



# Environmental Impact Assessment and Environmental Management Plan for a Multi-level Parking Project – A Case Study

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**Abstract—** *The purpose of Environmental Impact Assessment (EIA) process is to inform the decision makers and general public about the possible environmental outcomes of implementing the proposed project. EIA is a decision making tool employed to identify and evaluate environmental consequences of certain proposed development actions on physical environment as well as on social culture and health aspects of the local population dwelling around the proposed project. The EIA process identifies various available alternatives and mitigation measures required to reduce the environmental impact of the proposed project. The EIA process serve as an important procedural role for overall decision making process and it promotes transparency by involving public. This paper presents the significance of EIA in the sustainable development of a Construction project with a case study of an upcoming Multi-level Parking Project in Chandigarh. The environmental parameters under consideration in present work are Air, Water, Noise, Soil and Socio-Economic. A study period for collection of Base Line Environmental Data is from March 2013 to May 2012. The impact of this proposed project of several environmental parameters has been predicted and accordingly various mitigation measures have been suggested.*

**Keywords—** *Parking structures, Environment Impact Assessment, environmental pollution, Construction activities, Environmental impact of construction*

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## I. INTRODUCTION

The purpose of Environmental Impact Assessment (EIA) process is to inform the decision makers and general public about the possible environmental outcomes of implementing the proposed project. EIA is a decision making tool employed to identify and evaluate environmental consequences of certain proposed development actions on physical environment as well as on social culture and health aspects of the local population dwelling around the proposed project. It should be noted that EIA process does not guarantee that it will result in the clearance of the proposed project. If the EIA result indicates that there will be serious environmental impact then it may be rejected. There are authorities which are responsible to keep a balance between development and environment. Judicious decision is taken on the basis of EIA report only.

The EIA experience in India indicates that the lack of timely availability of reliable and authentic environmental data has been a major bottle neck in achieving the full benefits if EIA. The environment being a multi-disciplinary subject, a multitude of agencies are involved in collection of environmental data. However, no single organization in India tracks available data from these agencies and make it available in one place in a form required by environmental impact assessment practitioners. Further, environmental data is not available in enhanced forms that improve the quality of the EIA. The past failure of development planning processes to take adequate account of the detrimental impacts of economic development activities led to the advent of Environmental Impact Assessment (EIA) processes. Industrialized countries first employed EIA in the early 1970s. Since that time, most countries have adopted EIA process to examine the social and environmental consequences of the projects prior to their execution. EIA has an important role to play in resolving environmental problems through its ability to contribute to environmentally sound and sustainable development. Developing countries in Asia have recognised the importance of incorporating EIA processes is to provide information to decision makers and the public about the environmental implications of proposed actions before decision are made.

## II. METHODOLOGY:

The present study has been conducted on an upcoming multilevel parking project located in sector 17, Chandigarh which falls at centre of the city. Project proponent is M/s Municipal Corporation, Chandigarh and the Project falls under Category “B” of project activity no. 8(a) of construction projects. It proposes to provide parking of vehicles of 900-925 cars in multi-level parking. The total Plot Area is 10359.96 m<sup>2</sup> with Ground Coverage of 9990.34 m<sup>2</sup> and Built up area 39961.36 m<sup>2</sup>. It is an underground construction project with the maximum height of the building -34.6 ft (from the bottom of the basement). Here, study of baseline environmental status has been carried out in terms of various environmental parameters. Then, the EIA for the multilevel project has been prepared which comprises impact estimation on recognized parameters and mitigation measures have been recommended. Additionally, the assessment of entire impacts has been prepared with Leopold Matrix method, which aids in integrating appropriate mitigation measures wherever required for averting substantial effect on the environment.

### III. BASELINE ENVIRONMENTAL DATA

#### Air Quality:

Air quality was monitored at project site location for 24 hours, twice a month, for the study period of three months as per the guidelines specified by the MoEF. Monitoring was carried out for three months. The volumetric flow rate of each sampler was maintained at 1.1-1.2 lit/min. Collected air samples are analysed using standard procedures prescribed by CPCB and Indian Standards: IS:5182. High-Volume Air Sampler was deployed for ambient air monitoring (AAQM). Samples were analyzed for SO<sub>2</sub>, NO<sub>x</sub>, SPM and RSPM.

