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# THE IMPACT OF TRANS SUMATERA TOLL ROAD DEVELOPMENT ON THE NATIONAL ROAD IN PALEMBANG CITY

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## Abstract

The toll road network in Indonesia is growing very rapidly in line with the plan of the Government of the Republic of Indonesia to build 24 toll roads on the island of Sumatra which will connect every provincial capital. The impact of toll road construction is certainly different in each region, and those who feel the greatest impact in the areas closest to them. Toll roads, both existing and planned, cause the development of local roads in the vicinity directly or indirectly. Development of road network systems can affect the movement so that network performance becomes better and increasing road capacity is not the right solution to overcome congestion on the road. This study discusses the impact of the construction of the Trans Sumatra toll road on the national road network in the city of Palembang by using four-step models and a macro simulation program, namely the software PTV Visum. The model reliability test resulted in a determinant coefficient ($R^2$) of 0.7227, which means it represents the existing traffic conditions in the field. The modeling stage is continued to predict the performance of the road network after the Trans Sumatra Toll Road operates. Prediction results show in 2036 there will be a decrease in the level of service with the increase in the V/C Ratio of National Roads that directly access the Trans Sumatra Toll Road. Adding more traffic lanes in 2031 and 2036 on these roads, will significantly improve the performance of the National Road network. The unification of the Trans Sumatra toll gate also helps to increase the level of service on the nearest road.

***Key Words:*** *PTV Visum, toll road, Trans Sumatera.*

## 1. INTRODUCTION

Transportation is a system created to meet human needs that are limited by distance and time, which is one of the most important parts of stimulating the economy. The development of a good road network system in one place has proven to increase job opportunities because it attracts investors to build new factories and companies in places that have good accessibility. An area with various kinds of potential needs to be connected by a network system that has facilities and infrastructure (modes) in the form of land, sea, and air in order to create effective and efficient movement.

One of the infrastructures that can support the transportation system is toll roads, which improves the distribution of goods and people, thereby improving socio cultural and economic condition. Toll roads, both existing and planned, cause the development of local roads in the vicinity directly or indirectly as a form of anticipation for the operation of toll roads. Changes in residential areas and land use around toll roads also encourage the development of a local road network around. The impact of toll road construction is certainly different in each region, and those who feel the greatest impact/benefits occur in nearby areas and the ability to manage speed affects vehicle queues at toll gates. Access roads must be well designed to improve land use and toll road effectiveness, so also, with new road network systems that connect between zones can affect the development movement so that network performance becomes better and reduce the traffic load. Increasing road capacity is not the right solution to overcome congestion on the road. This is, of course, based on the choice of road users to roads that have shorter travel times.

In accordance with the mandate of the Presidential Regulation of the Republic of Indonesia number 117 of 2015 concerning amendments to the Presidential Regulation number 100 of 2014 concerning the acceleration of toll road construction in Sumatra, there are 24 sections of the Trans Sumatra Toll Road which are planned to connect every provincial capital on the island of Sumatra. In South Sumatra Province, there is a toll road that connects Palembang City and Bakauheni Port in Lampung Province. This toll road is directly connected to several national roads, such as Srijaya Raya Road, Lingkar Selatan Road, Mayjen Yusuf Singadekane Road, and Ki Merogan Road. Based on the 2016 Palembang Metropolitan Road Network System Study conducted by the

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Directorate General of Highways, it is predicted that in 2019 the Srijaya Raya road section has a V/C ratio of 0.18, the Lingkar Selatan Road section has a V/C ratio of 0.42, the Mayjen Yusuf Singadekane Road section has a V/C ratio of 0.61, and Ki Merogan Road has a V/C ratio of 0.54. Taking into account the parameters above, the level of service (Level Of Service) of national roads around toll roads is already at level C, which means that drivers are limited in determining speed. The Trans Sumatra Toll Road, which will operate at the end of 2019, is predicted to increase traffic volume on national roads around the toll road and will change the distribution of vehicle movement in Palembang City.

This study, will discuss the impact of the construction of the Trans Sumatra Toll Road on the national road network in the city of Palembang by using four-step models and a macro simulation program. The results of this study are to know the impact on the national road network in Palembang City due to the operation of the Trans Sumatra Toll Road and the handling is taken to overcome these impacts. Transportation is a system created to meet human needs that are limited by distance and time which is one of the most important parts in order to stimulating the economy. The success of the development is strongly influenced by the role of transportation as a liaison for economic, political, and socio-cultural distribution. Without good and adequate transportation facilities and infrastructure, economic development can be hampered. In its implementation, transportation must be supported by a network system, facilities, and infrastructure in accordance with the concept of the National Transportation System (Sistranas).

## 2. METHODOLOGY

This research begins with the identification of problems in the field and is described in detail and sequentially in the background section. Then determine the purpose of this research to answer the existing problems. To get a good and comprehensive analysis concept, it is necessary to study the literature about previous research studies that have been carried out so that the development of this research can be carried out. The literature in this study includes literature related to the concept of road network systems, planning concepts, and transportation modeling concepts, so that the methods that will be used in this study are obtained. Then the general description of the study area was collected and the boundaries and scope of the research were determined. After that, secondary data was collected from various agencies relevant to the research, and primary data were collected using a traffic counting manual survey within six hours and a road inventory survey. The traffic counting data that has been collected will be processed according to the methods of the Indonesian Highway Capacity Manual 1997 (IHCM) to get the road peak hour traffic volume and the road inventory data will be processed to get the road capacity volume and free flow speed (FFS). Those three components will be input into PTV Visum to be modeled in Trip Generation, Trip Distribution, and Trip Assignment. Matrix origin-destination is needed to be created, and this study used the Demand Matrix Correction Method with Least Square and T-Flow Fuzzy Analysis. Least Square method provides a solution by minimizing the squared distance between the loading results and the observations. Whereas, T-Flow Fuzzy method was developed by the PTV Group based on research of Rosinowski (1994) who modeled traffic data as inaccurate values based on fuzzy theory.

