Signal Optimization using PTV Vistro for a Major BRTS Corridor in Pimpri – Chinchwad, Maharashtra

Presented by
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Mr. Athul Suresh, Traffic Engineer

10th UMI Conference – 5/11/2017

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Overview

- Project Information
- Signal Optimization using Vistro
- Case Study
- Findings

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Project Partners

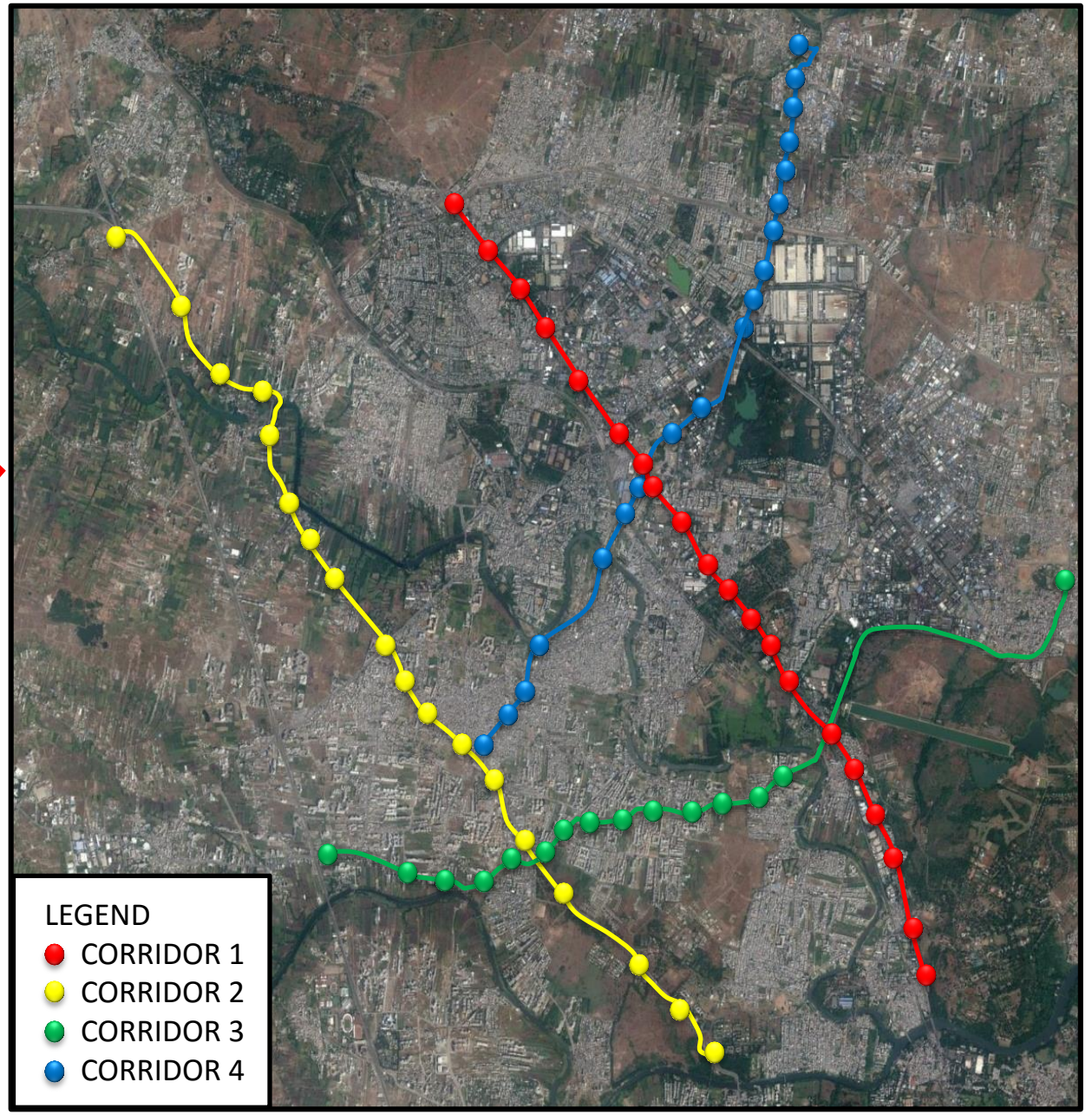
Pimpri Chinchwad Municipal Corporation (PCMC)

Pune Traffic Police

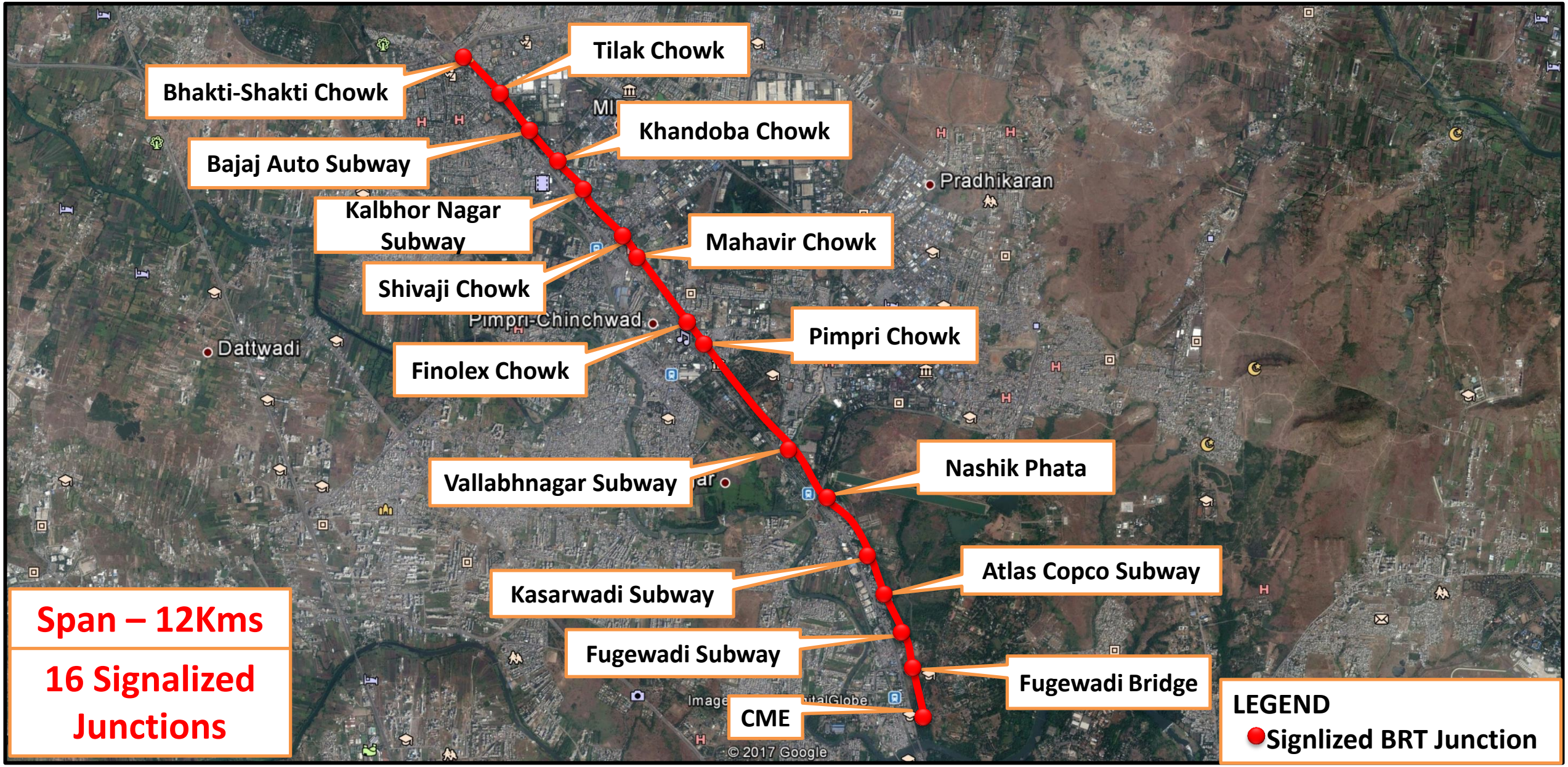
JP Traffic Automation Pvt. Ltd.

Global Traffic Solutions

Project Location



PCMC BRT Corridor - 1



Signal Timing Analysis

- Traffic police provide the signal timings based on their experience and observing the amount of traffic

- PCMC (Pimpri Chinchwad Municipal Corporation) with the recommendation of the World Bank opted to design their signal timing plans in a more scientific manner

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Signal Timing Analysis Tools

- Manually by IRC SP – 41
- PTV Vissim
- PTV Vistro
  (*Signal Timing Optimization)*
- Synchro etc.

