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Traffic Impact Study of Kalasipalyam Traffic and Transit Management Centre

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***Abstract*—Any development causes severe changes in the traffic conditions in the adjoining areas of the proposed development. Its effects have to be analyzed before the proposed development is implemented to check its severity on traffic conditions for public transport, private vehicles and pedestrians. The goal of a traffic impact study is to assess the potential impact of traffic generated by a proposed development or re-development and to identify the road way improvements required to ensure that the road network will operate safely and efficiently upon completion of t he development. A TTMC is proposed to develop at the existing Kalasipalyam bus stand, as the existing road networks do not have sufficient width and already congested the proposed development will definitely have an impact on the existing roadway networks. To address this impact the volume counts will be done and estimate the amount of traffic to be generated by a development. The collected data was analyzed to identify the Roadway Segments capacity and Level of Service (LOS), based on the Indian Roads Congress (IRC) standards sourced from Guidelines for Capacity of Urban Roads in Plain Areas IRC 106-1990. Whereas, the delay and queue lengths at the intersections are estimated using a micro simulation based software and the required mitigation measures will be identified for the better traffic operation condition and circulation in the study area under each scenario**

Keywords— Level of service, Capacity, Delay, Que Length)

I. INTRODUCTION

A Traffic and Transit Management centre (TTMC) is an integrated transportation facility with adequate amenities to encourage the use of public transport by catering to the requirements of all user groups. It helps in promoting the use of public transport through provision of park and ride facilities at the bus terminal. BMTC planned 45 Traffic and Transit Management centre's (TTMCs) in and around Bangalore, out of which 10 have been already completed and operated. BMTC has initiated a project of development of bus terminus cum commercial transport. The Bangalore Metropolitan Transport Corporation has initiated a project of redevelopment of bus stand in Kalasipalayam. The site is located in central part of the city near the main market area of Bangalore, which makes the site suitable for all types of commercial development. The map below presents the location of the project site with respect to the city. The proposed development would include facilities like bus terminals, commercial and office spaces, parking facility, etc. This change in land use from the bus stand to the TTMC would generate new bus schedules, private vehicles and pedestrian traffic. The proposed development will impact the traffic circulation pattern and flow on the surrounding roadway segments due to the increase in vehicular traffic.

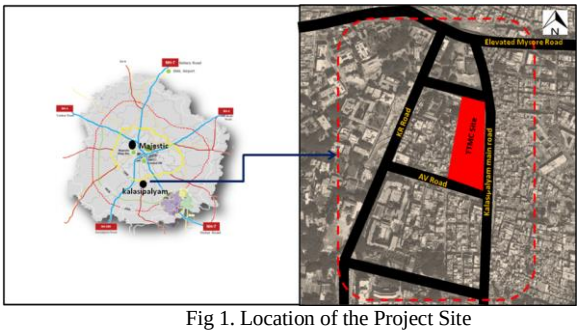

Fig 1. Location of the Project Site

1.1 Objectives of the Study:

- To review the existing traffic conditions of the study road networks.
- To estimate the potential traffic generation due to the proposed development.
- To assess the future traffic situation in the surrounding road network in terms of queue lengths and delays.
- To study the potential traffic impact of the proposed development on the surrounding road network.
- To consider road improvement proposals, if required and
- To recommend various roadway improvements and mitigation measures required to ensure safe and efficient vehicular and pedestrian circulation in the study area upon the completion of project.

1.2 Objectives of the Study:

- To analyze the existing and future year operation conditions of the roadway segments and intersections surrounding the project site.
- Identify Traffic Impacts from the proposed development on the roadway segments and intersections in the study area.
- Propose mitigation measures i.e. roadway improvements required to achieve acceptable operating conditions of the roadway segments and junctions, and efficient circulation patterns in the study area.
- Suggest vehicles and pedestrian entry and exit to the TTMC to reduce vehicular and pedestrian conflicts.

