

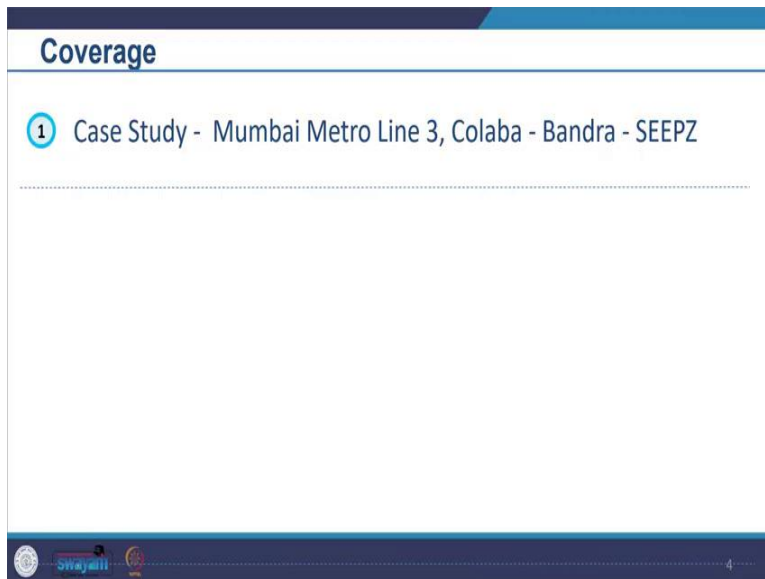
**Environmental Impact Assessment**  
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**Lecture - 58**

**EIA Case Study – Mumbai Metro Line 3, Colaba - Bandra - SEEPZ**

Welcome to the course Environmental Impact Assessment. And in today's session, we are going to look at the case study. In particular, we will look at a case study of Mumbai Metro line 3, which is proposed to run from Colaba Bandra to SEEPZ. When we do this case study will look at all the aspects that we have covered so far from the environmental concerns to legislation to different methods, public participation, and how we look at the alternatives and all that.

So, here you will see how whatever we have studied how that culminates into a case study. So, this is a very specific case study, but we will look at that and see how we are prepared and how does the case study looks like.

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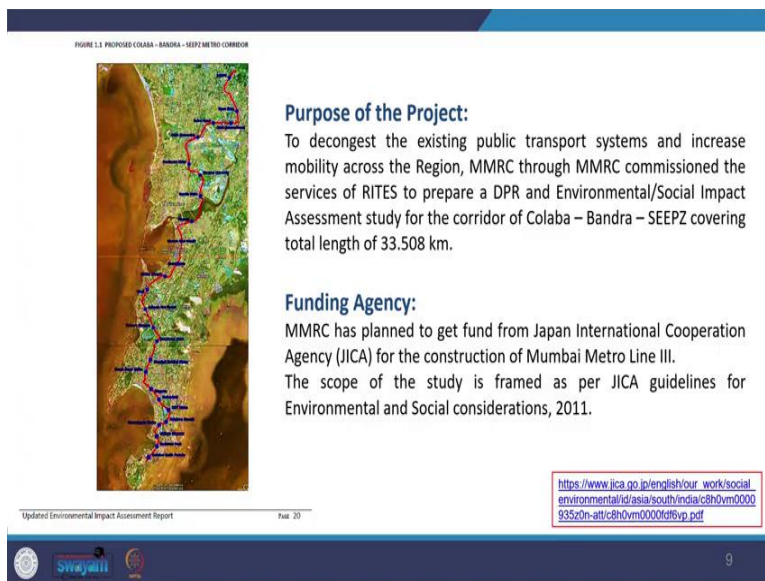
So, the coverage would include that will today in today's session, we will just look at the case study and the expected learning outcome is that you should be able to relate all the learnings from the environmental status to legislation, to different methods, to process, to public participation and alternatives. So, all the understanding you should be able to review from this particular case study.

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So looking at this case, which is proposing to have Mumbai Metro line 3, you can see in the diagram as well. So, it is proposed to run from Colaba Bandra to the SEEPZ area. If you remember, we had seen the social impact assessment for this particular report itself.

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So, the looking at the purpose of this project, so, it is mainly for decongesting, the existing public transportation system and increasing the mobility across the region. So, through this project, they are trying to reduce the environmental impact which is happening. So, through this project, they are trying to do this. We see that it has been funded by JICA, which is the Japan International Corporation Agency. And they are funding it for the construction of Metro Line 3. And if you look at it, this particular document provides the environmental impact assessments.

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### Salient Features of Project

- Design Speed: 80 kmph
- Scheduled speed: 30 kmph
- Power Demand (MVA): 89.46 MVA (2016)
- Sub Station: Colaba, Race course & Dharavi
- Capacity of 8 coach unit: 2406 Passengers
- Signaling & Train Control: Computer Based interlocking signaling, automatic train control /Protection.
- Fare Collection: Automatic Fare collection system
- Depot location: Arey Milk Colony (26.407 Hac)
- Train operation: 19 hours of the day (5 AM to 12 PM, i.e. midnight)
- Headway: 4.3 minutes (Colaba-Bandra), 6.7 minutes (Bandra-SEEPZ)
- Max.PHPDT: 25700 (2016)
- Project Cost: Rs. 243,400 Million
- Power requirement: 89.46 MVA (2016), 105.99 MVA (2021), 119.38 (2031)

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So, looking at the salient feature of the project, we see that it has a design speed of 80 kilometers per hour and, a scheduled speed of 30 kilometers per hour. And the range of power demand, the substations which will be there, the capacity of 8 coach units. So, that is going to take 2406 passengers and signaling and train control which will be their, fare collection, depot location, which is at Arey Milk colony, which you must have heard in the news as well.

And then also train operation, what will be the hours of operation and what is the headway. And then other details of the project costs, you can see, it is in the range of 243,400 million Indian currency, so you can see and what would be the power requirement. So, that is the scale of the project we are looking at.

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### Objectives and Scope of the Study

- Objective: facilitate the **Mumbai Metropolitan Region Development Authority (MMRC)** in the **preparation EIA report** as per requirement of regulatory and funding agency.
- Scope: of EIA includes the impacts resulting from pre-construction, construction and operation phases of Line I Metro corridor, Depot and sub-stations.
- MMRC has planned to get fund from Japan International Cooperation Agency (JICA) for the construction of Mumbai Metro Line III.

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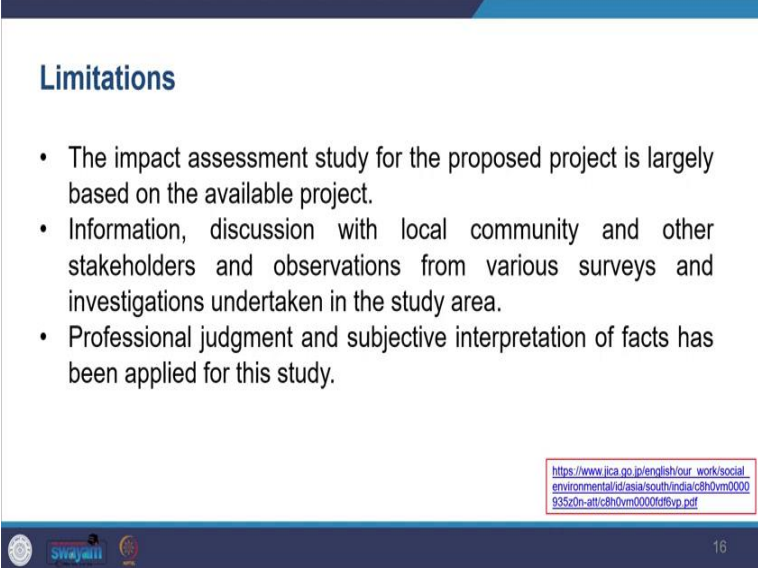
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The objective of the study, if you will see these EIA documents is to facilitate MMRDA which MMRDA which is the Mumbai Metropolitan Regional Development Authority in preparation of the EIA report as per the requirement of regulatory and funding agency. So you see how every EIA is made within the regulatory or the

funding agencies' requirements. So we see the scope of this EIA, which includes the impact resulting from all the phases of construction pre-construction, construction operation phases of this Metro corridor, and whatever ancillary functions depot and substations which will come up.

And since MMRC, has planned to get funding from the Japan International Cooperation Agency for the construction of the Mumbai Metro line, you will see that usually, Moe FCC does not require their, as per the list which we have studied it does not fall under environmental clearance, but since it is required by the funding agency, the environmental impact assessment report was prepared for this.

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**Limitations**

- The impact assessment study for the proposed project is largely based on the available project.
- Information, discussion with local community and other stakeholders and observations from various surveys and investigations undertaken in the study area.
- Professional judgment and subjective interpretation of facts has been applied for this study.

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So, looking at this limitation of this particular EIA report, you will see that the impact assessment study for the project was prepared largely based on the available project information. So, information they had and also discussions with the local community and stakeholders, and observations from various studies and investigations they undertook. And a lot of professional judgment and subjective interpretation of facts have been applied to the study.

So, they are also giving their limitation and places and you will see that an impact assessment study has been undertaken for alignment that was approved. So, you see the design was already there by MMRCA, done in 2015. So, based on that, the impact assessment in been done. So, how clearly they are stating based on what has been done? And then you see that, since Japan International Cooperation Agency JICA, was involved, they required that the EIA has to be done as they are the lending agency here.

So, according to them, they required that there should be a transparent and accountable process, as well as the active participation of key stakeholders is required. So, we had discussed this, that even funding agencies have their requirements. So, according to that EIA was prepared for this and they aligned with the World Bank

operation policy 4.0, which also we have studied. So you see how each thing are aligning here and how that references have been made.

And even you will see that JICA recognizes certain principles, that one has to undertake, while they are dealing with projects relating to a wide range of environmental and social impact, which has to be addressed through the project, and then how different measurements of environmental and social considerations have to be taken at the early stage of the project and then how accountability and transparency have to be maintained.

And how stakeholders' opinions have to be incorporated what kind of disclosures have to be make made and then how one needs to look into the capacity of the organization and operations of the project and then also implementation of the projects while undertaking environmental and social considerations. So, how even the implementation have to be undertaken there?

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**World Bank's Operational Policies and Guidelines**

Table 1.1 World Bank Operational Policy Requirements and Applicability

Safeguard Policy	Requirement
Environment Assessment (OP 4.01)	<p>The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.</p> <p><i>This policy applies to all projects requiring a Category (A) Environmental Assessment under OP 4.01. The project is also likely to have significant potential adverse environmental and social risks and impacts in its area of influence.</i></p>
Natural Habitats (OP 4.04)	<p>The Bank requires borrowers to incorporate into their development and environmental strategies analyses of any major natural habitat issues, including identification of important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, priorities for conservation, and associated recurrent-funding and capacity-building needs.</p> <p><i>Northern end of the project area is located at a distance of approximately 2 km from the boundary of the Sanjay Gandhi National Park. The sale significantly</i></p>

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So, here you see the World Bank's operational policies and guidelines which are given in the EIA report itself. So which they have acknowledged and then they have identified what are the requirements. So, this also you have already seen, so, environmental assessment, operational policy 4.01 Environmental Assessment, then you see the natural habitats, how they have to be taken care of.

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	large reserve habitat within the project area is a part of the vicinity of the MGN Regis together with its reserve lands, while the reserve forest of the Arany Ganga National Park is the most significant natural habitat in close proximity to the project area.		
Risk Management (EP 4.10)	In operating a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower cooperate in the project responses to strengthen such capacity.  This safeguard will not be applicable for the project.	Physical Cultural Resources (EP 4.11)	and permission will be obtained from the district administration for the same.  The borrower needs to address impacts on physical cultural resources in projects proposed for Bank financing, as an integral part of the environmental assessment (EA) process.  The proposed alignment is passing close to three historical monuments, CST Railway Station (local heritage cultural property), BMC Building and Western Railway Head Quarter (UNESCO world heritage sites) so that no significant impact is anticipated on the historical structures due to project activities during construction and operation.
Habitat Rehabilitation (EP 4.12)	World Bank recognizes that biodiversity rehabilitation measures stemming from forestry, transportation, and environmental damage where appropriate measures are carefully planned and carried out.  The land required for the project has been acquired by the state government as per the provisions set forth in the Motor Fuel Act and Land Acquisition Act. The project also meets both physical and economic displacement under the requirements under this Policy will be applicable for the project. A detailed Rehabilitation and Resettlement Plan has been prepared to be implemented by the project proponent.	Safety of Dams (EP 4.13)	When the Bank finances a project that includes the construction of a new dam, it requires that the dam be designed and its construction supervised by experienced and competent professionals.  This safeguard will not be applicable to this project.
Indigenous People (EP 4.10)	The Bank recognizes that the identities and cultures of indigenous Peoples are inextricably linked to the lands on which they live and the natural resources on which they depend.  This safeguard will not be applicable to this project.	Project in Disputed Areas (EP 7.40)	Projects in Disputed Areas may affect the relations between the Bank and its borrowers, and between the claimants to the disputed area. Therefore, the Bank will only finance projects in disputed areas when either there is no objection from the other claimant to the disputed area, or when the special circumstances of the case support Bank financing, notwithstanding the objection.  This safeguard will not be applicable to this project. The project will ensure that all land acquired is transferred in the name of project and no aliquated land is involved.
Forests (EP 4.16)	If a project involves significant conversion or degradation of natural forests or other natural habitats that the Bank deems are not critical, and the Bank determines that there are benefits to the project and that a cost-benefit and comprehensive analysis demonstrates that overall benefits from the project substantially outweigh the environmental costs, the Bank may finance the project provided that a comprehensive mitigation plan is implemented.  The proposed project does not involve diversion of forest land. However the development will entail cutting of trees along the alignment right of way. (2008)	Projects on International Waterways (EP 7.50)	The Bank recognizes that the cooperation and goodwill of riparians is essential for the efficient use and protection of the waterway. Therefore, it attaches great importance to riparian riparian agreements or arrangements for these purposes for the entire waterway or any part thereof.  This safeguard will not be applicable to this project.

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Applicable World Bank Group IEG Guidelines

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Then how even the pest management involuntary resettlement, which also we have seen. Indigenous people's consideration has to be undertaken even that has been addressed, how the forest, physical cultural resources, the safety of dams, projects, and disputed areas project on international waterways. So, all these have been acknowledged and referred to in the EIA document, As you see, they have also addressed the equator principle 3, also that reference has been made. So, you have also gone through that while we studied the subject.