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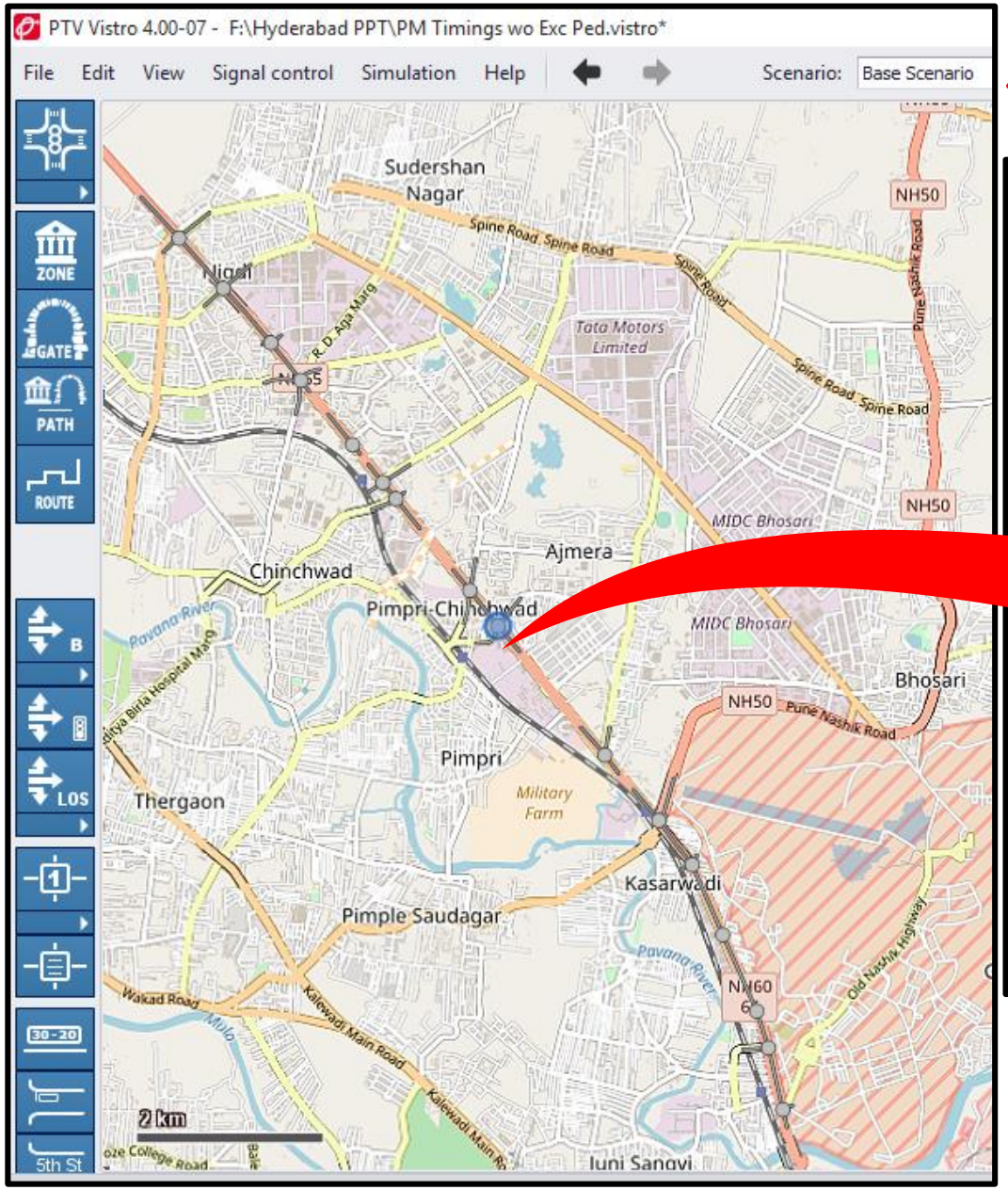
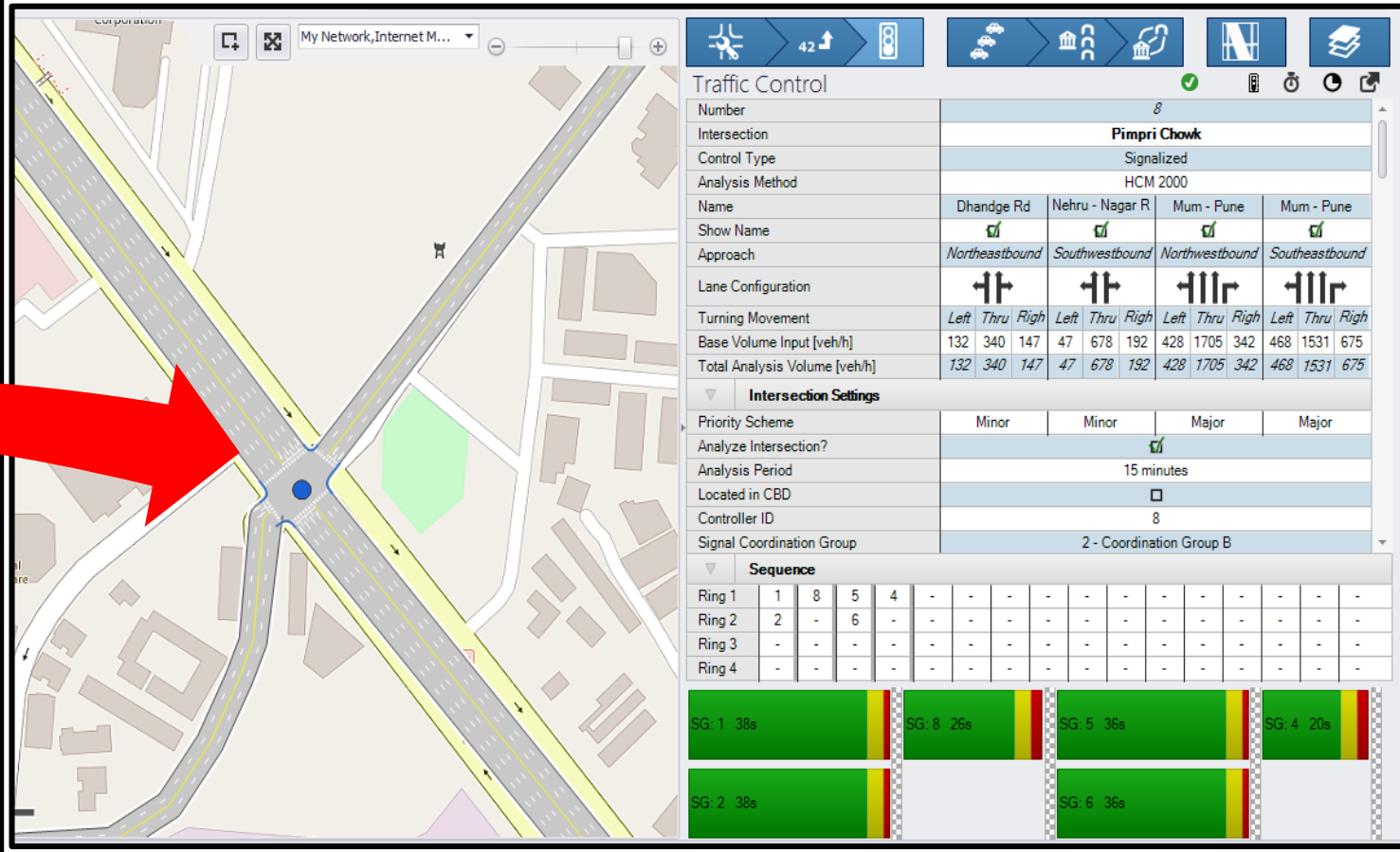
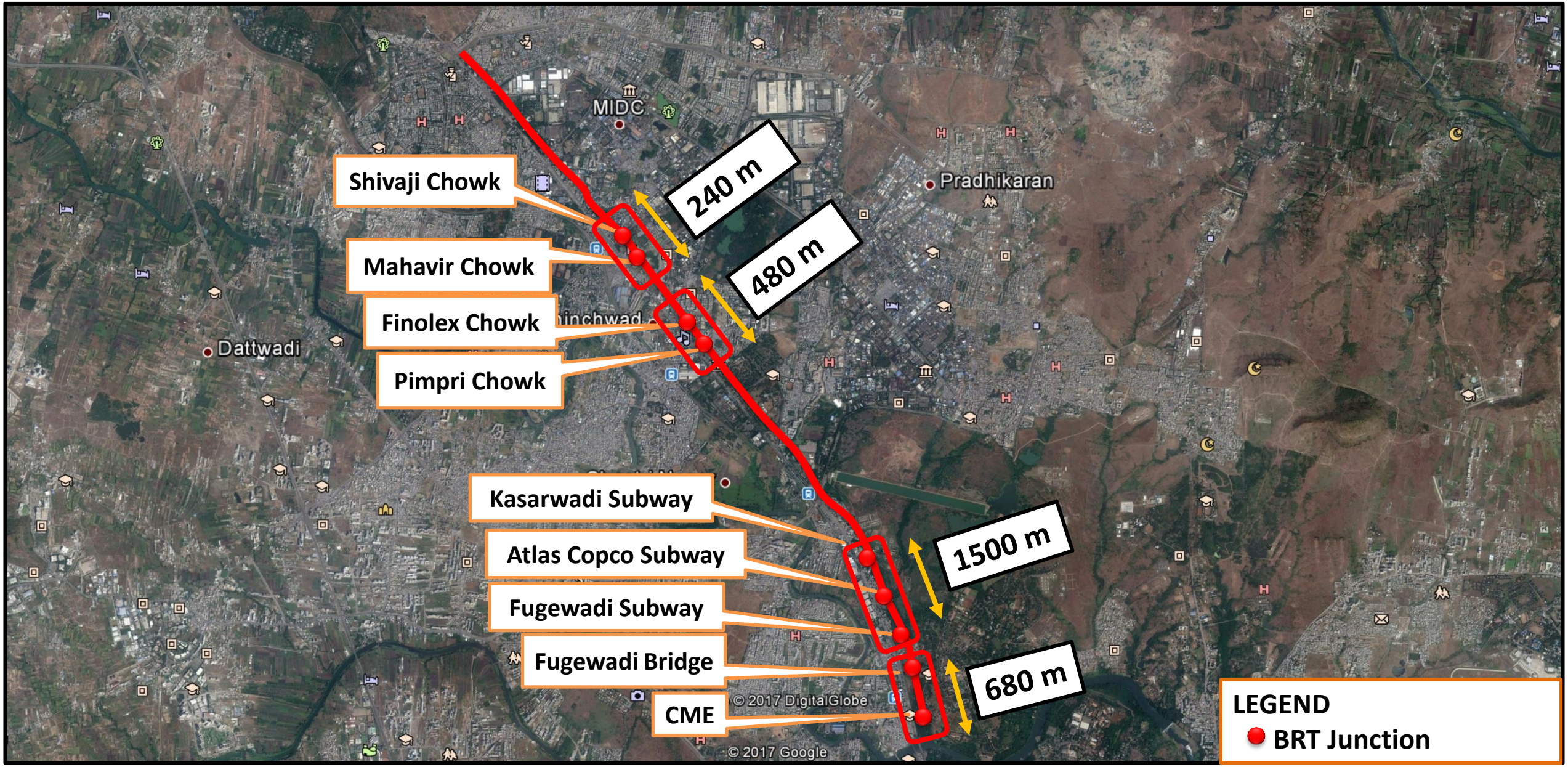
Signal Timing Analysis by PTV Vistro

Vistro Network



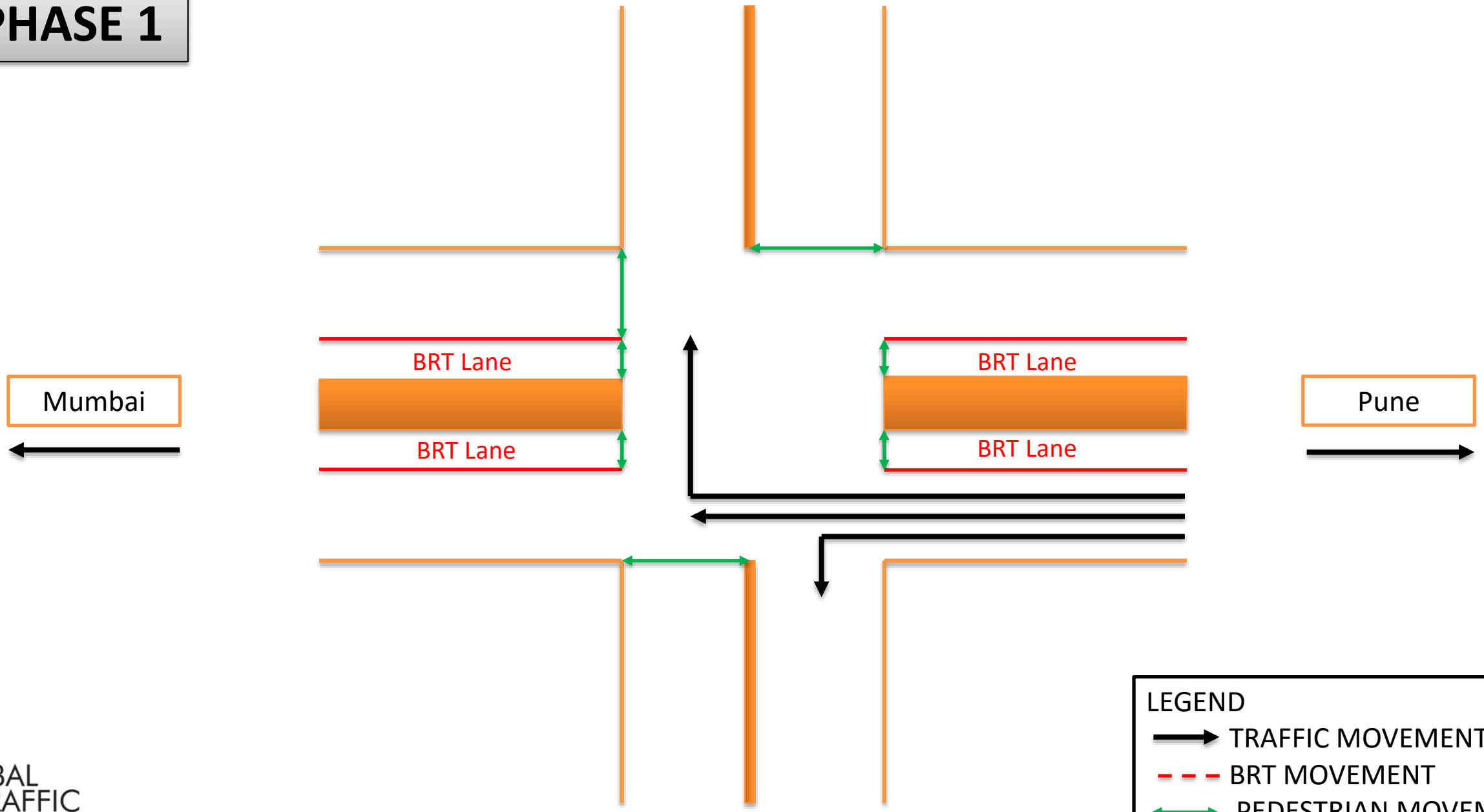


Junction Coordination



BRT Phasing

PHASE 1



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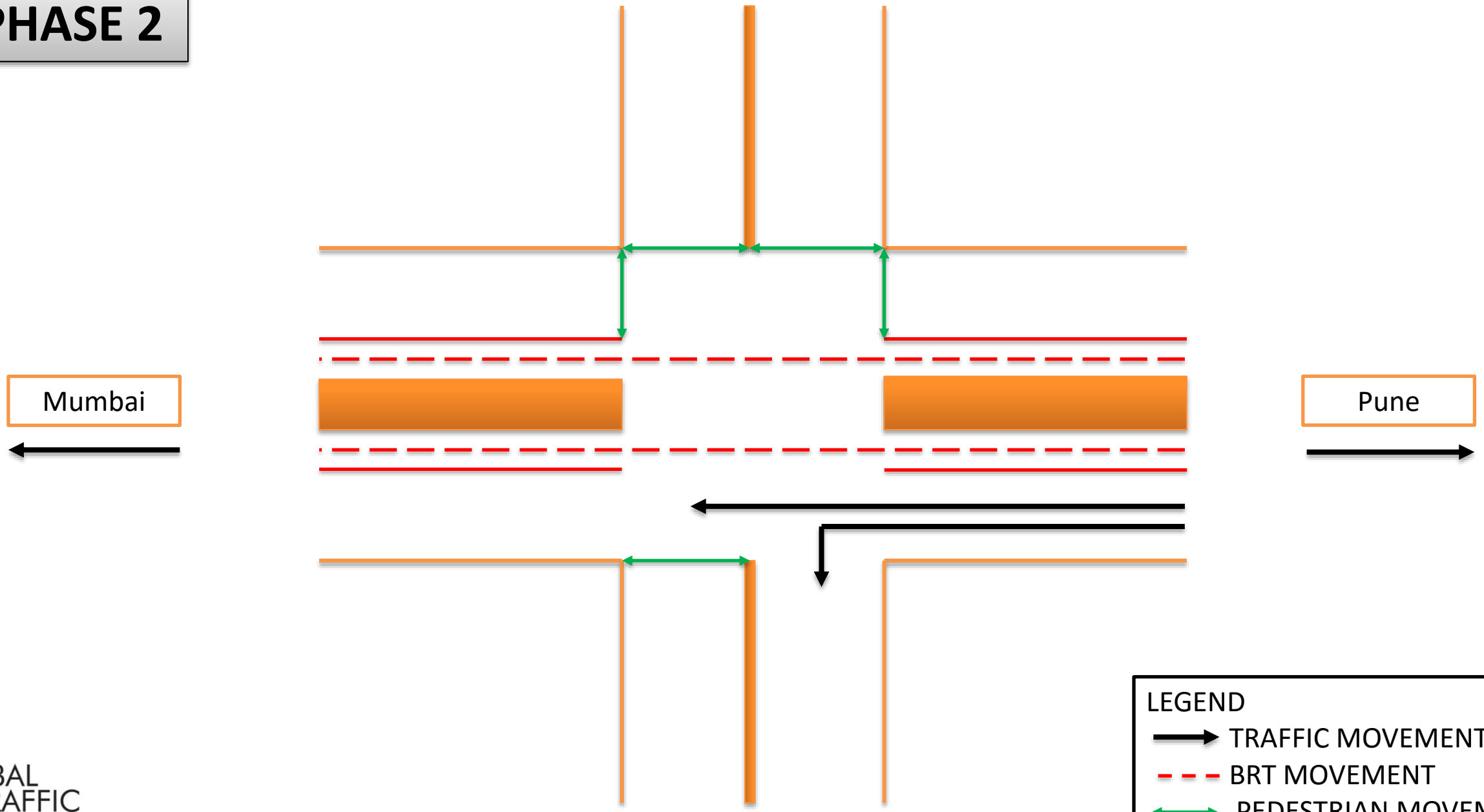
BRT Phasing