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II. LITERATURE REVIEW

2.1 JOSE REGIN F. REGIDOR AND RENE VAL R. TEODORO:

Traffic Impact Assessment for Sustainable Traffic Management and Transportation Planning in Urban Areas

Traffic impact assessment (TIA) is a powerful tool for engineers and planners to determine the possible effects of a project on the transportation and traffic system. Often it is applied only to the direct impact area and countermeasures for potential negative impacts are specific for the development. This paper presents TIA as a useful tool for local governments, especially for managing traffic and in planning their respective transportation systems. Two cases involving projects that were required to undertake TIA are compared, and results are examined in relation to the sustainability of traffic management and transportation planning strategies in Metro Manila and in other cities as well. The experiences presented and discussed in this paper underline the need for the government to take an active role in promoting TIA.

2.2 Sunil Kumar V And J. Ranjitha:

Improvement of Traffic Operations in Congested Signalized Intersections a Case Study in Bangalore City

Intersections are usually considered as the critical points within the network and the evaluation of their performance provides valuable understanding and useful indication about the performance of the system. The capacity of signalized intersection is of more significant because such intersections often control the ability of the city streets to accommodate traffic. In Bangalore city, most of the signalized intersections are congested and operate in LOS E or F.The objective of the present study is to improve the performance operation of the signalized intersections by investigating the proper alternatives to enhance the traffic capacity. To achieve this objective, Bilekahalli signalized intersection in Bangalore city, along the Bannerghatta road, were selected. The required data for the study purpose like Road Inventories and Traffic Volume Counts were collected using video cameras. The results of this study revealed the selected traffic facility currently undergoes serious degradation causing breakdown conditions. Thus, urgent considerations must be given regarding the upgrading in the LOS by suggesting many alternatives.

2.3 SHYAM PRAKASH.K AND SAI SRAVAN.S

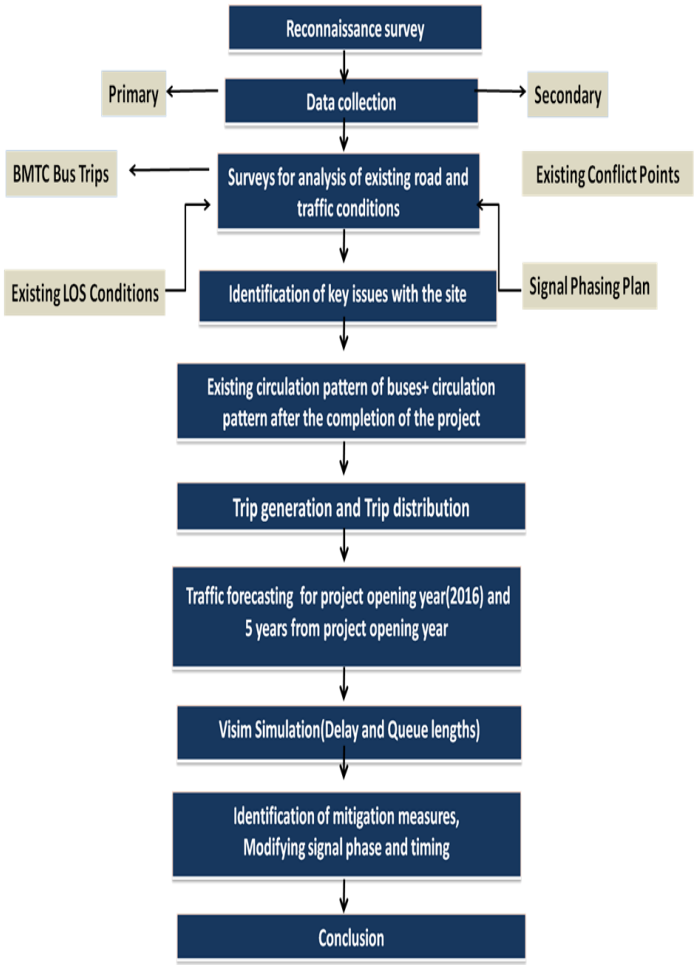
Traffic Impact Study at 3 Legged Intersections

