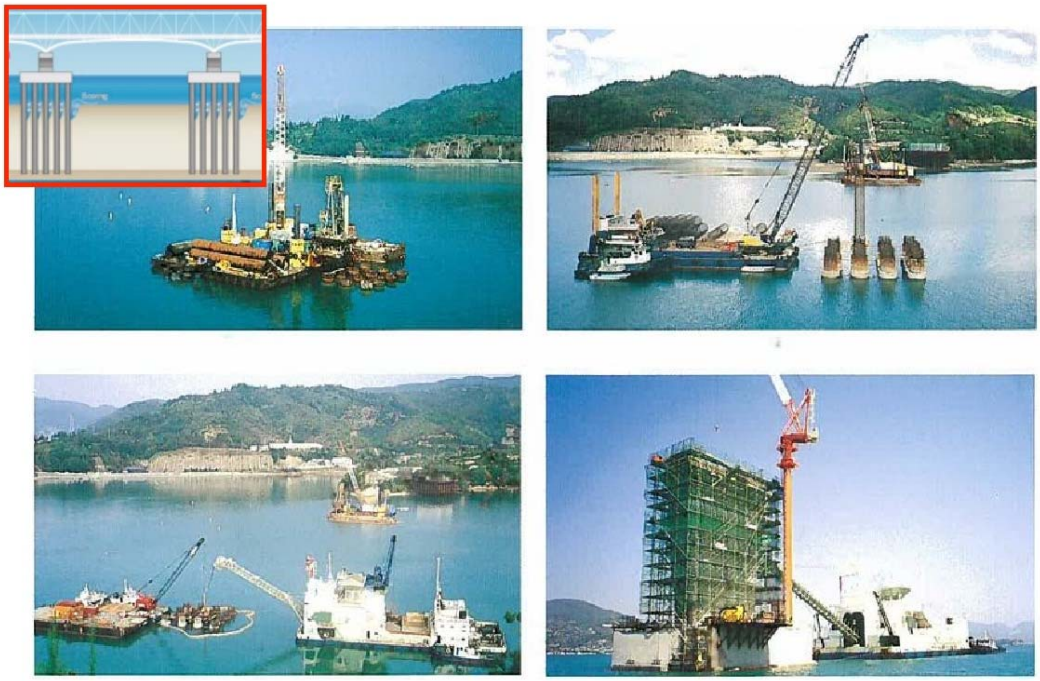
No adverse impacts are expected due to no-activities which discharges polluted water from

project facilities.

(4) Mitigation Measures

1) During Construction

- ✓ Turbid waste water from earthwork area on the land shall be mitigated and treated in sedimentation pond, if required.
- ✓ In the sea section, the bored pilling methodology shall be adopted not to generate significant turbid water
- ✓ Waste oil shall be store and dispose to designated site
- ✓ Domestic waste water and night soil from base camp shall be treated and discharged.



Source: JICA Study Team

Figure 6.1.6 Bored Piling Methodology for Pollution Control

2) After Construction

In the mudflat section, storm water should be collected by every pier and discharged on pile caps not to excavate mudflat area by the falling water.

(5) Evaluation

1) During Construction

Turbid water may be generated by the construction activities. However the impacted time and duration is limited during constriction and the impacted area is limited near bridge pier, also impacts are minimized by planned mitigation measures, therefore, the degree of impacts is acceptable level.

Additionally organic polluted water from labor camp site and leaking oil & grease will be managed by contractor under observation of supervision consultant and the proponent. Thus

these impacts are prevented appropriately.

6.1.3. **Waste**

(1) Result of Baseline Survey

In general, domestic waste from household is discharge to designated waste box, and the township collected all waste from the box and disposes them to designated dumping site, namely Deonar and Mulund dumping site in Mumbai and Turbhe in Navi Mumbai. Night soil in the city area is treated in sewerage plant namely Zone1-7 treatment plants in Mumbai and 7 sewerage treatment plants in Navi Mumbai respectively.

With regard to construction waste such as concrete and cutting trees are used for construction material. Muck soil also shall be tested, treated and disposed at designated site under relevant laws such as environmental protection law.

(2) Potential Impacts

1) During Construction

Construction waste such as muck soil & cut mangrove trees in the sea section, waste soil in the land section, temporary structures and cutting trees are expected. Additionally domestic waste, waste water and night soil may be generated from construction labor camp.

2) After Construction

No impacts are expected from project activities due to no facilities which generate liquid and solid waste such as a service area.

(3) Impact Forecast

1) During Construction

Estimated waste volume on each item is shown below.

Table 6.1.13 Estimated Waste in the Project Area

Type of Waste	Estimated Volume
1. Muck Soil in the Sea note1)	98,910 m3
2. Waste Soil on the Land note1)	2,374 m3
3. Trees in CRZ note2)	13.9 m3
4. Domestic waste and general waste (mainly from labor campsite) note3)	756 kg/day

Note1): Sea section: 17.5km/ 0.05km/span x 8piles/span x 20m/depth x pile area (0.75*0.75*PI)
Note2): Mangrove lost area on CRZ clearance 0.1776 ha x 5000 trees/ha x 0.05m*0.05m*PI*2m
Note3): 0.51 kg waste/person in Mumbai * number of labour in the camp site (3,000 x 0.5 workers/ day)

Excavated muck soil from the sea section is estimated around 99,000 m3, and general waste soil on the land section is 2,400m3 respectively. Additionally cutting mangrove volume is app. 13.9m3.
Domestic waste and night soil is generated at base camp for workers, estimated volume is around 760kg/day.

2) After Construction

Basically no waste from MTHL project, thus almost no impacts on this item.

(4) Mitigation Measures

1) During Construction

Construction waste (trees and waste soil including much soil)

- ✓ After considering the possibility of reuse, construction waste shall be disposed at designated disposal site after treating (totally 14 designated direct landfill site in Mumbai and Navi Mumbai)

Garbage from base camp

- ✓ Garbage at workers camp and waste oil shall be brought to designated disposal site or facility

Night soil

- ✓ Water treatment facility such as septic tank shall be introduced to the workers camp.

(5) Evaluation

1) During Construction

All generated construction waste and domestic waste are reused and/or disposed under adequate mitigation measures, thus it is not likely to give significant impacts on this item.

6.1.4. Soil Contamination and Sediment Quality

(1) Result of Baseline Survey

According to Rapid EIA 2012, following monitored data is indicated. Only density of Lead is exceeding standard level.

Table 6.1.14 Soil Quality Survey Results on Rapid EIA 2012

Site	Monitored Item (Standard Values)						
	Zinc mg/l (no standard)	Copper µg/l (no standard)	Total Manganese mg/l	Lead mg/l (0.01mg/l)	Cadmium mg/l (0.01mg/l)	Iron µg/l	Cobalt mg/l
Zone I (Sewri: Land)	1,800					Absence	Absence
Zone II (Sewri: Sea)	-	2,000		**0.483** (Exceeding)	0.00084 (Not exceed)	Absence	Absence
Zone III (Sea)	-		0.000053			Absence	Absence
Zone IV(Shivaji Nagar)	250	1,500	Absence	**0.498** (Exceeding)	0.0006 (Not exceed)	Absence	Absence
Zone V	-					Absence	Absence

Note) this table was made based on the description of Rapid EIA 2012
Source: Rapid EIA 2012

Table 6.1.15 Environmental Standard for Soil Pollution

Substance	Target level of soil quality examined through leaching and content tests
1. cadmium	**0.01 mg/l in sample solution and less than 0.4mg/kg in rice for agricultural land**
2. total cyanide	not detectable in sample solution
3. organic phosphorus	not detectable in sample solution
4. lead	**0.01 mg/l or less in sample solution**
5. chromium (VI)	0.05 mg/l or less in sample solution
6. arsenic	0.01 mg/l or less in sample solution, and less than 15 mg/kg in soil for agricultural land (paddy fields only)
7. total mercury	0.0005 mg/l or less in sample solution
8. alkyl mercury	not detectable in sample solution
9. PCBs	not detectable in sample solution
10. copper	less than 125 mg/kg in soil for agricultural land (paddy fields only)
11. dichloromethane	0.02 mg/l or less in sample solution
12. carbon tetrachloride	0.002 mg/l or less in sample solution

13. 1,2-dichloroethane	0.004 mg/l or less in sample solution
14. 1,1-dichloroethylene	0.02 mg/l or less in sample solution
15. cis-1,2-dichloroethylene	0.04 mg/l or less in sample solution
16. 1,1,1-trichloroethane	1 mg/l or less in sample solution
17. 1,1,2-trichloroethane	0.006 mg/l or less in sample solution
18. trichloroethylene	0.03 mg/l or less in sample solution
19. tetrachloroethylene	0.01 mg/l or less in sample solution
20. 1,3-dichloropropene	0.002 mg/l or less in sample solution
21. thiuram	0.006 mg/l or less in sample solution
22. simazine	0.003 mg/l or less in sample solution
23. thiobencarb	0.02 mg/l or less in sample solution
24. benzene	0.01 mg/l or less in sample solution
25. selenium	0.01 mg/l or less in sample solution

The above standards are not applicable to:
1) Places where natural toxic substances exist such as near mineral veins, and
2) Places designated for storage of toxic materials such as waste disposal sites.

Note) Prescript treatment methodology for polluted soils is not established yet under Indian laws and regulation at the moment. Thus DUTCH Guidelines for Contamination Assessment of Soil is used in India.

Source: Ministry of Environment and Forests in India

- Zinc : Zinc was found to be around 250 mg/l in Zone IV & around 1,800 mg/l in Zone I.
- Copper: Zone II and Zone IV showed 2,000 and 1,500 µg/l.
- Manganese: The total manganese was found to be absent in Zone IV. Zone III showed the presence of 0.000053 mg/L of Manganese.
- Lead: Zone II and Zone IV showed 0.483 and 0.498 mg/l with exceeding standard value.
- Cadmium: Cadmium was found to be around 0.00084 mg/L and 0.00061 mg/L in Zone II and Zone IV.
- Iron: There was complete absence of iron in the sediments.
- Cobalt: There was complete absence of iron in the sediments.

(2) Potential Impacts

1) During Construction

Construction waste soil such as muck soil from the piling points in the sea section and cutting soil from earthwork area is generated. The muck soil may be polluted based on the baseline survey and may give adverse impacts where dumping site of the waste soil.

2) After Construction

No impacts are expected from project activities.

(3) Impact Forecast

1) During Construction

Excavated muck soil from the sea section is estimated around 99,000 m3, and general waste soil on the land section is 2,400m3 respectively.

Table 6.1.16 Estimated Waste in the Project Area

Type of Waste	Estimated Volume
1. Muck Soil in the Sea note1)	98,910 m3
2. Waste Soil on the Land note1)	2,374 m3

Note1): Sea section: 17.5km/ 0.05km/span x 8piles/span x 20m/depth x pile area (0.75*0.75*PI)

(4) Mitigation Measures

1) During Construction

Polluted excavated soil including muck soil shall be treated, and then reused and/or disposed at designated site in accordance relevant laws and regulations.

(5) Evaluation

1) During Construction

All generated construction waste soil are reused and/or disposed after soil analysis under relevant laws, thus it is not likely to give significant impacts on this item.

6.1.5. Noise and Vibration

(1) Result of Baseline Survey

1) **Noise**

Monitored Ambient Noise

Ambient noise monitoring was carried out as per IS: 3029-1980 to know the existing ambient noise levels in the study area of MTHL at the same locations as discussed in air quality as shown in Figure 6.1.1. The analysis of the monitoring is presented in Table 6.1.17. Permissible standards prescribed by CPCB are presented in Table 6.1.19.

It can be observed that the existing noise levels are exceeding the permissible limit excepting Mahul near power plant industrial area.

Table 6.1.17 Ambient Noise Level (Monitored in 2011)

Location (Area Code)	Date	Noise Levels in dB(A)							Standard
		Leq (Day)	Leq (Night)	Lmax	Lmin	L90	L50	L10	L_{eq}: day/night
1. Sewri (A)	03/10/11 to 05/10/11	76 (Exceeding)	61.1	80	50	54	72	78	75/70
	10/10/11 to 12/10/11	75.4 (Exceeding)	60.5	80	50	53	72	78	75/70
	20/10/11 to 22/10/11	75.4 (Exceeding)	61.6	80	50	53	72	78	75/70
	29/10/11 to 31/10/11	76 (Exceeding)	62.6	80	50	54	72	79	75/70
	1/12/11 to 03/12/11	75.8 (Exceeding)	61.8	80	50	53	72	79	75/70
	07/12/11 to 09/12/11	76 (Exceeding)	61.9	80	50	52	73	79	75/70
	14/12/11 to 16/12/11	75.8 (Exceeding)	61.8	80	50	52	73	79	75/70
	21/12/11 to 23/12/11	76 (Exceeding)	61.9	80	50	52	73	79	75/70
2. Shivaji Nagar (C)	03/10/11 to 05/10/11	62.6 (Exceeding)	54.6 (Exceeding)	69	44	46	59	65	55/45
	10/10/11 to 12/10/11	62.1 (Exceeding)	56.2 (Exceeding)	69	44	47	59	64	55/45
	20/10/11 to 22/10/11	62.1 (Exceeding)	56.4 (Exceeding)	69	44	48	59	64	55/45
	29/10/11 to 31/10/11	62.3 (Exceeding)	54.4 (Exceeding)	69	44	58	63	53	55/45
	1/12/11 to 03/12/11	62.2 (Exceeding)	55.3 (Exceeding)	69	44	46	59	65	55/45
	07/12/11 to 09/12/11	62.3 (Exceeding)	55.6 (Exceeding)	69	44	45	60	65	55/45
	14/12/11 to 16/12/11	65.3 (Exceeding)	59 (Exceeding)	72	47	51	62	68	55/45
	21/12/11 to 23/12/11	65.2 (Exceeding)	60 (Exceeding)	72	47	50	62	68	55/45
3. Chirle (C)	03/10/11 to 05/10/11	67 (Exceeding)	60.4 (Exceeding)	72	49	50	63	70	55/45
	10/10/11 to 12/10/11	68	61.3	74	50	53	65	71	55/45

Location (Area Code)	Date	Noise Levels in dB(A)							Standard
		Leq (Day)	Leq (Night)	Lmax	Lmin	L90	L50	L10	L_{eq}: day/night
		(Exceeding)	(Exceeding)						
	20/10/11 to 22/10/11	68 (Exceeding)	61.2 (Exceeding)	75	50	53	65	70	55/45
	29/10/11 to 31/10/11	67.7 (Exceeding)	62 (Exceeding)	85	57	61	78	82	55/45
	1/12/11 to 03/12/11	68.5 (Exceeding)	62.2 (Exceeding)	75	50	52	65	71	55/45
	07/12/11 to 09/12/11	68.3 (Exceeding)	62.3 (Exceeding)	75	50	52	64	71	55/45
	14/12/11 to 16/12/11	68.7 (Exceeding)	60.8 (Exceeding)	75	50	52	62	72	55/45
	21/12/11 to 23/12/11	68.5 (Exceeding)	62.5 (Exceeding)	75	50	53	65	71	55/45
4.Mahul (I) (near power plant)	03/10/11 to 05/10/11	66.6	59.2	72	48	49	63	69	75/70
	10/10/11 to 12/10/11	67.2	59.9	74	49	51	64	70	75/70
	20/10/11 to 22/10/11	67.3	61	74	49	50	64	70	75/70
	29/10/11 to 31/10/11	67.2	59	74	49	52	64	70	75/70
	1/12/11 to 03/12/11	67.1	60.4	73	49	51	64	70	75/70
	07/12/11 to 09/12/11	67.1	61.5	74	49	52	64	69	75/70
	14/12/11 to 16/12/11	67.4	60.3	74	49	51	64	70	75/70
	21/12/11 to 23/12/11	67.7	61.6	74	49	53	64	70	75/70
5. Gate Way of India (B)	14/12/11 to 16/12/11	66.2 (Exceeding)	60.2 (Exceeding)	73	48	50	63	69	65/55
	21/12/11 to 23/12/11	66.3 (Exceeding)	59.3 (Exceeding)	73	48	52	62	69	65/55
6.Gavan (C)	14/12/11 to 16/12/11	68.8 (Exceeding)	60.4 (Exceeding)	75	50	52	65	71	65/55
	21/12/11 to 23/12/11	68.3 (Exceeding)	60.4 (Exceeding)	75	50	53	65	70	65/55

Note:
Figure in the bracket indicates the category of area as per the CPCB standards
Leq - Equivalent continuous sound pressure level in dB(A)
Lmax - Maximum Instantaneous Noise Level in dB(A)
Lmin - Minimum Instantaneous Noise Level in dB(A)
L10 - Sound pressure level exceeded 10 percent of the total sampling time in dB(A)
L50 - Sound pressure level exceeded 50 percent of the total sampling time in dB(A)
L90 - Sound pressure level exceeded 90 percent of the total sampling time in dB(A)

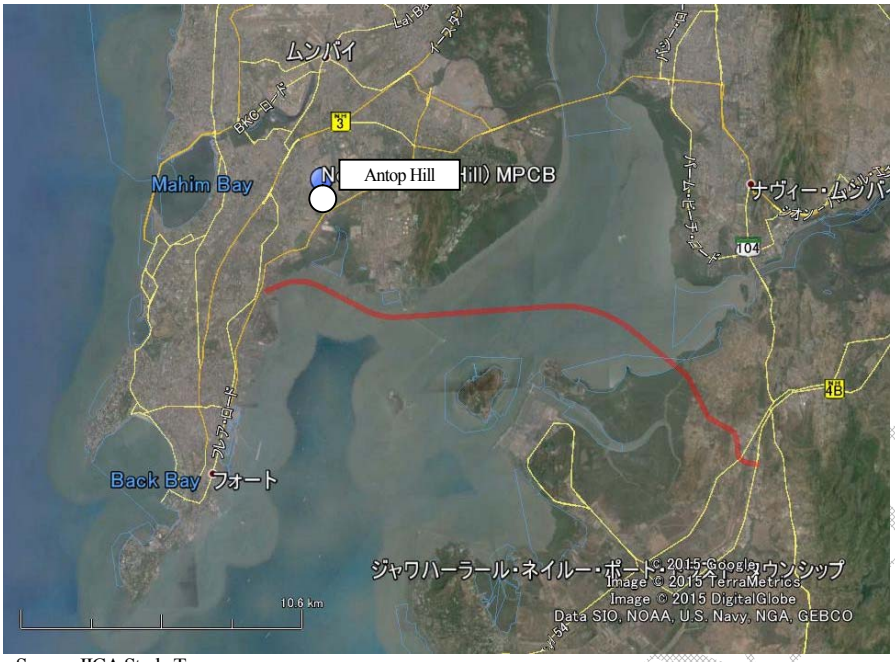
Secondly Data of Ambient Noise

Ambient noise is monitored by MPCB, and the nearest monitoring location from project site is Antop Hills residential area. The latest data is shown below. All monitored data is exceeding standard values for residential area.

Table 6.1.18 Ambient Noise Monitoring Data (December 2014)

Location (Area Code)	Date and Time		Noise Levels in dB(A)						Standard
			Leq	Lmax	Lmin	L90	L50	L10	L_{eq}
Antop Hills (Residential)	14th Dec. 2014 6 AM- 10 PM:	Daytime	**67.1 (Exceeding)**	82.1	51.0	78.0	69.5	59.6	55
	14th Dec. 2014 10 PM- 6 AM:	Night Time	**63.4 (Exceeding)**	82.2	51.7	73.2	61.9	54.1	45
	15th Dec. 2014 6 AM- 10 PM:	Daytime	**63.6 (Exceeding)**	72.6	59.0	51.3	70.5	64.7	55
	15th Dec. 2014 10 PM- 6 AM	Night Time	**60.1 (Exceeding)**	75.4	51.3	71.6	57.6	52.1	45

Source: Report on Ambient Noise Monitoring of Metropolitan Cities in Maharashtra 2014 (Maharashtra Pollution Control Board)



Source: JICA Study Team

Figure 6.1.7 Ambient Noise Monitoring Location by MPCB (2014)

Table 6.1.19 Ambient Noise Standards in Respect of Noise (MoEF Standard)

Area Code	Category of Area/Zone	Limits in dB(A) Leq*	
		Leq Day time	Leq Night time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note
Day time shall mean from 6.a m to 10 p.m.
Nighttime shall mean from 10 p.m. to 6 p.m.
Silence zone is defined as an area comprising not less than 1000 metres around hospitals, educational institutions and courts. The silence zones are zones which are declared as such by the competent authority.
Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.
*dB(A)Leq denotes the time weighted average of the level of sound in decibles on scale A which is related to human hearing.

On Rapid EIA 2012, the noise monitoring was carried out at only 6 points, and it seems that all points may be affected by another noise sources such as traffic and industrial activities since the noise level is too high over 62dB(A) at all points. Therefore, the average of L90 of 6 monitoring points is calculated and is used as the background noise of the region, since L90 represents the base noise in most cases, and is very close to background noise.

Table 6.1.20 Background Noise of the Area

	The average of L90
Background Noise (dB(A))	52.7

Source: Rapid EIA 2012

2) **Vibration**

Monitored Location

The ground vibration monitoring for 'Mumbai Trans Harbour Line' was carried out on 2nd and 3rd of May 2015. The monitoring included two locations which are considered as sensitive areas from the project point of view. The surveyed points are shown in Figure 6.1.1.

Observation of the Data

The monitoring was carried out by measuring the vibration velocity, and then the vibration velocity is converted to vibration level by the conversion formula L=20log(v)+71 (v is the vibration velocity, L is the vibration level) in order to compare the Japanese standard in vibration level. All converted vibration level meets traffic vibration standard level.

Measurement Output

Table 6.1.21 Vibration Monitoring Result at Sewri (No.1)

Year/Date/Time 2015	Measured values Vibration velocity (mm/s)	Converted values Vibration level (dB)	Standard Value (Japanese Standard in dB)	Evaluation (Meet or Exceeds standard)
3rd May 7:00	0.080	49.1	Day Time 70	Meet Japanese Standard
8:00	0.080	49.1		
9:00	0.079	49.0		
10:00	0.077	48.7		
11:00	0.080	49.1		
12:00	0.0807	49.1		
13:00	0.080	49.1		
14:00	0.076	48.6		
15:00	0.074	48.4		
16:00	0.075	48.5		
17:00	0.080	49.1		
18:00	0.078	48.8		
19:00	0.075	48.5		
20:00	0.077	48.7		
21:00	0.078	48.8	Night Time 65	Meet Japanese Standard
22:00	0.071	48.0		
23:00	0.079	49.0		
2nd May 24:00	0.0763	48.7		
1:00	0.076	48.6		
2:00	0.077	48.7		
3:00	0.080	49.1		
4:00	0.077	48.7		
5:00	0.083	49.4		
6:00	0.076	48.6		

Source: JICA Study Team

Table 6.1.22 Vibration Monitoring Result at Shivaji Nagar (No.2)

Year/Date/Time 2015	Measured values Vibration velocity (mm/s)	Converted values Vibration level (dB)	Standard Value (Japanese Standard in dB)	Evaluation (Meet or Exceeds standard)
3rd May 7:00	0.079	49.0	Day Time 70	Meet Japanese Standard
8:00	0.075	48.5		
9:00	0.076	48.6		
10:00	0.0747	48.5		
11:00	0.074	48.4		
12:00	0.0805	49.1		
13:00	0.0773	48.8		
14:00	0.0728	48.2		
15:00	0.0782	48.9		
16:00	0.0744	48.4		
17:00	0.0757	48.6		
18:00	0.076	48.6		
19:00	0.077	48.7		
20:00	0.078	48.8		
21:00	0.075	48.5	Night Time 65	Meet Japanese Standard
22:00	0.072	48.1		
23:00	0.077	48.7		
2nd May 24:00	0.079	49.0		
1:00	0.0833	49.4		
2:00	0.074	48.4		
3:00	0.078	48.8		
4:00	0.081	49.2		
5:00	0.080	49.1		
6:00	0.082	49.3		

Source: JICA Study Team

Table 6.1.23 Traffic Vibration Standard

Class		Day Time 7:00-20:00 (dB)	Night Time 20:00-7:00 (dB)
Japanese Standard	Mainly residential area	65	60
	Mainly commercial and industrial area	70	65

Source: Japanese Standards (vibration regulation)

(2) **Potential Impacts**

1) **During Construction**

Noise and vibration generation is expected due to works of construction machines and equipment.

2) **During Operation**

Traffic Noise and Vibration is expected because of the increase in traffic number and travelling speed in the project area.

(3) **Impact Forecast**

1) **During Construction**

Construction noise and vibration is generated by operation of construction machines and devices in the project area.

Construction noise and vibration may affect a degree of impacts to residential area in the daytime mainly. Estimated construction noise is less than 85dB(A) which is Japanese standard for construction noise on the boundary of construction yard. With regard to construction vibration, it is estimated less than 75dB which is Japanese standard for construction vibration on the boundary of construction yard in the daytime.

Many investigation and simulation results on the projects show that the noise level and vibration level are less than the standards. Therefore, the noise and vibration during the construction of MTHL can be expected to be less than the Japanese standard.

2) **After Construction**

a) Noise

The forecasted points are shown in Figure 6.1.3 and Figure 6.1.4

The ASJ-2008 model is used to predict traffic noise. Three station points are calculated, and the results are shown below.

Table 6.1.24 Forecasted Traffic Noise at the Station Points (without background level)

Point		ST1 Sewri			ST2 Elaphanta			ST3 Shivaji Nagar		
Distance from the road		0m	10m	200m	0m	10m	200m	0m	10m	200m
day	Road surface	63	66	59	66	68	59	61	63	54
	Ground	54	54	56	53	53	55	52	53	52
night	Road surface	59	62	55	61	63	55	57	58	49
	Ground	49	49	51	49	49	51	48	48	48

Source: JICA Study Team

The total noise of each station points is calculated by compositing the traffic noise and background noise (52.7dB, reference as in Table 6.1.20), the results are shown below. The forecasted noise level at all three points are below Indian standard and IFC standard.

Table 6.1.25 Forecasted Traffic Noise at the Station Points (with background level)

Point (landuse)		ST1 Sewri (0-200m: Industry)			ST2 Elaphanta (0-200m: Right of way)			ST3 Shivaji Nagar (0-50m: Right of way 50-200m: Commercial)			Indian Standard dB(A) (Industrial and Commercial) ** IFC Standard
Distance from road		0m	10m	200m	0m	10m	200m	0m	10m	200m	
day	Road surface	64	66	60	66	68	60	62	63	56	75 (Industrial) *65 (Commeicial) ** IFC: 70 (Industrial and Commercial)
	Ground (evaluated values)	56	56	57	56	56	57	55	56	*55	
night	Road surface	60	62	57	62	64	57	58	59	54	70 (Industrial) *55 (Commercial) ** IFC: 70 (Industrial and Commercial)
	Ground (evaluated values)	54	54	55	54	54	55	54	54	*54	

Note) * : The actual land use at evaluated point 200m in Shivaji Nagar is commercial area. Other points are in the right of way, thus the standard for industrial area is adopted
**: IFC Standard for Industrial and Commercial: day 70 dB(A)/ night 70 dB(A)
Source: JICA Study Team

As a reference, the noise of the monitoring points in EIA is also calculated by compositing the traffic noise and observed noise, the results are as following.

Table 6.1.26 Forecasted Traffic Noise at the Station Points (with background level)

Location		Sewri	Shivaji Nagar	Chirle	Mahul	Gate Way of India	Gavan (Elephanta)
1. Observed average in 2011	Day	76	63	68	67	66	69
	night	62	57	62	61	59	60
2. Forecasted Traffic noise (impacted by only traffic)	Day	56	52	56	56	56	56
	night	51	48	51	51	51	51
Total (1+2: composed)	Day	76	64	68	67	67	69
	night	62	57	62	61	60	61

Source: JICA Study Team

As shown above, the noise at some observed points is higher than Indian standard since the current noise (observed value in Rapid EIA) is higher than the standard already. However, the influence of MTHL is very small since the traffic noise caused by MTHL in monitoring points is so low that it can be ignored comparing with the current noise.

b) Vibration

The forecasted points are shown in Figure 6.1.3 and Figure 6.1.4. All they are same points as noise and air forecast points.