PHASE 2



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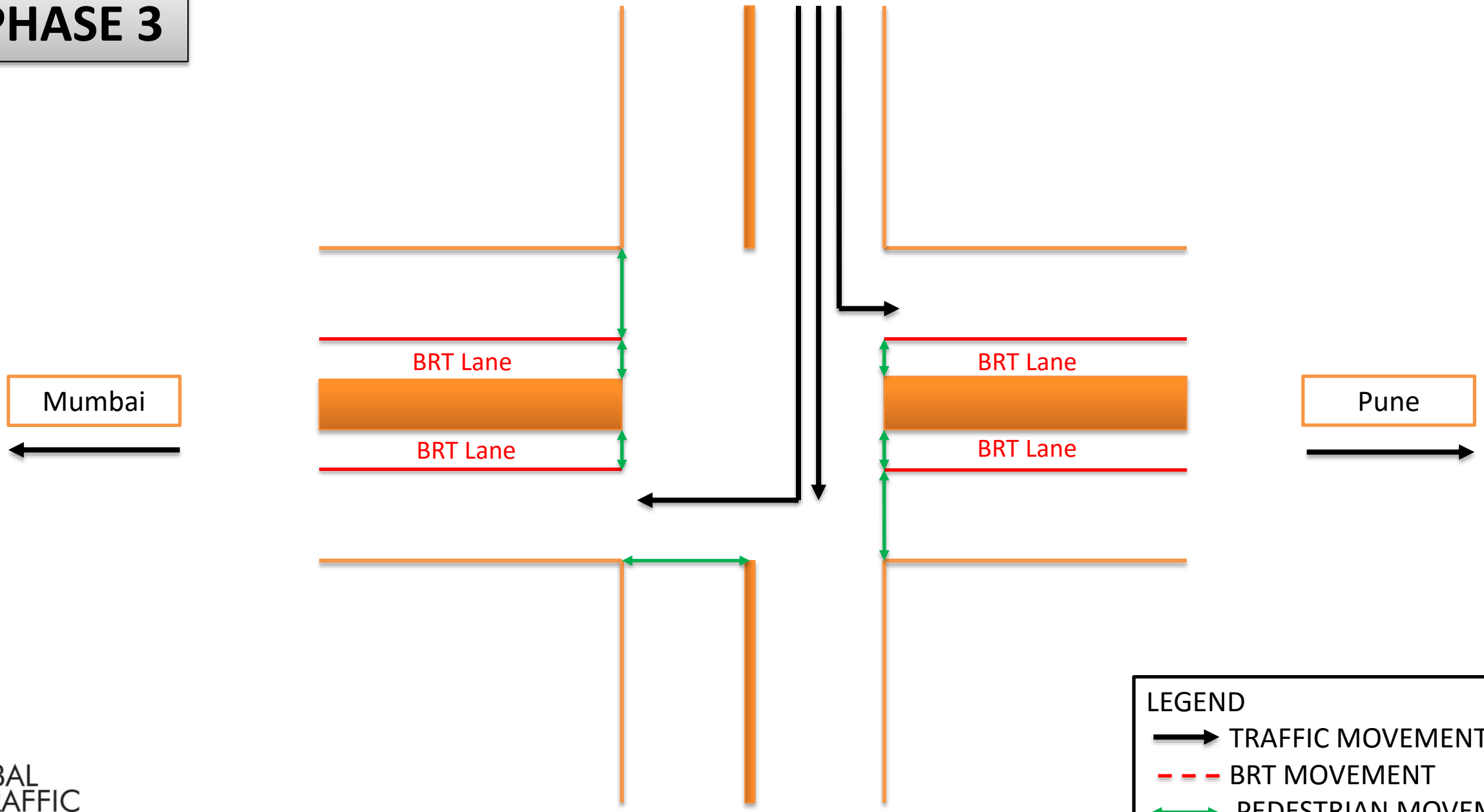
BRT Phasing

PHASE 3



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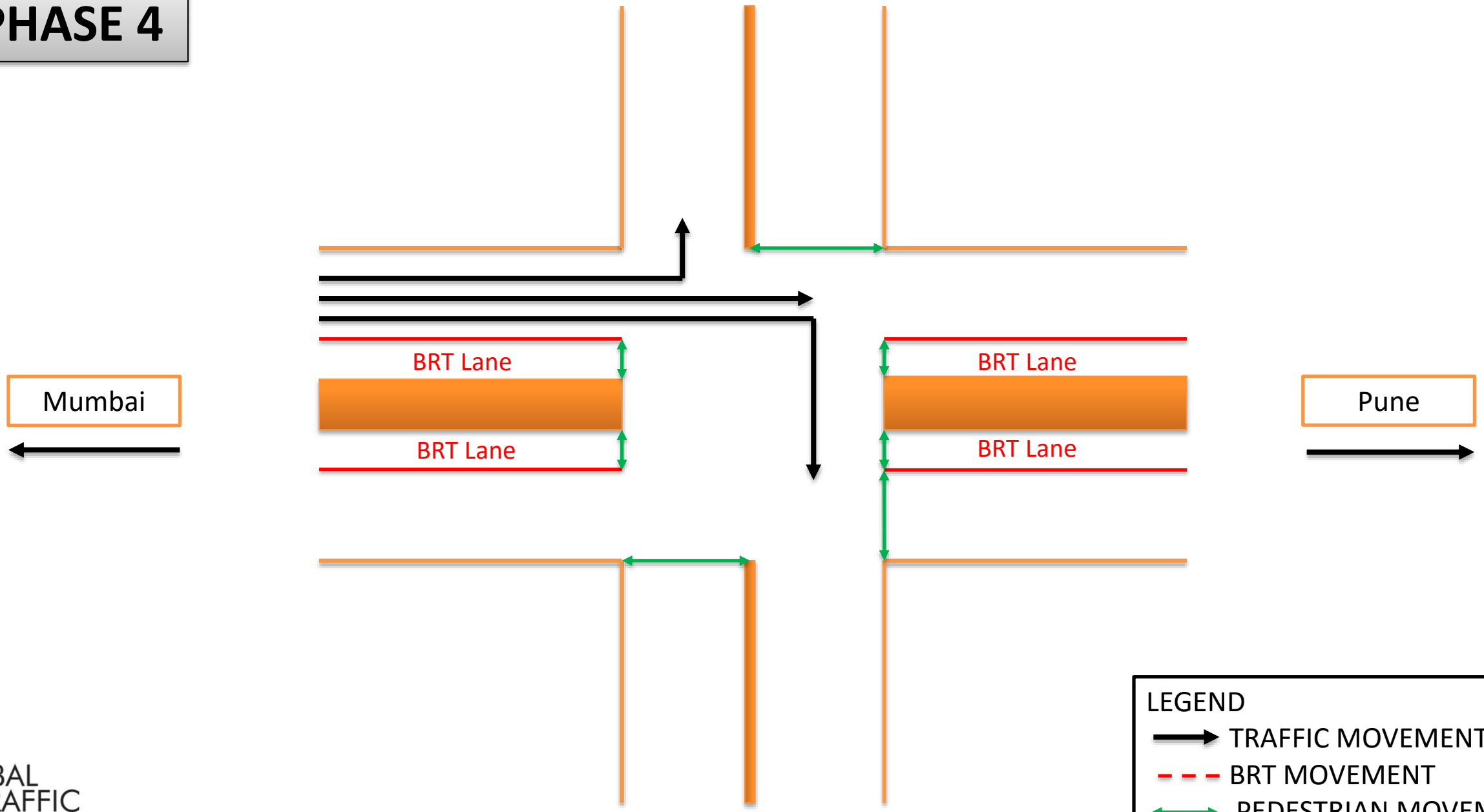
BRT Phasing

PHASE 4



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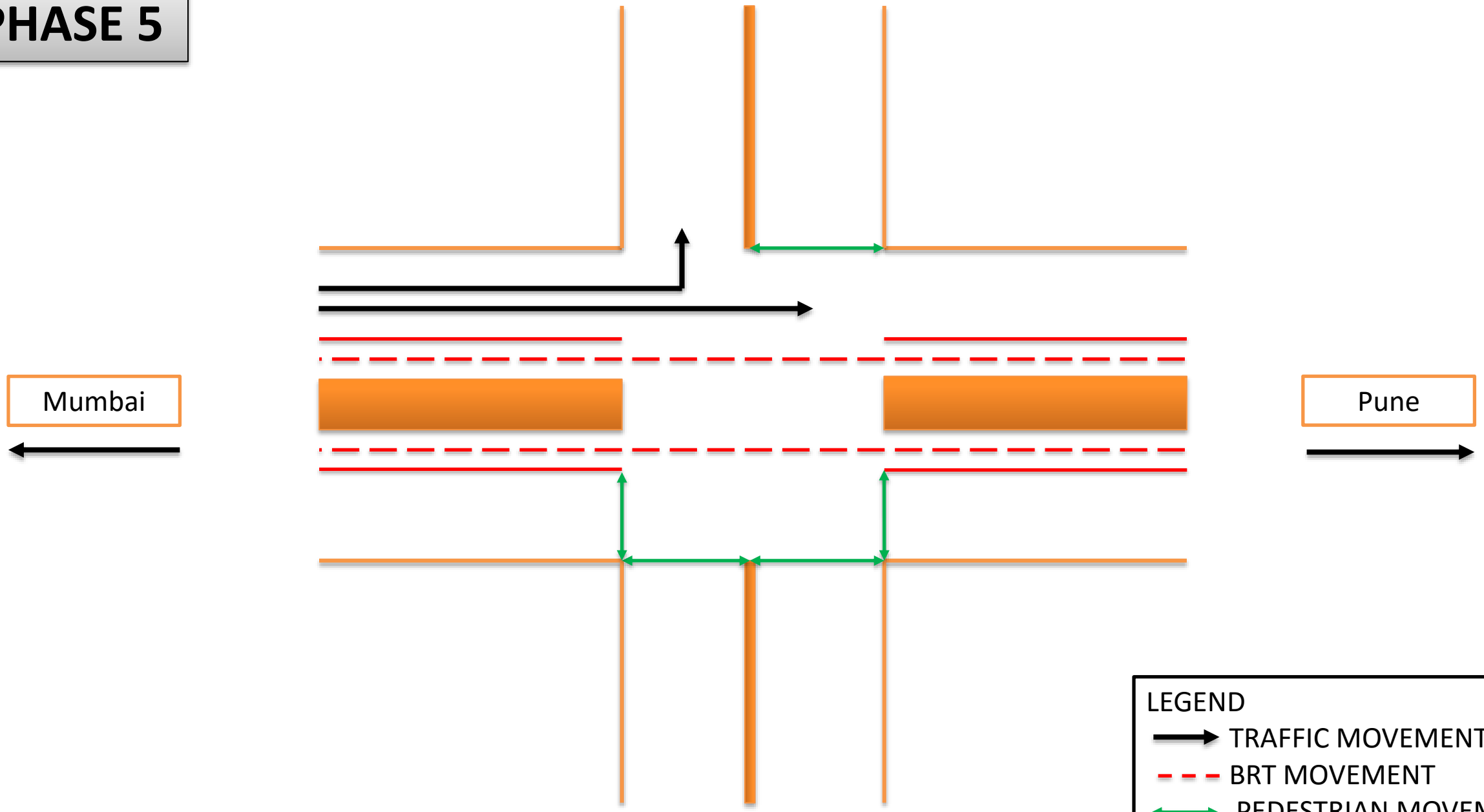
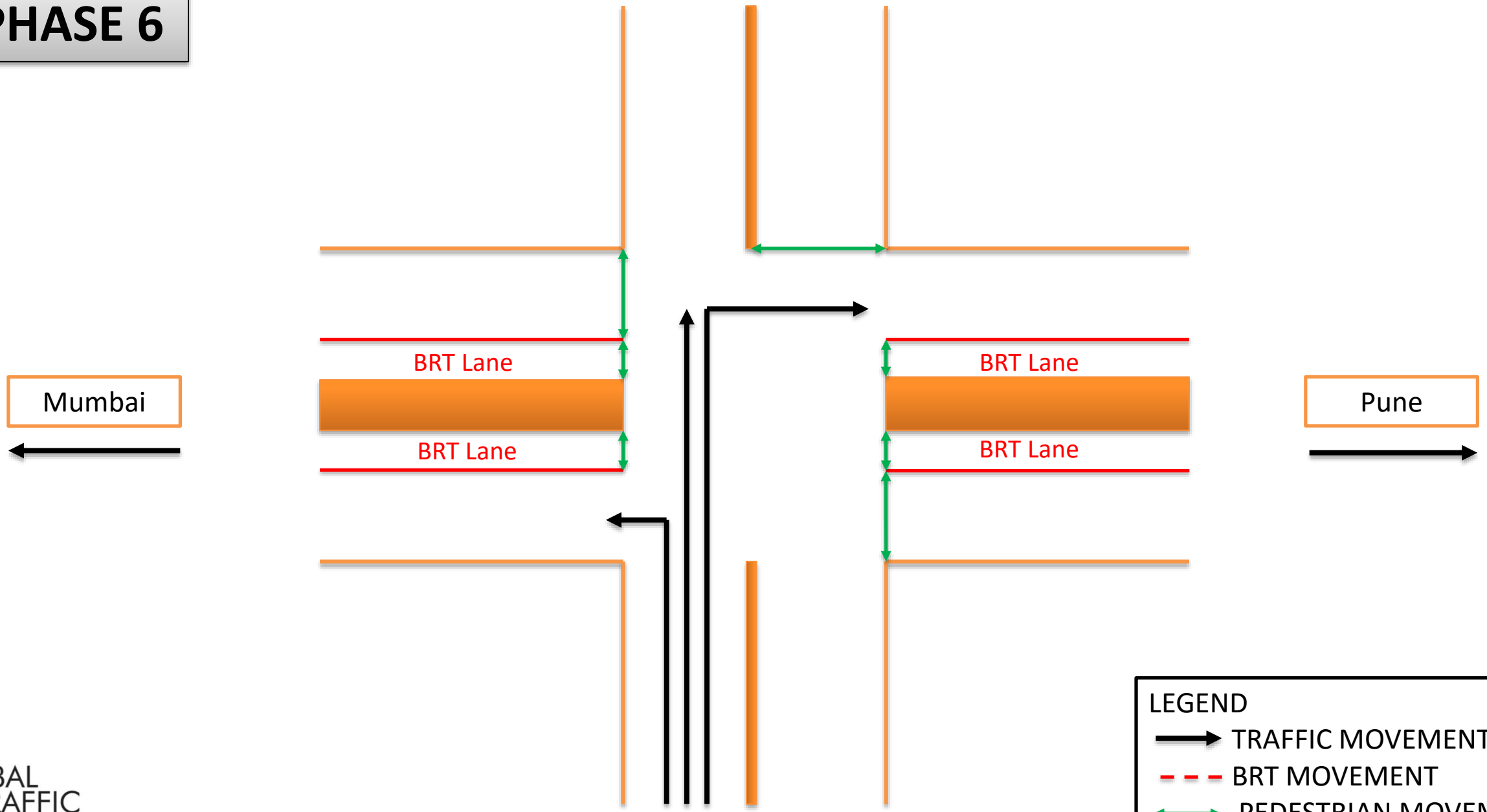
BRT Phasing