A TIS generally includes a description of the scope and intensity of the proposed project, a summary of the projected impacts and any required mitigation measures. The goal of a traffic impact study is to assess the potential impact of traffic generated by a proposed development or re-development and to identify the road way improvements required to ensure that the road network will operate safely and efficiently upon completion of the development. For the traffic impact study, a three legged intersection was chosen at Durgaghat in Vijayawada, Andhra Pradesh and conducted a traffic volume count. In this paper the observations shows that the capacity of dual lane carriageway with both directions (14mts) was exceeds by the volume travels at that junction. Normally the capacity of two-lane both direction carriage way is 3000 pcu's/day (IRC 106:1990), but the study area results says that the peak hour vehicular traffic was 5000pcu's. To measure the traffic volume counts manual method of count was adopted.

III. METHODOLOGY AND DATA COLLECTION

The methodology adopted for the study is to identify the project generated traffic volumes and its impact on the roadway network surrounding the project site for existing, project opening Year 2016, and Cumulative Year 2021 conditions.

3.1 Flow Chart:



3.2 Data Collection:

Data collection is done in the form of primary and secondary surveys where primary surveys like traffic volume counts, speed and delay, and pedestrian count survey, etc were carried out to obtain an idea of traffic scenario of the study area. The secondary data collected from various agencies comprised of the existing land use patterns, bus route details from BMTC.

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Table 3.1 Equivalent PCU Factors

Vehicle Type	Equivalent PCU factors for Junctions	
	Less than 5% composition in traffic stream	5% & above composition in traffic stream
Standard Bus	2.2	3.7
Mini Bus	1.5	1.5
Car/Jeep/Van	1	1
Two Wheelers	0.5	0.75
Auto Rickshaw	1.2	2
Truck	2.2	3.7
MAV	4	5
LCV	1.4	2
Tractors	4	5
Cycles	0.4	0.5
Carts	2	3
Cycle Rickshaw	1.5	2

Source: IRC: 106-1990

Table 3.2 Observed Daily Traffic Volume at Various Intersections

Location No	Location	Total Traffic
		In Vehicles
1	K.R Market	48268
2	Victoria Hospital	15752
3	Armugam Mudaliar Road	14183
4	Albert Victor Road	20352
5	Bangalore Medical College	6562
6	KIMS Junction	17992
7	Basappa Circle	41901

Table 3.3 Observed Peak Hour Traffic Volume at Various Intersections

Location No	Location	Peak Hour	Total Traffic
			In Vehicles
1	K.R Market	10:15-11:15	10379
2	Victoria Hospital	9:15-10:15	3810
3	Armugam Mudaliar Road	10:30-11:30	2463
4	Albert Victor Road	10:00-11:00	3299
5	Bangalore Medical College	8:00-9:00	1035
6	KIMS Junction	10:00-11:00	2965
7	Basappa Circle	10:15-11:15	8448

3.3 Speed and Delay study:

The floating car technique has been used for obtaining data wherein the driver is instructed to follow the designated route course, while maintaining the average speed of other traffic and accompanied by trained members of the team who record the travel time, and delay.

3.3.1 Study Corridors:

The study area was divided into 7 nodes and the survey was carried out between these nodes. The distances of the various road links were computed from scaled maps. The survey vehicle had made specific runs between these nodes during peak and off peak hours. The delay or the time lost during the travel period was noted down and the time, location and cause of these delays are recorded by the observers in the moving car. The data obtained in the pre-structured survey sheets were entered and checks on the range of values and validity of data was done before analysis