Then the vibration formula, which is widely used in the calculation of traffic vibration in Japan, is used to predict traffic vibration. Three station points are calculated, and the results are shown below. All forecasted vibration level are lower than the Japanese standard.

Table 6.1.27 Forecasted Traffic Vibration at the Station Points (without background level)

Point		ST1 Sewri			ST2 Elaphanta			ST3 Shivaji Nagar			standard
Distance from road		0m	10m	200m	0m	10m	200m	0m	10m	200m	
Vibration Level (dB)	Day	48	47	45	50	48	45	46	45	42	65
	Night	48	47	45	50	49	45	46	45	42	60

Source: JICA Study Team

(4) Mitigation Measures

1) During Construction

The expected noise and vibration does not give significant impacts, however, construction noise and vibration levels near residential area should be minimized by following mitigatiom measures;

- ✓ Selecting low-noise equipment.
- ✓ Avoiding works of heavy equipment during night time.
- ✓ Informing the construction schedule to surrounding communities to obtain their consensus.

2) During Operation

Forecasted noise and vibration level does not give significant impacts along the road, however, following mitigation measures are proposed.

- ✓ Proponent should propose appropriate land use plan such as commercial area along the road.
- ✓ Although noise barrier is not necessary since the forecasted level is not exceeding the noise standard, as a reference, the noise level with noise barrier (height of 1m) is also calculated. The calculation results show that the noise level at ground height is almost the same with that of no-noise- barrier, and therefore it can be seen that the effect of noise barrier is very limited for the ground height. However the project proponent will monitor the noise level after construction and take necessary mitigation measures when the noise level exceeds standard level.

Table 6.1.28 Result of Comparison Analysis of the noise level with/without Mitigation Measure

Point			ST-1 Sewri			ST-2 Elephanta Island			ST-3 Shivaji Nagar		
Distance from road			0m	10m	200m	0m	10m	200m	0m	10m	200m
With 1m height noise barrier	1. Traffic noise level (daytime)	Road surface	60.0	63.4	57.9	62.4	64.6	56.7	57.9	59.5	51.3
		Ground	53.5	53.6	54.2	52.7	52.9	53.5	51.6	51.7	49.9
	2. Total composed noise level (daytime)	Road surface	60.7	63.8	59.0	62.8	64.9	58.2	59.0	60.3	55.1
		Ground	56.1	56.2	56.5	55.7	55.8	56.1	55.2	55.2	54.5
Without noise barrier	Total composed noise level (daytime)	Road surface	63.6	66.5	60.2	66.0	67.8	60.0	61.8	63.0	56.2
		Ground	56.1	56.2	57.3	55.9	56.1	57.3	55.4	55.7	55.4
Effect of noise barrier (change of noise level)		Road surface	-2.8	-2.7	-1.2	-3.2	-3.0	-1.8	-2.7	-2.7	-1.2
		Ground	0.0	0.0	-0.8	-0.2	-0.3	-1.1	-0.2	-0.4	-0.8

Source: JICA Study Team

(5) **Evaluation**

1) **During Construction**

In the daytime, it is expected that impacts from construction activities is reduced by mitigation measures and meet standard values such as 85 dB(A) noise and 75 dB vibration, thus it is not likely to give serious impacts to surrounding area.

In the night time, the construction activities will give a degree of impacts to the nearest residential area, however, implementation of mitigation measures minimize the impacts and the degree of impacts will be acceptable level for inhabitants.

2) **After Construction**

The forecasted noise and vibration level meets standard values, thus it is not likely significant impact on this item. Since the noise-reducing effect of noise barrier is not very high, it is not necessary to build a noise barrier. Especially necessity to build noise barrier in Thane Creek (sea) section is very low.

6.2. Natural Environment

6.2.1. Protected Area and Ecosystem

(1) Result of Baseline Survey

1) Survey Item

The survey items on protected area and ecosystem are shown below;

- Sensitivity test
- Biodiversity Study
- Migratory bird
- CRZ Areas of the Alignment

2) Survey Area

The survey area includes Thane creek, flanked by Sewri mud-flats & Shivaji Nagar mud-flats on either side. For survey purpose, the area was divided into 3 zones as shown in Table 6.1.10 and Figure 6.1.5:

- Zone II : Sewri mud- flat
- Zone III : Thane Creek (sea)
- Zone IV : Shivaji Nagar mud- flat

(2) Potential Impacts

1) Survey Methodology

6 sampling sites were considered in the survey area, keeping in view, tidal influences, and a holistic picture of the wetlands on both sides and the thane creek. These sites were distributed as two sites each in the mud- flat areas, & 2 sites in the Thane creek.

Quantitative Estimation of Flora in Wetland areas :

Flora in the wetland areas mainly included mangrove species. These were quantitatively estimated using quadrants of 10 x 10 m2 dimensions. The wetland areas were further divided as per the tidal influence viz. high tide, mid tide & low tide. Thus quadrants were laid accordingly in each tidal area, and species and count of flora was estimated.

Source: Rapid EIA 2012

Figure 6.2.1 Survey to estimate Mangrove species & count

Quantitative estimation of fauna in Wetland areas :

Mud-flats are very important as this type of habitat provides home and food for animals like Crustaceans, Mollusk's, Insects, Pisces, Reptiles, Avian's, as well as Mammals. These were determined similarly, in each tidal zone mentioned above, by laying 1x1 m2 quadrants.

Source: Rapid EIA 2012

Figure 6.2.2 Burrows present in Mud flat area of Shivaji Nagar

Source: Rapid EIA 2012

Figure 6.2.3 Shells present in Mud flat area of Shivaji Nagar

Collection of Water Samples :

Water samples were collected in the mud flat areas during high and low tides. Similarly surface water samples were collected in the Thane Creek during high and low tides.

2) **Survey Result**

A) Sensitivity test

a. Water quality

Water quality of Sea water was determined based on the physical & chemical attributes is as given in Table 6.1.28:

Table 6.2.1 Physical & Chemical Attributes in Aquatic Medium

Sites	Tide	pH	Temp	Salinity	Alkalinity	Hardness	DO	BOD	COD

			ºC	‰	ppm	mg/L	(mg/L)	(mg/L)	mg/L
Zone II	High	7.5	28	32.95	14	46	1.20	0.97	100
	Low	7.5	24.5	32.95	14	47	1.48	1.32	105
Zone III	High	7	23.5	32.95	12	32	3.10	0.42	105
	Low	7	28	32.95	14.5	34	2.40	0.42	76
Zone IV	High	7	26	32.95	10	36	3.03	0.83	100
	Low	7	28	32.95	9.5	30	2.05	0.12	85

Source: Rapid EIA 2012

Observations:

- pH

The pH of the water samples was found to be between 7-7.5. There is no significant difference in high tide and low tide. Acidity is measured using the pH scale, where items are given a numerical value between 0 and 14. Historically, ocean pH has averaged around 8.17, meaning that ocean waters are slightly basic. But with the rising CO2 concentration causing acidification, today the pH levels are around 8.09, edging the waters closer to neutral.

- Temperature

Surface water temperature was found to be between 23 to 28 ºC. But the temperature was found to low at Zone III during high tide. However, considering the ambient temperature range for the west coast of India is in normal range. The study revealed the temperature was in a normal range but it was found that the temperature at low tide was found to be more than the high tide.

- Salinity

The salinity range of the surface waters around India shows great seasonal fluctuations owing to the influence of the monsoon rains as a result of river discharge. The salinity was found to be 32.95‰ at all the Zones.

- Alkalinity

Alkanility in itself is not harmful to human beings, still the water supplies with less than 100mg/L are desirable for domestic use. The alkalinity ranges from 9.5 to 14 ppm.

Hardness

Hardness was found to be in the range of 30 to 47mg/L

- DO

DO values ranges between 1.2 to 3.1 mg/L.

- BOD

During the recent study the BOD1 varied from 0.12 mg/L to 1.32 mg/L. The BOD was found to be lowest at Zone III during low tide. The BOD values were found to be comparable to that of standard value. High BOD values results from high oxygen demanding substances disposed to coastal waters. It suggests that the sewage contamination may be less in these areas.

- COD

The COD was found to be highest at low tide at Zone II and high tide at Zone III with values 105 mg/L; and within acceptable limits of 250 mg/L.

b. Determination of Nutrients

Nutrients in an aquatic medium encourage/ deplete the growth of biota. Three primary nutrients of the coastal aquatic medium, namely, nitrate, phosphate and silica, were determined.

Nitrates, Phosphates, Silicates in aquatic medium is given in below.

Table 6.2.2 Nutrients in Aquatic Medium

Sites	Tide	Nitrates µg/l	Phosphates µg/l	Silicates mg/L
Zone II	High	2,600	76.06	0.125
	Low	2,750	64.79	0.227
Zone III	High	1,200	45.07	0.227
	Low	1700	14.08	0.193
Zone IV	High	440	25.35	0.17
	Low	1700	33.8	0.079

Source: Rapid EIA 2012

Observations:

- Nitrates

Nitrate is considered to be the micronutrient, which controls primary production in the euphotic surface layer. The lowest nitrate values of 440 µg/L was found at high tide at Zone IV and the highest values of 2750 µg/L was found at the low tide at Zone II.

- Phosphates

Inorganic phosphate is also an important nutrient like nitrogen compound in the primary production of the sea. The concentration of phosphate especially in the coastal waters is influenced by the land run off, fertilizers used in nearby areas and domestic sewage. The lowest value of phosphates was found to be 14.08 µg/l at Zone III and the highest at Zone II with 76.06 µg/l.

- Silicates

Silicon is the most abundant element in the earth after oxygen. Despite its overabundance in nature, it occurs in meagre quantities in water. The concentration of silica in natural waters is usually between 1 to 30 mg/L but may reach as high as 100mg/L in hot springs. The silicates ranged from 0.079 to 0.227 mg/L.

The analysis of the above three nutrients showed that they were within the permissible limits (10mg/L or less for nitrate) and (0.1 mg/L or less for phosphate).

c. Analysis of Dissolved Trace Metals in Aquatic Medium:

Dissolved trace metals taken up by the coastal halophytic biota are required in minute quantities for survival, though in high amount it injures their physiology and morphology. The presence of the following dissolved trace metals were investigated, viz. zinc (Zn), copper (Cu), manganese (Mn), iron (Fe), cobalt (Co), lead (Pb) and cadmium (Cd).

Heavy metal in water samples is given in Table 6.1.28.

Table 6.2.3 Heavy metals concentration in Aquatic Medium

Sites	Tide	Zinc mg/l	Copper µg/l	Magnesium mg/l	Iron mg/l	Lead mg/l	Cobalt mg/l	Cadmium mg/l
Zone II	High	50	37.5	Nil	Nil	Nil	Nil	0.0000027
	Low	12.5	Nil	Nil	Nil	Nil	Nil	0.000012
Zone III	High	37.5	25	Nil	Nil	Nil	Nil	0.000017
	Low	62.5	Nil	Nil	Nil	Nil	Nil	0.000014
Zone IV	High	12.5	50	Nil	Nil	Nil	Nil	0.000013
	Low	37.5	Nil	Nil	Nil	Nil	Nil	0.000045

Source: Rapid EIA 2012

Observations:

- Zinc

Zinc is present in the galvanising paints, pigments, insecticides, cosmetics and their

discharge increases their concentration in the waste. The zinc values are ranging from 12 mg/l to 63 mg/l

- Copper

Copper in the natural waters also results in higher concentration due to pollution. Samples from low tides at all the three Zones did not show any presence of copper whereas at high tide they were in the range of 25 to 50 µg/l.

- Cadmium

Cadmium is present in the waste water from electroplating, chemical industries and milling and mining wastes from lead-zinc mines. It accumulates in various parts of the body. The concentration of cadmium varied between 0.0000027 to 0.000045 mg/l.

Magnesium, Iron, Lead and Cobalt were found to be absent in the water samples from all the Zones.

B) Biodiversity Study

a. Biodiversity for Defining of Ecology:

Biodiversity is the variety and differences among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part. Many variables are united in a common string of biosphere and the tiers of variability are :

- Ecosystem tier
- Community tier
- Species tier
- Genetic tier

Present study deals with studying diversity of flora & fauna at species level through Shannon Weaner Index, Index of dominance.

Shannon Weaner Index:

The Shannon Weaner Index (H'), is one of several diversity indices used to measure diversity in categorical data.

$$H' = - \sum(Ni/N) \times \ln (Ni/N)$$

Where;

Ni= Number of individuals in a species

N= Total number of individuals of all the species in the quadrant

Index of dominance:

$$\text{Index of dominance} = \sum(Ni2/N2)$$

Where;

Ni= Number of individuals in a species

N= Total number of individuals of all the species in the quadrant

Stress Index :

$$\text{Stress Index (I)} = K [(No- Ns)/N(Nt)]$$

Where;

N= Number of species

K= Dimension of Quadrant

No= Number of opportunistic species

Ns= Number of sensitive species

Nt= Total no. of individual of all species in quadrants

Phytoplankton, their biomass and diversity :

Phytoplankton is a primary source of food in the marine environment. The concentration and the numerical abundance of the phytoplankton indicate the fertility of a region.

The diversity index (Shanon-Weaver index –H') which is less than 1, it is indicating poor species diversity in many of the sites. Many of the phytoplankton does not appear to form food source for economically important species. Majority of the phytoplankton species encountered are stress tolerant which grow in polluted creek water. Various phytoplankton groups were observed and their Shanon Weaver index is shown in Table 6.2.4.

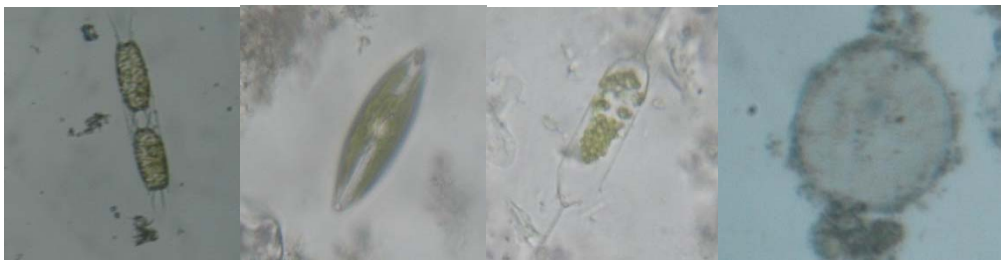
Faunal diversity fluctuates from 5 to 7 genera. The common forms were Skeletonema spp., Bidulfia spp., Cosinodiscus spp., Nitzchia spp., Pleurosigma spp., Rhizosolenia spp. which are stress tolerant and withstand estuarine pollution.

Phytoplankton population analysed at various sites showed that their numerical abundance varied from 20 x 103 to 93 x 103 nos/L. The biomass varied from 0.055 to 0.705 gm/L in the region shown in Table 6.2.6. Phytoplankton observed by microscope are indicated in Figure 6.2.5.

Table 6.2.4 Phytoplankton Observed in Aquatic Medium

Zone	Tide	Cell count ($\times 10^3$/L)	No. Of genera	Major Genera	Frequency	Dominance	Shanon weaver index
II	High	58	6	Skeletonema Bidulphia Coscinodiscus	0.9397	0.883	0.05847
	Low	92.5	7	Skeletonema Coscinodiscus Pleurosigma	0.9355	0.8752	0.0623
III	High	31.6	6	Skeletonema Coscinodiscus Rhizosolenia	0.869	0.756	0.122
	Low	51.6	5	Skeletonema Bidulphia Coscinodiscus	0.913	0.8336	0.083
IV	High	20.3	5	Skeletonema Bidulphia Nitzchia	0.689	0.4748	0.256
	Low	44.8	5	Nitzchia Bidulphia Skeletonema	0.3495	0.349	0.3674

Source: Rapid EIA 2012



Bidulfia spp. *Navicula spp.* *Diatylum spp.* *Cosinodiscus spp.*

Source: Rapid EIA 2012

Figure 6.2.4 Phytoplankton Species

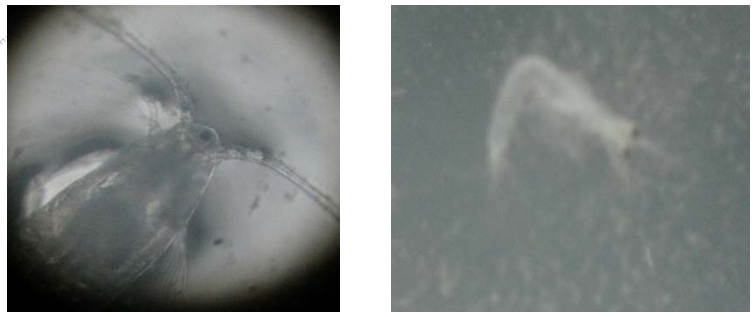
Zooplankton, their biomass and diversity

The concentration and the numerical abundance of the zooplankton indicate the fertility of a region. Various zooplankton groups were observed as indicated in Figure 6.2.6, and their Shanon Weaver index are shown in Table 6.2.5.

Table 6.2.5 Zooplankton observed in Aquatic Medium

Zone	Tide	Cell count ($\times 10^3$/L)	No. Of genera	Major Genera	Freq-uency	Domi-nance	Shanon weaver index
II	High	5.5	5	Tintinnopsis Rhabdonellopsis	0.6364	0.405	0.2876
	Low	2.5	5	Tintinnopsis fish eggs	0.2667	0.01711	0.3525
III	High	4	7	Sagitta Eutintinnus Dyphis	0.3334	0.1112	0.3662
	Low	6.6	8	Fish eggs codonellopsis copepods	0.2272	0.5165	0.33675
IV	High	5.66	5	tintinnopsis eutintinnus	0.3235	0.10467	0.3651
	Low	2.5	8	tintinnopsis barnacal nauplius	0.3334	0.1112	0.3662

Source: Rapid EIA 2012



Copepod *Mysis larva*

Source: Rapid EIA 2012

Figure 6.2.5 Zooplankton Species

Faunal diversity showed 7 types of genera. The common forms were Nauplii spp., Zoea of crab, Copepods and Tintinids.

The Shanon Weaver Index was found to be less than 1 at all the sites. This shows that the population density of zooplankton is found to be not good at the time of sampling. Large population of zooplankton could graze the phytoplankton population to near extinction. This in turn would cause collapse of zooplankton and the entire food chain until phytoplankton recovers.

Table 6.2.6 Biomass quantity of Phytoplankton & Zooplankton

Zone	Tide	Phytoplankton g/L	Zooplankton g/L
II	High	0.055	0.22
	Low	0.105	0.47
III	High	0.16	0.85
	Low	0.47	0.325
IV	High	0.165	0.465
	Low	0.705	0.325

Source: Rapid EIA 2012

Benthos diversity (quantitative estimation of fauna)

Biological diversity of fauna in the 2 segments is given in Table 6.2.7.

Table 6.2.7 Biodiversity of Fauna

Name of the animal species	Zone II		Zone III		Zone IV	
	High Tide (HT)	Low Tide (LT)	HT	LT	HT	LT
Crabs	8	3	Water analysis Parameters		156	9
Mud Skippers	-	-			1	-
Telescopium Telescopiaum	-	-			1	1
Cerithium Morus	-	6			-	562
Nerita Crepidularia	14	11			-	-
Polycheat Worms	-	36			-	-
Slugs	12	15			-	-
Total (N)	34	71			158	572
Index Of Frequency (C)	0.4117	0.5071			0.9287	0.9825
Index Of Dominance (D)	0.1715	0.2572			0.9873	0.9657
Shannon Weaner Index (H)	0.365433	0.34445			0.01262	0.01734
Stress Index (I)	0.05	0.093			0.327	0.3269

Source: Rapid EIA 2012

Biological Diversity of Flora :

Biological diversity of flora in the 2 segments is given in Table 6.2.8.

Table 6.2.8 Biodiversity of Flora

	Name of species	No/ quadrant (zone ii)			No/ quadrant (zone iii)	No/ quadrant (zone iv)		
Trees (mangroves)		Ht	Mt	Lt	Study not conducted	Ht	Mt	Lt
1	Avicennia marina	0	0	3		3	6	4
2	Sonneratia apetala	0	0	1		--	--	--
Shanon weaner index	Shannon-wiener index (log):0.8113					--	--	--
	Shannon-wiener index (ln):0.5623					--	--	--
	Shannon-wiener index (adjusted)* : 81.13%					--	--	--
Index of dominance	0.9					1		
Stress index (i)						--		
Sapling (mangroves)		Ht	Mt	Lt	Study not conducted	Ht	Mt	Lt
1	Avicennia marina	54	52	50		7	0	0
2	Sonneratia apetala	0	0	1		--	--	--
Shanon weaner index	Shannon-wiener index (log):0.05562					--	--	--
	Shannon-wiener index (ln):0.03855					--	--	--
	Shannon-wiener index (adjusted)*: 5.562%					--	--	--
Index of dominance	0.994					1		
Stress index (i)	25					48.039		

Note) HT: High Tide; MT: Mid Tide; LT: Low Tide

Source: Rapid EIA 2012

Observations:

- Phytoplankton, their biomass and diversity:

Phytoplankton is a primary source of food in the marine environment. The concentration and the numerical abundance of the phytoplankton indicate the fertility of a region. The diversity index (Shanon-Weaver index –H') which is less than 1, indicates poor species diversity in many of the Zones. Many of the phytoplanktons do not appear to form food source for economically important species. Majority of the phytoplankton species encountered are stress tolerant which grow in polluted creek water.

- Zooplankton, their biomass and diversity:

The concentration and the numerical abundance of the zooplankton indicate the fertility of a region. The shanon weaver index was found to be less than 1 at all the Zones. This shows that the population density of zooplankton is found not to be good at the time of sampling. Large population of zooplankton could graze the phytoplankton population to near extinction. This in turn would cause collapse of zooplankton and the entire food chain until phytoplankton recovers.

b. Analysis of Microbens in Aquatic Medium:

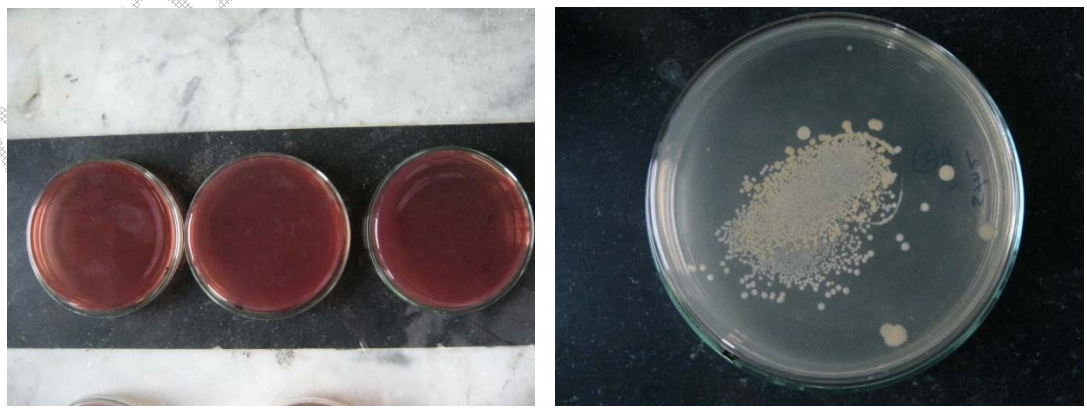
Microbial population

The water samples were collected at all sites using sterile 250 ml sterile polyvinyl bottles and preserve for analysis. Pour plate method was use to culture the organisms. The agar media used for analysis were Nutrient agar, MacConkey agar. Plates were incubated at 37°C for 24 hrs and total viable count was taken. Organisms were identified and counted on the basis of their colour characteristics.

Table 6.2.9 Bacterial population in surface waters (number × 103/ml)

Zone	Tide	Mac Conkey Agar SPC/ml	Nutrient Agar SPC/ml
1	High	Nil	80
	Low	Nil	Nil
2	High	Nil	0.5
	Low	Nil	Nil
3	High	Nil	2.4
	Low	Nil	9

Source: Rapid EIA 2012



Absence of coliform enteric in Mac Agar *Presence of E.coli and other bacteria In NA*

Source: Rapid EIA 2012

Figure 6.2.6 Bacterial Colonies

Observations:

- Microbial population:

Bacterial count in the water at all Zones was analyzed. All high tide samples show absence of enteric coli colonies.

c. List of Avifauna Species :

Avifauna species were spotted during the field survey & sample collection. Head count of the Avian(Birds) and Lepidopteran (Butterflies) population is given in Table 6.2.10. and Table 6.2.11.

Out of the 17 species of birds spotted in the study area, 1 are migratory while the rest are known to be residents. Most birds seen were those that fell in the Least Concern category of the IUCN Red List, except for the black headed ibis (*Threskiornis melanocephalus*) and Intermediate Egret (*Mesophoyx intermedia*) which is Near Threatened.

In the 2008 survey, Out of the 78 species of birds spotted in the study area, 15 are migratory while the rest are known to be resident. Most migratory birds seen were those that fell in the Least Concern category of the IUCN Red List, except for the Lesser Flamingo (*Phoenicopterus minor*) which is Near Threatened (Table 6.2.12).

