

SHIVAJINAGAR

PUNE

St. 10
6x350m

CP-39
E- 374465.9812
N- 2053560.8422
RL- 554.734

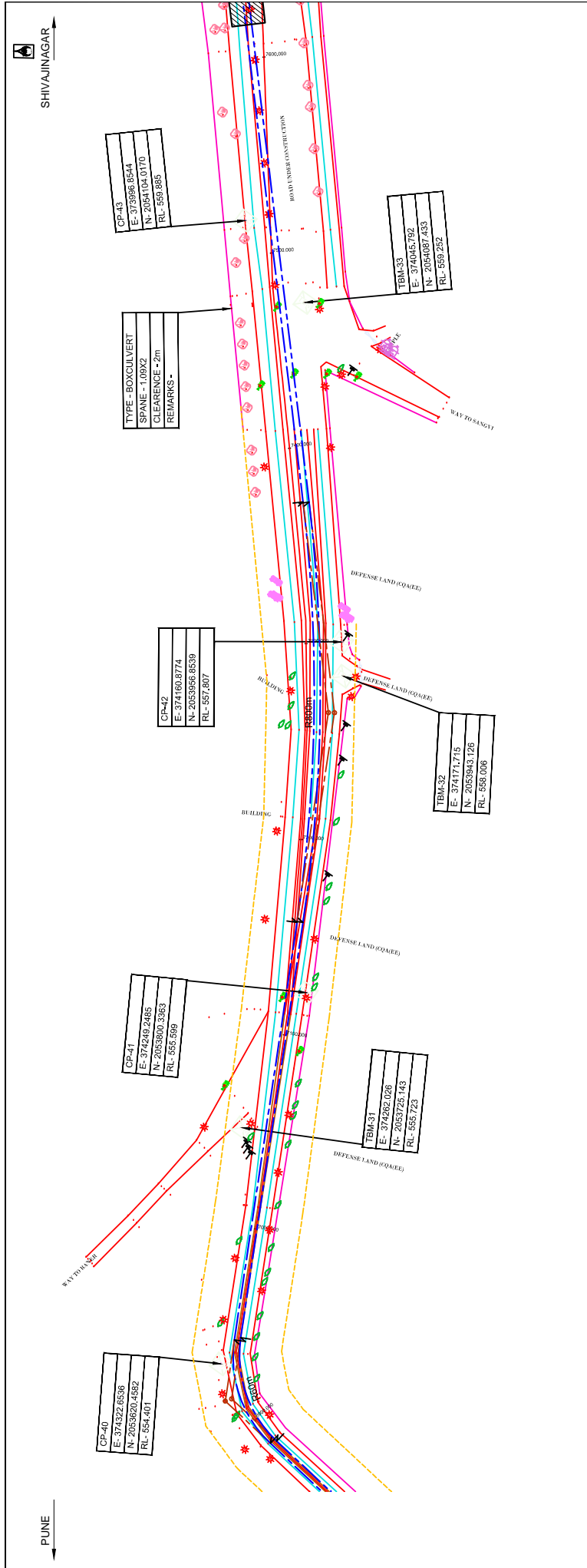
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N- 2053560.8422
RL- 555.156

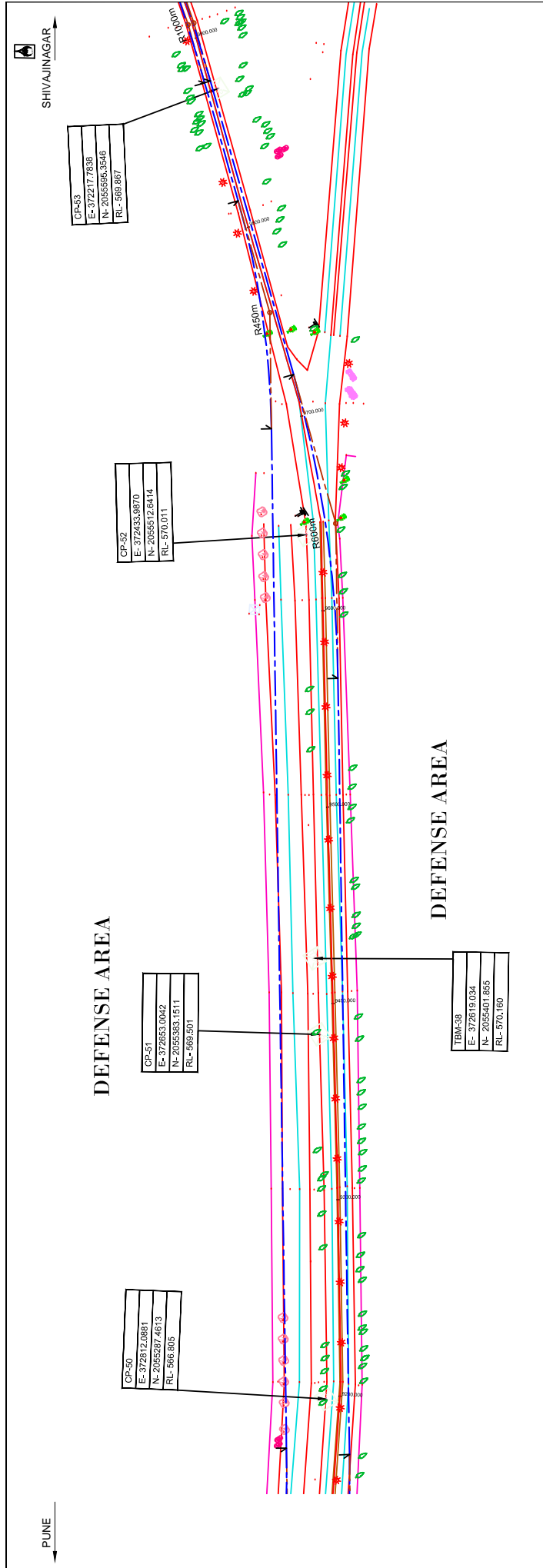
TBM-30
E- 374572.475
N- 2053499.817
RL- 556.639

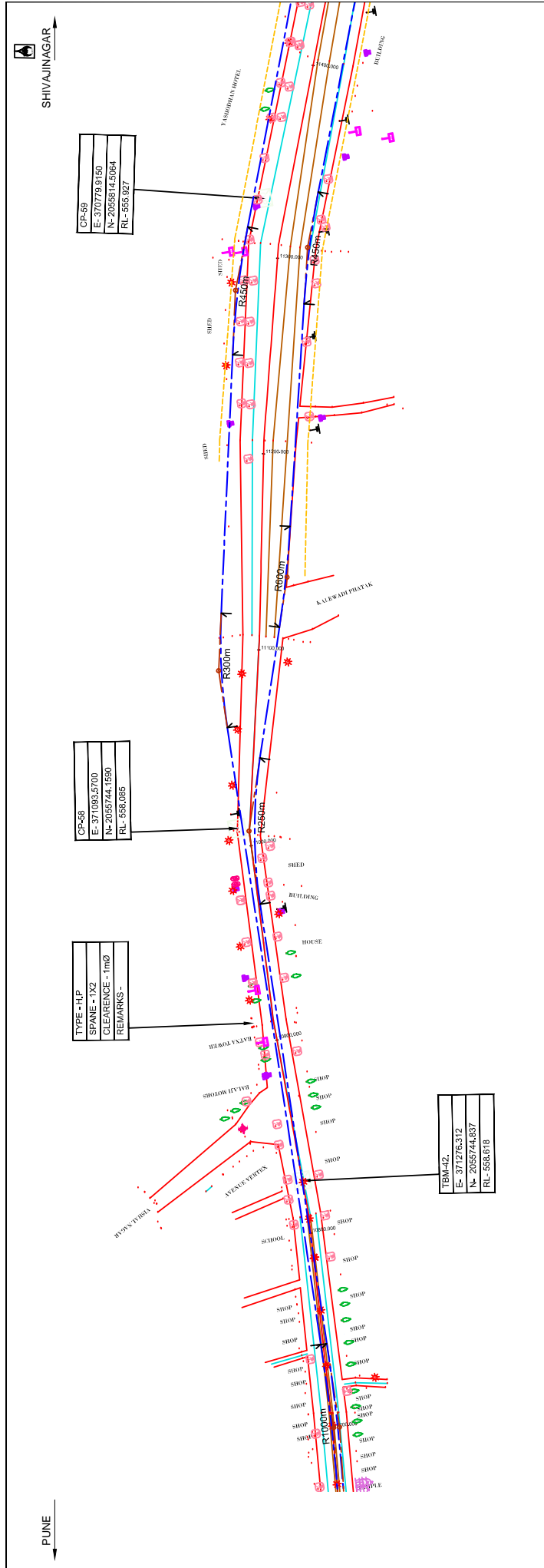
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E- 374583.2192
N- 2053561.2433
RL- 554.862

TBM-23
E- 374588.774
N- 2053528.161
RL- 555.027

TBM-27
E- 374718.936
N- 2053038.552
RL- 457.283







PUNE

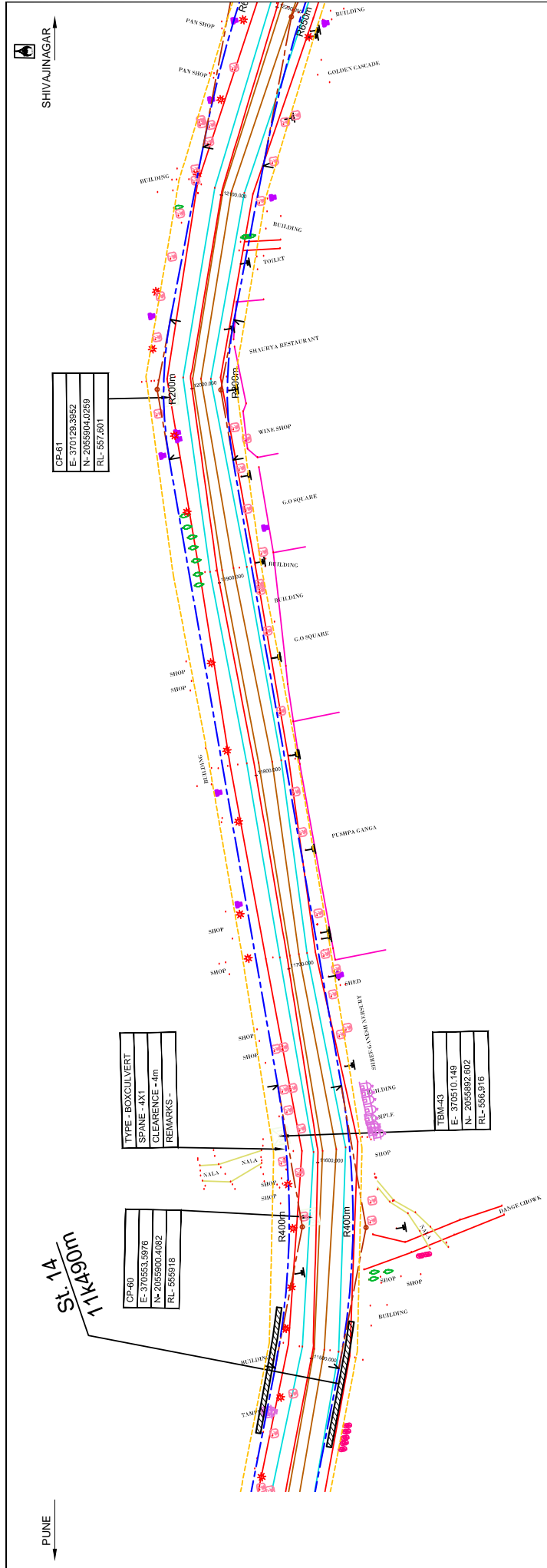
SHIVAJINAGAR

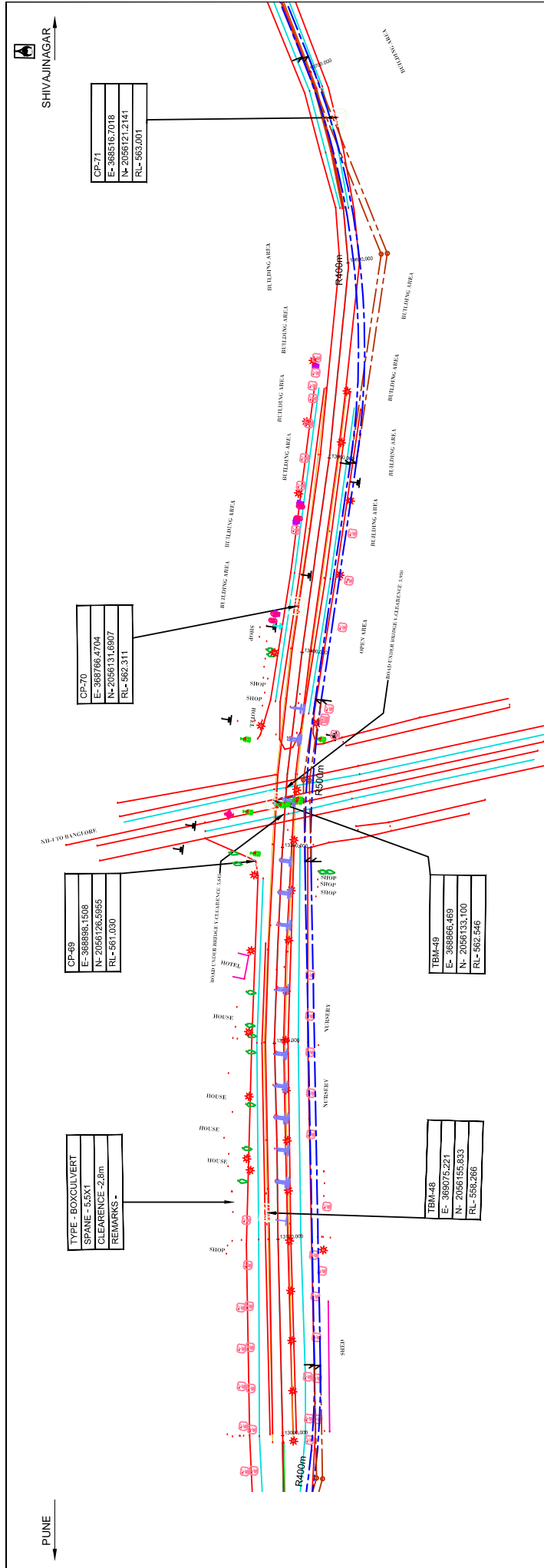
CP-59
E- 370779.9150
N- 2065874.8064
RL- 555.927

CP-48
E- 371093.5700
N- 2055744.1590
RL- 556.065

TYPE - H/P
SPAN - 1X2
CLEARANCE - 1mØ
REMARKS -

TBM-42
E- 371276.312
N- 2065744.837
RL- 556.718





TYPE - BOX CULVERT
SPAN - 5x5x1
CLEARANCE - 2.8m
REMARKS -

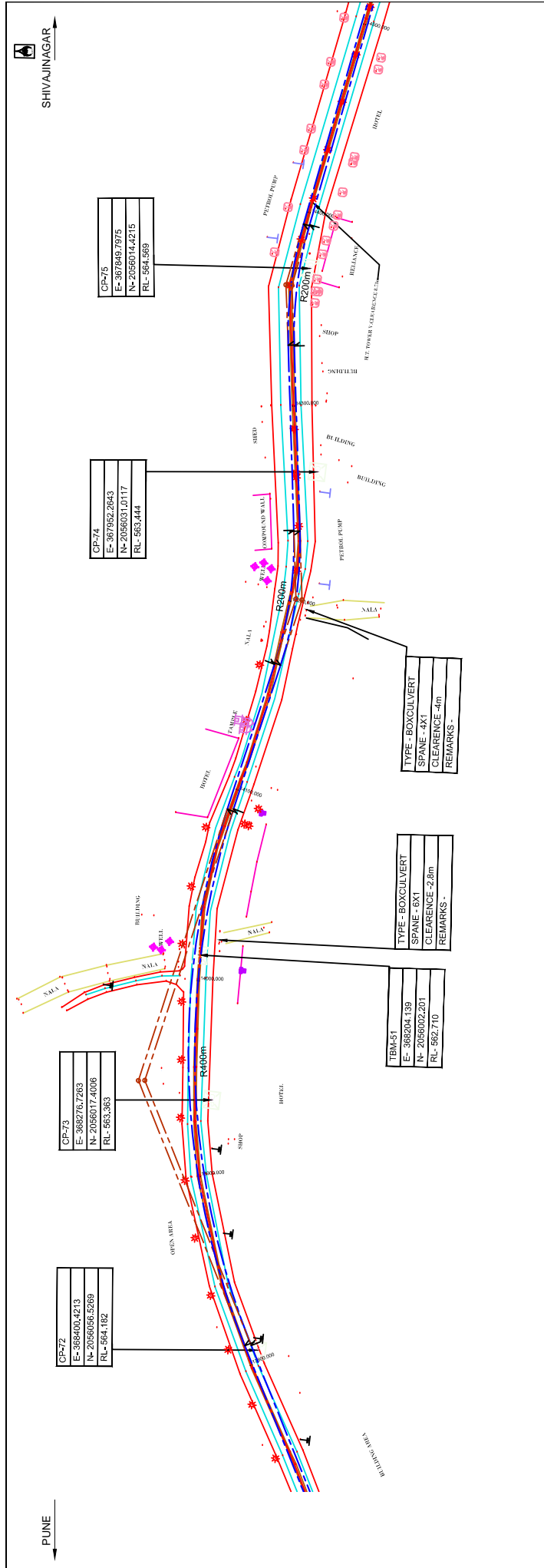
CP-69
E- 388988.1508
N- 2058126.9585
RL- 561.030

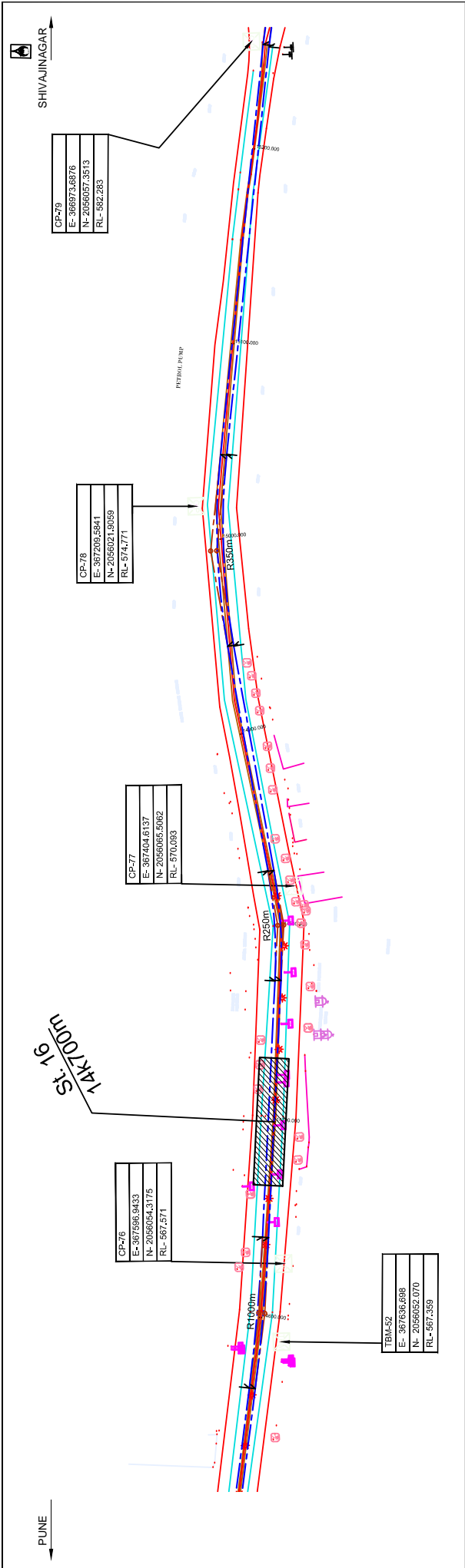
CP-70
E- 388766.4704
N- 2058131.6807
RL- 562.311

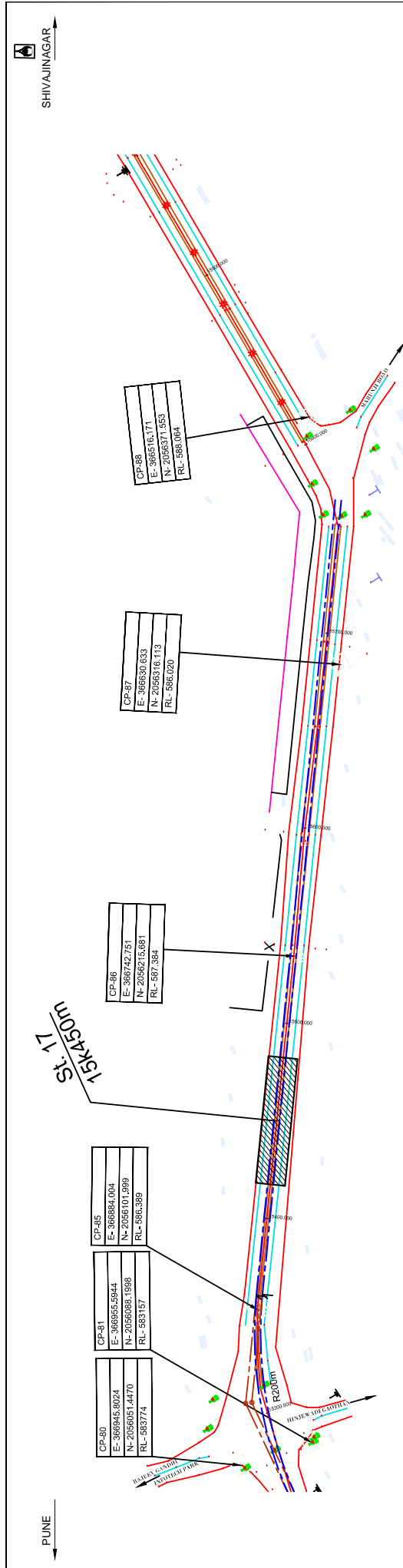
CP-71
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N- 2058121.2141
RL- 563.001

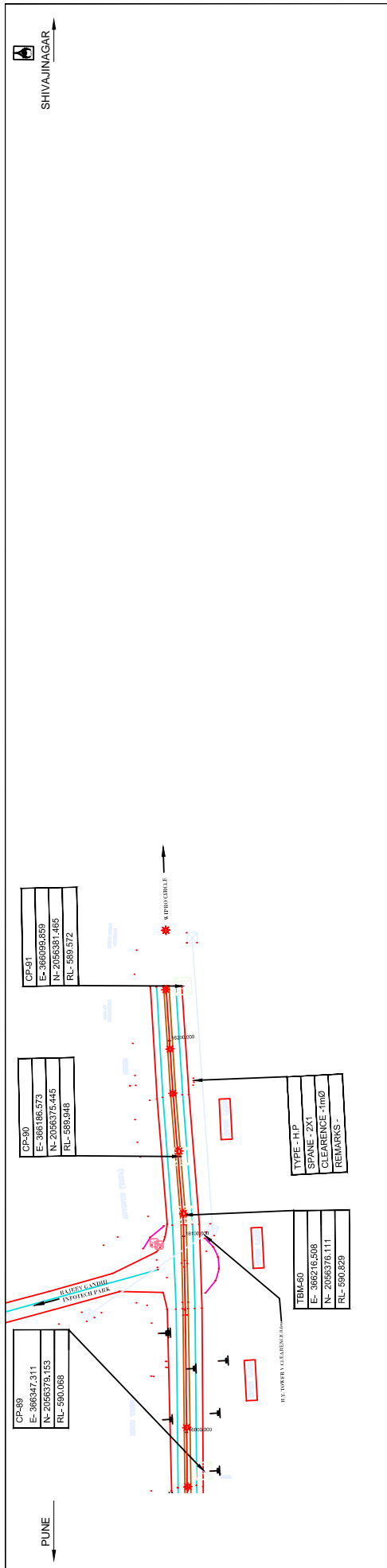
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E- 388075.221
N- 2058165.833
RL- 562.266

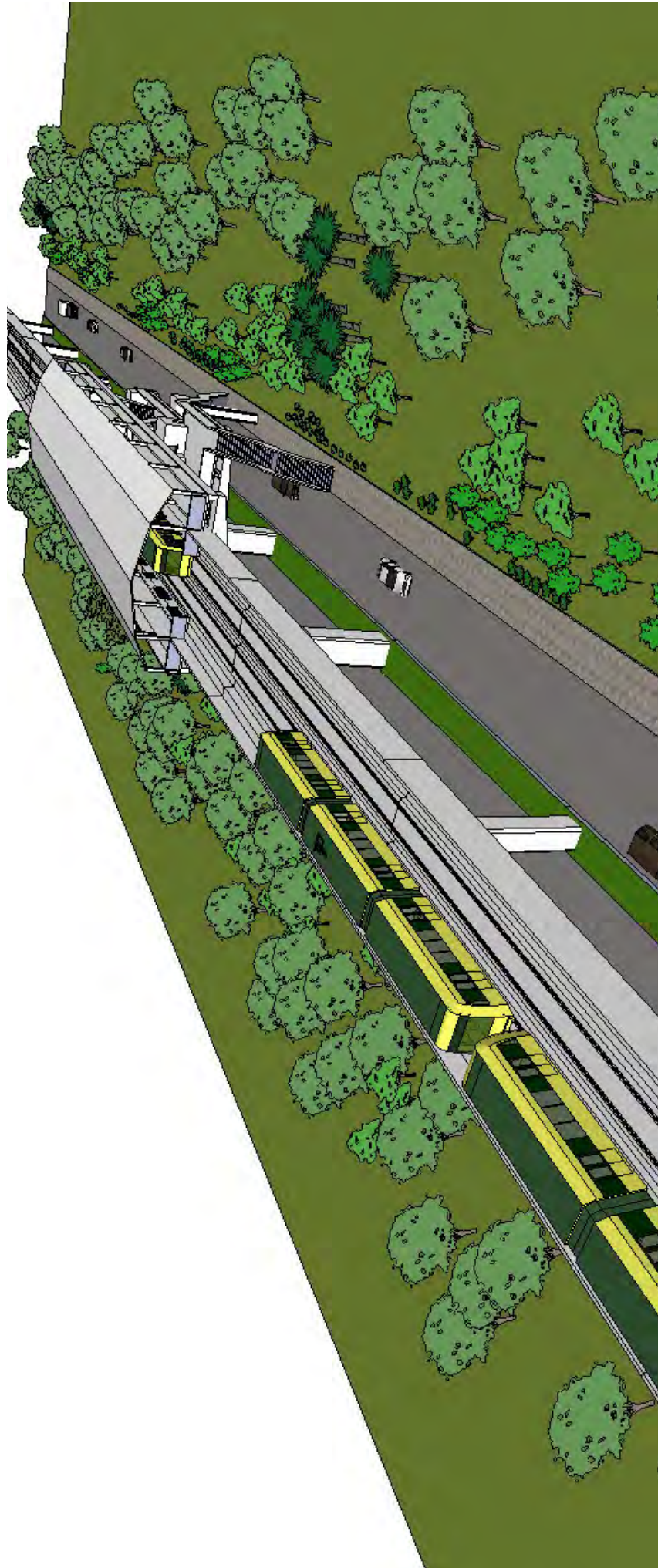
TBM-49
E- 388886.469
N- 2058133.100
RL- 562.546