PHASE 5



BRT Phasing

PHASE 6



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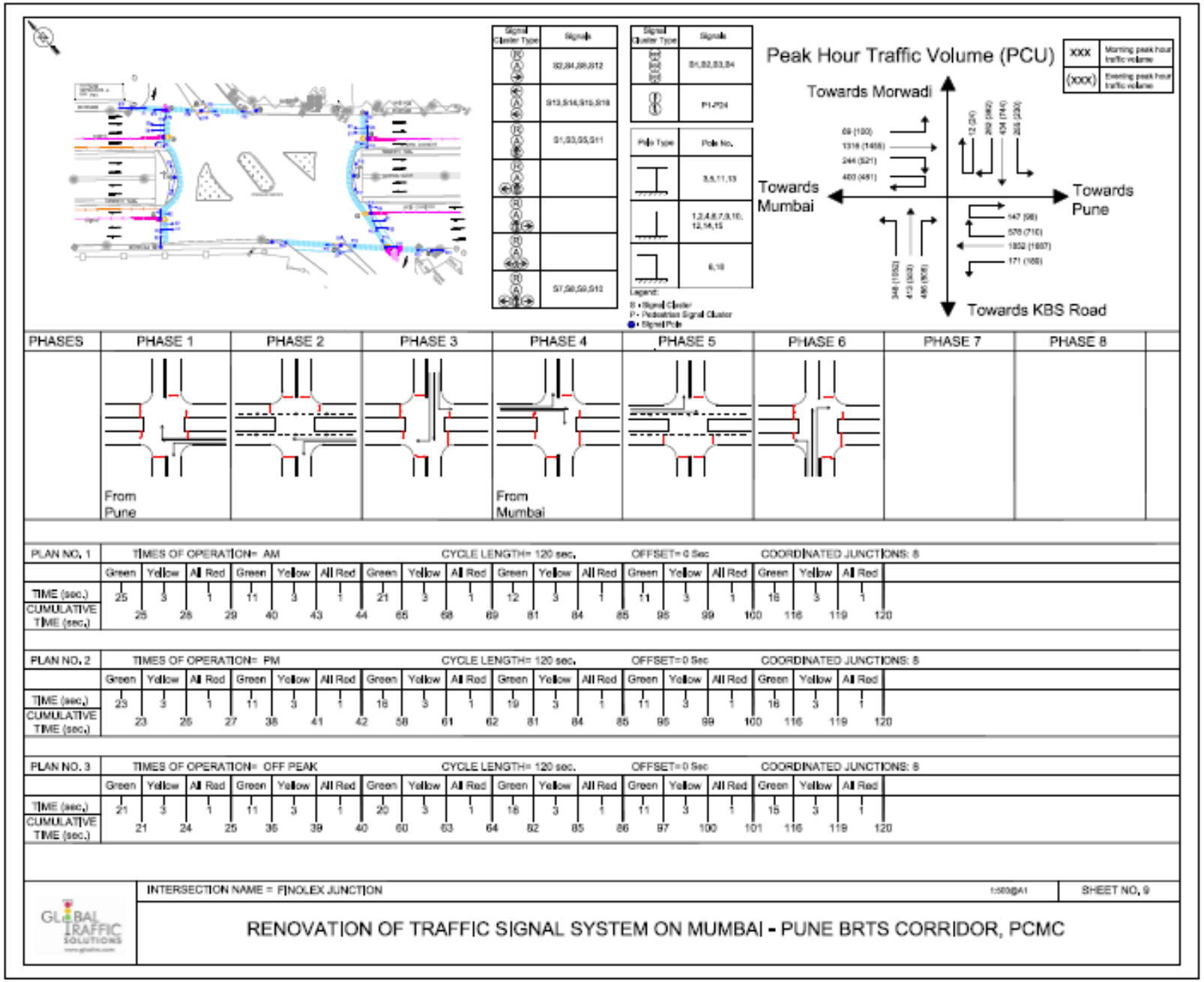
BRT Signal Phasing & Timing Plan



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Case Study

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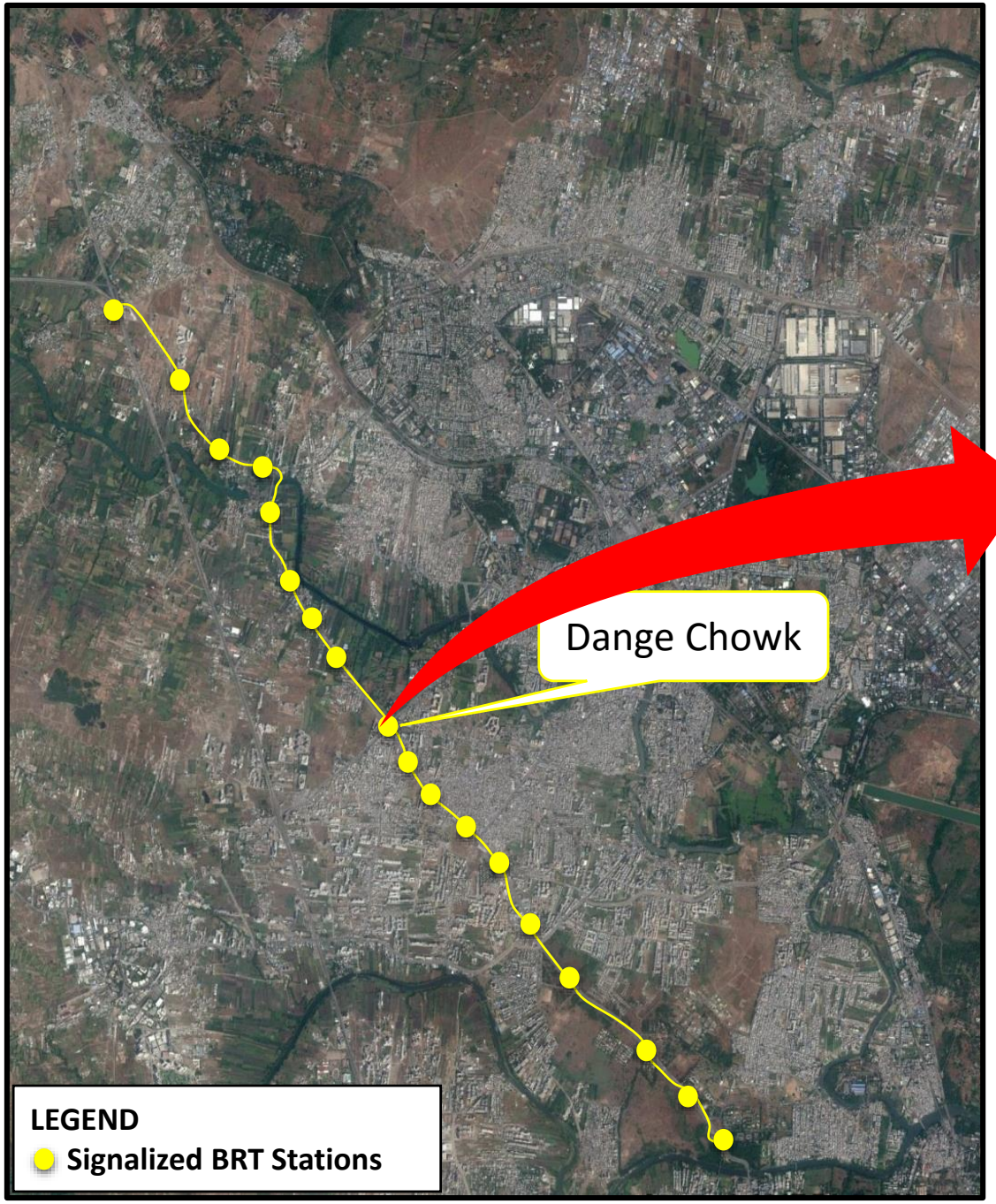
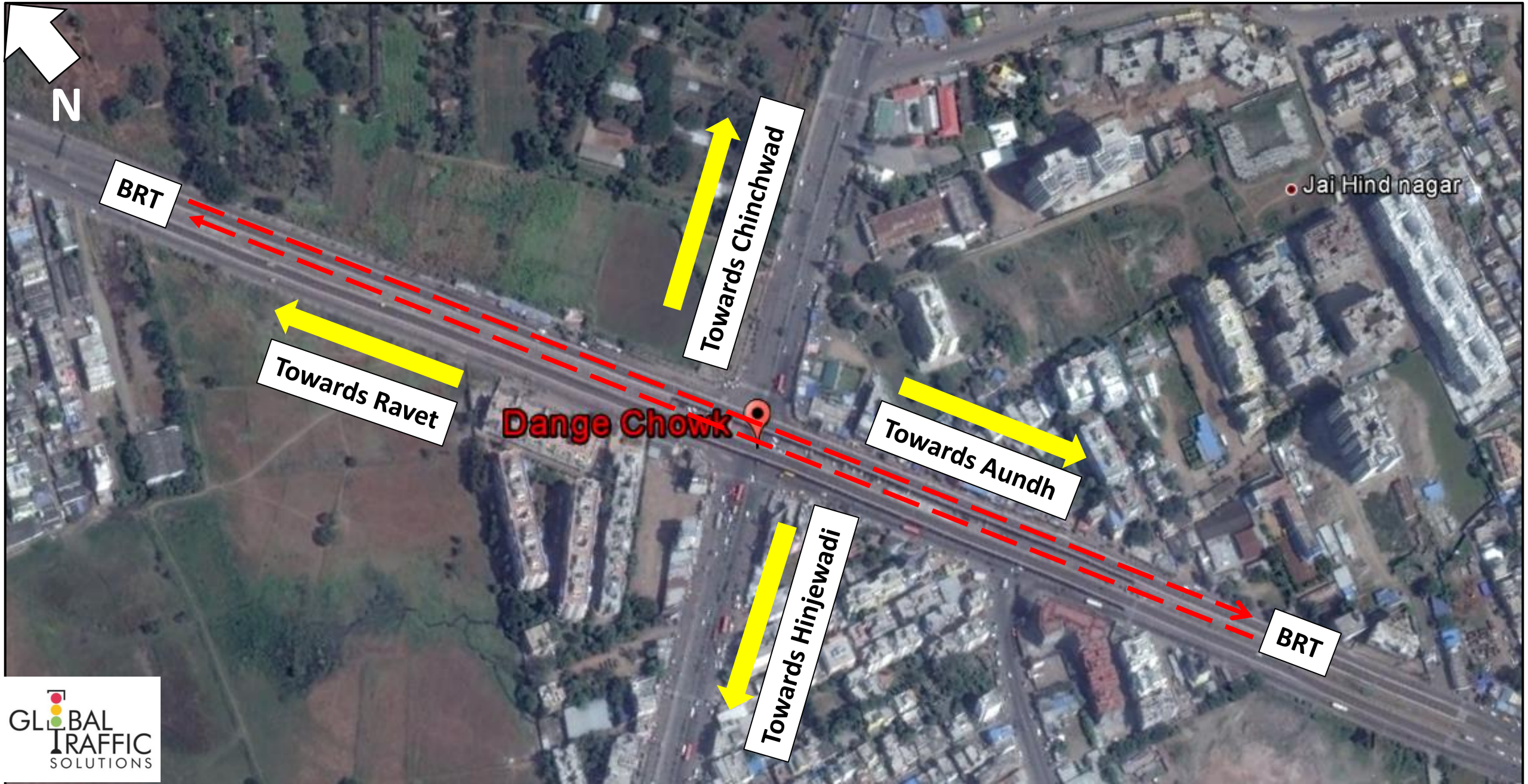
DANGE CHOWK

GLOBAL TRAFFIC SOLUTIONS

Dange Chowk



Aerial View


N
BRT
Towards Chinchwad
Towards Ravet
Dange Chowk
Towards Aundh
Towards Hinjewadi
BRT
Jai Hind nagar
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The Real Challenge !!!!!!!!!!!

The Real Challenge !!!!!!!!!!!