The validity of the data taken must be ensured in order to represent the current conditions in the field. It used the Coefficient of Determination Test (R-Square) Method for the validation between the volumes of the highway in the model and the volumes that have been surveyed. After getting the existing model, the model needed to be forecasted, and an exponential smoothing forecast is used. Exponential smoothing is a time series forecasting method for unvariate data that can be extended to support data with a systematic trend or seasonal component. After all those steps above, the final step is running the model and analyzing the Road Level of Service (LOS). Overall, the flow chart for the stages of this research can be seen in Figure 1.

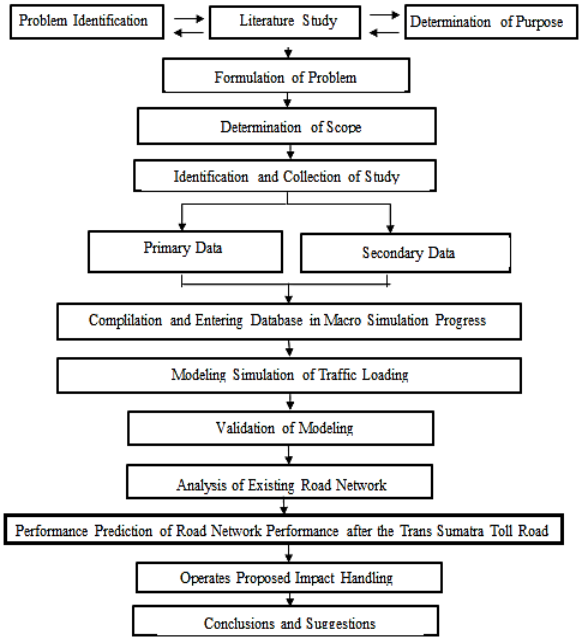



Figure 1. Research Flowchart

The formation of origin and destination matrices as the basis for trips on the network is formed using the basic matrix that has been previously surveyed in the field that shown in Figure 2.

| 23 x 23 | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Name | | Kertapati | Jakabaring | Gandus | Ilir Barat | Bukit Kecil | Plaju | Ilir Timur I | Ilir Timur II | Seberang Ulu | Kemuning | g-Alang L | Kalidoni | Ilir Barat I | Sukarami | Sako | atang Bor | Ilir Timur 3 | berang Ul | Indralaya | Banyu Asir | Mariana | njung Api- | ayu Agun |
| | | Sum | 51.00 | 36.00 | 87.00 | 70.00 | 64.00 | 33.00 | 31.00 | 36.00 | 36.00 | 41.00 | 54.00 | 38.00 | 39.00 | 81.00 | 65.00 | 27.00 | 22.00 | 24.00 | 27.00 | 35.00 | 24.00 | 22.00 | 33.00 |
| 1 | Kertapati | 46.00 | 2.00 | 1.00 | 11.00 | 6.00 | 1.00 | 1.00 | 1.00 | 3.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 2.00 | 4.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2 | Jakabaring | 36.00 | 1.00 | 0.00 | 8.00 | 3.00 | 5.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | Gandus | 48.00 | 4.00 | 1.00 | 2.00 | 8.00 | 7.00 | 1.00 | 2.00 | 1.00 | 1.00 | 2.00 | 2.00 | 1.00 | 1.00 | 3.00 | 2.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 2.00 |
| 4 | Ilir Barat | 25.00 | 1.00 | 1.00 | 2.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | Bukit Kecil | 25.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 4.00 |
| 6 | Plaju | 28.00 | 3.00 | 1.00 | 2.00 | 1.00 | 2.00 | 0.00 | 1.00 | 1.00 | 1.00 | 2.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 7 | Ilir Timur II | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 8 | Ilir Timur I | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 9 | Seberang Ulu II | 36.00 | 1.00 | 1.00 | 8.00 | 3.00 | 5.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 10 | Kemuning | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 11 | Alang-Alang Lebar | 28.00 | 2.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 5.00 |
| 12 | Kalidoni | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 13 | Ilir Barat I | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 14 | Sukarami | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 15 | Sako | 23.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 16 | Sematang Borang | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 17 | Ilir Timur 3 | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 18 | Seberang Ulu I | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 19 | Indralaya | 174.00 | 14.00 | 4.00 | 18.00 | 11.00 | 12.00 | 6.00 | 6.00 | 7.00 | 4.00 | 6.00 | 12.00 | 8.00 | 5.00 | 21.00 | 22.00 | 3.00 | 1.00 | 3.00 | 0.00 | 7.00 | 2.00 | 1.00 | 1.00 |
| 20 | Banyu Asin | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 |
| 21 | Mariana | 25.00 | 2.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 |
| 22 | Tanjung Api-Api | 22.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| 23 | Kayu Agung | 240.00 | 8.00 | 11.00 | 20.00 | 23.00 | 17.00 | 7.00 | 4.00 | 7.00 | 11.00 | 13.00 | 17.00 | 10.00 | 14.00 | 36.00 | 19.00 | 4.00 | 1.00 | 1.00 | 3.00 | 8.00 | 2.00 | 1.00 | 3.00 |