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	<p><b>1.7 LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK</b></p> <p>Since the adoption of The Kyoto Protocol in December 1997 which was entered into force on 16 February 2005, that developing countries are principally responsible for the current high level of GHG emission into the atmosphere due to industrial activities. The protocol commits the developed countries to reduce 5 percent pollution against 1990 level over the five years period 2008-12.</p> <p>The need for a well-developed legal mechanism is to conserve resources, protect the environment and ensure the health and well-being of the people in India was felt. Keeping the pace with international laws, the Ministry of Environment and Forest enacted Environmental Protection Act in 1986. Over the years, the Government of India has framed several policies and promulgated number of Acts, Rules and Notifications aimed at management and protection of the environment. During last three decades an extensive network of environmental legislation has grown and presently it has a fairly complex body of environmental legislation aimed at ensuring that the development process meets the overall objective of promoting sustainability in the long run. The available legal Acts and legislation relevant during the study are:</p> <ul style="list-style-type: none"> <li>1 The Water (Prevention and Control of Pollution) Act, 1974 (Amendment 1988)</li> <li>2 The Water (Prevention and Control of Pollution) Cess Act, 1977, (Amendment 2002),</li> <li>3 The Water (Prevention and Control of Pollution) Cess Rules, 1978, 1981</li> <li>4 The Air (Prevention and Control of Pollution) Act, 1981 (Amendment 1987)</li> <li>5 Noise Pollution (Regulation and Control) Rules, 2000 (Amendment 2002, 2006)</li> <li>6 Municipal Solid Waste Rules, 2000</li> <li>7 The Environment (Protection) Act, 1986, amended 1991,</li> <li>8 The Environment (Protection) Rules, 1986,</li> <li>9 The Indian Forest Act, 1927,</li> <li>10 Forest (Conservation) Act, 1980, amended 1988,</li> <li>11 Forest (Conservation) Rules, 2003,</li> <li>12 The Wild Life (Protection) Act 1972, Amendment, 2002</li> <li>13 The Metro Railway (Prevention) Act 2009</li> <li>14 Metro Railway (Construction of Work) Act, 1978</li> <li>15 Delhi Metro Railway (Operation and Maintenance) Act, 2002</li> <li>16 The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010</li> </ul> <p>The EIA is conducted as per "Guidelines for Environmental and Social considerations" of ICA. These guidelines are formulated based on the World Bank Operation Policy (OP - 4.01). The Environmental Impact Assessment covers the proposed on-site activities as well as the transportation of the generated waste to the waste disposal sites.</p> <p>Updated Environmental Impact Assessment Report June 27</p> <p><a href="https://www.ica.go.jp/en/shour_work/social_environmental/asia/south/india/c8h0vm0000935v0n-att/c8h0vm0000k0f6vp.pdf">https://www.ica.go.jp/en/shour_work/social_environmental/asia/south/india/c8h0vm0000935v0n-att/c8h0vm0000k0f6vp.pdf</a></p>
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Thereafter, you see that they also address legal policy and institutional framework. So, within all the domains all the domain which you have studied, you can look at the list here, you can see the water-related domain, what kind of policies would be applicable, noise pollution related, what kind of laws will be applicable likewise municipal solid waste rules Environmental Protection Act, forest wildlife, Metro railway, Metro railway, Delhi

Metro railway and ancient monuments and archaeological sites and remain so, you see how legal policy and institutional framework has been addressed.

So, they have systematically they have looked at all the aspects, law, and regulation guidelines, and then what features they would adopt, will be applicable or not, and reasons for their applicability and whose responsibility will be, implementation responsible agencies, so, they have identified all the legal requirements here.

So, you have gone through all of these you can see all this air-related noise forest. So, we have done elaborate coverage of all the legislative parts. So, you see how that has to be addressed in an EIA report. So, you also see hazardous waste management, then motor vehicle development control regulation, then resettlement and rehabilitation. So, all these have been addressed here in the EIA report.

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**1.9 Applicable International Conventions**  
 Environmental problems which migrate beyond the jurisdiction (trans-boundary) require power to control such issues through international co-operation by either becoming a Contracting Party (CP) i.e. and/or treaty or as a signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. The relevant international conventions are as provided in Table 1.3 below.

**Table 1.3: Applicable International Conventions**

S. No.	International Conventions	Salient Features
1	Montreal Protocol on Substances That Deplete the Ozone Layer (and subsequent Amendments)	India signed the Montreal Protocol along with its London Amendment on 17-9-1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 03rd March, 2003.
2	Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations Framework on Climate Change.  The 3 <sup>rd</sup> Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.
3	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals & Pesticides in international Trade was adopted by India at the Conference of Plenipotentiaries at Rotterdam in 1998.

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**1.10 Clearance Requirement for the Project**  
 MMBC shall ensure that all necessary approvals/clearances are in place before implementation. Before commencement of the construction the necessary permissions required for the project is given in Table 1.4 below.

**Table 1.4 : Clearance requirement for the Project**

Parameter	Project Stage	Approval Authority	Responsibility
Resettlement permission	Before construction	State Government, Maharashtra	MMBC
Consent to Establish	Before construction	Maharashtra State Pollution Control Board	Contractor
Consent to Operate	After Construction	Maharashtra State Pollution Control Board	Contractor
Permission to store hazardous material	Before construction	Maharashtra State Pollution Control Board	Contractor
Explosive license	Before construction	Chief controller of explosives	Contractor
PUC certificates for use of vehicles for construction	Before construction	Department of Transport	Contractor

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So, likewise, you also see applicable international conventions. So, we have also studied this. So, you see in the EIA report how they are also acknowledging international conventions. So, starting from the Montreal Protocol

to the Kyoto Protocol and all that has been listed here. Further, what kind of clearance requirements will be needed for the project has been also specified here in the table, you can see permission for the tree cutting, development permission near World Heritage structure, disposal permissions, resettlement permissions, consent to establish, consent to operate, permission to store hazardous material, explosive license and all certificates for use of vehicles for construction and so on. So, you see how all clearance requirements have been also notified here.

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**Table 1.5: Legal Enforcement Agencies**

S. No.	Agency	Functions
Central Level		
1.	Ministry of Environment, Forests and Climate Change (MoEFCC)	<p>MoEFCC is responsible for the implementation and enforcement of the Environment Protection Act, 1986, and Rules issued under the Act, including the EIA notification. Under sections 3 and 5 of the EP Act, 1986, it retains enormous powers to issue directions in the interests of environment protection.</p> <p>The specific functions of MoEFCC include the following:</p> <ul style="list-style-type: none"> <li>• Environmental policy planning;</li> <li>• Effective implementation of legislation;</li> <li>• Monitoring and control of pollution;</li> <li>• Environmental Clearances for industrial and development</li> </ul>

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S. No.	Agency	Functions
2.	Central Pollution Control Board (CPCB)	<p>CPCB was created in September 1986 for the control of water, air and noise pollution, land degradation and hazardous substances and waste management. The specific functions of CPCB include the following:</p> <ul style="list-style-type: none"> <li>• Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution.</li> <li>• Coordinate the activities of SPCBs and provide them with technical and research assistance.</li> <li>• Establish and keep under review quality standards for surface and groundwater as well as for air quality.</li> <li>• Planning and initiation of national programmes for the prevention, control and abatement of pollution through the Water and Air Acts and</li> <li>• The CPCB is responsible for the overall implementation and monitoring of water and air pollution control under the Water Act, 1974, and the Air Act, 1986 respectively.</li> </ul>
3.	The National Green Tribunal	<p>National Green Tribunal was constituted in 2010 for the effective and expeditious disposal of cases pertaining to environmental protection and conservation of forests and other natural resources including enforcement of any legal rights relating to environment and giving relief and compensation for damages to persons and property.</p> <p>The Tribunal will hear applications from all civil cases relating to implementation of the following regulations:</p> <ul style="list-style-type: none"> <li>• The Water Act, 1974;</li> <li>• The Water (Conservation) Act, 1977;</li> <li>• The Forest Conservation Act, 1980;</li> </ul>
State Level		
4.	Central Ground Water Authority	<p>Central Ground Water Authority was constituted under Section 3 (1) of the Environment Protection Act, 1986 to regulate and control development and management of ground water resources in the country.</p> <p>The Authority has been conferred with the following powers:</p> <ul style="list-style-type: none"> <li>• To regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for the purpose.</li> </ul>
5.	Maharashtra Pollution Control Board (MPCB)	<p>Maharashtra Pollution Control Board (MPCB) is responsible for controlling pollution from any activities in the state of Maharashtra. The board performs following functions:</p> <ul style="list-style-type: none"> <li>• To plan comprehensive program for the prevention, control or abatement of pollution and noise emissions thereof.</li> <li>• To collect and disseminate information relating to pollution and the prevention, control or abatement thereof.</li> <li>• To inspect sewage or trade effluent treatment and disposal facilities and air pollution control systems and to review plans, specifications or any other data relating to the treatment plants, disposal systems and air pollution control systems in connection with the consent granted.</li> <li>• Supporting and encouraging the developments in the field of pollution control, waste recycle reuse, eco-friendly practices etc.</li> <li>• To educate and guide the entrepreneurs in improving environment by suggesting appropriate pollution control technologies and techniques.</li> <li>• Creation of public awareness about the clean and healthy environment and attending the public complaints regarding</li> </ul>

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S. No.	Agency	Functions
		pollution.
2.	Maharashtra Department of Environment (MDE)	The Department of Environment (MDE) of Maharashtra is the nodal agency for planning, promotion, coordination and monitoring the implementation of all the aspects of environment other than those dealt with by Maharashtra Pollution Control Board.
3.	Maharashtra Forest Department	Maharashtra Forest Department is managed by Principal Chief Conservator of Forests (PCF), who is responsible for forest related management in the State. He is supported by Assistant PCF (APCF), Chief Conservator of Forests (CCF) and Divisional Forest Officers (DFO) for all matters related to Division of forested and management of forest in the divisions within the State.  The main objective of the Forest department are : <ul style="list-style-type: none"> <li>To ensure environmental stability by restoring ecological balance in forest ecosystems.</li> <li>To increase the forest cover/tree cover in the state, and enhance the quality of forests.</li> <li>To conserve the wide array of bio diversity through scientific management and improve habitat conditions for improved forest health.</li> <li>To protect and develop the forest catchment areas of rivers, lakes, reservoirs and all other ecosystems.</li> </ul> Also, the matters related to Wildlife conservation are managed by Wildlife (WILDLIFE) who is supported by Conservator of Forests (WILDLIFE) and District Wildlife Officers (DWOs) for management and safety of wildlife in the State.
4.	Maharashtra State Electricity Board	As per new electricity Act 2003 Maharashtra State Electricity Board (MSEB) has been reconstituted as Maharashtra State Electricity Board in 4 companies as of 01/04/2005. These companies are registered with Company Registrar, Mumbai as follows: <ul style="list-style-type: none"> <li>M.S.E. Hydro Co. Ltd.</li> <li>Maharashtra State Power Generation Co. Ltd.</li> <li>Maharashtra State Transmission Co. Ltd.</li> <li>Maharashtra State Distribution Co. Ltd.</li> </ul>

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Then you see the institutional framework within which they are working. So, the key institution that is responsible is the Ministry of Environment and Forest, the nodal agency to which we have been referring all the time. So, you see, that is the key agency here, and the other agencies which you have also studied Central Pollution Control Board, as well as National Green Tribunal then you also have the central groundwater authority and then also the state-related Maharashtra Pollution Control Board and so on.

So, all that has been listed, you can have a look at this report. So, that was about the institutional framework. Now, moving ahead to approach and methodology, so, what approach did they adopt here, so, you see that as per the technical feasibility, the alignment was undertaken for the socio-economic acceptability and there were a lot of factors that guided how they would come up with the alignment for the metro rail.

So, based on the final alignment of the proposed alignment, then they worked out in different phases. So, impacts were assessed for various phases of the project cycle. So, we also try to see what project cycles are there. So, looking at the impact due to project location, impact due to project design, and impact due to product construction and project operation. So, based on that, they had done this plus, as we talked about like you also refer to a lot of other documents.

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**Following documents were reviewed by the GC in view of current situations and employer requirements:**

1. Detailed Project Report (Chapter 9 on Environment), by RITES 2012
2. EIA report by RITES in 2012.
3. Environmental and Social Management Plan, by IC 2014.
4. Environmental Baseline Monitoring Plan, by IC 2014.
5. Addendum to Environmental and Social Management Plan, by IC 2015.

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So, here they referred to the detailed project report DPR of the proposal. Plus EIA reports by rights and they also looked at the Environmental and Social Management Plan. And then they also looked at the Baseline Monitoring Plan and the Environment and Social Management Plan. So, all this was looked at.

(Refer Slide Time: 13:25)

**Appendix 1.1**

S. No.	Substance or Characteristic	Requirement (Normative Limit)	Underlying Effect under the Scenario (s)	Permissible limit in the absence of discharge
1	Surface Water quality	5	Water Quality	25
2	Water Quality	5	Water Quality	25
3	Water Quality	5	Water Quality	25
4	Water Quality	5	Water Quality	25
5	Water Quality	5	Water Quality	25
6	Water Quality	5	Water Quality	25
7	Water Quality	5	Water Quality	25
8	Water Quality	5	Water Quality	25
9	Water Quality	5	Water Quality	25
10	Water Quality	5	Water Quality	25
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25	Water Quality	5	Water Quality	25
26	Water Quality	5	Water Quality	25
27	Water Quality	5	Water Quality	25
28	Water Quality	5	Water Quality	25
29	Water Quality	5	Water Quality	25
30	Water Quality	5	Water Quality	25
31	Water Quality	5	Water Quality	25
32	Water Quality	5	Water Quality	25
33	Water Quality	5	Water Quality	25
34	Water Quality	5	Water Quality	25
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37	Water Quality	5	Water Quality	25
38	Water Quality	5	Water Quality	25
39	Water Quality	5	Water Quality	25
40	Water Quality	5	Water Quality	25
41	Water Quality	5	Water Quality	25
42	Water Quality	5	Water Quality	25
43	Water Quality	5	Water Quality	25
44	Water Quality	5	Water Quality	25
45	Water Quality	5	Water Quality	25
46	Water Quality	5	Water Quality	25
47	Water Quality	5	Water Quality	25
48	Water Quality	5	Water Quality	25
49	Water Quality	5	Water Quality	25
50	Water Quality	5	Water Quality	25

**Appendix 1.2**

S.No.	Parameter	Unit	Standard
1	Colour & Odour	-	All effluents should be made to remove colour and odour completely as far as practicable
2	Suspended Solids	mg/l	100
3	Particulate Matter	mg/l	100
4	pH value	-	6.5 to 8.5
5	Temperature	°C	shall not exceed 3°C above the receiving water temp.
6	Oil and grease	mg/l	10
7	Total residual Chlorine	mg/l	1.0
8	Ammoniacal Nitrogen	mg/l	50
9	Total Kjeldahl Nitrogen	mg/l	100
10	Free Ammonia	mg/l	5
11	Biochemical Oxygen Demand @ 5 days @ 20°C	mg/l	30
12	Chemical Oxygen Demand	mg/l	250
13	Acidity	mg/l	0.2
14	Mercury	mg/l	0.01
15	Lead	mg/l	0.1
16	Cadmium	mg/l	0.01
17	Hexavalent Chromium	mg/l	0.1
18	Total Chromium	mg/l	0.2
19	Copper	mg/l	0.5
20	Zinc	mg/l	0.5
21	Selenium	mg/l	0.05
22	Nickel	mg/l	0.3
23	Cyanide	mg/l	0.2
24	Fluoride	mg/l	2.0
25	Disinfectant Residues	mg/l	0.5
26	Sulphide	mg/l	2.0
27	Phenolic compounds	mg/l	1.0
28	Radioactive Materials	mg/l	10 <sup>-7</sup>
29	Disinfectant Residues	mg/l	10 <sup>-7</sup>
30	Disinfectant Residues	mg/l	10 <sup>-7</sup>
31	Disinfectant Residues	mg/l	10 <sup>-7</sup>
32	Disinfectant Residues	mg/l	10 <sup>-7</sup>
33	Disinfectant Residues	mg/l	10 <sup>-7</sup>
34	Disinfectant Residues	mg/l	10 <sup>-7</sup>
35	Disinfectant Residues	mg/l	10 <sup>-7</sup>
36	Disinfectant Residues	mg/l	10 <sup>-7</sup>
37	Disinfectant Residues	mg/l	10 <sup>-7</sup>
38	Disinfectant Residues	mg/l	10 <sup>-7</sup>
39	Disinfectant Residues	mg/l	10 <sup>-7</sup>
40	Disinfectant Residues	mg/l	10 <sup>-7</sup>
41	Disinfectant Residues	mg/l	10 <sup>-7</sup>
42	Disinfectant Residues	mg/l	10 <sup>-7</sup>
43	Disinfectant Residues	mg/l	10 <sup>-7</sup>
44	Disinfectant Residues	mg/l	10 <sup>-7</sup>
45	Disinfectant Residues	mg/l	10 <sup>-7</sup>
46	Disinfectant Residues	mg/l	10 <sup>-7</sup>
47	Disinfectant Residues	mg/l	10 <sup>-7</sup>
48	Disinfectant Residues	mg/l	10 <sup>-7</sup>
49	Disinfectant Residues	mg/l	10 <sup>-7</sup>
50	Disinfectant Residues	mg/l	10 <sup>-7</sup>