Video Showing Queue Length

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Vistro Analysis

Analysis were conducted for 3 scenarios:

- Scenario A – 120 sec Cycle (IRC/HCM/Default)
- Scenario B – 120 sec Cycle (Field Observations)
- Scenario C – 180 sec Cycle (Field Observations)

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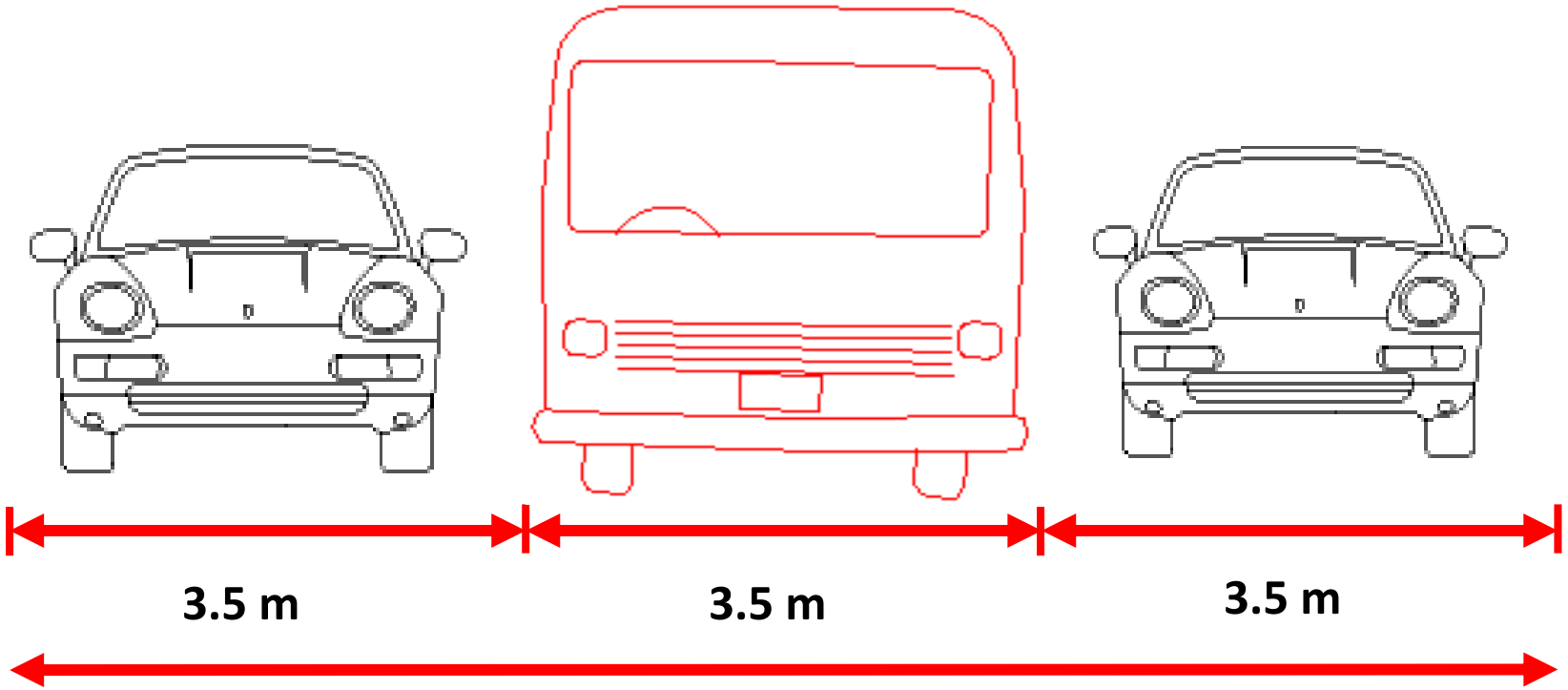
Scenario A - As per IRC & HCM (120 sec Cycle Length & standard saturation flow (540veh/hr/m))

Lane Configuration



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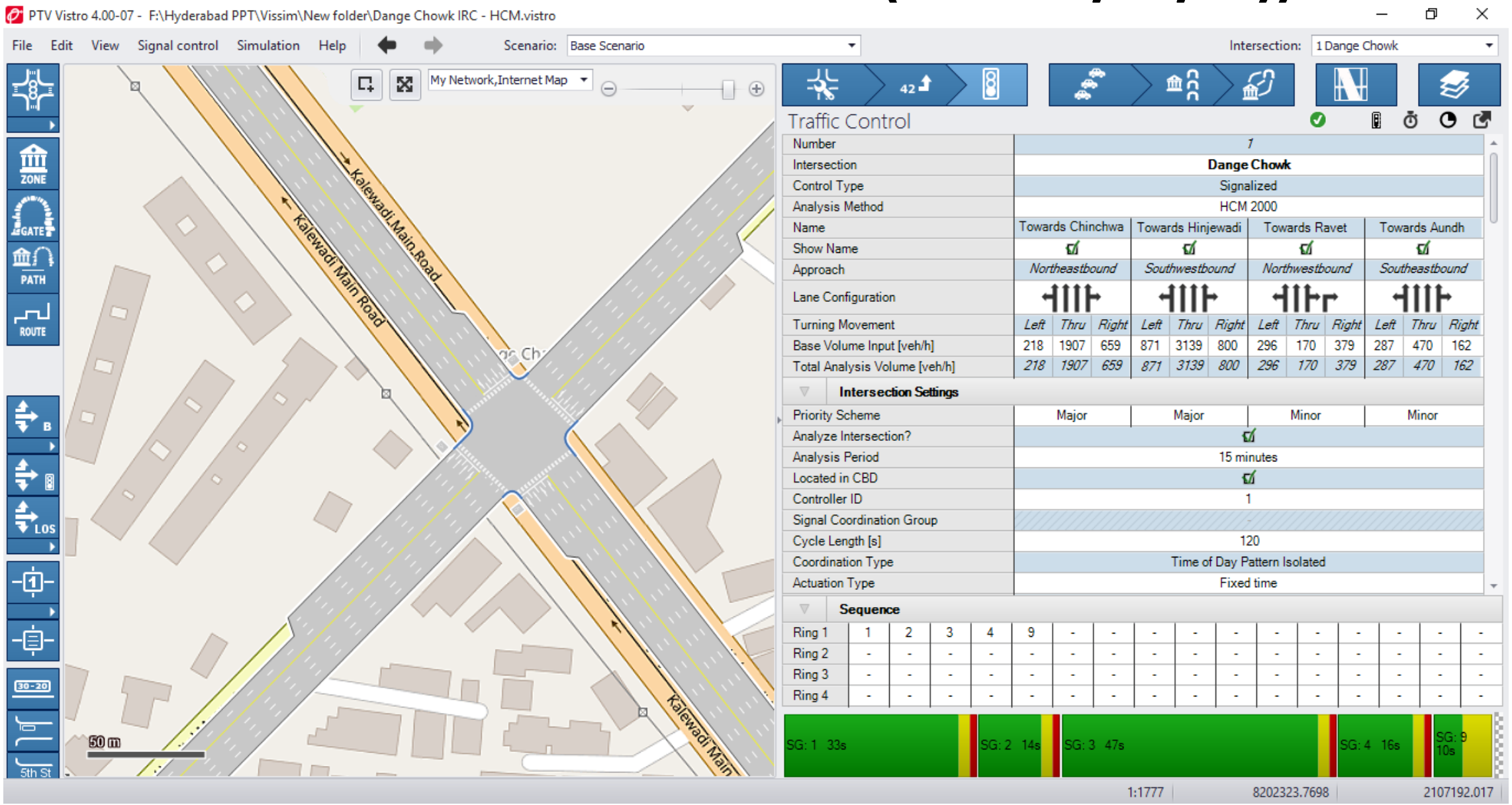
Scenario A - As per IRC & HCM (120 sec Cycle Length & standard saturation flow (540veh/hr/m))



Saturation Flow (IRC SP : 41 – 1994)

Width w in metre	3.0	3.5	4.0	4.5	5.0	5.5
Saturation flow(s) (PCUs) per hr.	1850	1890	1950	2250	2550	2990

7.6.1.2. **Effect of Gradients :** For each 1 per cent of uphill gradient, the saturation flow decreases by 3 per cent and for each 1 per cent of downhill gradient, saturation flow increases by 3 per cent. The gradient shall be the average slope between the stop line and a point on the approach 60 m before it.

7.6.1.3. **Effect of right turning traffic :** If the right turning movements from opposite directions cause the intersection to lock, then the capacity of the intersection cannot be easily assessed. Under non-locking conditions, the effects of right turning traffic depend on whether or not conflicting traffic, moves on the same phase and on whether or not the right turning traffic is given exclusive lanes. There are four possibilities.

(i) No opposing flow, no exclusive right turns : The saturation flow can be obtained as from 7.6.1.1.

(ii) No opposing flow, exclusive right-turning lanes : The saturation flow(s) depends on the radius of curvatures (r) and is given by :

$$s = \frac{1800}{1 + \frac{1.52}{r}}$$ PCUs/m for single file streams

and $$s = \frac{3000}{1 + \frac{1.52}{r}}$$ PCUs/m for double file streams

where r is radius of curvature in metres of the right turning steam through a right angle.

(iii) Opposing flow, no exculsive right turning lanes : The maximum number of right turning vehicles per cycle that can take advantage of gaps in the opposite stream can be determined from the following equations.

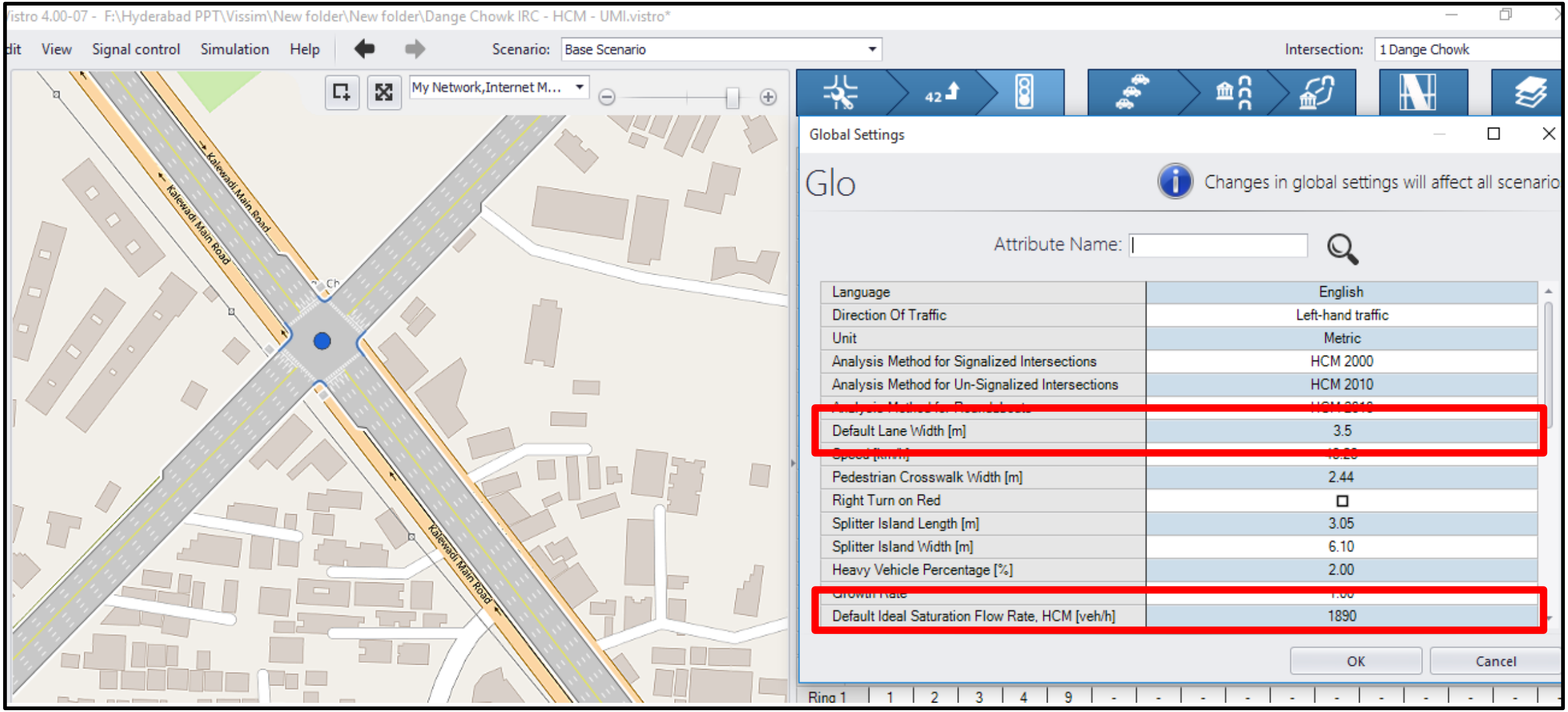
$$n_r = s_r \frac{(g \times s) - (g \times c)}{s - g}$$

Where s_r = right turning saturation flow
q = flow in opposing arm
s = saturation flow for opposing arm
g = green time
c = cycle time

(iv) Opposing flow, exclusive right turning lanes : There should be no delay to the straight ahead traffic using the same approach as the right turners, but there will be an effect on the cross phase and this

Width w in metre	3.0	3.5	4.0	4.5	5.0	5.5
Saturation flow(s) (PCUs) per hr.	1850	1890	1950	2250	2550	2990

Scenario A - As per IRC & HCM (120 sec Cycle Length & standard saturation flow (540veh/hr/m))



Scenario A - Inference

Lane Group Results

X, volume / capacity	2.28	2.37	2.30	1.12	1.35	2.23	1.55
d, Delay for Lane Group [s/veh]	624.75	656.80	661.12	163.57	235.46	630.23	313.34
Lane Group LOS	F	F	F	F	F	F	F
Critical Lane Group	☑	☑	☑	☐	☐	☑	☐
50th-Percentile Queue Length [veh]	80.48	141.41	31.32	9.85	14.05	29.91	18.97
50th-Percentile Queue Length [m]	613.28	1077.51	238.66	75.04	107.05	227.90	144.51
95th-Percentile Queue Length [veh]	128.77	226.25	50.17	17.13	23.32	47.93	30.77
95th-Percentile Queue Length [m]	981.25	1724.01	382.32	130.54	177.72	365.22	234.48