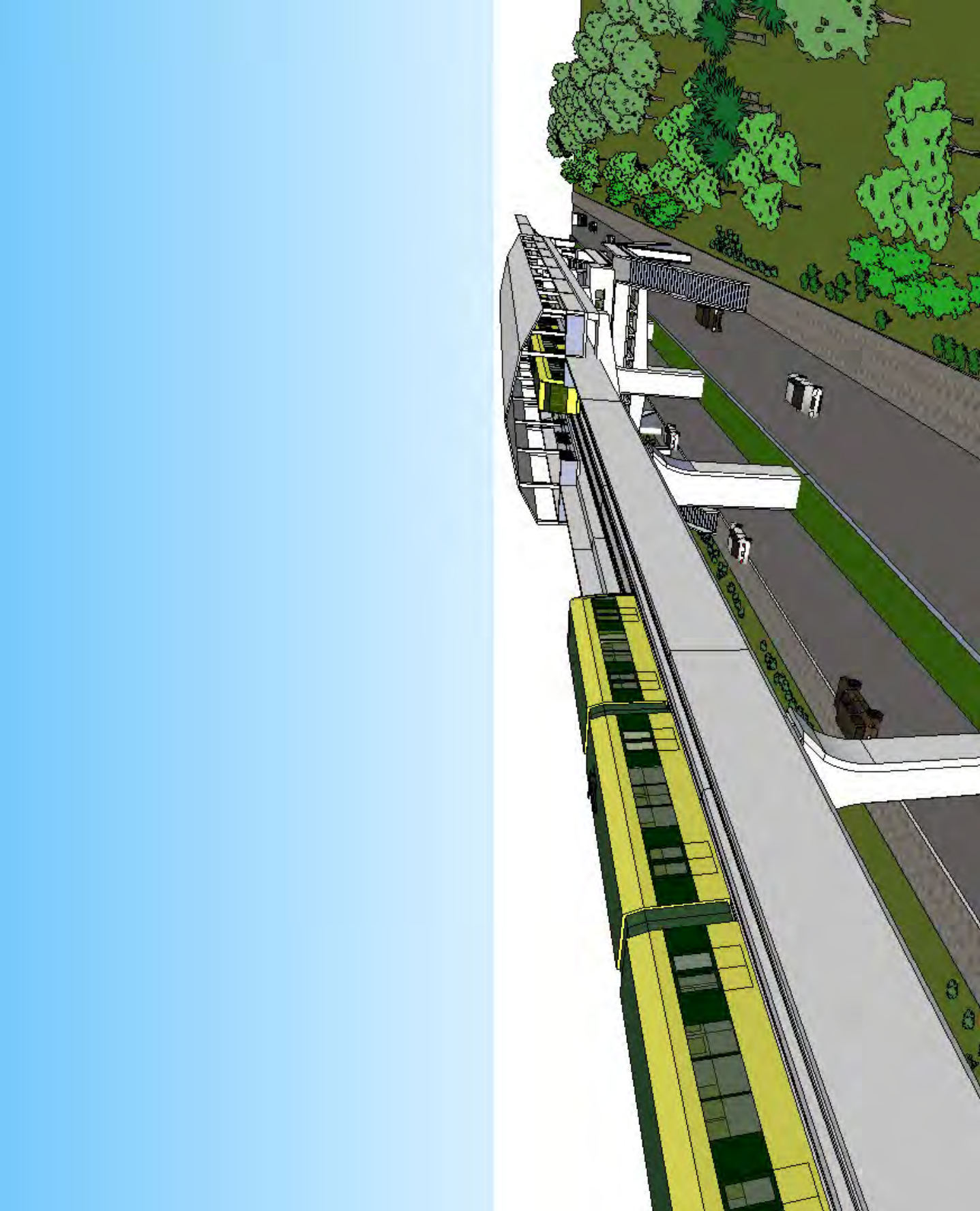




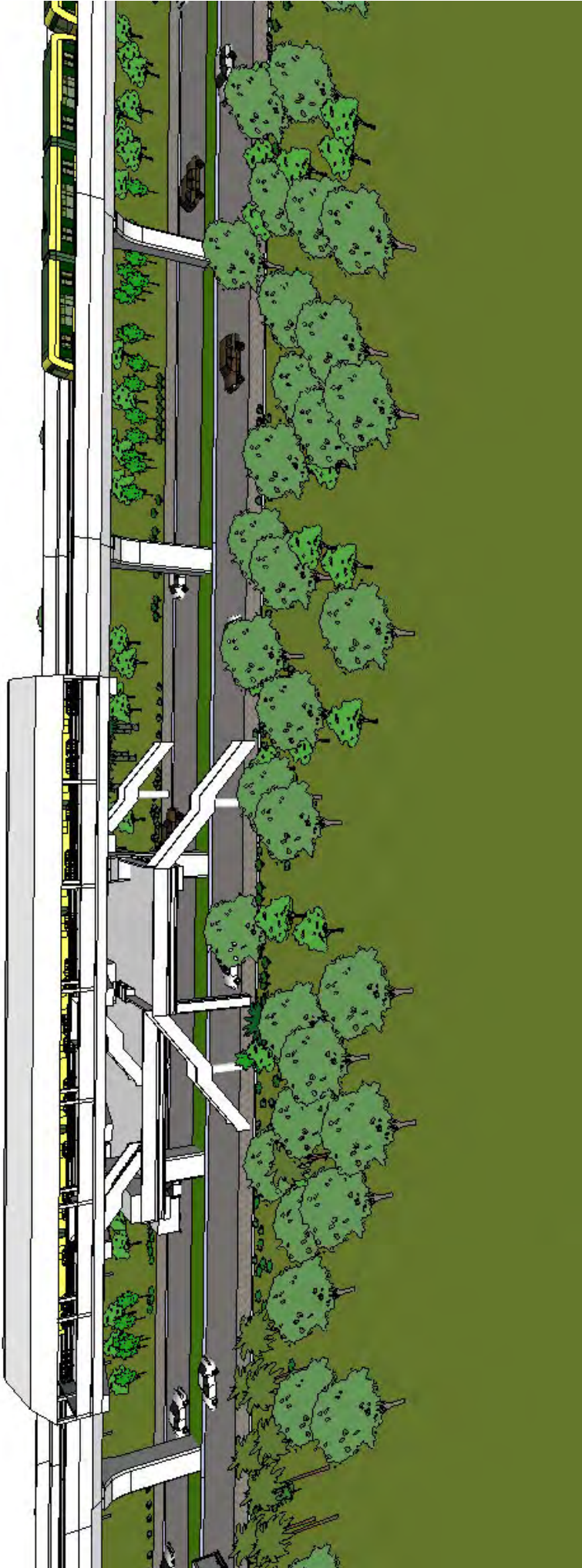




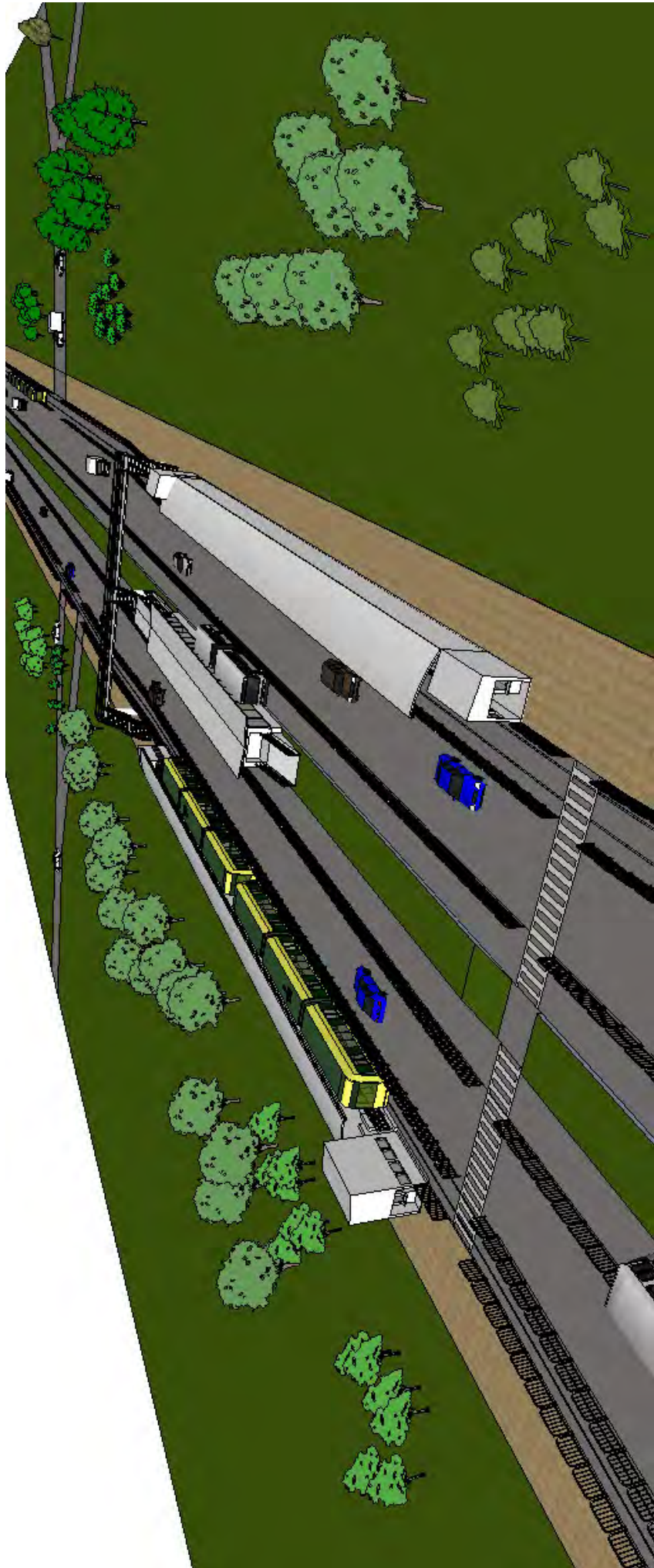


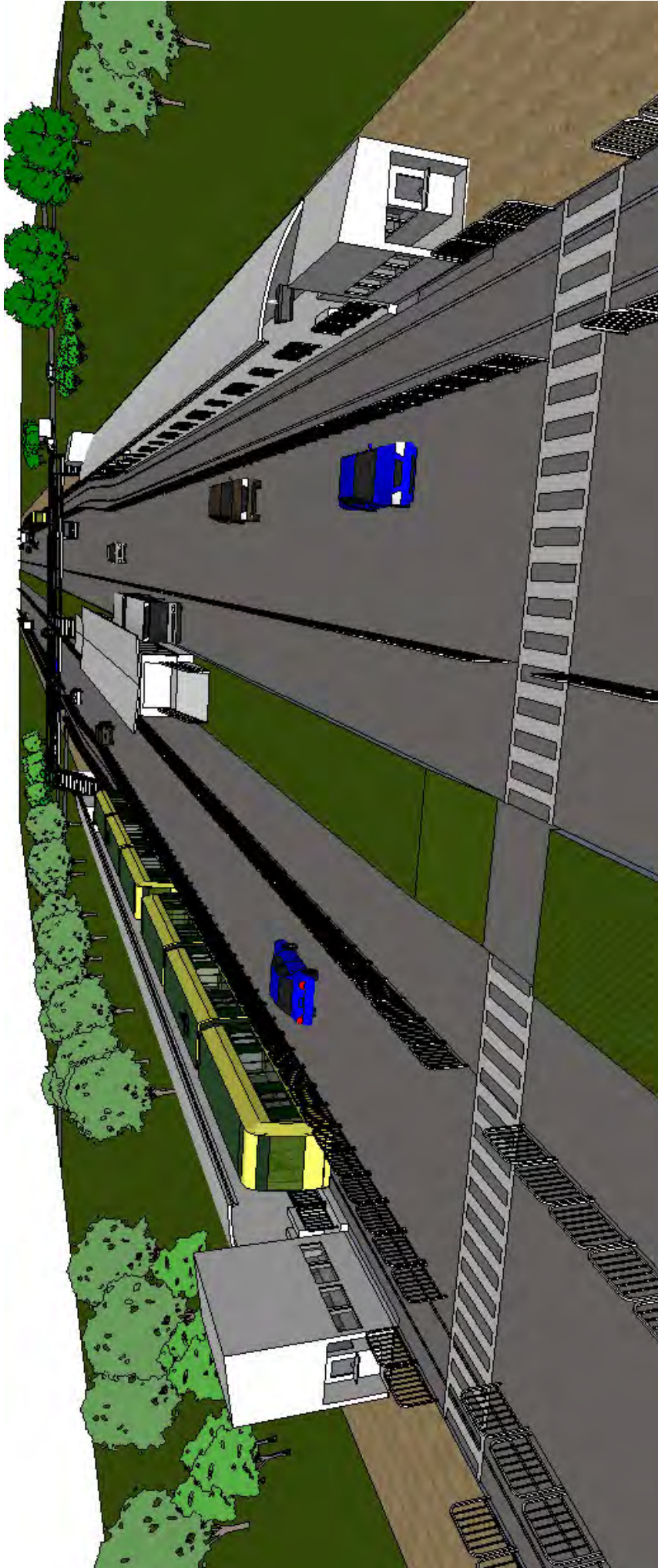


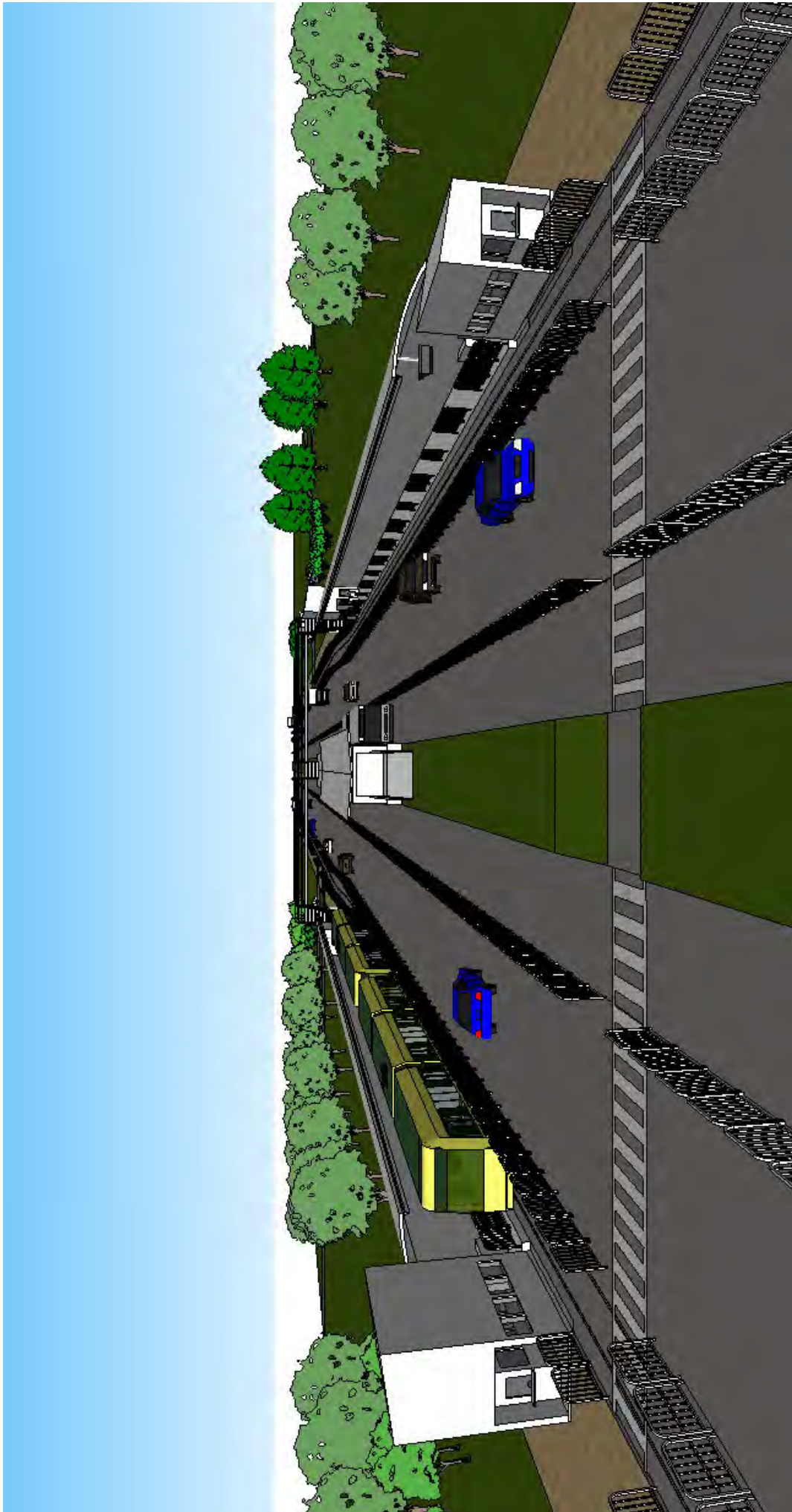


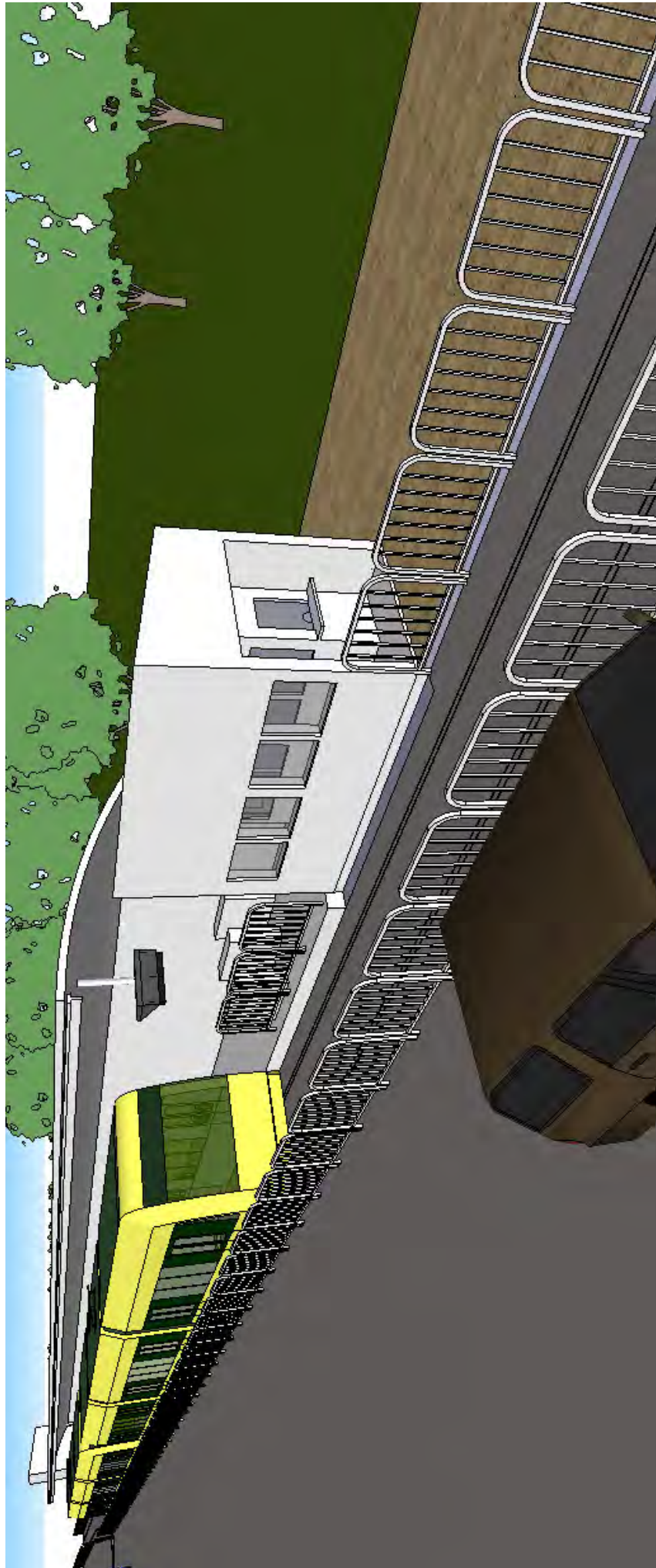


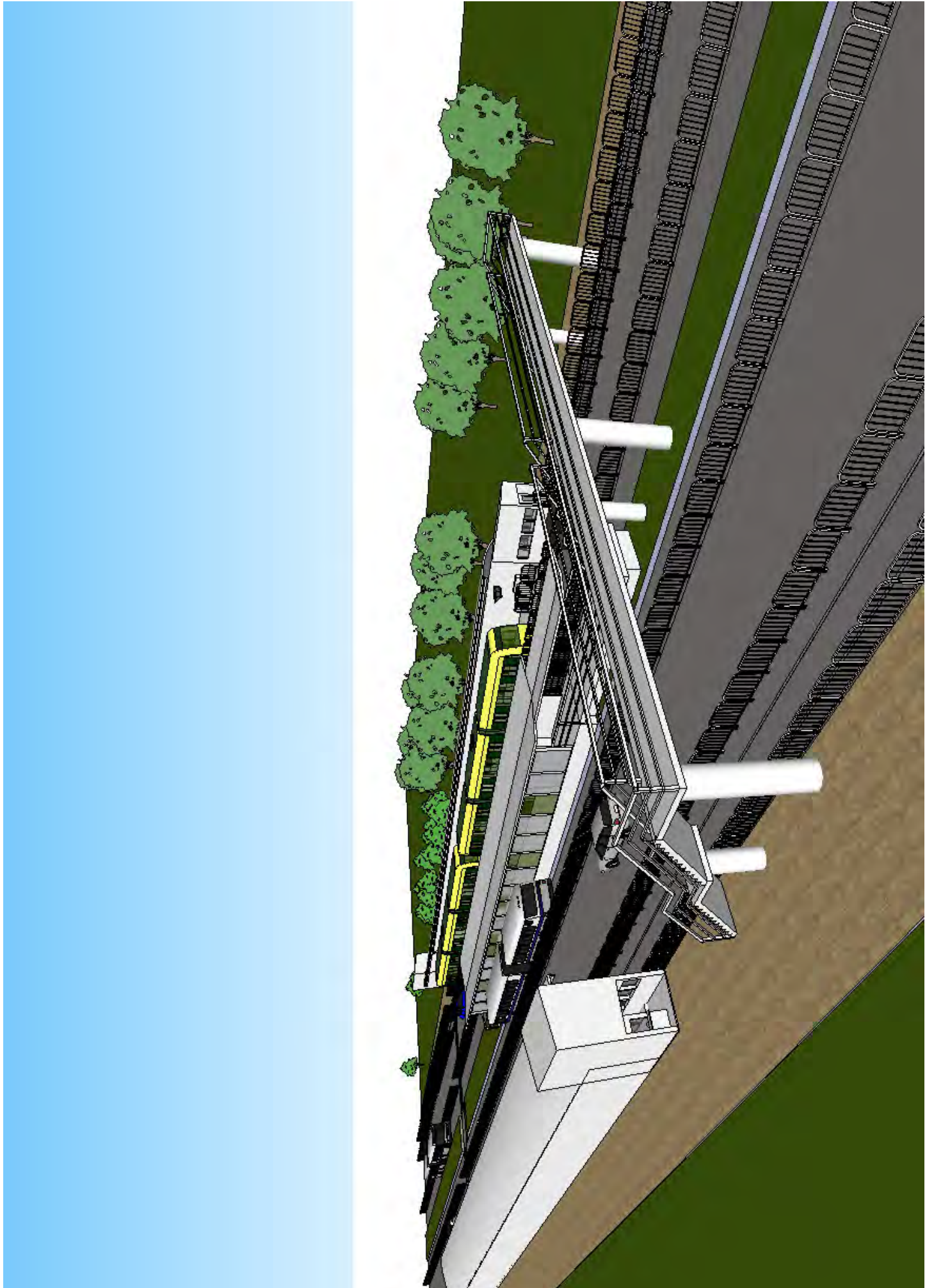












APPENDIX-18: Geological Column



Project : PREPARATORY SURVEY ON THE URBAN RAILWAY PROJECT IN PUNE																	
Borehole No: BH-01			CLIENT : ORIENTAL CONSULTANTS CO. LTD.				JOB NO : : IGPL-MUM-068/012										
Sheet : 1 of 1			Casing size (mm) : 150/76				Date of Start : : 08-07-2012										
T.D. (m) : 5.10 Below EGL			Drilling Equipment : Rotary Drilling Rig				Date of Completion : 08-07-2012										
			Co-ordinates : E 0379809 / N 2049029				Water Depth (m) : -----										
DEPTH BELOW EGL	SAMPLE & INSITU TEST DEPTH	TYPE	SPT - NUMBER OF BLOWS			Depth below EGL	SYMBOL	DESCRIPTION	C _u /φ KN/m ²	CLAY, %	SILT, %	SAND, %	GRAVEL, %	W _L / I _p / MC, %	TCR %	SCR %	RQD %
			0-15	15-30	30-45												
0	0.00 - 0.50	█				0.00	MADE GROUND (recovered as pieces of Basalt)										
1	0.50 - 1.50	█												22	9	9	
2	1.50 - 1.80	█	24	50	>100	1.50	Very dense, blackish, SAND	5	93		2						
3	2.10 - 3.60	█				2.10	Moderately weak to moderately strong, slightly weathered, greyish BASALT with secondary minerals infilling							99	95	91	
4	3.60 - 5.10	█												98	95	87	
5																	
6							Borehole Terminated at 5.10m below EGL										
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

Remarks :

Legends

□ - SPT █ - UDS █ - DS

W_L - Liquid Limit I_p - Plasticity Index MC - Moisture Content

T.D. : Termination Depth
EGL : Existing Ground Level
RL - Reduced Level

█ - Rock Recovery □ - No Recovery

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

CHECKED BY : KKJ

APPROVED BY : ST



Project : PREPARATORY SURVEY ON THE URBAN RAILWAY PROJECT IN PUNE

Borehole No: BH-02	CLIENT : ORIENTAL CONSULTANTS CO. LTD.	JOB NO :	: IGPL-MUM-068/012
Sheet : 1 of 1	Casing size (mm) : 150/76	Date of Start :	: 08-07-2012
T.D. (m) : 8.50 Below EGL	Drilling Equipment : Rotary Drilling Rig	Date of Completion ::	08-07-2012
Co-ordinates : E 0376342 / N 2050622		Water Depth (m) : -----	

DEPTH BELOW EGL	SAMPLE & INSITU TEST DEPTH	TYPE	SPT - NUMBER OF BLOWS			Depth below EGL	SYMBOL	DESCRIPTION	C _u / KN/m ²	CLAY, %	SILT, %	SAND, %	GRAVEL, %	W _L / I _p / MC, %	TCR %	SCR %	RQD %		
			0-15	15-30	30-45													N VALUE	
0	0.00 - 0.50					0.00	Very soft blakish CLAY with sand		25	59	15	1	59/25/-						
1	1.50 - 1.60		50 blows/5 cm		>100	1.50	MADE GROUND (recovered as gravel size BASALT fragments)												
2	2.50 - 4.00													25	-	-			
3	4.00 - 5.50													38	-	-			
4	5.50 - 6.00					5.50	Weak, highly weathered brownish BASALT							58	24	-			
5	6.00 - 7.50					6.00	Moderately weak to moderately strong slightly weathered greyish BASALT with secondary minerals							93	91	91			
6	7.50 - 8.50													97	73	73			
7																			
8																			
9							Borehole Terminated at 8.50m below EGL												
10																			
11																			
12																			
13																			
14																			
15																			

Remarks :

Legends

- SPT	- UDS	- DS	W_L - Liquid Limit	I_p - Plasticity Index	MC - Moisture Content	T.D. : Termination Depth EGL : Existing Ground Level RL - Reduced Level
- Rock Recovery	- No Recovery	TCR - Total Core Recovery	SCR - Solid Core Recovery	RQD - Rock Quality Designation		

CHECKED BY : KKJ

APPROVED BY : ST



Project : PREPARATORY SURVEY ON THE URBAN RAILWAY PROJECT IN PUNE

Borehole No: BH-03	CLIENT : ORIENTAL CONSULTANTS CO. LTD.	JOB NO : : IGPL-MUM-068/012
Sheet : 1 of 1	Casing size (mm) : 150/76	Date of Start : : 07-07-2012
T.D. (m) : 4.20 Below EGL	Drilling Equipment : Rotary Drilling Rig	Date of Completion :: 07-07-2012

Co-ordinates : E 0374621 / N 2053396

Water Depth (m) : -----

DEPTH BELOW EGL	SAMPLE & INSITU TEST DEPTH	TYPE	SPT - NUMBER OF BLOWS			Depth below EGL	SYMBOL	DESCRIPTION	C _u /φ KN/m ²	CLAY, %	SILT, %	SAND, %	GRAVEL, %	W _L / I _p / MC, %	TCR %	SCR %	RQD %
			0-15	15-30	30-45												
0	0.00 - 0.50	█				0.00	MADE GROUND (gravelly SAND)		7	23	41	29	40/13/-				
1	1.20 - 2.70	▨				1.20	Moderately strong, slightly weathered, greyish amygdaloidal BASALT							100	98	98	
2																	
3	2.70 - 4.20	▨												100	97	97	
4																	
5							Borehole Terminated at 4.20m below EGL										
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

Remarks :

Legends

□ - SPT █ - UDS ▨ - DS

W_L - Liquid Limit I_p - Plasticity Index MC - Moisture Content

T.D. : Termination Depth
EGL : Existing Ground Level
RL - Reduced Level

▨ - Rock Recovery □ - No Recovery

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

CHECKED BY : KKJ

APPROVED BY : ST



Project : PREPARATORY SURVEY ON THE URBAN RAILWAY PROJECT IN PUNE

Borehole No: BH-04	CLIENT : ORIENTAL CONSULTANTS CO. LTD.	JOB NO : : IGPL-MUM-068/012
Sheet : 1 of 1	Casing size (mm) : 150/76	Date of Start : : 05-07-2012
T.D. (m) : 7.00 Below EGL	Drilling Equipment : Rotary Drilling Rig	Date of Completion :: 05-07-2012

Co-ordinates : E 0368999 / N 2056129

Water Depth (m) : -----

DEPTH BELOW EGL	SAMPLE & INSITU TEST DEPTH	TYPE	SPT - NUMBER OF BLOWS			N VALUE	Depth below EGL	SYMBOL	DESCRIPTION	C _u /φ KN/m ²	CLAY, %	SILT, %	SAND, %	GRAVEL, %	W _L / I _p / MC, %	TCR %	SCR %	RQD %
			0-15	15-30	30-45													
0	0.00 - 0.50	█					0.00	Medium dense to dense sandy SILT (Filled up soil)		19	55	22	4	61/24/-				
1																		
2	1.50 - 1.95		11	19	25	44				9	43	41	7	60/25/-				
3																		
4	3.00 - 3.45		9	26	35	61	3.00	Very dense, reddish silty SAND		7	23	63	7	44/14/-				
5																		
6	4.00 - 5.50						4.00	Moderately strong, slightly weathered, reddish brown BASALT with secondary minerals							99	97	87	
7	5.50 - 7.00														98	71	42	
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
Borehole Terminated at 7.00m below EGL																		

Remarks :