**Appendix 1.3**

Characteristics	Designated Use Class of Inland Waters				
	A	B	C	D	E
pH value	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5
Dissolved Oxygen, mg/l	5	4	4	4	4
Biochemical Oxygen Demand @ 5 days @ 20°C, mg/l	2	3	3	3	3
Total dissolved solids, mg/l	50	500	500	500	500
Chlorides as Cl <sup>-</sup> , mg/l	200	200	200	200	200
Colour (Pt-Co), mg/l	10	500	500	500	500
Chlorides as Cl <sup>-</sup> , mg/l	200	200	200	200	200
Sulphate as SO <sub>4</sub> , mg/l	400	400	400	400	400
Iron as Fe, mg/l	0.3	0.3	0.3	0.3	0.3
Fluoride as F <sup>-</sup> , mg/l	1.5	1.5	1.5	1.5	1.5
Lead as Pb, mg/l	0.1	0.1	0.1	0.1	0.1
Copper as Cu, mg/l	1.5	1.5	1.5	1.5	1.5
Zinc as Zn, mg/l	1.5	1.5	1.5	1.5	1.5
Hexavalent Chromium as Cr <sup>6+</sup> , mg/l	0.05	0.05	0.05	0.05	0.05
Total Dissolved Solids, mg/l	500	500	500	500	500
Total Hardness (CaCO <sub>3</sub> ), mg/l	300	300	300	300	300
Mercury as Hg, mg/l	0.01	0.01	0.01	0.01	0.01
Chlorides as Cl <sup>-</sup> , mg/l	200	200	200	200	200
Cyanide as CN <sup>-</sup> , mg/l	0.05	0.05	0.05	0.05	0.05

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Appendix 14

**NATIONAL AMBIENT AIR QUALITY STANDARDS**

Pollutant	Time Weighted Average	Industrial, Residential, Rural & Other Area	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO <sub>2</sub> ), µg/m <sup>3</sup>	Annual	50	20
	24 Hours**	80	80
Nitrogen Dioxide as NO <sub>2</sub> , µg/m <sup>3</sup>	Annual	40	30
	24 Hours**	80	80
Particulate Matter (size less than 10µm) or PM <sub>10</sub> , µg/m <sup>3</sup>	Annual	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5µm) or PM <sub>2.5</sub> , µg/m <sup>3</sup>	Annual *	40	40
	24 Hours**	60	60
Ozone (O <sub>3</sub> ) µg/m <sup>3</sup>	8 Hours**	100	100
	24 Hours**	180	180
Lead (Pb) µg/m <sup>3</sup>	Annual *	0.50	0.50
	24 Hours**	1.0	1.0
Carbon Monoxide (CO) ng/m <sup>3</sup>	8 Hours**	02	02
	1 Hour**	04	04
Ammonia (NH <sub>3</sub> ) µg/m <sup>3</sup>	Annual *	100	100
	24 Hours**	400	400
Benzene (C <sub>6</sub> H <sub>6</sub> ) µg/m <sup>3</sup>	Annual *	05	05
Benzo (a) pyrene (BaP) particulate phase only ng/m <sup>3</sup>	Annual *	01	01
Arsenic (AS) ng/m <sup>3</sup>	Annual *	06	06
Nickel (Ni) ng/m <sup>3</sup>	Annual *	20	20

Source: Central Pollution Control Board Notification dated 19<sup>th</sup> November 2009  
 \* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week hourly at uniform intervals  
 \*\* 24 hourly or 08 hourly or 01 hourly monitored values, as 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.

Appendix 15

**NATIONAL AMBIENT NOISE STANDARDS**

Category of Zones	Leq in dB (A)	
	Day *	Night
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone **	50	40

Source: Central Pollution Control Board  
 \* Day Time is from 6.00 AM to 9.00 PM.  
 \*\* Silence Zone is defined as an area up to 100m around premises of Hospitals, Educational Institutions and Courts. Use of vehicle horn, loudspeaker and bursting of crackers is banned in these zones.

[https://www.ica.go.jp/eng/shi/our\\_work/social\\_environmental/asia/southindia/c8h0vm0000935r0n-att/c8h0vm0000k0fyp.pdf](https://www.ica.go.jp/eng/shi/our_work/social_environmental/asia/southindia/c8h0vm0000935r0n-att/c8h0vm0000k0fyp.pdf)

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So, here you see how they aligned with refer to different standards. So, we have also seen different standards, you see that they have looked at the drinking water quality standards, effluent discharge standards, and then tolerance limits for inland surface water quality. So, all these sources have been identified for you in previous lectures. So, you also see national ambient air quality standards and national ambient noise standards.

So, all these are addressed in the report, you can have a look. So now, the next part is what we see in the EIA report, as we also learned about the structure of the EIA report. So, you see there is a project description. So, I am not going to get into the complete details of the project description, but I will just tell you the key elements, so, that we understand the associated impacts.

(Refer Slide Time: 14:15)

**CHAPTER 2 PROJECT DESCRIPTION**

**2.1 EXISTING SYSTEMS**

Mass transport needs of Mumbai Metropolitan Region (MMR) are met by Suburban Trains and Buses. MMR consists of Greater Mumbai, Thane and Rajkot districts. The proposed Metro Rail project in Greater Mumbai where vehicular traffic consists of two wheeler, auto rickshaw, car, two, buses, commercial vehicles and others. Population and growth rate of vehicles in Greater Mumbai for the year 2001 and 2008 are depicted in Table 2.1.

Table 2.1 GROWTH RATE OF VEHICLE IN GREATER MUMBAI

S.No.	VEHICLES	NO. OF VEHICLES	GROWTH RATE (%)	
		2001	2008	
1	Two Wheelers	647,892	885,466	13%
2	Auto Rickshaws	104,104	108,812	2%
3	Car	408,120	507,408	8%
4	Taxis	54,048	54,833	0.4%
5	Buses	12,200	13,201	8%
6	Commercial vehicles	54,361	73,120	8%
7	Others	2,340,770	6,770	-2%
	Total	3,294,394	3,818,837	8%

**2.2 PROPOSED METRO SYSTEM IN MUMBAI**

There is no existing metro system in Mumbai. Line 1 from Versova to Chhatrapati is under construction. The Mumbai Metro Line 1 is operational since July 2014. Line 2 (Chhatrapati Bandra to Andheri) is under construction and completion will be around the 01<sup>st</sup> Quarter of the year 2020. As per the Mumbai Master Plan proposed by DMRC, Table 2.2 depicts Mumbai Metro Corridor in different phases of construction as shown in Figure 2.1. 01<sup>st</sup> phase for phase 1 metro corridor was opened and during the period 2007-2010. Line 1, Versova to Andheri-Chhatrapati, Line 2, Chhatrapati-Bandra to Marolli and Line 3, Colaba-Bandra to Durgam, DMRC, also completed the 01<sup>st</sup> phase of Line 1 & 2.

Table 2.2 MUMBAI METRO MASTER PLAN

LINE NO.	CORRIDOR	LENGTH (KM)	PHASE	IMPLEMENTATION
1	Versova - Andheri/Chhatrapati	15.0	-	-
2	Chhatrapati - Bandra to Marolli	31.87	I	2009-2011

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1	Colaba - Bandra	20.40		
4	Chhatrapati - Dabaur (East)	7.5	II	2010-2014
5	Chhatrapati - Marolli	12.4		
6	DMC to Karpangru via Airport	15.5		
7	Andheri (East) - Dabaur (East)	18.0		2010-2011
8	Hutheasa Chok - Chhatrapati	21.8		
9	Sewai - Prahadani	1.5	III	
		149.57		

Phase wise length of metro corridor as per Master Plan and as per amendment is depicted in Table 2.3.

Table 2.3 LENGTH OF MUMBAI METRO PHASES

S.No.	Phase	Length (KM) in Master Plan	Length (KM) as per amendment
1	Phase 1	47.27	76.26
2	Phase 2	35.50	35.50
3	Phase III	42.8	49.3
	Total	149.57	161.06

**Project Description**

The proposed MMR2 connecting Colaba-Bandra to Sewai (East) Electronic Export Processing Zone (EEPZ) Metro Corridor will facilitate the commuters to travel from south Mumbai to Airport via Mumbai Bandra Sewai Complex (MBC) will also provide direct access to the economic hubs such as DMCC, Maharashtra Industrial Development Corporation (MIDCO) Industrial Estate, IICET, and various business units in Electronic Exporting, Maharashtra. The total length of the proposed metro corridor is 21.14 km. The entire Metro corridor is proposed to be constructed underground. Figure 2.2 illustrates the proposed routing of MMR2.

The entire length of 21.14 km is divided into 7 packages that collectively comprises of 26 stations as described in Table 2.3.

**Above Ground Structures**

Above ground station structures for the proposed MMR2, which will not underground include the following:

- Entry/Exit Structures

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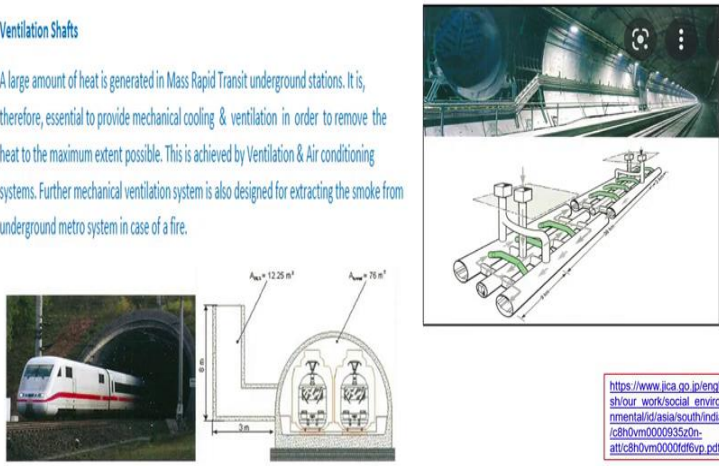
So, here project description gives, like, what is the existing transportation scenario and why this particular metro line has been proposed. So, if you remember the need of the project has to be emphasized. So, and then the details of the project have to be given. So, you see there that they have talked about the existing system and

then the proposed metro system in Mumbai and what all will happen within that, so, they are giving the project description here. So, we are in this just to understand the nature of the project.

(Refer Slide Time: 14:50)

**Ventilation Shafts**

A large amount of heat is generated in Mass Rapid Transit underground stations. It is, therefore, essential to provide mechanical cooling & ventilation in order to remove the heat to the maximum extent possible. This is achieved by Ventilation & Air conditioning systems. Further mechanical ventilation system is also designed for extracting the smoke from underground metro system in case of a fire.



$A_{Sha} = 12.25 \text{ m}^2$        $A_{Sha} = 78 \text{ m}^2$

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**TBM Worksites:**

Activities proposed to be carried out at TBM worksites will include TBM operations like launching, retrieval, TBM maintenance operations, mucking, lining intake etc. TBM worksites are required to be located midway between stations at some places on tunnel alignment and at locations where mid shafts are located. 23 TBM worksites have been proposed for MML3, indicative nearest station to TBM work site is tabulated in Table 2.2.

**Table 2.2: Description of TBM work sites of MML3**

Sr. No.	TBM work sites	Area (m <sup>2</sup> )	Location (indicative nearest station)
1	TWS 1	4538	Cuffe Parade Station
2	TWS 2	3988	Oral Maldein - Charchgate
3	TWS 3	3450	CST - Station
4	TWS 4	2352	CST - Station
5	TWS 5	7012	Mumbai Central Station
6	TWS 6	5130	Mumbai Central Station
7	TWS 7	2356	Race Course - Science Museum Station
8	TWS 8	4232	Race Course - Science Museum Station
9	TWS 9	39254	Worli Station
10	TWS 10	2100	Worli Station
11	TWS 11	24740	Siddhi Vinayak Station
12	TWS 12	1448	Diadar Station
13	TWS 13	3864	Mid-Shaft St Xavier College - Dharavi Station
14	TWS 14	1123	Dharavi Station
15	TWS 15	1408	Dharavi Station
16	TWS 16	8860	BKC Station
17	TWS 17	3513	BKC Station
18	TWS 18	3230	Mid Vent Shaft Agipada - Santacruz station
19	TWS 19	2820	Sahar Road Station
20	TWS 20	5693	Sahar Road Station
21	TWS 21	2624	CSIA International Station
22	TWS 22	500	CSIA International Station
23	TWS 23	12744	Mid-Shaft BMC play ground - Marol Naka

**Tunnel Boring Machine**



<https://www.herrenknecht.com/en/references/referencedetail/mumbai-metro-line-3/>

[https://www.lica.go.jp/english/our\\_work/social\\_environmental/asia/southindia/c8h0vm00093520n-att/c8h0vm000006f6vp.pdf](https://www.lica.go.jp/english/our_work/social_environmental/asia/southindia/c8h0vm00093520n-att/c8h0vm000006f6vp.pdf)

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There might be ventilation shafts because there will be a lot of underground stations, that have a lot of ventilation requirements, and a lot of heat is generated in the process. So, those kinds of requirements would come, and then there would be tunnel boring machine work sites, so, which will create underground tunnels.

So, for that, you will see how much description of tunnel boring machine work sites would be the number of sites had been listed here in the report, and where it will be located during the construction of the project. So, all that has been identified, I have put the picture of just a tunnel boring machine so, that we understand what scale what kind of thing we are talking about.

(Refer Slide Time: 15:33)


**Casting Yards**

The Metro Line 3 being underground needs tunnel lining segments to be pre-cast to be assembled at site the length of tunnels for different packages are given below Table 2.4

**Table 2.4 Details of Tunnels and openings/Station Boxes**

CONTRACT PACKAGE	Station From	Starting Chaining	Station To	End Chaining	Tunnel Length (m)	Tunnel Diameter (m)	Station Boxes/ Openings/ Tunnel Piles (m <sup>2</sup> )
UGC-01	STARTING	487.56	Colli Franchise	117.54	1712.02	483	
	Colli Franchise	122.541	Vidhan Bhawan	1169.05	1169.109	251	
	Vidhan Bhawan	156.05	Churhighat Metro	2041.011	491.361	281	
	Churhighat Metro	2366.012	Haramba Chowk	2969.483	622.669	252	
	Haramba Chowk	3209.083	CST Metro	3202.722	546.484	281	
UGC-02	CST Metro	4652.058	Kalbadva Station	4649.433	636.375	207	
	Kalbadva Station	4890.78	Girgaon Station	5319.861	464.081	298	
	Girgaon Station	5657.439	Girgaon Road Metro	6441.424	336.993	207	
UGC-03	Girgaon Road Metro	7365	Mumbai Central	7867.66	472.66	281	
	Mumbai Central	8352.769	Mahalaxmi	8922.52	831.511	281	
	Mahalaxmi	9198.001	Science Museum	10096.398	898.397	365	
UGC-04	Science Museum	10461.49	Acharya Atrey Station	11110.366	679.88	281	
	Acharya Atrey Station	11426.36	Worli Station	12562.364	1172.008	281	
	Worli Station	12877.37	Sikh Viharik Station	14362.029	1284.658	257	
UGC-05	Sikh Viharik Station	14419.09	Dadar Metro Station	15513.985	1114.895	324	
	Dadar Metro Station	15857.68	Shivajinagar Station	17230.274	1381.533	303	
	Shivajinagar Station	17953.86	Chhava Station	18992.369	1407.311	281	
	Chhava Station	19318	BKC Station	20678.709	1403.789	473	
UGC-06	BKC Station	21149.71	Vidyanagar	22000.556	860.648	281	
	Vidyanagar	22295.38	Santacruz Station	23003.141	721.784	272	
	Santacruz Station	23291.14	MID Ventilation Shaft	24877.019	581.896	26	
	MID Ventilation Shaft	23963.02	CMA Domestic	25498.04	1295.588	217	

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<https://www.turmetalk.com/India-12Mar2020-Mumbai-Metro-Line-3-excavation-methods-advance-and-statistics.php>

[https://www.ica.go.jp/english/our\\_work/social\\_environmental/asia/southindia/c8h0vm000935z0n-att/c8h0vm00000ct6p.pdf](https://www.ica.go.jp/english/our_work/social_environmental/asia/southindia/c8h0vm000935z0n-att/c8h0vm00000ct6p.pdf)

And then there might be, there will be also need for casting yards. So, all this will be pre-constructed and then would be taken to the construction site. So, you will see the details of tunnels and openings, station boxes, which would be there as the casting yards, and where all these from these casting yards would be and how much area they would take. So, I have put the picture also so, that we understand what the casting yard looks like.