Table 6.2.10 Avian (Birds) species spotted

Zone	Zone II		Zone IV	
	Name	IUCN Status	Name	IUCN Status
Name of Specie	1 Common sandpiper #3	LC	1 Red vented bulbul	LC
	2 Western reef egret	LC	2 Indian pond heron	LC
	3 Blue rock pigeon	LC	3 Small green bee eater	LC
	4 Intermediate egret #1	NE	4 Shikra	LC
	5 White throated kingfisher	LC	5 Black kite	LC
	6 Small blue kingfisher	LC	6 Intermediate egret #1	NE
	7 Black headed gull #4	LC	7 Red wattled lapwing	LC
	8 Black headed ibis #2	NT	8 Bush lark sp.	LC
	9 Little egret	LC	9 Black headed ibis #2	NT
			10 Common sandpiper #3	LC
			11 Little stint	LC
			12 Black headed gull #4	LC
Sub Total		**9**		**12**
Total	**17**			

Note) The survey was conducted under spot survey on the Rapid EIA 2012
Source: Rapid EIA 2012

Table 6.2.11 Lepidopteron (Butterflies) species spotted

Zone	Zone II	Zone IV
Name of Species	Plain tiger	Yellow orange tip
	Striped tiger	Common jezebel
	Common crow	Striped tiger
	Denied eggfly (female)	Small salmon arab
Total	**4**	**4**

Source: Rapid EIA 2012

Table 6.2.12 Comprehensive Recorded Birds Species (2008-2012)

No	Bird Category	Species Name		Recorded in 2008 note3)		Rapid EIA 2012 note4)		Type Note1)	Status on IUCN Note2)
		English Name	Scientific Name	Sewri Mahul Creek	Shivaji Nagar Nhava	Sewri	Shivaji Nagar		
1	Duck	Comb Duck	*Sarkidiornis melanotos*	✓				R	LC
2		Lesser Whistling Duck	*Dendrocygna javanica*	✓				R	LC
3		Spot-billed Duck	*Anas poecilorhyncha*		✓			R	LC
4	Egrets,	Great Egret	*Casmerodius albus*	✓	✓			R	LC
5	Herons &	Intermediate Egret	*Mesophoyx intermedia*	✓	✓	✓	✓	R	NE

6	Ibis	Little Egret	*Egretta garzetta*	✓	✓	✓		R	LC
7		Western reef Egret	*Egretta sacra*	✓	✓	✓		R	LC
8		Grey Heron	*Ardea cinerea*	✓				R	LC
9		Little Heron	*Butorides striatus*	✓	✓			R	LC
10		Indian Pond Heron	*Aedeola grayii*	✓	✓		✓	R	LC
11		Black headed Ibis	*Threskiornis melanocephalus**	✓	✓	✓	✓	R	NT
12		Painted Stork	*Mycteria leucocephala**	✓				R	NT
13	Bird of Prey	Greater Spotted eagle	*Aquila clanga***	✓				R	VU
14		Pariah (Black) Kite	*Milvus migrans*	✓			✓	R	LC
15		Brahminy Kite	*Haliatur Indus*	✓	✓			R	LC
16		Eurasian Marsh Harrier	*Circus aeruginosus*	✓	✓			R	LC
17		Osprey	*Pandion haliaetus*	✓	✓			R	LC
18		Shikra	*Accipiter badius*	✓			✓	R	LC
19		Barn Owl	*Tyto alba*	✓				R	LC
20	Roller	Indian Roller	*Coracias benghalensis*		✓			R	LC
21	Waders	Lesser Sand Plover	*Charadrius mongolus*	✓	✓			R	LC
22		Little Ringed Plover	*Charadrius dubius*	✓				R	LC
23		Black-tailed Godwit	*Limoaas limosa*	✓				R	NT
24		Eurasian Curlew	*Numenius arquata*	✓	✓			R	NT
25		Whimbrel	*Neumenius phaeopus*	✓				R	LC
26		Common Redshank	*Trianga erythropus*	✓	✓			R	LC
27		Common Greenshank	*Tringa nebularia*	✓	✓			R	LC
28		Grey Plover	*Pluvialis squatarola*	✓	✓			R	LC
29		Ruddy Turnstone	*Arenaria interpres*	✓				R	LC
30		Common sandpiper	*Actitis hypoleucos*	✓	✓	✓	✓	R	LC
31		Terek Sandpiper	*Xenus cinereus*	✓				R	LC
32		Redwattled Lapwing	*Vanellus indicus*	✓			✓	R	LC
33		Curlew Sandpiper	*Calidris ferruginea*	✓				R	LC
34		Little Stint	*Calidris minuta*	✓	✓		✓	R	LC
35		Black winged Stilt	*Himantopus himantopus*	✓				R	LC
36		Dunlin	*Calidris alpina*	✓				M	LC
37		Pied Avocet	*Recurvirostra avosetta*	✓				R	LC
38		Temminck's Stint	*Calidris temminckii*	✓				M	LC
39		Sandpiper	*Tringa stagnatilis*	✓				M	LC
40	Gulls & Terns	Brown-headed Gull	*Larus brunnicephalus*	✓				M	LC
41		Black Headed Gull	*Larus ridibundus*	✓		✓	✓	M	LC
42		Gull billed Tern	*Gelochelidon nilotica*	✓	✓			M	LC
43		Caspian Tern	*Sterna caspia*	✓	✓			M	LC
44		Little tern	*Sterna albifrons*	✓				M	LC
45		Whiskered Tern	*Chlidonias hybridus*	✓				R	LC
46		Heuglin's Gull	*Larus heuglini*		✓			R	LC
47	Flamingos	Lesser Flamingo	*Phoenicopterus minor**	✓				M	NT
48		Greater Flamingo	*Phoenicopterus rubber*	✓				M	LC
49	Pigeons, Parakeets & Coucal	Rock Pigeon	*Columba livia*	✓				R	LC
50		Rose ringed Parakeet	*Psittacula krameri*	✓				R	LC
51		Greater Coucal	*Centropus sinensis*	✓				R	LC
52		Blue Rock Pigeon				✓		R	LC
53	Kingfisher	White throated Kingfisher	*Halycon smyrnensis*	✓	✓	✓		R	LC
54		Common Kingfisher	*Alcedo atthis*	✓	✓			R	LC
55		Black capped Kingfisher	*Halycon pileata*	✓				R/M	LC
56		Small blue Kingfisher				✓		R	LC
57	Passerines	Asian Pied Starling	*Sturnus contra*	✓				R	LC
58		Asian Keol	*Eudynamis scolopacia*	✓				R	LC
59		House Crow	*Corvus splendens*	✓	✓			R	LC
60		Large-billed (Jungle) crow	*Coverus macrohynchos*	✓	✓			R	LC
61		Golden Oriole	*Oriolus oriolus*	✓				M	LC
62		White throated Fantail	*Rhipidura albicollis*	✓				R	LC
63		Barn swallow	*Hirunda rustica*	✓	✓			M	LC
64		Asian palm swift	*Cypsiurus balasiensis*	✓				R	LC
65		Red-vented Bulbul	*Pycnonotus cafer*	✓			✓	R	LC
66		White eared Bulbul	*Pyycnonotus leucotis*	✓	✓			R	LC
67		Ashy Prinia	*Prinia socialis*	✓				R	LC
68		Blyth's Reed Warbler	*Acrocephalus dumetorum*	✓				R	LC
69		Common tailor Bird	*Orthotomus sutorius*	✓				R	LC
70		Oriental Magpie Robin	*Copsychus saularis*	✓				R	LC
71		Purple rumped Sunbird	*Nectarinia zeylonica*	✓				R	LC
72		Citrine Wagtail	*Motacilla citreola*	✓				R	LC
73		White Wagtail	*Motacilla alba*	✓				R	LC
74		Yellow Wagtail	*Motacilla flava*	✓				M	LC
75		House Sparrow	*Passer domesticus*	✓	✓			R	LC
76		Spotted Dove	*Streptopelia chinensis*		✓			R	LC

77		Small Green Bee-eater	*Merops orientalis*		✓		✓	R	LC
78		Rufuous tailed Shrike	*Lanius isabellinus*		✓			M	LC
79		Indian Robin	*Saxicoloides fulicata*		✓			R	LC
80		Clamorous Reed Warbler	*Acrocephalus stentoreus*		✓			R	LC
81		Bush lark	*Mirafra erythroptera*				✓	R	LC
Sub Total				70	34	9	12		
Total				78		17			

Note 1) Type: Resident (R) or Migratory (M)
Note2) IUCN status: Extinct (EX), Threatened (CR, EN, VU), Near Threatened (NT), Least Concern (LC), Not Evaluated (NE)
Note3) The survey for avifauna was conducted from October 2006 to August 2008 at mainly 2 points Sewri Port and Tata power station.
Note4) The survey for avifauna was conducted in Rapid EIA 2012
Source: Compiled from Study of Flamingos and Migratory Birds 2008 (MMRDA/Salim Ali Centre for Ornithology and Natural History)

d. Considerable Bird Species and Expected Impacts:

The Sewari area and the entire Thane Creek is declared as Important Bird Area by Birdlife International in 2004. The listed up considerable species such as NT and VU on IUCN Redlist are shown in Table 6.1.13. The 6 species out of 7 species are resident, only Lesser Flamingo is migratory bird. These 6 species are using the project area as a part of feeding area, not nesting area due to surrounding vegetation and land use. However only Lesser Flamingo is using the project area as not only feeding area, but also roosting site near ST5-5.5 km near TATA power plant. During construction, all of 7 species may avoid feed in the project area certain period of time due to construction activities, however, Sewri mudflat is located near industrial area with high noise level and human activities. Hence such considerable birds get back again and start to feed near project site gradually. However road lighting may give impacts on Flamingo's roosting area located near ST5-5.5km, thus mitigation measures for minimizing impacts shall be considered.

Table 6.2.13 Recorded Considerable Bird Species and Impacts

No.	English Name (Scientific Name)	Category Note	Nesting environment Note3	General targets for feeding	Role of project area	Impact forecast
1	Black headed Ibis (*Threskiornis melanocephalus*)	NT/R	A colony in waterside forests	Fish, Insecta etc.	Feeding area	[During Cost] This species may avoid project area, but get back gradually [Operation] Feeding area may change, but basically get back again in the project area and continue feeding
2	Painted Stork (*Mycteria leucocephala*)	NT/R	A colony in waterside forests	Fish, Aquatic organism etc.	Feeding area	[During Cost] This species may avoid project area, but get back gradually [Operation] Feeding area may change, but basically get back again in the project area and continue feeding
3	Greater Spotted eagle (*Aquila clanga*)	VU/R	The forest of the waterfront (On the trees)	Small mammals, Birds, Fish etc.	Part of the Feeding area	[During Cost] This species may avoid project area, but get back gradually [Operation] Part of the Feeding area may change, but basically get back again in the project area and continue feeding
4	Black-tailed Godwit (*Limoaas limosa*)	NT/R	A grass of the banks of the wetlands and lakes.	Crustacea, Bristle worm, Shellfish etc.	Feeding area	[During Cost] This species may avoid project area, but get back gradually [Operation] Feeding area may change, but basically get back again in the project area and continue feeding
5	Eurasian Curlew (*Numenius arquata*)	NT/R	Slightly dry grasslands and wetlands	Crustacea, Bristle worm etc.	Feeding area	[During Cost] This species may avoid project area, but get back gradually [Operation] Feeding area may change, but basically get back again in the project area and continue feeding
6	Lesser Flamingo (*Phoenicopterus minor*)	NT/M	Coastal zone of saltwater lakes and coastal lagoons.	Algae (Bule-greenalgae, diatoms etc.)	Feeding area, Roosting area	[During Cost] This species may avoid project area, but get back gradually [Operation] Flying course may change, but basically get back again in the project area and continue feeding

Note1) NT: Near Threatened, VU: V, R: Resident, M: Migratory
Note2) Impacts on each listed considerable species are forecasted based on site survey, literature survey and interviews with Japanese and Indian mudflat and migratory bird specialists
Note3) Any colonies and nesting areas have not been observed on Rapid EIA 2012. Additionally any nesting areas were not observed on 17-18th Sep 2015 in Sewri and Shivaji Nagar.

Source: JICA Study Team

e. Level of Bio-Accumulation as Indicator of Interraction with Ecology:

Conservative pollutants like heavy metals are non-biodegradable in nature and hence get accumulated within the body tissues of the organisms. Such accumulations are injurious to the biota, often leading to morbidity as well as mortality. The concentrations of bio-accumulation were determined by acid digestion method. The residue materials were tested by Atomic Absorption Spectroscopy.

Heavy metals in root, shoot & leaves of Avecinia marina was analysed & results of analysis is given in Table 6.2.14.

Table 6.2.14 Concentration of Heavy Metals in Halophytic Vegetation

Sites	sample	Magnesium mg/l	Iron mg/l	Lead mg/l	Zinc mg/l	Copper µg/l
Zone II	Stem	0.0000065	0.153	0.00746	2050	950
	Root	0.0000045	0.128	0.0207	1500	350
	Leaves	--	--	--	1400	1200
Zone IV	Stem	0.000011	0.184	0.0394	1800	2200
	Root	0.000043	0.0651	0.0439	2400	2550
	Leaves	--	--	--	1800	1150

Source: Rapid EIA 2012

Heavy metals muscles of Cupia toli was analysed & results of analysis is given in Table 6.2.15.

Table 6.2.15 Concentration of Heavy Metals in Commercial Fin-fishes

Sites	**Magnesium mg/l**	**Iron mg/l**	**Lead mg/l**	**Zinc mg/l**	**Copper µg/l**
Zone III	0.000037	0.391	0.0302	1200	250

Source: Rapid EIA 2012

f. Sediment Analysis:

Sediment characteristics:

Table 6.2.16 Physico- Chemical Characteristics

Item / Zone	% composition of sand					Type of sediment	Organic carbon content (%)
	Granule/very coarse	Medium sand	Fine sand	Very fine sand	Coarse silt		
Zone II	31.4	54.4	5.4	2.3	6.5	Sand	3.28
Zone IV	4	42.3	5.6	10.8	37.3	Sand with some amount of silt	2.83

Source: Rapid EIA 2012

Heavy Metal:

According to Rapid EIA 2012, following monitored data is indicated. Only density of Lead is exceeding standard level.

Table 6.2.17 Soil Quality Survey Results on Rapid EIA 2012

Site	Monitored Item (Standard Values)						
	Zinc mg/l (no standard)	Copper µg/l (no standard)	Total Manganese mg/l	Lead mg/l (0.01mg/l)	Cadmium mg/l (0.01mg/l)	Iron µg/l	Cobalt mg/l
Zone I (Sewri: Land)	1,800					Absence	Absence
Zone II (Sewri: Sea)	-	2,000		**0.483** (Exceed)	0.00084 (Not exceed)	Absence	Absence
Zone III (Sea)	-		0.000053			Absence	Absence

Zone IV(Shivaji Nagar)	250	1,500	Absence	**0.498** (Exceed)	0.0006 (Not exceed)	Absence	Absence
Zone V	-					Absence	absence

Note) this table was made based on the description of Rapid EIA 2012
Source: Rapid EIA 2012

Table 6.2.18 Environmental Standard for Soil Pollution

Substance	Target level of soil quality examined through leaching and content tests
1. cadmium	**0.01 mg/l in sample solution and less than 0.4mg/kg in rice for agricultural land**
2. total cyanide	not detectable in sample solution
3. organic phosphorus	not detectable in sample solution
4. lead	**0.01 mg/l or less in sample solution**
5. chromium (VI)	0.05 mg/l or less in sample solution
6. arsenic	0.01 mg/l or less in sample solution, and less than 15 mg/kg in soil for agricultural land (paddy fields only)
7. total mercury	0.0005 mg/l or less in sample solution
8. alkyl mercury	not detectable in sample solution
9. PCBs	not detectable in sample solution
10. copper	less than 125 mg/kg in soil for agricultural land (paddy fields only)
11. dichloromethane	0.02 mg/l or less in sample solution
12. carbon tetrachloride	0.002 mg/l or less in sample solution
13. 1,2-dichloroethane	0.004 mg/l or less in sample solution
14. 1,1-dichloroethylene	0.02 mg/l or less in sample solution
15. cis-1,2-dichloroethylene	0.04 mg/l or less in sample solution
16. 1,1,1-trichloroethane	1 mg/l or less in sample solution
17. 1,1,2-trichloroethane	0.006 mg/l or less in sample solution
18. trichloroethylene	0.03 mg/l or less in sample solution
19. tetrachloroethylene	0.01 mg/l or less in sample solution
20. 1,3-dichloropropene	0.002 mg/l or less in sample solution
21. thiuram	0.006 mg/l or less in sample solution
22. simazine	0.003 mg/l or less in sample solution
23. thiobencarb	0.02 mg/l or less in sample solution
24. benzene	0.01 mg/l or less in sample solution
25. selenium	0.01 mg/l or less in sample solution

The above standards are not applicable to:
1) Places where natural toxic substances exist such as near mineral veins, and
2) Places designated for storage of toxic materials such as waste disposal sites.
Source: Ministry of Environment and Forests in India

- Zinc : Zinc was found to be around 250 mg/l in Zone IV & around 1800 mg/l in Zone I.
- Copper: Zone II and Zone IV showed 2000 and 1500 µg/l.
- Manganese: The total manganese was found to be absent in Zone IV. Zone III showed the presence of 0.000053 mg/L of Manganese.
- Lead: Zone II and Zone IV showed 0.483 and 0.498 mg/l. The values at Zone II and IV are exceeding standard value.
- Cadmium: Cadmium was found to be around 0.00084 mg/L and 0.00061 mg/L in Zone II and Zone IV.
- Iron: There was complete absence of iron in the sediments.
- Cobalt: There was complete absence of iron in the sediments.

C) Inference

a) Surface water Physical and Chemical Properties.

Physical properties

- Temperature

Water temperature was measured at Zone II, III and IV. Temperature was measured at the top of water column between 11 am and 3 pm. The study revealed the temperature was in a normal range but it was found that the temperature at low tide was found to be more than the high tide.

- pH

Acidity is measured using the pH scale, where items are given a numerical value between 0 and 14. Historically, ocean pH has averaged around 8.17, meaning that ocean waters are slightly basic. But with the rising CO2 concentration causing acidification, today the pH levels are around 8.09, edging the waters closer to neutral. In this study too, the pH was found to be between 7 – 7.5.

- Salinity

The salinity was found to be in around 32.95‰.

- DO

The DO values were found to be less in the Zone III as compared to the other two Zones.

- BOD

The BOD values were found to be comparable to that of standard value. High BOD values results from high oxygen demanding substances disposed to coastal waters. It suggests that the sewage contamination may be less in these areas.

- COD

COD values were found to be within the acceptable limits of 250mg/L.

- Alkalinity

Alkalinity is important for fish and aquatic life because it protects or buffers against pH changes (keeps the pH fairly constant) and makes water less vulnerable to acid rain. The values of alkalinity were found to be almost similar to the earlier report.

- Hardness

The hardness of all the three Zones was found to be low as compared to the previous data.

Chemical Properties of water

- Nitrate, Phosphate and silicate

The analysis of the above three nutrients showed that they were within the permissible limits (10mg/L or less for nitrate) and (0.1 mg/L or less for phosphate).

- Heavy metals

The amount of zinc present was found to be more than the standard limit of 0.1mg/L. Copper was found to be absent in low tide readings of all the three Zones. But it was found to be slightly higher in Zone II and IV and it was more than the standard limit of 0.02mg/L in Zone IV during high tide. Cadmium was also found to be very less as compared to the standard limit. Manganese, Iron, Lead and cobalt were absent in all the three Zones.

✓ Heavy metals in sediments

Manganese was found to be absent in sediments from Zone IV and present in meagre amounts in Zone II. Lead was found to be more than the permissible limits (0.05mg/L). Cadmium was found to be less than the permissible limits (0.1mg/L). Iron and cobalt are absent in the sediments. Zinc and copper were found to be higher than their standard values.

✓ Heavy metals in mangrove vegetation

Stem, root, leaves of Avecinia marina were analysed for the presence of heavy metals. Zinc and copper were found to be high in all three parts of A. marina in both the Zones. Manganese, Iron and Lead were absent in the leaves from both the Zones. Iron and lead were found to be less than the permissible amount as compared to the sediment concentrations.

✓ Heavy metals in commercial fin fishes

Iron and lead were found to be less than the permissible amount of 20mg/l and 0.05mg/l respectively. Zinc and copper was found to be higher as seen similar to the sediments.

✓ Sediment analysis and organic carbon content

The organic content of soil greatly influences the plant, animal and microorganism populations in that soil. Decomposing organic material provides many necessary nutrients to soil inhabitants. Both, Zone II and IV have poor organic content. The sediment type is sandy having particle size + 0.2mm.

✓ Analysis of phytoplankton

All these Zones show the presence of stress and pollutant related phytoplanktons. Shanon weaver index and biomass were found to be less indicating poor diversity in this area. The population of phytoplanktons was not healthy.

✓ Analysis of zooplankton

The diversity of zooplankton was found to be poor. The biomass and Shanon weaver index were also less.

✓ Bacterial study

Enteric coliforms were found to be absent in all the three Zones. Nutrient agar showed the presence of E.coli and some other types of bacteria.

D) Ecological Status Report:

a. Attributes of Zones:

Sewri Mud- flat (Zone II) :

- Physiochemical conditions in this zone were found to be in the normal range.
- Mangroves showed poor diversity, with presence of only Avicennia species.
- Among the phytoplankton species, the Shanon Weaver Index was found to be less than one. This indicates poor species diversity. Also, species found were stress tolerant.
- The zone showed absence of enteric coliforms. This indicates absence of fecal contamination.
- Thus the zone is found to be especially polluted due to presence of sea vessels, which could add in Zn & Cu & such other heavy metal contamination.

- On the whole, the zone has relatively less organic contamination due to sewage or such other effluent, but the heavy metal contamination was found in aquatic & sediment medium, which was further found to be accumulated in mangrove species.

Thane Creek (Zone III) :

- Water in this region receives effluent discharges from industries & CETPs in the area. This may be one of the reasons for high levels of Cu, Zn & Cd in the zone.
- Bioaccumulation was also found in fin- fish in the zone.
- Specific enteric bacterial population was found to be absent in this zone.
- Water in this zone is found to be polluted by heavy metals & the biodiversity is also low.

Shivaji Nagar Mud- flat (Zone IV) :

- Heavy metal concentration in this zone was similar to that observed in Sewri area.
- Physiochemical characteristics of water were found to be conducive to the growth of mangroves.
- Mangroves diversity was mainly dominated by presence of Avicennia species, with a few surviving Sonneratia species.
- The area towards the high tide region, near the road, was found to be contaminated due to anthropogenic activities; also the mangrove density was low at the periphery. However, the mid tide & low tide regions appeared relatively untouched by anthropogenic agtivities.

b. Levels of Stress:

Sewri Mud- flat (Zone II):

- pH, temperature, Salinity, alkalinity was found to be normal.
- Dissolved oxygen was found to be less as compared to the Shivaji Nagar Mudflat area. However, the BOD & COD was found to be low, implying a lesser organic load.
- Heavy metal contamination was also found to be on the lower side in aquatic medium, except the presence of Zn, Cu, & Cd. Lead was found in the sediments.
- Nitrates concentration was found to be ranging from 2.6 – 2.75 mg/l. Phosphates & Silicates concentration too was found to be on the lower side.
- The mangrove density was found to be low as compared to the Shivaji Nagar mud-flat.

Thane Creek (Zone III):

- Zoo & Phytoplankton species showed diversity on the lower side.

- Heavy metal contamination was present.

Shivaji Nagar Mud- flat (Zone IV):

- Mangrove density was high in this region. Most of the mangrove species found were in the sapling stage (stunted growth), with only a few full grown trees.
- However, the diversity index was low, with Avicennia species indicating major dominance.
- Bioaccumulation of heavy metals was found in mangroves.
- The area did show presence of phytoplankton & zoo-plankton species of stress tolerant types.

Table 6.2.19 Comparative Biodiversity

Area/Item	ZONE II	ZONE III	ZONE IV
Macro flora (qualitative)	Only avicennia species were observed in the area There were approximately an equal no of tree & seedings of avicennia found. Mangrove density was also found to be low.	--	Species of avicennia dominated the macro-flora diversity, with a few sonneratia species. Most of the macro- flora found were in sapling stage, with a few full grown trees present. Mangrove density was found to be high.
Macro flora (quantitative)	Very poor diversity, with index of dominance= 1	--	Poor diversity, with diversity index= 0.994 & shanon weaver index= 5.562%
Macro fauna (qualitative)	Poor	--	Moderate
Zooplankton diversity	Poor	Moderate	Poor
Phytoplankton diversity	Very poor	Poor	Poor
Avian diversity	9 species of birds were spotted in this zone a few of which included black headed ibis, white throated kingfisher, western reef egret etc.	--	About 12 bird species were spotted in this area, a few of which included red vented bulbul, common sandpiper, black headed gull etc.

Source: Rapid EIA 2012

F) Findings of the study

The findings of the above study lead to a number of important conclusions. These are as follows

1) The two tracts marked as CRZ I, namely the Sewri mud-flat and the Shivaji Nagar mud-flat, are under ecological stress. Detailed survey of mangrove in Shivaji Nagar site revealed that mangrove patches are degraded and dominated by Avicennia marina with stunted growth as low as 0.25 m - 0.75 m in height and low diversity. The major reason of destruction of mangroves is due to cutting for fuel purposes.

2) For the above reason, the existing eco-system cannot be described as sensitive.

3) The pollution load in the zone inhibits normal development of physiology and morphology. Hence the growth and reproduction of the different mangrove species get affected. In this zone, the mangroves growth will be hampered until the circumstances of pollution are radically amended.

4) The Shivaji Nagar mud-flat, has relatively less stress in terms of pollution. However, the tidal movement in this segment, which is one of the basic conditions of sustainance of mangrove ecosystem, has been drastically cut off by the ONGC road which is passing parallel with the coastaline in Shivaji Nagar. This has not only inhibited the input of required nutrients to the system on which the mangroves are sustained, but the diversity of Phytoplankton has also been drastically reduced. This has paved the way of decline of several feeding filter bivalves.

The major repository of pollution is the waters of the Thane Creek in Segment III. To remove

the circumstances of pollution is in itself a difficult task. With all the will that the managers of environment can muster, cleaning up will take a long time, because the heavy metals already deposited in the soil are not going to disappear soon.

G) Migratory Birds

a) Findings on Rapid EIA 2012 (MMRDA)

The mudflats and mangroves constitute the ecological settings of the project area. have mudflats and mangrove area. The Sewri end of the mudflat experiences migratory birds during winter season.

The Sewri mudflat area is known to attract lesser flamingoes (*Phoeniconaias minor*) and a few number of greater flamingoes (*Phoeniconaias rosues*) from November to June every year. About 10,000 to 15,000 flamingoes which are Near Threatened on the IUCN's Red List are known to visit this site.

Although important migratory birds have s not been confirmed in the survey of the 2012 survey, these migratory birds have a stay at this habitat for a limited period and leave the area in the beginning of summer back to their original habitat. They feed themselves on the minute aquatic creatures in the mudflats and also enjoy the high salinity nature. Monitoring programme will be taken up during construction phase to monitor the movement of the migratory birds. Due to slight increase in noise level during construction phase, it is supposed that the migratory bird colonies/areas will not have permanent shifting. It is expected that they may slightly shift, if at all, during construction phase, to avoid any disturbance. It has been observed during the study that during high tide period on the mudflats these birds shifts themselves to other areas and come back again during low tide. Even during movements of boats etc they tend to shift for temporary period. There are a few industries very near to these mudflats, which generate typical noise levels due to industrial operations. It is expected that construction of this project will not affect the habitation of the migratory birds permanently.

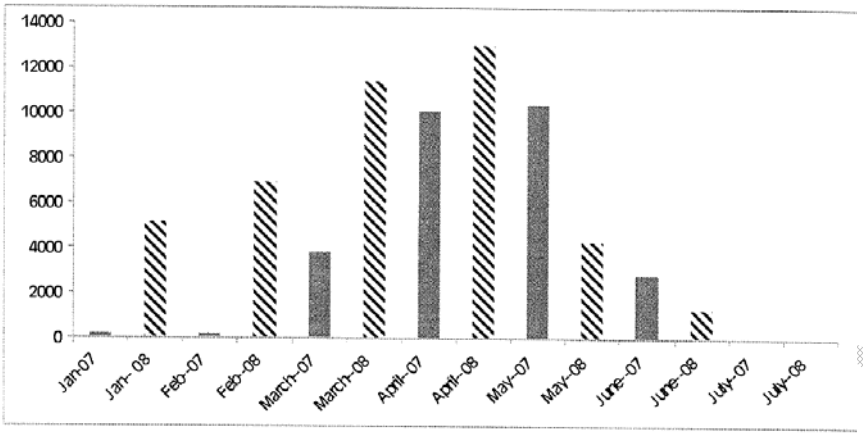
b) Findings on Study of Flamingos and Migratory Birds 2008 (MMRDA/Salim Ali Centre for Ornithology and Natural History)

Salim Ali Centre for Ornithology and Natural History studied the FlemingosFlamingos and other migratory birds in the Sewri - Mahul and Nhava Mudflats and the findings and recommendations of this study which will help build an appropriate to take necessary mitigation plan steps for the protection of birds in the area. Following are some of the observation in the report.