Legends

- SPT - UDS - DS

W_L - Liquid Limit I_p - Plasticity Index MC - Moisture Content

- Rock Recovery - No Recovery

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

T.D. : Termination Depth
 EGL : Existing Ground Level
 RL - Reduced Level

CHECKED BY : KKJ

APPROVED BY : ST



Project : PREPARATORY SURVEY ON THE URBAN RAILWAY PROJECT IN PUNE

Borehole No: BH-05	CLIENT : ORIENTAL CONSULTANTS CO. LTD.	JOB NO : : IGPL-MUM-068/012
Sheet : 1 of 1	Casing size (mm) : 150/76	Date of Start : : 04-07-2012
T.D. (m) : 4.10 Below EGL	Drilling Equipment : Rotary Drilling Rig	Date of Completion : 05-07-2012
Co-ordinates : E 0366209 / N 2056397		Water Depth (m) : -----

DEPTH BELOW EGL	SAMPLE & INSITU TEST DEPTH	SPT - NUMBER OF BLOWS				Depth below EGL	SYMBOL	DESCRIPTION	C _u /φ KN/m ²	CLAY, %	SILT, %	SAND, %	GRAVEL, %	W _L / I _p / MC, %	TCR %	SCR %	RQD %
		0-15	15-30	30-45	N VALUE												
0	0.00 - 0.50					0.00	MADE GROUND (SANDY SILT)		7	36	54	3	37/8/-				
1	0.80 - 1.10													NIII	NIII	NIII	
2	1.10 - 2.60					1.10	Moderately weak to moderately strong, slightly weathered reddish brown amygdaloidal BASALT							96	71	16	
3	2.60 - 4.10													97	95	74	
4																	
5							Borehole Terminated at 4.10m below EGL										
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

Remarks :

Legends

□ - SPT ■ - UDS ▨ - DS

W_L - Liquid Limit I_p - Plasticity Index MC - Moisture Content

T.D. : Termination Depth
EGL : Existing Ground Level
RL - Reduced Level

▨ - Rock Recovery □ - No Recovery

TCR - Total Core Recovery SCR - Solid Core Recovery RQD - Rock Quality Designation

CHECKED BY : KKJ

APPROVED BY : ST

Bore Hole No	Depth (m)		Sample Type (D/S/SPT/UDS)	MMC (%)	Density (t/m ³)		Soil Classification (USC)	Grain Size Analysis (%)			Consistency Limits (%)			Swell Properties		Triaxial Shear Test		Direct Shear Test		Consolidation Test			Standard/Modified Proctor	Laboratory CBR (%)			Specific Gravity (G)	Remarks		
	From	To			Mechanical analysis	Silt		Clay	Liquid (w _L)	Plastic (w _p)	Shrinkage (w _s)	Free Swell Index (%)	Swelling Pressure (Mpa)	Type of Test: UU	φ ^o	Type of Test: CD	φ ^o	Pre Consolidation Pressure (Mpa)	Comm. pressure Index (C _c)	Initial Void Ratio (e ₀)	Soaked	Unsoaked		2.5 mm	5.0 mm	2.5 mm			5.0 mm	6.0 mm
	Gravel	Sand			Hydrometer Analysis	Plasticity Index (I _p)		Free Swell	C (Kpa)	φ ^o	CD	φ ^o	Swelling Pressure (Mpa)	φ ^o	φ ^o	φ ^o	φ ^o	φ ^o	φ ^o	φ ^o	φ ^o	φ ^o		φ ^o	φ ^o	φ ^o			φ ^o	φ ^o
BH-01	1.50	1.80	SPT	-	-	-	-	2	93	5	-	N/P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BH-02	0.00	0.50	D/S	-	-	-	-	1	15	59	25	34	25	-	-	-	-	-	-	-	-	-	-	-	-	-	2.54			
BH-03	0.00	0.50	D/S	-	-	-	-	29	41	23	7	27	13	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6			
BH-04	0.00	0.50	D/S	-	-	-	-	4	22	55	19	37	24	-	-	-	-	-	-	-	-	-	-	-	-	-	2.68			
	1.50	1.95	SPT	-	-	-	-	7	41	43	9	35	25	-	-	-	-	-	-	-	-	-	-	-	-	-	2.58			
	3.00	3.45	SPT	-	-	-	-	7	63	23	7	30	14	-	-	-	-	-	-	-	-	-	-	-	-	-	2.64			
BH-05	0.00	0.50	D/S	-	-	-	-	3	54	36	7	29	8	-	-	-	-	-	-	-	-	-	-	-	-	-	2.66			



SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Job No :IGPL-MUM/

Project : PREPARATORY SURVEY ON THE URBAN RAILWAY PROJECT IN PUNE
 CLIENT : ORIENTAL CONSULTANTS CO. LTD.

D/S - Disturbed Sample
 UDS - Undisturbed Sample
 NMC - Natural Moisture Content
 C - Cohesion in Mpa
 UU - Un-Consolidated Un-drained
 CU - Consolidated Un-Drained
 CD - Consolidated Drained
 φ - Angle shearing resistance

Prepared By : VN

Checked By : TVS

Approved By : SJT

Tested By : KB



SUMMARY OF LABORATORY TEST RESULTS ON ROCK SAMPLES

Project : PREPARATORY SURVEY ON THE URBAN RAILWAY PROJECT IN PUNE

Job No. : IGPL-MUM-068/012

Date : 13/7/2012

BH No.	Depth(m)	Length (cm)	Diameter (cm)	Test Condition	Moisture Absorption (%)	Porosity (%)	Unit Weight (g/cm ³)	Specific Gravity	Point Load Index Strength(Mpa)	Uniaxial Compressive Strength (Mpa)	Corrected Uniaxial Compressive Strength (Mpa)	Modulus of Elasticity	Brazilian Test	Remarks
BH-1	2.10-3.50	4.72	5.31	SOAKED	2.18	4.89	2.24	2.34	0.65	14.24	12.32	-	-	
	2.10-3.50	10.65	5.41	SOAKED	1.20	3.14	2.62	2.67	-	37.00	36.92	-	-	
	3.60-5.10	10.32	5.46	SOAKED	1.09	2.82	2.60	2.56	-	7.74	7.68	-	-	
BH-2	5.50-6.00	3.53	5.32	SOAKED	1.43	3.70	2.59	2.54	0.14	3.16	2.52	-	-	
	6.00-7.50	10.63	5.44	SOAKED	0.99	2.46	2.50	2.53	-	27.62	27.53	-	-	
	6.00-7.50	10.60	5.44	SOAKED	2.69	6.17	2.29	2.31	-	22.54	22.47	-	-	
BH-3	7.50-8.90	10.68	5.46	SOAKED	1.14	2.96	2.59	2.60	-	34.67	34.57	-	-	
	1.20-2.70	10.60	5.45	SOAKED	2.67	6.48	2.43	2.45	-	23.69	23.61	-	-	
	2.70-4.20	10.67	5.43	SOAKED	1.57	3.96	2.52	2.55	-	43.02	42.92	-	-	
BH-4	4.00-5.50	10.67	5.44	SOAKED	1.15	2.94	2.57	2.60	-	29.90	29.83	-	-	
	5.50-7.00	10.72	5.44	SOAKED	1.33	3.44	2.59	2.74	-	27.92	27.87	-	-	
	5.50-7.00	6.81	5.41	SOAKED	1.85	4.66	2.51	2.54	0.50	10.91	10.16	-	-	
BH-5	1.10-2.60	6.04	5.44	SOAKED	1.45	3.78	2.61	2.52	0.85	18.64	16.95	-	-	
	1.10-2.60	10.73	5.39	SOAKED	0.93	2.41	2.58	2.63	-	29.49	29.47	-	-	
	2.60-4.10	10.65	5.41	SOAKED	1.22	2.98	2.44	2.49	-	42.99	42.90	-	-	

Checked By: VN

Approved by : ST

Table A20-2 Roadside OD Survey Sheet

Urban Railway Project in Pune City Roadside OD Passenger Survey Sheet

Name of the Road :

Interviewer :

Location:

Date :

Direction:

Day :

Time (24:00 Hour Format)

Vehicle Type	Occupancy	Trip Frequency	Origin of Trip	Destination of Trip	Purpose of Trip	How many times a week do you usually ride the bus?	"Do you use public transport when private transport is available?"**	"If so, what is the main reason?***

Vehicle type

1. Two-Wheeler
2. Three-Wheeler
3. Car
4. Van
5. Taxi- Small
6. Taxi- Large

Trip frequency

1. Multiple trips a day
2. Daily
3. Alternate Day
4. Weekly
5. Fortnightly
6. Monthly

Purpose of trip

1. Work
2. Business
3. Education
4. Social
5. Tourism & Recreation
6. Others

1. Faster
2. Less expensive
3. Others(Please specify)

- Yes
- No

Source: Study Team

Table A20-3 Stated Preference Sheet

Urban Railway Project in Pune City Stated Preference Survey Format Pune Metro Region & JICA

Date Of Survey:
Location Name:

Enumerator's Name:

1 Personal Details

Age
Occupation
Sex

2 Vehicle Ownership

No	
Car	<input type="text"/> 1 <input type="text"/> >1
2-Wheeler	<input type="text"/> 1 <input type="text"/> >1

3 Monthly Income in Rs (check one)

<10000	<input type="checkbox"/>
10000-20000	<input type="checkbox"/>
20000-30000	<input type="checkbox"/>
30000 to 50000	<input type="checkbox"/>
50000 to 75000	<input type="checkbox"/>
75000 to 1 lakh	<input type="checkbox"/>
Above 1 lakh	<input type="checkbox"/>

4 Do you receive a commutation allowance?

allowance? Circle one: Yes No
If yes, how much? Rs. per month

5 Travel Particulars (Please specify full travel details)

Origin
Destination
Start Time In Hrs
End time in Hrs

6 Dominant Mode of Travel

Two-wheeler	<input type="checkbox"/>
Own Car	<input type="checkbox"/>
Taxi	<input type="checkbox"/>
Company Bus	<input type="checkbox"/>
Public Bus	<input type="checkbox"/> AC/Non-AC
Three-Wheeler	<input type="checkbox"/>
Shared Auto	<input type="checkbox"/>
Shared Taxi	<input type="checkbox"/>

7 Frequency of Trip

Daily
Alternate Days
Weekly
Occasionally

8 Purpose

1. Work	<input type="text"/>
2. Business	<input type="text"/>
3. Education	<input type="text"/>
4. Social	<input type="text"/>
5. Tourism & Recreation	<input type="text"/>
6. Other	<input type="text"/>

9. Parking Fee (Rs) if any you paid

8. Accompanied Travelers

No. of Adults
No. of Children

Pune and PCMC are considering to implement Light Rail Transit (LRT) service from Shivaji Nagar to Hinjewadi. LRT service frequency will be every five minutes & will be completely air-conditioned. There will also be feeder services & parking facilities at major stations. In this regard, we wish to know your opinion about your willingness to shift to the LRT given the scenarios below.

10. SCENARIOS & RANKING, Please give your opinion based on your present mode of travel

Bus					
Circle the Distance of Your Trip on the LRT Corridor (Distance in Km)	Max. Savings in Minutes if you Use LRT (incl. waiting & in-vehicle time)	How much are you willing to pay to ride on the LRT for your trip given the stated savings in time? Tick (✓) the appropriate option.			
		Fare Level-1	Fare Level-2	Fare Level-3	Fare Level-4
<=3	13	8	12	16	20
3-6	18	11	17	22	26
6-9	23	14	21	28	39
9-12	34	17	26	34	52
12-15	40	21	32	42	65
Car/2-Wheeler					
Circle the Distance of Your Trip on the LRT Corridor	Max. Savings in Minutes if you Use LRT (incl. waiting & in-vehicle time)	How much are you willing to pay to ride on the LRT for your trip given the stated savings in time? Tick (✓) the appropriate option.			
		Fare Level-1	Fare Level-2	Fare Level-3	Fare Level-4
6-9	7	14	21	28	39
9-12	15	17	26	34	52
12-15	20	21	32	42	65
3-wheeler					
Circle the Distance of Your Trip on the LRT Corridor	Max. Savings in Minutes if you Use LRT (incl. waiting & in-vehicle time)	How much are you willing to pay to ride on the LRT for your trip given the stated savings in time? Tick (✓) the appropriate option.			
		Fare Level-1	Fare Level-2	Fare Level-3	Fare Level-4
<=3	7	8	12	16	20
3-6	11	11	17	22	26
6-9	15	14	21	28	39
9-12	25	17	26	34	52
12-15	30	21	32	42	65

How much is your bus fare for the selected distance?

Rs.

How much is your fare for the selected distance?

Rs.

Source: Study Team

APPENDIX-21: LRT Demand Forecast for the Year 2048

Below, an estimate of the travel demand for the LRT in 2048 is carried out and the sufficiency of its transportation capacity confirmed.

First, the population for Pune Metropolitan Region (PMR) for 2048 is estimated based on the trend analysis of the data indicated in section 3.6 of the main report. As illustrated in Figure A21-1, the population of PMR in 2048 will become approximately 14.52 million.

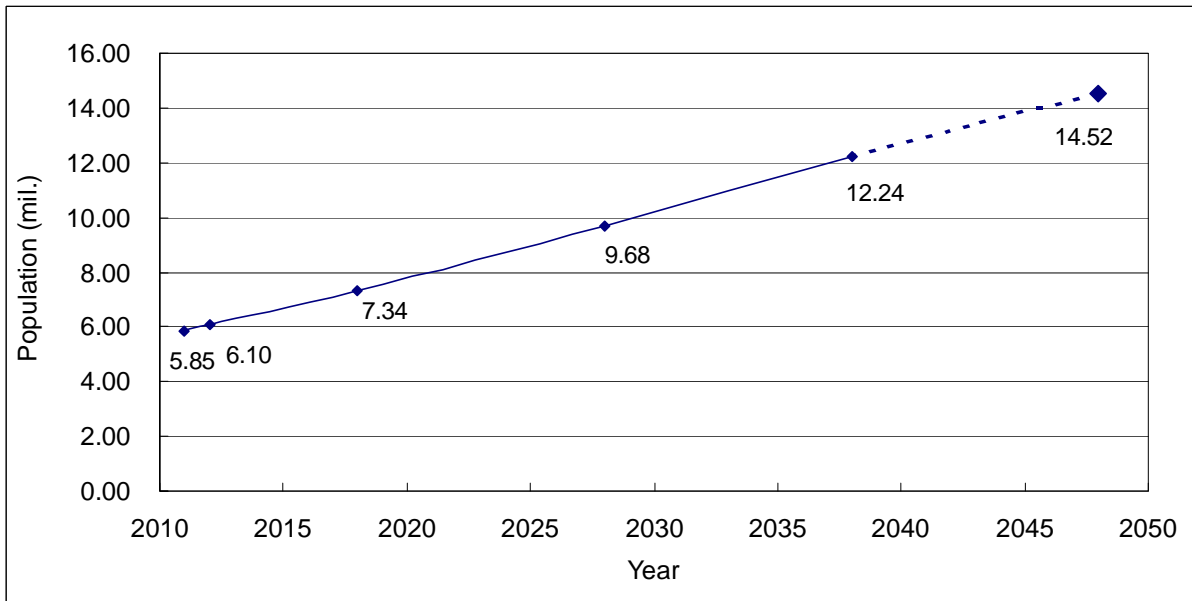


Figure A21-1 PMR Population Trend till the Year 2048

Source: Study Team

According to the travel demand model, the relationship between the growth in trip making and population is constant. Based on this relationship, growth in trip making for the period of 2028 to 2038 is multiplied by the population growth rate for 2038 to 2048 to arrive at the growth rate for trip making for the period of 2038 to 2048, which is 2%. With this estimate, the number of daily trips in 2038 of 13.01 million grows to 16.14 million in 2048 (see Figure A21-2).

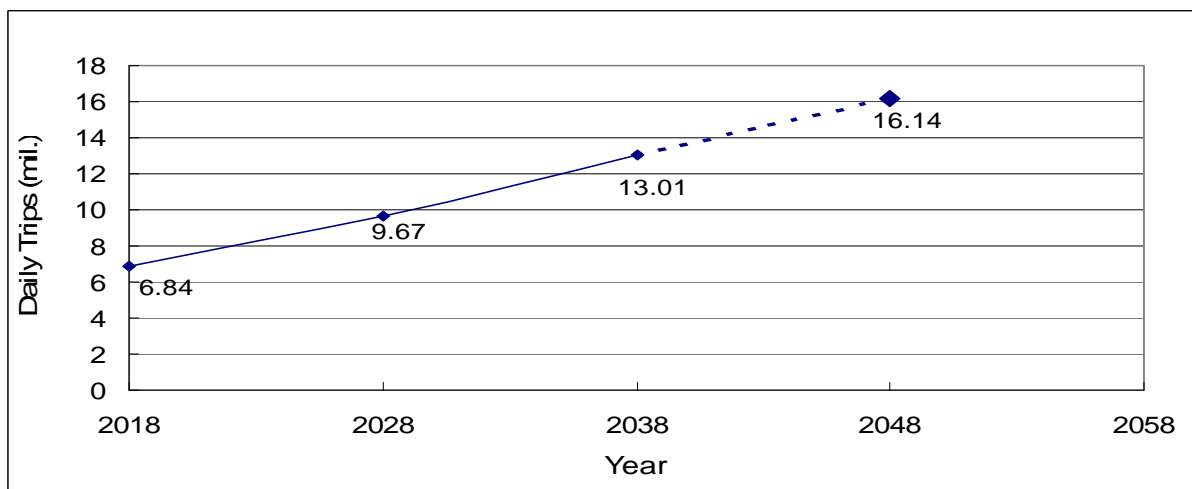


Figure A21-2 Trend in Daily Trips in PMR till the Year 2048

Source: Study Team

In the case of Fare Level-2, LRT’s peak-hour trips account for 5% of PMR’s daily trips in 2038. It is assumed that this relationship remains the same for 2048. Based on this assumption, the number of LRT peak-hour trips is approximately 80,000. By applying these trips to update the 2038 OD matrix, the number of peak-hour trips in the peak direction is calculated and the trend till 2048 plotted in Figure A21-3.

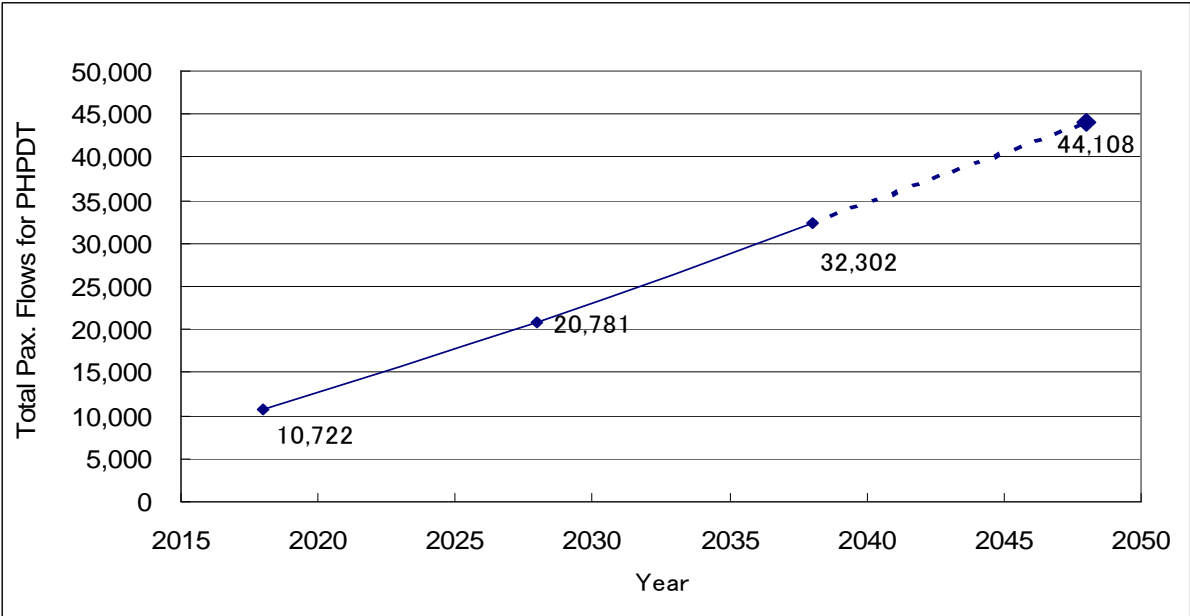


Figure A21-3 Peak Hour Peak Direction Passenger Flows for Partially Elevated LRT

Source: Study Team

In Figure A21-4 the trend in maximum sectional load for Fare Level-2 is given. As the figure shows, the LRT will be capable of coping with travel demand in the year 2048. However, to achieve this it will be necessary to increase the length of the LRT from 60m to 70m with an headway of 2.5 minutes.

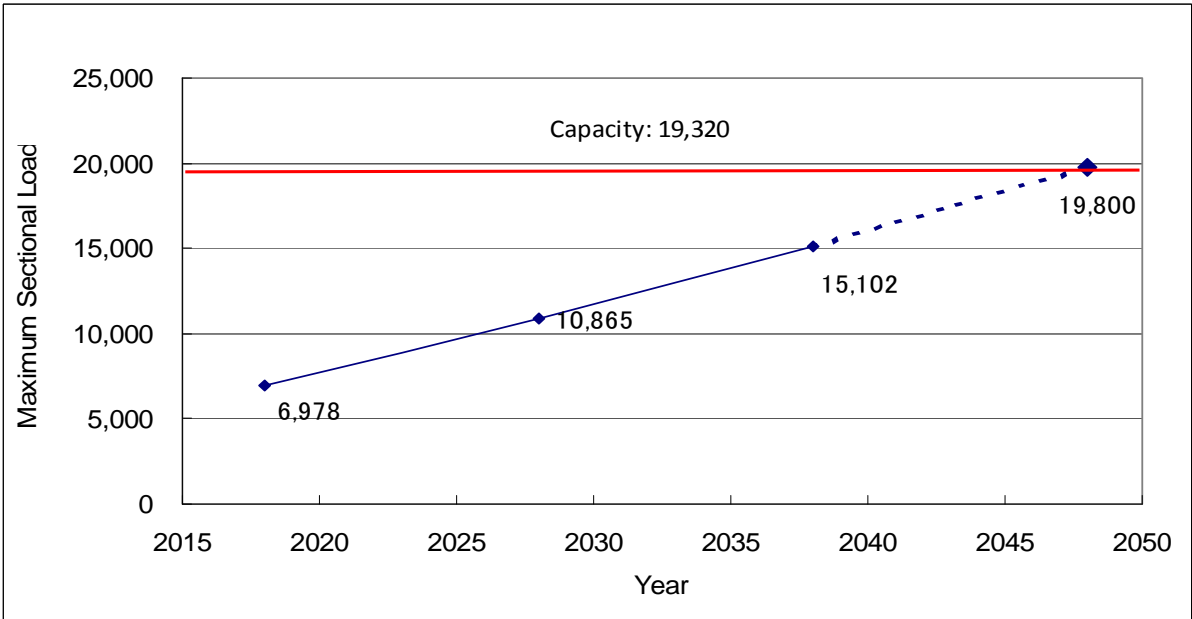


Figure A21-4 Peak Hour Maximum Sectional Load for Partially Elevated LRT

Source: Study Team

APPENDIX-22: PMC Environmental Study(Water quality, Air quality, Noise)

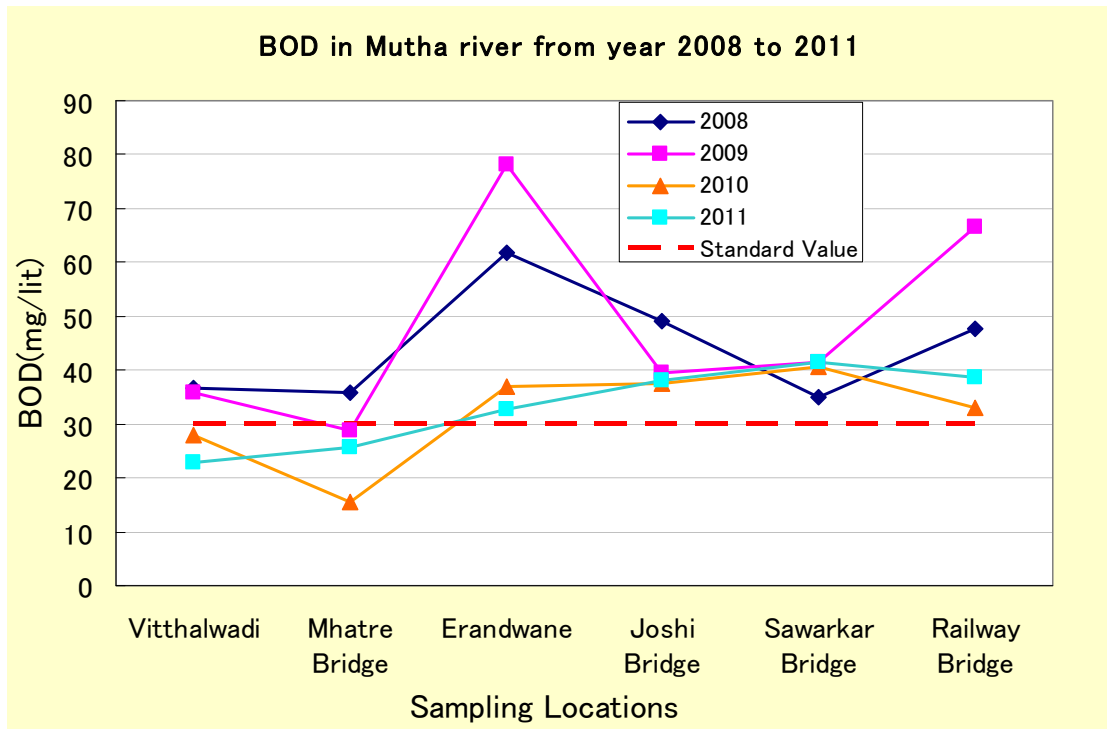


Figure A22-1 BOD (Mutha River) 2008-2011

Source: PMC Environmental Status Report (2011-2012)

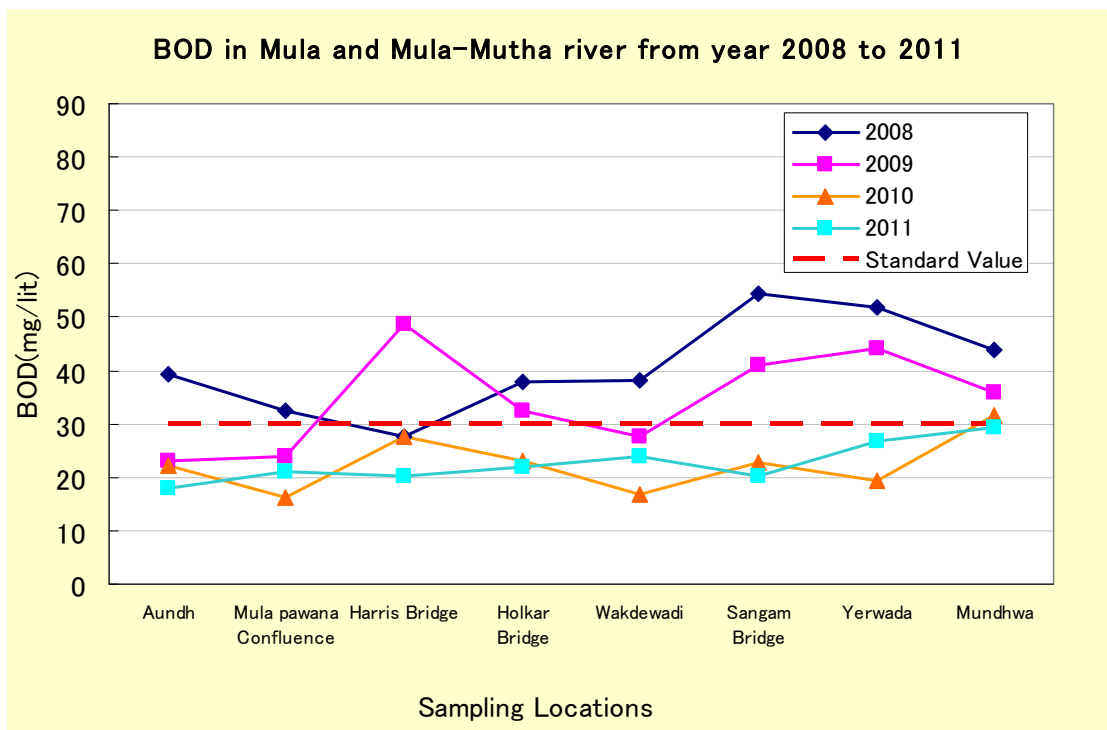


Figure A22-2 BOD (Mula and Mula-Mutha river) 2008-2011

Source: PMC Environmental Status Report (2011-2012)