(Refer Slide Time: 16:04)

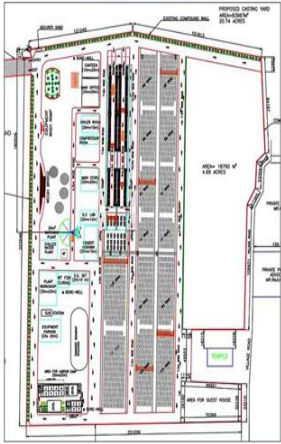
**Table 2.5 : Details of allocation of Casting yards for different packages**

Location	Area m <sup>2</sup>	Distance from Package	
		First	Second
Existing casting yard at Wadala – Simplex	81227	Package 1 16 km	Package 2 14 km
Existing Monorail casting yard at Wadala	83150	Package 3 12 km	Package 4 9 km
BKC near Mithi River	35028	Package 5 6 km	
Kanjur Marg Plot (Near Eastern Express Highway)	80576	Package 6 14 km	Package 7 10 km

**Table 2.6 : Details of Casting Yards proposed**

Contract	Location	Size in Sq.m.	Distance (km)
UGC-01	Existing casting yard at Wadala – Simplex	36947	16
UGC-02	Existing casting yard at Wadala – Simplex	44280	15
UGC-03	Existing Monorail casting yard at Wadala	41575	12
UGC-04	Existing Monorail casting yard at Wadala	41575	9
UGC-05	BKC near Mithi River	35028	6
UGC-06	Kanjur Marg Plot (Near Eastern Express Highway)	40058	14
UGC-07	Kanjur Marg Plot (Near Eastern Express Highway)	40518	10

**Figure 2.2: Typical Casting Yard for two Packages**



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And then also various locations where these casting yards would come and then, what are the details of different casting yards proposed here, so, you see the range of places which are proposed, and then they have also provided the drawings of casting yards. As you can see here in the drawing, so, they have explained the complete project details in detail, we are skipping those details here. Further, they have analyzed the alternatives we discussed, like to ensure that what has been proposed is the best available alternatives or optimum alternatives that have to be established.




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**Analysis of Alternatives**

**Depot Planning**

The proposed corridor would require a dedicated depot for the maintenance of the rakes.



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So, another Alternative they tried on Depot planning, like where all the depot would come from. The project needed a dedicated depot for the maintenance of the rakes. So, you can see the picture of what rakes are like and they would need a depot for that.

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**Proposed Alternative sites for Depot**

Following sites had been selected for the depot having requisite size along the alignment.

- Mahalaxmi Race Course
- Kalina University Land
- Aarey Milk Colony Land



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So, you will see that they have proposed alternative sites for the depot, you can see on the map how they have these sites Mahalakshmi Race Course, then you can see in some central part, Kalina University land and then Aarey Milk Colony. So, finally, the project description tells that they are going to build it at the Aarey Milk colony.

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**2.6 MAJOR SECTION OF PROPOSED METRO CORRIDOR (LINE III)**

The proposed Metro corridor will facilitate the commuters to travel from South Mumbai to Airport via Mahim-BKC. It will also provide direct access to the economic hubs such as BKC, MIDC Industrial Estate, SEEPZ and famous landmarks such as Kalina University, Mahalaxmi etc. The proposed 33.51 km metro corridor has been divided into six sections as depicted in **Table 2.7**.

TABLE 2.7 MAJOR SECTIONS OF METRO CORRIDOR (PHASE III)

S.NO.	MAJOR SECTIONS	LENGTH IN KM
1	Colaba/WTC/Cuffe Parade to CST	4.475
2	CST to Science Museum	7.000
3	Science Museum to Mahim	7.000
4	Mahim to Airport	7.000
5	Airport Region	5.000
6	Airport to SEEPZ	3.033
	Total	33.508

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So, a major section of the proposed Metro corridor is also provided like at phase 3, where they will do it, then ridership on the proposed Metro corridor. So, that study is also undertaken, then, you also see, they have provided construction methodology. So, that is also with extensive detail has been provided. So, I am not getting into the details.

So, what kind of construction strategy they have adopted here has been well explained. So, as we had discussed before even the designs can change, even the layouts can change, and there can be many alternatives. So, now with the construction methodology, they are handling the environmental part.

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**2.12 CONSTRUCTION METHODOLOGY**

Construction of the underground section shall be done by Cut and Cover, NATM and Tunnel Boring Machine (TBM). Station will be constructed either by Cut and Cover or NATM method depending upon the availability of space.

**2.12.1 Construction Strategy**

Design and build contracts will be adopted for proposed corridor. There will be three major contracts 1. Civil Works, 2. System Contract and 3 Depot Contract. Under civil contract, Architectural finishes, firefighting and general electrification will be included along with the civil construction works. System contract will be on the basis of design, construct and installation which will include Traction and Power Supply, Signal and Telecommunication, Lifts, Escalators, Fare collection, Rolling Stock, Track and Signages. Layout, design and construction and general electrification comes under the Depot contract.

**2.12.2 Construction Period**

It is proposed to complete the project in a time period of 60 months.

**2.12.3 Updates on Construction Period**

The construction period of all the 7 packages are same 3600 days (around 4.5 years). The commercial date of operation is targeted at May 2023 for the entire corridor.

**2.12.4 Construction methodologies**

- Construction of station box by cut & cover method
- Construction of station box by New Austrian Tunneling Method (NATM)
- Construction of tunnels by Tunnel Boring Machine (TBM)

There are total twenty six underground stations planned for Mumbai Metro Line 3. Out of twenty six, thirteen stations are to be constructed by cut & cover method and seven will be built by NATM.

**Stations to be built by cut & cover method**

It has recommended the following thirteen stations to be built by cut & cover

- Colaba Parade
- Colaba Mahim
- Churni Lake
- CST Mahim
- Mumbai Central
- Mahalaxmi
- Science Museum
- Alhappa Shiv Chokh
- Brund
- Sahy Vihar
- Colaba
- Chopra
- WTC
- Winkfield
- Chakraborty
- Wankhede
- Chakraborty
- Wankhede
- Wankhede
- Wankhede

The report was prepared by C-10-May-2022 and since then no changes have been made in station location and size.

In this review, the construction methodologies of each station will be examined and ensure that the specified method is the most suitable and cost effective. At the same time if any information is missing, it will be supplemented.

Two types of structural forms have been suggested for cut & cover stations namely at CSC (Type A cut & cover station box) and precast (Type B cut & cover station box).

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So, you can see the construction, they have also mentioned the construction period, the construction methodology, which they have used, and then all the details of different locations where they will undertake that. So, that was about the construction methodology.



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**CHAPTER-3 ENVIRONMENTAL BASELINE DATA**

**3.1 ENVIRONMENTAL SCOPING**

This chapter describes the existing environmental settings in the study area. The objective of Environmental Impact Assessment (EIA) is to ascertain the baseline environmental conditions and then assess the impacts as a result of the proposed project during various phases of the project cycle. Data on land environment has been collected and compiled from various published sources and field focused surveys. Attributes of the physical environment like air, water, soil, and noise quality in the surrounding area were assessed primarily through field studies, and by undertaking monitoring and analysis of samples collected from field. Information about geology, hydrology, prevailing natural hazards like earthquakes, etc. have been collected from literature review and authoritative information made available by government departments. Climatological data was collected from Indian Meteorological Department. The methodology adopted for data collection is highlighted wherever necessary. A scoping matrix along with the frequency schedule for data collection for environmental attributes is summarized in **Table 3.1.**

**TABLE 3.1**

**ENVIRONMENTAL ATTRIBUTES AND FREQUENCY OF MONITORING**

S. NO	ATTRIBUTE	PARAMETER	FREQUENCY	SOURCE
<b>LAND ENVIRONMENT</b>				
1.	Soil	Soil Characteristics	Once	Field studies and Detailed project report
2.	Geology	Geological Status	—	Literature review
3.	Seismology	Seismic Hazard	—	Literature review
<b>WATER ENVIRONMENT</b>				
4.	Water Quality	Physical, Chemical and Biological parameters	One Season	Field studies/Literature review
<b>AIR, NOISE AND METEOROLOGY</b>				
5.	Ambient Air Quality	PM2.5, PM10, SO2, NOx, CO, HC	Two Season	Field Studies/Literature review
6.	Meteorology	Temperature, Relative Humidity, Rainfall, wind direction and speed	Data	India Meteorological Department/Literature review
7.	Noise	Noise levels in dB (A)	One Season	Field monitoring
8.	Vibration	Vibrations in VdB	—	Field monitoring & modeling

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**3.2 LAND ENVIRONMENT**

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 11 m above the sea level (a MSL). Mumbai is located along western Indian coast of India from 18° 52' north latitude and 72° 52' east to 19° 30' longitude. Parameters involved in land environment are, physiography, geology and soils, and vicinity. These are discussed in the following paragraphs.

**3.2.1 Physiography**

The physiographic features of the Mumbai district is broad and flat terrain flanked by north-south trending hill ranges. The hill ranges form almost parallel ridges in the eastern and western part of the area. The Western - Eastern hill ranges are the other hill extending in the eastern and western part running NW - SE. The maximum elevation of the area is 616 m above mean sea level (amsl) at some of the peaks of hill ranges. Trombay Island has north-south trending hills with maximum elevation of 30 m above mean sea level (amsl). Malabar, Colaba, Worli and Hill hills are the isolated small ridges trending north-south in the western part of the district. The Pooza - Bandra hills form the largest hills located in the central part of the Western Island and are the feeder ranges for the three lakes i.e., Pooza, Vihar and Tolly. There are a number of creeks, dissecting the area, among them, there is the largest creek. Other major creeks are Malabar, Malad and Maladiv which penetrate to the sea and give rise to mud flats and swamps. The area is drained by Malabar, Vihar, Dahanu and Pooza creeks. These small creeks are the source, from small streams which merge with each other resulting in swamps and mud flats in the low lying areas.

**3.2.2 Geology and soils**

The entire Western Mumbai area is occupied by Deccan basalt flows and the associated pyroclastic rocks and the volcanic rocks of upper tertiary to paleogene age. The Deccan basalt of Mumbai district is considered to be the younger basalt of Deccan age. Overall the geology around Mumbai indicates presence of different rock units and differentiation with intertonguing levels, conglomerates and tuffs. The strata differentiation are of limited occurrence. Soil types include Aridisols and Spodosols. The agriculture soil will include mineral material as indicated by current building and graded building. The basal flows of the area have been grouped into composition flows of a particular type, simple flows and flows which are not full in the above categories and have termed as unclassified flows. The healthy flows are typically of quartz and hypersthene normative with minor amount of olivine.

**3.2.3 Socio-economic**

S	Socio-economic aspects	Socio-economic	Once	Field Studies, literature review
10	Trees	Number/Species	Once	Field Studies

**3.2.4 Ecology**

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 11 m above the sea level (a MSL). Mumbai is located along western Indian coast of India from 18° 52' north latitude and 72° 52' east to 19° 30' longitude. Parameters involved in land environment are, physiography, geology and soils, and vicinity. These are discussed in the following paragraphs.

**3.2.5 Meteorology**

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 11 m above the sea level (a MSL). Mumbai is located along western Indian coast of India from 18° 52' north latitude and 72° 52' east to 19° 30' longitude. Parameters involved in land environment are, physiography, geology and soils, and vicinity. These are discussed in the following paragraphs.

**3.2.6 Seismology**

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 11 m above the sea level (a MSL). Mumbai is located along western Indian coast of India from 18° 52' north latitude and 72° 52' east to 19° 30' longitude. Parameters involved in land environment are, physiography, geology and soils, and vicinity. These are discussed in the following paragraphs.

**3.2.7 Noise and Vibration**

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 11 m above the sea level (a MSL). Mumbai is located along western Indian coast of India from 18° 52' north latitude and 72° 52' east to 19° 30' longitude. Parameters involved in land environment are, physiography, geology and soils, and vicinity. These are discussed in the following paragraphs.

**3.2.8 Air Quality**

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 11 m above the sea level (a MSL). Mumbai is located along western Indian coast of India from 18° 52' north latitude and 72° 52' east to 19° 30' longitude. Parameters involved in land environment are, physiography, geology and soils, and vicinity. These are discussed in the following paragraphs.

**3.2.9 Water Quality**

The project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 11 m above the sea level (a MSL). Mumbai is located along western Indian coast of India from 18° 52' north latitude and 72° 52' east to 19° 30' longitude. Parameters involved in land environment are, physiography, geology and soils, and vicinity. These are discussed in the following paragraphs.

Now, coming on to the baseline data. So, that is the key part of the environmental impact assessment. So, where they are establishing baseline data. So, here you see that they use mostly secondary data as well as references from the other studies and they have also conducted studies. So, just to look at we have already covered baseline data, and how to undertake it domain-wise in detail, so, we are just going to skim through and then see how how it comes in the report.

So, you will see here that they have provided environmental attributes and frequency of monitoring, and then they have identified how it is impacting the land environment.

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**TABLE 3.2**

**SOIL TEST RESULTS**

S.No.	PARAMETER	LOCATION					
		Cuffe Parade	Jacob Circle	Worli	International Airport	SEEPZ	Aarey Colony
1	pH	7.10	7.60	7.87	7.19	6.80	6.28
2	Conductivity (mS/cm)	0.80	0.85	0.53	1.46	0.19	0.18
3	Sodium (As Na, mg/100gm)	22.61	21.02	35.59	18.34	7.62	3.45
4	Organic Matter (% By Mass)	1.80	1.48	1.37	0.90	1.15	1.53
5	Nitrogen (N, Kg/hectare)	121.99	33.77	28.81	10.09	30.72	41.57
6	Calcium (As Ca, mg/100g m)	329.94	648.09	710.94	487.05	263.16	141.40
7	Chloride (As Cl, mg/100g m)	450.63	404.54	289.29	262.86	299.22	208.55
8	Magnesium	85.80	81.03	126.32	162.07	135.85	102.48

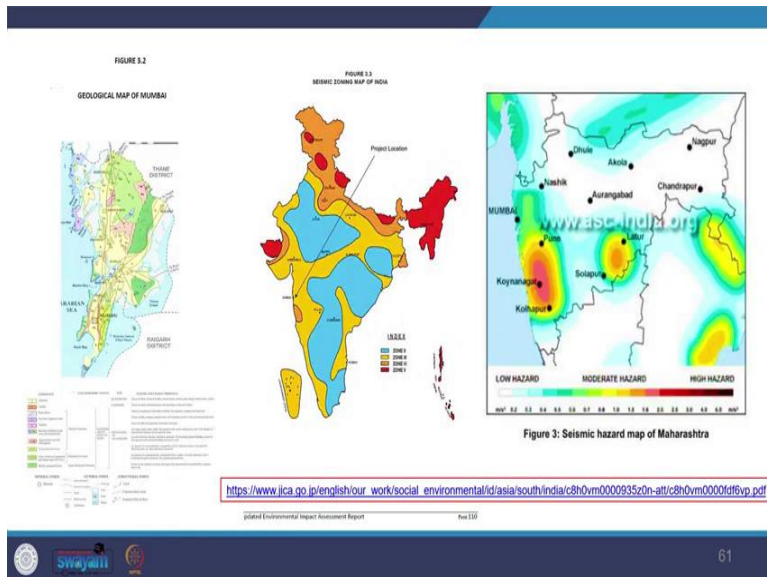
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**Table 3.3: Summary of available ground investigation data (Factual Report and GRI) by IC (2014)**

Contract ID →	UGC-01	UGC-02	UGC-03	UGC-04	UGC-05	UGC-06	UGC-07	Depot
Number of Boreholes at Stations	20	16	22	11	20	11	12	15
Number of Boreholes along Bored Tunnels	11	12	11	20	12	14	10	-
Depth of Boreholes (m) below ground	5.5 m to 30m	10.5 m to 28.5m	8m to 28m	7.5m to 27m	6m to 28m	6.5m to 25m	11m to 25m	7m to 11.3m
Average Depth of Ground Water Table (m) below ground	3.2m	4.3m	5.1m	4.1m	3.5m	3.3m	3.6m	4.0m
Depth of Rock head (m) below ground	2.5m to 11m	5m to 12.3m	2m to 18m	4m to 14m	2m to 12m	1.5m to 8m	1m to 8m	1.6m
Types of Rocks Observed	Basalt, Breccia	Basalt, Breccia	Basalt, Breccia, Shale, Tuff	Basalt, Breccia, Tuff	Basalt, Breccia, Tuff	Basalt, Breccia, Tuff	Basalt, Breccia	Basalt, Breccia

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Then you can see how they have presented all the tables related to soil test results, then you can see all the data which was available with the ground investigation data which was already there, and you can see a geological map of Mumbai, then you can see the Seismic zone map and then Seismic hazard map of Maharashtra.