All values in µg/m<sup>3</sup>

TABLE I  
AIR QUALITY STATUS AT PROJECT SITE

Project Site	March 2013				April 2013				May 2013			
	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>
Minimum	127.4	70.9	6.8	28.9	130.1	76.4	6.9	27.7	138.4	80.1	7.1	31.3
Maximum	151.7	89.2	11.4	37.6	160.8	94.5	10.9	38.6	169.7	97.8	9.3	39.7
Average	139.2	81.7	9.6	32.7	148.6	85.7	9.4	33.1	156.8	88.9	8.5	34.4
Standards	100	60	80	80	100	60	80	80	100	60	80	80

TABLE II  
AIR QUALITY STATUS NEAR BSNL TELEPHONE EXCHANGE

Near BSNL Telephone Exchange	March 2013				April 2013				May 2013			
	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>
Minimum	130.1	85.1	6.9	27.4	134.4	86.5	7.1	31.3	139.8	88.3	6.5	31.7
Maximum	155.4	94.2	11.5	39.7	167.2	98.3	10.9	37.6	168.1	97.5	11.3	38.1
Average	140.2	88.3	9.8	33.5	148.9	91.9	8.7	36.2	157.8	93.7	8.6	35.8
Standards	100	60	80	80	100	60	80	80	100	60	80	80

TABLE III  
AIR QUALITY STATUS NEAR NEELAM CINEMA

Near Neelam Cinema	March 2013				April 2013				May 2013			
	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>
Minimum	125.9	72.5	7.3	30.3	131.5	70.4	7.1	31.6	140.3	89.2	7.9	30.7
Maximum	149.6	92.5	11.5	39.5	158.5	95.8	12.4	37.8	165.5	97.3	12.3	40.4
Average	141.1	85.7	9.8	36.7	143.6	87.9	10.7	35.7	157.4	94.1	10.9	37.4
Standards	100	60	80	80	100	60	80	80	100	60	80	80

TABLE IV  
AIR QUALITY STATUS NEAR SBI HEAD OFFICE

Near SBI Head Office	March 2013				April 2013				May 2013			
	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>
Minimum	132.3	80.1	7.0	32.5	140.2	88.4	7.1	36.5	138.6	88.3	6.8	34.6
Maximum	154.2	94.6	11.4	37.8	163.4	98.5	11.1	41.8	167.5	96.5	11.6	38.3
Average	145.5	84.4	9.6	34.6	150.5	93.2	9.5	37.3	155.5	92.9	8.8	36.7
Standards	100	60	80	80	100	60	80	80	100	60	80	80

TABLE V  
AIR QUALITY STATUS NEAR HOTEL PARK PLAZA

Near Hotel Park Plaza	March 2013				April 2013				May 2013			
	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>	SPM	RSPM	SO <sub>2</sub>	NO <sub>x</sub>
Minimum	135.7	75.5	7.4	28.7	136.5	77.8	7.8	32.6	150.6	84.2	7.5	32.7
Maximum	144.7	93.4	11.6	37.9	167.7	96.9	12.2	40.1	170.5	96.6	11.9	41.4
Average	140.6	84.7	9.7	34.6	153.6	88.2	10.4	36.7	161.3	91.1	10.1	37.9
Standards	100	60	80	80	100	60	80	80	100	60	80	80

#### Inference:

SPM: The maximum value of SPM detected at all the monitoring locations was 139.25 µg/m<sup>3</sup> which surpasses the NAAQ standards.

RSPM: The maximum value of SPM detected at all the monitoring locations was 85.4  $\mu\text{g}/\text{m}^3$  which surpasses the NAAQ standards.

SO<sub>2</sub>: The monitoring was carried out at all the stations nearby the project site. The SO<sub>2</sub> values are well within the permissible limits in all the locations.

NO<sub>2</sub>: The NO<sub>x</sub> concentration values were observed to be well within the permissible limits in all the locations.

#### Noise Monitoring:

Ambient noise monitoring was carried out in 1 km radius of the proposed Multi-level Parking project. The main source of noise are vehicular movement and commercial activities. Noise survey was conducted over continuous period of one week around the proposed project and nearby sites. The Average values of Noise level is given in following table.