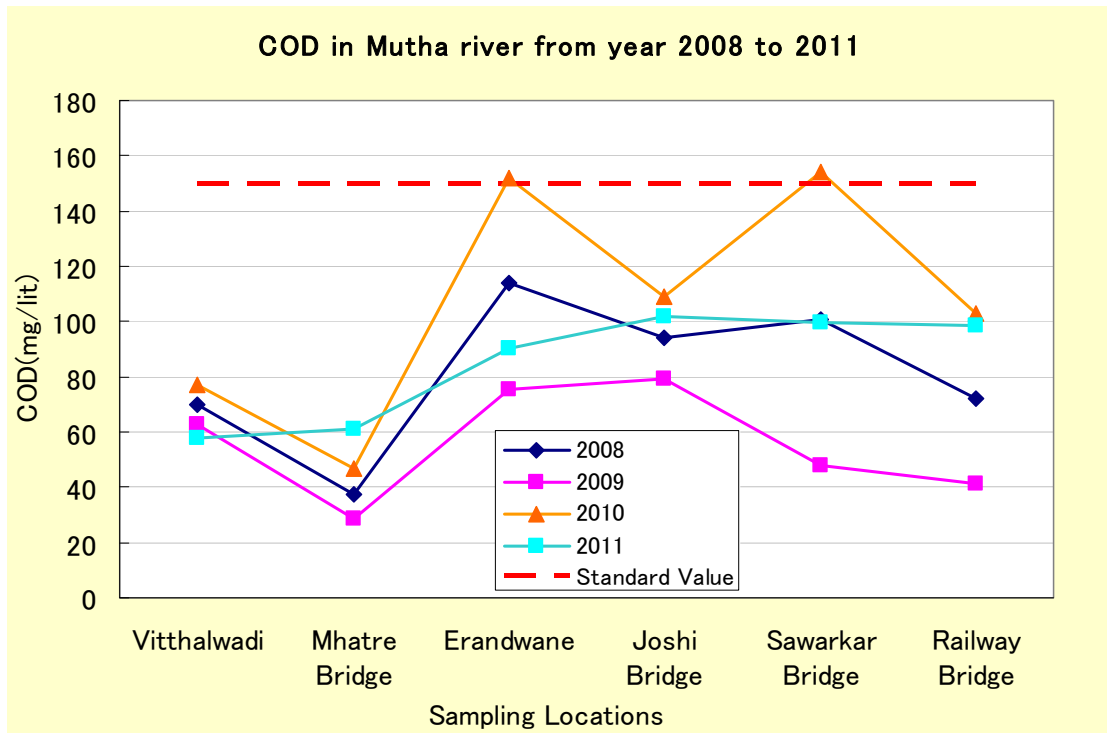


Figure A22-3 COD (Mutha river) 2008~2011

Source: PMC Environmental Status Report (2011-2012)

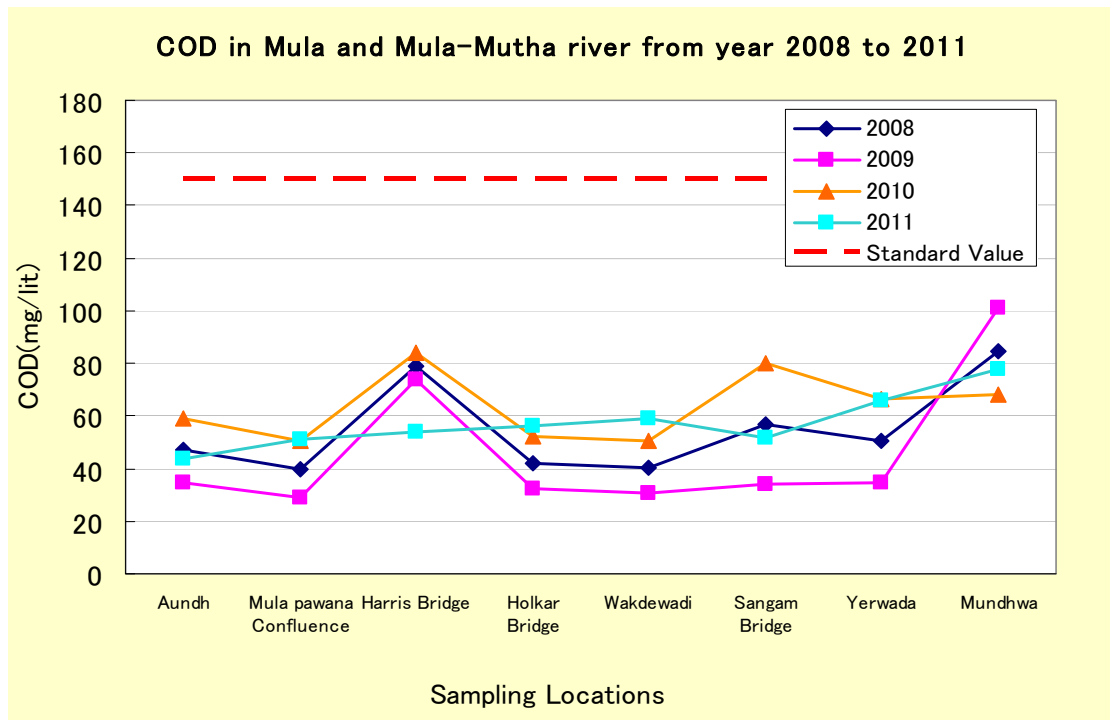


Figure A22-4 COD (Mula and Mula-Mutha river) 2008~2011

Source: PMC Environmental Status Report (2011-2012)

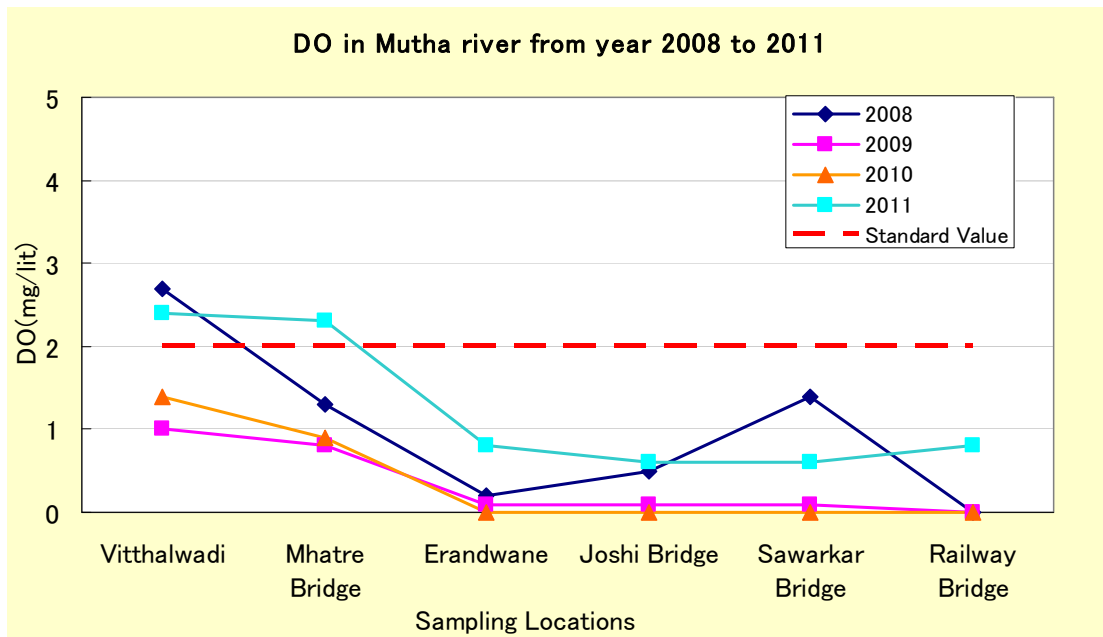


Figure A22-5 DO (Mutha river) 2008~2011

Source: PMC Environmental Status Report (2011-2012)

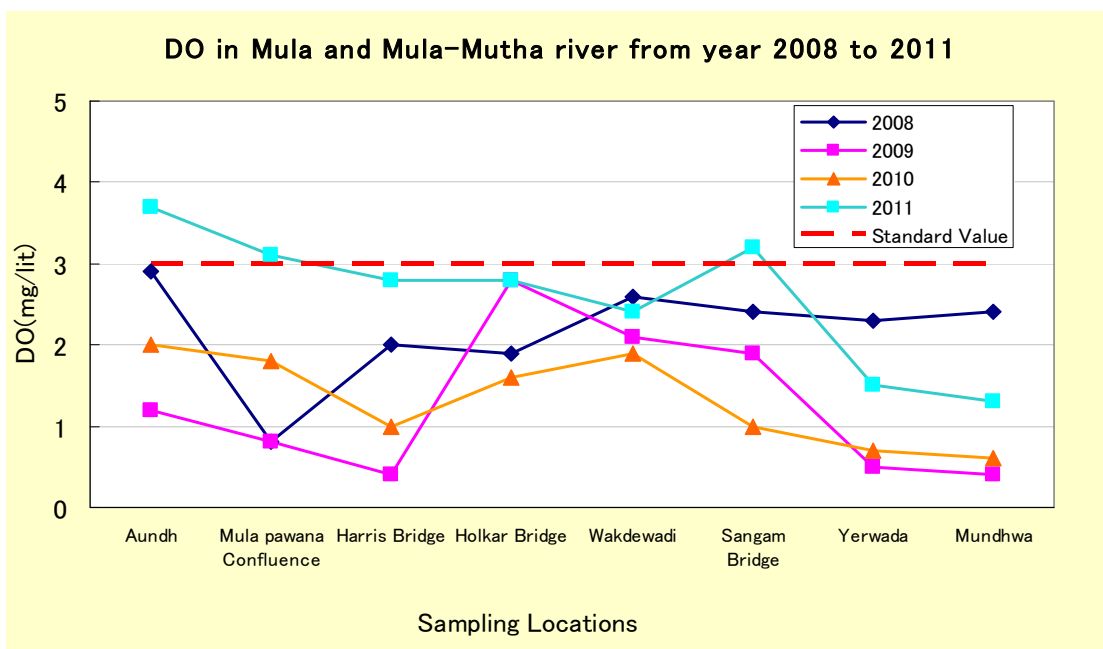


Figure A22-6 DO (Mula and Mula-Mutha river) 2008~2011

Source: PMC Environmental Status Report (2011-2012)

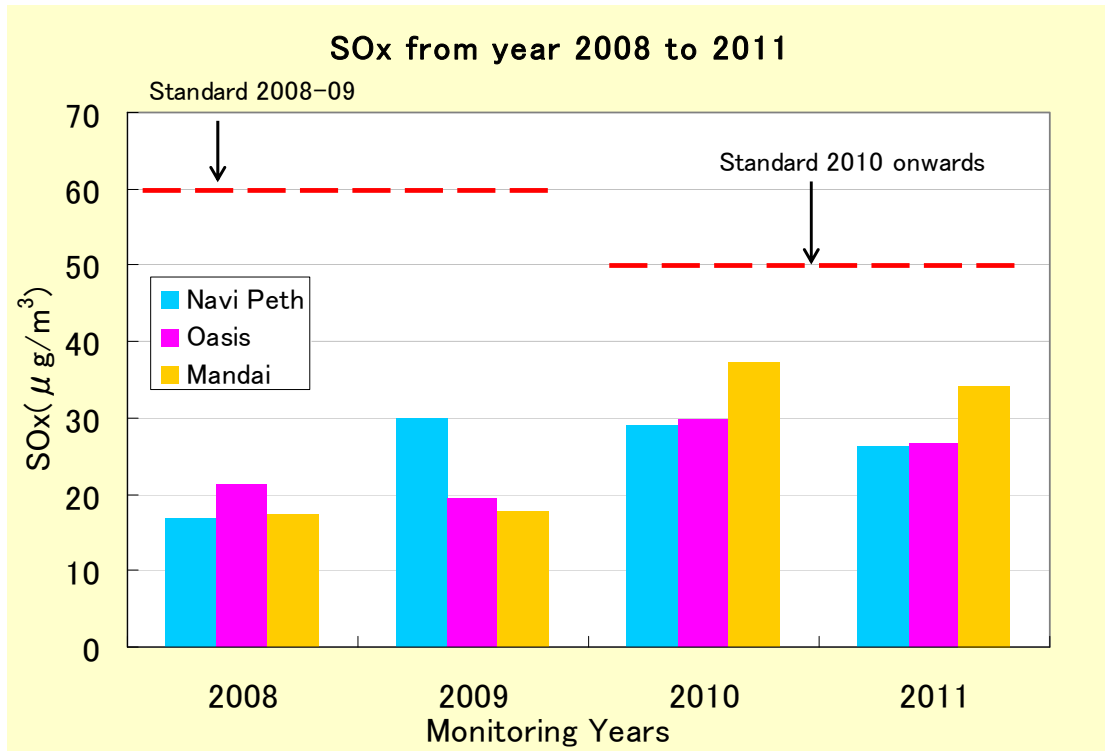


Figure A22-7 SOx 2008-2011

Source: PMC Environmental Status Report (2011-2012)

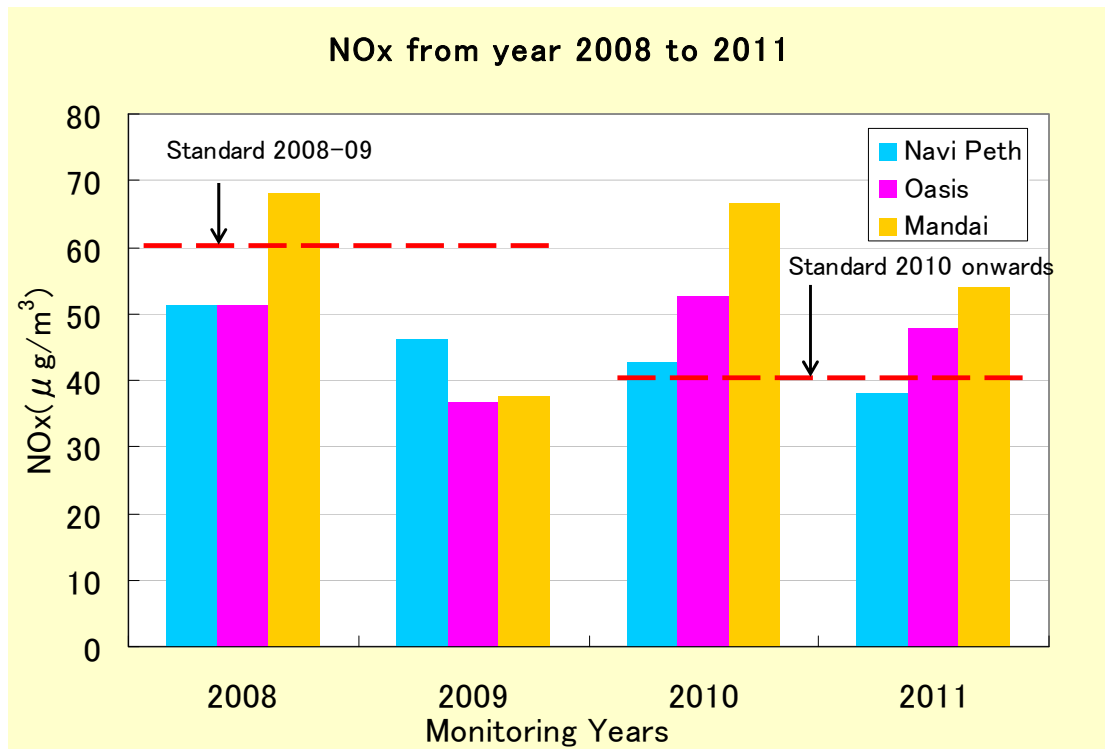


Figure A22-8 NOx 2008-2011

Source: PMC Environmental Status Report (2011-2012)

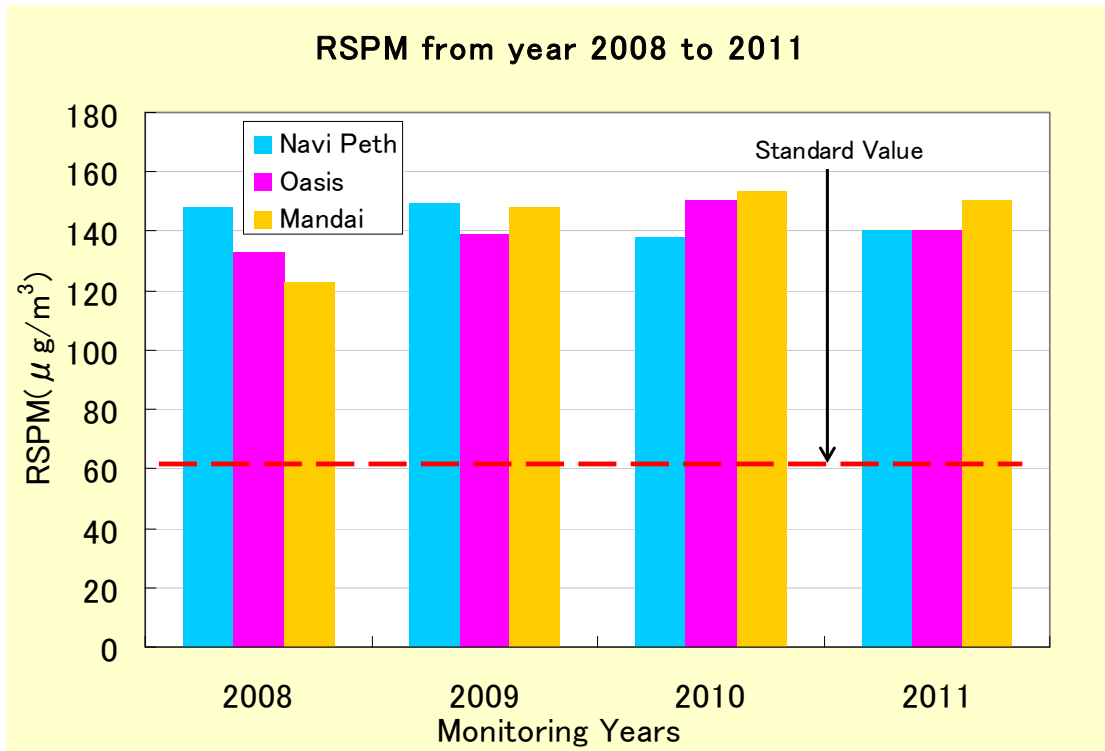


Figure A22-9 RSPM 2008~2011

Source: PMC Environmental Status Report (2011-2012)

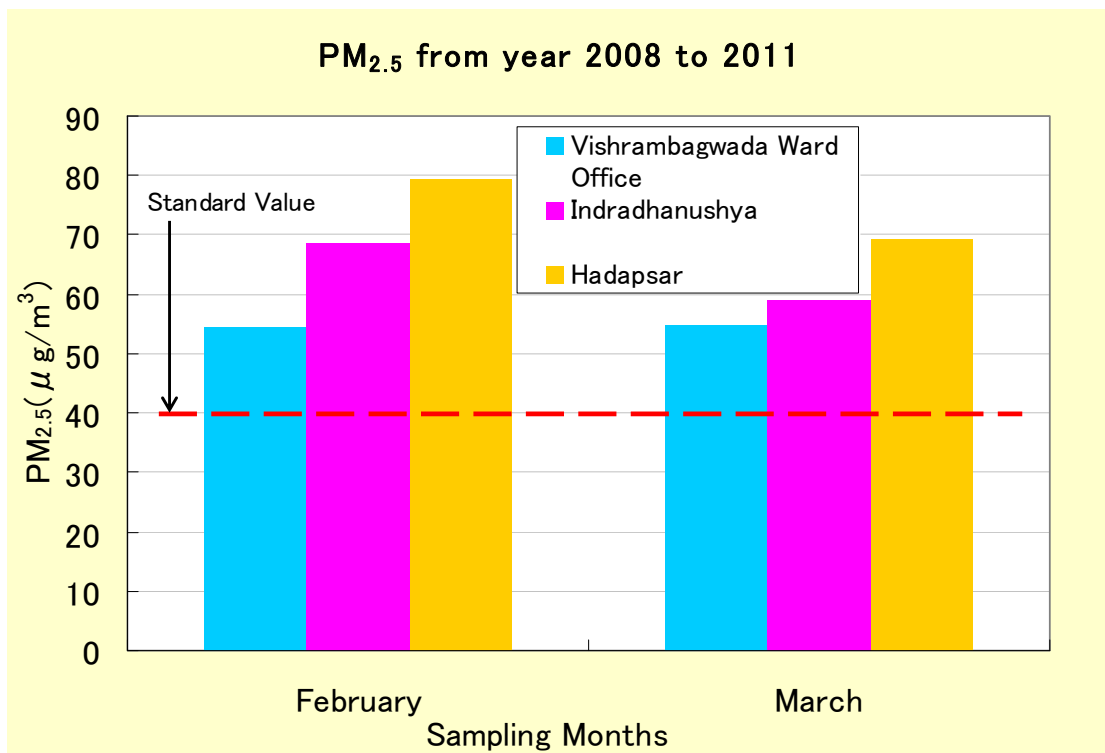


Figure A22-10 PM_{2.5} 2011

Source: PMC Environmental Status Report (2011-2012)

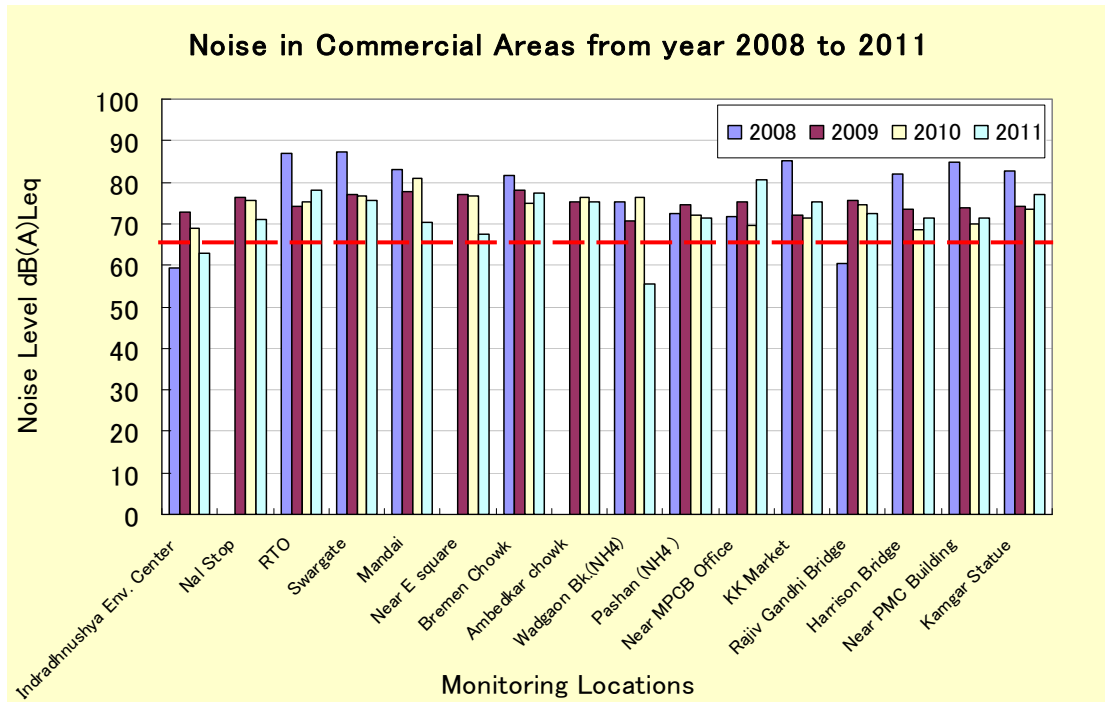


Figure A22-11 Noise in Commercial Areas 2008-2011

Source: PMC Environmental Status Report (2011-2012)

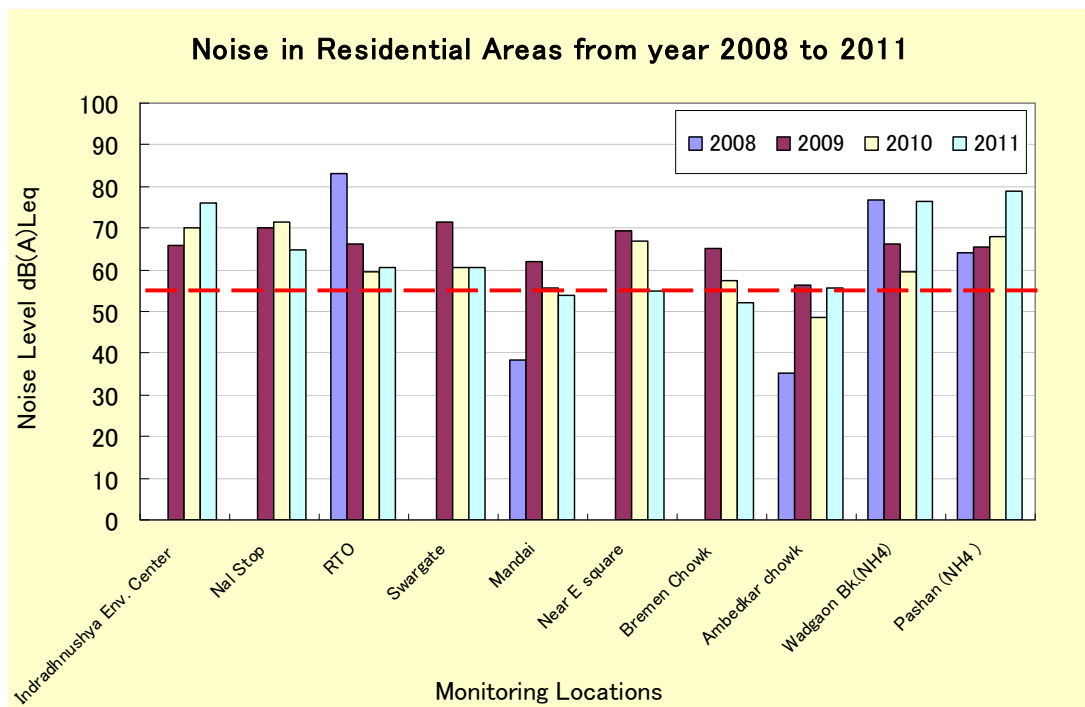


Figure A22-12 Noise in Residential Areas 2008-2011

Source: PMC Environmental Status Report (2011-2012)

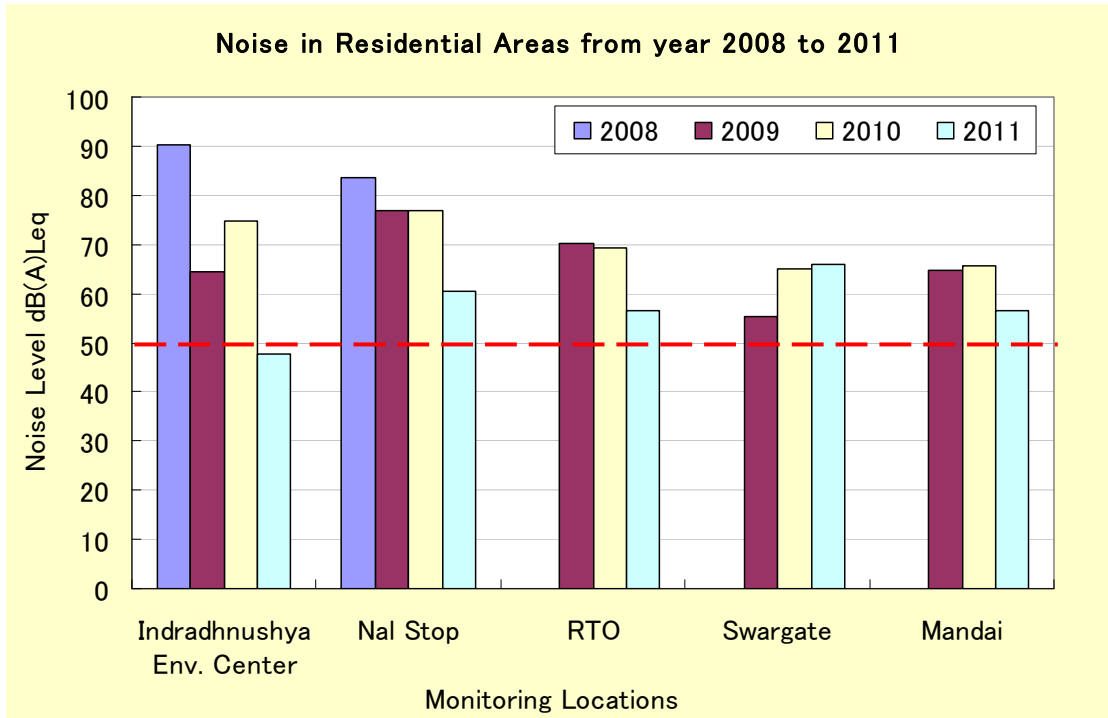


Figure A22-13 Noise in Silence Areas 2008-2011

Source:PMC Environmental Status Report (2011-2012)

APPENDIX-23: Pictures of Land Acquisition's Area

Source: All pictures are taken by JICA Study Team

St9~10: Police Station and Police Training Center



St9 Pic.1 : South of Police Station



St9 Pic.2 : Police Station



St9 Pic.3 : Police Training Center



St9Pic.4: North of Police Training Center

Near Mula river: Temple, Residence, Retailer, School, Park



Near Mula river Pic. 1 : North of Temple



Near Mula river Pic. 2 : South of Temple



Near Mula river Pic. 3 : In front of Temple



Near Mula river Pic. 4 : Area under construction



Near Mula river Pic. 5 : Retailer



Near Mula river Pic. 6 : Retailer



Near Mula river Pic. 7 : Retailer



Near Mula river Pic. 8 : Retailer



Near Mula river Pic. 9: Retailer



Near Mula river Pic. 10: Retailer



Near Mula river Pic. 11: Retailer



Near Mula river Pic. 12: Residence



Near Mula river Pic.13: Residence



Near Mula river Pic. 14: Retailer



Near Mula river Pic. 15: Residence



Near Mula river Pic. 16: Residence



Near Mula river Pic. 17 : Residence



Near Mula river Pic. 18 : Retailer



Near Mula river Pic. 19 : Retailer



Near Mula river Pic. 20 : Residence



Near Mula river Pic. 21 : Residence



Near Mula river Pic. 22 : Bus Stop



Near Mula river Pic. 23 : School



Near Mula river Pic. 24 : School



Near Mula river Pic. 25: Temple



Near Mula river Pic. 26: Park near Temple

East of NH4: Retailer



East of NH4 Pic.1: Retailer



East of NH4 Pic.2: Retailer



East of NH4 Pic.3: Retailer



East of NH4 Pic.4: Retailer



East of NH4 Pic.5: Retailer



East of NH4 Pic.6: Retailer



East of NH4 Pic.7: Retailer



East of NH4 Pic.8: Retailer



East of NH4 Pic.9: Retail



East of NH4 Pic.10: Empty Land



East of NH4 Pic.11: Empty Land



East of NH4 Pic.12: Empty Land



East of NH4 Pic.13: Residence of Labors



East of NH4 Pic.14: Area under construction



East of NH4 Pic.15: Retail



East of NH4 Pic.16: Retail



East of NH4 Pic.17:Retailer



East of NH4 Pic.18:Retailer

West of NH4: Retailer and Residence



West of NH4 Pic. 1: Retailer



West of NH4 Pic.2: Retailer



West of NH4 Pic.3: Retailer



West of NH4 Pic.4: Empty Land



West of NH4 Pic.5: Residence



West of NH4 Pic.6: Residence



West of NH4 Pic.7: Retailer



West of NH4 Pic.8: Retailer



West of NH4 Pic.9: Retailer



West of NH4 Pic.10: Residence



West of NH4 Pic.11 : Retailer

Depot: Factory, School, Residence, Field



Depot Pic.1: School



Depot Pic.2: School



Depot Pic.3: South of School



Depot Pic.4: South of School



Depot Pic.5: East of School



Depot Pic.6: West of School



Depot Pic.7: Factory



Depot Pic.8: Residence near School



Depot Pic.9: Residence South of School



Depot Pic.10: Residence South of School



Depot Pic.11: Residence South of School



Depot Pic.12: Field of Sorghum



Depot Pic.13: Sorghum



Depot Pic.14: Residence near Field



Depot Pic.15: Residence near Field



Depot Pic.16: Residence near Field



Depot Pic.17: South of Field



Depot Pic.18: West of Field

APPENDIX-24: Suggested ToR of Environmental and Social Study for proposed LRT Construction Project

Table A1 summarizes major tasks of the EIA study to be required for the proposed LRT Project. Tables A2 -A4 summarize the baseline environmental social information collection, relevant field studies such as the roadside air quality survey, and socio-cultural studies, respectively. Relevant studies for the application of tree cutting permits are to be conducted as part of the EIA study (see Task Items 1-9 and 5, listed in Table A1 and Task Item 9, listed in Table A3). In Pune, the environmental monitoring of several parameters such as the roadside air quality and the water quality have been monitored periodically since 2004 (see Table 7.2.1). Those monitoring results and/or database shall be incorporated in the baseline environmental information collection work listed in Tables A1 and A2.