Observation

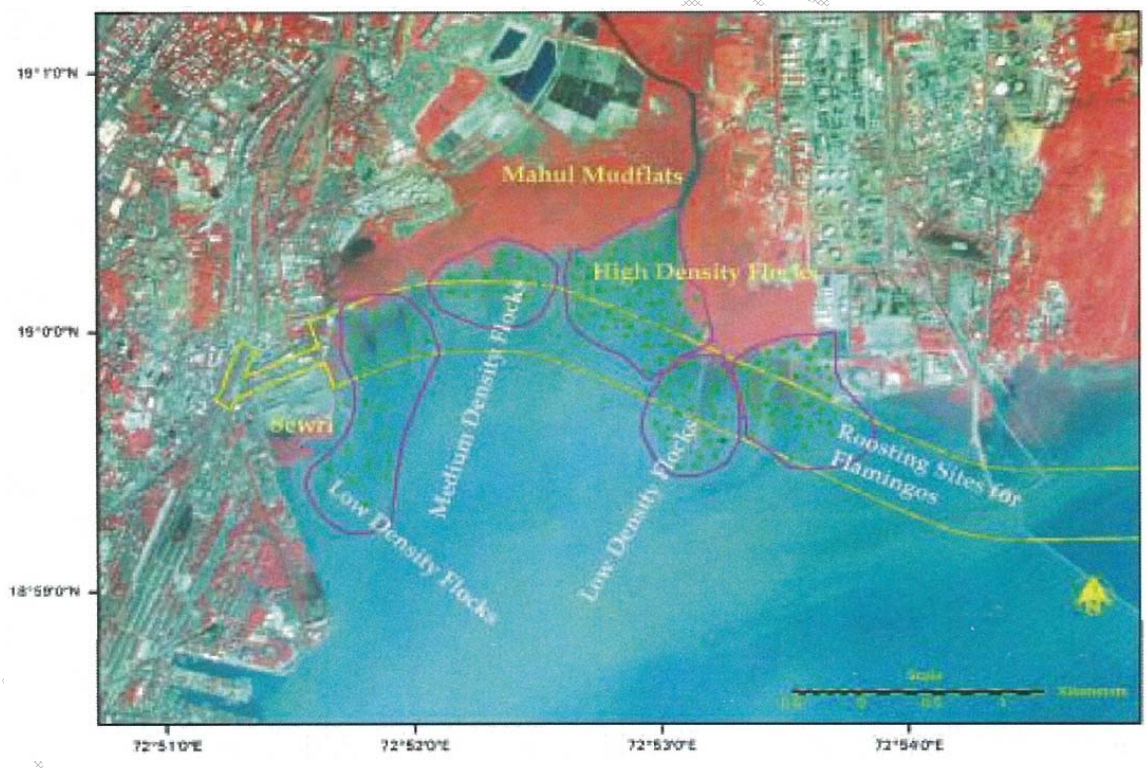
- According to the report, number of recorded species are 70 species in Sewri Section and 34 species in Shivaji Nagar Section in 2008 as shown in Table 6.2.12 Comprehensive Recorded Birds Species (2008-2012).
- The average number of Black headed Ibis, a near threatened category species was found to be 18 and four juvenile birds were observed in Sewri during February 2008.
- The lesser flamingo started arriving in the area during December 2006 in small numbers, and increased slowly in March 2007 and in large numbers in April 2007reaching the peak in May 2007. They started leaving the area in June with a few

juveniles remaining in June-July 2007.



Source: Study of Flamingos and Migratory Birds 2008 (MMRDA/Salim Ali Centre for Ornithology and Natural History)

Figure 6.2.7 Abundance of the Lesser Flamingo in the Sewri-Mahul region (during January-July 2007 and 2008)



Source: Study of Flamingos and Migratory Birds 2008 (MMRDA/Salim Ali Centre for Ornithology and Natural History)

Figure 6.2.8 Details of the areas used by Flamingos in the Sewri-Mahul Section

- Disturbance was caused by the ship repair activities at Sewri and tourist going closer to the flamingos by boat. The local people catching crabs did not cause much disturbance. Small construction works by Tata Power caused slight disturbance, but the birds got adjusted and went back to the area after the construction was over. This shows their adjustable nature with local movements as recorded elsewhere in the

world.

- Heavy metal contamination in water, sediment and fish samples from the study locations showed high levels were of Iiron, Nnickel and Ccopper in the sediment in Sewri and Cchromium and Ccadmium in Mahul because of effluents from industry, domestic sewage and ship repair. These would create toxicity to the biota on a long-term exposure .

Recommendations on the report regarding MTHL

- Mangrove restoration programs may be undertaken in suitable areas. These areas also need to be identified.
- Long term monitoring and detailed studies during the construction work of MTHL.

D) CRZ Areas of the Alignment

CRZ Clearance issured on 19th July 2013 and its implications on this project have been discussed in detail in Chapter 1 of this report.

The CRZ maps of the Mumbai and Navi Mumbai have s been collected and the alignment of the proposed project has been superimposed on themit. The maps shows the CRZ categorization of the MTHL alignment as CRZ I and CRZ II. The proposed alignment passes through different types of environment like CRZ and sea. According to the types of environment encountered, the proposed alignment segments can be conveniently subdivided into five zones as follows.

Table 6.2.20 Environmental Protected Zone (Coastal Regulation Zone: CRZ)

Zone No	Zone Feature	Chainage	Length in km	CRZ areas
I	Land	0.5 to 1.0	0.5	0.15 km in CRZ-II
II	Mudflats and sparse Mangroves	1.0 to 2.5	1.5	CRZ-I
III	Sea	2.5 to 16.98	14.48	-
IV	Mudflats and sparse Mangroves	16.98 to 17.58	0.6	0.10 Km in CRZ II & 0 .5km in CRZ-I
V	Land	17.58 to 22.00	4.42	-

Source: Rapid EIA 2012

The attributes of each segment are described below.

Table 6.2.21 Feature on each Coastal Regulation Zone

Zone No	Zone Feature
I	Zone I starts from east of Sewri rly station in the east-central part of the city of Mumbai near the Sewri railway station on the Harbour Line and ends on the edge of the high-water line at the Thane Creek. Here the proposed alignment would pass through urbanized land of the City of Mumbai. There are many port related infrastructure within this zone. 0.15 km of this zone.
II	Zone II extends between the high-water and the low-water lines of the Thane Creek hugging to the island of Mumbai. This zone is known as the Sewri mud-flat, which in places has coastal halophytic vegetation. This mud-flat, subject to the concurrence of the GOI, has been defined by the GOM as CRZ - I. The Survey of India (SOI), in their topographical maps, prepared some thirty years ago, have marked the coastal halophytic vegetation found on the Sewri mud-flat as belonging to mangrove type.
III	Zone III stretches across the Thane Creek between the low-water lines along the island of Mumbai and the mainland of Maharashtra. This zone is heavily used to sustain port related activities. The marine environment in this zone provides the nutrients to the coastal halophytic vegetation on the Sewri and the Shivaji Nagar or Nhava mud-flat.
IV	Zone IV is another mud-flat flanking the mainland, bounded by low-water and high-water lines of the Thane Creek. This is known as the Shivaji Nagar or Nhava mud-flat. This mud-flat, subject to the concurrence of the GOI, has also been classified as CRZ - I by the GOM. The SOI has also marked the coastal halophytic vegetation of this mud-flat as of mangrove type.
V	Zone V extends from the high-water line towards higher grounds on the mainland. This has terrestrial environment with farm lands, villages, roads, stone quarries, etc

Source: Compiled based on Rapid EIA 2012

The statement of area for MTHL falling in CRZ is shown in the following table

Table 6.2.22 Area Statement of bridge/Viaduct in CRZ

Sr No	Zone	Area of Bridge in CRZ in Sqm	No of Piers	Size of Pier	Total area of pier in CRZ in sqm	Cost in Crore INR (x 10 mil)
SEWRI SIDE						
1	CRZ I	45,000	62	3mX4m	744	481.5
2	CRZ II	4,500	8	3mX4m	96	48.15
	Total	**49,500**	**70**		**840**	**529.65**
CHIRLE SIDE						
1	CRZ I	15,000	22	3mX4m	264	160.5
2	CRZ II	3,000	6	3mX4m	72	32.1
	Total	**18,000**	**28**		**336**	**192.6**
	Grand Total	**67,500**	**98**		**1,176**	**722.25**

Source: Rapid EIA 2012

(3) Potential Impacts

1) **During Construction**

✓ Fauna

- Operation such as construction related vehicle and heavy equipment, also construction activities.
- Inflow and installation of base camp construction officials

✓ Flora

- Cutting mangrove, other trees and vegetation

2) **After Construction**

✓ Fauna

- Increase in traffic number
- The presence of viaduct and related facilities
- Existence of bridge may give impacts on tidal flow and mudflat

✓ Flora

- Existence of bridge may give impacts on tidal flow and mudflat

(4) **Impact Forecast**

1) **During Construction**

✓ Fauna

The items examined to forecast the impact are as below:

- Loss of mudflat and mangrove and/or their habitats caused due to by excavation for the piles
- Turbid water due to activities in the creek area and inflowing from construction area may impact on aquatic fauna.
- Part of the mudflat ecosystem is likely to be temporarily lost during the construction of the project which may result in drying of the mudflat around pile area and concurrent reduction in the food resources of migratory birds.
- If the base camp and construction yard are established installed near the feeding grounds

of migratory birds(mainly Flamingo and black headed ibis), migratory birds may avoid the area and fly away to other mudflat in Mumbai harbour temporarily. However, in general, such birds may return to their habitat after completion of the work in those stretches.

✓ Flora

- A part of mangrove area will be cut by the construction activiteis, however, the drying of the mudflat may increase only around piles and provide habitas of the mangrove.

2) **After Construction**

✓ Fauna

- Some migratory birds are accidentally killed on the road and bridge due to increase of traffic volume.
- The presence of elevated road, there is a risk of inhibiting the flight path of the Flamingo.
- Impact on the Flamingo roost is concerned by due to the irradiation of lighting of the road and traffic noise
- According to the result of forecast on hydology in article 6.2.2 Hydrology, existence of piers does not give significant impacts on entire of tidal flow and physical condition of mudflat, thus it is expected that such insignificant impacts on tidal flow and phisical condition of mudflat does not give adverse impacts on ecosystem in the mudflat.

✓ Flora

- The drying of the mudflat may be caused by existence of bridge piers, however, such area is limited around the piers and may provide possible environment for mangrove growth.

(5) **Mitigation Measures**

The proposed mitigation measures are set up based on CRZ clearance specific condition of MOEF, Rapid EIA 2012 approved by MMRDA, interview with specialists of mudflat and migratory birds in India and Japan and other project cases in Japan.

1) **During Construction**

✓ Fauna

- Adoption of excavation methodology for the minimal turbid water prevention (i.e. bore casing and excavation)
  (Referred project name: Shikoku Odan Expressway in Japan)
- Minimization of affected area on mangrove area and mudflat by adoption of temporary jetty construction road
  (Referred project name: Lake Man of Okinawa in Japan)
- Establishment of construction plan in consideration with lifecycle of migratory birds such as Flamingos, if possible. (i.e. Construction of temporary jetty may be constructed during rainy season)
  (Referred project name: Shikoku Odan Expressway in Japan, Isewangan Expressway in Japan)
- Installation of silencer with construction machines and/or low-noise machines near CRZ and mudflat in accordance with CRZ clearance.
  (Referred project name: Shikoku Odan Expressway in Japan, Isewangan Expressway in Japan)
- It is recommended that implementation of detailed baseline survey for fauna and preparation of monitoring plan in the project area before design-build stage

✓ Flora

- Implementation of the compensatory mangrove plantation in accordance with CRZ clearance specific condition on July 2013 (5 times of cutting mangrove: 0.1776 ha x 5 = 0.888 ha)
  (Referred project name: Lake Man of Okinawa in Japan)
- Implementation of monitoring for migratory birds such as Flamingos in accordance with CRZ clearance general condition on July 2013.
- It is recommended that implementation of detailed baseline survey for flora and preparation of monitoring plan in the project area before design-build stage

2) **After Construction**

✓ Fauna

- Sound barriers shall be installed on both sides of the road in CRZ area and Flaming distributed area so as to minimize the adverse impacts to the migratory birds in accordance with CRZ clearance specific conditions.
  (Referred project name: Shin Meishin Expressway Asuka IC- Nabeta IC in Japan and Case of rail-kill the Keiyo Line in Japan)
- Adoption of bridge type not to give significant impacts on migratory bird flying course in mudflat area. Distribution area and flying course for such as Flamingo should be identified through baseline survey prior to construction stage.
  (Referred project name: Shikoku Odan Expressway in Japan)
- Pre-stressed super structure shall be used in the mud flat area for construction as committed on CRZ clearance
- Lighting which does not give significant adverse impacts to roosting area of Flamingos should be installed in accordance with CRZ clearance specific condition.
  (Referred project name: Tokyo Bay Aquiline in Tokyo, Shin Meishin Expressway Asuka IC- Nabeta IC in Japan)
- Prohibit to use vehicle horn in mudflat section
  (Referred project name: Shikoku Odan Expressway in Japan, Isewangan Expressway in Japan)
- Implementation of periodical monitoring for migratory birds such as Flamingos in accordance with CRZ clearance general condition on July 2013

✓ Flora

- Implementation of replanting shall be done in accordance with CRZ specific condtion in Nahava area, however, detailed specific area, methodology and management & maintenance plan is not established yet at the moment. Thus detailed replanting and management shall be planed under considering surrounding vegetation and ecosystem during detailed design stage. (this management plan shall be prepared before construction stage under discussion with Ministry of Environment and Forests and Mahashtra State)
  (Referred project name: Lake Man of Okinawa in Japan)

Source: Panasonic Eco-solutions (Project name: Shin Meishin Expressway Asuka IC- Nabeta IC in Japan)

Figure 6.2.9 Noise Barrier with Lighting System in the handrail/noise barrier/view barrier

(6) **Evaluation**

The existing information on the project area suggests that the project area does not have rich environment, mangrove vegetation and a plenty of migratory birds mainly Flamingos are feeding on the mudflat between from November to June. Construction activities of MTHL may cause noise during construction stage, thus some group of migratory birds may avoid the adjacent area and flyaway to other area in Mumbai basin temporarily. However since several mitigation measures will be conducted, the migratory birds may again get back to same habitat gradually. Additionally turbidity from excavated area in the sea and cutting mangrove area will be minimized by appropriate mitigation measures such as adoption of bored piling methodology and installation of temporary jetty in the mudflat.

On the other hand, during operation phase, travelling vehicles generate noise and existence of viaduct may give adverse impacts for migratory birds. For minimization of these impacts, not only CRZ specific conditions, but also additional measures such as consideration of lighting system not to give impacts on Flamingo's roosting area are planned.

When unexpected events and phenomena has been confirmed after construction and during construction, appropriate to take action in consultation with relevant organizations such as MMRDA with general consultant and contractor, environmental department of Maharshtra and MoEF.

Thus, it is not likely to give serious impacts on project area including mudflat ecosystem under implementation of appropriate mitigation measures.

6.2.2. **Hydrology**

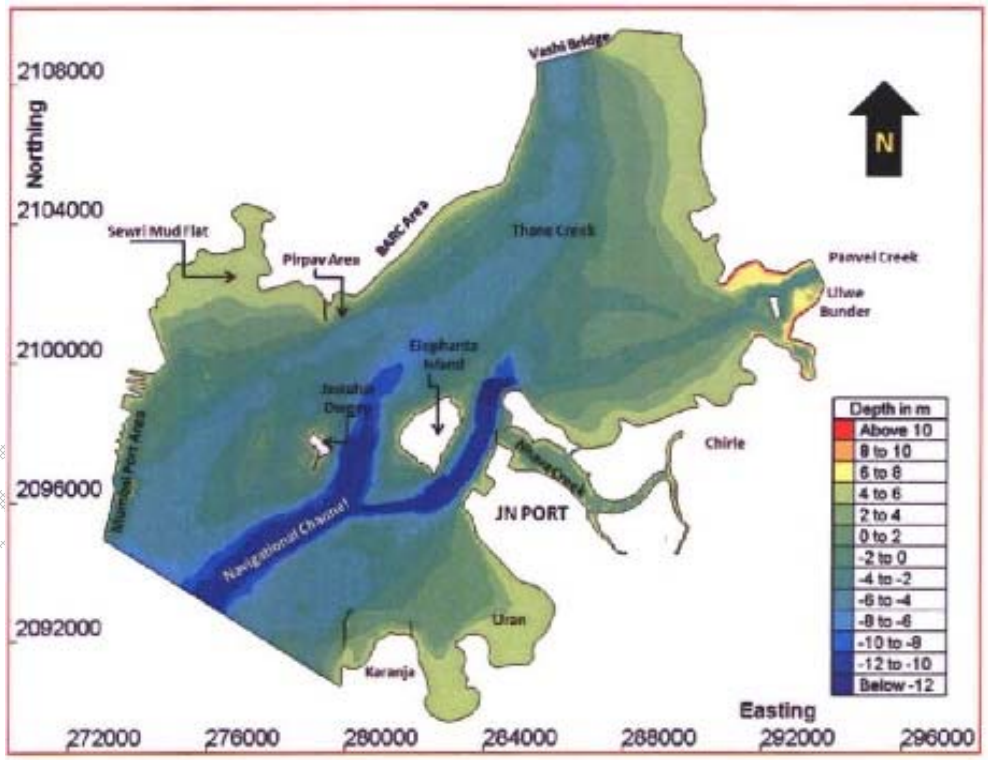
(1) Current Condition

Mumbai lies on the western coast of Arabian Sea, and is classified a "Tropical wet and dry or savanna climate" (by Köppen-Geiger classification: Aw). The climate of Aw have a pronounced dry season, with the driest month having rainfall less than 60 mm and less than 1/25 of the total annual rainfall. The summer and the winter climate are controlled by the south-west / north-east monsoons, and the autumn and spring seasons are practically indistinguishable. The Mumbai comes under the direct influence of the south-west monsoon

from June to September, it is usually very heavy, and 93% or more of the annual rainfall occurs from June to September. November to March is the North East monsoon period. Although occasional high wind speeds are experienced during the North East monsoons, rainfall is negligible.

Rivers flowing into the Mumbai Bay are ranked as the river of a relatively small basin in Indian rivers, and there are basins of 1358 hectares, only in the upper river basin of the MTHL. The tidal currents of the Mumbai Bay in the target region are mainly due to tidal ebb and flow. However, during South West monsoon, due to heavy rainfall, run off from rivers / creeks could considerably alter the flow pattern.

The tidal flow is unsteady and the magnitude and direction of the tidal current varies with respect to location, time and depth. According to the past observation results (June 2004) of tidal current, maximum velocity is observed as 0.77m/s on location along the proposed MTHL. Also, on the nautical chart, maximum velocity is described as 3knot (1.54m/s) / 2knot (1.03m/s) at the time of flood-tide and ebb-tide respectively. In addition, it was reported that the combination of ebb tide and heavy discharge from creeks during monsoon, it reaches up to 4 knots (2.06m/s). The dominant tide in the Mumbai Harbour is the semidiurnal tide with a period of 12 hours and 40 minutes. The tidal chart diagram of the Mumbai port is shown in Table 6.2.23 From tidal chart diagram, fluctuations of average spring and neap tides are observed as 3.66m (c)-i) in the next table) and 1.44m (d)-h)). Also, the difference between recorded highest high tide and lowest low tide is 5.85m (b)-k)), the recorded highest high tide including storm surge of cyclone etc. is 5.39m (c)) above CDL(Chrat Datum Level). This big difference in height between ebb and flow tide produce the intertidal zone as the result. This intertidal zone is one of a number of marine biomes or habitats, including estuaries, neritic, surface and deep zones.



Source: The Central Water and Power Research Station (CWPRS) Technical Report No.5165 (Mar, 2014)

Figure 6.2.10 Bathymetry Layout of the Mumbai Bay

Table 6.2.23 Each Statistical Tide Level of Mumbai Port

Tide	Above(+) or Below(-) from Chart Datum	Above(+) or Below(-) from MSL of Indian Survey Datum
a) Design Highest High Tide Level (HHTL)	+ 5.60 m	+ 3.09 m
b) Highest High Water recorded	+ 5.39 m	+ 2.88 m
c) Mean High Water Spring Tides. (MHWS)	+ 4.42 m	+ 1.91 m
d) Mean High Water Neap Tides. (MHWN)	+ 3.30 m	+ 0.79 m
e) Highest Low Water	+ 2.74 m	+ 0.23 m
f) Mean Sea Level. (MSL)	+ 2.51 m	+ 0.00 m
g) Lowest High Water.	+ 2.48 m	- 0.03 m
h) Mean Low Water Neap Tides. (MLWN)	+ 1.86 m	- 0.65 m
i) Mean Low Water Spring Tides. (MLWS)	+ 0.76 m	- 1.75 m
j) Chart Datum Level (CDL)	+ 0.00 m	- 2.51 m
k) Lowest Low Water recorded	- 0.46 m	- 2.97 m

Source: Mumbai Port Trust

(2) Potential Impacts

1) During and After Construction

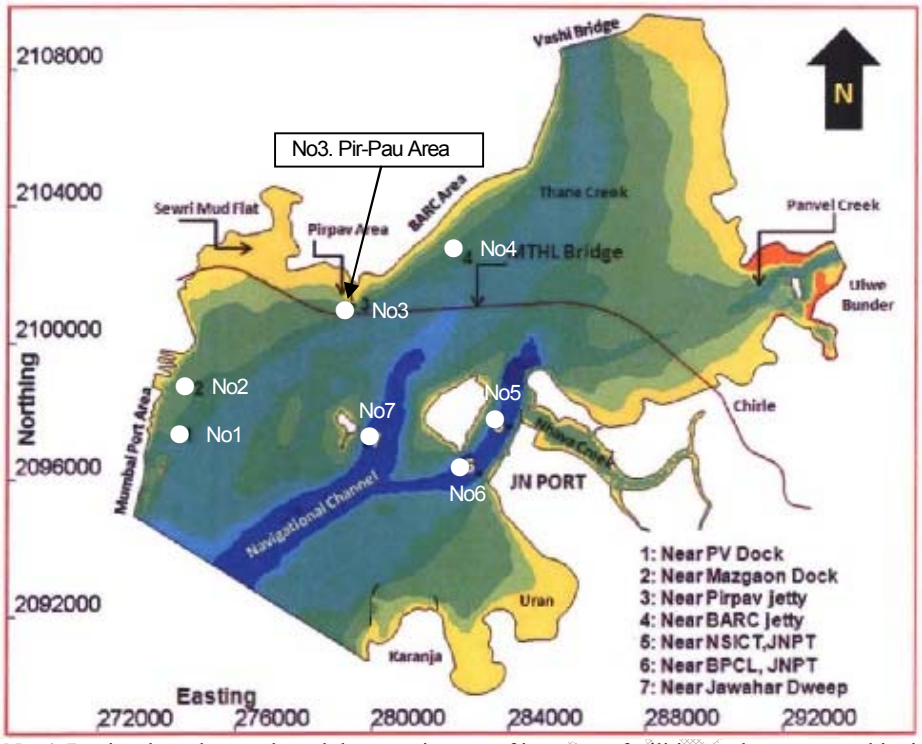
Construction of bridge may change hydrological situation of the creek and sea.

(3) Impact Forecast

1) During and After Construction

The hydraulic analysis have studied at 2014 by the Central Water and Power Research Station (CWPRS), for both cases with / without of the construction of the MTHL with 50-180 m span length. In this study, seven (7) important analysis points have been set up as shown in Figure 6.2.11 due to existence of important facilities such as ports and jettties. The precondition of the mathematical model for tidal hydrodynamics is shown in Table 6.2.24 Precondition of the mathematical model for Tidal Hydrodynamics.

According to FEM (Finite Element Method) result, at the nearest point of the project alignment No.3 named Pir-Pau with 150m span length, there is negligible increase and decrease in current strength during ebb and flood tide as shown in Figure 6.2.12 in case of ebb tide at Pir-Pau. Additionally flow patern image at Shivaji Ngar point on Figure 6.2.13 also shows few impacts. It was reported that it will not have any hydraulic impacts on functioning of other points. It means that it is not likely to give significant impacts on the function of transportation and sedimentation. Thus it is expected that existence of piers does not affect physical condition of the mudflat.



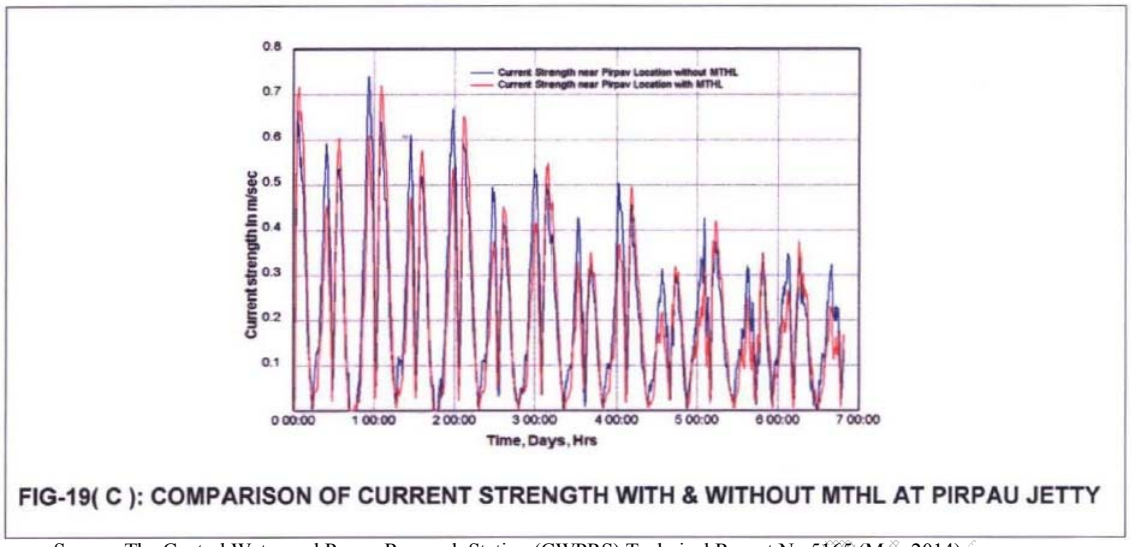
Note) 7 points have been selected due to existence of important facilities such as ports and jetties
Source: The Central Water and Power Research Station (CWPRS) Technical Report No.5165 (Mar, 2014)

Figure 6.2.11 Hydraulic Analysis Areas in the Mumbai Basin

Table 6.2.24 Precondition of the mathematical model for Tidal Hydrodynamics

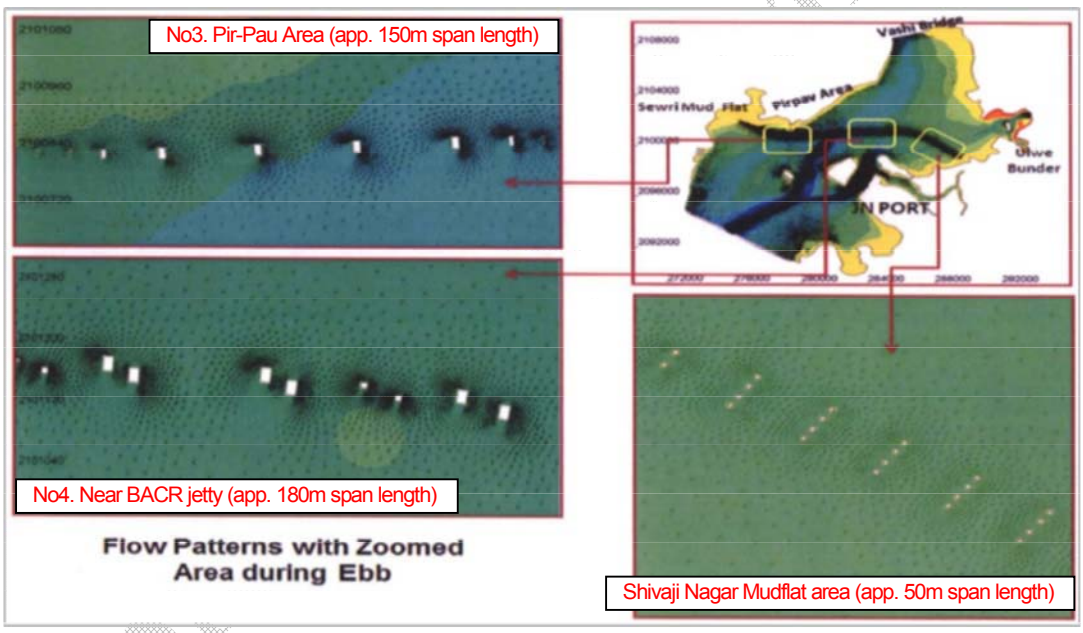
Items		Case-1 Without MTHL	Case-2 With MTHL	Remarks
Analysis Area		193		
Bathymetry data		Provided by CWPRS		
Influence by MTHL bridge		Not considered	Considered Span lengths are varied from 50m to 180m of same conditions as 2012 F/S study. In a similar way, pier shapes are taken in the analysis model as quasi-shapes by triangular finite elements.	
Boundary Conditions and Reproduction Period		Observed tidal levels at Apollo bunder (Mumbai Port), Vashi bridge (Thane creek) and Ulwe Bundar (Panvel creek) from 08.05.2013 to 03.06.2013		
Observed Tidal current for the calibration		Six locations in Analysis area from 27.05.2013 to 03.06.2013		
Summary of FEM hydraulic model	No. of Nodes for finite element mesh	21,018	129,120	
	No. of Elements for finite element mesh	39,921	250,681	Triangular finite elements
	Usage Software	TELEMAC-2D		
	Analysis method	Two-dimensional unsteady flow by hydrodynamic equations of Saint Venant's		

Source: The Central Water and Power Research Station (CWPRS) Technical Report No.5165 (Mar, 2014)



Source: The Central Water and Power Research Station (CWPRS) Technical Report No.5165 (Mar, 2014)

Figure 6.2.12 Comparison of Current Strength With/Without MTHL at No3 Pir Pau Jetty



Source: The Central Water and Power Research Station (CWPRS) Technical Report No.5165 (Mar, 2014)

Figure 6.2.13 Flow pattern around Piles of MTHL Bridge during Ebb Tide

(4) Mitigation Measures

1) During and after Construction

Although Hydraulic impacts are negligible, the monitoring of the tidal level and current should be conducted at the bridge sites by installing water alarm system during and after the construction of MTHL. Furthermore, the bathymetric survey around the MTHL should be conducted periodically, and will be confirmed that the sea bed level is higher than the design scour depth. When the sea bed gets closer to the design scour depth, the surrounding of pier around the sea bed will be protected by appropriate material such as the riprap or geobag.

