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EIA of Bandra Worli Sea Link

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Abstract:
There is a direct and all too visible correspondence between vehicular traffic and environmental pollution, especially in metros like Mumbai and Delhi where levels of atmospheric pollutants (sulphur dioxide, nitrogen dioxide, particulate matter and benzene) found largely in vehicular exhaust are alarmingly high and beyond any permissible or safe limits. The Bandra Worli Sea Link Road Project (BWSLP) is a part of the Western Freeway Sea Project, which, in turn, is part of a larger proposal of upgrade the road transportation network of greater Mumbai as per the report prepared by the Central Road Research Station, which had been commissioned by the Maharashtra Government. In its final form the Bandra Worli Sea-Link (BWSL) also known as the western freeway work is an eight-lane freeway running a length of 6km, which starts from Mahim interchange and ends at Worli Sea face. The BWSL connects to Nariman Point via the Western Freeway Sea link Project to complete an integrated road system connecting the island city to the suburbs. Hindustan Construction Company India (HCC) has executed the project that was commissioned by the Maharashtra State Road Development Corporation (MSRDC).Sustainable and equitable solutions are the need of the hour. It is in light of current trends that the we are seeking to investigate into the Bandra Worli Sea Link. Whether or not the Sea Link is needed has to be discussed keeping in mind human, environmental and economic costs.

Keywords: *Bandra Worli Sea Link, environmental pollution, sustainable, vehicular traffic*

1. Introduction

1.1. Conceptual Framework for EIA Studies

"Environmental impact assessment" denotes the attempt to predict and assess the impact of development projects on the environment. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project.

The planning and management of impact for our project, “Bandra Worley Sea Link” constitutes 10 Steps Approach .

2. Step 1- Project Description and Need

2.1. Location of the Project – Mumbai, Maharashtra, India

2.2. Coordinates of the Project: 19.0365° N, 72.8172°

2.3. Salient Features of the Bandra-Worli Sea-Link (BWSL)

- An 8-lane bridge with 2-lanes dedicated for buses to ease traffic congestions.
- Length of bridge = 5.6 km, Width = 25m
- Single tower supported 500m long Cable Stayed Bridge at Bandra Channel and Twin Tower supported 350 m Cable Stayed Bridge at Worli Channel for each carriageway which is made of eco-friendly material.
- An intelligent bridge with state-of-art systems for traffic monitoring, surveillance, information and guidance, instrumentation, emergency support etc.
- Development of promenade and landscaping to enhance the environment.

2.4. Need for the Project

- Bandra Worli Sea Link Project is one of the most highly recommended projects of all the transport studies done for the metropolitan region during the last forty years.
- At present, Mahim causeway is the only link connecting western suburbs to island city of Mumbai. The existing north-south western corridor is highly trafficulated and congested during the peak hours results in a bottleneck on the Mahim causeway indirectly raising the noise and pollution level of the city.

2.5. Statistics Regarding Traffic in the City

- Vehicular traffic measuring about 1,20,000 PCU during peak hours on the Mahim causeway every day.
- It takes about forty minutes to travel from Mahim causeway to Worli, a distance of about 8 km.
- The construction of this project would give some relief to the Mumbaikars which indirectly reduce traffic level cause less fuels to burn and reduce the pollution levels of the city to some extent.

2.6. Time taken

- Originally planned as far back as 1983, some say even earlier, work on the BWSL was finally cleared in 1999. opened to the public on 30 June 2009
- Time taken for construction ~ 10 yrs approximately.

2.7. Agencies Involved during Construction

- Client/owner
- Maharashtra State Road Development Corporation Ltd. (MSRDC)
- Design Consultants
- Sverdrup Asia Ltd,
- AGRA Earth &Environmental INC,
- KPMG India Pvt. Ltd,
- Dar Consultants etc.
- Main Contractor
- Hindustan Construction Company Ltd.