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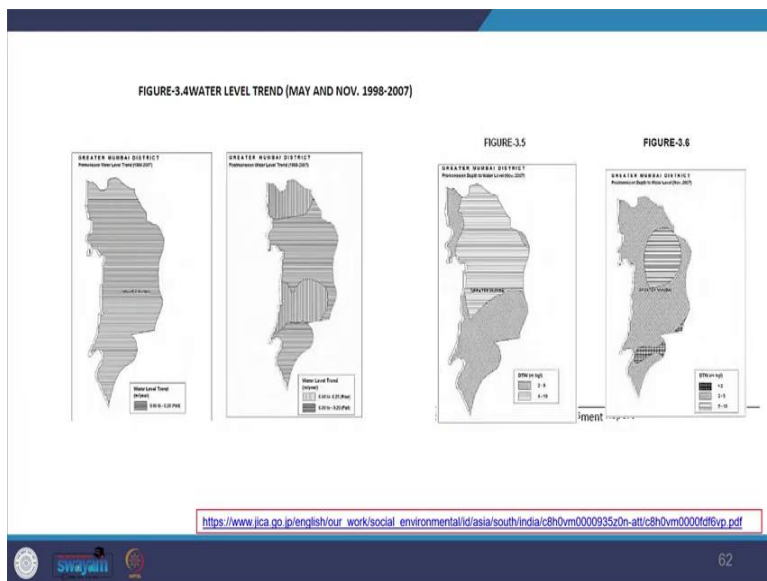


TABLE 3.5  
WATER QUALITY AT PROJECT SITE

PARAMETER	LOCATION							
	1	2	3	4	5	6	7	8
pH	7.20	7.21	6.89	7.10	7.02	6.98	7.41	7.72
Total Hardness as CaCO <sub>3</sub> (mg/l)	48.0	6031.07 .00	3500	140.00	44.00	444.72	126.48	379.44
Calcium (As Ca, mg/l)	8.02	11.22	480.96	38.48	9.62	107.93	107.93	55.60
Alkalinity (As CaCO <sub>3</sub> , mg/l)	51.08	52.39	2060.19	143.91	80.15	466.44	102.29	249.2
Chloride (As Cl, mg/l)	13.80	9.86	5518.86	25.62	11.83	181.99	58.71	68.49
Magnesium (As Mg, mg/l)	6.80	7.78	558.90	10.69	4.86	42.63	11.90	58.49

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Figure 3.7: Hydrogeology of Mumbai



Figure 2: Hydrogeology of Mumbai

3.4.1 Meteorology

Mumbai experiences tropical savanna climate. The climatic conditions in project area are experienced four distinct seasons monsoon (June-September), post monsoon (October-December), winter (December-February) and summer (March-May).  
The normal annual rainfall over the district varies from 1800 mm to about 2400 mm. It is minimum in the central part of the district around Kurla (1804.8 mm). It gradually increases towards north and reaches a maximum annual variation 2382.2 mm. The relative humidity at Mumbai ranges between 54.5% to 85.5%. Records of monthly total rainfall, mean maximum and mean minimum relative humidity of Mumbai obtained from Regional Meteorological Department (RMD), Colaba and Santacruz has been presented in Table 3.6 to Table 3.8.

TABLE 3.6 A MONTHLY TOTAL RAINFALL AT STATION: COLABA

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLY TOTAL RAINFALL (MM)	2009	0.00	0.00	0.00	0.00	0.00	269.3	175.3	284.1	284.1	284.1	284.1	284.1
2010	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1
2011	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1

TABLE 3.7 MONTHLY TOTAL RAINFALL AT STATION: SANTACRUZ

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLY TOTAL RAINFALL (MM)	2009	0.00	0.00	0.00	0.00	0.00	284.1	284.1	284.1	284.1	284.1	284.1	284.1
2010	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1
2011	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1	284.1

TABLE 3.8 MONTHLY MEAN RELATIVE HUMIDITY AT STATION: COLABA

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLY MEAN RELATIVE HUMIDITY (%)	2009	61	66	79	75	70	62	55	52	52	58	58	58
2010	61	66	79	75	70	62	55	52	52	58	58	58	58
2011	61	66	79	75	70	62	55	52	52	58	58	58	58

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and MS) has been graphically presented in Figure 3.47 to Figure 3.52. The updated air quality data is presented in Figure 3.28 to 3.35.

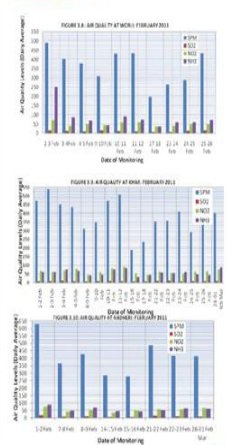


Figure 3.46 AQI at Bandra, May 2015

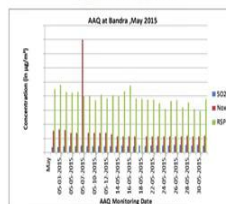


Figure 3.48 AQI at Bandra, July 2015

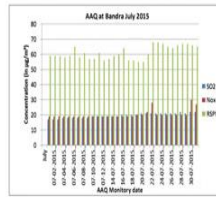


Figure 3.47 AQI at Bandra, June 2015

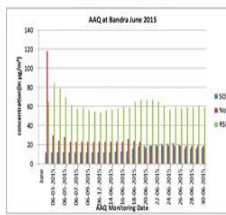
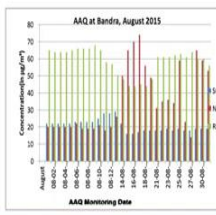


Figure 3.49 AQI at Bandra, August 2015



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So, they have studied all that, water level trend they have studied in this place, water quality at the project site, the hydrology of Mumbai they have studied and the metrology data they have gathered here, and then a very

intensive study of air quality data and for different, different you can see for different months they have collected the data here. So, I have just snipped some of this elaborate data there.

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**NOISE ENVIRONMENT**

Date: 11/01/2012 to 12/01/2012

Location: BKC

**TABLE 3.14**  
NOISE LEVELS AT VARIOUS LOCATIONS

Date: 10/01/2012 to 11/01/2012

Location: Mahim

Time	Hourly Leq dB (A)	Result dB (A)
MIDNIGHT	52.8	Leq(24hrs.) 67.0
1:00 AM	50.2	L10 72.7
2	49.5	L50 69.5
3	52.9	L90 67.5
4	49.3	Lday 68.3
5	55.9	Lnight 60.9
6	59.7	Ldn 69.4
7	63.3	Lmax 74.1
8	65.1	Lmin 49.3
9	66.4	
10	68.2	
11	69.4	
12 NOON	73.2	
13	74.1	
14	68.3	
15	67.4	
16	69.2	
17	68.7	
18	65.3	
19	64.2	
20	63.4	

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Time	Hourly Leq dB (A)	Result dB (A)
MIDNIGHT	51.2	Leq(24hrs.) 68.6
1:00 AM	49.4	L10 73.4
2	48.3	L50 71.4
3	47.1	L90 69.2
4	49.6	Lday 70.3
5	52.4	Lnight 53.0
6	58.9	Ldn 68.9
7	61.3	Lmax 74.3
8	65.3	Lmin 47.1
9	68.2	
10	72.4	
11	69.7	
12 NOON	74.3	
13	72.6	
14	73.1	
15	68.3	
16	72.8	
17	71.4	
18	70.1	
19	69.9	
20	68.6	
21	59.3	
22	52.7	
23	50.8	

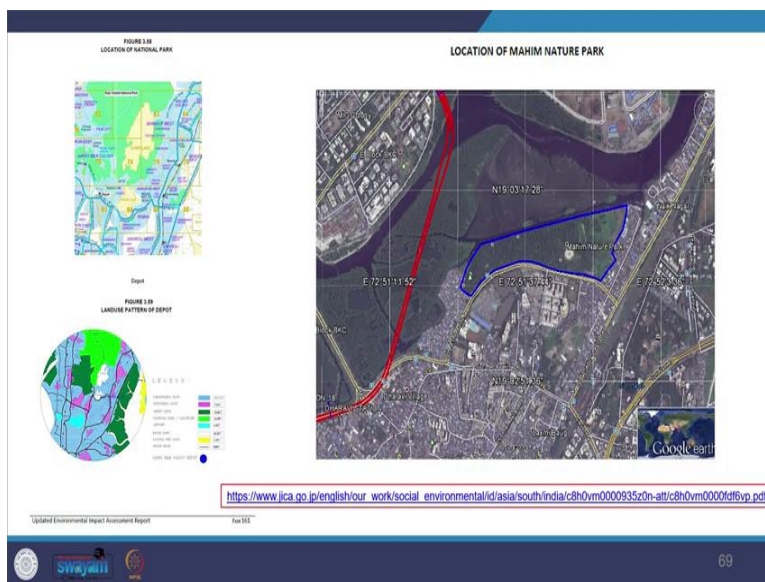
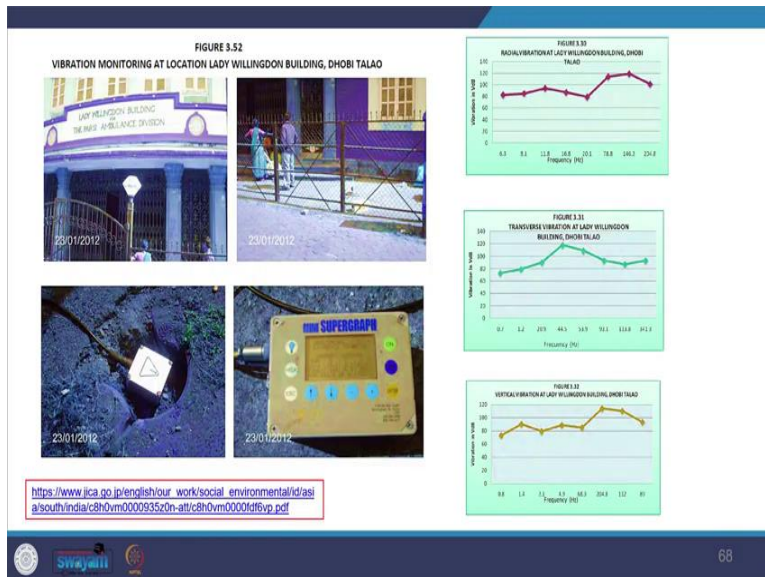
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**TABLE 3.15**  
VIBRATION MONITORING LOCATION

Sl	LOCATION	LATITUDE	LONGITUDE
1	Lady Willington Building, Dhobi Talao, near Metro Cinema, Mahapalka Road.	18° 56' 34.64" N	72° 49' 46.57" E
2	Nanaldas Bhau Jewelers, K Gajanan Vertak Chowk, Lamington Road.	18° 57' 24.59" N	72° 48' 59.58" E
3	Mittal Towers, Maharshi Valmiki Chowk, Press Journal Marg.	18° 55' 30.54" N	72° 49' 30.37" E
4	Central Assurance Building, opp to Commissioner Building, Dr. Dadabhai Naorji Road.	18° 56' 9.74" N	72° 50' 1.24" E
5	Bhikha, Behram, Parsees Well, Hutatma Chowk.	18° 55' 58.24" N	72° 49' 46.95" E
6	Chhatrapati Shivaj Terminus (CST), Mumbai CN Road	18° 56' 23.30" N	72° 50' 06.01" E

**FIGURE 3.51**  
LOCATION OF VIBRATION MONITORING

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And they have also connected collected data on the noise environment. Also, vibration data has been collected on the map they have also shown from where all which places they have collected this data. So, you can see how they have put the pictures and also evidence of how and when they are collecting that data.

So, you can also see the dates, the equipment's coming, and the location coming in the picture. And then how they are preparing the drafts related to that. So, other you see here they are also talking about the National Park, then also land use pattern from where the depot is coming, and then what all area Mahim nature park which is coming here.

(Refer Slide Time: 22:15)

Table 3.16 : Globally Threatened & Legally Protected Species of Mumbai Region

Sr. No.	Scientific Name	Zoological Group	IUCN Status*	WPA Schedule
1	<i>Loris lydekkerianus</i>	Mammalia	LC	I
2	<i>Macaca radiata</i>	Mammalia	LC	II
3	<i>Semnopithecus entellus</i>	Mammalia	LC	II
4	<i>Moschola mosina</i>	Mammalia	LC	I
5	<i>Canis aureus</i>	Mammalia	LC	II
6	<i>Vulpes benghalensis</i>	Mammalia	LC	II
7	<i>Panthera pardus</i>	Mammalia	LC	I
8	<i>Felis chaus</i>	Mammalia	LC	II
9	<i>Prionailurus bengalensis</i>	Mammalia	LC	I
10	<i>Prionailurus rubiginosus</i>	Mammalia	VU	I
11	<i>Prionailurus viverrinus</i>	Mammalia	EN	I
12	<i>Viverricula indica</i>	Mammalia	LC	II
13	<i>Paradoxurus hermaphroditus</i>	Mammalia	LC	II
14	<i>Herpestes edwardsii</i>	Mammalia	LC	II
15	<i>Herpestes smithi</i>	Mammalia	LC	II
16	<i>Motis crossicaudata</i>	Mammalia	EN	I
17	<i>Pavo cristatus</i>	Aves	LC	I
18	<i>Dendrocygna bicolor</i>	Aves	LC	I
19	<i>Ardeotis nyctea</i>	Aves	NT	-
20	<i>Micropus leucorhynchus</i>	Aves	NT	-
21	<i>Thalassidroma leucorhynchus</i>	Aves	NT	-
22	<i>Platyoeca leucorhynchus</i>	Aves	LC	I
23	<i>Falco chrysurus</i>	Aves	NT	I
24	<i>Falco jugger</i>	Aves	NT	I
25	<i>Falco peregrinus</i>	Aves	LC	I
26	<i>Ficedula albicollis</i>	Aves	LC	I
27	<i>Haliaeetus leucogaster</i>	Aves	LC	I
28	<i>Nesophes peroupiensis</i>	Aves	EN	I
29	<i>Gyps bengalensis</i>	Aves	CR	I
30	<i>Gyps indicus</i>	Aves	CR	I
31	<i>Sarcogyps calvus</i>	Aves	CR	IV
32	<i>Accipiter badius</i>	Aves	LC	I
33	<i>Limosa limosa</i>	Aves	NT	-
34	<i>Python molurus</i>	Reptilia	VU	I
35	<i>Atretium schotzum</i>	Reptilia	LC	II
36	<i>Python moseleyi</i>	Reptilia	NA	II
37	<i>Xenochrophis piscator</i>	Reptilia	NA	II
38	<i>Naja naja</i>	Reptilia	NA	II
39	<i>Daboia russelii</i>	Reptilia	LC	II
40	<i>Chamaeleo zeylanicus</i>	Reptilia	LC	II
41	<i>Varanus bengalensis</i>	Reptilia	LC	I

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So, they have identified all the legally protected species. So, we have studied how we need to identify that is the basics that you identify in every context in every country, what is the protected list, so they have taken it as for the Mumbai region, so you can see an elaborate list coming here. Even this list goes very long; I have just taken one snap.