(5) Evaluation

1) During and After Construction

The study of bridge hydraulics in the Mumbai Bay has been conducted on 2014 by the Central Water and Power Research Station (CWPRS). In the Study, the insignificant changes in flow speed and direction only around piers are indicated in Figure 6.2.13 graphically, however, the changes of ebb tidal flow speed at forecasted points are not significant as shown in Figure 6.2.12, thus it is not expected that construction of new bridge affects on entire of hydrological situation and physical condition of mudflat.

6.2.3. **Topography and Geology**

(1) Current Condition

The topographical and geological features are described in the chapter "3.1.Topography, Geography and Hydrology".

(2) Potential Impacts

1) During and After Construction

Any considerable topography and geological sites are not located in the project area, thus no impact is expected. However embankment section may have risks of land slide.

(3) Impact Forecast

1) During and After Construction

The area of earthworks and embankment is shown in the next figure. An embankment section is located from ST 17+000 to 17+900 and from ST 21+300 to 21+800 as an interchange in Shivaji Nagar and Chirle, the cutting section is located from ST 19+500 to 19+900 as a Tollgate approach road.

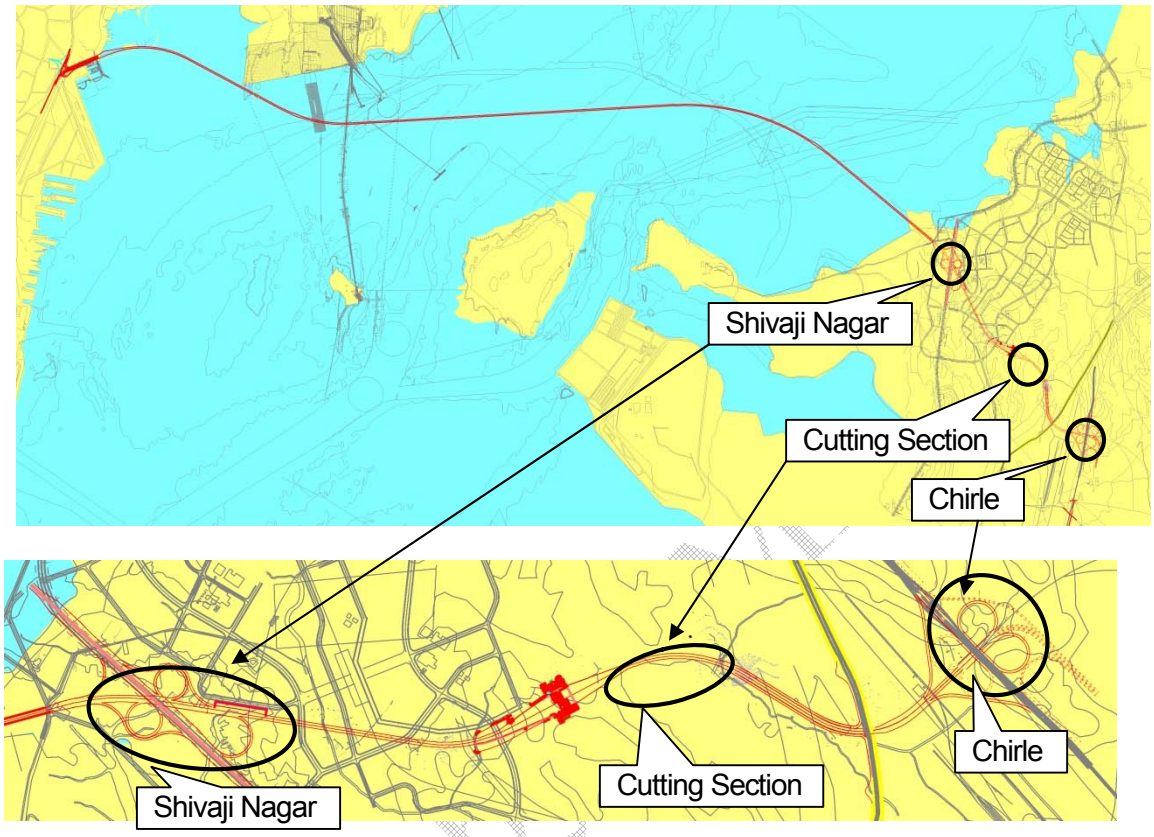
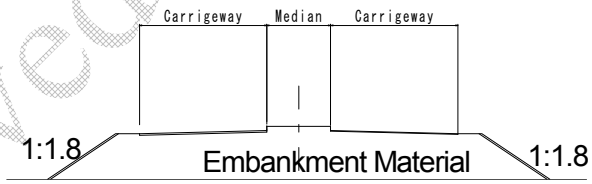
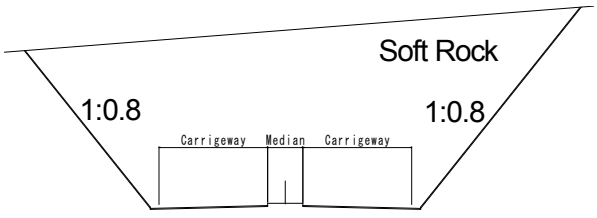


Figure 6.2.14 Major Earthwork Sections in the Project Area

Embankment (Shivaji Nagar and Chirle)



Cutting Section



Source: JICA Study Team

Figure 6.2.15 Typical Cross Section on the Earthwork Area

Storm water may give adverse impacts on its stability due to surface water flow, and such rain water causes turbid water from earthwork area during monsoon season. However, the toll gate section is located on rock mountain, thus, it is expected that soil erosion and landslide is not caused during monsoon season.

(4) Mitigation Measures

1) During and after Construction

The cutting section is assumed to soft rock area based on the past studies and field survey, hence, the slop gradient is adopted 1:0.8, and the embankment is selected 1:1.8 as the slope of general respectively. These slope gradients are stabilized in accordance with Guideline of earthwork (Japan Road Association). Additionally appropriate slope protection measures are adopted, as required.

Planting slope protection method

Mortar Spraying slope protection method

Source: JICA Study Team

Figure 6.2.16 Slope Protection Measures (sample)

(5) Evaluation

1) During and After Construction

Implementation of appropriate designing and mitigation measures such as slope protection and periodical monitoring & maintenance will mitigate the expected impacts. Thus it is not likely to give significant impacts on stability of earthwork section.

6.3. Social Environment

Since approximately 96ha land acquisition is almost completed in Navi Mumbai side with satisfied under policy of JICA's guidelines, some social environment items such as resettlement, land acquisition, the poor, local economy, land use, existing social infrastructures and gender are discussed on only Mumbai side on this report. Detailed description on Navi Mumbai side is given on SIA report.

6.3.1. Involuntary Resettlement

(1) Result of Baseline Survey

A total of 229 project affected families (PAFs) and 53 business shops, and totally 1,272 persons are recorded as Project Affected Persons (PAPs) in Sewri side.

A category-wise outline of PAHs and outline of affected structures & houses are shown below;

Table 6.3.1 Number of Project Affected Families and Persons in Sewri Side

No	Item	Number
1	Impact on Structure (no.)	317
1.1	Loss of Residence (no.)	229
1.2	Loss of Business(no.)	53
1.3	Other structure (no.) (see item No5 and 6)	35
2	Impact on PAFs/PAPs(no.)	317
2.1	Total PAFs (Residential 229, business 53)	282
2.2	Total PAPs	1,272
3	Titleholder (no.)	0
4	Non-Titleholder (no.)	282
5	Impact on Community Resources(no.) Community Temple: 5 Community Mosque: 1 Women's group facility: 3 Community Toilet:1	10
6	Impact on government structures(no.)	25
7	MTHL Land / Sea area acquisition area (ha) Sewri Section: 8.6ha Sea Section 810 ha Navi Mumbai Section: 96 ha	Total : 914.6 ha Land : 104.6 Sea : 810

Source: MMRDA, CIDCO & BSES data from JICA study team

(2) Potential Impacts

1) During Construction

As shown in Table 6.3.1 Number of Project Affected Families and Persons, 1,272 resettlers are caused by the construction of MTHL.

2) After Construction

No impacts are expected

(3) Impact Forecast

1) During Construction

As shown in Table 6.3.1 Number of Project Affected Families and Persons, number of PAFs and relocated persons is 282 and 1,272 to be displaced are identified based on SIA survey.

(4) Mitigation Measures

1) During Construction

Major mitigation measures are as follows;

- ✓ Holding consultation meetings for understanding of compensation policy
- ✓ Implementation of adequate compensation on JICA Guidelines
- ✓ Implementation of livelihood restoration program based on Social Impact Assessment (SIA)
  (Detailed implementation programs are described in the SIA report)

2) After Construction

Monitoring and assessing will be conducted regarding livelihood of PAPs, appropriate restoration and enhancement of living standards will be considered in accordance with SIA.

(5) Evaluation

1) During Construction

Although 1,272 resettlers are caused by the project, implementation of appropriate compensation, resettlement and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item.

6.3.2. **The Poor**

(1) Result of Baseline Survey

The annual family income of PAPs is shown in Table 6.3.2. In the Sewri area, 146 (58.9 %) of affected families earn income ranging from 50,000 to 100,000 INR. On the other hand, yearly expenditure less than 300,000 INR indicates 96.3%.

Table 6.3.2 Income of PAPs in Sewri Section

Annual Income	Total	
	No.	%
Less than 50,000	28	11.3
50,000 K – 100,000 (1 Lakh.)	146	58.9
1 Lakh - 5 Lakh	71	28.6
5 Lakh & Above	3	1.2
Total	**248**	**100.0**

Source – BSES data from JICA study team

Table 6.3.3 Expenditure of PAPs in Sewri Section

Annual Expenditure	Total	
	No.	%
Less than 100,000 (1 Lakh)	105	46.8
100,000 to 300,000 (1 Lakh – 3 Lakh)	111	49.5
300,000 to 500,000 (3 Lakh – 5 Lakh)	8	3.7
500,000 and above (5 Lakh -)	0	0
Total	224	100.0

Source: BSES data from JICA study team

The poverty line in urban area Maharashtra state indicates app. 1,560 INR/month and 18,720 INR/year in accordance with Table 3.7.6 respectively. According to basic social economic survey (BSES), 4 PAPs are categorized as under-poverty line in the survey area Sewri Section.

Table 6.3.4 Under Poor-line and other Vulnerable People

Category	Total	
	No.	%
1. Scheduled Caste (SC)	6	10.4%
2. Scheduled Tribe (ST)	2	3.4%
3. Below Poverty line (BPL)	4	6.9%
4. Widow Headed Household and Window	28	48.3%
5. Divorce Headed Household	5	8.6%
6. Women Headed House (WHH)	10	17.2%
7. Physically Disabled	3	5.2%
Total	58	100.0%

Source: JICA Study Team

(2) Potential Impacts

1) During Construction

According to SIA survey, 4 PAPs under poverty line are recorded in the project area, thus, resettlement may have risks of income reduction due to loss job.

2) After Construction

No impacts are expected

(3) Impact Forecast

1) During Construction

4 PAPs under poverty line to be displaced are identified based on SIA survey, thus such displaced PAPs may have income reduction due to increase of commuting time and loss of job temporarily.

(4) Mitigation Measures

1) During Construction

Major mitigation measures are as follows;

- ✓ Holding consultation meetings for understanding of compensation policy
- ✓ Implementation of adequate compensation based on JICA Guidelines
- ✓ Implementation of livelihood restoration program for income loss
  (Detailed implementation programs are described in the SIA report)

2) After Construction

Monitoring and assessing will be conducted regarding livelihood of PAPs, appropriate restoration and enhancement of living standards will be considered in accordance with SIA.

(5) Evaluation

1) During Construction

Any house heads under poverty line are not impacted by the project, however the displaced

house heads may have risks of income reduction. Hence implementation of appropriate compensation and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item.

6.3.3. Local economy such as employment and livelihood

(1) Result of Baseline Survey

With regard to income and expenditure, the survey results are shown in Table 6.3.2 and Table 6.3.3. Table 6.3.5 shows the main occupation of family heads. More than half of family heads are private service workers, and app. 23.7% belongs to businessand trade activities.

Table 6.3.5 Occupation of Family Heads

Occupation	Total	
	No.	%
1. Fishing	2	0.5
2. Labour	42	9.4
3. Business /Trade	106	23.7
4. Govt. Service	10	2.2
5. Private Service	257	57.5
6. Maid Servant	8	1.8
7. Others	22	4.9
Total	**447**	**100.0**

Source: JICA Study Team

(2) Potential Impacts

1) During Construction

Major occupation is private sector and business&trade who are working near project area. Thus resettlement may cause income reduction due to long commuting time or loss of job.

2) After Construction

Basically no impacts are expected on this item because most impacts are given during construction phase.

(3) Impact forecast

1) During Construction

According to Table 6.3.5, census and economic surrey on SIA, loss of income is expected on private sector and business & trade workers mainly.

(4) Mitigation Measures

1) During Construction

Major mitigation measures are as follows;

- ✓ Holding consultation meetings for understanding of compensation policy and livelihood restoration programs
- ✓ Implementation of adequate compensation based on JICA's Guidelines
- ✓ Implementation of livelihood restoration program for income loss (detailed implementation programs are described in the SIA report)

2) After Construction

Monitoring and assessing will be conducted regarding livelihood of PAPs, appropriate

restoration and enhancement of living standards will be considered in accordance with SIA.

(5) Evaluation

1) During Construction

Although 447 PAPs and their properties are impacted by the project, implementation of appropriate compensation and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item.

6.3.4. Land use and Utilization of Local Resources

(1) Result of Baseline Survey

Approximately 8.6 ha compound of Mumbai Port Trust (MPT) will be affected by the project, and some areas are used for residential and commercial shops as shown in Table 6.3.1. Some house heads and shop owners have a lease contract with MPT in Sewri Section. Additionally, in the sea section, traditional fishermen have own customary fishing ground. Detailed data is shown in SIA report.

(2) Potential Impacts

1) During Construction

As described in Table 6.3.5, private service workers, fishermen and business & trade workers are working in the project area and near project area, thus such working space is reduced by the construction of MTHL.

2) After Construction

Development activities without any permission from the local government along the alignment may be caused and unplanned development may give adverse impacts from the view of social environment and natural conservation.

(3) Impact forecast

1) During Construction

Approximately 8.6 ha MPT compound including commercial and housing land with 229 families and 53 shops will be used for construction site and yard, additionally in the sea section between ST500 to ST17600, customary fishing ground will be reduced by the construction of MTHL.

2) After Construction

Surrounding area of the MTHL may be used for commercial area and small factory compound without any permission from authorities.

(4) Mitigation Measures

1) During Construction

Major mitigation measures are as follows;

- ✓ Holding consultation meetings for understanding of compensation policy and livelihood restoration programs for affected persons including fishermen
- ✓ Implementation of adequate compensation for affected properties based on JICA's Guidelines

- ✓ Implementation of livelihood restoration program for income loss based on JICA's Guidelines
  (detailed implementation programs are described in the SIA report)

2) After Construction

Management of appropriate land use in accordance with approved land use plan along the road.

(5) Evaluation

1) During Construction

Although totally 8.6 ha compound in Sewri area and customary fishing area is affected by the project in the sea section, implementation of appropriate compensation and social assistance will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item.

2) After Construction

Appropriate land use management by road management organization and local government will minimize expected adverse impacts. And such appropriate land use management will give positive impacts in the affected area from the view of economic and natural environment considerations.

6.3.5. Existing Social Infrastructure and Services

(1) Result of Baseline Survey

According to SIA survey, no sensitive receptors such as public school and public hospital and local meeting places are observed in the affected area. However community level temple, mosques and women's group accommodation are recorded in the project area as shown in Table 6.3.1.

(2) Potential Impacts

1) During Construction

Construction of MTHL will affect to community temple & mosque and women's group facility. Additionally traffic restriction in construction area may give impacts on commuting traffic and access in the project area.

2) After Construction

No adverse impacts are expected

(3) Impact forecast

1) During Construction

Traffic restriction area in the project area, inhabitants and commuting people including students will spend much time than usual for passing such construction area. Additionally displacement of community level temples & mosques and women's group facilities may give adverse impacts on prayers and group members.

(4) Mitigation Measures

1) During Construction

Construction of diversion road adjacent to the constructed road is required from the view of

traffic safety and smooth traffic flow. Additionally existing community road will be connected with new bypass for access to the public facilities.

On the other hand, following mitigation measures shall be implemented;

- ✓ Holding consultation meetings for understanding of compensation policy
- ✓ Implementation of adequate compensation or displacement in accordance with JICA Guidelines
  (Detailed implementation programs are described in the SIA report)

(5) Evaluation

1) During Construction

Construction activities will give adverse impact on access to public facilities and commuting time, additionally displacement of community level temples and mosque will be caused. However implementation of mitigation measures will minimize the impacts. Thus it is not likely to give serious impacts on this item.

6.3.6. Local Conflicts

(1) Result of Baseline Survey

According to comments in the local level stakeholder meetings and socialization meetings on Social Impact Assessment, local inhabitants and local authorities requested to ensure job opportunities as construction workers.

(2) Potential Impacts

1) During Construction

Conflicts or disputes between communities may be raised if imbalance in hiring workers is caused.

2) After Construction

No adverse impacts are expected

(3) Impact forecast

1) During Construction

Conflicts or disputes between communities may be raised if imbalance in hiring workers is caused.

(4) Mitigation Measures

1) During Construction

Followings are proposed mitigation measures;

- ✓ Local workforce is prioritized for construction of the MTHL
- ✓ Implementation of appropriate education for hired workers from other area and countries

(5) Evaluation

1) During Construction

The hired workers from other areas may have conflicts with inhabitants, however

implementation of mitigation measures will minimize the impacts. Thus it is not likely to give serious impacts on this item.

6.3.7. Landscape

(1) Result of Baseline Survey

As shown in Chapter 3, 2 sites are selected from the view of major viewpoints and landscape resources within 5 km from the project area. In this range, Sewri fort as registered heritage and Elaphant Caves designated as the World Cultural Heritage is located. The locations and features are shown below.

Source: JICA Study Team

Figure 6.3.1 Tourism Points near Project Area

Table 6.3.6 Features of Selected View Points and Landscape

Site Name	Feature	Landscape from the site
1. Seweri Fort	The Sewri Fort is a fort in Mumbai built by the British at Sewri. Built in 1680, fort served as a watch tower, atop a quarried hill overlooking the Mumbai harbour. The fort is currently owned by Maharashtra state's Department of Archaeology and Museums. It is classified as a Grade I heritage structure.	Mudflat, mangrove trees in the Mumbai bay is seen from the fort. Especially from November to May, migratory birds, particularly the lesser flamingoes are seen from this view point.
2. Elephanta Cave	The Elephanta Caves are a network of sculpted caves located on Elephanta Island, or Gharapuri in Mumbai Harbour, 10 kilometres to the east of the city of Mumbai in the Indian state of Maharashtra. The island, located on an arm of the Arabian Sea, consists of two groups of caves—the first is a large group of five Hindu caves, the second, a smaller group of two Buddhist caves. The Hindu caves contain rock cut stone sculptures, representing the Shaiva Hindu sect, dedicated to the Lord Shiva. The rock cut architecture of the caves has been dated to between the 5th and 8th centuries, although the identity of the original builders is still a subject of debate. The main cave (Cave 1, or the Great Cave) was a Hindu place of worship until Portuguese rule began in 1534, after which the caves suffered severe damage. This cave was renovated in the 1970s after years of neglect, and was designated a UNESCO World Heritage Site in 1987 to preserve the artwork.	The Elephant cave is registered as the World Cultural Heritage. This site is located near rock mountain, thus tourists cannot see outside from the entrance of the caves. Although sea view points are located on the approach path of the caves, the distance between the points where can see outside and project site is around 2km.

Source: JICA Study Team

Source: JICA Study Team

Figure 6.3.2 Landscape from Viewpoint at Sewri Fort (No.1)

Source: JICA Study Team

Figure 6.3.3 Landscape from the Entrance of Elephanta Caves (World Cultural Heritage) (No.2)

(2) Potential Impacts

During and after construction of the sealink, landscape from the Sewri Fort maybe change due to appearance of viaduct after construction and related temporary jetty only during construction. On the other hand, landscape from entrance of the Elephanta Caves registered as the World Cultural Heritage does not change by the project because the rock mountain with the caves blocks tourists view.

(3) Impact Forecast

The degree of impact is forecasted by making a photomontage after construction. The photomontage is shown below

Source: JICA Study Team

Figure 6.3.4 Photomontage from View Point at Sewri Fort

The landscape elements are mainly mangrove trees, mudflat and skyline of opposite hilly area. According to the photomontage, a part of mangrove and mudflat are blocked or reduced by construction of the sealink, however the viaduct does not give impacts on the skyline of hilly area and the changed area is negligible on this photomontage.

(4) **Mitigation Measures**

To mitigate adverse impacts on the view, the monotone color harmonized with surrounding current landscape has been adopted shown in Figure 6.3.4.

(5) **Evaluation**

The changes before and after construction of sealink are unavoidable. However the structure does not give serious impact on skyline apposite hilly area, and the color of structure harmonize with surrounding mudflat and mangroves than other colors.

Additionally, Non Objection Certificate (NOC) regarding passing through near heritage sites such as Sewri Fort and Elephanta Caves had been issued from relevant authority in 2003.

Thus it is evaluated that the project does not give serious impacts on this item.

6.3.8. **Gender**

(1) Potential Impacts

1) During Construction

In other projects, compensated cash and properties are not provided to affected house family members fairly, and the men head or men family members spend the compensated money not

for right purpose.

2) After Construction

No adverse impacts are expected

(2) Impact forecast

1) During Construction

According to result of basic economic survey on SIA, any gender gaps and risks caused by the project on this item are not identified. Thus it is not likely to give serious impacts on this item.

6.3.9. **Infection Disease**

(1) Result of Baseline Survey

According to interview survey with inhabitants, major infection diseases are dengue fever, malaria and diarrhea. However such statistical data is not recorded in this area.

(2) Potential Impacts

1) During Construction

Infectious diseases such as STDs are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provoke to provide habitats of mosquito that possibly transmits dengue and malaria fever.

2) After Construction

Inappropriate drainage maintenance may provide a habitat of carrier mosquito.

(3) Impact forecast

1) During and Construction

Hired construction workers and skilled equipment operators may contact with inhabitants and spread infection diseases.

Additionally puddles in the construction area and insufficient drainage will provide a habitat of carrier mosquito for dengue fever and malaria.

2) After Construction

Insufficient maintenance of drainage and bridges may provide some puddles and small pond, such environment may be habitat of mosquito larva.

(4) Mitigation Measures

1) During Construction

Followings are proposed mitigation measures;

- ✓ Installation of sufficient drainage facilities not to provide habitat for vector mosquito
- ✓ Provision of adequate temporary sanitation facilities
- ✓ Enforcement of medical screening and periodical medical check-up
- ✓ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness of the labors is promoted

2) After Construction

Followings are proposed mitigation measures;

- ✓ Installation of sufficient drainage facilities not to provide habitat for vector mosquito
- ✓ Implementation of periodical maintenance for drainages and bridges

(5) Evaluation

Inflow of workers during construction may provide opportunity for spreading infection disease. Additionally insufficient and inappropriate drainage and maintenance during and after construction may also provide habitats of mosquito larvae. However implementation of mitigation must prevent and minimize these adverse impacts. Thus it is not likely to give serious impacts on them.

6.3.10. **Labor Environment**

(1) Potential Impacts

1) During Construction

Inappropriate labour environment and working without safety measures in accordance with relevant laws and regulations may cause accident during construction.

2) After Construction

No impacts are expected

(2) Impact forecast

1) During and Construction

Working without considering labor laws and regulations in the construction area may cause accident. For instance, working without out helmet and working boots have risks to injure head and foot.

(3) Mitigation Measures

1) During Construction

Followings are relevant laws and regulations shall be followed by the contractor and workers;

- ✓ Indian labour laws and regulations such as "Building And Other Construction Workers (Regulation of Emloyment and Conditions of Service) Act,1996" and "The building and other construction worker's welfare cess Act, 1996"
- ✓ IFC Performance Standard 2 Labor and Working Conditions

(4) Evaluation

The labour environment is secured when the contractor under observation of general consultant follows Indian laws such as "Building And Other Construction Workers (Regulation of Emloyment and Conditions of Service) Act,1996", "The building and other construction worker's welfare cess Act, 1996" and international standards such as "IFC Performance Standard 2 Labor and Working Conditions".

6.3.11. **Accident**

(1) Result of Baseline Survey

According to statistical Mumbai Police Department, number of fatal and injured case in 2014 is 350 and 14,684 persons respectively as shown in Table 6.3.7

Table 6.3.7 Number of Traffic Accident in Mumbai

Occupation	2013	2014
1. Injured	15,224	14,684
2. Fatal	387	350
Total	15,611	15,034

Source: Mumbai Police Department (7th October 2014/dnindia)

(2) Potential Impacts

1) During Construction

Construction machines and vehicles are operated near residential area and public facilities such as school and hospital, additionally there will be some restricted areas in the construction areas. Thus number of traffic accident may increase in construction area and on the road where construction machines use.

2) After Construction

Number of traffic accident may increase due to increase of traffic number and travelling speed after construction of MTHL.

(3) Impact forecast

1) During Construction

According to construction plan, construction machines and trucks will be operated for 4.5 years. Thus risks of traffic accident increase on the commuting roads.

2) After Construction

Number of traffic accident may increase due to increase of traffic number and travelling speed after construction of MTHL.

(4) Mitigation Measures

1) During Construction

Followings are proposed mitigation measures;

- ✓ Deploying flagman at the gate and crossing points of the construction vehicles
- ✓ Installation of safety sign board
- ✓ Installing fence around the construction site to keep out local people such as children
- ✓ Installation of lightning in the night time near construction area
- ✓ Installation of parking for idling construction machines
- ✓ Restricting mobilization speed in the construction site
- ✓ Safety training for the workers and safety patrol at the construction site by supervisors

2) After Construction

Followings are proposed mitigation measures;

- ✓ Installation of sign board and road making for speed limit
- ✓ Implementation of advertisement for traffic safety campaign
- ✓ Enforcement of traffic controls by police

(5) Evaluation

Traffic volume must increase during and after construction of MTHL, hence, number of accident increase in conjunction with traffic volume. However implementation of mitigation must prevent and minimize these adverse impacts. Thus it is not likely to give serious impacts on them.