3. Step 2- Pertinent Institutional Information

3.1. EIA Process in India

- Screening

- Scoping and consideration of alternatives
- Baseline data collection
- Impact prediction.
- Assessment of alternatives, delineation of mitigation measures and environmental impact statement.
- Public hearing
- Environment Management Plan
- Decision making
- Monitoring the clearance conditions

3.2. Environmental Laws and Regulations in India

- The Air (Prevention and Control of Pollution) Act 1981, as amended by Amendment Act, 1987
- The Environment (Protection) Act, 1986
- The National Environment Tribunal Rules, 1995
- The Water (Prevention and Control of Pollution) Amended Rules, 1989
- The Noise Pollution (Regulation and Control) Rules, 2000

3.4. Project Location

- As far as possible, prime agricultural land/forest, land may not be converted into an industrial site.
- Land acquired should be minimal but sufficient to provide for a green belt wherein the treated wastewater, if possible/suitable, could be utilised from wastewater treatment systems.
- Adequate space must be provided for storing solid waste. The space and the waste can be made available for possible reuse in future.
- The layout and form of the project must conform to the landscape of the area without unduly affecting the scenic features of that place.
- The Noise Pollution (Regulation and Control) Rules, 2000

3.5. Assessment of Alternatives

- Alternatives should cover both project location and process technologies.
- Alternatives should also consider the 'no project' option.
- Alternatives should then be ranked for selection of the best environmental option for optimum economic benefits to the community at large.

3.6. Public Hearing

- As per the Circulars and Guidelines issued by the Central Ministry of Environment and Forests (MoEF), dated 27th January 1994, 4th May 1994 and 10th April 1997, under the Environment Protection Act (EPA) it is clear that a Public Hearing is mandatory in development projects such as the Bandra Worli Sea Link.
- This is to be done through the most widely circulated newspapers in the area, one of which must be published in a vernacular language.

3.7. Monitoring Clearance Conditions

- Monitoring should be done during both the construction and operations phases of a project.
- Where the impact exceeds the predicted levels, corrective action should be taken.

3.8. Regarding the Project Report

- According to schedule (iv) of notice dated 10th April 1997, issued by Ministry of Environment and Forests (MoEF), whoever applies for Environmental Clearance of projects has to submit 20 sets of a summary of the salient features of the project and other relevant documents as prescribed, to the concerned State Pollution Control Board so that the same can be made accessible to the concerned persons in case of a public hearing.

4. Step 3- Identification of Potential Impacts

4.1. Impact on Water

- The project construction constricted the mouth of the city's Mithi River which is the city's biggest storm water drain.
- Almost 800 million litres of sewage is discarded every day in the Mahim Creek, besides the thousands of industries that release effluents that are located in Dharavi and upstream of the Mithi River. If the construction goes on, and the flow of the river is restricted by the said reclamation, the sewage will stagnate during the monsoon and pose an immense health risk to the population of Mumbai.
- The blocking of tidal water near the mouth of Mahim Creek may result in changes on the level of sea-water in the area.

- The lives of several fishing villages are threatened due to frequent tidal effect in the region.

4.2. Impact on Soil

- Sea Water diverted towards the Mahim-Worli coastal belt and is contributing to erosion along the beaches.
- The size of mangroves has reduced to 50 per cent of its original size in the last few years due to changed properties of soil near mithi river coast.

4.3. Impact on Livelihood

- The project may directly affect the livelihood of fisher folk from Worli village and they fear a similar fate in Khar-Danda, Juhu-Koliwada and Versova with the proposed coastal road.
- Approximately 20,000 people are dependent on fishing as an occupation and due to siting of the project and the extent of reclamation, the fishermen would be denied entry to the seas owing to constructional hazards.