Movement, Approach, & Intersection Results

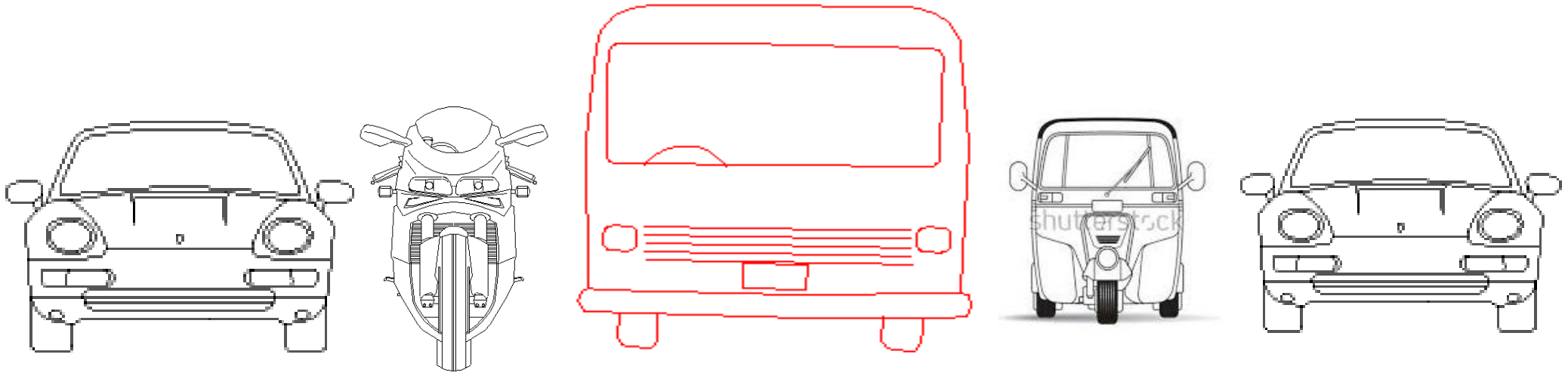
d_M, Delay for Movement [s/veh]	624.75	624.75	624.75	656.80	656.80	656.80	661.12	163.57	235.46	630.23	313.34	313.34
Movement LOS	F	F	F	F	F	F	F	F	F	F	F	F
Critical Movement	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
d_A, Approach Delay [s/veh]	624.75			656.80			370.10			412.30		
Approach LOS	F			F			F			F		
d_I, Intersection Delay [s/veh]	597.37											
Intersection LOS	F											
Intersection V/C	1.776											

Sequence

Ring 1	1	2	3	4	9	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Scenario B - As per Calibrated Lane Geometry (120 sec Cycle Length & standard saturation flow (720veh/hr/m))

Lane Configuration



2.7 m | 2.8 m | 2.5 m | 2.5 m

10.5 m

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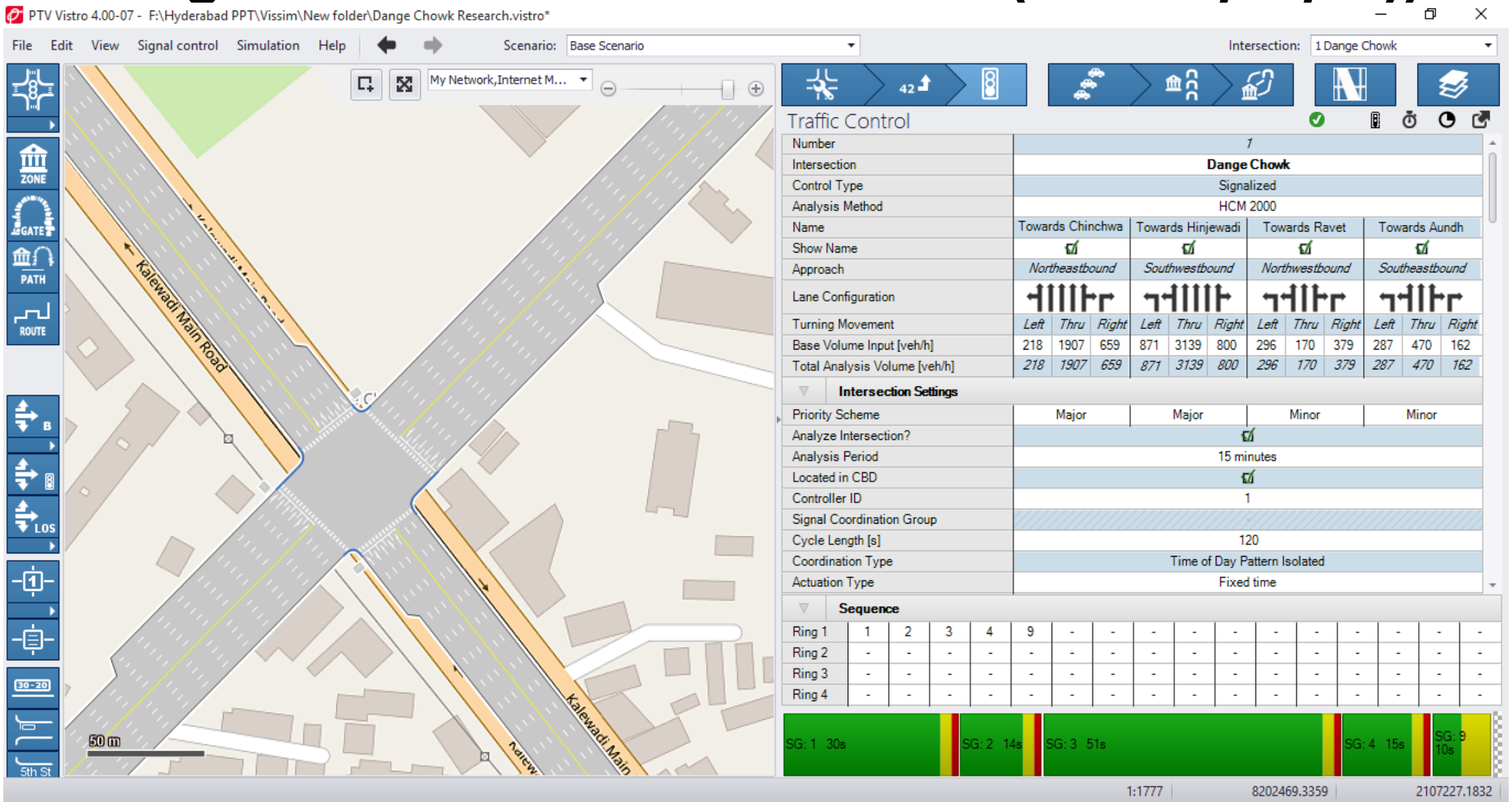
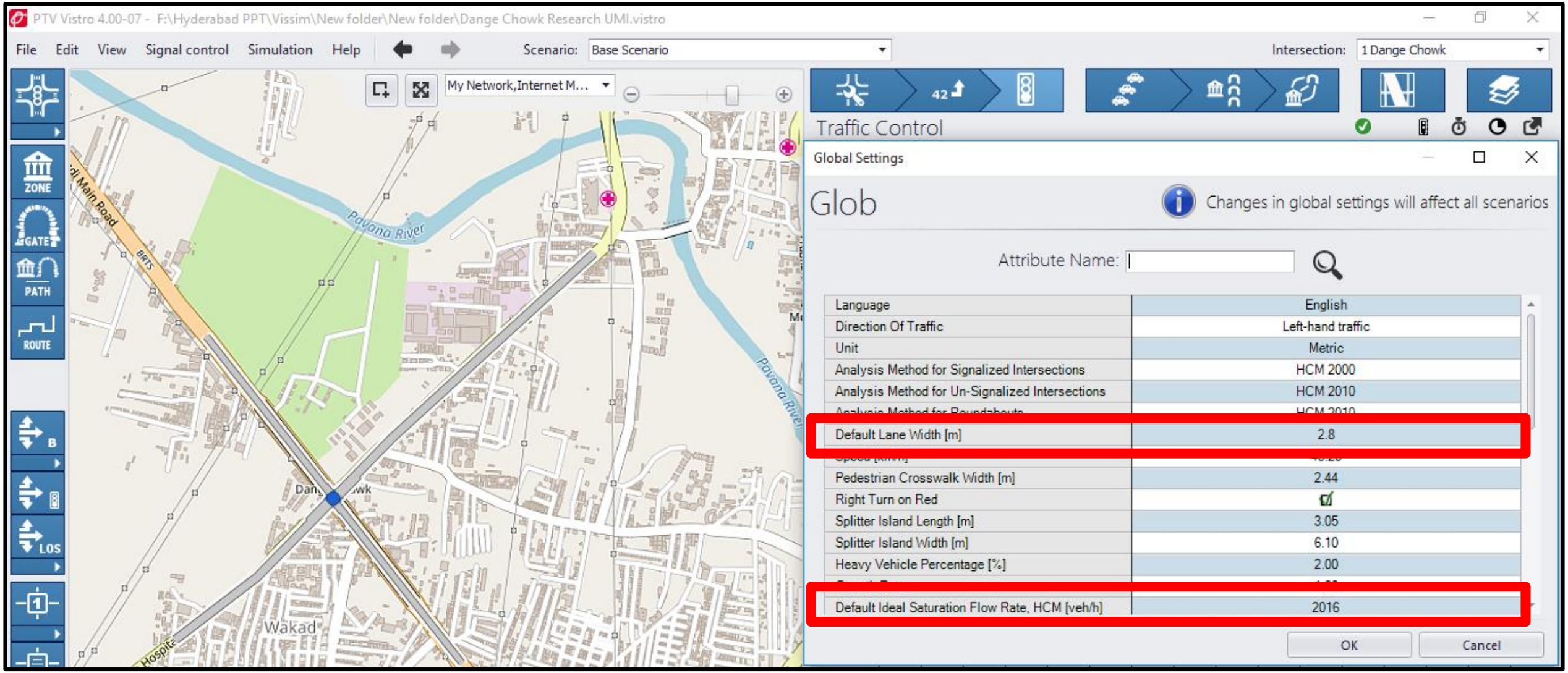
Scenario B - As per Calibrated Lane Geometry (120 sec Cycle Length & standard saturation flow (720veh/hr/m))



Scenario B - As per Calibrated Lane Geometry (120 sec Cycle Length & standard saturation flow (720veh/hr/m))



Scenario B - Inference

Lane Group Results

X, volume / capacity	1.24	1.24	0.90	1.09	1.20	1.03
d, Delay for Lane Group [s/veh]	158.32	149.49	74.70	130.40	160.38	134.44
Lane Group LOS	F	F	E	F	F	F
Critical Lane Group	☑	☑	☐	☑	☑	☐
50th-Percentile Queue Length [veh]	32.41	55.74	7.71	10.91	13.06	8.48
50th-Percentile Queue Length [m]	246.97	424.75	58.75	83.15	99.55	64.62
95th-Percentile Queue Length [m]	395.53	679.61	106.57	142.41	166.58	115.25

Movement, Approach, & Intersection Results

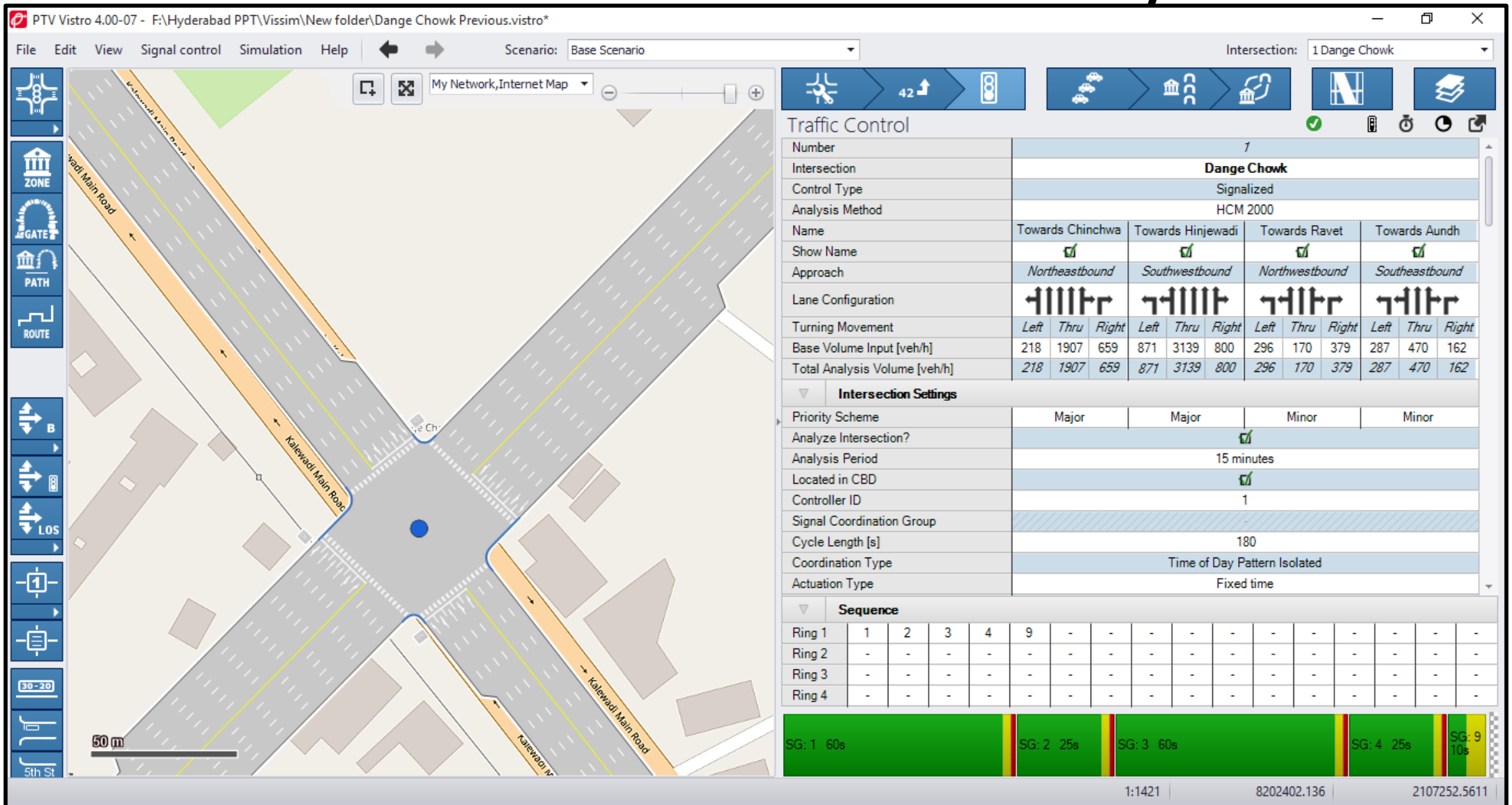
d_M, Delay for Movement [s/veh]	158.32	158.32	158.32	149.49	149.49	149.49	74.70	74.70	130.40	160.38	160.38	134.44
Movement LOS	F	F	F	F	F	F	E	E	F	F	F	F
Critical Movement	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐
d_A, Approach Delay [s/veh]	158.32			149.49			99.68			155.80		
Approach LOS	F			F			F			F		
d_I, Intersection Delay [s/veh]	148.24											
Intersection LOS	F											
Intersection V/C	0.935											