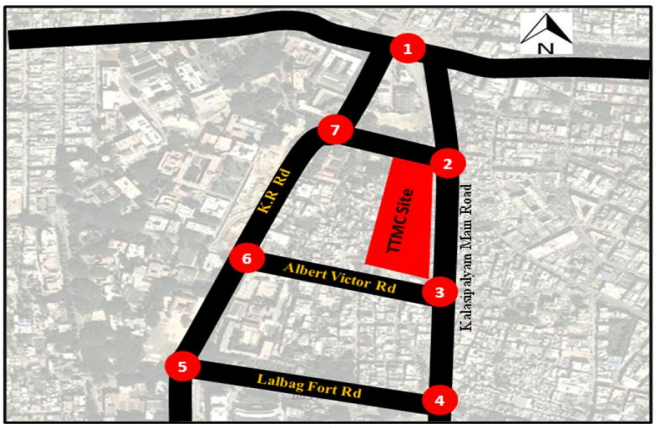

Figure 3.1 Nodes Selected for Speed and Delay Study

The delay or the time lost by traffic during the travel period may be either due to fixed delays or operational delays. Fixed delay occurs primarily at intersections due to traffic signals and at level crossings. Operational delays are cause by the interference of traffic movements, such as turning vehicles, pedestrians etc., and due to insufficient capacity and by accidents. Therefore the overall travel speed between the origin and destination points of travel is invariably lower than the desired running speed.

Speed and delay study has provided section wise estimate of journey time, running time, delay. The results of the speed and delay studies are useful in detecting the spots of congestion, the causes and in arriving at suitable remedial measures. It was observed that the K.R road between node 6 and 7 has the maximum delay and lower journey speed.

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Table 3.4 Summary of Running Speed and Journey Speed

Sl .No	From Node	To Node	Dist (Km)	Avg Time without delay(Sec)	Avg Delay time(Sec)	Running Speed(kmph)	Avg Journey Speed(kmph)
1	1	2	0.2	59	5	12.2	11.3
2	2	3	0.3	57	15	18.9	15.0
3	3	4	0.3	55	45	19.6	10.8
4	4	5	0.5	61	75	29.5	13.2
5	5	6	0.3	41	57	26.3	11.0
6	6	7	0.4	91	109	15.8	7.2
7	7	1	0.2	48	140	15.0	3.8
8	3	6	0.4	82	47	17.6	11.2
9	6	5	0.3	40	58	27.0	11.0
10	5	4	0.5	68	90	26.5	11.4
11	4	3	0.3	53	17	20.4	15.4

IV. EXISTING CONDITION

4.1 Study Area:

The proposed project consists of 4 acres 15 guntas area. The existing land use includes a bus stand and office of the Traffic officer and a temple. Currently all the private, KSRTC, and BMTC buses are using the bus stand.

The site is near the two markets Krishna Rajendra and Kalasipalyam it is suitable for all types of commercial development. Because of these two main markets pedestrian traffic is more. The site is around 2 Km away from the Kempegowda (Majestic) Bus stand and Bangalore junction railway station. From the Eastern side, the site is 2.5 km away from Cubbon Park and major government offices like VidhanSoudha, VikasaSoudha and High court complex. The map below shows the study area.

4.2 Existing Land Use Pattern and Major Trip Attractors

The land use within 0.5km radius includes public or semi public, commercial and also includes Bangalore Medical College, Victoria Hospital to the west side,K.R Market to the North side and Kalasipalyam market to the east side. The land use within 1km radius includes commercial, public or semi public and residential. There are several trip attractors in the study area among those only major trip attractors which would attract large amount of traffic are shown in the figure below. Major trip attractors are Kalasipalyam market, Krishna Rajendra market, KIMS, Bangalore medical college, Vanivilas hospital, Victoria hospital, & Government dental college. Among these two main markets Kalasipalyam market and Krishna Rajendra market will attract more traffic these two markets come within 1km radius and attracting more trips which will have an impact on the road networks around the Kalasipalyam bus stand. Figure 4.2 shows the existing land use surrounding the project site and major trip attractors within 0.5km and 1km radius of the project site.