Figure 2. Prior Matrix 23x23 from Road Side Interview Survey

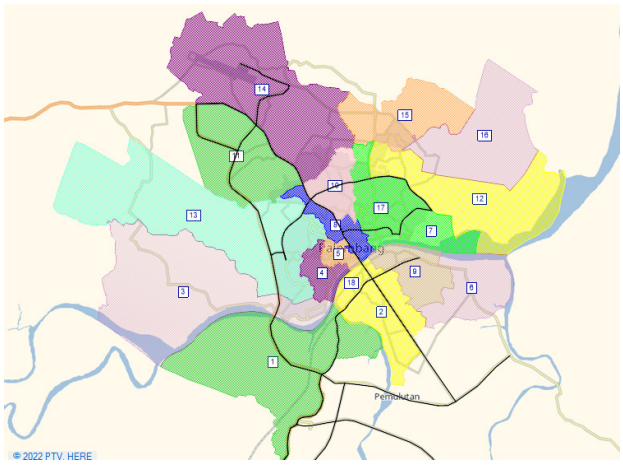



Figure 3. Road Network System and Internal Zone

The matrix is estimated using traffic data which is the result of a traffic survey that has been carried out. The estimation model is used using the procedures provided at PTV VISUM through Demand Matrix Correction with T-flow Fuzzy and Least Square Method. As for the assignment, the equilibrium assignment method is used with the following process that shown in Figure 4:

| Number: 4 | Execution | Active | Procedure | Reference object(s) | Variant/file |
|---|---|---|---|---|---|
| 1 | | ☒ | PrT assignment ... | C Car ... | Equilibrium assignment |
| 2 | | ☒ | Demand matrix correction ... | C Car ... | TFlowFuzzy |
| 3 | ▷ | ☐ | PrT assignment ... | C Car ... | Equilibrium assignment |
| 4 | | ☐ | PrT Survey Report ... | | |

Figure 4. Procedure *Sequence Running* for Visum using T-Flow Fuzzy and Equilibrium Assignment Method

The following process is the validation results of the origin-destination matrix with the Coefficient of Determination Test (R-Square) Method. The validation is made between the traffic volumes at the peak hour of the highway in the model and the volumes that have been surveyed.

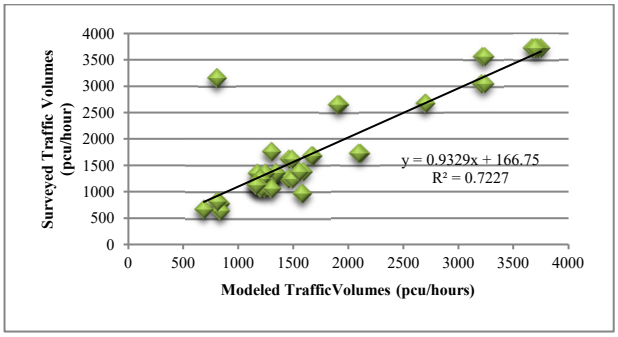



Figure 5. $R^2$ Value between the Surveyed Traffic Volumes and Modeled Traffic Volumes is more than Standard (0.67)

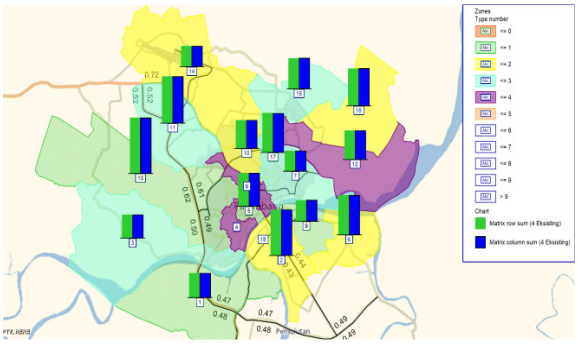
Figure 5 shows the $R^2$ of the model is 0.7227 which is higher than 0.67 which means that model is the strong one. The matrix result that has been mention shown in the Figure 6.

The magnitude of the generation and pull (pcu/hour) in each zone in Palembang can be seen in Figure 7. The zones with the most generation and attraction are industrial, office and residential areas, namely Ilir Barat, Alang-Alang Lebar, and Jakabaring sub-districts, while the zones with the lowest generation and attraction are Gandus, Ilir Timur II, and Sukarami sub-districts. The zones with the lowest generation are the zone with low population density or less economic activities.