4.4. Impact on Land

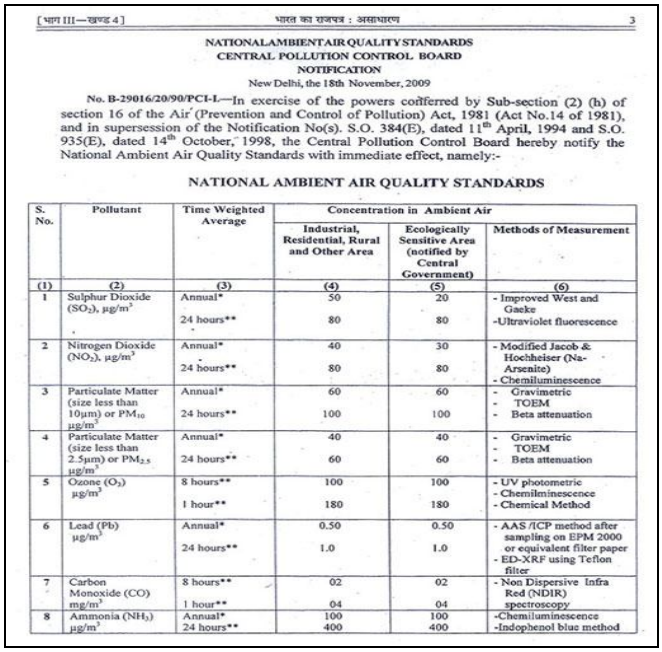
- The project with the base of the Mahim creek getting shallower because of siltation, there is a greater trust on other parts of the coastline like the Versova beach. The erosion here become a geological hazard, and has assumed alarming proportions.

4.5. Impact on Flora and Fauna

- The reclamation of land near the Shivaji Park region would have a severe impact on the marine ecology.
- The project have an adverse effect on the sea creatures like lobsters, crabs, and prawns etc. which are found in abundance in the coastal areas, but would be severely affected because of pollution created due to the project.

5. Step 4- Description of Affected Environment

5.1 Air Standards



[भाग III—खण्ड 4] भारत का राजपत्र : असाधारण 3

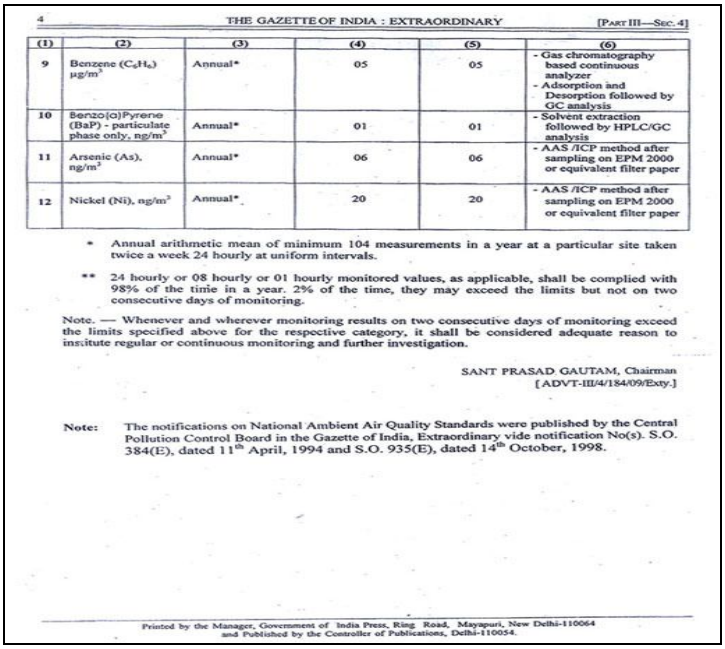
NATIONAL AMBIENT AIR QUALITY STANDARDS
CENTRAL POLLUTION CONTROL BOARD
NOTIFICATION

New Delhi, the 18th November, 2009

No. B-29016/20/90/PCI-L.—In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in supersession of the Notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect, namely:-

NATIONAL AMBIENT AIR QUALITY STANDARDS

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m³	Annual*	50	20	- Improved West and Gaeke
		24 hours**	80	80	-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m³	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours**	80	80	- Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m³	Annual*	60	60	- Gravimetric - TOEM
		24 hours**	100	100	- Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m³	Annual*	40	40	- Gravimetric - TOEM
		24 hours**	60	60	- Beta attenuation
5	Ozone (O_3) µg/m³	8 hours**	100	100	- UV photometric - Chemiluminescence
		1 hour**	180	180	- Chemical Method
6	Lead (Pb) µg/m³	Annual*	0.50	0.50	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) mg/m³	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour**	04	04	
8	Ammonia (NH_3) µg/m³	Annual*	100	100	-Chemiluminescence
		24 hours**	400	400	-Indophenol blue method



4 THE GAZETTE OF INDIA : EXTRAORDINARY [PART III—SEC. 4]

(1)	(2)	(3)	(4)	(5)	(6)
9	Benzene (C_6H_6) µg/m³	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m³	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m³	Annual*	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m³	Annual*	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

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

** 24 hourly or 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.

Note. — Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

SANT PRASAD GAUTAM, Chairman
[ADVT-III/4/184/09/Exty.]