Table-24-A1 Major Tasks for EIA-related Study

Items to be collected	
1	<p>Descriptions of Baseline Environmental Condition</p> <p>Describe the environmental baseline condition of selected pre-feasibility projects.</p> <ol style="list-style-type: none"> 1) Bio-Physical condition 2) Socio-Cultural condition <p>More detailed descriptions are summarized in Table-A2.</p>
2	<p>Environmental Field Survey</p> <p>Carry out the following environmental field surveys,</p> <ol style="list-style-type: none"> 1) Roadside Air Quality Survey 2) Roadside Noise Survey 3) Roadside Vibration Survey 4) Soil Survey 5) Sediment Survey 6) Water Quality Survey 7) Groundwater Quality Survey 8) Hydrological Survey 9) Tree Inventory Survey <p>More detailed descriptions are summarized in Table A3.</p>
3	<p>Social Survey</p> <p>Carry out the following social surveys,</p> <ol style="list-style-type: none"> 1) Socio-Cultural Survey 2) RAP-related survey 3) RAP-related survey (illegal squatters) <p>More detailed descriptions are summarized in Table A4.</p>
4	<p>Environmental Impact Assessment</p> <p>The evaluation of the potential environmental impacts of the three project stages such as 1) pre-construction phase, 2) construction phase, and 3) operational phase shall be described. Additionally, the following impact assessment studies shall be conducted in order to stress the advantages/disadvantages of the proposed project quantitatively.</p> <ol style="list-style-type: none"> 1) Vehicular Emission Study (CO2) 2) Air Quality Prediction Study 3) Noise Prediction Study 4) Vibration Prediction Study 5) Run-off (road surface drainage) Study 6) Urban Vegetation Impact Study 7) Mula River Flood Prediction Study 8) Regional Land Subsidence Prediction Study 9) Visual Impact Study 10) Socio-Economic Impact Study

5	Environmental Mitigation
	Describe comprehensive, effective measures for the mitigation (i.e., avoidance, reduction, and elimination) of negative impacts for the pre-construction, construction and operation phases of the project. In particular, the re-vegetation plan, based on study results of both the tree inventory survey (Item 9 of Table 6.4.3) and the urban vegetation impact study shall be developed.
6	Environmental Management
	Establish an appropriate environmental management plan. Specific objectives of this plan are to 1) define organizational and administrative arrangements for the environmental monitoring including the definition of responsibilities of staff, coordination, liaison and reporting procedures, and 2) to discuss the procedures for proactive environmental management, so that potential problems can be identified and mitigation measures adopted prior to the construction commencement.
7	Environmental Monitoring
	Establish an appropriate environmental monitoring program. The scope of the monitoring plan is 1) to identify the monitoring tasks, 2) to identify the nature and the schedule of the monitoring, and 3) to identify samples to be taken for analysis and parameters to be measured.
8	Public Involvement
	Describe the contents of both the stakeholder meetings and the information disclosures held for selected pre-feasibility projects. Following are the major items to be checked within this item, Stakeholder Meetings (1) Entire Schedule of stakeholder meetings (e.g., dates and places) (2) List of Participants (3) Minutes of Meeting (4) Hand outs and/or brochures, used for the public participation process. Information Disclosure (1) Outline of the entire information disclosure process (dates and the methods for disclosures: Internet, library, newspaper and others). (2) Disclosure (public review) periods (3) Comments and/or questions collected from the information disclosure.

Source: v This Study, 2012

Table-A24-2 Baseline Environmental and Social Conditions

1. Bio-Physical condition
1) Regional hydrology (e.g., major tributaries, channels, regional water balance) 2) Water quality of surface/subsurface water within the study area. 3) Air quality 4) Regional drainage 5) Roadside noise/vibration/air quality 6) Climate 7) Geology 8) Disaster Records (e.g., past earthquake, landslide, inundation or flood events) Especially, past flood events of Mula River shall be investigated. 9) Soil/sediment 10) Biological Environment
2. Socio-Cultural condition
1) Cultural (historical and archaeological) resources (e.g., Ruins, memorial facilities, historic spots and others) 2) Visual resources (e.g., scenic zones, townscape) 3) Land take/resettlements (e.g., conditions of existing roadside buildings) 4) Illegal squatters 5) Land use 6) Water use (e.g., water supply system, wells and others) 7) Schools, hospitals, parks, libraries, religious facilities. 8) Waste Disposal Sites (location, capacity, treatment method) 9) Vehicle Registration 10) Vehicle Inspection/Maintenance Program 11) Clean Fuel Program 12) Sewerage system

3. Pollution
<ul style="list-style-type: none"> 1) Roadside Air Quality 2) Roadside Noise 3) Roadside Vibration 4) Soil Contamination 5) Sediment Contamination 6) Water Contamination 7) Bad odour

Source: This Study, 2012

Table-24-A3 List of Field Environmental Studies

1. Roadside Air Quality
<p>Carry out 24-hour continuous survey at five points across the study area. Parameters: PM2.5, PM10, CO, HC, NOX, and SOX Traffic volume by vehicle type Survey Campaign: At least twice (once in the rainy season and the other in the dry season). Note that one survey point shall be for baseline air quality condition across Pune City, which would represent the air quality environment without significant negative impacts from nearby traffic volume.</p>
2. Roadside Noise
<p>Carry out 24-hour continuous survey at five points across the study area. Parameter: Leq Traffic volume by vehicle type Survey Campaign: At least twice (once in the rainy season and the other in the dry season). Note that one survey point shall be for baseline noise condition across Pune City, which would represent the noise environment without significant negative impacts from nearby traffic volume.</p>
3. Roadside Vibration
<p>Carry out 24-hour continuous survey at five points across the study area. Parameter: L₁₀ Traffic volume by vehicle type Survey Campaign: At least twice (once in the rainy season and the other in the dry season). Note that one survey point shall be for baseline vibration condition across Pune City, which would represent the vibration environment without significant negative impacts from nearby traffic volume.</p>
4. Soil Survey
<p>A soil survey is to be carried out at five points in total across the study areas in order to obtain the baseline soil characteristics data that would support the identification of potential contaminated soil sites. Several heavy metals and other contaminant parameters such as arsenic, PCB, Chrome, iron, lead, zinc and mercury are of concern.</p>
5. Sediment Survey
<p>A sediment survey is to be carried out at two points in total across the proposed construction areas, inside and nearby Mula River in order to obtain the baseline port sediment characteristics data that would support the identification of potential contaminated sediment sites. Several heavy metals and other contaminant parameters such as arsenic, PCB, Chrome, iron, lead, zinc and mercury are of concern.</p>
6. Water Quality Survey
<p>Two sampling points in total shall be designated along Mula River around the study area (e.g., one point in a downstream site and the other in an upstream site). Ten parameters such as pH, turbidity, DO, BOD, COD, conductivity, temperature, SS, E-Coliform and Total Coliform are of concern. Available current water quality data from the competent agencies and/or organizations is to be examined to improve the credibility of the whole water quality data collected in this study.</p>
7. Groundwater Quality Survey
<p>Three or four sampling points in total shall be designated around the study area. The exact number of sampling points for wells shall be determined based on the existing groundwater usage information, to address the proposed baseline environmental and social information collection. Ten parameters such as pH, turbidity, DO, BOD, COD, conductivity, temperature, SS, E-Coliform and Total Coliform are of concern. Available current water quality data from the competent agencies and/or organizations is to be examined to improve the credibility of the whole water quality data collected by this study.</p>

<p>8. Hydrological Study</p> <p><u>7.1 Literature Review</u> Carry out a literature review/or database search that would contain appropriate regional hydrological information based on the available hydrological and/or meteorological data such as,</p> <ol style="list-style-type: none"> Rain Regional Groundwater Level Groundwater pumping rate (locations included) Evapo-transpiration data Regional Drainage System <p><u>7.2 Regional Water Balance</u></p> <ol style="list-style-type: none"> Analyse regional water balance under non-flood condition (dry and rainy seasons) Analyse regional water balance under flood events.
<p>9. Tree Inventory Survey</p> <p>A tree inventory survey is to be carried out in the green areas located within the areas of concern in order to grasp the existing tree inventory and prepare for the permit application for tree-cutting to be required for the implementation of the proposed project.</p> <p>Methodology</p> <ol style="list-style-type: none"> Determine the green areas located inside of the areas of concern. Prepare a tree inventory by grasping the following information, <ol style="list-style-type: none"> Name of Tree (academic, English and local name) GPS Coordinates DBH (Diameter at Breast Height) Photo records of each tree. IUCN-status Others Prepare a tree distribution and/or vegetation map.

Source: This Study, 2012

Table-24-A4 List of Relevant Socio Cultural Studies

<p>1. Socio-Cultural Survey</p> <p>Community participation plays an important role for proper infrastructure project planning and management. It is essential to examine a variety of aspects of the proposed project based on the current community's needs and priorities. A questionnaire-based socio-cultural survey is to be carried out in order to properly grasp the public opinion about this proposed project as well as current concerns about the urban transport system of Pune from nearby communities. It is recommended to have 500 interviews (or samples) inside and outside of the study area. The opinion survey sheet will be provided to local a consultant by the JICA Study Team.</p>
<p>2. RAP-related Survey</p> <p>As mentioned in Section 6.1, the study area is classified as of either mixed residential/commercial areas or farm lands, and has a certain amounts of private property such as houses and/or office complexes that will be affected by the implementation of the proposed project.</p> <p>Survey items such as an inventory of the property owners, type of property (e.g., house, multi-tenant building and others), lease agreement and others shall be developed based on the Land Law of 1894 and the JICA Guideline as well as relevant laws and/or regulations.</p>
<p>3. RAP-related Survey (illegal squatters)</p> <p>Some communities of illegal squatters exist along the existing railway line. According to the JICA Guideline, it is recommended to take appropriate social considerations for those communities in case of expropriation.</p> <p>Following are the majors items to be summarized within this study,</p> <ol style="list-style-type: none"> Property owner and his/or her household structure (# of family member) Length of stay Type of Housing Occupation Reason to settle in this current place. Willing to move out if requested. Others

Source: This Study, 2012

APPENDIX-25: Domestic Floral Species to be used for the Design of Green Space

Table A25-1 NAME OF INDIGENIOUS TREES

Sr.NO.	NAME OF TREE	S.NO.	NAME OF TREE
1	Kasmal	71	Kailashpati
2	Mangolia	72	Supari
3	Sonchapha	73	Naral
4	Pandhra chapha	74	Kevada
5	Ashok	75	Bamboo
6	Shendri	76	Pimparana
7	Vayvaran	77	Devdat
8	Kokam	78	Pine
9	Nag chapha/Nakesar	79	Pandhra Shirish
10	Kanak	80	Rakht rohida
11	Saal	81	Dhavada
12	Pandhari dhoop	82	Hinganabet
13	Bhend	83	Apta
14	Gorakh Chinch	84	Kate sayar
15	Rudraksh	85	Taad
16	Bel	86	Asan
17	Kavath	87	Panchunda
18	Sayali	88	Anjan
19	Neem	89	Mohogony
20	Bor	90	Bhokar
21	Reetha	91	Dandus
22	Kusum	92	Sisu
23	Babul	93	Tembuni
24	Saundad	94	Umbar
25	Shirish	95	Anant
26	Muchkund	96	Kakad
27	Bahava	97	Shivan
28	Kanchan	98	Papada
29	Chinch(Tamarind)	99	Amba
30	Pallas	100	Bakan
31	Pangara	101	Kalam
32	Bibva	102	Bartondi
33	Rakht chandan	103	Tuti
34	Shisu	104	Kadipatta
35	Shisma	105	Tetu
36	Karanj(Pongaimia pinnata)	106	Tivas
37	Tivas	107	Sindhi
38	Bhadras	108	Shammi
39	Arjun(Terminalia)	109	Bija
40	Herada(Terminalia)	110	Khair
41	Jamun(Syzigium)	111	Reetha
42	Taman(Lagesstronia)	112	Sita Ashok
43	Kadamba	113	Biba
44	Haldu	114	Haadga

Sr.NO.	NAME OF TREE	S.NO.	NAME OF TREE
45	Nilgiri	115	Ambada
46	Moha (Madhucaindica)	116	Jungli Badaam
47	Khirini	117	Arjun
48	Parizaat	118	Behada
49	Satvin	119	Biti
50	Aakash neem	120	Nandrukh
51	Kalavash	121	Payar
52	Shivan	122	Dikamali
53	Saag	123	Saag
54	Chandan(Sandal)	124	Jamun
55	Awala	125	Awala
56	Putrvati	126	Guava
57	Vad	127	Pomegranate
58	Pimpal	128	Orange
59	Rubber	129	Sweet lime
60	Phanas	130	Chikoo
61	Mulberry		
62	Karvat		
63	Chinar		
64	Suru		
65	Indian Popular		
66	Valunja		
67	Khajoor		
68	Maharukh		
69	Yen		
70	Taad		

Note: Original list is written in Hindi

APPENDIX-26: Questionnaire Sheet for RAP-related Socio-Economic Survey (Sample)

This is the sample sheet for the socio-economic survey and it is designed to collect relevant information about the socio-economics and resources and to understand the communities to be affected by the implementation of the proposed LRT project. The information to be collected will be used to make a detailed and balanced assessment of the potential impacts of the Pune LRT project.

It is noted that any criteria and/or norms used in these survey sheets shall be modified based on the latest social conditions around the project site. Also, it is strongly recommended that additional questions shall be introduced to produce a more meaningful survey.

Survey Date _____

Interviewee _____

Interviewer _____

100 SURVEY QUESTIONNAIRE IDENTIFICATION		
A	Survey Control Number:	
B	Type of Occupants:	1. Legal; 2. Illegal.
C	Date of Interview:	
D	Place of Interview:	
E	Name of Interviewer:	
G	Time of Interview	

101 BASIC PROFILE OF PAPs (Data of people affected by the project)		
A	Name of interviewee: (only adult members)	
B	Address of the interviewee:	
	a) House No. & Street:	
	b) Unit	
	c) Village	
C	Location of house:	1. Rural 2. Semi-rural 3. Urban 4. Farm
D	Relation to head of family: (choose one)	1. Myself; 2. Wife; 3. Child; 4. Partner; 5. Other (notify).
E	How long have you been living here?	
F	Are there any tenants in this house? If yes, number of tenants?	
G	How many years have the tenants resided here?	
H	What is the most serious problem of the family's livelihood in the present?	1. 2.
I	Where is the main income source of the family (notify):	

102 BASIC PROFILE OF HEAD OF FAMILY

A	Name of head of family:									
B	Gender:	1. Male;	2. Female.							
C	Age:									
D	Marital status:	1. Married;	2. Single;	3. Divorced						
		4. Separated	5. Widow							
E	Current Occupation:	1. Gov. service; 2. Private service;								
		3. Business; 4. Wage employee;								
		5. Agriculture; 6. Daily wage labour;								
		7. Unemployed;								
		8. Other (notify).								

F	Level of education completed:	1. Illiterate; 2. Can read only;								
		3. Can both read and write;								
		4. Kindergarten 5. Primary school;								
		6. Secondary school; 7. University								
		8. University or specific technical school								
		9. Others								

H	Faith (Religion): (Choose one)	1. Buddhist; 2. Hindu 3. Muslim								
		4. Other (Specify)								

I	Total number of family members: (including infants and children)	<table border="1"> <thead> <tr> <th>Total</th> <th>Females</th> <th>Males</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>			Total	Females	Males			
Total	Females	Males								
J	Total number of households in one structure: (e.g. if there are 2 households in one house, record as "2")									

103 HOUSING BUDGET

A	Average Income	Daily (Rupees)	Monthly (Rupees)	Yearly (Rupees)
	a) Agriculture			
	b) Wage labour			
	c) Business/Trading			
	d) Service			
	e) Livestock & animal Husbandry			
	f) Fishing & Aquaculture			
	g) Cottage Craft			
	h) Forestry			
	j) Salary			
	k) Other (notify)			
	Total income			

B	Have you taken any loans?	1. Previously; 2. Currently; 3 Never; 4 Don't know.
	If YES ask for details – amount, when, from whom, when due to repay	

104 ACCESS TO UTILITIES

A	Potable Water in the village (which isn't transportable) (Choose all that apply)	Dug well (Private: Protected or Unprotected); Dug well (Common: Protected or Unprotected); Pump well (Private: Protected or Unprotected); Pump well (Common: Protected or Unprotected); Public water supply; Bought from water vendors; Other facilities (Specify); _____ _____ Other natural water sources (Specify) _____ _____
B	Toilet Facilities: (Choose main one)	In-door toilet; Out-door toilet (Private); Out-door toilet (Common); Not available.
C	Access to Electricity:	Power line; Generator (Private); Generator (Common); Battery; Not Available.

105 Others

A	Have you experienced any hazard such as flood or storm? If Yes, please specify. (Choose all that apply)	No; Yes; Flood; Storm; Others
B	If Yes is the answer to A, how often have you experienced these events?	Frequently Others (please specify)
C	How did you survive that hazard? (Notify in detail)	

200 TYPE OF IMPACTS

A	Type of social impacts related to the land acquisition under the project: (Choose all that apply)	Loss of landholding/farmland; Loss of housing; Loss of structures/assets; Loss of crops and/or trees; Loss of (Impacts on access to) facilities, services, or natural resources; Loss of businesses/enterprises; Loss of income and/or livelihood (Specify) _____ _____ Loss of access to productive assets Others (Specify) _____ _____ _____
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201 LAND OWNER/FARMLAND LOST

A	Land Ownership:	State-owned; State-owned land for rental with the Certificate of Land; State-owned land for rental with Occupancy License; Private-owned land for rental or borrow; Group-or community owned; Uncertain ownership; Illegal land occupation with Land paper; Illegal land for production without approval.										
B	How many ha or m ² of land (Specify; paddy field (rain-fed and/or irrigated, tree plantation etc.) is to be lost by the project?	<table border="1"> <tr> <td>1. Structure</td> <td>(..... ha, m²)</td> </tr> <tr> <td>2. Agriculture/field</td> <td>(..... ha, m²)</td> </tr> <tr> <td>3. Fruit orchard</td> <td>(..... ha, m²)</td> </tr> <tr> <td>4. Others</td> <td>(..... ha, m²)</td> </tr> <tr> <td>Total</td> <td>(..... ha, m²)</td> </tr> </table>	1. Structure	(..... ha, m ²)	2. Agriculture/field	(..... ha, m ²)	3. Fruit orchard	(..... ha, m ²)	4. Others	(..... ha, m ²)	Total	(..... ha, m ²)
1. Structure	(..... ha, m ²)											
2. Agriculture/field	(..... ha, m ²)											
3. Fruit orchard	(..... ha, m ²)											
4. Others	(..... ha, m ²)											
Total	(..... ha, m ²)											
C	What % of your total income is to be affected by losing the land?	Less than 20 %: More than 20 %:										
D	Do you have any legal documents for your land?	Yes; No.										
E	If yes, type of legal document?	Land Use Certificate; Land Survey Certificate; Provincial Land Certificate; Temporary Land Use Certificate Land Tax Receipt Land Tax Return; Land Declaration Certificate; Permanent land paper										
	Whose name appears on the land certificate											

F	What types of trees and how many trees are to be lost due to the project?	Size of tree 1) Large (D \geq 20 cm), 2) Medium (D \geq 10cm), 3) Small (D $<$ 10 cm) Kind of tree 1) Fruit, 2) Fire wood for self-consumption, 3) Fire wood for sale Age of trees Number of trees
G	What % of your total income is to be affected by losing the trees?	Less than 20 %: More than 20 %:

202 HOUSING LIKELY TO BE LOST

A	What is the type of house likely to be affected? (Choose one) <u>Take photo of the house.</u>	Single floor; Two floors; Three floors or more Apartment/Row house, duplex; Small room connected to others; Tents or temporary simple hut; Other (Specify) _____ _____
B	What per cent of your house is to be affected by the project	Less than 20 %: More than 20 %:
C	Roof: (Choose one)	1. Corrugated iron 2. Tiles/CPAQ 3. Natural materials; 4. Other (Specify) _____ _____
D	Walls: (Choose one)	1. All concrete; 2. Concrete and wood 3. All wood; 4. Natural materials; 5. Others (Specify) _____ _____
E	Housing ownership:	Self-owned; Owned structure for rental; Privately owned house for rental or borrow; Group-/Community-owned; Uncertain ownership; Illegal Occupation; Others (Specify) _____ _____
F	If rented, how much do you pay per month?	(.....Rupees/month)
G	Living area/Floor area:	(.....m ²)
H	Number of bedrooms:	
I	Age of house:	(.....year)

203 OTHER STRUCTURES/ASSETS LIKELY TO BE LOST (PERSONAL or COMMUNAL)

A	Type of structure: (Choose all that apply)	1. Residential; 2. Commercial; 3. Residential & Commercial; 4. Office; 5. Health facility; 6. Cattle shed; 7. Farm house; 8. Boundary wall/Fencing; 9. Church, temple or shrine; 10. Well; 11. Hand pump; 12. School; 13. Graveyard/Crematorium Ground; 14. Others (Specify) _____ _____															
B	Address of the structure:																
	House No. & Street:																
	Units																
	Village																
C	Ownership of the structure: (Choose one)	Self-owned; State-owned structure for rental; Privately owned house for rental or borrow; Group-/Community-owned; Uncertain ownership; Illegal Occupation; Others (Specify) _____ _____															
D	What is (are) the market value of the structure(s) in the current condition?	<table border="1"> <thead> <tr> <th data-bbox="813 1294 1018 1328">Material</th> <th data-bbox="1026 1294 1220 1328">Unit</th> <th data-bbox="1228 1294 1380 1328">Total</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	Material	Unit	Total												
Material	Unit	Total															
E	If rented how much do you pay per month?																

A	The present conditions of the access to existing facilities and impacts on the conditions by the project					
	Destination	Average time per trip (minutes)	Frequency (a trip every): 1 day; 2-3 days; 1 week; 2 weeks; 1 month; 2 months; 6 months; 1 year.	How do you travel Walk Bicycle Oxcart Horse Truck Motor bike; Car Bus Others.	Distance (km)	Impacts by the project Access lost; Impact on facility No impact.
	Village office					
	Market					
	School					
	Farmland					
	Hospital/Healthcare					
	Religion centre					
	Other facility (notify)					
Natural resource (e.g. hunting, fishing, etc.)						

205 LOST BUSINESS/ENTERPRISE

A	How long has the business/enterprise been active?	Years Months
B	Ownership	1 Self owned/family owned 2 Company 3 Partnership (no.) 4 Other
C	Nature of the Structure of the business/enterprise? (Choose all that apply)	1. Shop; 2. Storage/Warehouse; 3. Workshop; 4. Factory; 5. Others (notify)
D	What kind of business have you been doing? (Specify)	1. 2.
E	Do you have authorized business licenses?	
F	How many workers are there?	