Sequence

Ring 1	1	2	3	4	9	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1:1777 | 8202371.5809 | 2107361.162

Scenario C- Existing Condition (180 sec Cycle Length & measured saturation flow rate)



Scenario C - Inference

Lane Group Results

X, volume / capacity	1.24	2.01	1.03	1.10	1.33	1.01
d, Delay for Lane Group [s/veh]	176.26	518.86	129.94	157.57	239.09	152.38
Lane Group LOS	F	F	F	F	F	F
Critical Lane Group	☑	☑	☐	☑	☑	☐
50th-Percentile Queue Length [veh]	41.96	101.62	12.26	14.72	18.49	11.39
50th-Percentile Queue Length [m]	319.70	774.38	93.45	112.16	140.86	86.81
95th-Percentile Queue Length [veh]						
95th-Percentile Queue Length [m]	511.60	1239.01	157.56	185.36	228.86	147.79

Movement, Approach, & Intersection Results

d_M, Delay for Movement [s/veh]	176.26	176.26	176.26	518.86	518.86	518.86	129.94	129.94	157.57	239.09	239.09	152.38
Movement LOS	F	F	F	F	F	F	F	F	F	F	F	F
Critical Movement	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐
d_A, Approach Delay [s/veh]	176.26			518.86			142.33			223.81		
Approach LOS	F			F			F			F		
d_I, Intersection Delay [s/veh]	353.96											
Intersection LOS	F											
Intersection V/C	1.277											

Sequence

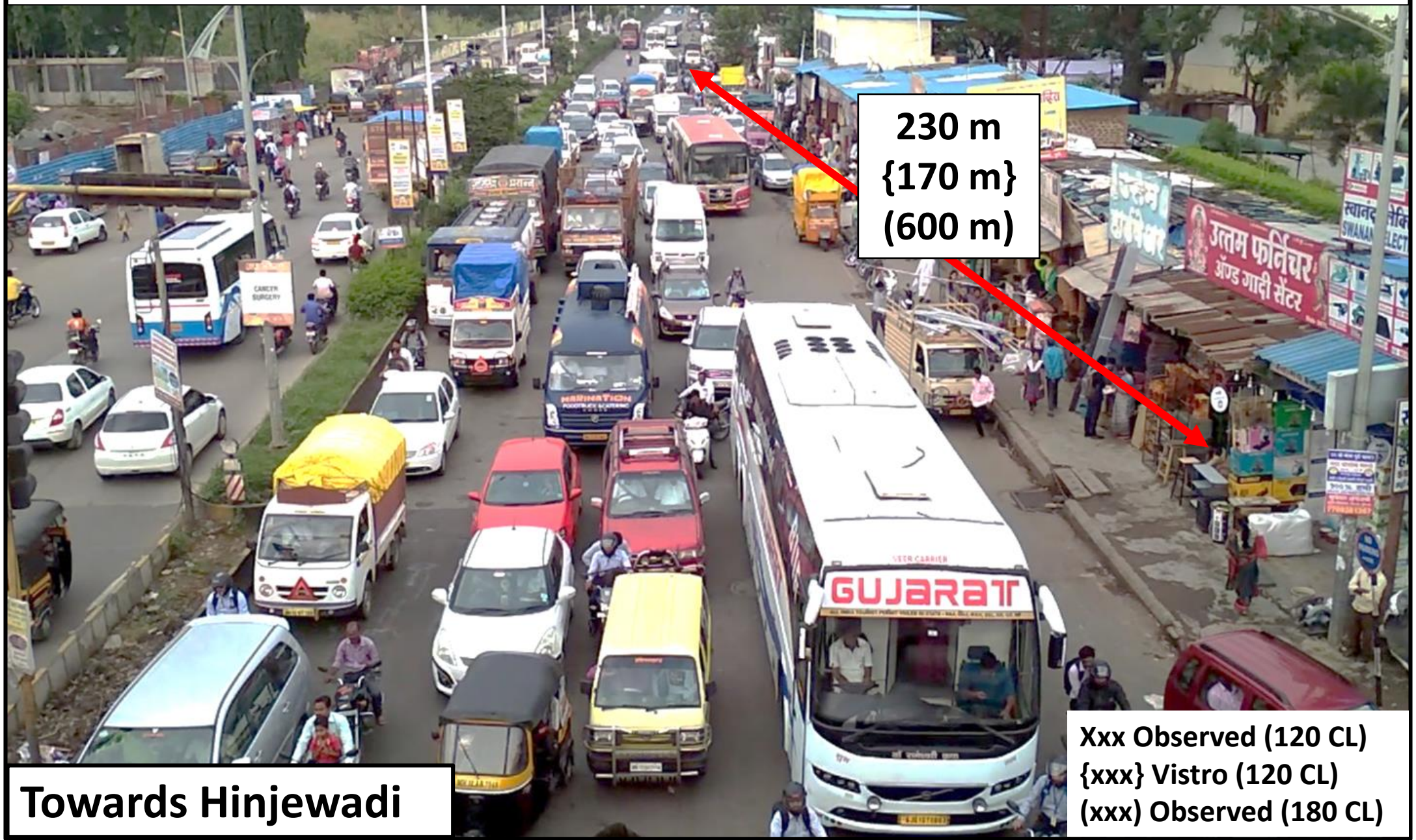
Ring 1	1	2	3	4	9	-	-	-	-	-	-	-	-	-	-	-
Ring 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ring 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Inference Summary

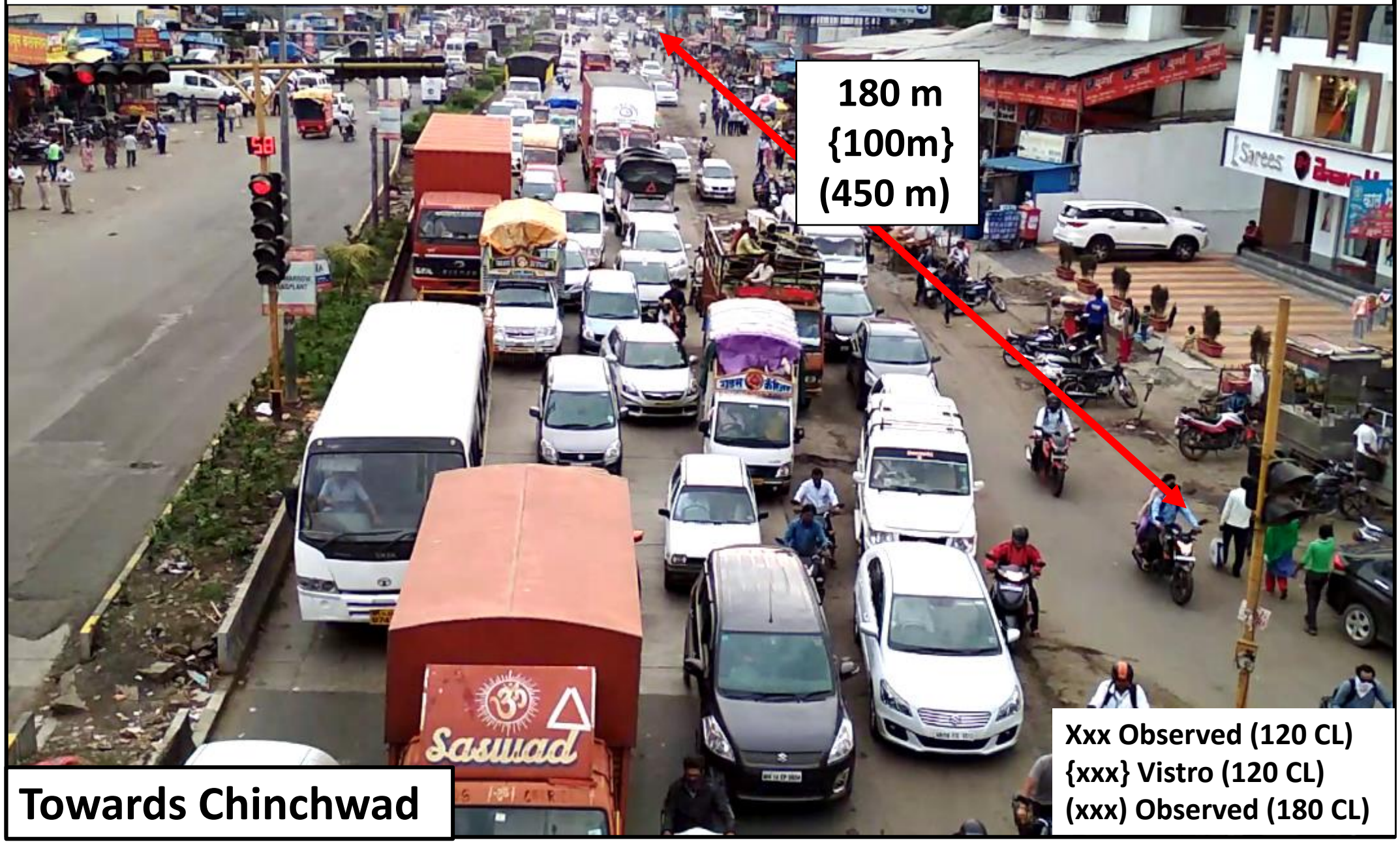
Scenario	Queue Length (m)		Delay (sec/veh)	V/C Ratio	LOS
	Towards Hinjewadi	Towards Chinchwad			
A (120 CL & std. saturation flow)	1724	981	597	1.776	F
B (120 CL & field saturation flow)	680	395	148	0.935	F
C (180 CL & field saturation flow)	1239	512	354	1.277	F

Video Showing BRT Bus Bunching

Queuing


230 m
{170 m}
(600 m)
GUJARAT
उत्तम फर्निचर
ऑण्ड गादी सेंटर
Towards Hinjewadi
Xxx Observed (120 CL)
{xxx} Vistro (120 CL)
(xxx) Observed (180 CL)

Queuing


180 m
{100m}
(450 m)
Towards Chinchwad
Xxx Observed (120 CL)
{xxx} Vistro (120 CL)
(xxx) Observed (180 CL)