6.3.12. Cross Boundary Impacts and Climate Change

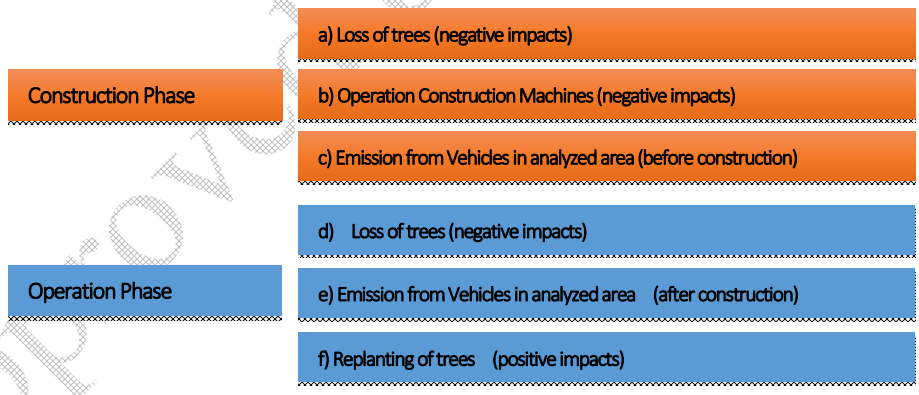
(1) Potential Impacts

1) During Construction

Deforestation of mangrove for land clearance will generate greenhouse gasses such as CO2. At the same time, operation of construction machines and construction activities generate the CO2.

2) After Construction

Greenhouse gas around the MTHL may increase by the traffic. However traffic flow in the analysis area must be improved after construction of MTHL, thus total generated CO2 is estimated on both cases "With/Without Project". Only the estimated travelling speed will increase in case of "With Project" as shown in the next table.



Source: JICA Study Team

Figure 6.3.5 Analyzed Item on CO2 Generation

(2) Impact forecast

1) During Construction

The expected activities which give negative impact on generation of greenhouse gases such as COs are;

a) Cutting trees on developed area

b) Operation of Construction machines

c) Emission from Vehicles in analyzed area (before construction)

The result of analysis is show below articles respectively.

a) Cutting trees on developed area

According to CRZ clearance, loss of mangrove area is 0.1776 ha. Affected area out of CRZ is estimated 0.0264ha shown in below.

Table 6.3.8 Estimated CO2 Volume by Cutting Tree

Area	Affected mangrove area (ha)	CO2 sink Unit (t/ha) Note***	Lost volume of carbon sink (CO2 t)	Cutting Duration (Year)	Lost volume of carbon dioxide sink (CO2 t/Year)
1. CRZ (Sewri and Navi Mumbai side)Note*	0.1776	524.48	93.15	1	93.15
2. Out of CRZ (Navi Mumbai Side)Note**	0.0264	524.48	13.85	1	13.85
Total	0.2040	524.48	107.00	1	107.00

Note

*: CRZ Clearance July 2013 (Sewri: (CRZ-I Number of piers 62 x (3x4) m2/pier = 744 m2) + (CRZ-II Number of Piers 8 x (3x4)m2/pier = 96 m2) = 840 m2, Navi Mumbai: (CRZ-I Number of piers 22 x (3x4) m2/pier = 264 m2) + (CRZ-II Number of Piers 6 x (3x4)m2/pier = 72 m2) = 336m2 totally 0.1176ha on affected piers area + other affected area 0.06 ha : Grand total is 0.01776 ha)

**: Mangrove area out of CRZ is from ST. 16500 to ST. 16980 and from ST. 17580 to 17900. Number of main route without ramp section is 22 piers. 22 piers x (3x4) = 264 m2

***: Biomass Mangrove = 192 Ct/ha above ground biomass + 94.08 Ct/ha below ground biomass (ratio 0.49) = 286.08 Ct/ha
CO2 Sink Unit = 286.08 x (44/12) x CF (0.5)= 524.48 CO2 t/ha.

b) Impact of Construction Machines Operation

The estimated generated CO2 unit volume is given from a reference, and the quantitative analysis is carried out in accordance with these values. The result of analysis is shown below, totally 45,683 t-CO2 during construction and 13,052 CO2-t per year.

Table 6.3.9 Estimated CO2 Volume by Construction Activities

Type of Structure	Unit (CO2 t/km)	Length (km)	Generated CO2 t	Construction year	Generated CO2 t/year
Embankment	3401.7	1.2	4,082	4.5	907
Bridge (PC)	2101.05	19.8	41,601	4.5	9,245
Total		21.0	45,683		13,052

Source: JICA Study Team
Generated CO2 Unit: Highway Technology Research Center in Japan (2004 December)
Highway with 4 carriage way, Earth work section: 2,267.8t-CO2/km, Steel Bridge Section: 1,287 t-CO2/km, PC Bridge Section: 1400.7 t-CO2/km, Tunnel Section: 713.5 t-CO2/km

c) Emission from Vehicles in analyzed area (before construction)

The estimated generated CO2 from traffic network is shown below;

Table 6.3.10 Estimated CO2 Volume from Traffic (before construction 2015)

Period	Year	Estimated (CO2 t/year) Source: Road Traffic Without Project
Before Construction	2015	4,534,386

Source: JICA Study Team

2) Operation Phase

The expected activities which give negative impact on generation of greenhouse gases such as CO2 are;

d) Cutting trees on developed area

e) Replanting of mangrove

f) Emission from Vehicles in analyzed area

The result of analysis is show below articles respectively.

d) Impact of Cutting Trees (Negative impacts)

Estimated lost volume of carbon sink is 107.0 CO2 t/year as shown in Table xxx.

e) Replanting of mangrove (Positive impacts)

According to specific condition on the CRZ clearance issued in 2013, 5 times of cutting mangrove area shall be replanted on the Nhava side designated by MoEF. Thus although 0.1776 ha of mangrove is cut during construction stage, 5 times of 0.1776, 0.888ha mangrove area will be created by mitigation measures in accordance with CRZ clearance.

Table 6.3.11 Estimated CO2 Volume by Cutting Tree

Area	Replanted mangrove area(ha)Note*	CO2 sink Unit (t/ha) Note**	Created volume of carbon sink (CO2 t/year)
1. CRZ (Sewri and Navi Mumbai side)	0.888	524.48	465.74

Note)
*: Replanted mangrove area = 0,1776 x 5 times in accordance with CRZ Clearance = 0.888 ha
**: Biomass Mangrove = 192 Ct/ha above ground biomass + 94.08 Ct/ha below ground biomass (ratio 0.49) = 286.08 Ct/ha
CO2 Sink Unit = 286.08 x (44/12) x CF (0.5)= 524.48 CO2 t/ha.
Source: JICA Study Team

f) Emission from Vehicles in analysed area (Positive impacts with project)

Basically travelling speed in the analyzed area must increase due to improvement of traffic, thus total generated greenhouse gas such as CO2 will decrease after construction.

Table 6.3.12 Estimated CO2 Volume from Traffic (Operation Phase 2022, 2032 and 2042)

Period	Year	Estimated (CO2 t/year)	
		Without Project	With Project
After Construction	2022	729,433	729,488
After Construction	2032	986,541	984,706
After Construction	2042	1,392,036	1,390,991

Source: JICA Study Team

3) Compiled Result of Quantitative Analysis

The estimated comprehensive CO2 volume is shown below. Although negative impacts are predicted during construction 4.5 years in case of "With Project" due to mainly construction activities, basically positive impact is given by the project operation phase due to improvement of traffic stream after 2032. Thus it is not likely to give significant impact on the generation of CO2.

Table 6.3.13 Compiled Estimated CO2 Volume during Construction and Operation Phase

Year	Estimated (CO2 t/Year)										1. Without - 2. With Project
	Without Project					With Project					
	Construction Works (t/year)	Road Traffic (t/year)	Cut Mangrove (t/year)	Replanting Mangrove (t/year)	1. Without Project Total (CO2 t/y)	Construction Works	Road Traffic	Cut Mangrove (t/year)	Replanting Mangrove (t/year)	2. With Project Total (CO2 t/y)	
2015	0	454,386	0	0	454,386	0	454,386	0		454,386	0
2018	0	591,914	0	0	591,914	10,152	591,914	107		602,173	-10,259
2022	0	729,443	0	0	729,443	0	729,488	107	-466	729,595	-152
2032	0	986,541	0	0.0	986,541	0	984,706	107	-466	984,813	1,728
2042	0	1,392,036	0	0.0	1,392,036	0	1,390,991	107	-466	1,391,098	939

Source: JICA Study Team

(3) Mitigation Measures

With regard to cutting mangrove during construction, replanting mangrove will be conducted in accordance with CRZ clearance in 2013.

(4) Evaluation

Negative impacts are forecasted during construction due to construction activities such as operation of construction machines, however, traffic stream in the analyzed area will be improved by the construction of MTHL operation phase. Thus it is likely to give positive impacts on this item.

CHAPTER 7 ENVIRONMENTAL MANAGEMENT PLAN

7.1. Mitigation Measures

An Environmental Management Plan (EMP) has been recommended in this chapter. This EMP takes into account all the environmental impacts identified for MTHL and the corresponding mitigation measures to ameliorate the same. The EMP presented below includes:

- ✓ Specific actions to be taken vis-à-vis site-specific issues;
- ✓ Mitigation measures for abatement of the undesirable impacts caused during construction and operation stages
- ✓ Agencies responsible for its implementation & supervision;
- ✓ Post project Environmental Monitoring Program to be undertaken after commissioning of the project
- ✓ Environmental status reporting frequency; and
- ✓ Institutional arrangement, Strengthening of their capabilities, and role.
- ✓ Mitigation measure and monitoring plan is merged from Rapid EIA 2012 prepared by MMRDA, CRZ clearance specific condition and JICA Scoping report commented by JICA Advisory Committee.
- ✓ The cost for all mitigation measures is including a part of construction cost except replanting mangrove. The cost of replanting mangrove in accordance with CRZ clearance is estimated 60 Lakh INR on Rapid EIA 2012
- ✓ Detailed mitigation measures and monitoring plan should be establish in the future under MMRDA and General Consultant

Environmental management plan during construction phase and operation phase is listed below.

Table 7.1.1 Environmental Management Plan

Area	No	Item (on Rapid EIA 2012)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
Pollution	1	Air pollution (Air quality)	☐ All vehicles and machineries shall obtain & maintain the 'Pollution under Control Certificate (PUC)'. These vehicles will be maintained so that emissions conform to the standards prescribed in the certificate. ☐ Vehicles carrying construction material shall be covered to avoid spilling ☐ Asphalt mixing plant (Hot mix and batching plants) shall be over 500 m away from any communities and 300 m from the road as far as possible to avoid any air emissions from these plants. ☐ Water sprinkling shall be carried out twice or thrice each day on earth road/unpaved sections of road and construction yard near residential area to avoid dust generation ☐ The exhaust of DG set will be released at the height prescribed by MPCB (Maharashtra Pollution Control Board) so that it does not affect nearby population.	☐ Appropriate land use management along the road (commercial and industrial area) ☐ Monitor periodically ambient air quality at suggested locations ☐ Enforcing different control measures to minimize the air pollution	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)

Area	No	Item (on Rapid EIA 2012)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
	2	Water pollution (Water Quality/ Construction of labor camp/ Siting of borrow and quarry material areas)	☐ Turbid waste water from construction area shall be mitigated and treated in sedimentation pond, if required ☐ In the sea section, the casing and excavation methodology shall be adopted not to generate significant turbid water. ☐ There shall be no water drawl in CRZ area ☐ Waste oil shall be stored and disposed to designated site ☐ Provision of sanitation facilities at the labor camps, also the location of camps will be at least 200 m away from any water sources. ☐ Domestic waste water and night soil from base camp shall be treated and discharged. ☐ Septic tanks will be provided in accordance with Coastal Regulation Zone Notification, 2011. The disposal of treated water shall conform to the regulations of MPCB (Maharashtra Pollution Control Board). ☐ Uncontrolled digging of borrow pits will be avoided to prevent water accumulation, which results in breeding of vector disease. ☐ Providing adequate drainage structure ☐ Avoiding obstruction of existing drainage during filling	☐ Turbid water from road surface shall be collected through drainage and treated by sedimentation trench ☐ In the mudflat section, storm water should be collected by every pier and discharged on pile caps not to excavate mudflat area by the falling water.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	3	Waste (Solid waste management/ Construction of labor camp/ Topography, Soil and Geology)	☐ After considering the possibility of reuse, construction waste shall be disposed at designated disposal site with the approval of competent authority to ensure that it do not cause any impact to the environment ☐ Proper sanitation facilities suc as septic tank shall be provided at construction workers camp. Garbage/muck materials generated will be analyzed prior to dumping / disposal in the identified locations with the approval of competent authority to ensure that it do not cause any impact to the environment ☐ There will be no disposal of solid or liquid wastes on coastal area. Solid waste Management will be as per Municipal Solid (Management and Handling) Rules, 2000	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	4	Soil Contamination (Topography, Soil and Geology/ Siting of borrow and quarry material areas)	☐ Polluted excavated soil including muck soil shall be disposed at designated site with the approval of competent authority to ensure that it do not cause any impact to the environment	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	5	Noise and Vibration (Ambient Noise)	☐ Adoption of low-noise equipment ☐ All the construction equipment's shall be provided with exhaust silencers as committed. ☐ Noise containment barriers shall be provided on both sides of the bridge in mudflat areas (CRZ-IA) so as to minimize the likely impacts to the migratory birds ☐ Avoiding works of heavy equipment during night time. ☐ Provision of using ear plugs by workers exposed to high noise levels ☐ Informing the construction schedule to surrounding communities to obtain their consensus.	☐ Proponent will propose appropriate land use plan such as commercial area along the road ☐ Noise barrier shall be installed as required ☐ Periodic monitoring of ambient noise levels at suggested locations ☐ Erecting signboards at sensitive and residential locations prohibiting use of horns ☐ Growing road side plantation to prevent the noise levels.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)

Area	No	Item (on Rapid EIA 2012)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
	8	Bottom Sedimentation (Topography, Soil and Geology(No.4))	☐ Polluted excavated soil including muck soil shall be treated, and then reused and/or disposed at designated site in accordance relevant laws and regulations.	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Natural Environment	9 and 10	Protected Area (Reserved Forest and Fauna) and Ecosystem (Ecology and Biodiversity/ Ecology/Construction of labor camp)	☐ Adoption of excavation methodology for the turbid water prevention (i.e. bore casing and excavation) ☐ Temporary jetty would be constructed in the mudflats for movement of vehicles and machinery to avoid the disturbance to mudflats/mangroves. ☐ Establishment of construction plan in consideration with lifecycle of migratory birds such as Flamingos. ☐ Installation of silencer with construction machines in accordance with CRZ clearance. ☐ Implementation of monitoring for migratory birds such as Flamingos in accordance with CRZ clearance general condition on July 2013. ☐ Implementation of the compensatory mangrove plantation in accordance with CRZ clearance specific condition (5 times of cutting mangrove: 0.1776 ha x 5 = 0.888 ha) where MoEF appoints. ☐ It is recommended that implementation of detailed baseline survey for fauna & flora and preparation of monitoring plan in the project area before design-build stage.	☐ Installation of noise barrier for not to cause "Fly-Kill" on the viaduct as required ☐ Sound barriers shall be installed on both sides of the road in CRZ area and Flamingo's distributed area in accordance with CRZ clearance specific conditions. ☐ Adoption of bridge type which does not give significant impacts on migratory bird flying course in mudflat area. note) Distribution area and flying course should be identified through baseline survey prior to construction stage. ☐ Pre-stressed super structure shall be used in the mud flat area for construction as committed on CRZ clearance ☐ Lighting which does not give significant adverse impacts to roosting area of Flamingos should be installed in accordance with CRZ clearance specific condition. ☐ Prohibit using vehicle horn in mudflat section (Installation of sign boards). ☐ Implementation of monitoring for migratory birds such as Flamingos in accordance with CRZ clearance general condition on July 2013. ☐ Implementation of appropriate management and maintenance of mangrove plantation area	MMRDA & Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	11	Hydrology	☐ The monitoring of the tidal level and current should be conducted at the bridge sites by installing water alarm system during and after the construction. ☐ The bathymetric survey around the MTHL should be conducted periodically, and will be confirmed that the sea bed level is higher than the design scour depth. Designing of bridges with sufficient capacity not to give impacts on tidal conditions. ☐ There shall be no water drawl in CRZ area.	Same monitoring and mitigation measures during construction shall be done	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	12	Topography and geology (Topography, Soil and Geology)	☐ Installation of slope and stabilizing embankment with appropriate measures	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)

Area	No	Item (on Rapid EIA 2012)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
Social Environment	13	Involuntary resettlement	☐ Implemention of SIA; ・ Holding consultation meetings for understanding of compensation policy. ・ Implementation of adequate compensation on JICA Guidelines. ・ Implementation of livelihood restoration program based on SIA.	Monitoring based on SIA	MMRDA	MMRDA
	14	The poor	☐ Implementation of SIA	Monitoring based on SIA	MMRDA	MMRDA
	16	Local economy such as employment and livelihood (Quality of Life/Fisheries)	☐ Implementation of SIA	Monitoring based on SIA	MMRDA	MMRDA
	17	Land use and utilization of local resources (Land use/Fisheries)	☐ Holding consultation meetings for understanding of compensation policy and livelihood restoration programs for affected persons including fishermen. ☐ Implementation of adequate compensation for affected properties based on JICA's Guidelines. ☐ Implementation of livelihood restoration program for income loss for fishermen based on JICA's Guidelines.	☐ Management of appropriate land use in accordance with approved land use plan along the road.	MMRDA	MMRDA (propose to MCGM and CIDCO)
	19	Existing social infrastructures and services (Utility services and community severance)	☐ Implementation of SIA	Monitoring as required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	22	Local conflict of interests	☐ Local workforce is prioritized for construction of MTHL ☐ Implementation of appropriate education for hired workers from other area and countries.	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	24	Landscape (Aesthetics and landscape)	☐ Adoption of appropriate design and color harmonized with surrounding current landscape ☐ Landscaping of borrow pits	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	27	Infectious diseases such as HIV/AIDS	☐ Installation of sufficient drainage facilities not to provide habitat for vector mosquito. ☐ Provision of adequate temporary sanitation facilities. ☐ Enforcement of medical screening and periodical medical check-up. ☐ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness of the labors and local inhabitants is promoted.	☐ Installation of sufficient drainage facilities not to provide habitat for vector mosquito. ☐ Implementation of periodical maintenance for drainages and bridges.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	28	Labour Environment	☐ Implementation and follow relevant laws and regulations "Building And Other Construction Workers (Regulation of Employment and Conditions of Service) Act,1996" and "The building and other construction worker's welfare cess Act, 1996" and IFC Performance Standard 2 Labor and Working Conditions	Not required	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Other	29	Accident (Accident hazards and safety)	☐ Secure assistance from local police for traffic control during construction phase. ☐ Safety measures will also be undertaken by installing road signs and marking for safe and smooth movement of traffic. ☐ Setting up of appropriate detours. ☐ Restricting mobilization speed in the	☐ Implementation of advertisement for traffic safety campaign. ☐ Prepare and administer a monitoring system on road accidents. ☐ Installation of sign board and	Contractor (Construction Company) in consultation with Traffic Police	MMRDA

Area	No	Item (on Rapid EIA 2012)	Mitigation Measures		Responsibility	
			During Construction	Operation	Implementation Agency	Responsible Agency
			construction site. ☐ Installation of parking for idling construction machines. ☐ Installing gate structure at the entrance of the construction site to set up restricted area ☐ Deploying flagman at the gate and crossing points of the construction vehicles. ☐ Installing fence around the construction site to keep out local people such as children. ☐ Installation of lightning in the night time near construction area. ☐ Labourers will be equipped with proper safety gears like helmets gloves and gumboot. ☐ Periodic health check-up of construction worker. ☐ Safety training for the workers and safety patrol at the construction site by supervisors. ☐ Monthly safety meeting	road making for speed limit. ☐ Enforcement of traffic controls by police.	Department	
	30	Cross Boundary impacts and climate change	☐ Replanting mangrove and street trees same amount of cutting trees (Replanting of mangrove shall be done 5 times of cutting trees in CRZ as per specific condition on CRZ clearance)	☐ Maintenance of planted trees and mangroves through periodical inspection	MMRDA	MMRDA

Source: JICA Study Team

Additionally all committed specific conditions on CRZ clearance on 2013 will be conducted by MMDA as shown in the next table.

Table 7.1.2 Mitigation Measures on CRZ Clearance for MTHL

No.	Conditions	Response on Mitigation Measures
1	As per the CRZ notification, 2011, at least five times the number of mangroves destroyed/cut during the construction process shall be replanted. Mangrove plantation in an area of 30 ha shall be carried out as committed against loss of 0.1776 ha of mudflats/mangroves. Permission from the High Court of Bombay shall be obtained with respect to mangrove cutting.	MMRDA will replant 5 times of cutting mangrove in the appointed area by MoEF
2	Proponent shall provide lighting in consulting in consulting with the Bombay Natural History Society so as to minimize the likely impacts to the migratory birds	MMRDA will setup traffic light inside of bridge handrail especially in CRZ and flamingo roosting area
3	All the construction equipment's shall be provided with exhaust silencers as committed	Low noise construction machines and with exhaust silencer is installed during construction
4	Noise containment barriers shall be provided on both sides of the bridge in mudflat areas (CRZ-IA) so as to minimize the likely impacts to the migratory birds	Noise barrier is installed in CRZ and roosting /feeding are of migratory birds such as flamingo
5	There shall be no dreading and reclamation for the project	Dreading and reclamation is not planned on this project in the CRZ.
6	Pre-stressed super structure shall be used in the mud flat area for construction as committed	Pre-stressed super structure will be used in the mud flat area CRZ
7	The muck materials shall be analyzed prior to dumping / disposal in the identified locations with the approval of competent authority to ensure that it do not cause any impact to the environment	The muck soil is generated from excavated points of piles. The excavated soil is analyzed and disposed at designated and authorized dumping site.
8	Proponent informed that there is no fishing activity in the area since it is a navigation channel for the nearby ports. However, navigation channel is provided with 25m for ships and 9.1 m for fishing boats.	Sufficient prescript vertical clearance under discussion with relevant authorities.
9	All the recommendations of the MCZMA shall be strictly compiled with.	All recommendation of the Maharashtra Coastal Zone Management Authority will be reflected to mitigation measures, if any
10	There shall be no building construction beyond 20,000 sqm.	No building is planned in CRZ. Only toll gate is planned out of CRZ in Navi Mumbai side
11	There shall be no water drawal in CRZ area	No polluted water from project in CRZ. However

		storm water will be flow down from the road in monsoon season.
12	There shall be no disposal of solid or liquid wastes on coastal area. Solid waste Management shall be as per Municipal Solid (Management and Handling) Rules, 2000.	There is no activities to discharge and dispose solid and liquid waste from project activities in CRZ
13	Sewage shall be treated and the Treatment Facility shall be provided in accordance with the Coastal Regulation Zone Notification, 2011. The disposal of treated water shall conform to the regulations of State Pollution Control Board.	Sewage including polluted water and night soil does not generate from project activities in CRZ
14	The project proponent shall set up a separate environmental management cell for effective implementation of the stipulated environmental safeguard under the supervision of a Senior Executive.	MMRDA will setup environmental management cell for MTHLin MMRDA
15	The funds earmarked for environment management plan shall be included in the budget and this shall not be diverted for any other purposes.	MMRDA will secure budge for MTHL

Source: CRZ Environmental Clearance (MOEF 19th July 2913)

7.2. Environmental Monitoring Plan

7.2.1. Construction Phase

Environmental monitoring plan for pre and during construction phase is proposed as follows.

Table 7.2.1Environmental Monitoring Plan Pre and During Construction Phase

Category	No	Impacted Item on JICA Guidelines	Parameter	Method	Location	Frequency a year	Cost (INR)	**Standard** Central Pollution Control Board (CPCB) – Ministry of Evironment & Forest (MoEF)
Pollution	1	Air pollution	SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, Pb, CO, NH_3, C_6H_6, BaP, As, Ni, CH_4 and CO_2 (14 Items)	Same method as baseline survey Or Establis fixed monitoring station at 2 locations	**2 Locations** where baseline monitoring was carried out. (2 locations: Sewri and Shivaji Nagar)	**4 times / year x 4.5 years** (Once every quarter –Summer, Winter, post-monsoon) (24 hr/day for 2 consecutive working days per week for 2 weeks except CO which is 8 hr/day)	1800,000	National Ambient Air Quality Standards (NAAQS) by Central Pollution Control Board (CPCB) (Standard for 24hrs: Industrial and Residential/ Ecological Sensitive area) • SO_2: 80 / 80μg/m^3 • NO_2: 80 / 80μg/m^3 • PM_{10}: 100 / 100μg/m^3 • $PM_{2.5}$: 60 / 60μg/m^3 • O_3: 180 / 180μg/m^3 • Pb: 1.0 / 1.0μg/m^3 • CO: 0.4 / 0.4mg/m^3 • NH_3: 400 / 400μg/m^3 • C_6H_6: 0.5 / 0.5μg/$m^{3(anual)}$ • BaP: 0.1 / 0.1μg/$m^{3(anual)}$ • As: 0.6 / 0.6mg/$m^{3(anual)}$ • Ni: 20 / 20mg/$m^{3(anual)}$
	2	Water pollution	pH, BOD, DO, Turbidity and O&G	Same method as baseline survey	**3 Locations** Near excavated area in Zone II (Sewri mudflat), Zone III and Zone IV where baseline monitoring was carried out.	**4 times / year x 4.5 years** Once every quarter – Summer, Winter and post-monsoon	810,000	Marine water quality Standards – Class SW-IV Harbour Waters (MPCB) • pH : 6.5-9 • DO: 3 mg/l • Turbidity: 30 NTU • BOD: 5 mg/l • O & G: 10 mg/l
	3	Waste	Volume of waste soil, cutting tree and domestic garbage	Record volume of generated waste	**3 Locations** (1. Sewri camp site 2. Mangrove cutting area 3. Navi Mumbai camp site))	**4 times / year x 4.5 years**	324,000	**Municipal Soild Waste Management Rules, 2013** Generated waste shall be reused or disposed at designated site. (The construction waste can be dumped in legally authorized dumping grounds in Navi Mumbai by CIDCO with association of Navi Mumbai Municipal Corporation (NMMC) which is located in Taloja. Remaining i.e. from Mumbai side, MMRDA can be taken care of and dumped the construction waste in association with Municipal Corporation of Greater Mumbai (MCGM) on authorised sites i.e. Deonar, Mulund and Gorai.