APPENDIX-27: 9.2 Financial and Economic Analysis)

27-1. Financial Cash Flow Table of SPV

- 1-A. Base Scenario 1: Case 2a(iii)
- 1-B. Base Scenario 2: Case 2a(v)
- 1-C. Base Scenario 3: Case 3a(v)

27-2. SPV Equity IRR for Financial Structure Variation Scenarios

- 2-A. Base Cases including Base Scenarios
- 2-B. Central and State Tax Exemption Cases
- 2-C. Central and State Tax Exemption + Power Tariff Reduction Cases
- 2-D. No FSI Contribution Cases
- 2-E. No FSI Contribution + Central and State Tax Exemption Cases

27-3. Financial Cash Flow Table of Base Cases for PMRC

- 3-A. Case P2a(iii)-1
- 3-B. Case P2a(v)-1
- 3-C. Case P3a(v)-1

27-4. Financial Cash Flow Graphs of All Analyzed Cases for PMRC

27-5. Calculation Table of Public Cost Sharing Rate to Total Initial Investment

- 5-A. Base Scenario 1: Case 2a(iii)+ Case P2a(iii)
- 5-B. Base Scenario 2: Case 2a(v)+ Case P2a(v)
- 5-C. Base Scenario 3: Case 3a(v)+ Case P3a(v)

27-6. Result of Financial and Economic Analysis in Case of Entirely Elevated Alignment

- 6-A. Project Cost
- 6-B. Financial and Economic Internal Rate of Return
- 6-C. Financial Cash Flow Graphs of PMRC (3 Base Cases)

1-B. Base Scenario 2: Case 2a(v)

Conditions	Evaluation Index		Financing		Revenue Item		Price Escalation (Local Currency)		Price Escalation (Foreign Currency)		Note
	Equity IRR	WACC	16.0%	10.0%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Net Present Value (NPV)	16.0%	10.0%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	Stability ratio of subsidy to initial investment cost excluding land related cost. Investment cost excluding land related cost is applicable for 10 consecutive years out of the first 20 years of the project in infrastructure sector.
Internal Rate of Return (IRR)	16.0%	10.0%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy (Million USD)	1000	15%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (%)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Type	Equity	Debt	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Period (Year)	5	5	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Operational)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Construction)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Investment Cost)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Total)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Operational)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Construction)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Investment Cost)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	
Subsidy Rate (Total)	15%	35%	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	2019-2028	

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030													
a Revenue	1,005	1,176	2,424	2,447	3,332	3,608	3,911	4,240	4,601	5,040	5,524	6,058	6,647	7,296	8,012	8,802	9,673	10,634	11,693	12,858	13,031	13,511	14,009	14,526	15,062	15,619	16,197	16,797			
Passenger Revenue	733	801	2,186	2,288	2,899	3,112	3,399	3,742	4,054	4,472	4,931	5,438	5,988	6,585	7,230	7,923	8,665	9,456	10,296	11,185	12,083	12,619	12,982	13,463	13,988	14,522	15,071	15,640			
Service Fee Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
FSI Contribution	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	
Other Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
CO&M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Start cost	258	272	286	301	317	341	369	398	419	444	467	482	518	545	578	606	640	673	708	746	777	810	844	879	916	954	994	1,036	1,080		
Maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
(Utility subsidy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Depreciation	0	310	342	367	387	407	427	447	467	487	507	527	547	567	587	607	627	647	667	687	707	727	747	767	787	807	827	847	867		
EBITDA	0	310	342	367	387	407	427	447	467	487	507	527	547	567	587	607	627	647	667	687	707	727	747	767	787	807	827	847	867		
EBITDA (incl. Subsidy)	0	310	342	367	387	407	427	447	467	487	507	527	547	567	587	607	627	647	667	687	707	727	747	767	787	807	827	847	867		
Profit before tax	0	310	342	367	387	407	427	447	467	487	507	527	547	567	587	607	627	647	667	687	707	727	747	767	787	807	827	847	867		
(Operational VGF Subsidy)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Corporate Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Profit after tax	0	310	342	367	387	407	427	447	467	487	507	527	547	567	587	607	627	647	667	687	707	727	747	767	787	807	827	847	867		
Equity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional investment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt outstanding	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest payment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash flow available for debt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt service coverage ratio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Life Coverage Ratio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash flow after repayment of interest and principal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPV for Project IRR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NPV for Equity IRR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Discounted Payoffs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity IRR	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	
WACC	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	
DSFR Average	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	

Source: Study Team

1-C. Base Scenario 3: Case 3a(v)

Conditions	Equity FFR Index		Financing		Revenue Item		Price Evaluation (Local Currency)		Price Evaluation (Foreign Currency)		Note																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	Net Present Value (Discount rate)	Mlt. Rte. %	17.8%	1.0%	Million R\$ of cash flow	ES	2012-2028	2012-2028	2012-2028	2012-2028																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
a	Revenue	1,105	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
b	Service Fee Revenue	730	807	0	2,186	2,847	3,079	3,332	3,608	3,911	4,240	4,601	5,000	5,434	5,908	6,427	6,991	7,600	8,264	8,984	9,768	10,607	11,511	12,489	13,541	14,668	15,881	17,181	18,569	20,047	21,625	23,304	25,085	26,968	28,954	31,044	33,239	35,540	37,948	40,464	43,089	45,824	48,669	51,624	54,690	57,867	61,155	64,554	68,064	71,685	75,417	79,260	83,214	87,279	91,455	95,742	100,141	104,651	109,272	114,004	118,847	123,801	128,864	134,036	139,317	144,707	150,206	155,814	161,531	167,357	173,293	179,340	185,497	191,765	198,144	204,634	211,235	217,947	224,770	231,704	238,749	245,905	253,172	260,550	268,039	275,639	283,350	291,172	299,105	307,148	315,301	323,563	331,934	340,414	348,903	357,501	366,208	375,024	383,949	392,983	402,126	411,378	420,738	430,205	439,778	449,457	459,241	469,130	479,124	489,223	499,427	509,735	520,147	530,663	541,284	552,010	562,841	573,776	584,815	595,958	607,204	618,552	630,002	641,555	653,211	664,969	676,829	688,791	700,855	713,021	725,288	737,656	750,124	762,692	775,360	788,127	801,003	813,988	827,081	840,282	853,590	867,005	880,526	894,153	907,885	921,722	935,664	949,711	963,863	978,120	992,482	1,006,949	1,021,521	1,036,198	1,050,980	1,065,867	1,080,859	1,095,956	1,111,157	1,126,462	1,141,871	1,157,384	1,172,999	1,188,716	1,204,535	1,220,456	1,236,478	1,252,601	1,268,825	1,285,150	1,301,575	1,318,100	1,334,725	1,351,450	1,368,275	1,385,200	1,402,225	1,419,350	1,436,575	1,453,900	1,471,325	1,488,850	1,506,475	1,524,200	1,542,025	1,559,950	1,577,975	1,596,100	1,614,325	1,632,650	1,651,075	1,669,600	1,688,225	1,706,950	1,725,775	1,744,700	1,763,725	1,782,850	1,802,075	1,821,400	1,840,825	1,860,350	1,880,075	1,899,900	1,919,825	1,939,850	1,959,975	1,980,200	2,000,525	2,020,950	2,041,475	2,062,100	2,082,825	2,103,650	2,124,575	2,145,600	2,166,725	2,187,950	2,209,275	2,230,700	2,252,225	2,273,850	2,295,575	2,317,400	2,339,325	2,361,350	2,383,475	2,405,700	2,428,025	2,450,450	2,472,975	2,495,600	2,518,325	2,541,150	2,564,075	2,587,100	2,610,225	2,633,450	2,656,775	2,680,200	2,703,725	2,727,350	2,751,075	2,774,900	2,798,825	2,822,850	2,846,975	2,871,200	2,895,525	2,919,950	2,944,475	2,969,100	2,993,825	3,018,650	3,043,575	3,068,600	3,093,725	3,118,950	3,144,275	3,169,700	3,195,225	3,220,850	3,246,575	3,272,400	3,298,325	3,324,350	3,350,475	3,376,700	3,403,025	3,429,450	3,455,975	3,482,600	3,509,325	3,536,150	3,563,075	3,590,100	3,617,225	3,644,450	3,671,775	3,699,200	3,726,725	3,754,350	3,782,075	3,809,900	3,837,825	3,865,850	3,893,975	3,922,200	3,950,525	3,978,950	4,007,475	4,036,100	4,064,825	4,093,650	4,122,575	4,151,600	4,180,725	4,209,950	4,239,275	4,268,700	4,298,225	4,327,850	4,357,575	4,387,400	4,417,325	4,447,350	4,477,475	4,507,700	4,538,025	4,568,450	4,598,975	4,629,600	4,660,325	4,691,150	4,722,075	4,753,100	4,784,225	4,815,450	4,846,775	4,878,200	4,909,725	4,941,350	4,973,075	5,004,900	5,036,825	5,068,850	5,100,975	5,133,200	5,165,525	5,197,950	5,230,475	5,263,100	5,295,825	5,328,650	5,361,575	5,394,600	5,427,725	5,460,950	5,494,275	5,527,700	5,561,225	5,594,850	5,628,575	5,662,400	5,696,325	5,730,350	5,764,475	5,798,700	5,833,025	5,867,450	5,901,975	5,936,600	5,971,325	6,006,150	6,041,075	6,076,100	6,111,225	6,146,450	6,181,775	6,217,200	6,252,825	6,288,550	6,324,375	6,360,300	6,396,325	6,432,450	6,468,675	6,505,000	6,541,425	6,577,950	6,614,575	6,651,300	6,688,125	6,725,050	6,762,075	6,799,200	6,836,425	6,873,750	6,911,175	6,948,700	6,986,325	7,024,050	7,061,875	7,100,000	7,138,325	7,176,850	7,215,475	7,254,200	7,293,025	7,331,950	7,371,075	7,410,300	7,449,625	7,489,050	7,528,575	7,568,200	7,607,925	7,647,750	7,687,675	7,727,700	7,767,825	7,808,050	7,848,375	7,888,800	7,929,325	7,969,950	8,010,675	8,051,500	8,092,425	8,133,450	8,174,575	8,215,800	8,257,125	8,298,550	8,340,075	8,381,700	8,423,425	8,465,250	8,507,175	8,549,200	8,591,325	8,633,550	8,675,875	8,718,300	8,760,825	8,803,450	8,846,175	8,889,000	8,931,925	8,974,950	9,018,075	9,061,300	9,104,625	9,148,050	9,191,575	9,235,200	9,278,925	9,322,750	9,366,675	9,410,700	9,454,825	9,499,050	9,543,375	9,587,800	9,632,325	9,676,950	9,721,675	9,766,500	9,811,425	9,856,450	9,901,575	9,946,800	9,992,125	10,037,550	10,083,075	10,128,700	10,174,425	10,220,250	10,266,175	10,312,200	10,358,325	10,404,550	10,450,875	10,497,300	10,543,825	10,590,450	10,637,175	10,684,000	10,730,925	10,778,050	10,825,275	10,872,600	10,920,025	10,967,550	11,015,175	11,062,900	11,110,725	11,158,650	11,206,675	11,254,800	11,303,025	11,351,350	11,399,775	11,448,300	11,496,925	11,545,650	11,594,475	11,643,400	11,692,425	11,741,550	11,790,775	11,840,100	11,889,525	11,939,050	11,988,675	12,038,400	12,088,225	12,138,150	12,188,175	12,238,300	12,288,525	12,338,850	12,389,275	12,439,800	12,490,425	12,541,150	12,592,075	12,643,100	12,694,225	12,745,450	12,796,775	12,848,200	12,899,725	12,951,350	13,003,075	13,054,900	13,106,825	13,158,850	13,210,975	13,263,200	13,315,525	13,367,950	13,420,475	13,473,100	13,525,825	13,578,650	13,631,575	13,684,600	13,737,725	13,790,950	13,844,275	13,897,700	13,951,225	14,004,850	14,058,575	14,112,400	14,166,325	14,220,350	14,274,475	14,328,700	14,383,025	14,437,450	14,491,975	14,546,600	14,601,325	14,656,150	14,711,075	14,766,100	14,821,225	14,876,450	14,931,775	14,987,200	15,042,725	15,098,350	15,154,075	15,209,900	15,265,825	15,321,850	15,377,975	15,434,200	15,490,525	15,546,950	15,603,475	15,660,100	15,716,825	15,773,650	15,830,575	15,887,600	15,944,725	16,001,950	16,059,275	16,116,700	16,174,225	16,231,850	16,289,575	16,347,400	16,405,325	16,463,350	16,521,475	16,579,700	16,638,025	16,696,450	16,754,975	16,813,600	16,872,325	16,931,150	16,990,075	17,049,100	17,108,225	17,167,450	17,226,775	17,286,200	17,345,725	17,405,350	17,465,075	17,524,900	17,584,825	17,644,850	17,704,975	17,765,200	17,825,525	17,885,950	17,946,475	18,007,100	18,067,825	18,128,650	18,189,575	18,250,600	18,311,725	18,372,950	18,434,275	18,495,700	18,557,225	18,618,850	18,680,575	18,742,400	18,804,325	18,866,350	18,928,475	18,990,700	19,053,025	19,115,450	19,177,975	19,240,600	19,303,325	19,366,150	19,429,075	19,492,100	19,555,225	19,618,450	19,681,775	19,745,200	19,808,725	19,872,350	19,936,075	20,000,000	20,064,025	20,128,150	20,192,375	20,256,700	20,321,225	20,385,850	20,450,575	20,515,400	20,580,425	20,645,550	20,710,775	20,776,100	20,841,625	20,907,350	20,973,175	21,039,100	21,105,225	21,171,550	21,238,075	21,304,800	21,371,725	21,438,850	21,506,175	21,573,700	21,641,425	21,709,350	21,777,475	21,845,800	21,914,325	21,983,050	22,051,975	22,121,100	22,190,425	22,260,050	22,329,875	22,400,000	22,470,325	22,540,850	22,611,575	22,682,500	22,753,725	22,825,150	22,896,775	22,968,600	23,040,625	23,112,850	23,185,275	23,257,900	23,330,825	23,403,950	23,477,275	23,550,800	23,624,525	23,698,450	23,772,575	23,846,900	23,921,525	23,996,350	24,071,375	24,146,600	24,222,025	24,297,650	24,373,475	24,449,500	24,525,725	24,602,150	24,678,775	24,755,600	24,832,625	24,909,850	24,987,275	25,064,900	25,142,825	25,220,950	25,299,275	25,377,800	25,456,525	25,535,450	25,614,575	25,693,900	25,773,525	25,853,350	25,933,375	26,013,600	26,094,025	26,174,650	26,255,475	26,336,500	26,417,725	26,499,150	26,580,775	26,662,600	26,744,725	26,827,050	26,909,575	26,992,300	27,075,225	27,158,350	27,241,675	27,325,200	27,408,925	27,492,850	27,577,075	27,661,500	27,746,125	27,830,950	27,916,075	28,001,400	28,087,025	28,172,850	28,258,975	28,345,300	28,431,825	28,518,550	28,605,475	28,692,600	28,780,025	28,867,650	28,955,475	29,043,500	29,131,725	29,220,150	29,308,775	29,397,600	29,486,625	29,575,850	29,665,275	29,754,900	29,844,725	29,934,750	30,024,975	30,115,400	30,206,025	30,296,850	30,387,875	30,479,100	30,570,525	30,662,150	30,753,975	30,846,000	30,938,225	31,030,650	31,123,275	31,216,100	31,309,125	31,402,350	31,495,775	31,589,400

Appendix-27-2: SPV Equity IRR for Financial Structure Variation Scenarios

2-A. Base Cases including Base Scenarios

Case	Case 1a(i)	Case 1a(ii)	Case 1a(iii)	Case 2a(i)	Case 2a(ii)	Case 2a(iii)	Case 2a(iv)	Case 2a(v)	Case 3a(i)	Case 3a(ii)	Case 3a(iii)	Case 3a(iv)	Case 3a(v)
Sector													
Public	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work
SPV	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock
Government Subsidy	20% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment
Non-Fare Box Revenue	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box
SPV Financing	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30
Debt: Equity	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Borrowing Rate	22 (7) years	22 (7) years	22 (7) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years
Term (grace period)	8.5%	9.8%											
Equity IRR- Fare Box Rev.	6.5%	8.5%	9.8%	11.7%	12.8%	14.1%	15.7%	17.6%	13.9%	13.9%	15.3%	16.9%	18.9%
Equity IRR- Service Fee Revenue: 100% of Fare box collected	11.0%	12.0%	13.3%	12.0%	13.3%	14.1%	14.7%	16.6%	13.1%	13.1%	14.3%	15.9%	17.8%
Equity IRR- Service Fee Revenue: 95% of Fare box collected	10.2%	11.2%	12.4%	10.2%	11.2%	12.4%	13.8%	15.5%	12.2%	12.2%	13.4%	14.8%	16.6%

Source: Study Team

2-B. Central and State Tax Exemption Cases

Case	Case 1a(i)	Case 1a(ii)	Case 1a(iii)	Case 2a(i)	Case 2a(ii)	Case 2a(iii)	Case 2a(iv)	Case 2a(v)	Case 3a(i)	Case 3a(ii)	Case 3a(iii)	Case 3a(iv)	Case 3a(v)
Sector													
Public	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work
SPV	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock
Government Subsidy	20% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment
Non-Fare Box Revenue	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box
SPV Financing	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30
Debt: Equity	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Borrowing Rate	22 (7) years	22 (7) years	22 (7) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years
Term (grace period)	8.6%	10.9%	12.3%										
Equity IRR- Fare Box Rev.	8.6%	10.9%	12.3%	14.5%	15.9%	17.4%	19.3%	21.7%	17.2%	17.2%	18.8%	20.8%	23.3%
Equity IRR- Service Fee Revenue: 100% of Fare box collected	13.7%	14.5%	15.5%	13.7%	15.0%	16.5%	18.2%	20.5%	16.3%	16.3%	17.8%	19.7%	22.0%
Equity IRR- Service Fee Revenue: 95% of Fare box collected	12.9%	13.7%	14.1%	12.9%	14.1%	15.5%	17.2%	19.3%	15.3%	15.3%	16.7%	18.5%	20.7%

Source: Study Team

2-C. Central and State Tax Exemption + Power Tariff Reduction Cases

Case	Case 1a(i)	Case 1a(ii)	Case 1a(iii)	Case 2a(i)	Case 2a(ii)	Case 2a(iii)	Case 2a(iv)	Case 2a(v)	Case 3a(i)	Case 3a(ii)	Case 3a(iii)	Case 3a(iv)	Case 3a(v)
Sector													
Public				Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work
SPV	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock
Government Subsidy	20% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment
Non-Fare Box Revenue	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box
SPV Financing	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30
Debt: Equity	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Borrowing Rate	22 (7) years	22 (7) years	22 (7) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years
Equity IRR- Fare Box Rev.	9.1%	11.4%	12.9%	-	-	-	-	-	-	-	-	-	-
Equity IRR- Service Fee Revenue: 100% of Fare box collected	-	-	-	15.2%	16.7%	18.3%	20.2%	22.8%	16.7%	18.1%	19.7%	21.8%	24.5%
Equity IRR- Service Fee Revenue: 95% of Fare box collected	-	-	-	14.4%	15.8%	17.3%	19.2%	21.6%	15.8%	17.1%	18.7%	20.7%	23.2%
Equity IRR- Service Fee Revenue: 90% of Fare box collected	-	-	-	13.6%	14.9%	16.3%	18.1%	20.4%	14.9%	16.2%	17.7%	19.6%	22.0%

Source: Study Team

2-D. No FSI Contribution Cases

Case	Case 1a(i)	Case 1a(ii)	Case 1a(iii)	Case 2a(i)	Case 2a(ii)	Case 2a(iii)	Case 2a(iv)	Case 2a(v)	Case 3a(i)	Case 3a(ii)	Case 3a(iii)	Case 3a(iv)	Case 3a(v)
Sector													
Public				Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work
SPV	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Land Acquisition Civil Work Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock
Government Subsidy	20% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment
Non-Fare Box Revenue	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box
SPV Financing	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30	70-30
Debt: Equity	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Borrowing Rate	22 (7) years	22 (7) years	22 (7) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years
Equity IRR- Fare Box Rev.	5.9%	7.7%	8.9%	-	-	-	-	-	-	-	-	-	-
Equity IRR- Service Fee Revenue: 100% of Fare box collected	-	-	-	10.7%	11.7%	12.8%	14.1%	15.7%	11.8%	12.6%	13.7%	15.1%	16.8%
Equity IRR- Service Fee Revenue: 95% of Fare box collected	-	-	-	10.0%	10.9%	12.0%	13.2%	14.8%	10.8%	11.8%	12.9%	14.2%	15.7%
Equity IRR- Service Fee Revenue: 90% of Fare box collected	-	-	-	9.4%	10.2%	11.2%	12.4%	13.9%	10.1%	11.0%	12.0%	13.2%	14.7%

Source: Study Team

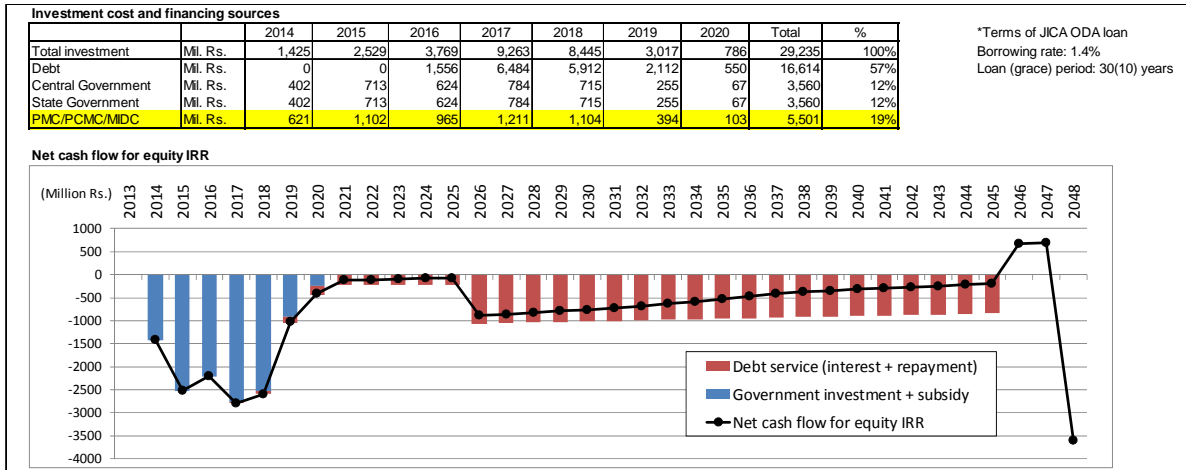
2-E. No FSI Contribution + Central and State Tax Exemption Cases

Case	Case 1a(i)	Case 1a(ii)	Case 1a(iii)	Case 2a(i)	Case 2a(ii)	Case 2a(iii)	Case 2a(iv)	Case 2a(v)	Case 3a(i)	Case 3a(ii)	Case 3a(iii)	Case 3a(iv)	Case 3a(v)
Sector													
Public	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work	Land Acquisition Civil Work Track Work
SPV	Land Acquisition Civil Work Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	Track Work E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock	E&M Rolling Stock
Government Subsidy	20% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment	10% of Initial Investment	20% of Initial Investment	30% of Initial Investment	40% of Initial Investment	50% of Initial Investment
Non-Fare Box Revenue	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box	5% of Fare Box
SPV Financing	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30	70:30
Debt: Equity	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Borrowing Rate	22 (7) years	22 (7) years	22 (7) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years	20 (5) years
Term (grace period)													
Equity IRR- Fare Box Rev.	7.8%	9.9%	11.2%	-	-	-	-	-	-	-	-	-	-
Equity IRR- Service Fee Revenue: 100% of Fare box collected	13.2%	14.4%	15.7%	17.3%	17.3%	17.3%	17.3%	19.3%	15.5%	16.9%	16.9%	18.5%	20.6%
Equity IRR- Service Fee Revenue: 95% of Fare box collected	12.4%	13.5%	14.8%	16.3%	16.3%	16.3%	16.3%	18.1%	14.6%	15.9%	15.9%	17.4%	19.4%
Equity IRR- Service Fee Revenue: 90% of Fare box collected	11.6%	12.6%	13.8%	15.2%	15.2%	15.2%	15.2%	17.0%	13.7%	14.9%	14.9%	16.3%	18.1%

Source: Study Team

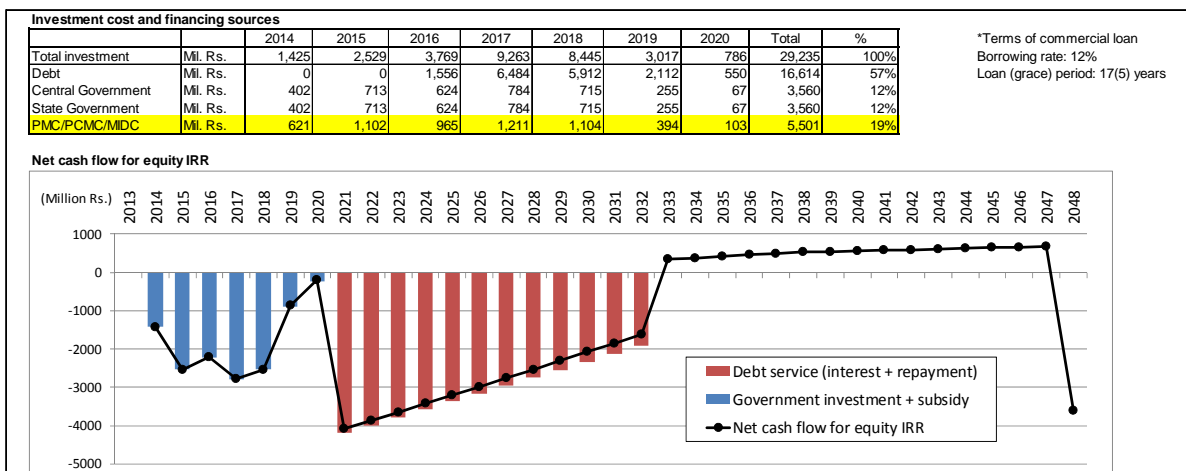
Appendix-27-4: Financial Cash Flow Graphs of All Analyzed Cases for PMRC

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case	
Case P2a(iii)-1	Land Civil work	29,235	PMC/PCMC/MDC	5,501	18.8%	Track work	Case 2a(iii) * 30% of initial investment subsidized by public * 95% of fare box revenue is received as service fee SPV equity IRR: 13.3%
			VGF State government	3,560	12.2%	E&M	
			VGF Central government	3,560	12.2%	Rolling Stock	
			Debt (JICA ODA loan)	16,614	56.8%		



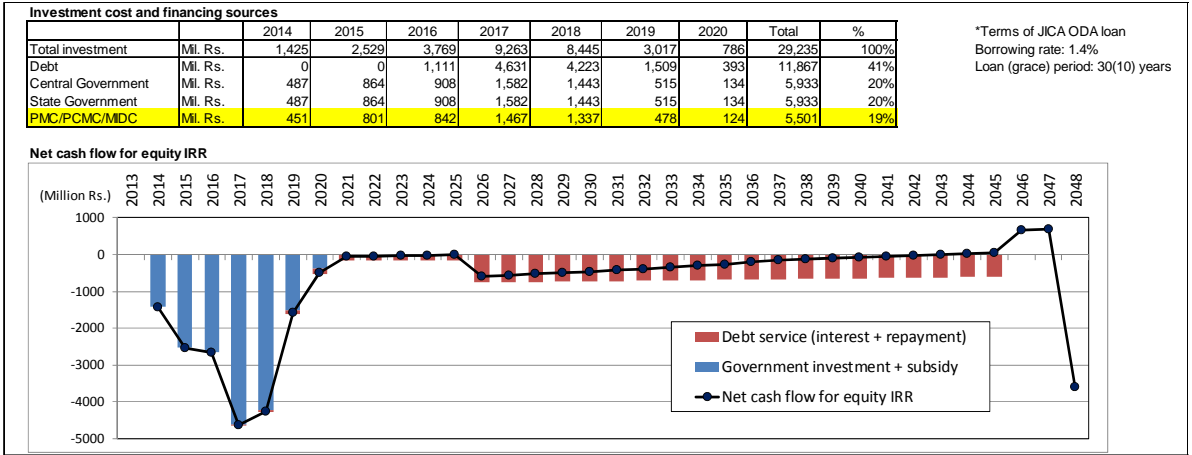
Source: Study Team

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case	
Case P2a(iii)-2	Land Civil work	29,235	PMC/PCMC/MDC	5,501	18.8%	Track work	Case 2a(iii) * 30% of initial investment subsidized by public * 95% of fare box revenue is received as service fee SPV equity IRR: 13.3%
			VGF State government	3,560	12.2%	E&M	
			VGF Central government	3,560	12.2%	Rolling Stock	
			Debt (Commercial loan)	16,614	56.8%		



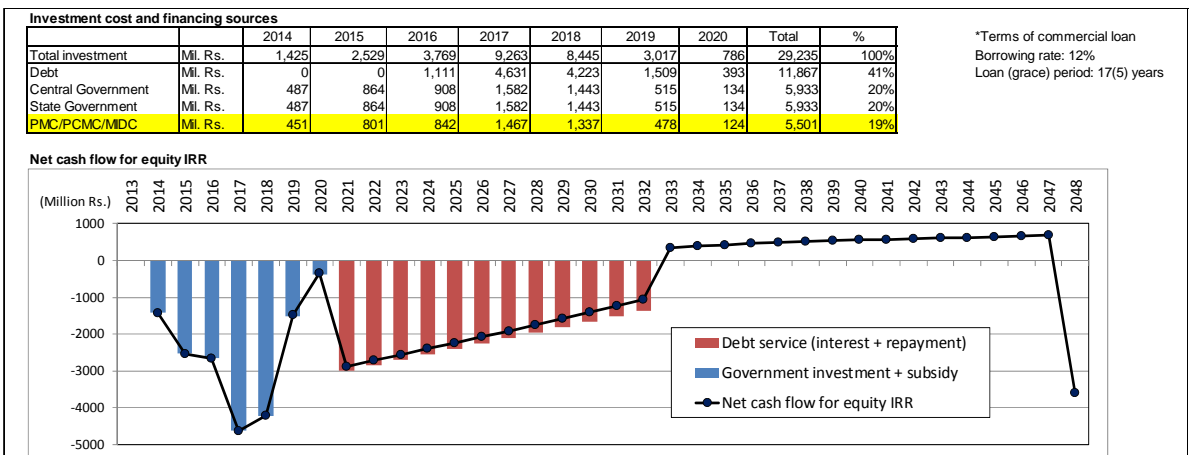
Source: Study Team

Public (PMRC)				SPV			
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)			Undertaking	Case
Case P2a(v)-1	Land Civil work	29,235	PMC/PCMC/MDC	5,501	18.8%	Track work	Case 2a(v) * 50% of initial investment subsidized by public * 95% of fare box revenue is received as service fee SPV equity IRR: 16.6%
			VGF State government	5,933	20.3%	E&M	
			VGF Central government	5,933	20.3%	Rolling Stock	
			Debt (JICA ODA loan)	11,867	40.6%		



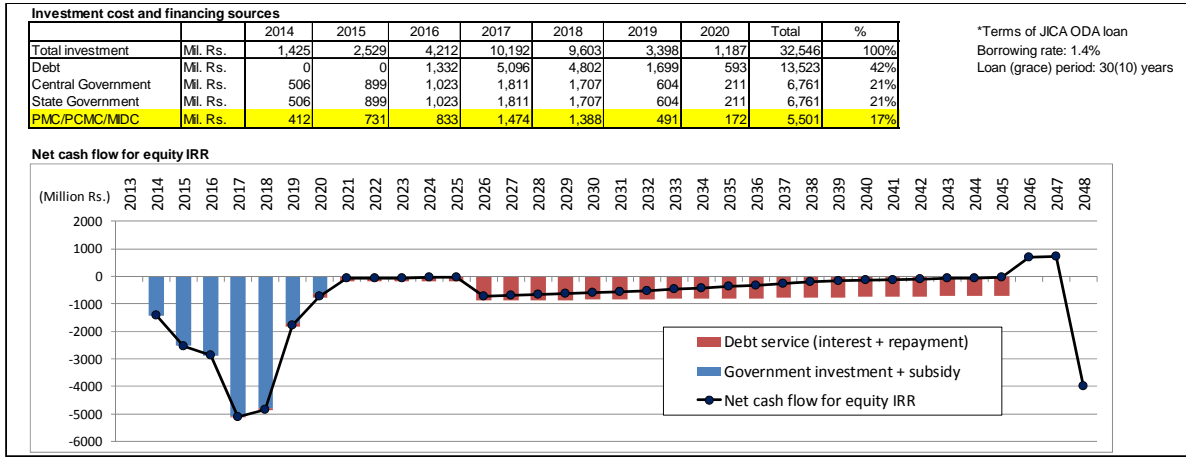
Source: Study Team

Public (PMRC)				SPV			
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)			Undertaking	Case
Case P2a(v)-2	Land Civil work	29,235	PMC/PCMC/MDC	5,501	18.8%	Track work	Case 2a(v) * 50% of initial investment subsidized by public * 95% of fare box revenue is received as service fee SPV equity IRR: 16.6%
			VGF State government	5,933	20.3%	E&M	
			VGF Central government	5,933	20.3%	Rolling Stock	
			Debt (Commercial loan)	11,867	40.6%		