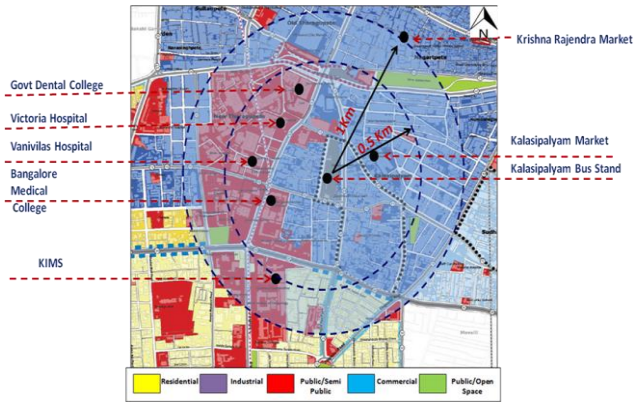

Figure 4.1 Existing Land Use Pattern and Major Trip Attractors

4.3 Existing Bus Operation at Kalasipalyam

	Vehicles	Trips
BMTC	618	3320
KSRTC	162	549
Private Operators	118	472
Total	898	4341

4.4 Existing Operation Conditions:

Existing operation conditions of the study roadway networks and intersections near the proposed project site were evaluated with respect to the following to identify the deficiencies with respect to vehicle and pedestrian traffic.

1. Roadway segments -Volume to Capacity Ratio and LOS
2. Intersections - Delay and Queue Length
3. Existing pedestrian facilities - Foot Path Connectivity and Pedestrian Crossings

4.4.1 Level of service:

V/C	LOS	Performance
0.0 - 0.2	A	Excellent
0.2 - 0.4	B	Above Average
0.4 - 0.6	C	Average
0.6 - 0.8	D	Below Average
0.8 - 1.0	E	Poor
1.0 - 1.2	F	Very Poor

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Level of Service A: Represents a condition of free flow. The general level of comfort and convenience provided to the road user is excellent.
Level of Service B: Represents zone of stable flow, with the drivers still having reasonable freedom to select their desired speed.
Level of Service C: The general level of comfort and convenience declines noticeably at this level, average travel speeds are about 50 percent of the average free flow speed.
Level of Service D: Represents the limit of stable flow, with conditions approaching unstable flow.
Level of Service E: Represents operating conditions when traffic volumes are at or close to the capacity level.
Level of Service F: Represents zone of forced or break down flow. The average travel speeds are between 25 percent and 33 percent of free flow speed.

All the road networks selected for the study are operating at an LOS D or better during existing peak hour conditions with the v/c ratio ranging from 0.54-0.8 except the K.R road and Lalbag Fort road which is operating at an LOS E with the v/c ratio ranging from 0.83-0.85, this shows that during peak hour these roads are congested and there is more traffic blockage on this stretch compared to Albert Victor road, and Kalasipalyam main road. The figure below shows the existing LOS conditions of the road networks.

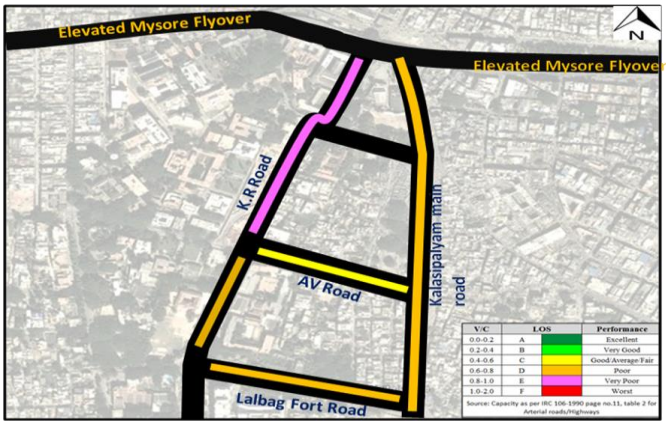

Figure 4.2 Existing Operating LOS Conditions

4.5 Existing Operation Conditions at the signalized Intersections:

To evaluate the existing operation conditions, the delay and queue lengths at the study intersections are calculated. The existing peak hour delay and queue lengths were computed for the following intersection.