Note: The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India, Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998.

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5.2. Air Quality Condition

Table 3.7: Major Air Quality Parameters for Selected Locations in Maharashtra during 1997-2004 (µg/m ³)

Parameter	Year	Location									
		Thane	Nashik	Nagpur	Chandrapur	Solapur	Mumbai	Dombivili	Aurangabad	Ambernath	Pune
SO_2	1997-98	13-40	5-24	4-40	18-43	16-21	6-51	29	12.62	28	49.15
	1998-99	9-35	7—38	6-48	24-54	13-17	12-46	24	-	49	-
	1999-00	10.8-54.5	6.5-37.4	5.5-31.8	16-33	17.9	9-43	34	-		43.46
	2000-01						7-26			37.27	
	2001-02	19.2-22.4	11.1-29.8	9.5-10.1	-	19.5-46.27	7-25	-	-	-	36.5-44.4
	2002-03						14-40			28.02	
	2003- 04	6- 70	17.1- 58.3	6.1- 29.3	-	-	11.2- 14.2	-	14.8- 15.1	-	8.4- 35
NO_x	1997-98	34-41	15-34	16-55	29-53	35-47	22-60	66	8.71	20	58.1
	1998-99	23-32	9-37	9-52	29-53	25-45	19-49	31	-	36	-
	1999-00	20.1-25.9	13.6-21.9	12.6-52.8	28.2-54.2	45-45.6	18-46	37.4	-	40.5	58.43
	2000-01						14-69			75.73	
	2001-02	50.2-75.6	58-94.3	169.7-194.7	174.8-214	179.5-200.7	16-57	94.3	-	66.49	48.4-101.7
	2002-03						24-96			159.8	
	2003- 04	6.5- 27	16.7- 55.8	18.4- 69.6	-	-	45.8- 107	-	14.8- 15.8	-	11.8- 47.5
SPM	1997-98	156-343	159-199	114-133	116-132	229-314	166-441	211	673	203	310.5
	1998-99	141-179	143-190	146-161	172-181	222-247	162-356	124	-	217	-
	1999-00	-	-	163.83	-	-	108-424	-	-	-	199
	2000-01						148-373			252.15	
	2001-02	-	-	-	-	-	120-390			185.33	61-27.37
	2002-03						172-463			190.48	
	2003- 04	201.6- 3621 *	163.19- 8398	80.1- 1114.3●	-	-	-	-	40.5- 181.7	-	102.7- 440.2

Note: 3621* indicates sampling site, 8398 indicates commercial area, 1114.3● indicates industrial area

5.3. Water Quality Standards

Table 1.4
Primary Water Quality Criteria for Class SW-IV Waters (For Harbour Waters)

S.No.	Parameter	Standards	Rationale/Remarks
1.	pH range	6.5-9.0	To minimize corrosive and scaling effect. .
2.	Dissolved Oxygen	3.0 mg/l or 40 percent saturation value, which ever is higher.	Considering bio-degradation of oil and inhibition to is oxygen production through photosynthesis.
3.	Colour and Odour	No noticeable colour or offensive odour.	None from reactive chemicals which may corrode paints/metallic surfaces.
4.	Floating Matters Oil, grease and scum (including Petroleum products)	10 mg/l	Floating matter should be free from excessive living organisms, which may clog or coat operative parts of marine vessels/equipment. .
5.	Fecal Coliform	500/100 ml (PAN)	Not exceeding 1000/100 ml in 20 percent of samples in the year and in 3 consecutive samples in monsoon months.
6.	Biochemical Oxygen Demand (3 days at 27°C)	5 mg/l	To maintain water relatively free from pollution caused by sewage and other decomposable wastes
7.	Biochemical Oxygen Demand (BOD) (3 days at 27°C)	3 mg/l	Restricted for bathing (aesthetic quality of water). Also prescribed by IS:2296 1974.