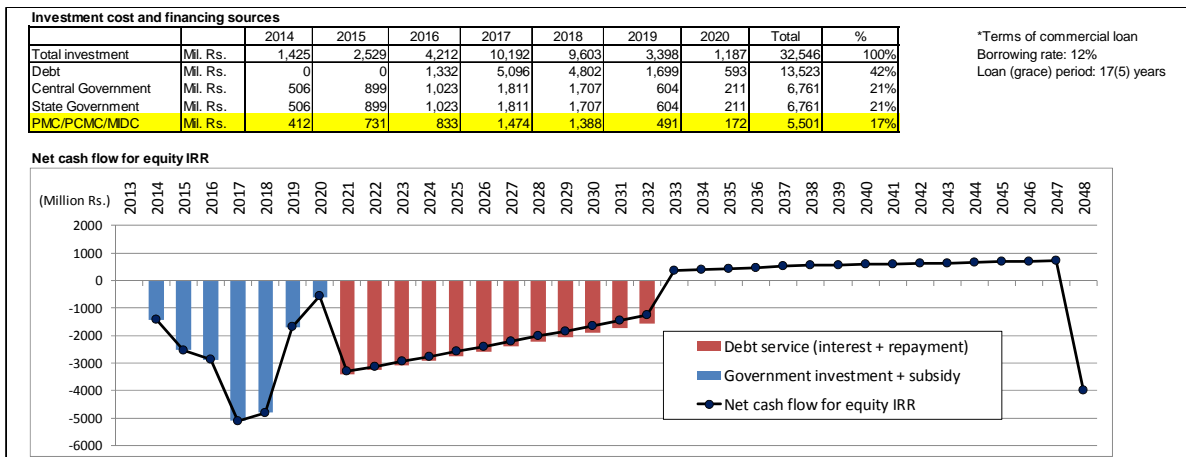
Source: Study Team

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case	
Case P3a(v)-1	Land	32,546	PMC/PCMC/MDC	5,501	16.9%	E&M Rolling Stock	Case 3a(v) * 50% of initial investment subsidized by public * 95% of fare box revenue is received as service fee SPV equity IRR: 17.8%
	Civil work		VGF State government	6,761	20.8%		
	Track work		VGF Central government	6,761	20.8%		
			Debt (JICA ODA loan)	13,523	41.5%		



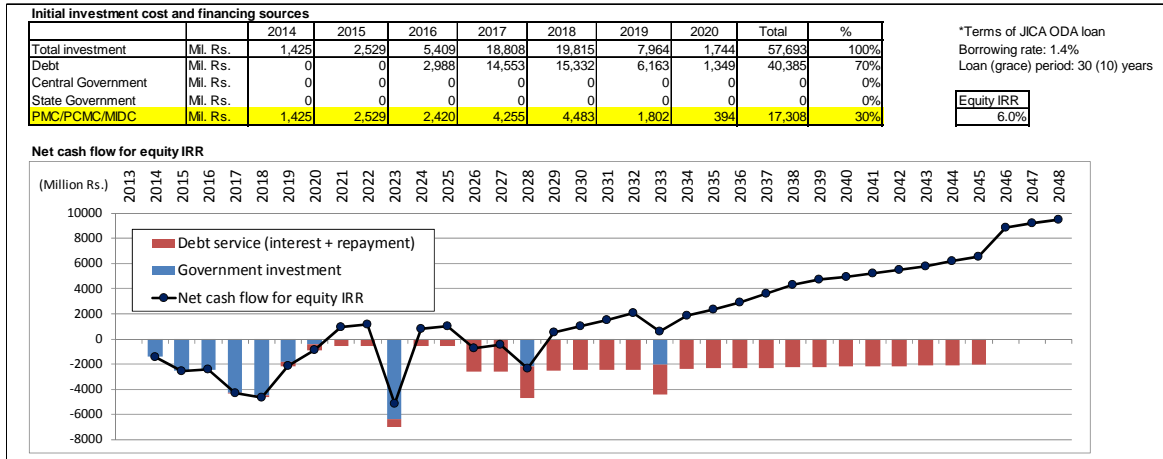
Source: Study Team

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case	
Case P3a(v)-2	Land	32,546	PMC/PCMC/MDC	5,501	16.9%	E&M Rolling Stock	Case 3a(v) * 50% of initial investment subsidized by public * 95% of fare box revenue is received as service fee SPV equity IRR: 17.8%
	Civil work		VGF State government	6,761	20.8%		
	Track work		VGF Central government	6,761	20.8%		
			Debt (Commercial loan)	13,523	41.5%		



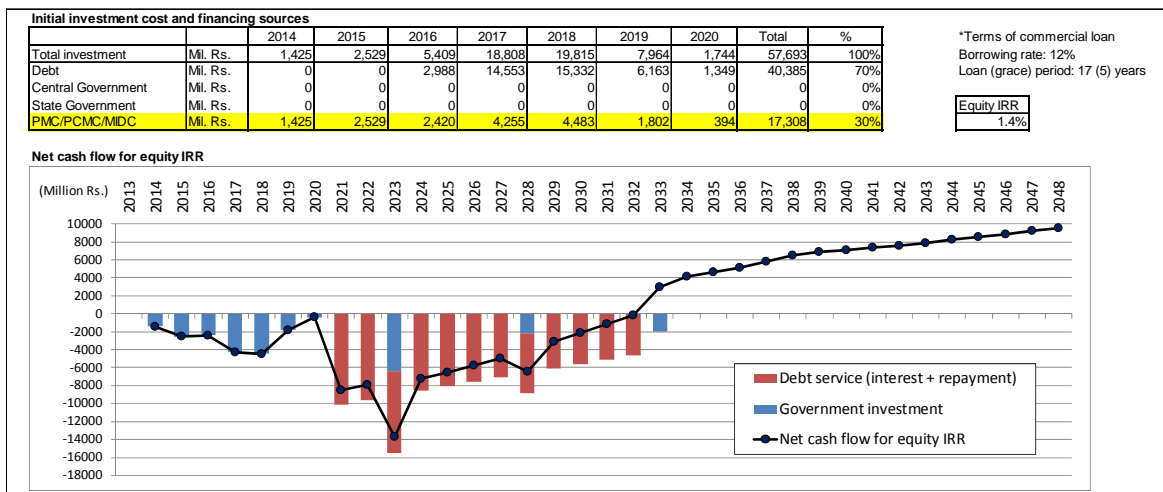
Source: Study Team

Public (PMRC)					SPV	
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case
Case P1-1	Fully public undertaking	57,693	Gov. Budget (PMC/PCMC/MIDC)	17,308	30%	-
			Debt (JICA ODA loan)	40,385	70%	-



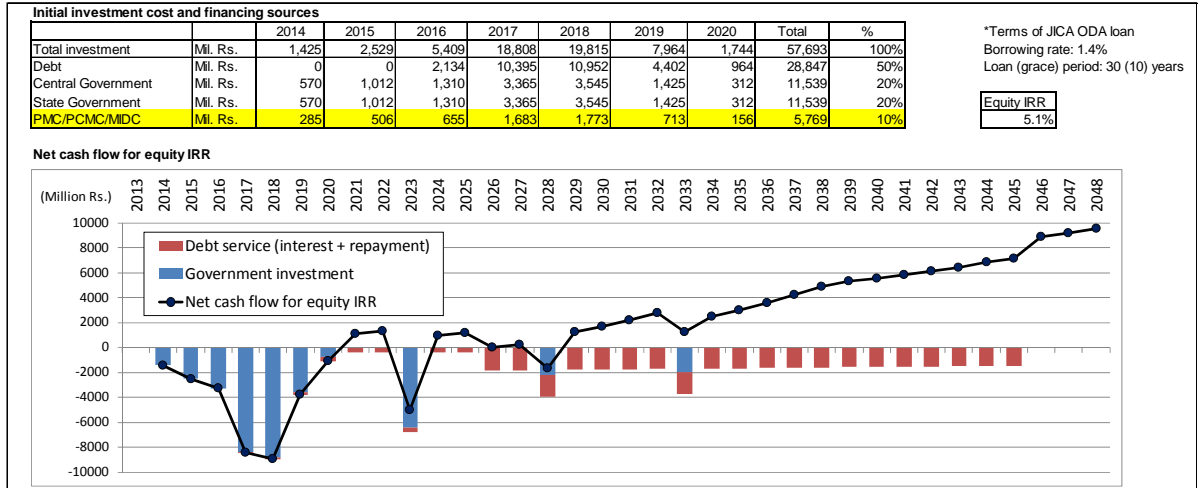
Source: Study Team

Public (PMRC)					SPV	
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case
Case P1-2	Fully public undertaking	57,693	Gov. Budget (PMC/PCMC/MIDC)	17,308	30%	-
			Debt (Commercial loan)	40,385	70%	-



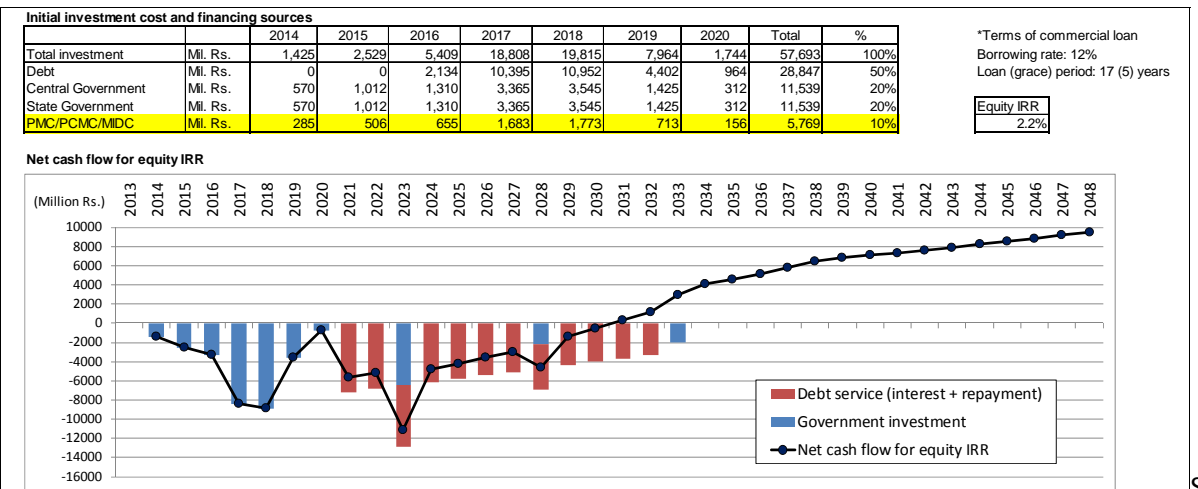
Source: Study Team

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case	
Case P1-3	Fully public undertaking	57,693	Gov. Budget (PMC/PCMC/MDC)	5,769	10%	-	-
			Gov. Budget (State government)	11,539	20%		
			Gov. Budget (Central government)	11,539	20%		
			Debt (JICA ODA loan)	28,847	50%		



Source: Study Team

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case	
Case P1-4	Fully public undertaking	57,693	Gov. Budget (PMC/PCMC/MDC)	5,769	10%	-	-
			Gov. Budget (State government)	11,539	20%		
			Gov. Budget (Central government)	11,539	20%		
			Debt (Commercial loan)	28,847	50%		



Source: Study Team

Appendix-27-5: Calculation Table of Public Cost Sharing Rate to Total Initial Investment

5-A. Base Scenario 1: Case 2a(iii)+ Case P2a(iii)

COST SHARING & FUNDING -Public/Private				(VGF: 30%)*															
Investment		Amount	Share	Funding		Share	Share of												
		INR m	%	within	INR m	within	total												
Initial Investment Total		57,693	100.0%	Initial Investment Total		57,693	100.0%												
Land	Public	5,501	9.5%	Public	29,235	50.7%													
Civil	Public	23,734	41.1%	VGF Central Govt	3,560	6.2%													
Track	Private	3,312	5.7%	VGF State Govt	3,560	6.2%													
E&M	Private	9,011	15.6%	PMC/PCMC/MIDC sub	5,501	9.5%													
Rolling Stock	Private	16,136	28.0%	PMRC Borrowing	16,614	28.8%													
VGF Allocation				Overall Funding															
		Fundnig Req	Allocated																
Total VGF		57,693	15,658	27.1%	VGF	15,658	27.1%												
Public		29,235	7,120	24.4%	Public	22,114	38.3%												
Private		28,459	8,538	30.0%	Private	19,921	34.5%												
				<table border="1"> <tr> <td>VGF</td> <td>15,658</td> <td>27.1%</td> </tr> <tr> <td>Public</td> <td>22,114</td> <td>38.3%</td> </tr> <tr> <td>Private</td> <td>19,921</td> <td>34.5%</td> </tr> <tr> <td>Total</td> <td>57,693</td> <td>100.0%</td> </tr> </table>				VGF	15,658	27.1%	Public	22,114	38.3%	Private	19,921	34.5%	Total	57,693	100.0%
VGF	15,658	27.1%																	
Public	22,114	38.3%																	
Private	19,921	34.5%																	
Total	57,693	100.0%																	

* Land cost is excluded from VGF calculation.

VGF+Public: 65.5%

Source: Study Team

5-B. Base Scenario 2: Case 2a(v)+ Case P2a(v)

COST SHARING & FUNDING -Public/Private				(VGF: 50%)*															
Investment		Amount	Share	Funding		Share	Share of												
		INR m	%	within	INR m	within	total												
Initial Investment Total		57,693	100.0%	Initial Investment Total		57,693	100.0%												
Land	Public	5,501	9.5%	Public	29,235	50.7%													
Civil	Public	23,734	41.1%	VGF Central Govt	5,933	10.3%													
Track	Private	3,312	5.7%	VGF State Govt	5,933	10.3%													
E&M	Private	9,011	15.6%	PMC/PCMC/MIDC sub	5,501	9.5%													
Rolling Stock	Private	16,136	28.0%	PMRC Borrowing	11,867	20.6%													
VGF Allocation				Overall Funding															
		Fundnig Req	Allocated																
Total VGF		57,693	26,096	45.2%	VGF	26,096	45.2%												
Public		29,235	11,867	40.6%	Public	17,368	30.1%												
Private		28,459	14,229	50.0%	Private	14,229	24.7%												
				<table border="1"> <tr> <td>VGF</td> <td>26,096</td> <td>45.2%</td> </tr> <tr> <td>Public</td> <td>17,368</td> <td>30.1%</td> </tr> <tr> <td>Private</td> <td>14,229</td> <td>24.7%</td> </tr> <tr> <td>Total</td> <td>57,693</td> <td>100.0%</td> </tr> </table>				VGF	26,096	45.2%	Public	17,368	30.1%	Private	14,229	24.7%	Total	57,693	100.0%
VGF	26,096	45.2%																	
Public	17,368	30.1%																	
Private	14,229	24.7%																	
Total	57,693	100.0%																	

* Land cost is excluded from VGF calculation.

VGF+Public: 75.3%

Source: Study Team

5-C. Base Scenario 3: Case 3a(v)+ Case P3a(v)

COST SHARING & FUNDING -Public/Private (VGF: **50%**)*

Investment		Amount	Share
		INR m	%
Initial Investment Total		57,693	100.0%
Land	Public	5,501	9.5%
Civil	Public	23,734	41.1%
Track	Public	3,312	5.7%
E&M	Private	9,011	15.6%
Rolling Stock	Private	16,136	28.0%

VGF Allocation			
	Fundnig Req	Allocated	
Total VGF	57,693	26,096	45.2%
Public	32,546	13,523	41.5%
Private	25,147	12,574	50.0%

* Land cost is excluded from VGF calculation.

Funding		Share within	INR m	Share of total
Initial Investment Total			57,693	100.0%
Public		100.0%	32,546	56.4%
VGF Central Govt		20.8%	6,761	11.7%
VGF State Govt		20.8%	6,761	11.7%
PMC/PCMC/MIDC sub		16.9%	5,501	9.5%
PMRC Borrowing		41.5%	13,523	23.4%
Private		100.0%	25,147	43.6%
Equity (30%)		15.0%	3,772	6.5%
Debt (70%)		35.0%	8,802	15.3%
VGF		50.0%	12,574	21.8%

Overall Funding

VGF	26,096	45.2%
Public	19,023	33.0%
Private	12,574	21.8%
Total	57,693	100.0%

VGF+Public: 78.2%

Source: Study Team

Appendix-27-6: Result of Financial and Economic Analysis in Case of Entirely Elevated Alignment

6-A. Project Cost

Without Price Escalation and Exchange Rate Fluctuations

(Unit: Million Rs.)												
Total Cost	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1) Construction/Procurement												
Civil Works		0	0	1,665	6,659	6,473	1,998	946	0	0	0	17,740
Track		0	0	282	564	669	209	209	0	0	0	1,933
E&M		0	0	743	1,485	2,037	552	276	0	0	0	5,093
Rolling Stock		0	0	0	3,285	3,285	1,643	0	2,746	845	704	12,508
Sub total		0	0	2,689	11,993	12,464	4,401	1,431	2,746	845	704	37,273
(2) Others												
Land acquisition, Utility relocation		1,112	1,894	1,112	0	0	0	0				4,118
Consulting service		0	0	134	600	623	220	72				1,649
Contingency		0	0	141	630	654	231	75	137	42	35	1,946
Sub total		1,112	1,894	1,388	1,229	1,278	451	147	137	42	35	7,713
(3) Tax												
Tax & Duty		200	341	708	2,267	2,356	832	270	494	152	127	7,747
Total		1,312	2,235	4,785	15,489	16,097	5,684	1,848	3,377	1,039	866	52,734

Initial Investment
17,740
1,933
5,093
8,213
32,979
0
4,118
1,649
1,731
7,499
0
6,974
47,452

Foreign Currency Portion												
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1) Construction/Procurement												
Civil Works		0	0	0	0	0	0	0	0	0	0	0
Track		0	0	66	132	157	49	49	0	0	0	453
E&M		0	0	330	660	905	245	123	0	0	0	2,262
Rolling Stock		0	0	0	3,285	3,285	1,643	0	2,746	845	704	12,508
Sub total		0	0	396	4,077	4,347	1,937	172	2,746	845	704	15,223
(2) Others												
Land acquisition, Utility relocation		0	0	0	0	0	0	0	0	0	0	0
Consulting service		0	0	20	204	217	97	9				546
Contingency		0	0	21	214	228	102	9	137	42	35	788
Sub total		0	0	41	418	446	199	18	137	42	35	1,335
(3) Tax												
Tax & Duty		0	0	75	771	822	366	32	494	152	127	2,838
Total		0	0	511	5,266	5,614	2,501	222	3,377	1,039	866	19,396

Local Currency Portion												
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1) Construction/Procurement												
Civil Works		0	0	1,665	6,659	6,473	1,998	946	0	0	0	17,740
Track		0	0	216	432	512	160	160	0	0	0	1,480
E&M		0	0	413	826	1,132	307	153	0	0	0	2,831
Rolling Stock		0	0	0	0	0	0	0	0	0	0	0
Sub total				2,293	7,916	8,117	2,465	1,259	0	0	0	22,051
(2) Others												
Land acquisition, Utility relocation		1,112	1,894	1,112	0	0	0	0	0	0	0	4,118
Consulting service		0	0	115	396	406	123	63				1,103
Contingency		0	0	120	416	426	129	66	0	0	0	1,158
Sub total		1,112	1,894	1,347	811	832	253	129	0	0	0	6,379
(3) Tax												
Tax & Duty		200	341	634	1,496	1,534	466	238	0	0	0	4,909
Total		1,312	2,235	4,274	10,224	10,483	3,183	1,627	0	0	0	33,338

Source: Study Team

With Price Escalation and Exchange Rate Fluctuations

Total Cost												(Unit: Million Rs.)
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1) Construction/Procurement												
Civil Works		0	0	1,962	8,180	8,285	2,664	1,314	0	0	0	22,406
Track		0	0	343	720	897	295	310	0	0	0	2,564
E&M		0	0	927	1,960	2,844	815	431	0	0	0	6,977
Rolling Stock		0	0	0	4,711	5,063	2,721	0	5,202	1,776	1,642	21,113
Sub total		0	0	3,232	15,570	17,088	6,495	2,056	5,202	1,776	1,642	53,060
(2) Others												
Land acquisition, Utility relocation		1,207	2,143	1,311	0	0	0	0	0	0	0	4,662
Consulting service		0	0	162	779	854	325	103	0	0	0	2,222
Contingency		0	0	170	817	897	341	108	260	89	82	2,764
Sub total		1,207	2,143	1,642	1,596	1,752	666	211	260	89	82	9,648
(3) Tax												
Tax & Duty		217	386	847	2,943	3,230	1,228	389	936	320	296	10,790
Total		1,425	2,529	5,721	20,109	22,069	8,388	2,655	6,398	2,184	2,019	73,498

Initial Investment
22,406
2,564
6,977
12,494
44,441
0
4,662
2,222
2,333
9,217
0
9,238
62,897

Foreign Currency Portion												
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1) Construction/Procurement												
Civil Works		0	0	0	0	0	0	0	0	0	0	0
Track		0	0	88	189	241	81	87	0	0	0	688
E&M		0	0	440	946	1,394	406	218	0	0	0	3,405
Rolling Stock		0	0	0	4,711	5,063	2,721	0	5,202	1,776	1,642	21,113
Sub total		0	0	528	5,846	6,699	3,208	305	5,202	1,776	1,642	25,206
(2) Others												
Land acquisition, Utility relocation		0	0	0	0	0	0	0	0	0	0	0
Consulting service		0	0	26	292	335	160	15	0	0	0	829
Contingency		0	0	28	307	352	168	16	260	89	82	1,302
Sub total		0	0	54	599	687	329	31	260	89	82	2,131
(3) Tax												
Tax & Duty		0	0	100	1,105	1,266	606	58	936	320	296	4,686
Total		0	0	682	7,550	8,651	4,143	395	6,398	2,184	2,019	32,023

Local Currency Portion												
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1) Construction/Procurement												
Civil Works		0	0	1,962	8,180	8,285	2,664	1,314	0	0	0	22,406
Track		0	0	254	530	655	214	223	0	0	0	1,877
E&M		0	0	487	1,014	1,449	409	213	0	0	0	3,572
Rolling Stock		0	0	0	0	0	0	0	0	0	0	0
Sub total		0	0	2,704	9,724	10,389	3,287	1,750	0	0	0	27,855
(2) Others												
Land acquisition, Utility relocation		1,207	2,143	1,311	0	0	0	0	0	0	0	4,662
Consulting service		0	0	135	486	519	164	88	0	0	0	1,393
Contingency		0	0	142	511	545	173	92	0	0	0	1,462
Sub total		1,207	2,143	1,588	997	1,065	337	179	0	0	0	7,517
(3) Tax												
Tax & Duty		217	386	747	1,838	1,964	621	331	0	0	0	6,104
Total		1,425	2,529	5,039	12,559	13,418	4,245	2,261	0	0	0	41,475

Source: Study Team

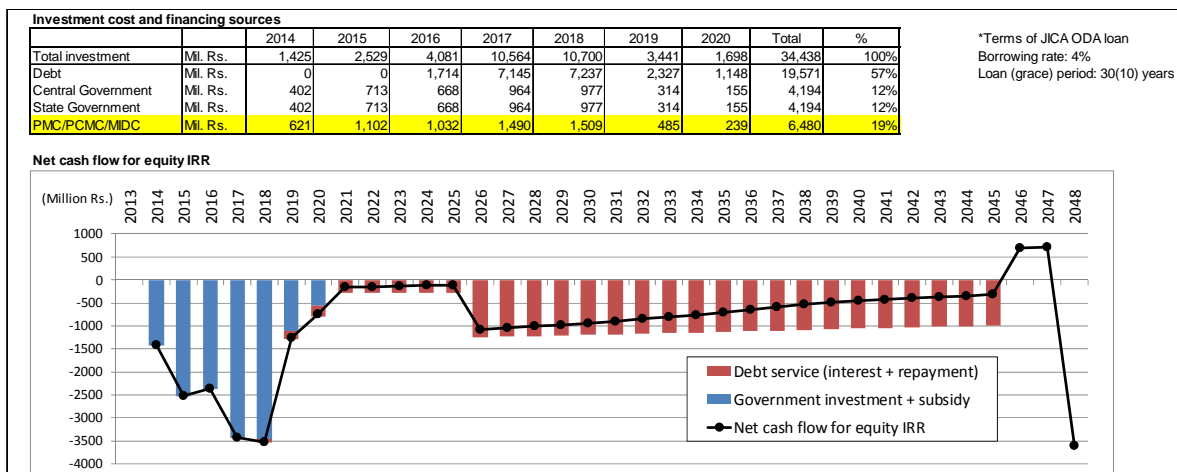
6-B. Financial and Economic Internal Rate of Return

Project FIRR	Economic IRR
4.8%	13.3%

Source: Study Team

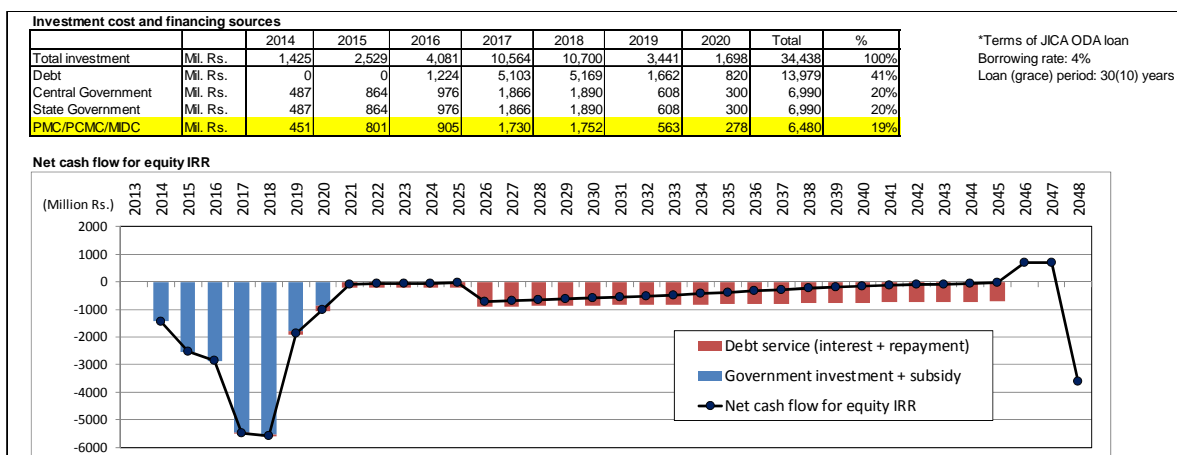
6-C. Financial Cash Flow Graphs of PMRC (3 Base Cases)

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)			Undertaking	Case
Case P2a(iii)-1	Land Civil work	34,438	PMC/PCMC/MDC	5,501	16.0%	Track work	Case 2a(iii)
			VGF State government	4,341	12.6%	E&M	* 30% of initial investment subsidized by public
			VGF Central government	4,341	12.6%	Rolling Stock	* 95% of fare box revenue is received as service fee
			Debt (JICA ODA loan)	20,256	58.8%		SPV equity IRR: 13.3%



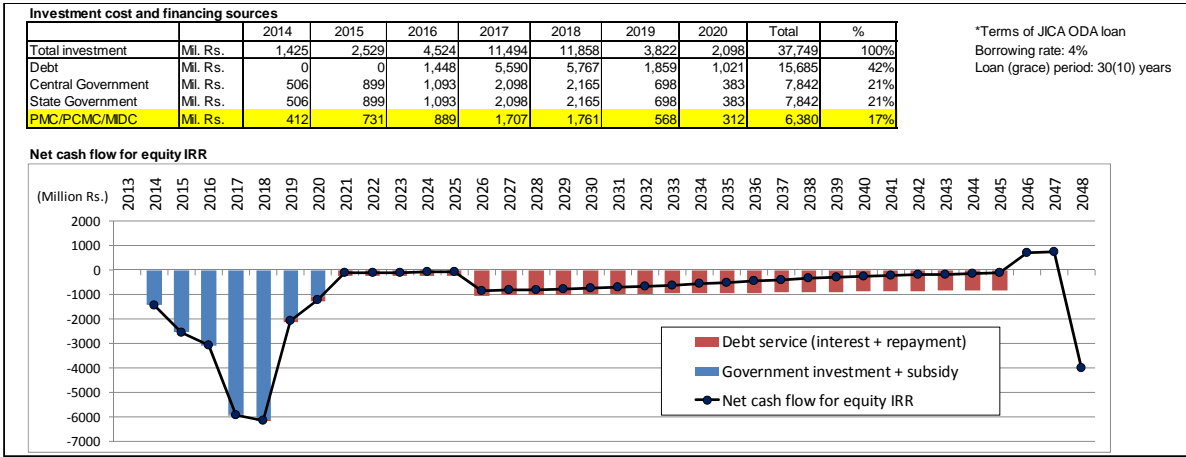
Source: Study Team

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)			Undertaking	Case
Case P2a(v)-1	Land Civil work	34,438	PMC/PCMC/MDC	5,501	16.0%	Track work	Case 2a(v)
			VGF State government	7,234	21.0%	E&M	* 50% of initial investment subsidized by public
			VGF Central government	7,234	21.0%	Rolling Stock	* 95% of fare box revenue is received as service fee
			Debt (JICA ODA loan)	14,469	42.0%		SPV equity IRR: 16.6%