1. K.R Market.
2. Basappa Circle.
3. KIMS.
4. BMC Junction.
5. Victoria Hospital Junction.

Table 4.1 Operation Condition at the Study Intersections

Intersections	Existing condition			
	Delay(Sec/Veh)	Queue Length (m)		Throughput(Vehicles)
K.R Market Bust Stop	70	168	W-S	4486
Basappa Circle	166	205	W-N	2403
KIMS	66	151	E-S	1848
BMC Intersection	24	77	E-S	2341
Victoria Hospital Intersection	2	12	SW-SE	1904

4.6 Key Issues:

- Many foot paths around the study area are discontinuous and are not pedestrian friendly and many foot paths are occupied by vendors hence pedestrians struggle to walk on such a narrow foot path.
- Traffic blockage at junction 3 as this is unsignalized and there is a conflict between the buses taking left turn while exiting from the bus stand and the vehicles moving on the Kalasipalyam main road.
- Junction 7 is very much congested during peak hours and large queue lengths due to buses taking right turn while heading towards bus stand.
- No legal parking places around the bus stand hence people will leave their vehicles beside the foot paths and in front of the shops which will leave narrow lane for the BMTC buses.

5 FUTURE OPERATING CONDITIONS

In Bangalore city the vehicle growth is in between 7%-10% per annum so in this study a growth rate of 7% is used to forecast the future year traffic volumes at the study roadway segments and intersections. The future traffic projection was done for the year for year 2021 conditions.

5.6 Cumulative Year 2021- Level of Service

The cumulative year traffic analysis was done for the year 2021 conditions, to identify impacts on the roadway networks and study intersections selected for the study.

5.6.1 Roadway Segments:

During the year 2021 all the roads will be operating at an LOS F except Albert Victor road which would operate at LOS E.

- Kalasipalyam main road, Lalbag fort road and K.R road would operate at LOS F with v/c ratio between 1.05-1.26.
- Albert Victor Road would operate at LOS E with v/c ratio of 0.81.

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The project would have a significant impact at the following roadway segments.

- Among all the roads which would also operate at LOS F most significant impact can be seen on the Kalasipalyam main road in South bound direction between Lalbag fort road and Albert Victor road where LOS changes from 1.09 to 1.11 after adding project generated volume.
- The project would not have a impact on the Kalasipalyam main road in North bound direction.
- The project would have a significant impact on Lalbag fort road, K.R road and Kalasipalyam main road in South bound direction since the addition of project volume would increase the v/c ratio by 0.01.

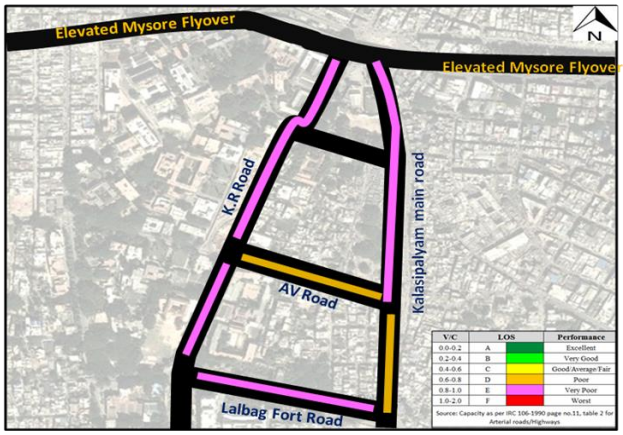

Figure 5.1 Year 2021 LOS Condition (Without Project)

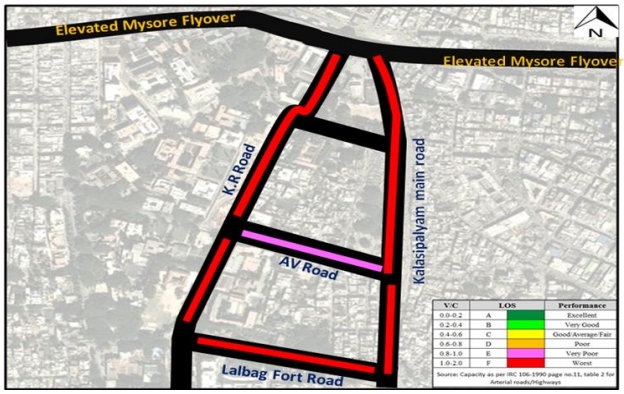

Figure 5.2 Year 2021 LOS Condition (Without Project)