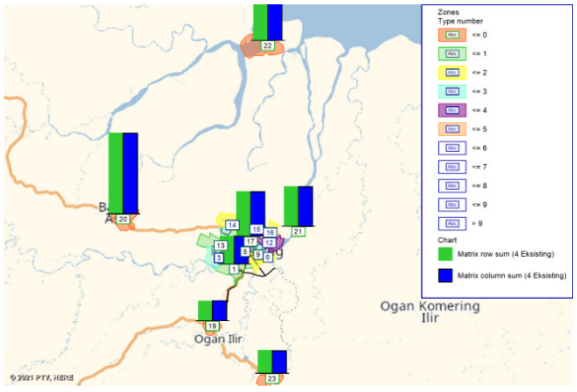
 

| 23 x 23 | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Name | | Kertapat | skabarir | Gandus | Ilir Barat | ukit Kec | Plaju | ir Timur | ir Timur | erang U | emunin | -Alang l | Kalidoni | Ilir Barat | Sukarami | Sako | atang Bo | ir Timur | erang U | ndralaya | anyu As | asar Rab | iga Sun | ara Tela |
| | | Sum | 820.20 | 1544.86 | 785.32 | 784.86 | 1114.77 | 1325.53 | 677.46 | 991.07 | 709.43 | 948.46 | 1574.79 | 972.25 | 1874.54 | 687.81 | 1031.08 | 1255.37 | 1317.45 | 1392.42 | 594.47 | 2389.72 | 1171.24 | 1086.52 | 667.18 |
| 1 | Kertapati | 820.53 | 0.00 | 126.02 | 40.77 | 40.77 | 69.52 | 74.16 | 3.75 | 24.74 | 38.37 | 18.52 | 65.60 | 22.44 | 8.00 | 18.34 | 26.89 | 22.44 | 20.85 | 62.52 | 9.41 | 41.18 | 49.96 | 26.89 | 9.41 |
| 2 | Jakabaring | 1542.78 | 124.68 | 0.00 | 100.04 | 100.04 | 77.17 | 52.11 | 12.61 | 83.27 | 42.59 | 63.17 | 100.96 | 38.81 | 19.62 | 49.34 | 71.10 | 38.81 | 62.30 | 69.39 | 100.42 | 92.46 | 55.45 | 72.36 | 116.07 |
| 3 | Gandus | 785.26 | 40.86 | 101.32 | 0.00 | 50.82 | 55.89 | 59.62 | 2.65 | 17.49 | 30.85 | 23.09 | 81.76 | 19.10 | 9.96 | 22.85 | 33.51 | 19.10 | 25.98 | 50.26 | 7.56 | 51.33 | 40.17 | 33.51 | 7.56 |
| 4 | Ilir Barat | 785.26 | 40.86 | 101.32 | 50.82 | 0.00 | 55.89 | 59.62 | 2.65 | 17.49 | 30.85 | 23.09 | 81.76 | 19.10 | 9.96 | 22.85 | 33.51 | 19.10 | 25.98 | 50.26 | 7.56 | 51.33 | 40.17 | 33.51 | 7.56 |
| 5 | Bukit Kecil | 1116.53 | 69.31 | 75.30 | 55.61 | 55.61 | 0.00 | 77.23 | 8.30 | 54.83 | 34.51 | 41.60 | 66.81 | 25.56 | 97.75 | 32.49 | 46.82 | 25.56 | 46.82 | 56.24 | 55.82 | 41.95 | 44.94 | 47.65 | 55.82 |
| 6 | Plaju | 1327.03 | 72.16 | 51.25 | 57.90 | 57.90 | 77.83 | 0.00 | 12.72 | 83.98 | 42.95 | 63.72 | 93.15 | 39.15 | 11.35 | 49.77 | 71.72 | 39.15 | 71.72 | 69.99 | 58.12 | 59.20 | 55.93 | 72.99 | 114.40 |
| 7 | Ilir Timur II | 677.06 | 3.85 | 12.35 | 2.73 | 2.73 | 8.33 | 12.66 | 0.00 | 7.74 | 5.66 | 5.87 | 9.43 | 156.40 | 13.80 | 4.59 | 113.49 | 156.40 | 113.49 | 9.22 | 9.15 | 5.92 | 7.37 | 6.73 | 9.15 |
| 8 | Ilir Timur I | 992.35 | 25.30 | 81.07 | 17.91 | 17.91 | 54.71 | 83.14 | 7.70 | 0.00 | 37.16 | 38.55 | 61.92 | 23.68 | 90.58 | 30.11 | 43.39 | 23.68 | 43.39 | 60.54 | 60.09 | 38.87 | 48.38 | 44.16 | 60.09 |
| 9 | Seberang Ulu II | 703.21 | 38.20 | 41.51 | 30.65 | 30.65 | 34.47 | 42.57 | 5.63 | 37.20 | 0.00 | 28.22 | 45.32 | 17.34 | 9.06 | 22.04 | 31.76 | 17.34 | 31.76 | 31.00 | 30.77 | 48.43 | 66.17 | 32.33 | 30.77 |
| 10 | Kemuning | 948.90 | 18.98 | 61.43 | 23.60 | 23.60 | 41.45 | 63.00 | 5.83 | 38.51 | 28.16 | 0.00 | 81.61 | 42.04 | 119.39 | 39.69 | 57.19 | 42.04 | 57.19 | 45.88 | 9.68 | 51.24 | 36.66 | 58.21 | 3.51 |
| 11 | Alang-Alang Lebar | 1572.76 | 66.49 | 98.92 | 82.69 | 82.69 | 66.30 | 89.81 | 9.33 | 61.59 | 45.03 | 81.28 | 0.00 | 67.24 | 418.26 | 14.20 | 20.83 | 67.24 | 91.48 | 73.38 | 12.31 | 31.90 | 58.64 | 20.83 | 12.31 |
| 12 | Kalidoni | 976.62 | 22.49 | 37.89 | 19.25 | 18.63 | 25.57 | 38.86 | 155.95 | 23.75 | 17.37 | 41.43 | 66.54 | 0.00 | 97.35 | 32.36 | 36.87 | 50.82 | 36.87 | 28.30 | 28.09 | 100.09 | 22.61 | 47.46 | 28.09 |
| 13 | Ilir Barat I | 1875.03 | 8.08 | 20.03 | 10.05 | 10.05 | 96.04 | 11.79 | 13.51 | 89.21 | 15.68 | 117.72 | 416.93 | 97.39 | 0.00 | 116.54 | 145.81 | 97.39 | 132.50 | 17.79 | 1.50 | 261.75 | 22.88 | 170.91 | 1.50 |
| 14 | Sukarami | 687.99 | 18.63 | 47.91 | 23.17 | 23.17 | 32.33 | 49.14 | 4.55 | 30.03 | 21.96 | 39.63 | 14.24 | 32.79 | 117.22 | 0.00 | 34.66 | 32.79 | 44.61 | 35.78 | 3.45 | 15.22 | 28.59 | 34.66 | 3.45 |
| 15 | Sako | 1022.19 | 26.92 | 60.81 | 33.97 | 33.97 | 46.58 | 70.79 | 114.63 | 43.27 | 31.64 | 57.10 | 20.88 | 37.35 | 145.49 | 34.65 | 0.00 | 37.35 | 50.82 | 51.55 | 5.06 | 22.31 | 41.19 | 50.82 | 5.06 |
| 16 | Sematang Borang | 1251.19 | 22.50 | 37.89 | 19.09 | 19.25 | 25.57 | 38.86 | 155.95 | 23.75 | 17.37 | 41.43 | 66.54 | 50.82 | 97.35 | 32.36 | 36.87 | 0.00 | 36.87 | 28.30 | 28.09 | 374.20 | 22.61 | 47.46 | 28.09 |
| 17 | Ilir Timur 3 | 1322.51 | 21.32 | 69.03 | 26.52 | 26.52 | 46.58 | 70.79 | 114.63 | 43.27 | 31.64 | 57.10 | 91.70 | 37.35 | 134.15 | 44.60 | 50.82 | 37.35 | 0.00 | 51.55 | 13.53 | 226.99 | 41.19 | 65.40 | 20.48 |
| 18 | Seberang Ulu I | 1394.43 | 62.62 | 68.04 | 50.25 | 50.25 | 56.51 | 69.78 | 9.23 | 60.97 | 31.19 | 46.26 | 74.30 | 28.42 | 10.88 | 36.13 | 52.07 | 28.42 | 52.07 | 0.00 | 50.44 | 412.59 | 40.61 | 52.99 | 50.44 |
| 19 | Indralaya | 579.78 | 9.28 | 100.16 | 7.45 | 7.45 | 55.25 | 58.94 | 9.03 | 59.62 | 30.49 | 3.38 | 11.98 | 27.79 | 1.46 | 3.35 | 4.91 | 27.79 | 8.80 | 49.69 | 0.00 | 7.52 | 39.70 | 4.91 | 50.82 |
| 20 | Banyu Asin | 2391.01 | 41.59 | 113.17 | 51.73 | 51.73 | 41.48 | 60.69 | 5.83 | 38.53 | 47.49 | 50.84 | 31.79 | 91.17 | 261.65 | 14.98 | 21.97 | 374.30 | 225.83 | 408.48 | 7.70 | 0.00 | 326.41 | 115.95 | 7.70 |
| 21 | Pasar Rabu | 1174.72 | 49.48 | 53.77 | 39.70 | 39.70 | 44.65 | 55.14 | 7.30 | 48.18 | 65.82 | 36.55 | 58.71 | 22.46 | 27.96 | 28.55 | 41.14 | 22.46 | 41.14 | 40.15 | 39.86 | 330.27 | 0.00 | 41.87 | 39.86 |
| 22 | Dermaga Sungsang | 1087.57 | 27.32 | 70.24 | 33.97 | 33.97 | 47.40 | 72.03 | 6.67 | 44.03 | 32.19 | 58.10 | 20.88 | 48.07 | 171.84 | 34.65 | 50.82 | 48.07 | 65.39 | 52.46 | 5.06 | 117.45 | 41.92 | 0.00 | 5.06 |
| 23 | Muara Telang | 682.08 | 9.28 | 115.41 | 7.45 | 7.45 | 55.25 | 114.80 | 9.03 | 59.62 | 30.49 | 11.79 | 11.98 | 27.79 | 1.46 | 3.35 | 4.91 | 27.79 | 31.59 | 49.69 | 50.82 | 7.52 | 39.70 | 4.91 | 0.00 |