Source: Study Team

Public (PMRC)					SPV		
Case	Undertaking	Initial Investment Cost (Mil. Rs)	Financing sources (Mil. Rs)		Undertaking	Case	
Case P3a(v)-1	Land	37,749	PMC/PCMC/MDC	5,501	14.6%	E&M Rolling Stock	Case 3a(v) * 50% of initial investment subsidized by public * 95% of fare box revenue is received as service fee SPV equity IRR: 17.8%
	Civil work		VGF State government	8,062	21.4%		
	Track work		VGF Central government	8,062	21.4%		
			Debt (JICA ODA loan)	16,124	42.7%		



Source: Study Team

**APPENDIX-28-2 (1): Allocation of Investment Cost (at 2012 prices)
without price escalation or exchange rate changes**

【外資・内資合計】												(Unit: Million Rs.)
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1)建設・調達費用												
Civil Works		0	0	1,460	5,839	5,109	1,752	438	0	0	0	14,597
Track		0	0	282	564	669	209	209	0	0	0	1,933
E&M		0	0	743	1,485	2,037	552	276	0	0	0	5,093
Rolling Stock		0	0	0	3,285	3,285	1,643	0	2,746	845	704	12,508
小計		0	0	2,484	11,173	11,100	4,155	923	2,746	845	704	34,131
(2)その他												
Land acquisition, Utility relocation		1,112	1,894	1,112	0	0	0	0				4,118
Consulting service		0	0	124	559	555	208	46				1,492
Contingency		0	0	130	587	583	218	48	137	42	35	1,781
小計		1,112	1,894	1,367	1,145	1,138	426	95	137	42	35	7,391
(3)税金												
Tax & Duty		200	341	670	2,112	2,098	785	174	494	152	127	7,153
合計		1,312	2,235	4,521	14,430	14,336	5,367	1,192	3,377	1,039	866	48,675
【外資】												
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1)建設・調達費用												
Civil Works		0	0	0	0	0	0	0	0	0	0	0
Track		0	0	66	132	157	49	49	0	0	0	453
E&M		0	0	330	660	905	245	123	0	0	0	2,262
Rolling Stock		0	0	0	3,285	3,285	1,643	0	2,746	845	704	12,508
小計		0	0	396	4,077	4,347	1,937	172	2,746	845	704	15,223
(2)その他												
Land acquisition, Utility relocation		0	0	0	0	0	0	0	0	0	0	0
Consulting service		0	0	20	204	217	97	9				546
Contingency		0	0	21	214	228	102	9	137	42	35	788
小計		0	0	41	418	446	199	18	137	42	35	1,335
(3)税金												
Tax & Duty		0	0	75	771	822	366	32	494	152	127	2,838
合計		0	0	511	5,266	5,614	2,501	222	3,377	1,039	866	19,396
【内資】												
	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1)建設・調達費用												
Civil Works		0	0	1,460	5,839	5,109	1,752	438	0	0	0	14,597
Track		0	0	216	432	512	160	160	0	0	0	1,480
E&M		0	0	413	826	1,132	307	153	0	0	0	2,831
Rolling Stock		0	0	0	0	0	0	0	0	0	0	0
小計		0	0	2,088	7,096	6,753	2,219	752	0	0	0	18,908
(2)その他												
Land acquisition, Utility relocation		1,112	1,894	1,112	0	0	0	0	0	0	0	4,118
Consulting service		0	0	104	355	338	111	38				945
Contingency		0	0	110	373	355	116	39	0	0	0	993
小計		1,112	1,894	1,326	727	692	227	77	0	0	0	6,056
(3)税金												
Tax & Duty		200	341	595	1,341	1,276	419	142	0	0	0	4,315
合計		1,312	2,235	4,009	9,165	8,722	2,865	971	0	0	0	29,279

At grade + Elevated for LRT

Total 48,675 Million Rs.

**APPENDIX-28-2 (2): The case of Whole Elevated for LRT
without price escalation or exchange rate changes**

(Unit: Million Rs.)												
【外資・内資合計】	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1)建設・調達費用												
Civil Works		0	0	1,665	6,659	6,473	1,998	946	0	0	0	17,740
Track		0	0	282	564	669	209	209	0	0	0	1,933
E&M		0	0	743	1,485	2,037	552	276	0	0	0	5,093
Rolling Stock		0	0	0	3,285	3,285	1,643	0	2,746	845	704	12,508
小計		0	0	2,689	11,993	12,464	4,401	1,431	2,746	845	704	37,273
(2)その他												
Land acquisition, Utility relocation		1,112	1,894	1,112	0	0	0	0	0	0	0	4,118
Consulting service		0	0	134	600	623	220	72	0	0	0	1,649
Contingency		0	0	141	630	654	231	75	137	42	35	1,946
小計		1,112	1,894	1,388	1,229	1,278	451	147	137	42	35	7,713
(3)税金												
Tax & Duty		200	341	708	2,267	2,356	832	270	494	152	127	7,747
合計		1,312	2,235	4,785	15,489	16,097	5,684	1,848	3,377	1,039	866	52,734

初期投資のみTotal	17,740
	1,933
	5,093
	8,213
	32,979
	0
	4,118
	1,649
	1,731
	7,499
	0
	6,974
	47,452

【外資】	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1)建設・調達費用												
Civil Works		0	0	0	0	0	0	0	0	0	0	0
Track		0	0	66	132	157	49	49	0	0	0	453
E&M		0	0	330	660	905	245	123	0	0	0	2,262
Rolling Stock		0	0	0	3,285	3,285	1,643	0	2,746	845	704	12,508
小計		0	0	396	4,077	4,347	1,937	172	2,746	845	704	15,223
(2)その他												
Land acquisition, Utility relocation		0	0	0	0	0	0	0	0	0	0	0
Consulting service		0	0	20	204	217	97	9	0	0	0	546
Contingency		0	0	21	214	228	102	9	137	42	35	788
小計		0	0	41	418	446	199	18	137	42	35	1,335
(3)税金												
Tax & Duty		0	0	75	771	822	366	32	494	152	127	2,838
合計		0	0	511	5,266	5,614	2,501	222	3,377	1,039	866	19,396

【内資】	2013	2014	2015	2016	2017	2018	2019	2020	2023	2028	2033	Total
(1)建設・調達費用												
Civil Works		0	0	1,665	6,659	6,473	1,998	946	0	0	0	17,740
Track		0	0	216	432	512	160	160	0	0	0	1,480
E&M		0	0	413	826	1,132	307	153	0	0	0	2,831
Rolling Stock		0	0	0	0	0	0	0	0	0	0	0
小計				2,293	7,916	8,117	2,465	1,259	0	0	0	22,051
(2)その他												
Land acquisition, Utility relocation		1,112	1,894	1,112	0	0	0	0	0	0	0	4,118
Consulting service		0	0	115	396	406	123	63	0	0	0	1,103
Contingency		0	0	120	416	426	129	66	0	0	0	1,158
小計		1,112	1,894	1,347	811	832	253	129	0	0	0	6,379
(3)税金												
Tax & Duty		200	341	634	1,496	1,534	466	238	0	0	0	4,909
合計		1,312	2,235	4,274	10,224	10,483	3,183	1,627	0	0	0	33,338

**Whole Elevated for LRT
Total 52,734 Million Rs.**

APPENDIX-28-3: Table of comparison of the advantages and disadvantages between a partial at-grade system and an entirely elevated system

	Items	Partial At-Grade	Entirely Elevated
1	Making use of Characteristics of the LRT	Since an LRT can run at-grade at a lower level, the LRT can reduce the inconvenience to passengers through easy boarding and easy transit to other transportation modes. Additionally, the at-grade station can be built on a small scale.	The elevated station forces Passengers to travel a long distance from the ground level to the platform and does not make use of the compact characteristics of LRT due to the elevated structure.
2	Number of at-grade stations	5 stations (3 stations in PMC area and 2 stations in PCMC area)	Nil
3	Elevated stations	16 stations (7 stations in PMC area, 3 stations in PCMC area and 6 stations in MIDC area)	21 stations (10 stations in PMC area, 5 stations in PCMC area and 6 stations in MIDC area)
4	Access to platform	Easy access from road level to platform in at-grade section.	Elevated station requires a large concourse under the platform.
5	Operation speed	Operation speed is restricted due to steep gradient.	Not restricted for operation speed.
6	Evacuation of passengers in emergency	Easy evacuation of passengers because of at-grade station.	The evacuation of passengers takes into consideration of the height due to the elevated structure.
7	Influence to road traffic	Level crossings need to be provided in the at-grade sections in the future.	No consideration for operation because it is entirely elevated
8	Railway system	Railway system needs to be coordinated with the road signals in the at-grade sections.	No consideration for road traffic.
9	Project cost	The public portion of the project cost can be reduced under a PPP scheme. The railway system is the same. Total is 48,675 Million Rs.	The public portion of the project cost is increased due to the entirely elevated system. The railway system is the same. Total is 52,734 Million Rs.

APPENDIX-29: Measures for Increase of Demand

1. Trains

Passenger demand is forecasted until the year 2038. PPHPD of the year 2038 will be 15,102 and in the Train Operation Plan operation head way at peak hour is 2.5 minute. Assuming that capacity of one train is 690 passengers, transportation capacity of peak hour is 16,560 passengers. Ratio of demand to transportation capacity is 91.2%.

When demand increases more, train will be extended longer to increase the capacity, because shortening the headway might block the road traffic.

Trains consist of 30m unit + 30m unit totally 60m long at the opening. One body unit will be inserted and length of one train will be 70m after enhancement.

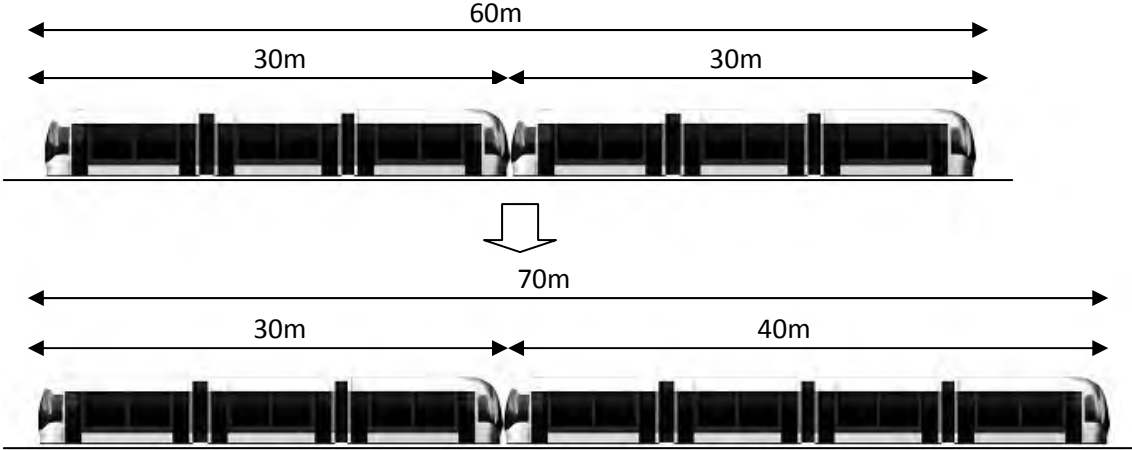


Figure A29-1 60m train and 70m train

Capacity of one train becomes 805 passengers after enhancement and transportation capacity of one hour with 2.5 minute headway becomes 19,320 passengers. It will be capable to transport until the year 2048 when the demand increase proportionally.

2. Structures

Stations will be constructed for 60m train at first and it will be extended when 70m trains are introduced.

As for depot and workshop, tracks will be constructed for 70m trains from the first time because it is difficult to extending the track and facilities.

FORM 1

(I) Basic Information

Name of the Project:

Location / site alternatives under consideration:

Size of the Project: *

Expected cost of the project:

Contact Information:

Screening Category:

- *Capacity corresponding to sectoral activity (such as production capacity for manufacturing, mining lease area and production capacity for mineral production, area for mineral exploration, length for linear transport infrastructure, generation capacity for power generation etc.,)*

(II) Activity

- 1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)**

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)		
1.2	Clearance of existing land, vegetation and buildings?		
1.3	Creation of new land uses?		
1.4	Pre-construction investigations e.g. bore houses, soil testing?		
1.5	Construction works?		
1.6	Demolition works?		
1.7	Temporary sites used for construction works or housing of construction workers?		

1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations		
1.9	Underground works including mining or tunneling?		
1.10	Reclamation works?		
1.11	Dredging?		
1.12	Offshore structures?		
1.13	Production and manufacturing processes?		
1.14	Facilities for storage of goods or materials?		
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?		
1.16	Facilities for long term housing of operational workers?		
1.17	New road, rail or sea traffic during construction or operation?		
1.18	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?		
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?		
1.20	New or diverted transmission lines or pipelines?		
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?		
1.22	Stream crossings?		
1.23	Abstraction or transfers of water form ground or surface waters?		
1.24	Changes in water bodies or the land surface affecting drainage or run-off?		
1.25	Transport of personnel or materials for construction, operation or decommissioning?		
1.26	Long-term dismantling or decommissioning or restoration works?		
1.27	Ongoing activity during decommissioning which could have an impact on the environment?		

1.28	Influx of people to an area in either temporarily or permanently?		
1.29	Introduction of alien species?		
1.30	Loss of native species or genetic diversity?		
1.31	Any other actions?		

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

S.No.	Information/checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
2.1	Land especially undeveloped or agricultural land (ha)		
2.2	Water (expected source & competing users) unit: KLD		
2.3	Minerals (MT)		
2.4	Construction material – stone, aggregates, and / soil (expected source – MT)		
2.5	Forests and timber (source – MT)		
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)		
2.7	Any other natural resources (use appropriate standard units)		

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies)		
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)		
3.3	Affect the welfare of people e.g. by changing living conditions?		
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,		
3.5	Any other causes		

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes		
4.2	Municipal waste (domestic and or commercial wastes)		
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)		

4.4	Other industrial process wastes		
4.5	Surplus product		
4.6	Sewage sludge or other sludge from effluent treatment		
4.7	Construction or demolition wastes		
4.8	Redundant machinery or equipment		
4.9	Contaminated soils or other materials		
4.10	Agricultural wastes		
4.11	Other solid wastes		

5. Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources		
5.2	Emissions from production processes		
5.3	Emissions from materials handling including storage or transport		
5.4	Emissions from construction activities including plant and equipment		
5.5	Dust or odours from handling of materials including construction materials, sewage and waste		
5.6	Emissions from incineration of waste		

5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)		
5.8	Emissions from any other sources		

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers		
6.2	From industrial or similar processes		
6.3	From construction or demolition		
6.4	From blasting or piling		
6.5	From construction or operational traffic		
6.6	From lighting or cooling systems		
6.7	From any other sources		

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials		
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)		
7.3	By deposition of pollutants emitted to air into the land or into water		
7.4	From any other sources		
7.5	Is there a risk of long term build up of pollutants in the environment from these sources?		

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances		
8.2	From any other causes		
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc)?		

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
9.1	<p>Lead to development of supporting, ancillary development or development stimulated by the project which could have impact on the environment e.g.:</p> <ul style="list-style-type: none"> • Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.) • housing development • extractive industries • supply industries • other 		
9.2	Lead to after-use of the site, which could have an impact on the environment		
9.3	Set a precedent for later developments		
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects		

(III) Environmental Sensitivity

S.No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value		
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or		

	other water bodies, coastal zone, biospheres, mountains, forests		
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration		
4	Inland, coastal, marine or underground waters		
5	State, National boundaries		
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas		
7	Defence installations		
8	Densely populated or built-up area		
9	Areas occupied by sensitive man-made land uses (<i>hospitals, schools, places of worship, community facilities</i>)		
10	Areas containing important, high quality or scarce resources (<i>ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals</i>)		
11	Areas already subjected to pollution or environmental damage. (<i>those where existing legal environmental standards are exceeded</i>)		
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (<i>earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions</i>)		

(IV). Proposed Terms of Reference for EIA studies

APPENDIX II

FORM-1 A (only for construction projects listed under item 8 of the Schedule)

CHECK LIST OF ENVIRONMENTAL IMPACTS

(Project proponents are required to provide full information and wherever necessary attach explanatory notes with the Form and submit along with proposed environmental management plan & monitoring programme)

1. LAND ENVIRONMENT

(Attach panoramic view of the project site and the vicinity)

1.1. Will the existing landuse get significantly altered from the project that is not consistent with the surroundings? (Proposed landuse must conform to the approved Master Plan / Development Plan of the area. Change of landuse if any and the statutory approval from the competent authority be submitted). Attach Maps of (i) site location, (ii) surrounding features of the proposed site (within 500 meters) and (iii) the site (indicating levels & contours) to appropriate scales. If not available attach only conceptual plans.

1.2. List out all the major project requirements in terms of the land area, built up area, water consumption, power requirement, connectivity, community facilities, parking needs etc.

1.3. What are the likely impacts of the proposed activity on the existing facilities adjacent to the proposed site? (Such as open spaces, community facilities, details of the existing landuse, disturbance to the local ecology).

1.4. Will there be any significant land disturbance resulting in erosion, subsidence & instability? (Details of soil type, slope analysis, vulnerability to subsidence, seismicity etc may be given).

1.5. Will the proposal involve alteration of natural drainage systems? (Give details on a contour map showing the natural drainage near the proposed project site)

1.6. What are the quantities of earthwork involved in the construction activity-cutting, filling, reclamation etc. (Give details of the quantities of earthwork involved, transport of fill materials from outside the site etc.)

1.7. Give details regarding water supply, waste handling etc during the construction period.

1.8. Will the low lying areas & wetlands get altered? (Provide details of how low lying and wetlands are getting modified from the proposed activity)

1.9. Whether construction debris & waste during construction cause health hazard? (Give quantities of various types of wastes generated during construction including the construction labour and the means of disposal)

2. WATER ENVIRONMENT

- 2.1. Give the total quantity of water requirement for the proposed project with the breakup of requirements for various uses. How will the water requirement met? State the sources & quantities and furnish a water balance statement.
- 2.2. What is the capacity (dependable flow or yield) of the proposed source of water?
- 2.3. What is the quality of water required, in case, the supply is not from a municipal source? (Provide physical, chemical, biological characteristics with class of water quality)
- 2.4. How much of the water requirement can be met from the recycling of treated wastewater? (Give the details of quantities, sources and usage)
- 2.5. Will there be diversion of water from other users? (Please assess the impacts of the project on other existing uses and quantities of consumption)
- 2.6. What is the incremental pollution load from wastewater generated from the proposed activity? (Give details of the quantities and composition of wastewater generated from the proposed activity)
- 2.7. Give details of the water requirements met from water harvesting? Furnish details of the facilities created.
- 2.8. What would be the impact of the land use changes occurring due to the proposed project on the runoff characteristics (quantitative as well as qualitative) of the area in the post construction phase on a long term basis? Would it aggravate the problems of flooding or water logging in any way?
- 2.9. What are the impacts of the proposal on the ground water? (Will there be tapping of ground water; give the details of ground water table, recharging capacity, and approvals obtained from competent authority, if any)
- 2.10. What precautions/measures are taken to prevent the run-off from construction activities polluting land & aquifers? (Give details of quantities and the measures taken to avoid the adverse impacts)
- 2.11. How is the storm water from within the site managed?(State the provisions made to avoid flooding of the area, details of the drainage facilities provided along with a site layout indication contour levels)
- 2.12. Will the deployment of construction labourers particularly in the peak period lead to unsanitary conditions around the project site (Justify with proper explanation)
- 2.13. What on-site facilities are provided for the collection, treatment & safe disposal of sewage? (Give details of the quantities of wastewater generation, treatment capacities with technology & facilities for recycling and disposal)

- 2.14. Give details of dual plumbing system if treated waste used is used for flushing of toilets or any other use.

3. VEGETATION

- 3.1. Is there any threat of the project to the biodiversity? (Give a description of the local ecosystem with its unique features, if any)
- 3.2. Will the construction involve extensive clearing or modification of vegetation? (Provide a detailed account of the trees & vegetation affected by the project)
- 3.3. What are the measures proposed to be taken to minimize the likely impacts on important site features (Give details of proposal for tree plantation, landscaping, creation of water bodies etc along with a layout plan to an appropriate scale)

4. FAUNA

- 4.1. Is there likely to be any displacement of fauna- both terrestrial and aquatic or creation of barriers for their movement? Provide the details.
- 4.2. Any direct or indirect impacts on the avifauna of the area? Provide details.
- 4.3. Prescribe measures such as corridors, fish ladders etc to mitigate adverse impacts on fauna

5. AIR ENVIRONMENT

- 5.1. Will the project increase atmospheric concentration of gases & result in heat islands? (Give details of background air quality levels with predicted values based on dispersion models taking into account the increased traffic generation as a result of the proposed constructions)
- 5.2. What are the impacts on generation of dust, smoke, odorous fumes or other hazardous gases? Give details in relation to all the meteorological parameters.
- 5.3. Will the proposal create shortage of parking space for vehicles? Furnish details of the present level of transport infrastructure and measures proposed for improvement including the traffic management at the entry & exit to the project site.
- 5.4. Provide details of the movement patterns with internal roads, bicycle tracks, pedestrian pathways, footpaths etc., with areas under each category.
- 5.5. Will there be significant increase in traffic noise & vibrations? Give details of the sources and the measures proposed for mitigation of the above.
- 5.6. What will be the impact of DG sets & other equipment on noise levels & vibration in & ambient air quality around the project site? Provide details.

6. AESTHETICS

- 6.1. Will the proposed constructions in any way result in the obstruction of a view, scenic amenity or landscapes? Are these considerations taken into account by the proponents?
- 6.2. Will there be any adverse impacts from new constructions on the existing structures? What are the considerations taken into account?
- 6.3. Whether there are any local considerations of urban form & urban design influencing the design criteria? They may be explicitly spelt out.

6.4. Are there any anthropological or archaeological sites or artefacts nearby? State if any other significant features in the vicinity of the proposed site have been considered.

7. SOCIO-ECONOMIC ASPECTS

7.1. Will the proposal result in any changes to the demographic structure of local population? Provide the details.

7.2. Give details of the existing social infrastructure around the proposed project.

7.3. Will the project cause adverse effects on local communities, disturbance to sacred sites or other cultural values? What are the safeguards proposed?

8. BUILDING MATERIALS

8.1. May involve the use of building materials with high-embodied energy. Are the construction materials produced with energy efficient processes? (Give details of energy conservation measures in the selection of building materials and their energy efficiency)

8.2. Transport and handling of materials during construction may result in pollution, noise & public nuisance. What measures are taken to minimize the impacts?

8.3. Are recycled materials used in roads and structures? State the extent of savings achieved?

8.4. Give details of the methods of collection, segregation & disposal of the garbage generated during the operation phases of the project.

9. ENERGY CONSERVATION

9.1. Give details of the power requirements, source of supply, backup source etc. What is the energy consumption assumed per square foot of built-up area? How have you tried to minimize energy consumption?

9.2. What type of, and capacity of, power back-up to you plan to provide?

9.3. What are the characteristics of the glass you plan to use? Provide specifications of its characteristics related to both short wave and long wave radiation?

9.4. What passive solar architectural features are being used in the building? Illustrate the applications made in the proposed project.

9.5. Does the layout of streets & buildings maximise the potential for solar energy devices? Have you considered the use of street lighting, emergency lighting and solar hot water systems for use in the building complex? Substantiate with details.

9.6. Is shading effectively used to reduce cooling/heating loads? What principles have been used to maximize the shading of Walls on the East and the West and the Roof? How much energy saving has been effected?

9.7. Do the structures use energy-efficient space conditioning, lighting and mechanical systems? Provide technical details. Provide details of the transformers and motor efficiencies, lighting intensity and air-conditioning load assumptions? Are you using CFC and HCFC free chillers? Provide specifications.

9.8. What are the likely effects of the building activity in altering the micro-climates? Provide a self assessment on the likely impacts of the proposed construction on creation of heat island & inversion effects?

9.9. What are the thermal characteristics of the building envelope? (a) roof; (b) external walls; and (c) fenestration? Give details of the material used and the U-values or the R values of the individual components.

9.10. What precautions & safety measures are proposed against fire hazards? Furnish details of emergency plans.

9.11. If you are using glass as wall material provides details and specifications including emissivity and thermal characteristics.

9.12. What is the rate of air infiltration into the building? Provide details of how you are mitigating the effects of infiltration.

9.13. To what extent the non-conventional energy technologies are utilised in the overall energy consumption? Provide details of the renewable energy technologies used.

10. Environment Management Plan

The Environment Management Plan would consist of all mitigation measures for each item wise activity to be undertaken during the construction, operation and the entire life cycle to minimize adverse environmental impacts as a result of the activities of the project. It would also delineate the environmental monitoring plan for compliance of various environmental regulations. It will state the steps to be taken in case of emergency such as accidents at the site including fire.



Environmental Consultancy & Laboratory
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Survey No. 87, Office No. 7/8, Bandal Prestige, Azad Nagar, Opp. Siddhivinayak Temple, Kothrud, Pune - 411 038.
Tel : +91-20-2538 01 93 / 2538 01 94 Telefax : +91-20-538 0148 E-mail : pune@ultratech.in

Date: 22.02.2013

To
PURP
CASABLANCA
1ST Floor,
Sangam Press Road
Opp. Karisma Soc. Kuthrud,
Pune 411038.

Sub: Initiating Metro link in Pune Metropolis

Ref: Our meeting on 22.02.2013 at Kuthrud, Pune 411038.

Dear Sir,

We had a meeting 22nd Feb, 2013 morning on the above subject in your office. This letter is I furtherance to that.

We were impressed by the keen-ness of your team on this development in PMC-PCMC-MIDC network. Though this was a preliminary meeting, you had given us adequate information to proceed further.

The starting point in any new project or activity is to look into the EIA Notification promulgated by Ministry of Environment and Forest (MoEF), New Delhi under Central Government, first time in 1994 and amended many times subsequently. It narrates the discipline of obtaining the Environmental Clearance (EC). The frame work steps are:

1. Screening
2. Scoping (getting ToR)
3. Writing draft EIA
4. Public Hearing/ Consultation
5. Writing Final EIA
6. Appraisal by EAC
7. Finally EC

The first step is screening. This aims at finding (1) whether our activity needs such EC and (2) if yes whether it comes under purview of EAC of MoEF in New Delhi (labeled as Category A) or is to be heard by State EAC (also appointed by MoEF, and called as Category B). We find that,

- The Metro Link or railways, as such is not covered anywhere in Column No.2 of the schedule.
- The activity of 'Highway' comes under 7 (f)
- The Aerial Ropeway comes in 7 (g)



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Tel : +91-20-2538 01 93 / 2538 01 94 Telefax : +91-20-538 0148 E-mail : pune@ultratech.in

- Building Construction comes in 8 (a) and
- Area development projects falls in 8 (b)
- The terrain concerned is not hilly (Above 1000 m MSL).

It therefore means that, by screening we come under Category B, which means to approach SEIAA/ SEAC in Mumbai. It is always better to obtain some EC so that our activity remains safe from the eyes of Public, NGO's & Environmentalists.

We therefore feel that, you should better approach SEAC under category 8 (a or b) so that, you do not attract any public hearing. What will be needed is the immediate preparation for filing Form 1 , 1 A and writing a conceptual Note / Prefeasibility Report. If we do this, the further step of fixing the TOR or scoping will be officially done by SEAC and we can voluntarily submit the scoping by ourselves also.

We are capable of doing this in short time as a starting point and thereafter the further steps like,

- Finding the environmental setting
- Study on Biodiversity
- Corporate Social responsibility
- Obtaining NOC's from Stake Holders, if any
- Judging the sensitive points from Environment, Heritage, Defense, Forest, Airport, High Tension Lines and similar angles.

We are very often going before SEAC and hence are acquainted with their system of analysis and appraisal. Thus we can help you, hopefully, without trial and error. We shall be more comfortable to work with you rather than any other local authority.

This is only a preliminary letter and more involved work we follow as per your requirement.

Thanking You,

Regards

Mr. Kishor Sawant

Director

ULTRA-TECH

Environmental Consultancy & Laboratory

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S. No. 87, Office No. 7/8,

Bandal Prestige , Azad Nagar,

Opposite Siddhivinayak Temple,

Kothrud, Pune- 411 038

Ph. no. 020- 25380193, 25380194, 25380148