TABLE VI  
NOISE LEVEL SURVEY CONDUCTED OVER A PERIOD OF A WEEK LIMITS IN DB(A)

S. No	Sampling Point	Day Time Leq (Average)	Day Time standards	Night time Leq (Average)	Night time standards
1	Project Site	65.9	65	48.8	55
2	Near BSNL telephone exchange, sec 17	72.9	65	49.1	55
3	Near Neelam Cinema, sec 17	65.8	65	47.6	55
4	Near SBI Head office, sec 17	70.2	65	48.5	55
5	Near Hotel Park Plaza, sec 17	66.8	65	51.6	55

#### Water Environment:

Water sample were collected from handpumps to analyse the groundwater quality of the city.

TABLE VII  
WATER SAMPLE ANALYSIS REPORT

S. No	Parameter			Units
		Sample 1	Sample 2	
1	pH	7.5	7.6	
2	Turbidity	6.0	6.4	NTU
3	Alkalinity	455	468	mg/l as CaCO <sub>3</sub>
4	Total Hardness	594	601	mg/l as CaCO <sub>3</sub>
5	Calcium Hardness	338	385	mg/l
6	Calcium	132	145	mg/l as Ca
7	Magnesium	48	54	mg/l as Mg
8	Total Suspended Solids	37	50	mg/l
9	Total dissolved Solids	375	405	mg/l
10	Chlorides	195	225	mg/l as Cl-
11	Sulphates	27	25	mg/l as SO <sub>4</sub>
12	Fluoride	0.44	0.51	mg/l as F
13	Silica	20.4	19.7	mg/l as SiO <sub>3</sub>
14	Iron	0.18	0.23	mg/l as Fe
15	Nitrate	0.17	0.19	mg/l as NH <sub>3</sub> N
16	Copper	BDL	BDL	mg/l as Cu
17	Zinc	BDL	BDL	mg/l as Zn
18	Lead	BDL	BDL	mg/l as Pb
19	Cadmium	BDL	BDL	mg/l as Cd

Sample 1: Groundwater sample from sector 23

Sample 2: Groundwater sample from sector 15

#### Soil Environment:

Soil samples were collected from the project site twice in the study period in the month of April and May. These samples were tested for various physicals and chemical parameters

TABLE VIII  
SOIL SAMPLE ANALYSIS REPORT

Parameter	Unit	Sample 1	Sample 2
pH		7.3	7.4
Moisture Content	%	14.6	15.1
Fixed residue	%	96.5	95.3
Organic content	%	3.5	4.7
Chloride as Cl	ppm	0.27	0.24
Sulphates as SO <sub>4</sub>	ppm	0.12	0.16
CaO	ppm	4527	4327

Sc	ppm	10	12
V	ppm	76	80
Cr	ppm	90	87
MnO	%	0.05	0.05
Fe <sub>2</sub> O <sub>3</sub>	%	3.87	4.01
Co	ppm	103	121
Ni	ppm	38	35
Cu	ppm	16	18
Zn	ppm	55	51

### Socio-Economic Environment:

TABLE IX  
DETAILS OF TOTAL POPULATION IN CHANDIGARH

Total Number of Districts	1
Total Number of Sub-Districts	1
Total Number of Villages	24
Total Number of Inhabited Villages	23
Total Number of Towns	1
Total Number of Statutory Towns	1

Total Population		Persons	Males	Females
	Total	900,635	506,938	393,697
	Rural	92,120	56,816	35,304
Population (0-6)		115,613	62,664	52,949
Literates ( 7 years and above)		643,245	382,686	260,556
Total workers		340,422	284,419	56,003
Main workers		328,989	277,050	51,939
Marginal workers		11,433	7,369	4,064
Cultivators		2,141	1,687	454
Agricultural Laborers		563	461	102
Household industry workers		3,880	2,504	1,376
Other workers		333,838	279,767	54,071
Literacy rate		81.9	86.1	76.5
Work participation rate		37.8	56.1	14.2
Percentage of total workers:				
Main workers		96.6	97.4	92.7
Marginal workers		3.4	2.6	7.3
Categories of total workers cultivators		0.6	0.6	0.8
Agricultural laborers		0.2	0.2	0.2
Household		1.1	0.9	2.5
Other workers		98.1	98.4	96.6