(Refer to Slide Time: 22:39)



## Sanjay Gandhi National Park

Table 3.17 : Common Plant Species of Sanjay Gandhi National Park



Sr. No.	Species	Habit	Family
1	<i>Alangium salvijolium</i>	Tree	Alangiaceae
2	<i>Ampelocissus latifolia</i>	Climber	Vitaceae
3	<i>Anogeissus latifolia</i>	Tree	Combretaceae
4	<i>Apluda mutica</i>	Grass	Poaceae
5	<i>Argyrea nervosa</i>	Climber	Convolvulaceae
6	<i>Argyrea sericea</i>	Climber	Convolvulaceae
7	<i>Arundinella pumila</i>	Grass	Poaceae
8	<i>Baliospermum montanum</i>	Forb	Euphorbiaceae
9	<i>Bauhinia foveolata</i>	Tree	Caesalpinaceae
10	<i>Bauhinia racemosa</i>	Tree	Caesalpinaceae
11	<i>Blumea sp.</i>	Forb	Asteraceae
12	<i>Bombax ceiba</i>	Tree	Bombacaceae
13	<i>Borassus flabellifer</i>	Tree	Arecaceae
14	<i>Bridelia retusa</i>	Tree	Euphorbiaceae
15	<i>Butea monosperma</i>	Tree	Fabaceae

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### Modified Habitats

#### 3.7.3.4 Mahim Nature Park, Dharavi

The Maharashtra Nature Park (MNP), popularly known as Mahim Nature Park (approximate location: 19° 03' 09" N, 72° 51' 42" E), situated on the southern bank of the Mithi River in the Dharavi area, is a planted woodland covering approximately 35 acres of land and serving as one of the larger green spaces of Mumbai city.

The proposed underground alignment of the MML3 between the Dharavi and BKC stations, spanning a length of approximately 1 km, passes within a distance of 0.5 km to the west and northwest of the MNP. The proposed Dharavi station box is located at a distance of less than 1 km to the west of the MNP, while the proposed BKC station box is located less than 1 km to the northwest of the MNP.

#### BPT Garden, Colaba

Sagar Uparan, also known as BPT Garden or Mumbai Port Trust Garden (approximate location: 18° 54' 37" N, 72° 49' 25" E), situated in the Sassoon Docks area of Colaba, is a botanical garden covering approximately 50,000 square metres and serving as one of the green spaces of the area. The proposed Cuffe Parade station of MML3 is situated less than 350 metres to the west of the garden.

#### 3.7.3.5 Colaba Woods Garden, Colaba

Colaba Woods, (approximate location: 18° 54' 45" N, 72° 49' 08" E), situated in the Cuffe Parade area of Colaba, is a garden covering approximately 30,000 square metres and serving as one of the green spaces of the area. Some of the accessory areas associated with the garden, comprising mainly a tennis court, a basket ball court, a children's playground, a plant-nursery and public walkways, fall within the proposed project-area of the Cuffe Parade station of MML3, while the main garden area is situated within 50 metres of it.

There are few more gardens which are within 500 m of the proposed alignment. The names of these gardens are as given below in Table 3.18.



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So, here you can see the also mangroves of the Mithi estuary. So, which is identified as a sensitive area. Then you can see Sanjay Gandhi National Park also which falls within the zone and then common plant species of the

Sanjay Gandhi National Park has been identified. An elaborate list has been created. Then we also learned about modified habitat. So, there is also a modified habitat in this area which is Mahim Nature Park, Dharavi, then you also see Colaba Woods garden here.

So, you can see in the picture these areas. So, you see that the identified potential ecological impact of the project, so, it would lead to the removal of trees it would lead to loss and degradation of biodiversity and it would lead to loss and degradation of soil. So, that was identified in the project, then further they looked into socio-economic conditions.

So, for this, they prepared a separate report Social Impact Assessment for the Mumbai Metro corridor. So, we have already seen that briefly when we were covering socio-economic impact assessment. However, I have given the link again if you wish to see the report again from this perspective, so, you can see it.

(Refer Slide Time: 24:01)



The slide displays the cover of the 'Updated Social Impact Assessment Report (Volume - I)' for the Mumbai Metro Line 3 project, prepared by MAPLE (Mumbai Metro Line 3 Environmental Consultants) in December 2020. The report is a General Consultant for Mumbai Metro Line 3. Logos for MMRCL and ACCOM are visible.

TABLE 3.19 OVERALL PROJECT IMPACTS

S. NO.	IMPACT	MAGNITUDE
1	Acquisition of Land (in Ha)	77.86
2	Impact on Structure (No.)	2575
2.1	Impact on PAFs	5886
2.2	Total PAFs (No.)	2471
2.3	Surveyed PAFs	1847 (624 Locked)
2.4	Surveyed PAFs	5886
3	Titleholder (No.)	937
4	Non-Titleholder (No.)	1534
5	Loss of Residence	1673
6	Loss of Business	798
7	Vulnerable PAFs	196
8	Impact on Community Resources	104

<https://www.mmrci.com/sites/default/files/SIA%20Report%202020.pdf>

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So, we see here that overall project impact, how much land would be acquired, how much impact it would have on the structure, how many project-affected people would be there, and total project-affected people and surveys people and so on all those details have been given.

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HISTORICAL MONUMENTS WITHIN VICINITY OF MML3 ALIGNMENT

Sr. No.	HISTORICAL MONUMENTS	DISTANCE FROM CENTRE OF METRO ALIGNMENT
1	CST Railway Station	40 metre
2	BMC Building	22 metre
3	Western Railway Head Quarter	45 metre

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And then other how it is going to influence all the historical sites. So, that is also given here. So, you see that they have identified CST railway station which is like of distance from the center of the Metro alignment, it is just 40 meters away, then you can see the BMC building which is 22 meters away, and Western Railway headquarters, which is 45 meters away. So, you can see all these CST, BMC, and Western Railway headquarters, and how they look like just so, that you can visualize them. And then also relate to the alignment. So, you can see in the map also, how it is.

(Refer Slide Time: 25:03)

LIST OF SENSITIVE RECEPTOR		
Sr. No.	Description	Within 100 m on Either side
1	Education Institutions(Schools and Colleges)	13
2	Hospital	22
3	Temple	21
4	Mosque	05
5	Church	06
6	Monuments/Statue	08
7	Nature Park	01
	Total	76

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Then, they have also identified the sensitive receptors. So, we have understood the concept of sensitive receptors. So, they have identified, so, you can see the educational institutions hospitals temples, mosques, and so on. They have identified how far it is. And then you can also see a tree inventory which they have done for each station along the Mumbai Metro line 3. So, the list almost goes 200 pages and we are talking about 500 Plus pages page of the EIA report.

So, the list of documentation goes on nearly 200 pages. So, you can see in which zone it is coming and how they have grouped it and which station it is, trees to be retained and trees to be removed all those numbers have been quite quantified here and trees to be planted. So, that is how they have undertaken intensive documentation they have undertaken. So, now looking at the negative environmental impact.

So, the negative environmental impact is like you have, they have identified as likely on the land Environment, Water, Air, Noise, biological environment, and socio-economic environments. So, they have identified all that and there are impacts due to the project locations, and then they are like you have project-affected people who will be dis effected economically or physically.

Then there will be also a change of land use then there will be also loss of trees and forests. Then also there will be a problem with utility drainage problems, and then there will be problems with the historical and cultural monuments and there has been an anticipated impact on the local transport facilities. So, you have already seen how one undertakes all these things. So, these are all covered in this particular report.

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**LAND REQUIREMENT (Ha)**

S.NO	PARTICULARS	PERMANENT LAND REQUIREMENT		TEMPORARY LAND REQUIREMENT	
		GOVERNMENT	PRIVATE	GOVERNMENT	PRIVATE
1	Depot	26.407	--	-	-
2	Stations	1.49	3.23	-	-
3	TSS	0.4	0.2	-	-
4	Cut & Cover Station	-	-	1.84	0.067
5	Construction Depot	-	-	10.95	1.23
<b>Total</b>		<b>28.297</b>	<b>3.43</b>	<b>12.79</b>	<b>1.29</b>

Source: DPR

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**4.2.3 Loss of Trees/Forests**

The proposed alignment of metro rail is in urban/ city area and not passing through any forest. Hence no loss of forest is anticipated. The trees are getting affected only at stations and at depot location since proposed alignment is underground. There are 589 trees observed along the alignment at station locations and 1652 trees are at depot (Refer Section 3.7.1). Hence the total number of trees observed on project site area is 2241. It is observed from the tree survey (Updated table given in Chapter 3) that, out of total 70% (i.e 1568) of the tree has girth below 1 metre which will be transplanted and remaining 30% (i.e 673) of the trees needs to be cut. With removal of these trees the process of CO<sub>2</sub> absorption and O<sub>2</sub> production will get affected and the losses are reported in TABLE 4.2. The loss of tree will have short term Heat-Island Phenomenon and would be mitigated after construction due to afforestation. The loss of tree will have short term heat-island phenomenon and would be mitigated after construction due to afforestation.

**TABLE 4.2**  
**OXYGEN DEFICIT DUE TO TREE LOSS**

SI	DESCRIPTION	QUANTITY
1.	Total no. of Trees to be cut	673
2.	Increase in CO <sub>2</sub> @ 21.8 Kg/year/ tree	14672 kg
3.	Decrease in Oxygen production @ 49 Kg/year/ tree	32977 kg

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Here you can quickly see how they have identified the land requirement for this particular project for all the components of the project. So, also the loss of trees and forests. So, the total number of trees to be cut is 673. What kind of increase will be there in carbon dioxide and what is the formula they have used for calculation and then decrease in oxygen production? So, that kind of calculation they have made.

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**4.2.6 Impact on Local Transport Facilities**


The metro rail has been proposed to cater the additional demand of present and future traffic requirement. Hence, no loss of job to the existing transport facilities is anticipated. The drivers of local transport facilities like buses, taxis, autos and rickshaws may be utilized to cater the requirement of transport from metro stations to work place and vice versa. Additional employment opportunities are also anticipated due to the proposed metro.

**4.2.7 Impact on Mangroves**

The proposed location of the BKC station of MML3 coincides with a patch of mangrove vegetation that is part of the natural mangrove forest growing on the Mithi River's estuarine mudflats. It represents an eco-tone, an interface between two ecosystem-types, in this case, between the freshwater ecosystem of the Mithi River and the marine ecosystem of the Arabian Sea.

This mangrove forest is an important ecosystem of the Mumbai region. It performs crucial ecological roles. It provides habitats for unique and diverse flora and fauna associated

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**Ecological Impacts**

- Loss, degradation and fragmentation of natural mangrove forest habitats
- Loss and/or degradation of ecosystem-services (erosion-control, storm-buffer and marine nursery)
- Loss of genetic and specific biodiversity

**Management Measures**

- Compensatory afforestation at a nearby site
- Plantation of five times as many plants as the number removed
- Plantation of native mangrove species

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All these are related to drainage and also historical and cultural monuments and the impact on local transportation facilities on mangroves and then they have identified the ecological impact so, which is like loss, degradation, and fragmentation of natural mangrove forest habitat.

So, we have studied what fragmentation means, what degradation and loss mean, and then the loss and degradation of ecosystem services we have already studied the loss of genetic and specific biodiversity, and we are familiar with that. Then, they took management measures like compensatory afforestation at the nearby site, the plantation of 5 times as many plants as the number removed, and the plantation of native mangrove species. So, that is what management measures they are going to adopt.

(Refer Slide Time: 28:26)

## Impacts Due To Project Design

Considered impacts, due to project designs are:

- Platform inlets and outlets,
  - Ventilation and lighting,
  - Metro station refuse, and
  - Risk due to earthquake.
- 
- No hazard is anticipated due to the proposed sizes of inlets and outlets.

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## Metro Station Refuse

The collection and removal of refuse from railway stations in a sanitary manner is of great importance for effective vector control, nuisance abatement, aesthetic improvement and fire protection. The refuse from railway station includes;

- Garbage,
- Rubbish, and
- Floor Sweepings.

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And then now, we see impacts due to project design. So, project design part they have platform inlet and outlet ventilation and lighting, Metro Station refuse, and risks due to earthquakes. So, most of it by the design, no hazard was anticipated to the proposed sizes of the inlet and outlet. And then they also studied how they are going to manage the garbage, rubbish, and floor-sweeping. So, that would be taken care of, and the risk due to the earthquake has been already taken care of within the design elements of the project.

(Refer Slide Time: 28:59)

## Impact Due to Project Construction

The most likely negative impacts related to the construction works are:-

- Soil erosion,
- Traffic diversion and risk of existing building,
- Impact of proposed road improvement works,
- Muck disposal,
- Dust Generation
- Increased water demand,
- Impact due to construction of Tunnel,
- Impact due to Land subsidence/Landslides,
- Impact due to Supply of Construction Material,
- Loss of Historical and Cultural Monuments,
- Impact due to Construction near Archeological Structures,
- Impact on Ground and Surface Water
- Air Pollution,
- Noise Pollution,
- Impact due to Vibration,

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Now looking at the impact due to the project construction. So, they have identified environmental hazards that will occur due to the construction work related to the soil they would be as soil erosion, traffic diversion, the impact of the proposed road improvement work, Muck disposal, dust generation, increased water demand impact due to the construction of the tunnel, impact due to land subsidence, landslides, supply of construction material, and then what kind of loss will happen to historic and cultural monuments and so on.

So, all that has been identified is what will happen during the construction of the project. So, you see how massive the project is. So, it will have an impact on several aspects just during its construction phase. Further, they have also looked into the health risks at the construction sites, we have also studied how to undertake health risks and we see the impact on sensitive receptors has been also studied here.

And then what kind of impact it will have due to the labor camp. So, they are going to have a labor camp with all the people working so, what kind of possibilities are there concerning health? So, there are construction workers are more prone to infectious diseases like HIV, AIDS, and so on. So, how those things will be taken care of, and then also impact due to blasting, and then also the ground vibration those calculations have been made.

(Refer Slide Time: 30:40)

### Impact Due to Project Operation

The negative impacts may cause during operation of the project due to increase in the number of passengers and trains at the stations:

- Noise pollution,
- Vibration Impact due to train,
- Water supply and sanitation at Stations,
- Refuse disposal and sanitation, and
- Electromagnetic Interference

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Now, so, that is about the construction phase. Now, we will look at the impact due to project operations. So, how they have looked into it, they have identified that there will be the impact on noise, and vibration impact due to trains, there would be the impact on water supply and sanitation at stations and refuse disposal and sanitation and Electromagnetic interference which can happen.