Figure 6. Existing Origin-destination 23 X 23 Matrix



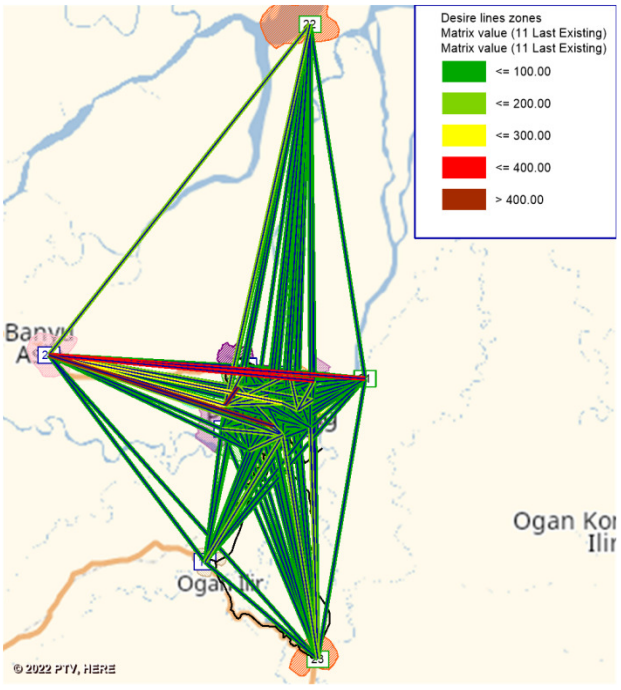
(a)



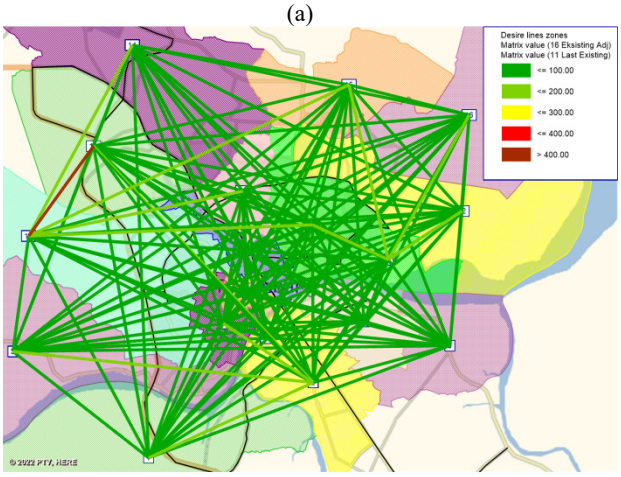

(b)