### IV. EVACUATION OF IMPACTS – PRESENTATION IN MATRIX FORM

In this study, an analogous model will be used to predict the impacts. The presentation of such prediction is best exhibited in matrix form. A derivative of the Leopold and Interaction form of matrix is proposed to be used. The matrix would incorporate a list of project activities that have potential environmental impact characteristics. Project actions are in horizontal row and environmental components in the vertical column. Adverse/ Beneficial impacts is indicated by (-) or (+) sign. Each environmental parameter is given a weightage to indicate its importance in applied scenario. This ranges from 0 (insignificant) to 150 (important/dominant). Increments are made in quantum of 25 or 50. Scoring of impacts range from -10 to +10. The scorings are tabulated below:

TABLE X  
IMPACT SCORING

Effect	Impact	Score
No effect/ damage	No impact	0 to 1
Short term	Slight impact	2
Occasionally reversible	Appreciable	4
Long term	Considerable	6
Permanent	Permanent	8
Drastic	Immediate	10

The activity impact matrix has been evaluated and prepared. 10 relevant environmental parameters have been studied for 8 activities of the project. The significance of weighted score evaluated as:

TABLE XI  
SIGNIFICANCE OF WEIGHTED SCORE

Up to 2500	No appreciable Impact on the Environment
2500-5000	Appreciable Impact & Appropriate Measures Required
5000-7500	Significant Impact; Major Environmental Control Required
7500-10000	Major Impact, Project Site to be considered
>10000	Not suitable: Alternate Site to be considered

If any of the activity results more than -10, the activity should be shelved.

### The Nomenclature used

W = Weight, A = Human Activities, B = Solid Waste, C = Liquid Effluent, D = Gas Emission,  
E = Parking Space Development, F= Transportation, G = Temporary Housing, H = Landscaping,  
NE = Net Effect, S = Scores. EP = Environment Parameter

TABLE XII  
PROJECT MATRIX

EP	W	A	B	C	D	E	F	G	H	NE	S
Land	100	0	-2	-1	0	-2	-2	0	5	-2	-200
Biotic Environ.	100	-1	-1	-2	-2	0	0	0	4	-2	-200
Air Quality	150	-1	0	0	-3	-1	-1	0	3	-3	-450
Ground Water	50	0	-2	-2	0	-1	0	0	2	-2	-100
Health	100	0	-2	-1	-1	-1	-1	0	3	-3	-300
Noise	100	-2	0	0	0	0	-1	-1	1	-3	-300
Employ.	100	1	1	1	1	4	2	0	0	10	1000
Socio Economic	100	1	0	0	0	4	0	-1	1	5	500
Safety	150	1	-3	-1	-2	-1	-1	0	1	-6	-900
Aesthetics	50	0	-1	-1	-1	1	-1	1	4	2	100

Net Total = -850

The Parking Project, without the meditative measures scores -850 points. This indicates that there would be no significant impact on the environment.

### V. MITIGATION MEASURES

The main aim of mitigation measures is to protect and enhance the existing environment of the project. The measures should have positive effects on environment. Environmental mitigations are essential and shall be undertaken in various phase of project cycle viz. preconstruction, construction and operation stage of the project.

TABLE XIII  
ENVIRONMENTAL MANAGEMENT PLAN (EMP) DURING CONSTRUCTION PHASE

Environmental Impact	Mitigation Measure	Time Frame	Responsibility	
			Implementation	Supervision
Recycling of construction waste	Use leftover concrete, mortar, aggregates and sand in base layer of pavement.	Pavement construction	Contactar	MC Chandigarh
Air pollution control	Transport construction material during non-peak hours. Optimize use of construction machinery. Maintain and sprinkle water on haul roads, plan mixing of concrete at an offsite batching.	Through construction duration	Contactar	MC Chandigarh
Noise pollution control	Provide acoustics enclosures for generators, provide safety equipment to workers, adhere to maintain schedule of machinery, avoid honking of vehicles	Through construction duration	Contactar	MC Chandigarh
Solid waste management	Provide sufficient number of garbage bins, segregate various types of solid waste and dispose/use appropriately, Dispose of safely the empty containers of paints, pesticides and other hazardous waste	Through construction duration	Contactar	MC Chandigarh
Workers health hazard	First aid facility at work site. Provide safe drinking water and adequate sanitation facility for workers	Through construction duration	Contactar	MC Chandigarh