(Refer Slide Time: 31:06)

### FIGURE 4.7 VIBRATION DUETO TRAIN AT LADY WILLINGTON BUILDING USING PIP

FIGURE 4.8 VIBRATION DUETO TRAIN AT K.GAJANAN VERTAK CHOWK, LAMINGTON ROAD USING PIP

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### OVERALL RESULT OF VIBRATION IMPACT

Sl	Location	Field Measured vertical vibration (VdB)	Vibration due to TBM Operation(VdB)	Vibration due to Metro Train Operation (VdB)	Standards of Vibration in (VdB)
1	Lady Willingdon Building.	113.9	144	85 to 90	65- 83
2	Narutamdas Bhau Jewelers, Lamington Road.	123.5	147.8	70 to 75	65- 83
3	Mittal Towers, Maharshi Valmiki Chowk	126	143	65 to 70	65- 83
4	Central Assurance Building, Dr. Dadabhai Naoroji Road.	124	147.8	65 to 70	65- 83
5	Bhikha, Behram, Parsees Well, Hutatma Chowk	113.9	143	68 to 70	65- 83
6	Chhatrapati Shivaji Terminus	110-126	147.3	90-95	65- 83

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### Water Supply and Sanitation

Public Health facilities such as water supply and sanitation are very much needed at the stations. The water demands will be for drinking, toilet, cleaning and also for other purpose like AC, chiller etc. The demand is presented in Table 4.9. It is assumed that there would be similar water requirements in Mumbai Metro corridors also. The Water Demand of existing Delhi Metro is corridors considered for requirement of Mumbai metro. Water should be treated before use upto WHO drinking water standards. Municipal supply/Ground water shall be used for this purpose.

S.No.	Particular	Water Demand at Each Station (KLD)	Total Water Demand (KLD)
1	At Stations for Drinking Purpose	6	162
2	For AC, cleaning, chiller and other purposes	240-250	6750
<b>Total</b>			<b>6912</b>

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### Impacts Due to Depot

The depot at Araey colony is planned for metro corridor Line III. The area of depot is about 26.407 hectares. The area at depot is vegetated with no habitation. The depot will have following facilities:

- Washing Lines,
- Operation and Maintenance Lines,
- Workshop, and
- Offices.

These facilities could generate water and noise issues. The area will be levelled through cut and fill method within the depot and additional earth will be taken from tunnelling to raise the ground level. Problems anticipated at depot sites are:

- Water supply,
- Effluent Treatment,
- Oil Pollution
- Noise Pollution,
- Surface drainage,
- Solid Waste,
- Cutting of trees.

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So, you see all that has been calculated here. You can see where all the locations they have been documenting and water supply and sanitation, how they have been recording the requirements. And then they also looked at the impact due to the depot. So, not just the real track, but also because of the operation of the depot.

So, where the cleaning would take place, so, washing lines operations, and maintenance workshop in an office, will have an impact on water supply, effluent treatment, oil pollution, noise surface drainage, solid waste, and cutting of trees would happen there. So, that was about the impact. Now looking at the positive environmental impacts, they looked at the negative looking at the positive environmental impact.

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**CHAPTER-5 POSITIVE ENVIRONMENTAL IMPACTS**

**5.1 POSITIVE ENVIRONMENTAL IMPACTS**

This chapter deals with the positive impacts of the project. The introduction of Metro Rail will also yield benefits from non-tangible parameters such as saving due to equivalent reduction in road construction and maintenance, vehicle operating costs, less atmospheric air pollution and socio-economic benefits of travel time, better accessibility, better comfort and quality of life. However, all benefits cannot be evaluated in financial terms due to non-availability of universally accepted norms.

The parameters such as economic growth, improvement in quality of life, reduction in public health problems due to reduction in pollution, etc have not been quantified.

Various positive impacts have been listed under the following headings:

- Employment Opportunities,
- Benefit to Economy,
- Mobility,
- Safety,
- Traffic Congestion Reduction,
- Reduction in the number of Vehicle Trips on the road,
- Less Fuel Consumption,
- Reduced Air Pollution,
- Carbon Dioxide Reduction,
- Reduction in Number of Buses,
- Saving in Road Infrastructure, and
- Traffic Noise Reduction.

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So, positive environmental impact was identified as employment, benefits to the economy, mobility, safety, traffic congestion reduction, reduction in the number of vehicle trips, less fuel consumption, reduced air pollution, carbon dioxide reduction in number of buses, saving and road infrastructure, traffic noise reduction. So, you see the initial argument, what we have been talking about environmental status, and then how we are looking at the sustainable way of approaching it.

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## 5.2 CHECKLIST OF IMPACTS

The impact evaluation determines whether a project development alternative is in compliance with existing standards and regulations. It uses acceptable procedures and attempts to develop a numeric value for total environmental impact. A transformation of the review of multiple environmental objectives into a single value or a ranking of projects is the final step in impact assessment. There are about numerous methods for carrying out impact assessment, which can be grouped into the following categories:

- Ad – hoc method,
- Checklist,
- Matrix,
- Network,
- Overlays,
- Environmental Index and
- Cost Benefit analysis.

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So, they have in the end also used the checklist of impact. So, how they are summarizing it, how they are looking at it. So, you look there are various methods of carrying out impact assessments. So, you see the Ad-hoc method, checklist method, Matrix, network, Overlays, Environmental Index, and Cost-benefit analysis.

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TABLE 5.10  
CHECKLIST OF IMPACTS

S. No.	Parameter	Negative Impact	No Impact	Positive Impact
<b>A. Impact due to Project Location</b>				
i	Displacement of People	*		
ii	Change of Land use	*		
iii	Loss of Trees	*		
iv	Loss of Cultural and Historical Structures	*	*	
v	Drainage & Utilities Problems	*		
vi	Impact on Local Transport Utilities			*
<b>B. Impact due to Project Design</b>				
i	Platforms, Inlets and Outlets		*	
ii	Ventilation and Lighting		*	
iii	Railway Station Release	*	*	
iv	Risk due to Earthquakes	*	*	
<b>C. Impact due to Project Construction</b>				
i	Soil Erosion	*		
ii	Traffic Obstructions and Risk to Existing Buildings	*		
iii	Air Pollution	*		
iv	Noise Pollution	*		
v	Impact due to Vibration	*	*	
vi	Health risk at construction site	*		
vii	Impact on Sensitive Receptors	*	*	
viii	Problem of excavated soil disposal	*		
ix	Dust Generation	*		
x	Problems of Soil Disposal	*		
xi	Labour Camp	*		
<b>D. Impact due to Project Operation</b>				
i	Noise & Vibration	*		
ii	Water Demands	*		
iii	Refuse disposal and sanitation	*		
iv	Electromagnetic Interference		*	
v	Employment Opportunities			*
vi	Benefit to Economy			*
<b>S. No. Parameter Negative No Impact Positive</b>				
vii	Mobility			*
viii	Safety			*
ix	Traffic Congestion Reduction			*
x	Less fuel Consumption			*
xi	Reduced Air Pollution			*
xii	Carbon dioxide Reduction			*
xiii	Traffic Noise Reduction			*
xiv	Reduction in Buses			*
xv	Reduction in Infrastructure			*

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So, here you see they have adopted the checklist of impact and all these impacts have been identified where it is a negative impact, no impact, and positive impact. So, you can look at this checklist of impacts. So, impact due to project location. So, here they are summarizing everything. Impact due to project location, you can see the impact due to project design, project construction project operation, and all the parameters that they have looked into.

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**CHAPTER - 6 ENVIRONMENTAL MANAGEMENT PLAN**

**6.1 APPROVALS/CLEARANCES REQUIREMENT**

On the basis of baseline study and identified negative impacts, issues like tree cutting, development near World Heritage Structures and muck disposal etc needs necessary approvals/clearance from the relevant concerned authorities. PMU will ensure that all necessary approvals/clearances are in place before implementation. Before commencement of the construction the necessary permissions required for the project is given in Table 6.1.

Issues	Provision of Laws / Regulations	Time of Submission	Required Documentation	Appraisal Authority
Permission for Tree Cutting	Forest Conservation Act, 1972 as modified up to 27 Nov 2006	45 days before the construction	Application enclosing Address of Site, Plans & drawings of the proposed construction approved by competent authority. Plan showing relocation to be filed	State Authority MCCMR, Mumbai
Development permission near World heritage Structures.	Development Control Regulations, 1991. Under MCOA Act, 1986.	Before Construction	Formal of submission to MCOA, MCOA Detailed address of the Location of Heritage structure as it falls into Alignment Plans & drawings of the proposed construction activities.	Municipal Heritage Committee, MCOA, MCOA Act, 1986
Muck disposal permission	Environment Protection Act	Before Construction	Location of Muck Dumping Site	State Pollution Control Board (MPCB/Coast. Of India)
Resettlement Permission	Resettlement & Rehabilitation Policy for Mumbai Urban Transport Project (MUTP) Amendment II Dec 2007	Before Construction	Social Impact Assessment & NER Report	State Government, Maharashtra
Consent for Establishment	Environment Protection Act	Before Construction	Site plan, sources of effluent, Discharge registers, Details of Water Pollution Control, Ambient Air Quality Index, Consent letter.	State Pollution Control Board (Maharashtra)
Consent to Operate	Environment Protection Act	After Construction	Site plan, Letter address report of effluent	State Pollution Control Board

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Further, they have prepared an environmental management plan. So, how they are looking at it and then they have prepared a Tabular form, all these issues which they have to take care of, which laws and regulations they would adhere to, by when they have to do it, what kind of documentation would be required and which will be the authority with which they will be dealing with.

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**6.3 MITIGATION MEASURES**

The main aim of mitigation measures is to protect and enhance the existing environment of the project. This section includes measures for:

- Compensatory Afforestation,
- Construction Material Management,
- Safety Management Measures during the construction period
- Labour Camp,
- Energy Management,
- Hazardous Waste Management,
- Environmental Sanitation,
- Utility Plan,
- Archaeological and Historical Preservation,
- Air Pollution Control Measures,
- Noise Control Measures,
- Vibration Control Measures,
- Traffic Diversion/Management,
- Soil Erosion Control,
- Muck Disposal,
- Draining of Water from Tunnel,
- Water Supply, Sanitation and Solid Waste Management,
- Sensitive Receptors
- Electromagnetic Interference
- Management Plans for Depot,
- Training and Extension, and
- Environmental Enhancement Measures.

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And then the range of mitigation measures, you can see a range of mitigation measures here, compensatory Afforestation, construction material Management, Safety management, labor camp, energy management, and hazardous waste management. So, all these range of mitigation measures will be taken.

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DETAILS OF TREES CUT AND TRANSPLANTATION

Sr. No	Particulars	Number of Trees observed	Number of trees to be cut	Number of trees to be Transplanted	Remarks
1	Along Alignment	589	177 (30%)	412 (70%)	(Stations, Entry & Exit)
2	Depot	1652	496 (30%)	660 (40%)	30% (i.e 496) trees in depot area will remain as where it is.
	<b>Total</b>	<b>2241</b>	<b>673</b>	<b>1072</b>	

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6.5 Environmental management and Monitoring plan

MMRC is required to incorporate a process of management and monitoring of all activities during the construction and operation phase of the proposed Project. The Environmental Management and Monitoring Plan (EMMP) intends to delineate management measures to minimise adverse impacts by allocating management responsibility for implementation of these measures during the construction and operational phase of the project.

The EMMP is formulated to mitigate the adverse environmental impacts that have been mentioned in the Environmental Impact Assessment (EIA) studies undertaken by RITES Limited (September 2012) and have been updated in this EA report. The EMMP is aimed at managing and monitoring the environmental parameters in a sustainable manner. The EMMP section is organised as follows,

- **Organisational Structure** – This section describes the role and responsibilities of personnel engaged by MMRC who will be responsible for implementing this EMMP.
- **Environmental Management Plan** – This Plan consists of a detailed description of the positive and negative environmental impacts anticipated from the proposed project, mitigation measures and the persons/committees responsible for ensuring implementation of the mitigation measures. Additional plans such as Muck disposal plan, solid waste plan, labour camp management plan, traffic management plan have also been provided.
- **Environmental Monitoring Plan** – The Environmental Monitoring Plan details the parameters and frequency of monitoring parameters, detailing the minimum requirements for periodic review and updation of the EMMP to address any new impacts due to change or modification of the project.
- **Documentation and record-keeping** – Specifies the requirements for documents to be maintained covering the social aspect.

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And what kind of plantations they are going to do here and then also environmental management and monitoring plan. So, what kind of organizational structure would be there, what is the environmental management plan, how are they going to monitor the plan, and then how they are going to maintain the documentation and record-keeping so that all has been discussed here?

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## 6.6 DISASTER MANAGEMENT

Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire and accidents. The first step is to identify the

causes which develop/ pose unexpected danger to the structural integrity due to construction. The potential causes are excessive load, cracks, failure and malfunctioning of sensing instruments, accident, etc. These need to be looked into with care.

### 6.6.1 Preventive Action

Once the likelihood of a disaster is suspected, action has to be initiated to prevent a failure. Engineers responsible for preventive action should be aware of availability of repair equipment, materials, labour and expertise for use during emergency.

### 6.6.2 Reporting Procedures

The level at which a situation will be termed a disaster shall be specified. This shall include the stage at which the surveillance requirements should be increased both in frequency and details. The Engineer-in-Chief should notify the officer for the following information:

- ❑ Exit points for the public,
- ❑ Safety areas in the tunnel, and
- ❑ Nearest medical facilities.

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### 6.6.3 Communication System

An efficient communication system is absolutely essential for the success of any disaster management plan. This has to be worked out in consultation with local authorities. More often, the entire communication system gets disrupted when a disaster occurs. The damage areas need to be clearly identified and provided with temporary and full proof communication system.

### 6.6.4 Emergency Action Committee

To ensure coordinated action, an Emergency Action Committee should be constituted. MD MMB will be the Chairman of this Committee. The committee may comprise of:

- ❑ Head of operations,
- ❑ Head of technical services,
- ❑ Head of security,
- ❑ Fire brigade,
- ❑ Police representatives, and
- ❑ NGO

Emergency Action Committee will prepare the evacuation plan and procedures for implementation based on local needs and facilities available. The plan should include:

- ❑ Demarcation of the areas to be evacuated with priorities,
- ❑ Safe route to be used, adequacy of transport for evacuation, and traffic control,
- ❑ Safe area and shelters,
- ❑ Security of property left behind in the evacuated areas,
- ❑ Functions and responsibilities of various members of evacuation teams, and
- ❑ Setting up of Joint Control Room.

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And then also the disaster management, how what kind of prevention actions they would take, what kind of reporting procedure would be followed, and what kind of communication system would be there Emergency Action Committee, which will be there.

6.7 EMERGENCY MEASURES

The emergency measures are adopted to avoid any failure in the system such as lights, fire, means of escape, ventilation shafts etc. The aim of Emergency Action Plan is to identify areas, population and structures likely to be affected due to a catastrophic event of accident. The action plan should also include preventive action, notification, warning procedures and co-ordination among various relief authorities. These are discussed in following sections.

6.7.1 Emergency Lighting

The emergency lights operated on battery power should be provided at each station. The battery system should supply power to at least 25% of the lights at the station, platforms, tunnels/viaducts for a period of 2 hours. The underground station should have transformer at each end of the platform. Both the transformers need to be kept energized and should feed independently alternate rows of lights so that in case of failure of one transformer, there will not be complete darkness. The tunnels need to be provided with fluorescent incandescent lamps at a spacing of 20 m.

6.7.2 Fire Protection

The building materials should be of appropriate fire resistance standard. For underground structures the fire resistance period should be at least 4 hours, and 2 hours for surface or overhead structures. Wood shall not be used for any purpose, excluding artificial wood products, which are flame resistant. The materials which have zero surface burning characteristics need to be used. The electrical systems shall be provided with automatic circuit breakers activated by the rise of current as well as activated by over current. The design of a station will include provision for the following:

- Fire prevention measures,
- Fire control measures,
- Fire detection systems,
- Means of escape,
- Access for fireman, and
- Means of firefighting.