Figure 7. (a) Existing Generation (b) Atttractiveness

It can be inferred from Figure 7 and Figure 8 that Banyuasin has the highest origin-destination movement. It happened because Banyuasin is not only an urban city but also a strategic area which is directly connected with another province. While Kayu Agung and Indralaya are the zones with the lowest origin destination. It maybe because the matrix was made for tracking travel by toll road, that is why the biggest travel focus on out of town trip.




(a)




(b)

Figure 8. (a) Entire Desire Line in Palembang City Model
(b) Internal Zone Desire Line Model

The trip assignment results using the origin-destination matrix that has been developed previously, are used to analyze the degree of saturation or volume capacity ratio on each modeled road segment in Palembang. As previously explained, trip assignment is carried out using the equilibrium method. From the Figure 9 it can be seen from the picture below that the Level of Service in the existing condition of the roads around the Palembang - Indralaya Toll Road is already at Level of Service (LOS) C and B (shown in yellow for C). and green for B) with VCR > 0.45. These include Soekarno Hatta Rd with VCR 0.62, Alamsyah Ratu Perwiranegara Rd with VCR 0.50, Yusuf Singadekane Rd with VCR 0.47, Ki Merogan Rd with VCR 0.43 and Lingkar Selatan Rd with VCR 0.47, 0.48 and 0.49. It indicates that the center of the city, which is the center of the economy is more crowded than the sub-urban area. But, the road closure to the toll road is an arterial road with the industrial and commercial areas along the way. That's why those roads have LOS of C.

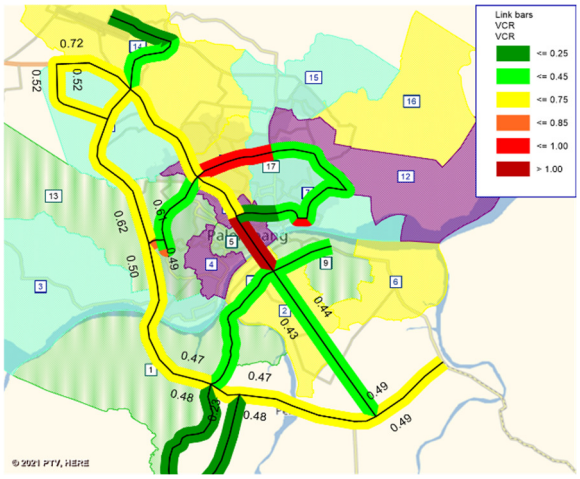
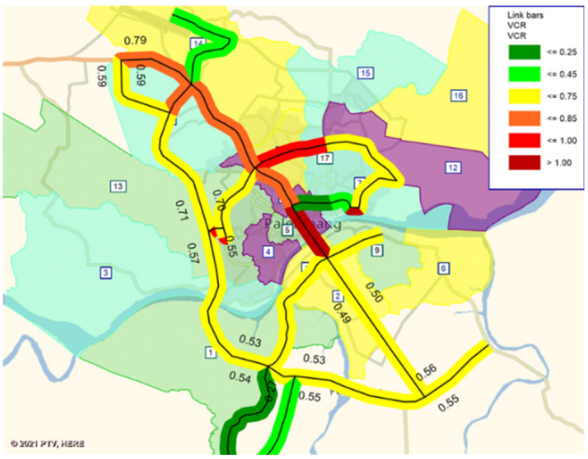
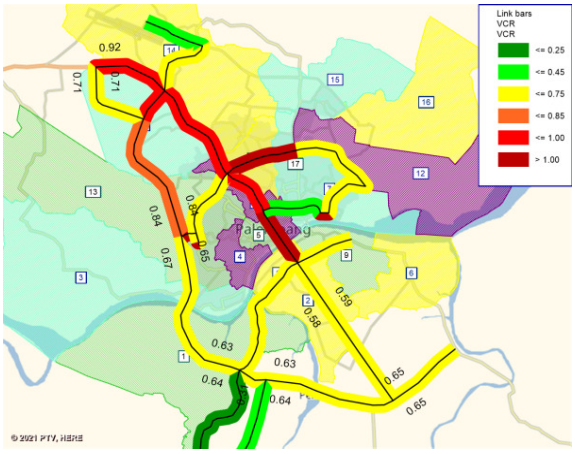



Figure 9. Results of Existing Traffic Imposition

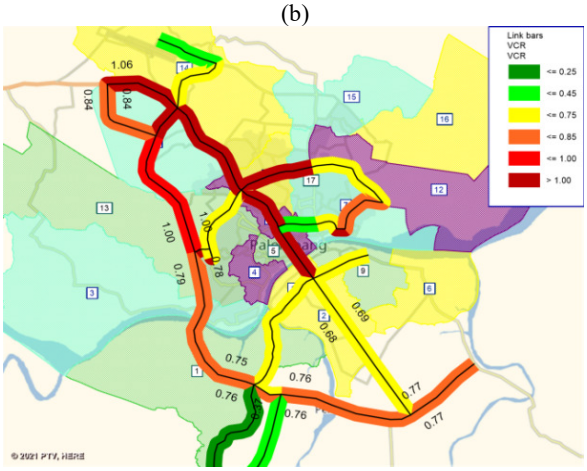
To find out the national road development needed due to the Palembang-Indralaya toll road, we need to know the performance of the road network in a do nothing and do something. Where the handling plan is carried out in 5 years, 10 years, and 15 years after the toll road construction is carried out. The performance of the road network in a do nothing in the first 5 years (2026) and the next 10 years (2031) and 15 years after (2036) after the existence of the toll road is obtained as follows.