TABLE XIV  
ENVIRONMENTAL MANAGEMENT PLAN (EMP) DURING OPERATION PHASE

Environmental Impact	Mitigation Measure	Time Frame	Responsibility	
			Implementation	Supervision
Noise pollution control	Install Scrubber at the outlet of DG sets. Use low sulphur fuel for DG sets. Periodic maintenance of DG sets as per defined schedule of manufacturer. Maintaining proper stack height of DG sets create pollution sink and noise barrier through plantation	Throughout operation period	Maintenance Unit	MC Chandigarh
Solid waste management	Segregate biodegradable and non-biodegradable waste. Observe housekeeping and periodic maintenance	Throughout operation period	Maintenance Unit	MC Chandigarh

Based on above mitigation measures, the project matrix is redeveloped. The Criteria utilized here is same as used in previous project matrix.

TABLE XV  
PROJECT MATRIX AFTER MITIGATION MEASURES

EP	W	A	B	C	D	E	F	G	H	NE	S
Land	100	0	0	0	0	1	1	1	5	8	800
Biotic Environ.	100	0	0	0	-1	0	0	0	2	1	100
Air Quality	150	0	0	0	-1	0	-1	-1	1	-2	-300
Ground Water	50	0	0	-1	0	0	0	0	1	0	0
Health	100	0	0	0	0	0	0	0	0	0	0
Noise	100	0	0	0	0	-1	0	0	0	-1	-100
Employ.	100	3	1	1	1	2	2	2	0	12	1200
Socio Economic	100	1	0	0	0	2	2	2	0	9	900
Safety	150	-1	0	-1	-1	-1	-1	0	1	-4	-600
Aesthetics	50	1	0	-1	0	-1	1	2	2	4	200

Net Total = 2200

Since it's a Multi-Level Parking Project the impacts will be adverse to lesser extent. After taking these migratory measures if an emergency arises then it can be controlled without affecting the environment or human life. With Control/Mitigation measures, this set up of project scored 1850 points. This indicates that there would be no impact on the environment with appropriate and suitable environment control measures.

## VI. CONCLUSIONS

Parking facilities are one of the critical factor in smooth operation of traffic in commercial centers. The Proposed project is one of the projects planned to be developed for a long term positive consequences. The proposed Multi-level parking project at Chandigarh will help in fighting the menace of increasing congestion in commercial plaza of Sector 17 due to exponential increase in commuters and automobiles. The Multi-level parking project invariably has potential environmental effects during the construction and operation phase including effects on air, noise and land environment. The significance of construction impacts will be limited; the mitigation measures will be taken for appropriate timing and routing of materials, delivery, maintenance of sanitary facilities etc.

In addition to above, the potential impact is also associated with the operation of the project. The environmental impact on air quality and noise quality will be minimized. The effluent generated if any will be combined with existing sewage system of Municipal Corporation.

The Multi-level project is designed to promote efficient parking facility to benefit of the urban community. It is expected to bring in a number of positive impacts on the environment and general public. Depending upon their significance and magnitude, some of them could be considered as tangible while others could be viewed as intangible benefits. Most of the positive benefits would occur during the operation phase, some of the positive benefits expected from the proposed Muti-level parking have been given below:

- Reduced congestion in commercial area due to availability of adequate parking.
- Safe and comfortable mode of transportation.
- No wastage of time as there will a systematic and efficient be parking facility.
- Better business opportunities in the commercial plaza as the facility will attract more consumers.
- Reduction in vehicular emissions loads resulting in improved air quality of the region.



For further research of the environmental impact of the project, health related surveys can be conducted in the vicinity of the project. Statistical analysis to find the association between pollution data and related health issues prominent in the vicinity can be performed. Data collected during EIA monitoring phase can be used to evaluate the efficiency of environmental management plan of the project and to pin-point its limitations.

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