5.4. Water – Worli Sea Water in 1990's

Parameters	Min	Max	Avg
pH	7.2	7.8	7.54
COD	128	496	240
BOD	10	24	17.91
DO	2.2	6.9	4.12
Faecal Coliform	297	394	352

5.5. Noise Pollution – National Ambient Noise Standards

Area Class	Day time (dB)	Night time (dB)
Residential	55	45
Commercial	65	55
Industrial	75	70
Silence Zone	50	40

5.6. Noise Pollution

- Normal talking sound level – 70dB
- Noise has high impact on construction workers.
- Noise mapping survey should have been carried out to know the actual traffic sound levels for the BWSL,
- However it wasn't carried outso we are presenting only the commonly available about theConstruction equipment.

Equipment	Sound Level (dB)
Pneumatic chip hammer	103-113
Earth Tamper	90-96
Jackhammer	102-111
Concrete joint cutter	99-102
Portable saw	88-102
Stud welder	101
Bulldozer	93-96
Crane	90-96
Hammer	87-95
Earthmover	87-94
Front-end loader	86-94
Backhoe	84-93

6. Step 5- Impact Prediction

6.1. Impact on Air Quality

- In Mumbai, road transport is a major source of air pollution, which has worsened by the order of 400 % in the last two decades and now poses a considerable health problem.
- After the BWSL became operational, about 45,000 vehicles would ply along the Worli sea face every day, against the earlier 3,000 to 5,000.
- The petition submitted in December 2010 states, "This increase in vehicular traffic has led to abnormally high levels of air and noise pollution in the area".
- It points out that a study conducted by the Maharashtra Pollution Control Board (MPCB) at Worli sea face shows that the respirable suspended particulate matter (RSPM) are more than twice the amount prescribed by the National Ambient Air Quality Standards issued by the Central Pollution Control Board.
- The reports submitted by the petitioners state that the RSPM at Worli is 432 microgram per cubic meter (µg/m), while the prescribed limit is 100 µg/m; the suspended particulate matter in the area is 2,051 µg/m, against the prescribed limit of 200 µg/m.
- Using Box-Model approach to calculate the concentration of various pollutants generated due to the amount of traffic at the BWSL.

We have,

$$Q = \frac{VER.T}{3600}$$

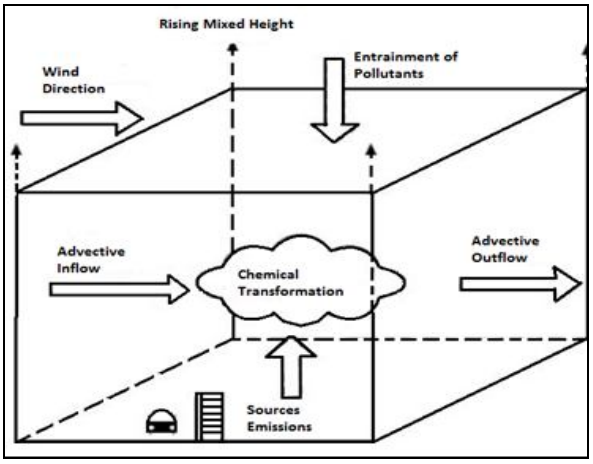
Where,

- VER = Vehicle emission rate; in g/sec*mile
- T = traffic flow rate; PCU/day
- Q= emission rate of gas/ mile
- Q_{total} = Q*Length of the bridge
- Estimated no of PCU's per day at the BWSL = 120,000.