Table 5.1 Operating Condition 2021 without project

Intersections	2021 without project			
	Delay(Sec/Veh)	Queue Length (m)		Throughput(Vehicles)
K.R Market Bust Stop	90	210	W-E	5337
Basappa Circle	215	420	W-S	2664
KIMS	103	176	E-W	3316
BMC Intersection	35	106	S-N	2841
Victoria Hospital Intersection	10	120	SW-SE	2153

Table 5.2 Operating Condition 2021 with project

Intersections	2021 with project			
	Delay(Sec/Veh)	Queue Length (m)		Throughput(Vehicles)
K.R Market Bust Stop	107	215	W-E	5247
Basappa Circle	218	424	W-S	2713
KIMS	114	258	E-W	3265
BMC Intersection	31	112	S-N	2927
Victoria Hospital Intersection	21	122	SW-SE	2194

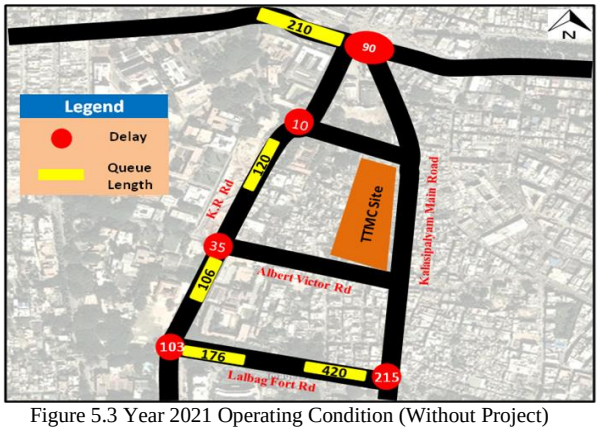

Figure 5.3 Year 2021 Operating Condition (Without Project)

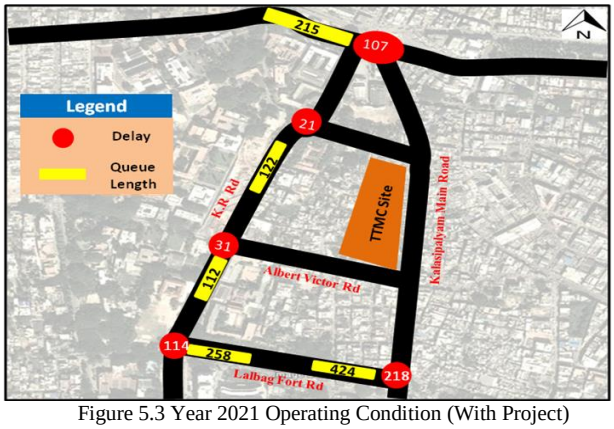

Figure 5.3 Year 2021 Operating Condition (With Project)

6 MITIGATION MEASURES

Based on the analysis, mitigation measures were proposed to improve the traffic operation conditions in the study area. The mitigation measures were proposed to reduce the overall delay, queue lengths and improve through put at the study intersections and also to reduce the impact from the project on the study roads.

The following are the mitigation measures proposed for the study area.

1. Prohibiting two way movements on the Kalasipalyam main road between Lalbag fort road and Albert Victor road and make it one way in the south bound direction.
2. A.M cross road/Kalasipalyam main road should be signalised and green signal for south bound traffic on the Kalasipalyam main road should be synchronized with the green signal at the Basappa circle.

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3. Green time for east bound traffic as well as west bound traffic at the market bus stop below the elevated Mysore flyover should be increased without changing cycle length.
4. Green time for the through movement at KIM's junction and Basappa circle should be increased for the same cycle length and signals along Lalbag fort road at KIMS junction and Basappa circle should be synchronised.
5. Right turn for private buses to enter Kalasipalyam bus stand should be prohibited on the K.R road near Victoria Hospital allowing only BMTC and KSRTC buses.
6. City market bus stop below the elevated Mysore flyover should be removed to improve the through traffic movement.

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