Category	No	Impacted Item on JICA Guidelines	Parameter	Method	Location	Frequency a year	Cost (INR)	**Standard** Central Pollution Control Board (CPCB) – Ministry of Evironment & Forest (MoEF)
	4 And 8	Soil Contamination/sedimentation	Heavy Metals & Oil & Grease (5-10 items shall be selected from Soil pollution standards)	Same method as baseline survey	**2 Locations** 1. Excavated muck soil and 2. stocked soil in the yard from cutting area	**1 times / year x 4.5 years**	108,000	Soil Pollution Standard in India (MOEF) • Cd: 0.01mg/l • Lead: 0.01mg/l • Chromium (VI): 0.05mg/l • Arsenic: 0.01mg/l • T-Mercury: 0.0005mg/l • Copper: 125mg/kg (some items shall be selected from totally 25 standards items)
	5	Noise and vibration	Ambient and road side noise (dB(A)L_{Aeq})	Same method as baseline survey (continuous 24 hrs)	**3 Locations** (1. Sewri, 2. ST migratory bird distribution area ST500-5500, 3. Shivaji Ngagar) Note) No2 and 3 locations where baseline monitoring was carried out.	**2 times / year x 4.5 years**	108,000	**-Construction Noise; 85dB(A)** **-Ambient Noise Standards in India (dB (A) $_{Leq}$)** 1.Industrial Area Day Time: 75 (6-22hr) Night Time: 70 (22-6hr) 2.Commercial Area: Day Time: 65 (6-22hr) Night Time: 55 (22-6hr) 3.Residential Area: Day Time: 55 (6-22hr) Night Time: 45 (22-6hr) 4.Silence Zone Day Time: 50 (6-22hr) Night Time: 40 (22-6hr)
			Vibration (dB L_{10} or mm/sec)	Same method as baseline survey (continuous 24 hrs)	↑ ditto	**2 times / year x 4.5 years**	54,000	**- Construction vibration 75dB** **-Vibration Standards roadside** 1. Commercial /Industrial Area Day Time: 70 (7-20hr) Night Time: 65 (20-7hr) 2. Residential Area: Day Time: 65 (7-20hr) Night Time: 60 (20-7hr)
Natural environment	9 and 10	Protected Area /Ecosystem	1.Monitoring of mudflat conditions including fauna-flora 2. Monitoring of Cutting Tree and replantation/ transplanting area 3.Monitoring of Mangrove Plantation area appointed by MoEF 4. Monitoring of sedimentation soil and ecological parameter (18items on Table 6.1.15 for soil and 7 items such as 1)Netprimary productivitye, 2)Chlorophyll-a, 3)Phosphate,	Ocular inspection and quantitative survey 1-1. Fauna-Flora Line-Point census and record number and appeared species 1-2: Mangrove density and community survey 1-3: Benthos Survey 2-1: Cutting trees confirmation 3-1: Mangrove survey in the replanted area	Along MTHL alignment and mangrove replant area	**4 times / year x 4.5 years**	6,480,000	Significant impacts are not caused by the project **Note)** **Detailed monitoring plan will be setup during basic design stage** Standard for Soil; Table 6.1.15 Sandar for Ecological Parameter: • Netprimary Productivity <1,500 mgC/m3/day at surface • Chlorophyll-a <4mg/m3 • Phosphate: 0.1-90µg/l • Nitrate: 1.0-500µg/l • Nitrite: <125µg/l • Particulate Organic Carbon: 10-100mg/m^3 • SiO2: 10-5,000µg/l

Category	No	Impacted Item on JICA Guidelines	Parameter	Method	Location	Frequency a year	Cost (INR)	**Standard** Central Pollution Control Board (CPCB) – Ministry of Evironment & Forest (MoEF)
			4)Nitrate, 5)Nitrite, 6)Particulate Organic Carbon, 7) SiO_2)					
	11	Hydrology	Flooding situation	Flood level measurement during high precipitation periods	**2 Locations** (CRZ at Sewri and Shivaji Nagar)	**4 times / year x 4.5 years**	540,000	Project activities and structures does not cause flooding and impacts on tidal conditions
	12	Topography and Geology	Conditions in embankment area	Visual survey about Stability of embankment	**2 Locations** (1. Embankment of Inter Change in Shibaji Nagar and 2 Cutting area at toll gate in Chirle)	**4 times / year x 4.5 years**	The cost is including with No17 Land use	Embankment shall be stabilized without any landslide and cracks
Social environment	13	Involuntary resettlement	Payment and implementation of social assistance in accordance with SIA	Consultation Meeting and/or Survey with the project affected persons (PAPs)	Affected area	Refer to SIA monitoring plan	Refer to SIA monitoring plan	Compensation shall be completed prior to actual construction activities and secure livelihood standards
	14	The poor	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	16	Local economy such as employment and livelihood	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	17	Land use and utilization of local resources	Situation of establishment of land use map	Confirmation of land use map	**2 Locations** (Sewri and Navi Mumbai side in the Affected area)	**2 times / year x 4.5 years**	180,000	Designated land use shall be secured without any unplanned development by local people and developers
	19	Existing social infrastructures and services	Condition of facilities to be displaced	Ocular inspection	Affected area	Refer to SIA monitoring plan	Refer to SIA monitoring plan	Compensation shall be completed prior to actual construction activities and secure livelihood standards
	22	Local conflict of interests	Construction worker's township	Confirmation of workers list from contractor	**2 Locations** (camp site in Sewri and Shivaji Nagar)	**4 times / year x 4.5 years**	180,000	Employment opportunity shall be provided fairly
	24	Landscape	Condition of landscape	Visual inspection	**1 Location** (View from Sewri Fort)	**1 time / year x 4.5 year** (Dry season)	22,500	Color of structure shall be adopted monotone color harmonized with surrounding landscape
	27	Infectious diseases such as HIV/AIDS	Number of infected patient	Confirmation of health check list from contractor	**2 Locations** (camp site in Sewri and Shivaji Nagar)	**4 times / year x 4.5 years**	180,000	Infection disease rate shall not be caused by the project
	28	Labour Environment	Construction worker's condition	Confirmation of safety devices and conditions via interviews	**2 Location** (camp site in Sewri and Shivaji Nagar)	**2 times / year x 4.5 years**	90,000	"Building And Other Construction Workers (Regulation of Emloyment and Conditions of Service) Act,1996", "The building and other construction worker's

Category	No	Impacted Item on JICA Guidelines	Parameter	Method	Location	Frequency a year	Cost (INR)	**Standard** Central Pollution Control Board (CPCB) – Ministry of Evironment & Forest (MoEF)
								welfare cess Act, 1996" and international standards such as "IFC Performance Standard 2 Labor and Working Conditions"
Other	29	Accidents	Number of accidents	Confirmation of accidents list from local government and State Traffic Police Department	**2 Locations** (camp site in Sewri and Shivaji Nagar)	**4 times / year x 4.5 years**	180,000	Any accidents are not caused by construction
	30	Cross Boundary impacts and climate change	Monitoring of replanting and transplanting trees and mangrove	Refer to No.9 and 10				
								Total Cost during Construction : 8,140,500 INR for 4.5 years

Source: JICA Study Team

7.2.2. **Operation Phase**

Environmental monitoring survey plan for operation phase is proposed as follows. Proposed monitoring period is **at least three (3) years**.

Table 7.2.2 Environmental Monitoring Survey Plan during Operation Phase

Category	No	Impacted Item on JICA Guidelines	Parameter	Method	Location	Frequency a year	Cost (INR)	**Standard** Central Pollution Control Board (CPCB) – Ministry of Environment & Forest (MoEF)
Pollution	1	Air pollution	SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, Pb, CO, NH_3, C_6H_6, BaP, As, Ni, CH_4 and CO_2 (14 Items)	Same method as baseline survey Or Establis fixed monitoring station at 2 locations	**2 Locations** (1. Embankment of Inter Change in Shibaji Nagar and 2 Cutting area at toll gate in Chirle)	**2 times / year x 3 years** (Once every quarter –Summer, Winter, post-monsoon) (24 hr/day for 2 consecutive working days per week for 2 weeks except CO which is 8 hr/day)	600,000	National Ambient Air Quality Standards (NAAQS) by Central Pollution Control Board (CPCB) (Standard for 24hrs: Industrial and Residential/ Ecological Sensitive area) • SO_2: 80 / 80μg/m^3 • NO_2: 80 / 80μg/m^3 • PM_{10}: 100 / 100μg/m^3 • $PM_{2.5}$: 60 / 60μg/m^3 • O_3: 180 / 180μg/m^3 • Pb: 1.0 / 1.0μg/m^3 • CO: 0.4 / 0.4mg/m^3 • NH_3: 400 / 400μg/m^3 • C_6H_6: 0.5 / 0.5μg/m$^{3(anual)}$ • BaP: 0.1 / 0.1μg/m$^{3(anual)}$ • As: 0.6 / 0.6mg/m$^{3(anual)}$ • Ni: 20 / 20mg/m$^{3(anual)}$
	2	Water pollution	pH, BOD, DO, Turbidity and O&G	Same method as baseline survey	**3 Locations** Zone II (Sewri mudflat), Zone III and Zone IV where baseline monitoring was carried out.	**4 times / year x 3 years** Once every quarter – Summer, Winter and post-monsoon	540,000	Marine water quality Standards – Class SW-IV Harbour Waters (MPCB) • pH : 6.5-9 • DO: 3 mg/l • Turbidity: 30 NTU • BOD: 5 mg/l • O & G: 10 mg/l
	4 And	Soil Contaminati	Heavy Metals & Oil & Grease	Same method as baseline survey	**3 Locations**	**1 time / year x 3 years**	108,000	Soil Pollution Standard in India (MOEF)

Category	No	Impacted Item on JICA Guidelines	Parameter	Method	Location	Frequency a year	Cost (INR)	**Standard** Central Pollution Control Board (CPCB) – Ministry of Environment & Forest (MoEF)
	8	on/ sedimentation	(5-10 items shall be selected from Soil pollution standards)		(Zone II, III and III)			• Cd: 0.01mg/l • Lead: 0.01mg/l • Chromium (VI): 0.05mg/l • Arsenic: 0.01mg/l • T-Mercury: 0.0005mg/l • Copper: 125mg/kg (some items shall be selected from totally 25 standards items)
	5	Noise and vibration	Ambient and road side noise (dB(A)L_{Aeq})	Same method as baseline survey	**2 Locations** Sewri and Shivaji Nagar where baseline monitoring was carried out.	**2 times / year x 3 years**	48,000	**Ambient Noise Standards in India (dB (A) $_{Leq}$)** 1.Industrial Area Day Time: 75 (6-22hr) Night Time: 70 (22-6hr) 2.Commercial Area: Day Time: 65 (6-22hr) Night Time: 55 (22-6hr) 3.Residential Area: Day Time: 55 (6-22hr) Night Time: 45 (22-6hr) 4.Silence Zone Day Time: 50 (6-22hr) Night Time: 40 (22-6hr)
			Vibration (dB L_{10} or mm/sec)	Same method as baseline survey		**2 times / year x 3 years**	24,000	**Vibration Standards (refer to Japanese standards along the road)** 1. Commercial /Industrial Area Day Time: 70 (7-20hr) Night Time: 65 (20-7hr) 2. Residential Area: Day Time: 65 (7-20hr) Night Time: 60 (20-7hr)
Natural environment	9 and 10	Protected Area / Ecosystem	1.Monitoring of mudflat conditions including fauna-flora 2. Monitoring of Cutting Tree and replantation/ transplanting area 3.Monitoring of Mangrove Plantation area appointed by MoEF 4. Monitoring of sedimentation soil and ecological parameter (18items on main text Table 6.1.15 for soil and 7 items such as 1)Netprimary productivitye, 2)Chlorophyll-a, 3)Phosphate, 4)Nitrate, 5)Nitrite, 6)Particulate Organic Carbon, 7) SiO_2)	Ocular inspection and quantitative survey 1-1. Fauna-Flora Line-Point census and record number and appeared species 1-2: Mangrove density and community survey 1-3: Benthos Survey 2-1: Cutting trees confirmation 3-1: Mangrove survey in the replanted area	Along MTHL alignment and mangrove replant area	**2 times / year x 3 years**	2,160,000	Significant impacts are not caused by the project **Note) Detailed monitoring plan will be setup during basic design stage** Standard for Soil; main text Table 6.1.15 Standards for Ecological Parameter: • Netprimary Productivity <1,500 mgC/m3/day at surface • Chlorophyll-a <4mg/m3 • Phosphate: 0.1-90µg/l • Nitrate: 1.0-500µg/l • Nitrite: <125µg/l • Particulate Organic Carbon: 10-100mg/m^3 • SiO2: 10-5,000µg/l

Category	№	Impacted Item on JICA Guidelines	Parameter	Method	Location	Frequency a year	Cost (INR)	**Standard** Central Pollution Control Board (CPCB) – Ministry of Environment & Forest (MoEF)
	11	Hydrology	Flooding situation	Flood level measurement during high precipitation periods	**2 Locations** (CRZ at Sewri and Shivaji Nagar)	**4 times / year x 3 years**	360,000	Project activities and structures does not cause flooding and impacts on tidal conditions
	12	Topography and Geology	Conditions in embankment area	Visual survey about Stability of embankment	**2 Locations** (1. Embankment of Inter Change in Shibaji Nagar and 2 Cutting area at toll gate in Chirle)	**2 times / year x 3 years**	Refer item No 17	Embankment shall be stabilized without any landslide and cracks
Social environment	13	Involuntary resettlement	Payment and implementation of social assistance in accordance with SIA	Consultation Meeting and/or Survey with the project affected persons (PAPs)	Affected area	Refer to SIA Monitoring plan	Refer to SIA monitoring plan	Compensation shall be completed prior to actual construction activities and secure livelihood standards
	14	The poor	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	16	Local economy such as employment and livelihood	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	17	Land use and utilization of local resources	Situation of establishment of land use map	Confirmation of land use map	**2 Locations** (Sewri and Navi Mumbai side in the Affected area)	**2 times / year x 3 years**	60,000	Designated land use shall be secured without any unplanned development by local people and developers
	24	Landscape	Condition of landscape	Visual inspection	**1 Location** (View from Sewri Fort)	**1 time / year x 3 year** (Dry season)	15,000	Color of structure shall be adopted monotone color harmonized with surrounding landscape
Other	29	Accidents	Number of traffic accidents	Confirmation of accidents list from local government and State Traffic Police Department	**On Mumbai Trans Harbour Link**	**2 times / year x 3 years**	30,000	Any accidents are not caused by construction
	30	Cross Boundary impacts and climate change	Monitoring of replanting and transplanting trees and mangrove	Refer to No.9 and 10				
								Total Cost: 3,945,000 INR for 3 years

Source: JICA Study Team

7.3. Cost, Financial Source and Frameworks

The objectives and design of the EMP and Environmental Monitoring Plan was described in earlier sections of this chapter. There is a necessity to form a proper 'Institutional Framework' for the effective implementation of the formulated environmental management & monitoring plan. The elements of this 'Institutional Framework' will co-ordinate and work with each other throughout the project, i.e. during pre-construction, construction & operation stage. The implementation of formulated environmental mitigation measures comes with a

cost so the budgeting of EMP is necessary and also the financial source that will provide this budget, are discussed in this section.

The suggested elements of 'Institutional Framework' for implementing EMP of MTHL project will be as follows:

a) MMRDA - Project Implementing Agency (PIA) and Environmental Cell

b) Financial Source – JICA & MMRDA

c) Project Contractor – Construction Company (PC)

d) General Consultant

- Project Management Consultant (PMC)
- Environmental Consultant (EC)

e) Environmental Authorized Agency - Statutory Bodies (Authorities)

- Maharashtra State Pollution Control Board (MPCB)
- Ministry of Environment and Forests

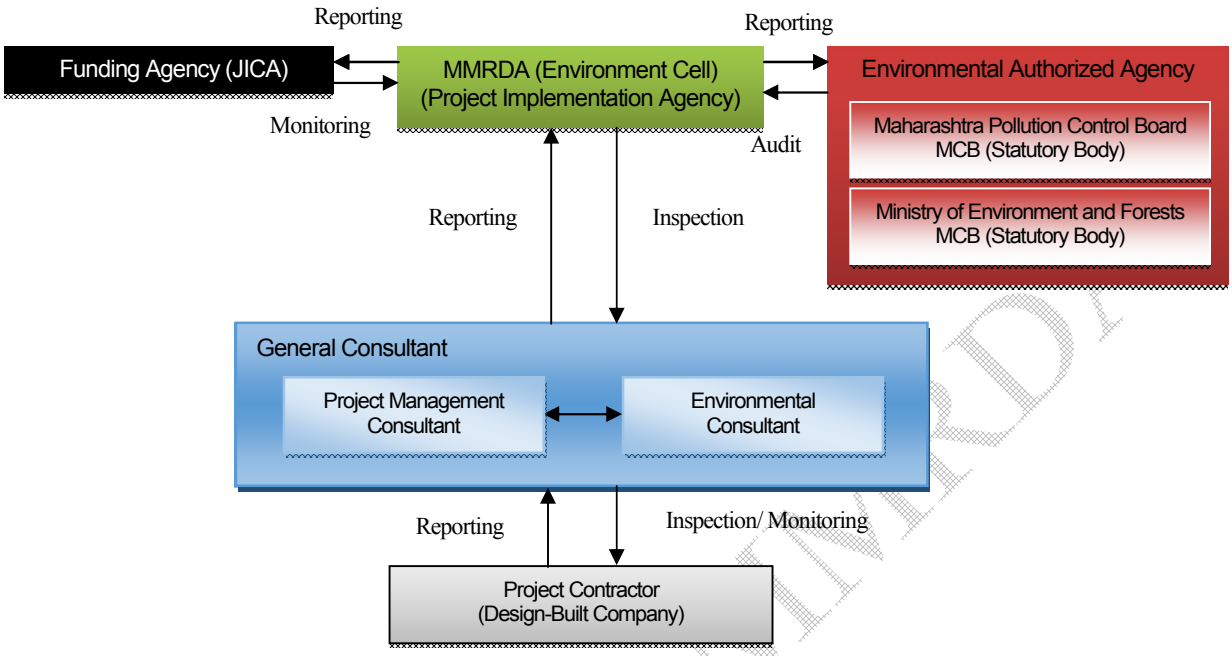
The Environmental Authorized Agency will not be a direct part of 'Institutional framework' but it will hold controlling authorities on it. It will review and approve the reports submitted by the PIA and can take necessary further actions, if any.

The above stated elements are part of the 'Institutional Framework' who will work together to effectively implement the formulated 'Environmental Management Plan'. The roles & responsibilities of these elements are given in Table 7.3.1 Roles & Responsibilities of Institutional Framework.

Table 7.3.1 Environmental Management and Monitoring Organization

Stage	Name of Organization	Roles & Responsibilities
	Project Implementing Agency and Environmental cell – PIA	
Pre-Construction & Construction	**MMRDA**	Initiate the co-ordinate process among the concerned organizations (Elements of Institutional Framework) for EMP implementation. Overseeing the implementation of the EMP by the PMC Approval of '6 monthly - Environmental Compliance Report' submitted by the EC and respond necessary action. After Approval sending the report to the MPCB. Finalization of the SIA during detailed design. Facilitate relocation of people & monitoring actual payments of compensation to affected stakeholders such as landowners, Structure owners etc.
	General Consultant	
	Project Management Consultant (PMC)	PIA will get the EMP implanted through PMC. PMC will work in association with Project Contractor (Construction Company) & the Environmental Consultant (EC) on a full time basis at the project site office. PMC will mainly look after managing engineering & construction related activities.
	Environmental Consultant (EC)	EC will look after implementation of approved environment measures on site. EC will be in constant touch with PMC & Project Contractor EC will facilitate PIA to obtain mandatory 'Consent to Establish' certificate from Maharashtra State Pollution Control Board (MPCB) before start of the Construction on site. EC will get the 6 monthly environmental monitoring done from the MoEF approved laboratory. EC will prepare an 'Environmental Compliance Report (ECR)' describing Status of approved Environmental Mitigation measures on site (submitted by PC) and Monitoring of Environmental Attributes (submitted by MoEF Approved Laboratory) on a six monthly basis and will submit it to the PIA for their approval. PIA will then submit the approved ECR to the MPCB.
	Project Contractor - PC	
	Construction Company	PC will implement approved EMP (mitigation measures) as directed by PMC & Environmental Consultant. The PC will submit the report for all conducted mitigation measures on site to the EC on a six monthly basis.
Operation (Twice in a year x 3 years)	**Project Implementing Agency – PIA**	
	MMRDA	PIA will oversee the compliance status of all environmental measures through their appointed consultants
	Appointed Consultant by MMRDA	Periodical inspection & maintenance of the MTHL EC will facilitate PIA to obtain mandatory 'Consent to Operate' certificate from Maharashtra State Pollution Control Board (MPCB) before start of operation of the project. EC will prepare annual 'Environmental Statement (Form V)' as mandated in CRZ clearance and submit to PIA for their approval. PIA after reviewing the same will submit to the MPCB.

Source: JICA Study Team



Source: JICA Study Team

Figure 7.3.1 Proposed Environmental Management and Monitoring Implementation Organization

All cost for environmental management plan such as mitigation measures are including in the physical contingency of project construction cost. On the other hands, cost for project management such as Environmental Cell in MMRDA will be secured on MMRDA annual budget.

CHAPTER 8 STAKEHOLDER MEETINGS

8.1. Objectives of the Meeting

It is mandatory to conduct local level stakeholder meeting twice for this EIA based on draft EIA process as per JICA Guidelines for Environmental and Social Consideration (2010).

Main objectives for holding local stakeholder meeting are shown below;

- ✓ To make aware stakeholders about the proposed MTHL project and project related proposed actions both before and after development decisions are made
- ✓ To understand the concerns of local project affected people and others who have plausible stake in the environmental impacts of the project.
- ✓ To inform stakeholders about the environmental and social adverse and positive impacts of the project.
- ✓ To exchange opinions regarding project and environmental issues
- ✓ To minimize probable adverse impacts of the project and to achieve speedy implementation of the project through bringing in awareness among the stakeholders about the benefits of the project

8.2. Meeting Notification and Language

(1) Scoping Stage

In case of "First Public Consultation", the publicity of meeting was carried out by sending separate "Invitation Letters" to the experts in various fields (as per JICA categorization requirement) while the stakeholders were invited through telephonic as well as personal invitation. The presentation was given in local "Marathi" language upon request of the participants.

(2) Draft Supplemental EIA Stage

In case of "Second Public Consultation", the publication was carried out by putting an advertisement in two local newspapers about three weeks prior to the date of the public consultation meeting. The Marathi advertisement was put up in "SAKAAL" and English advertisement was put up in "HINDUSTAN TIMES" newspapers. This presentation was also given in "Marathi" language.

8.3. Schedule of the meetings

Following local stakeholder meetings were held in July & August-September 2015. The schedule and agenda for stakeholder meetings are shown below;

Table 8.3.1 Schedule Stakeholder Meetings on EIA and SIA

Date & Venue	Objectives of the meeting	Major Agenda	Participants
7th July, 2015 Shakha office, Near Shri Krishna Hindu Hotel, Sewri Gadi Adda, Haji-bundar road, Sewri (E), Mumbai - 400 015	To discuss the social impacts of the project with the key Stakeholders (Project affected people)	Project outline, necessity of social survey and survey items, basic compensation policy and declaration of cut off data	• MMRDA • JICA Team • Project Affected Persons
29th July, 2015 Committee Room, 6th	To inform stakeholders about the proposed MTHL project & Explanation of draft modified	Project outline, Benefits of the project, Predicted environmental impacts, practical mitigation measures, monitoring plan and project schedule	• MMRDA • JICA Team • Relevant local government

Date & Venue	Objectives of the meeting	Major Agenda	Participants
Floor, MMRDA Office, B.K.C, Mumbai	Rapid EIA and formulation of basic consensus		(CIDCO, MPT & JNPT, ASI, NEERI) • Project affected persons • Experts from various fields as per JICA requirement
25th August (SIA 2nd PC) Sewri Koli Samaj Hall, 22/1 Koli Samaj Co.Op.Society, Sewri, Koliwada (E), Mumbai - 400015	To intimate to the stakeholders about the result of BSES and Resettlement & Rehabilitation Policy of MTHL.	Background, 1st SIA Stakeholder meeting (SSM), Result of BSES, Resettlement & Rehabilitation Policy of MTHL, Resettlement Site, Requesting opinions from PAPs.	• MMRDA • JICA Team • Project Affected Persons
15th September, 2015 Sewri Koli Samaj Hall, 22/1 Koli Samaj Co.Op.Society, Sewri, Koliwada (E), Mumbai - 400015	To inform/communicate to the stakeholders and public at large about the findings of the draft supplemental EIA. To discuss about the mitigation measures as suggested in the draft EIA.	Opening Remarks, Project in Brief, Objectives & schedule of public consultation meetings, details of first public consultation of EIA, result of reformed studies, Environmental Management Plan, Environment Monitoring Plan, Project Implementation Schedule, Exchange Opinions, Remarks	• MMRDA Team • JICA Team • Relevant local government (CIDCO, MPT & JNPT) • Experts from various fields as per JICA requirement • NGOs • Project affected persons

Source: JICA Study Team

8.4. Summary of Stakeholder Meeting

(1) Scoping Stage

1) Participants of the meeting

Table 8.4.1 Major Participants of Public Consultation on Scoping Stage

Date & States	Major Participants	
Mumbai, Maharashtra State 29th July 2015 2.00-4.00pm (at Committee Room, 6th Floor, MMRDA office, B.K.C, Mumbai)	MMRDA	[redacted]
	Other Government	
	NGO and/or Community specific group	
	PAPs	
	JICA Team	
Number of Total Participants	Government: 12, PAPs: 13, NGOs and Community Specific Group: 3, JICA Team: 6 Total: 34 (Male: 26, Female: 8)	

Source: JICA Study Team

2) Agenda

- ✓ Explanation of the objective of the meeting by JICA Team
- ✓ Explanation of project background & project features by JICA Study Team
- ✓ Explanation of MTHL alignment by JICA Study Team
- ✓ Explanation on need of Environmental & Social consideration in this project

- ✓ Explanation on supplemental EIA and RAP outline (process, extent of impact and study schedule) by JICA Study Team
- ✓ Explanation on Study Schedule (Timeline)
- ✓ Exchange of opinions

(Note): Contents above was explained in "Marathi" language based on the materials prepared for SHM and RAP Socialization at scoping stage

3) Major opinion and summary of discussion

JICA study team initiated the proceedings and welcomed the gathering and explained about the project in brief and EIA studies carried out. The study team presented the project and EIA findings in Marathi language to the participants. The meeting then opened for Questions & Answers session. The major opinions and discussions held in the meeting are given below:

Table 8.4.2 Major Opinions and Discussions of the Stakeholder Meeting

No	Major opinion and Answer			
	Question/Comment		Answer	
	Name/Position	Question	Name/Position	Answer
1	Scientist-NEERI	Who will do the funding to the project?	JICA Study Team	It is expected that the funding to the project is from "Japan International Cooperation Agency" (JICA).
2	Scientist-NEERI	In which season the environmental monitoring is carried out? Whether Marine water & Air quality monitoring is covered in this Reformed Rapid EIA?	JICA Study Team	Post monsoon season monitoring was carried out in the year 2012. JICA study Team will use the secondary data from Pollution Control Board, if any.
3	Scientist-NEERI	What activities are planned in the supplementary EIA?	JICA Study Team	JICA study Team has checked the old Rapid EIA Report 2012 based on the JICA guidelines, and will fill out the gaps. Vibration Study and Social Impact Assessment will be covered in the Supplemental EIA.
4	Manager EC-JNPT and Scientist-NEERI	Whether Mangrove Management Plan & Ecology Impacts are considered?	JICA Study Team	All these will be covered in the EIA finalized in the September 2015.
5	Superintending Archaeologist – Archaeological Survey of India	How much is the distance between alignment and Elephanta caves? Elephanta Caves has no electric connection. If project is passing at 1 km from Elephanta Caves then electricity should be converted.	JICA Study Team	Around 3 km from the alignment to Elephanta cave. With regard to provision of power, this cannot be considered under this project.
6	PAP	Long back, Mangrove Park was declared in Sewri. Is this taken into account?	JICA Study Team	JICA study Team will check on this. (After the meeting, It was confirmed that there is no such park declared by a competent authority like MOEF or Forest Dept.)
7	PAP	Give details of Slum Rehabilitation Plan.	JICA Study Team	MMRDA carried out 100 household surveys earlier and now 380 households survey is been carried out on SIA survey. MMRDA will study these survey results and follow MMRDA's Compensation Policy for Rehabilitation.
8	PAP	The PAP said this is a good project and we want such project. But the rehabilitation should be in the near area or in the same area. As per new law, should get new and good homes and commercial units.	Social Development Cell, MMRDA	MMRDA will take into account these points. But they cannot commit that they can shift the PAPs in the same area at the moment. But they will see the situation and try to shift the PAPs in the nearby area.
9	PAP	What about the houses which are not in impact zones?	Social Development Cell, MMRDA	Those who are interested to shift, MMRDA will think positively regarding the same. MMRDA will follow the policy in view of JICA R & R policy. House in lieu of house will be as per new policy. As per rule, 225 Sq.ft space will get per house. If more than 225 Sq.m then MUTP policy will be followed.
10	PAP	What about commercial area? Because these are not taken into account.	Social Development Cell, MMRDA	As per Government of India Act, commercial in lieu of commercial area policy is not there. Business may get lost, but MMRDA will take into account the number of business affected persons and will think on compensation.

11	PAP	Are worship/religious places taken into account?	Social Development Cell, MMRDA	MMRDA will think on shifting of these places out of project ROW (Right of Way). OR MMRDA will think on land compensation with discussion with the locals.
12	PAP	What if commercial area is above 3000 Sq.ft & has more than two or three properties?	Social Development Cell, MMRDA	The entitlement as per Policy is 225 sq. ft. If there titled property, the maximum area compensated will be 750 sq ft. For Non Titled properties irrespective of their sizes, 225 sq ft shall be given. For additional area up to 750 sq ft, they have to purchase it as per ready reconer rate.
13	PAP	If some people are not willing to shift then what will be the solution?	Social Development Cell, MMRDA	Government rules will be strictly followed during development. In many of the projects of MMRDA, it was observed that people want their homes in the same building. Temporary shifting will be given concerning with Mumbai Port Trust. It will be till building construction.