$$C = \frac{Q * t}{x * y * z}$$

Where

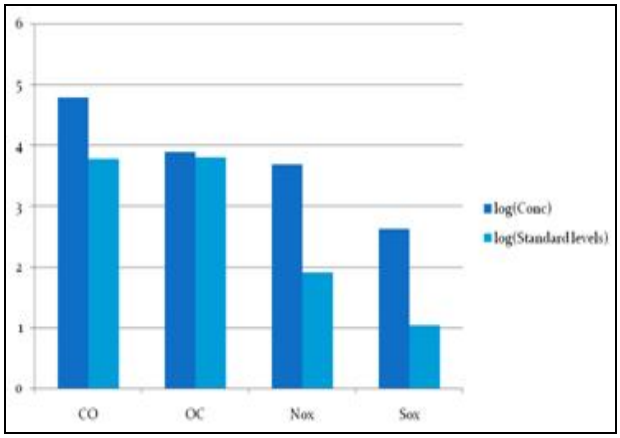
- **t =** time period over which assumption of uniform mixing in the box is made; in seconds
- **X=** length direction of the bridge = 5.6 km
- **Y=** width direction of bridge = 25 m.
- **Z=** Mixing Height = 1 km
- **C=** Concentration of gas (mg/m^3)



6.2 Impact on Air Quality - Summary of Results

Transport Mode	CO	OC	Nox	Sox
Car (single Occupancy) VER – vehicle emission rate	20.36	2.57	1.61	0.14
Q(g/s per mile)	28.27778	3.569444	2.236111	0.194444
Qtotal (g/s)	98.97222	12.49306	7.826389	0.680556
Conc.(mg/m^3)(8 hours)	20.36	2.57	1.61	0.14
Conc.(mg/m^3)(24 hours)	61.08	7.71	4.83	0.42
log(Conc)	4.785899	3.887054	3.683947	2.623249
Existing levels (24 hours)	6	6.32	0.08	0.011
log(Standard levels)	3.778151	3.800717	1.90309	1.041393

6.3. Impact on Air Quality - Summary of Results



6.4. Impact on Mangroves

- Mangroves are extremely eco sensitive and important areas and according to the Environmental clearance rules – "no excavation or dumping shall be allowed on wetlands, forest areas or other eco sensitive locations", however, there are around 90 pillars that will be raised between the Bandra and Worli end and 670 metres out of the 1,600 metres width of the mouth of Mahim Bay will be closed as per experts report and the CWPRS Report.
- Blocking of the mouth of the creek will prevent saline water flushing the creek and eventually lead to the death of the mangrove forests in the creek.

6.5. Impact on Land

- Scientists fear that the reclamation at Bandra would change the current direction of waves in the Mahim bay resulting in sand being lost from the shores of Mahim, Dadar, Shivaji Park and Prabhadevi.
- The foundations of the buildings on the coast around Mahim and Dadar would be threatened even more frequently by the incoming tides.
- If the present situation continues many of them will be flooded within the next few years. Much of Dadar beach has already been eroded and this amounts to a great social loss in terms of public spaces in Mumbai. (According to International Standards, the minimum amount of open space required is 4 acres per thousand persons but in Mumbai it is a mere 0.03 acres per 1,000 persons as per the 1991 census).

6.6. Impact on Livelihood

- The *West Island Freeway* project was proposed to span the entire western coastline of Mumbai to ease congestion. BWSL, a bridge over Mahim Bay, was proposed as the first phase of this freeway system offering an alternative route to the Mahim Causeway.
- It is estimated that the sea link will help saving Rs. 10 million annually due to congestion in traffic and length of the previous route and shorter new route.
- The sea link would result in much easier driving with reduction in mental stress and improvement in the quality of life.
- While earlier it used to take 40 minutes for drive between Bandra and Worli, now the distance is covered in mere 8 minutes resulting in large savings in time.
- There would be reduction in accidents due to shorter distance and wider roads.
- Extensive landscaping along the approaches and promenade would enhance the surrounding.