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ENVIRONMENTAL MANAGEMENT ACTION PLAN (EMP)

Environmental Impact	Mitigation Measures Taken or To Be Taken	Time Frame	Implementing Organization	Responsible Organization
<b>DESIGN PHASE</b>				
Metro Alignment	The proposed corridor alignment was selected to minimise the land disturbance to avoid archaeological sites, temples and other environmentally sensitive areas.	During Design	DPR and design consultant	PIU
Cultural Heritage	Avoided by adjustment of alignment.	During Design	DPR and design consultant	PIU

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<p><b>Water</b> Water use that design provides for safety of OHS and avoid design impact in the proximity of or otherwise likely to impact on a sensitive catchment</p> <p><b>PRE-CONSTRUCTION PHASE</b></p> <p><b>Water</b> The requirement of water for construction activities shall be planned and arranged from local sources and supply through water supply.</p> <p><b>Water</b> Options for hot disposal shall be studied and approved by the competent authority.</p> <p><b>Water</b> Options for hot disposal shall be studied and approved by the competent authority.</p> <p><b>Water</b> Options for hot disposal shall be studied and approved by the competent authority.</p> <p><b>Water</b> Options for hot disposal shall be studied and approved by the competent authority.</p>	<p><b>Construction Phase</b></p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p>	<p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p>	<p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p>	<p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p> <p><b>Water</b> Water shall be used judiciously during construction activities. Water shall be conserved wherever possible.</p>
<p><b>Construction</b> All pollution measures will be taken to prevent the water pollution in the construction area and other sensitive areas.</p> <p><b>Water</b> Measures shall be taken to avoid reuse of water. Construction agency shall be instructed accordingly. In future similar procedures shall apply for the water for construction and demarcation.</p> <p><b>Water</b> A minimum distance of any sewage or other facility from water sources should be 200 metres.</p> <p><b>Water</b> Sufficient and sufficient measures will be taken in the water disposal tank and sanitation facilities. Waste water will be treated periodically.</p> <p><b>Water</b> Garbage will be collected in a bin and disposed of daily. Camps will be located at a minimum distance of 200 m from water sources.</p>	<p><b>Construction</b> All pollution measures will be taken to prevent the water pollution in the construction area and other sensitive areas.</p> <p><b>Water</b> Measures shall be taken to avoid reuse of water. Construction agency shall be instructed accordingly. In future similar procedures shall apply for the water for construction and demarcation.</p> <p><b>Water</b> A minimum distance of any sewage or other facility from water sources should be 200 metres.</p> <p><b>Water</b> Sufficient and sufficient measures will be taken in the water disposal tank and sanitation facilities. Waste water will be treated periodically.</p> <p><b>Water</b> Garbage will be collected in a bin and disposed of daily. Camps will be located at a minimum distance of 200 m from water sources.</p>	<p><b>Construction</b> All pollution measures will be taken to prevent the water pollution in the construction area and other sensitive areas.</p> <p><b>Water</b> Measures shall be taken to avoid reuse of water. Construction agency shall be instructed accordingly. In future similar procedures shall apply for the water for construction and demarcation.</p> <p><b>Water</b> A minimum distance of any sewage or other facility from water sources should be 200 metres.</p> <p><b>Water</b> Sufficient and sufficient measures will be taken in the water disposal tank and sanitation facilities. Waste water will be treated periodically.</p> <p><b>Water</b> Garbage will be collected in a bin and disposed of daily. Camps will be located at a minimum distance of 200 m from water sources.</p>	<p><b>Construction</b> All pollution measures will be taken to prevent the water pollution in the construction area and other sensitive areas.</p> <p><b>Water</b> Measures shall be taken to avoid reuse of water. Construction agency shall be instructed accordingly. In future similar procedures shall apply for the water for construction and demarcation.</p> <p><b>Water</b> A minimum distance of any sewage or other facility from water sources should be 200 metres.</p> <p><b>Water</b> Sufficient and sufficient measures will be taken in the water disposal tank and sanitation facilities. Waste water will be treated periodically.</p> <p><b>Water</b> Garbage will be collected in a bin and disposed of daily. Camps will be located at a minimum distance of 200 m from water sources.</p>	<p><b>Construction</b> All pollution measures will be taken to prevent the water pollution in the construction area and other sensitive areas.</p> <p><b>Water</b> Measures shall be taken to avoid reuse of water. Construction agency shall be instructed accordingly. In future similar procedures shall apply for the water for construction and demarcation.</p> <p><b>Water</b> A minimum distance of any sewage or other facility from water sources should be 200 metres.</p> <p><b>Water</b> Sufficient and sufficient measures will be taken in the water disposal tank and sanitation facilities. Waste water will be treated periodically.</p> <p><b>Water</b> Garbage will be collected in a bin and disposed of daily. Camps will be located at a minimum distance of 200 m from water sources.</p>
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Safety with people and vehicles and signage	<ul style="list-style-type: none"> <li>Safety education and training</li> <li>Allow for adequate traffic flow around construction areas</li> <li>Provide adequate signage, barriers and flag persons for safety precautions</li> <li>Communication to the public through radio, TV &amp; newspaper announcements regarding the scope and breakdown of projects as well as certain construction activities causing obstructions or access restrictions</li> </ul>	During construction	Contractor	PUJ Traffic department
Increase in dust and noise levels	<ul style="list-style-type: none"> <li>Make certain that there is good drainage of all construction areas, to avoid creation of illegal water bodies</li> <li>Provide adequate sanitation and waste disposal of construction camps</li> <li>Provide adequate health care to workers</li> </ul>	Before construction At start-up Throughout construction	Contractor	PUJEMP environmental agency
Location of camp and storage areas	Location of camps and storage areas shall be as per the contract specifications	Throughout construction	Contractor	PUJEMP environmental agency
<b>OPERATION PHASE</b>				
New and existing	<ul style="list-style-type: none"> <li>Visible measures should be considered where warranted. The public shall be educated about the regulations of noise and vibration pollution and its regulations</li> </ul>	After completion of construction	Contractor	PUJEMP environmental agency
Environmental impact	<ul style="list-style-type: none"> <li>Mitigation Measures taken as per the EIA</li> </ul>	Throughout construction	Contractor	Environment Department
<b>WATER</b>				
Discharge	<ul style="list-style-type: none"> <li>Visible treatment shall be taken for treatment of all or reject areas before discharging the wastewater</li> </ul>	During operation of the treated plant	Contractor	PUJEMP environmental agency
Disposal of the treated effluent	<ul style="list-style-type: none"> <li>Options for final disposal shall be studied and selected</li> <li>The visible disposal mode shall be selected</li> <li>Labels to minimize the impact of receiving bodies. As far as possible zero discharge shall not be adopted</li> </ul>	During operation of the treated plant	Contractor	PUJEMP environmental agency

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Further, you also look at the emergency measures. So, what kind of emergency measures are provided in the project, emergency lighting, fire protection, and then they have developed in Environmental Management Action Plan EMP. So, you can see at various at the design phase, how they are doing it pre-construction stage, how they are undertaking it.

And then for all the aspects domain, which we have discussed, you can see here, then you can see the construction phase as well. And then you see at the operation phase as well how they are going to take it.

## CHAPTER-7 PUBLIC CONSULTATION

### 7.3 CONSULTATION AT PROJECT LEVEL

The consultations were conducted during the reconnaissance/ field visit during second and third week of January 2012 and based on informal unstructured interviews and focus group discussion. The objective of the consultation was to disseminate the project information and ascertain stakeholder's views on probable environmental and social impacts that may arise due to the implementation of the proposed project. Public were intimated about the consultation venue, date and time. The venues, date and time of the public consultations are presented in **Table 7.1**. RITES experts with MMRC officials explained about need of the project describing social and environmental issues like land acquisition, anticipated positive & negative impacts and use of techniques during construction and time frame of construction period during public consultation. About 93 people from different community participated for public consultation at project level. Of the total participants, 5 persons at Girgaon, 9 at Dharavi and 12 persons at Santacruz had raised the questions related to environmental issues.

The following issues were discussed during the consultations.

- Overall need of the project;
- Project location;
- Environmental concerns; and
- Social concerns

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TABLE 7.1  
PROJECT LEVEL PUBLIC CONSULTATION VENUE

S.No.	Venue of the Consultation	Public	No. Of Participant	Time and Venue
1	Girgaon		14	14.30 PM, 19 <sup>th</sup> Jan 2012
2	Dharavi		34	13.30 PM, 18 <sup>th</sup> Jan 2012
3	Don Nagar, Santacruz		45	14.00 PM, 17 <sup>th</sup> Jan 2012
4	Don Nagar, Santacruz			16.00 PM, 17 <sup>th</sup> Jan 2012

The photographs showing stakeholders participation at public consultation held at various places are shown in **Figure 7.1**.



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ISSUES RAISED	SUGGESTIONS OF STAKEHOLDERS	MITIGATION MEASURES
Muck Transportation	Compact engineering solution through traffic management, monitoring of air, noise and vibration and safety precautions.	Traffic regulatory measures would be developed during construction. Contractor in consultation with local government will prepare traffic management plan for the construction period. Water, air, noise monitoring will be conducted as per schedule. Vibration Monitoring during construction & Operation.
Air & Noise pollution	Pollution due to air and noise during the construction and insisted for regular air monitoring.	Latest technology will be adopted to minimize pollution during construction. Air & noise monitoring will be conducted regularly as per schedule.
Tree removal	Transplantation and some new trees should be afforested.	Cutting of trees will be minimized whenever possible. Compensatory afforestation will be done by transplanting & planting trees.
Work Schedule	Work should be carried out in systematic manner and working hours should be up to 6 pm.	Work will be carried out in systematic manner and the working hours would be up to 6 pm.
Employment	Job preference should be given to the local people.	As per policy contractors will give preference to affected PWD's.
Muck Disposal	Muck should be disposed at safer site.	Muck will be disposed at identified site & systematic manner. It will be reclaimed immediately after the project completion.
Construction Depot	It should be kept away from the habitation zone.	Depot has been planned at Aary Milk colony area which is well away from the habitation. All necessary pollution measures will be adopted at depot.
Labour Camp	Provide adequate sanitation facilities and safe drinking water at labour camps.	Adequate sanitation facilities and safe drinking water will be provided at labour camps.

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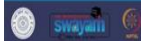




## 7.5 CONSULTATION AT CITY LEVEL

ISSUES RAISED	SUGGESTION/OBJECTION OF STAKEHOLDERS	MIMC REMARK
Metro Rail Alignment	Metro line 3 to be combined with Metro line 2 and One depot location can be saved. A letter addressed to the then C.S., GoM, Shri Johnny Joseph by Mr. Shideran, MD, DMRC was also discussed regarding Charakop - Bandra Colaba corridor and MIMC later changed as Charakop - Bandra - Marolund corridor.	PPP contract has been awarded for Metro Line 2 (Charakop - Bandra - Marolund). Merging with Line 3 is not possible at this stage. Area required for a combined depot will be much greater than the space available at any one site. Combined depot will not be feasible for Metro Train operation of Line-2 and Line-3.
Muck Disposal	Astey Mik Colony should be taken up very strongly. MIMC has a responsibility for mass public transport, it has also responsibility towards environment. How to dispose of the muck coming out of excavation? Where will it be dumped? Mumbai affected by seismic fault line and how you will evacuate passengers?	MIMC is working on several options for muck disposal. Due care will be taken with regards to environmental impact. Designs will account for Mumbai's seismic zone. Disaster and evacuation plans will be as per Indian standards.

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FIGURE 7.2  
PHOTOGRAPHS OF STAKEHOLDERS' CONSULTATION AT CITY LEVEL



DETAILS OF PUBLIC CONSULTATION HELD WITH PROJECT AFFECTED PEOPLE & VARIOUS OTHER ORGANISATIONS / INSTITUTIONS HELD AFTER 2012:

Sr.No.	Division	Date	Place
1	Quresheer Nagar-BBC	28-11-2014	Santhra G-Block Bandra Kurla Complex, Bandra (East)
2	Agipada (Santarnali) & Dhurati	03-12-2014	Santhra G-Block Bandra Kurla Complex, Bandra (East)
3	Sarjapur Nagar (Aarey Colony)	11-12-2014	Community Hall Sarjapur Nagar, Sakinaka Colony, Juhu (West)
4	MIDC	26-12-2014	Laboratory Welfare Centre Andheri - (East)
5	Mahadwar Nagar Police (West) Colony - Discussion Session	13-02-2015	Police Colony Mahadwar Nagar, Sakinaka, MIDC, Andheri (East)
6	Katodhari & Girgaon	02-03-2015 to 04-03-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.
7	Gulf Farside & Chembur Local Residents Association - Discussion Session	05-03-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.
8	Sabar (Dhank Nagar)	12-03-2015	Santhra G-Block Bandra Kurla Complex, Bandra (East)
9	Katodhari & Girgaon Action Committee	14-03-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.
10	India Merchant Chambers - Discussion Session With Them & Presentation	24-03-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.
11	Mumbai 1 <sup>st</sup> Press Club - Discussion Session With Them & Presentation	27-03-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.
12	MIDC Officers & MIDC Plot Owners	08-06-2015	Tenthonia / Regional office MIDC, Thane. One office Complex Bldg, 14 <sup>th</sup> Floor, Thane.
13	MIDC Officers & MIDC Plot Owners	12-06-2015	Association Office Fl. No. 15, Street No. 18, MIDC Ward, Andheri - East, Mumbai.
14	Orissa Club of India - Discussion Session With Them & Presentation	24-07-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.
15	Jeebhay Nagar Mahin	29-07-2015	Santhra G-Block Bandra Kurla Complex, Bandra (East)
16	Oral Street Association, Mumbai - Discussion Session With Them.	24-08-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.
17	Girgaon Khatodhari Residents Association - Discussion Session With Them.	28-08-2015	CR-2 Building, 14 <sup>th</sup> Floor Nariman Point, Mumbai.

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So, you see that they have also like it was the requirement of JICA, that they have to have a thorough public consultation. You have learned about the public consultation concept here. So, they have done consultation at the project level. Plus, you can see the picture here where all they did at the project level, and then they identified all the issues that were raised, and what kind of suggestions were made by the stakeholders.

And what kind of mitigation measures have been taken? So, all that has been documented. Then you also see the consultation at the city level. So, when did they conduct that has been documented what kind of issues were raised, what kind of suggestions were made, and what kind of actions have been taken to that?

So, you see that they have documented it, concerning photographs when and where they were conducted it and all that you can see the table where it was done, the date it was done place it was done, and what kind of inputs came and what kind of actions were taken. So, all that has been documented, you can see the minutes of the meetings also documented here. So, that is what we saw in the case study.

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**Summary**

- 1 Case study - Mumbai Metro Line 3- Colaba –Bandra -SEEPZ

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So, summarizing today, especially, while looking at this case study, we reflected upon all the learnings we have seen from, what kind of environmental context environmental pressure we are dealing with and what kind, how in practice, we handle all these aspects. So, by looking at Mumbai, metro line 3, Colaba, and Bandra SEEPZ, project we try to understand all those aspects.

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**References**

- 1 Social Impact Assessment Report (Volume -1), MAPLE Consortium - General Consultant for Mumbai Metro Line 3, December – 2020;  
[https://www.jica.go.jp/english/our\\_work/social\\_environmental/id/asia/south/india/c8h0vm0000935z0n-att/c8h0vm0000fd6vp.pdf](https://www.jica.go.jp/english/our_work/social_environmental/id/asia/south/india/c8h0vm0000935z0n-att/c8h0vm0000fd6vp.pdf)

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## Suggested Watch and Read



[https://www.youtube.com/watch?v=djtsErp4i0&t=4s&ab\\_channel=Bacteriatwork](https://www.youtube.com/watch?v=djtsErp4i0&t=4s&ab_channel=Bacteriatwork)



[https://www.youtube.com/watch?v=skb1Qlth9QM&ab\\_channel=ThinkAdvertising](https://www.youtube.com/watch?v=skb1Qlth9QM&ab_channel=ThinkAdvertising)



[https://www.youtube.com/watch?v=ukMJURHP9830&ab\\_channel=LondonAssembly](https://www.youtube.com/watch?v=ukMJURHP9830&ab_channel=LondonAssembly)

So, these were our key references for this. So, we looked at this case report, and I have given you the link for that. Our references were also to the other part of what course book which we have been using, and these are the suggested watch and read, winding up. Please feel free to ask questions. Let us know about any concerns you have, and do share your opinions, experiences, and suggestions. Looking forward to interacting and CO learning with you while exploring EIA.

Thank you.