(a)




(b)




(c)

Figure 10. Traffic Performance *Do Nothing* 2026 (a), 2031 (b), and 2036 (c)

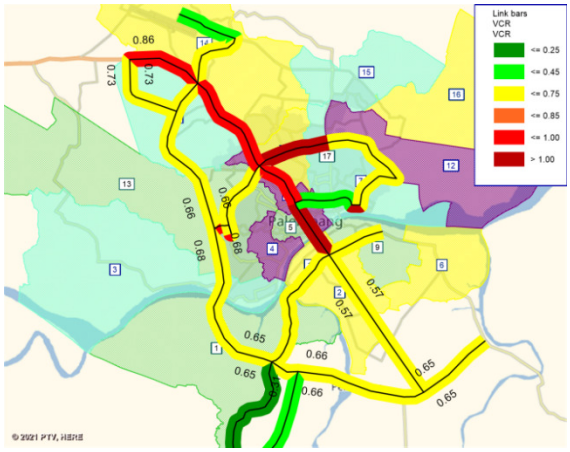
It can be seen from the picture above that the *Level Of Service* did *nothing* in 2026, 2031, and 2036 of the roads around the Palembang - Indralaya Toll Road increased with LOS C and D (shown in yellow for LOS C and red for LOS D). Handling the road network is done by looking at the do nothing condition. Where to walk around / to the toll gate location with VCR > 0.75 or with LOS D then handling must be done.

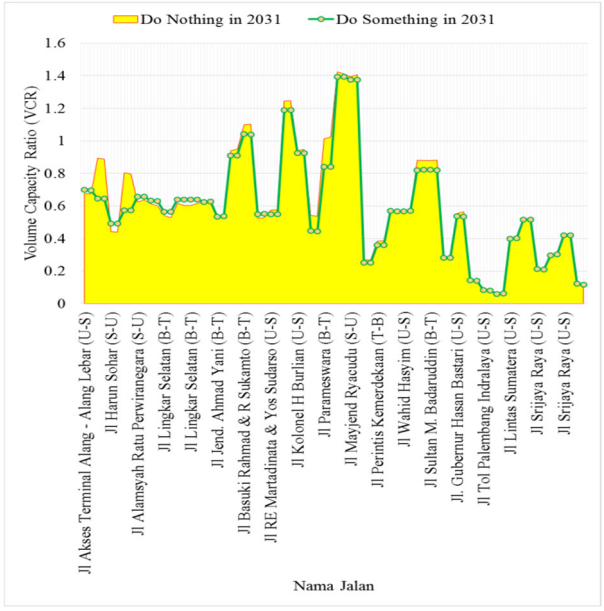
Therefore, it is proposed to *do something* as follows:

1) Soekarno Hatta Rd with a VCR of 0.84 in 2031. Therefore, *do something* for the operational year in 2031;
2) Alamsyah Ratu Perwiranegara Rd has a VCR of 0.79 in 2036, *do something* for the operational year in 2036;
3) Mayjen. Yusuf Singadekane Rd has a 0.75 VCR in 2036, *do something* for the operational year in 2036;
4) Lingkar Selatan Rd already has a VCR average of 0.765 in 2036, *do something* for the operational year in 2036.

The *do something* is 2031, with the handling in 2031 namely widening on Soekarno Hatta Rd 4/2 D 12.96 meters to 6/2 UD 19.96 meters, the performance of the road network is shown in the comparison in Figure 11 as follows:



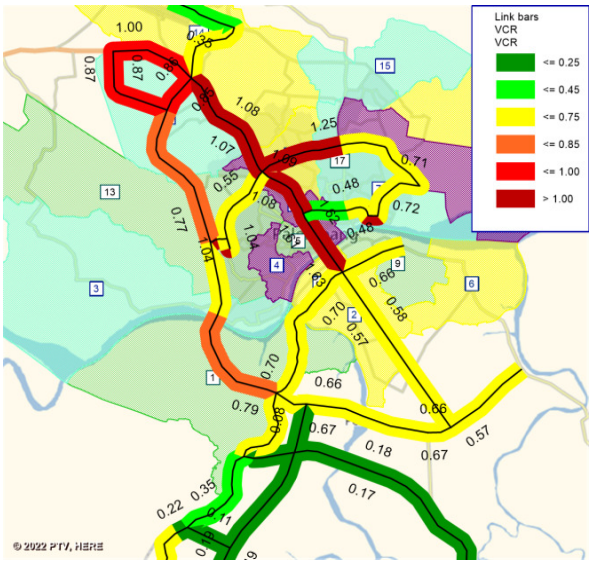

(a)