Source: JICA Study Team

Source: JICA Study Team

Figure 8.4.1 Photos of the 1st Public Consultation on EIA

(2) Draft EIA Stage

1) Participants of the meeting

Table 8.4.3 Participants of Public Consultation on Draft EIA Stage

Date & States	Major Participants	
15th September 2015	MMRDA	[redacted]
	Other Government	[redacted]
	Experts (as per JICA categorization)	[redacted]
	JICA Team	[redacted]
	Key PAPs	[redacted]
	NGO and/or Community specific group & others	[redacted]
Number of Total Percipients	Government: 13, Experts as per JICA Categorization: 1, PAPs: 66, NGOs and Community Specific Group: 17, JICA Team: 8 Total: 105 (Male: 91, Female: 14)	

Source: JICA Study Team

2) Agenda (common in both states)

- ✓ Explanation of the objective of the meeting
- ✓ Explanation of project outline by JICA Study Team
- ✓ Intimation of result/findings of the supplemental draft EIA
- ✓ Intimation of proposed mitigation measures
- ✓ Exchange of opinions

3) Major opinion and summary of discussion

JICA study team initiated the proceedings and welcomed the gathering and explained about the project in brief and EIA studies carried out. JICA study team presented the project and EIA findings in Marathi language to the participants. The meeting then opened for Questions & Answers session. The opinions and discussions held in the meeting are given below:

Table 8.4.4 Opinions and Discussions of the 2nd public consultation Meeting

No	Major opinion and Answer			
	Question/Comment		Answer	
	Name/Position	Question	Name/Position	Answer
1	NGO	We want this bridge to come up as it is a good public facility, but the bridge should be realigned. Flamingos are coming here and they stay for 6 months. We should look at how we can save them. We should use latest technology monitoring programme. Restoration program for the mudflats so that flamingo habitation area	MMRDA	Ok, we have noted these good suggestions.

		can be kept secured and citizens can enjoy the nature.		
2	NGO	Bridge should start from MPT. What are the impacts of the project on: • Marine life • Migratory Birds • Fisherman and fishing activities and its period • Remedial Measures for the PAPs • Earth strata impact for such 5 years long period • In the event of accidental release of gases • Aquatic life	JICA Study Team	The plan is to minimize the construction through construction of pillars with larger spans. Rain water & storm water will be discharged through the piles and not directly, in sea to avoid turbidity. Noise & vibration impacts will be minimized by installation of noise barriers with edge treatment so that this will also mitigate the impact of street lights on the aquatic biota specially flamingos. Piling/boring will be there for pillars and the outcomes will be disposed as per CRZ notification. Shorter spans will only be at interchanges in area at 50 mts.
3	Fishermen Society	Do all documents are open to public and are they in Marathi? What are the impacts on fishing activities and fisherman? What are mitigation measures?	JICA Study Team	Draft EIA will be submitted on 25th September and then it will be available on JICA website. Committee will be formed in one week to decide the impacts and mitigation measures for Fisherman and Fishing activities.
4	NGO	What about draft EIA reports and current status and updates. Whether detailed studies on migratory birds and fauna are been carried out? 150 species are noted in this area. 15000 flamingoes for 6 to 7 months visit this place. Not only noise barriers but also trees should be planted. Project will lead to environment degradation due to upcoming traffic on proposed link bridge. Impacts on mangroves and its cutting. Modelling should be just like Bandra Worli Sea Link.	JICA Study Team	Draft EIA will be submitted on 25th September and then it will be available on JICA website. Here only piers will be coming. There is no erosion because of piers. Flamingoes came in 1994. They are well noted still under Vashi & Airoli bridge without any mitigation measures. But in this proposed project except construction period no such impacts are anticipated. No erosion is expected. Mangroves generally increased due to siltation. Mangrove replantation will be carried out as per CRZ clearance.
5	PAP	What happens to public transport like trains? Traffic studies are done? What will be the toll cost? Will it cause financial burden?	MMRDA	No railway is part of the project. Navi Mumbai has already plan of development of an airport. Toll cost will be for all. Toll cost will be fixed in such a way that people will use the bridge.
6	PAP	Are trains included in this project?	MMRDA	No, Trains are not included in this project.
7	NGO	In proposed project area sanctuary is declared. Dumping is going /operational at Kanjur & JNPT. What will be the impact if such delineation will happen?	MMRDA	The distance between Thane creek and sanctuary is far. We have carried out traffic studies and reported in EIA. Flamingo study is carried out by the experts and only after this design is fixed.
8	PAP	Being a member of IIE, this project is very important and is proposed from long time. How this project will help to cope with increasing traffic and speed level? The balance should be done for positive impacts for both humans and flamingoes.	MMRDA	The benefits and cost cannot be thought at this stage. But yes, balanced approached will be maintained in this project.
9	NGO	Thane creek is far from sanctuary. But are necessary approvals obtained for the project and are these factors been considered?	JICA Study Team	Like no other projects, in this projects environmental impacts are considered. It is already explained that all necessary approvals are obtained. Now international and local experts are looking and studying about flamingoes. Hence all the points will be covered and reported in the supplemental EIA. New technology is proposed, but still we are open for good suggestions which will be discussed with JICA to ensure that this project will not create environmental disaster but for further projects it will be an example.
10	NGO	Does this project impact tidal pattern? And do the pillars cause impact on environment? What are the mitigation measures?	MMRDA	The Central Water and Power Research Station (CWPRS) carried out studies on these issues. And it is noticed that no such impacts are anticipated.

Source: JICA Study Team

Source: JICA Study Team

Figure 8.4.2 Photos of the 2nd Public Consultation

CHAPTER 9 SCHEDULE AND OTHER RELEVANT ACTIVITIES

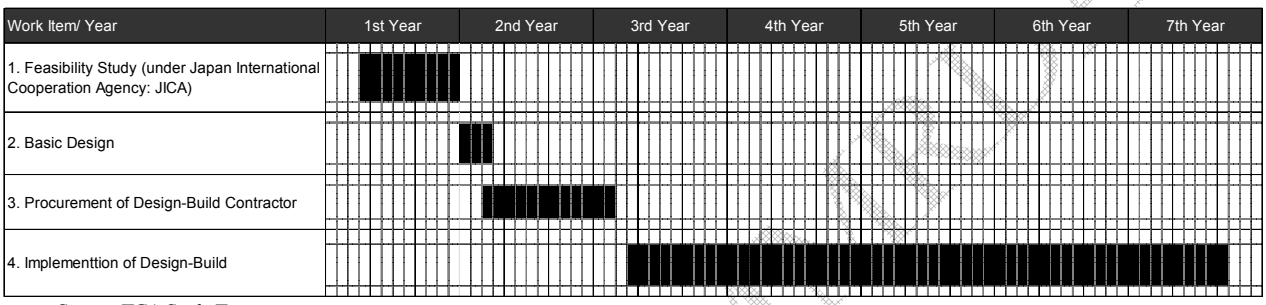
9.1. Construction Schedule (as of September 2015)

It is expected that "the design-build system" is adopted from the view of saving cost and time for this project after feasibility study and basic study.

Almost 1 year is required for bidding and selection of contractor, and 4.5 years are necessary for detailed design and construction period.

The tentative construction schedule is shown as of March 2015 is given in Table 9.1.1.

Table 9.1.1 Construction Schedule (as of September 2015)



Source: JICA Study Team

9.2. Other Necessary Permission to be obtained

Other necessary permission to be obtained by MMRDA before and during construction is shown below;

Table 9.2.1 Other Necessary Environmental Permissions

	Name of Permission to be obtained	Necessity and Status as of Sep. 2015	Status / Reasons
1	Environmental Certificate (EC) for EIA by Ministry of Environment and Forests (MOEF)	Not Required	· EC for EIA is not necessary on EIA notification in 2006 as of 2015. · MSRDC had obtained EC for old EIA law in 2005 with 5 years validity. Although the EIA is not necessary after 2006, MMRDA has updated this EIA as Rapid EIA for mainly obtaining of CRZ-Environmental Certificate.
2	EC for Coastal Regulation Zone by MOEF	Not Required (Already obtained in 2013)	· The EC of CRZ had been obtained from MOEF based on law of 2011 CRZ in 2013 with 5 years validity. (Until 18th July 2018). The EC is including mangrove cutting permission from MOEF. ✓ Law: Coastal Regulation Zone Notification 2011 ✓ Issued date of CRZ for MTHL: 18th July 2013 (valid until 17th July 2018)
3	Mangrove Cutting Tree Permission by MOEF	Not Required (Already obtained in 2013)	· According to interview with the person in charge environment in MMRDA, in general, a mangrove cutting permission shall be acquired by the proponent from the Forest Department of MOEF. However CRZ-EC was approved by MOEF and mangrove cutting permission was given on same CRZ-EC. As mentioned on CRZ-EF, MMRDA shall replant 5times of cutting mangrove trees (0.0176 x 5times = 0.888 ha) in appointed area of 30 ha in Nhava by MOEF before construction phase.
4	Maharashtra High Court Permission for Mangrove Cutting	Before Construction	· The proponent shall have Maharashtra high-court permission for cutting mangrove after obtaining CRZ-EC from MOEF. MMRDA has not obtained this permission yet as of Sep. in 2015. · This permission shall be obtained before actual cutting activities in construction stage based on CRZ-EC and Mangrove cutting permission. According to the person in charge environment in MMRDA, the process may take around 3 months after submission of application.
5	Tree Cutting Permission by Local Government	Before Construction	· All permissions shall be obtained after identification of final affected area and number of trees based on detailed design and investigation of affected trees. · The legal framework and process is show below (**Table 9.2.2)**
6	Non Objection Certificate from Maharashtra Pollution Control Board (MPCB)	Before Construction	· The contractor shall submit construction plan including activities and plant before actual construction activities, and then MPCB reviews and issue Non Objection Certificate in accordance with following laws and regulations; ✓ The Water (Prevention & Control of Pollution) Act, 1974 ✓ The Air (Prevention & Control of Pollution) Act, 1981 ✓ The Hazardous Wastes (Management and Handling) Rules, 1989

7	Environmental Certificate under EIA Notification Law 2006	As required	· The contractor shall have necessary an Environmental Certificate in accordance with EIA Notification 2006 from Maharashtra State and/or Central MOEF when the contractor develops new quarry, borrow pits and camp site, if required · Additionally the contractor shall follow JICA Guideline for Environmental and Social Considerations 2010

Source: JICA Study Team based on interviews with MMRDA

Table 9.2.2 Cutting Tree Permission Process

Permission to be obtained / Item	Mumbai Side	Navi Mumbai Side
1. Name of Permission	Permission for Logging of Project Affected Trees	Ditto
2. Applicable law and regulation	Maharashtra Felling of Trees (Regulations Acts, 1964) Amended in 2006	Ditto
3. Approval Authority	MCGM (Municipal Corporation for Greater Mumbai)	MCNM (Municipal Corporation for Navi Mumbai) Note)The permission is given from affected authority
4. Due date to be approved	67 days before cutting trees	Ditto
5. Process for obtaining permission	(1) Marking on affected area after detailed design (2) Fix the affected area based on detailed design (3) Site survey affected species, location and numbers (4) Submission of application form and result of survey (5) Inspection and review (xx days) (6) Issue of permission	Ditto
6. Process period	(4)-(6): 3-6 months (depend on case)	Ditto

Source: JICA Study Team based on interviews with MMRDA

9.3. Other Necessary Development Plan

(1) Quarry Site and Borrow Pit

The designated registered quarry sites and borrow pits are shown in Figure 9.3.1.

The contractor should use these registered quarry sites as possible as they can. However the contractor can use other designated and registered quarry sites or develop new sites under obtaining permission from relevant authority prior to actual construction activities. Additionally the contractor shall follow JICA Guidelines for Environmental and Social Considerations 2010, if required.

(2) Construction Yard and Labor Camp

The planned construction yard and labor camp is located in Sewri side and Navi Mumbai side respectively as shown in Figure 9.3.2.

The Construction and Camp Site in Sewri is located in Mumbai Port Trust compound app. 18 ha, on the other hand, the site in Navi Mumbai side is located on Right of Way of MTHL. A Part of the camp site in Shivaji Nagar has been secured by MMRDA.

The expected number of construction workers, scale and major construction facilities are shown below;

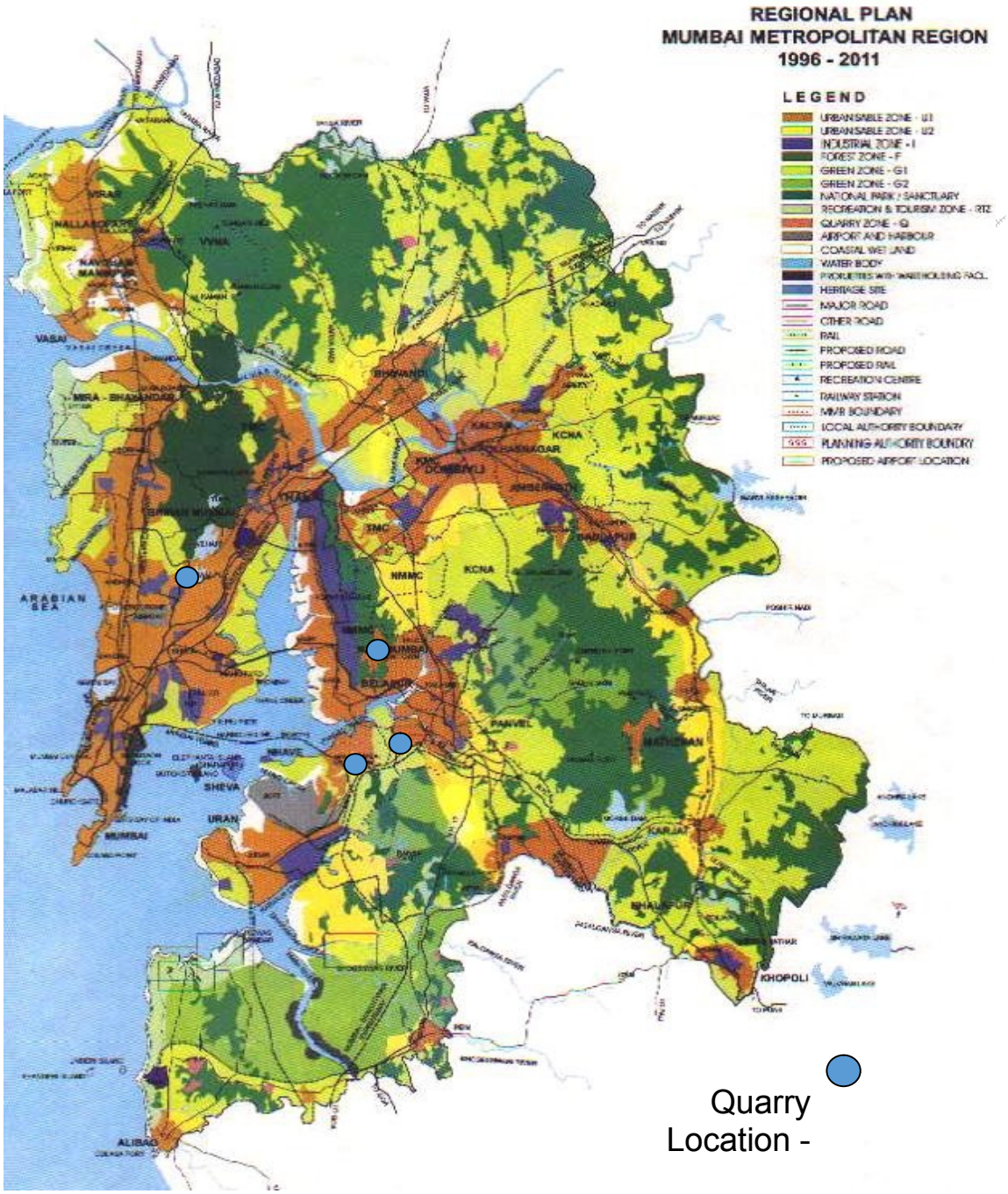
It is estimated that approximately totally 3,000/day workers at construction peak day time, and 1,000 workers are staying temporary accommodation on sites.

Table 9.3.1 Outline of Construction Yard

Item / Name of Site	Estimated Number of Workers (accommodated)	Function and Installed Plant
1. Sewri Construction Yard	1,540 (510)	Casting yard, material storage, workshop for construction machines and accommodation for workers
2. Shivaji Nagar Construction Yard	290 (1,000)	
3. Chirle Construction Yard	200 (600)	

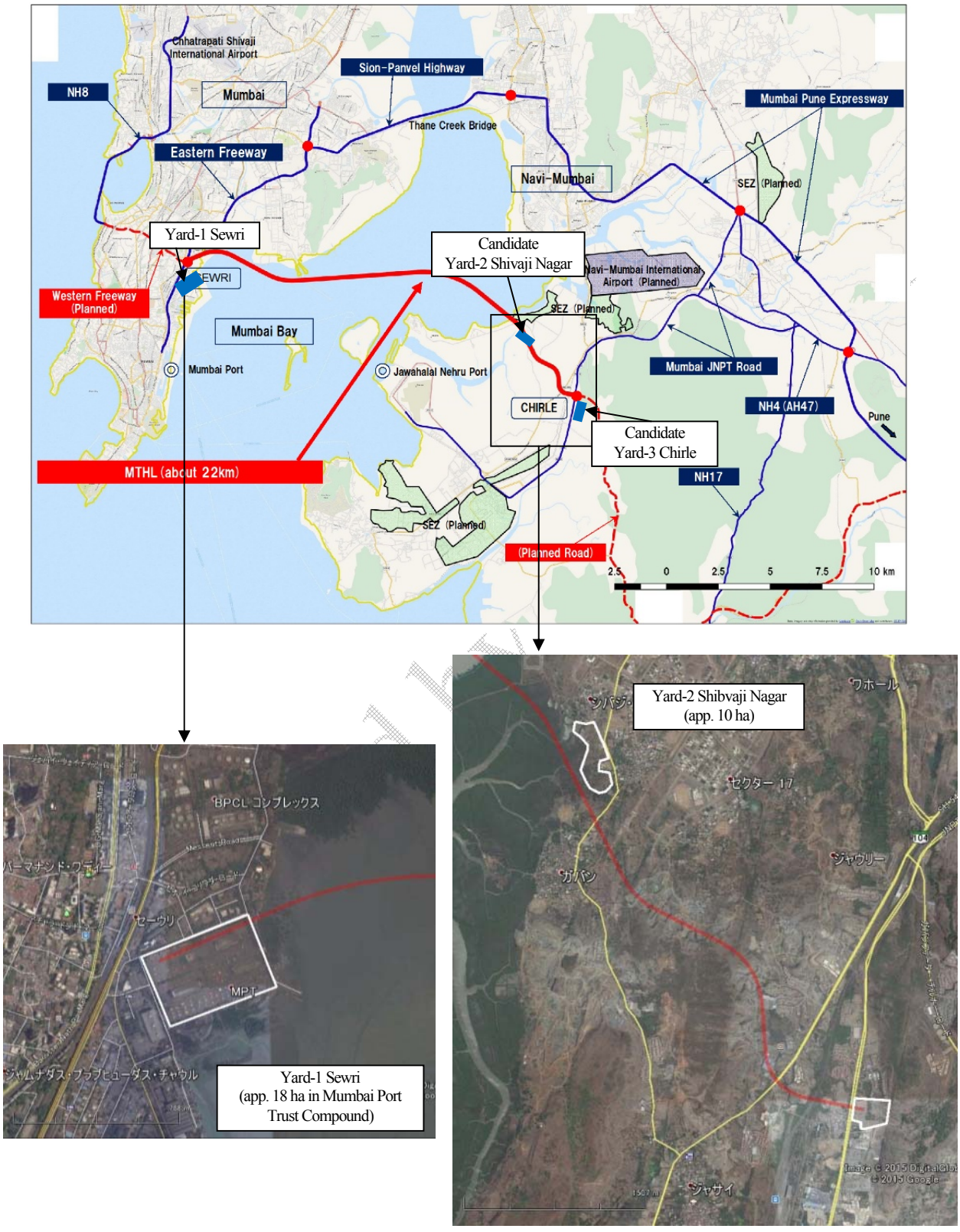
Source: JICA Study Team

Although all construction yard is secured by contractor, the contractor shall refer following scoping and mitigation measures and obtain necessary permissions in accordance with relevant Indian laws.



Source: Rapid EIA 2012

Figure 9.3.1 Designated Quarry Site near Project Area



Source: JICA Study Team

Figure 9.3.2 Tentative Construction and Camp Site on MTHL

As shown in Table 5.3.1 and Table 5.3.2, the degree of impacts for construction of base camp are evaluated in scoping matrix. Detailed degree of impacts and tentative recommended mitigation measure are shown in the next table.

Table 9.3.2 Reasons for Draft Scoping Matrix for Development of Construction Yard

Area	No.	Impacted Item	Rating Pre/During Const	Reasons of the Rating Pre/During Construction
Pollution	1	Air Pollution	D-	It is expected no activities to cause serious air pollution
	2	Water Pollution	B-	Organic polluted water may be discharged from base camp.
	3	Waste	B-	Domestic waste and night soil may be generated from construction base camp.
	4	Soil Contamination	B-	Oil and grease may leak from the storage and construction machines
	5	Noise and Vibration	D-	It is expected no activities to cause significant noise and vibration
	6	Ground subsidence	D-	No impacts are expected because any activities which cause ground subsidence not expected.
	7	Odor	D-	No impacts are expected because any activities which cause odor are not expected.
	8	Sediment quality	D-	No impacts are expected because any activities which generate polluted soil are not expected.
Natural Environment	9	Protected Area	C-	Candidate 3 sites are not located any protected area. However Shivaji Nagar Casting yard and Sewri yard are located near CRZ, thus construction activities may give adverse impacts with fauna and flora in CRZ.
	10	Ecosystem	C-	Shivaji Nagar Casting yard and Sewri yard are located near CRZ, thus construction activities may give adverse impacts with fauna and flora in CRZ
	11	Hydrology	D-	No impacts are expected because all casting yard are located on the land.
	12	Topography and geology	D-	Considerable topography and geological sites are not located in the candidate area, thus no impact is expected. Additionally cutting and construction of embankment is not planned in the yard.
Social Environment	13	Involuntary resettlement	D-	All candidate yards are located in right of way, and land acquisition, compensation, livelihood restoration program and clearance is done prior to construction period. Thus any adverse impacts are not expected on this item.
	14	The Poor	D-	↑ditto
	15	Indigenous and ethnic people	D-	↑ditto
	16	Local economy such as employment and livelihood	D-	↑ditto
	17	Land use and utilization of local resources	D-	↑ditto
	18	Water Usage	D-	↑ditto
	19	Existing social infrastructures and services	D-	↑ditto
	20	Social institutions such as local decision making institutions	D-	↑ditto Impacts are not expected, since local decision making institute will continue after the road construction.
	21	Misdistribution of benefit and damage	D-	Misdistribution of benefit and damage caused by the road & bridge construction is not expected.
	22	Local conflict of interests	D-	No impacts are expected because any activities which cause local conflicts
	23	Cultural Heritage	D-	All candidate yards are located in right of way, and land acquisition, compensation, livelihood restoration program and clearance is done prior to construction period. Thus any adverse impacts are not expected on this item.
	24	Landscape	D-	Building accommodation and casting yard does not give few impacts on changing land scape and duration is limited only during construction.
	25	Gender	D-	All candidate yards are located in right of way, and land acquisition, compensation, livelihood restoration program and clearance is done prior to construction period. Thus any adverse impacts are not expected on this item.
	26	Right of children	D-	Few impact is expected (child labor is prohibited under relevant laws)
	27	Infectious diseases such as HIV/AIDS	B-	Infectious diseases such as STD are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provoke to provide habitats of mosquito that possibly transmits dengue fever.
	28	Labor environment	B-	Construction work environment needs to be considered in accordance with relevant laws and regulations.
t h e	29	Accidents	B-	Construction vehicles may use existing local road near residential areas, thus number of traffic

Area	No.	Impacted Item	Rating Pre/During Const	Reasons of the Rating Pre/During Construction
				accident may increase.
	30	Cross boundary impacts and climate change	B-	Deforestation and operation of construction machines may increase greenhouse gases such as CO2.

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) , D: Few impacts are expected. Detailed quantitative survey is not necessary.
Source: JICA Study Team

Recommended mitigation measures are shown in Table 9.3.3. Since Shivaji Nagar and Sewri construction yard are located adjacent to CRZ and mangrove area, the contractor shall comply with CRZ notification and necessary consideration shall be done.

Table 9.3.3 Environmental Management Plan for Construction Yard During Construction

Area	No	Item	Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
Pollution	2	Water pollution	☐ There shall be no water drawl in CRZ area from Shivaji Nagar and Sewri Construction yard ☐ Provision of sanitation facilities at the labor camps, also the location of camps will be at least 200 m away from any water sources. ☐ Connection sewerage pipe from the construction yard ☐ Septic tanks will be provided in accordance with Coastal Regulation Zone Notification, 2011. The disposal of treated water shall conform to the regulations of MPCB (Maharashtra Pollution Control Board). ☐ Uncontrolled digging of borrow pits will be avoided to prevent water accumulation, which results in breeding of vector disease.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	3	Waste	☐ Proper sanitation facilities will be provided at construction workers camp. Garbage/muck materials generated will be analyzed prior to dumping / disposal in the identified locations with the approval of competent authority to ensure that it do not cause any impact to the environment ☐ There will be no disposal of solid or liquid wastes on coastal area especially Shivaji Nagar and Sewri construction yard. Solid waste Management will be as per Municipal Solid (Management and Handling) Rules, 2000.	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	4	Soil Contamination	☐ Oil and grease shall be stored and managed without leaking from machines and storage	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
	5	Noise and Vibration	☐ All the construction equipment's shall be provided with exhaust silencers as committed. ☐ Install noise barrier on the boundary of compound	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Natural Environment	9 and 10	Protected Area and Ecosystem	☐ Location of construction yard shall avoid near habitat of migratory birds ☐ Install sheet pile on boundary to cover workers activities near CRZ (Shivaji Nagar and Sewri Construction Yard) ☐ As per CRZ Notification 2011, discharge water and waste from the yard to CRZ is prohibited, thus the contractor shall treat and dispose liquid and solid in accordance relevant laws and regulations ☐ The Contractor shall carry out environmental education for workers not to poach surrounding wild animals and fishes ☐ The contractor shall necessary permissions for cutting street trees and/or mangrove	MMRDA & Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Social Environment	13	Involuntary resettlement	☐ Basically mitigation measures are not required because land acquisition and clearance will be done prior to construction phase, however, appropriate compensation shall be done in accordance with policy established on SIA, if additional land acquisition and compensation is required.	MMRDA	MMRDA
	27	Infectious diseases such as HIV/AIDS	☐ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness of the labors and local inhabitants is promoted. ☐ Adequate sanitary facilities will be provided to workers to avoid health related problems	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)

Area	No	Item	Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
			☐ Periodic health check up of workers will be done.		
	28	Labour Environment	☐ Implementation and follow relevant laws and regulations "Building And Other Construction Workers (Regulation of Employment and Conditions of Service) Act,1996" and "The building and other construction worker's welfare cess Act, 1996" and IFC Performance Standard 2 Labor and Working Conditions	Contractor (Construction Company)	MMRDA & General Consultant (PMC & EC)
Other	29	Accident	☐ Labors will be equipped with proper safety gears like helmets gloves and gumboot ☐ Installing gate structure at the entrance of the construction site to set up restricted area ☐ Deploying flagman at the gate and crossing points of the construction vehicles ☐ Installing fence around the construction site to keep out local people such as children ☐ Safety training for the workers	Contractor (Construction Company) in consultation with Traffic Police Department	MMRDA
	30	Cross Boundary impacts and climate change	☐ Replanting mangrove and street trees same amount of cutting trees ☐ Implementation of appropriate periodical machine maintenance	MMRDA	MMRDA

Source: JICA Study Team