Export to Vissim

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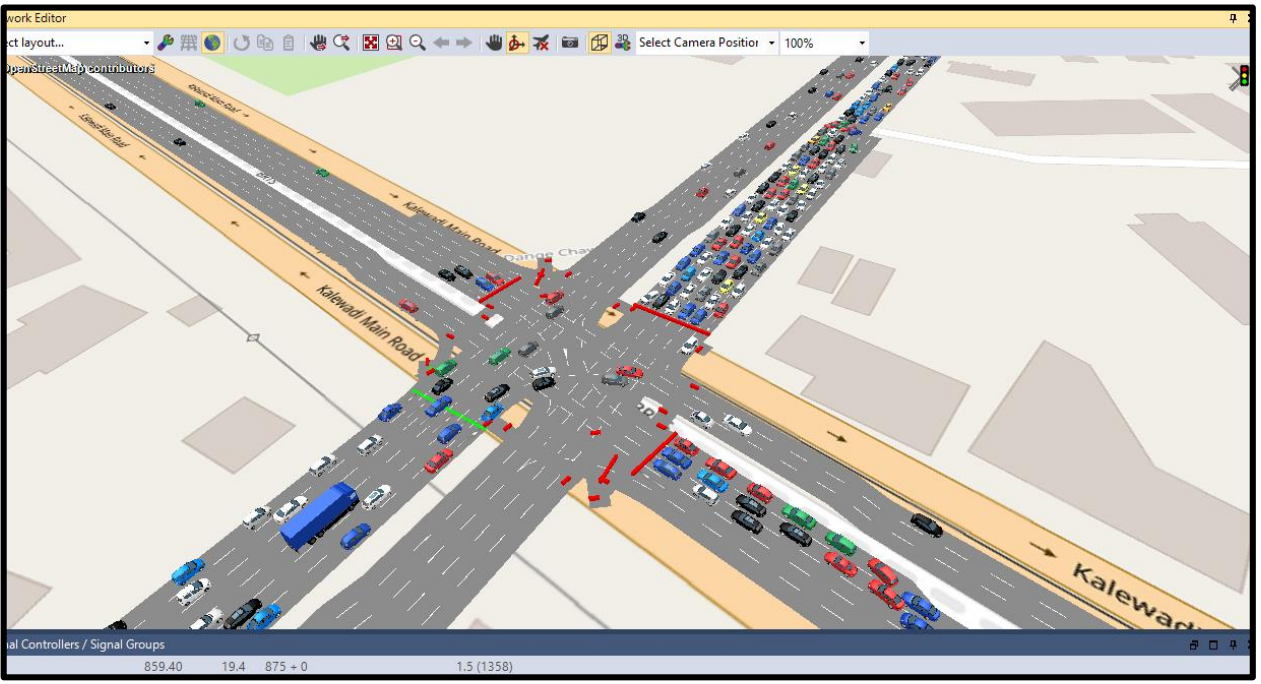
Kalewadi Main Road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OpenStreetMap contributors
Kalewadi Main Road
Kalewadi
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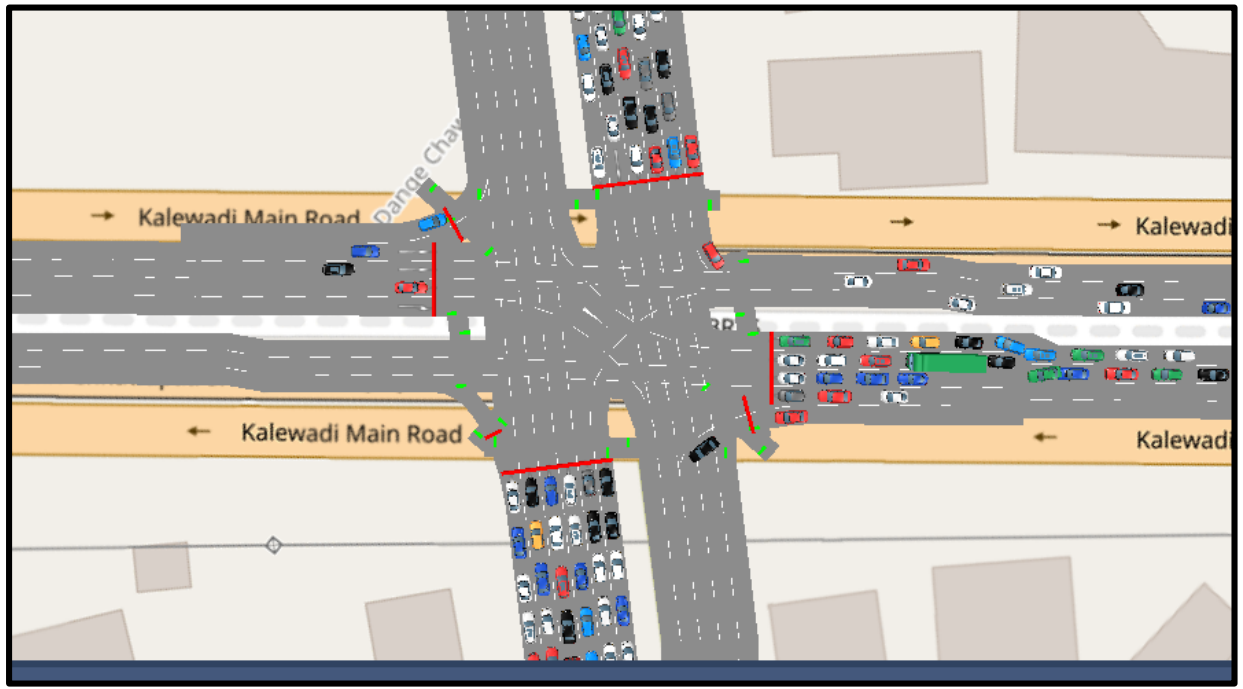
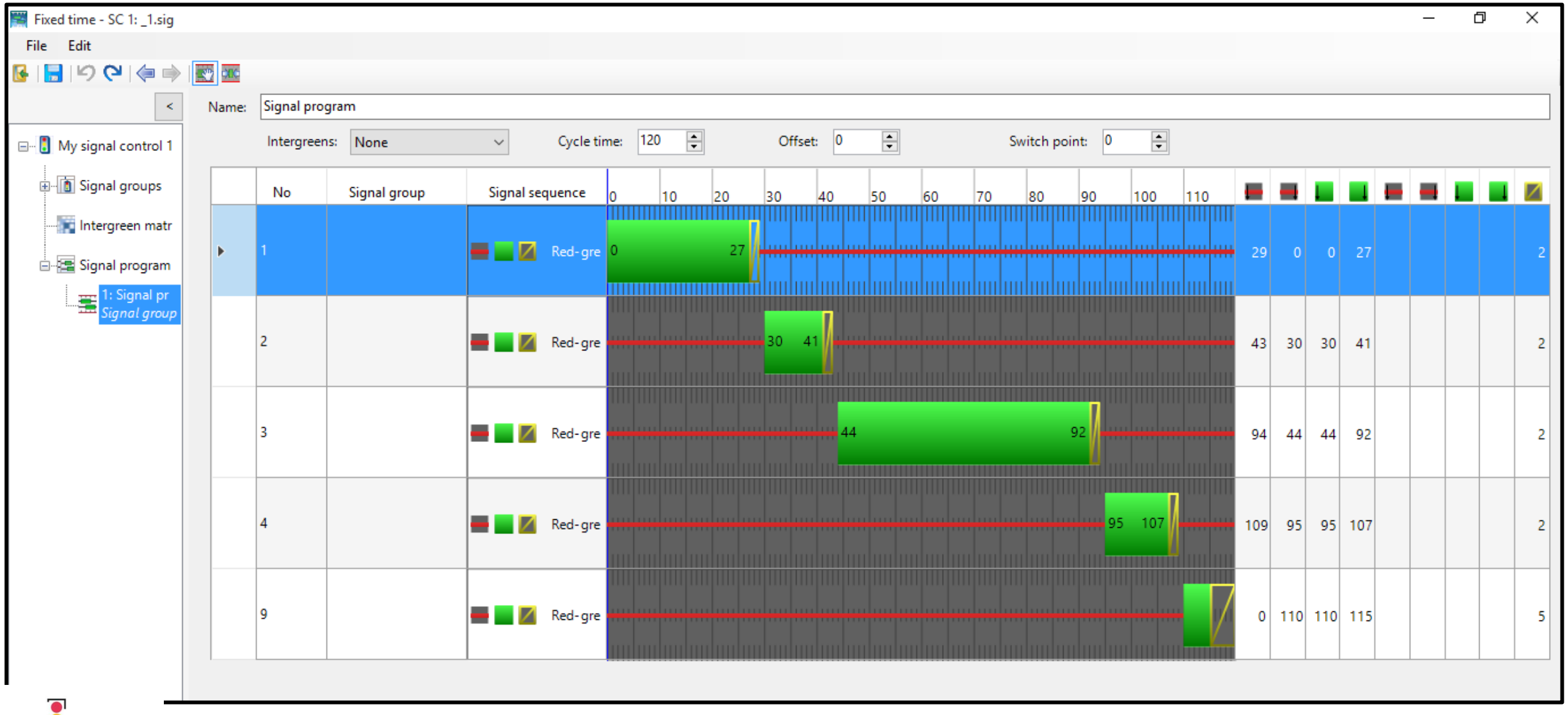
19.4
875 + 0
1.5 (1358)


Kalewadi Main Road
Kalewadi Main Road
Kalewadi

Signal Program



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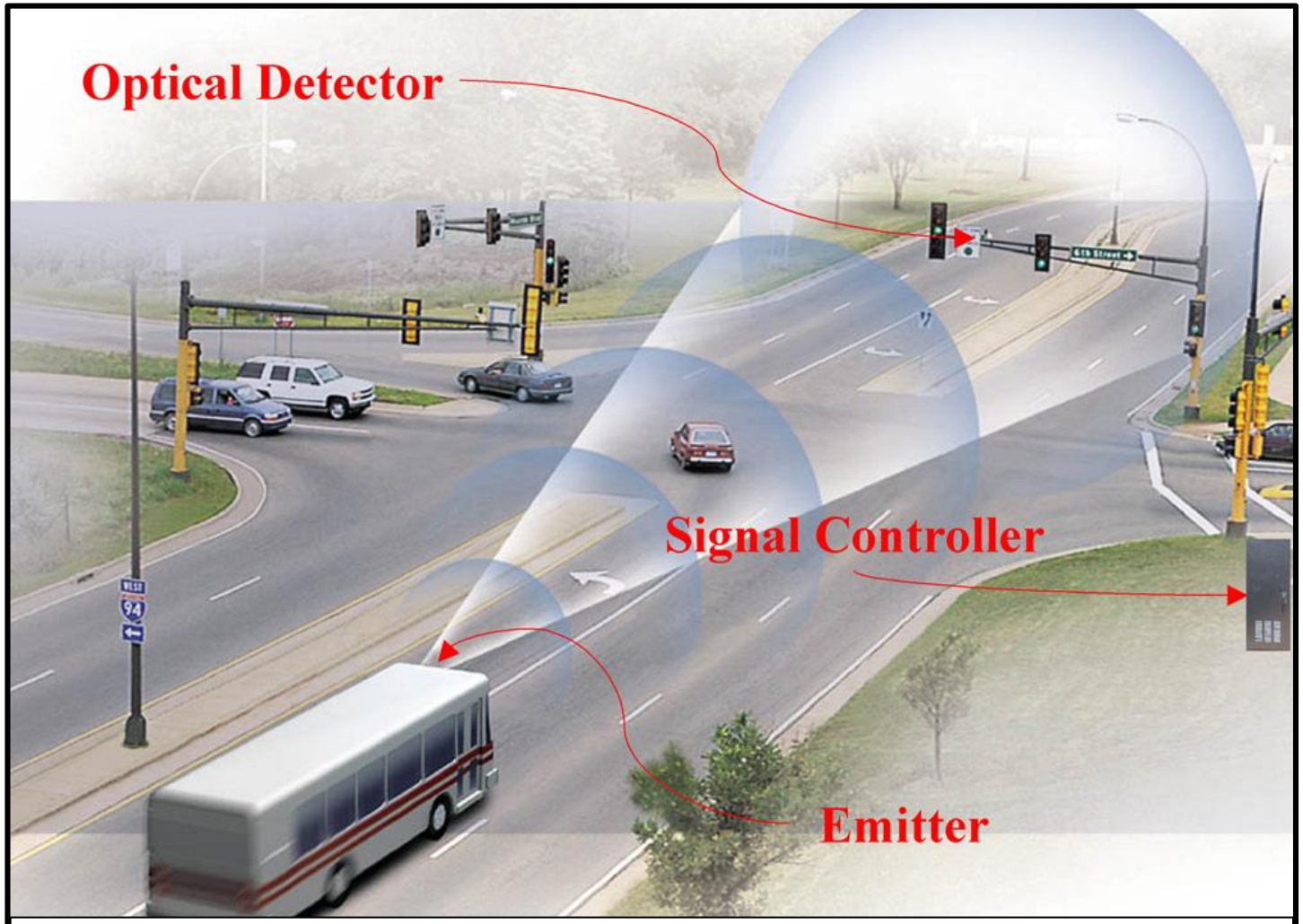
Recommendations

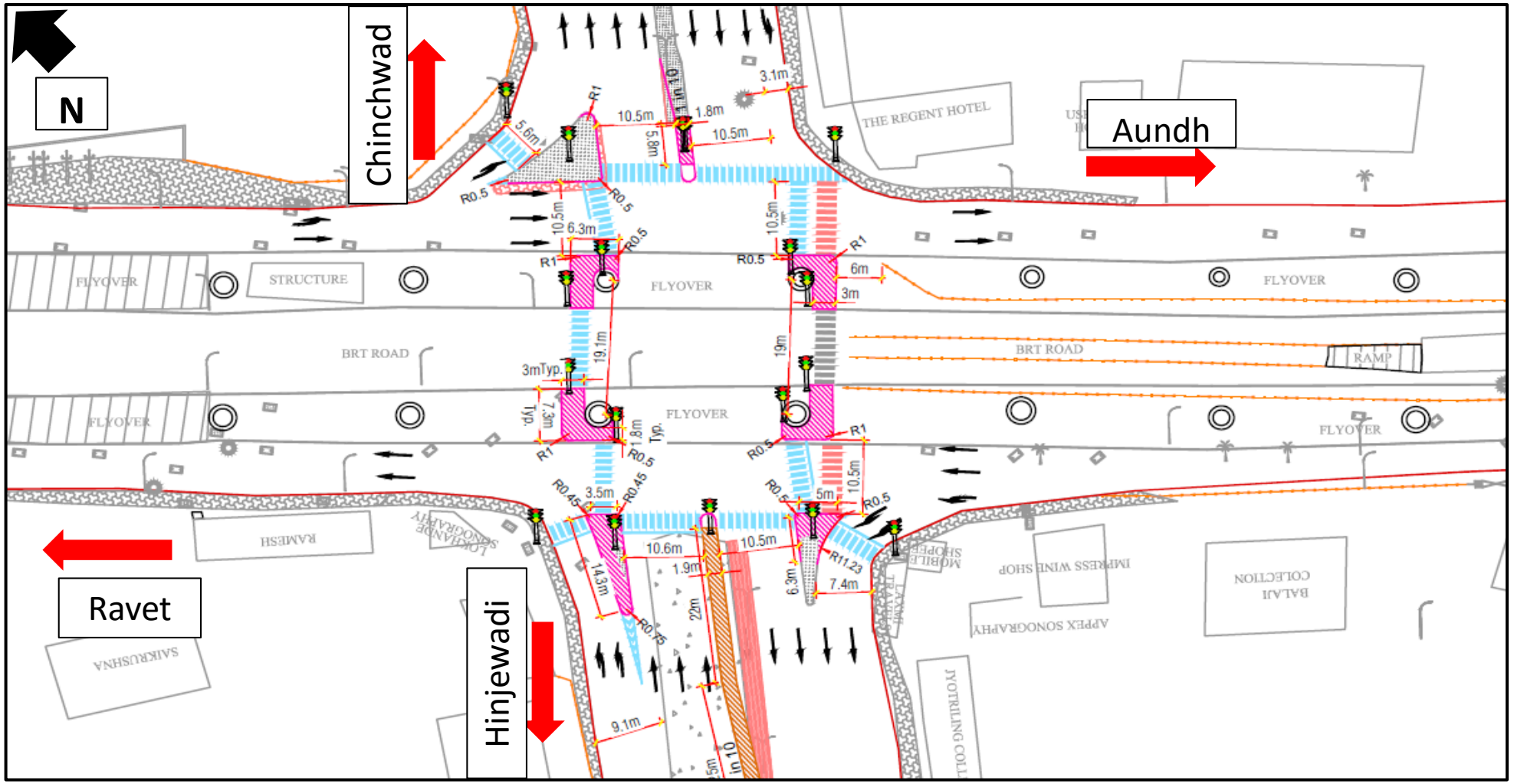
- Traffic Signal Priority for Buses



Source : publicpolicyforum.org

Recommendations

❖Junction Improvements



Dange Chowk

Thank You

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