7. Step 6- Impact Assessment – The Leopold Matrix

Parameters	**Physical**						
	Soils	**Ground Water**	**Surface Water**	**Ocean Water**	**Air**	**Noise**	**Erosion**
Modification of Regime	5	3	6	4	1	1	6
	4	6	4	8	1	1	6
Land Transformation and Construction	3	2	6	4	3	3	1
	3	2	3	2	3	6	1
Resource Extraction	2	2	2	2	1	1	1
	3	2	3	2	2	4	5
Land Alteration	5	3	3	1	2	2	5
	5	2	2	1	3	5	6
Changes in Traffic	1	1	1	1	-6	-3	1
	2	1	1	1	8	7	2
Waste Emplacement and Treatment	1	1	5	1	1	1	4
	5	5	8	7	1	2	1

Parameters	**Biological**		**Cultural**			
	Flora	**Fauna**	**Aesthetics**	**Livelihood**	**Cultural Status**	**Man-made facilities**
Modification of Regime	8	5	6	-7	-4	-8
	5	5	2	6	7	10
Land Transformation and Construction	8	4	4	6	-5	-3
	3	4	3	6	2	2
Resource Extraction	4	3	2	-3	4	1

	5	3	2	5	1	2
Land Alteration	8	4	2	-2	-3	-2
	7	6	3	3	3	4
Changes in Traffic	1	1	-5	-8	-5	-7
	1	1	4	6	7	8
Waste Emplacement and Treatment	4	3	1	3	1	1
	4	4	3	3	2	4

IA: RESULTS OF LEOPOLD MATRIX

Parameters	**Net magnitude**	**Net Impact**
Modification of Regime	26	59
Land Transformation and Construction	36	139
Resource Extraction	14	47
Land Alteration	28	147
Changes in Traffic	-27	-219
Waste Emplacement and Treatment	27	110
Overall	104	283

Parameters		**Net Magnitude**	**Net Impact**
Physical	Soils	17	67
	Ground Water	12	38
	Surface Water	23	95
	Ocean Water	13	53
	Air	2	-29
	Noise	5	14
	Erosion	18	78
Biological	Flora	33	157
	Fauna	20	87
Cultural	Aesthetics	10	17
	Livelihood	-11	-66
	Cultural Status	-20	-84

	Man-Made Facilities	-18	-144
Net magnitude		104	
Net Impact		283	

7.1. Result of Leopold Matrix

The matrix identifies the potential impacts associated with the project or alternatives.It performs a comprehensive review of the variety of interactions between project elements and environmental parameters, to identify important environmental factors, data needs, and less damaging alternatives.

The Overall analysis of the Leopold Matrix concludes that the net magnitude of impact is coming positive. So there is more negative impact due to the project.

7.2. IA: Public Participation

Public Participation is required for such a project involving the livelihood of as many people present here, and to gather public opinion about the activities of the project. However no such public meeting or hearing was held by the MMRDA for this project, and despite the oppositions faced by the government, the project was finally carried out and completed in Jan.2009.

8. Step 7- Impact Mitigation

An effective traffic management system design will need consideration of many important issues as listed hereunder:

- Development of mass transportation system for small distance trips
- Adequate road infrastructure and competent road engineering appropriate for the city
- Adequate capability and resources of the police and other enforcement authorities
- Development of flyovers and alternate roads to divert traffic load from areas with high PM10 and NOx concentrations.
- Proper decentralized town planning.
- Public understanding, respect and support for traffic management.
- Declaring some North South roads as one way roads during peak traffic hours.
- Upgrading, extension and synchronization of traffic signals.
- Provision of separate bus lines on some arterial roads.
- Imposing heavy penalties for violating traffic regulations.

8.1. Reducing the Impact on Mangroves

- More trees could be planted in the nearby region to negate the effects of traffic pollution and to reduce the impact of cutting of mangroves due to land reclamation.

8.2. Loss of Livelihood

- Adequate rehabilitation has to be provided for the fishermen affected by the project.

9. Step 8- Selection of Proposed Actions

A point that needs to be questioned is how both the planning and execution of the road projects have been entrusted to the Maharashtra State Road Development Corporation (MSRDCD), which is an engineering agency and has no expertise to take an overall view of the merits of such schemes. In fact the whole process has bypassed the apex planning body, the MMRDA (Mumbai Metropolitan Region Development Authority), as its transport expert, A.V. Ghangurde, publicly cited at a seminar.

9.1. Space Pollution: The Occupation of Space and Land Uptake by Transport

- In general, for a 5 km Journey to work public transport and pedestrians use 90 times less space for travelling than a car used for travelling and parking. Car transport and its infrastructure is a great consumer of space.

The table below shows how much space is required by each mode of Transport using Swiss data.

Table : Space required by various urban transport modes

Transport mode	Speed (km/hr)	Space required per person
Pedestrian	5	0.8 m2
Cyclist	10	3.0 m2
Fully occupied car	10	6.2 m2
Fully occupied car	40	20.0 m2
Car with 1 person	10	18.7 m2
Car with 1 person	40	60.0 m2
Bus: full and 1/3 full	10	3.1 m2 (full)/9.4 m2 (1/3 full)
Bus: full and 1/3 full	30	9.4 m2 (full)/28.1 m2 (1/3 full)
Light rail metro: full and 1/3 full	20	1.5 m2 (full)/4.6 m2 (1/3 full)
Light rail metro: full and 1/3 full	30	2.2 m2 (full)/6.9 m2 (1/3 full)

[Source: J. Whitelegg (1993a) p.79 after Navarro et al (1985)]
Environmental Improvement Programme. World Bank, October 1996

- The total number of vehicles in Mumbai in the year 1998-99 was 9,10,728, showing a compound growth rate of 7% per annum over a 12-year period. It is estimated that there will be 1.6 million vehicles by the year 2010 at the present rate of adding 250 vehicles per day.
- Length of roads in the city = 1975 sq.km
- No amount of increased road capacity would be able to handle this additional load of cars. In one of the most congested cities in the world with a shortage of public space, private transit demands a greater proportion of road space per passenger when you compare it with public transit.

10. Conclusion

- It is clear from the above report that not one but several aspects of the Environmental Regulations of the country have been violated. The most important being the non- consultation of the local community and the fact that the condition to hold a public hearing on the project was never complied with.
- Secondly the project as is planned will only seek to exacerbate the problem of vehicular pollution and traffic jams especially in the Worli-Haji Ali Area which is already severely congested.
- The most worrying part of the project is that in depth studies using current data have not been used to estimate the environmental impact of the project on the city's coastline, mangrove forests and marine ecology.
- Lastly as there has been no survey undertaken to elicit how much the citizens are willing to pay for the use of the As seen from the EIA conducted:
- Although the project has several beneficial features to it, like improving the lifestyle of the people of the city, there are various other methods discussed before which can address the problem of traffic congestion in the city in a more environment friendly and socially feasible way.

The project has a very high negative impact on the environment, and should not have been carried out.

11. References

1. Water quality standards for coastal waters, EPA, 1986 [GSR 7, dated Dec. 22, 1998
2. National Ambient Air Quality Standards, Central Pollution Control Board, 1994.
3. An enquiry into the Bandra-Worli sea link project, The Indian People's Tribunal on Environment and Human Rights, July 2001
4. Date, V.: 2000; "Reclamation Leads to Erosion along Coastal Mumbai"; Times of India
5. Lal, V.: 2000; 'Oops Sea Link was an Error'' Indian Express; May 1.
6. Mehta, M.; 2000; Nature Takes Revenge for Redefining Mahim Bay"; Mumbai Newsline
7. Indian Express; May 22.
8. Mungekar, N.; 2000; "Reclamation or Wrecklamation"; Times of India; February 6.
9. Nadkarni, V. C; 2000; "Experts Fret Over Health of Mumbaikars"; Sunday Times;
10. Times of India; October 15.
11. Maharashtra State Road Development Corporation; "Western Freeway Sea Link: Executive
12. Summary; Mumbai.
13. Mayur R.; "Revolt against TheWorli – Bandra Sea Link Project";
14. Sustainable Future.
15. Ministry of Environment and Forests; 1999; Environment Clearance Regulations for
16. Construction of WorliBandra Link Road Project In Mumbai"; Government Of India,
17. No./12011 19-92-IA-III; New Delhi