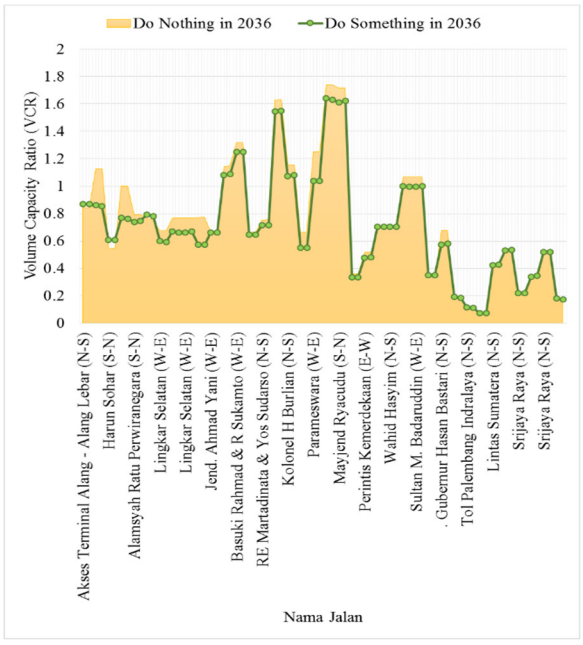

(b)

Figure 11. (a) Traffic Performance Maps *Do Something* 2031 (b) Graphic Comparison of Do Nothing and Do Something in 2031

While the do something condition in 2036, with the handling in 2036, namely the widening of Letjen. H. Alamsyah Ratu Perwiranegara, Mayjen Jendral Yusuf Singadekane, and the Lingkar Selatan Road from 4/2 D to 6/2 D with a width of 7 meters, the road network performance is shown in the following Figure 12.




(a)




(b)

Figure 12. (a) Traffic Performance Maps *Do Something* 2036 (b) Graphic Comparison of Do Nothing and Do Something in 2036

It can be seen from the picture above LOS in the condition of *doing something* in 2036 from the streets around the Palembang - Indralaya Toll Road. It can be seen that Letjen. H. Alamsyah Ratu Perwiranegara Road, Mayjen Yusuf Singadekane Road, Lingkar Selatan Road and the surrounding roads have improved performance. The unification of the toll gates is

proposed to be one at the Palembang Toll Gate. The unification of this toll gate does have a consequence where it is necessary to build an interchange that connects the Kapal Betung Toll Road and the Palindra Toll Road as shown in image below. However, this proposal can reduce the traffic volume of the intersection under the Kertapati Fly Over and increase connectivity for toll road users. This is because users of the Palindra Toll Road can immediately move to the Kapal Betung Toll Road without the need to leave the toll road and vice versa. In addition, the benefit of this proposal is that the performance of Srijaya Raya Road has increased, from LOS C to LOS B as can be seen in image below.

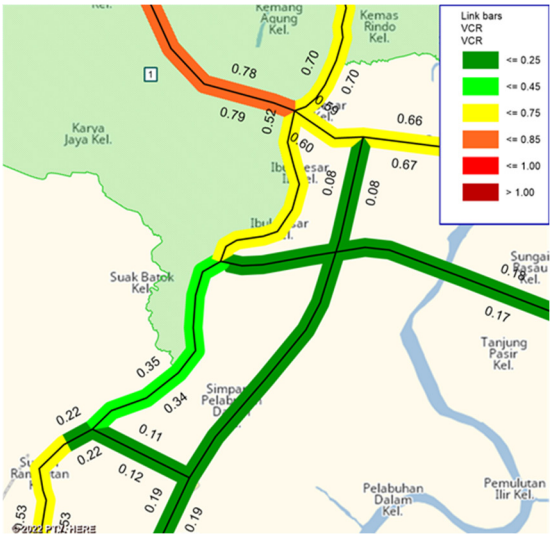


Figure 13. Condition of No Toll Gate Integration in 2036

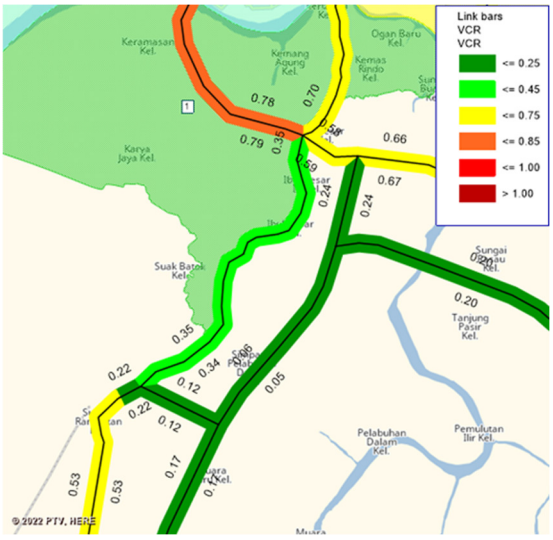


Figure 14. Conditions with Toll Gate Unification in 2036

Based on the results of running programs that have been carried out. Both Do Nothing and Do Something resulted in the National Road Network development program in Palembang City after the Toll Road Construction, which can be displayed in the handling matrix as Table 1 below:

Table 1. Matrix of Final Handling of the National Road Network in Palembang City after Toll Road Construction

| No | Road names that affected by toll road | Year of handling | | |
|---|---|---|---|---|
| | | 2026 | 2031 | 2036 |
| 1 | Road widening on Soekarno Hatta Rd from 4/2 D 12.96 m to 6/2 UD 19.96 m with 7 m width | | x | |
| 2 | Road widening on Letnan H. Alamsyah Ratu Perwiranegara Rd from 4/2 D 11.91 m to 6/2 UD 18.91 m with 7 m width | | | x |
| 3 | Road widening on Mayjen Yusuf Singadekane Rd from 4/2 D 14.56 m to 6/1 UD 21/56 m with 7 m width | | | x |
| 4 | Road widening on Lingkar Selatan Rd from 4/2 D 12/39 m to 6/2 UD 19.39 m with 7 m width | | | x |

## 3. CONCLUSION AND SUGGESTION

Traffic movement in Palembang City in the study of the development of the national road network in Palembang City due to the operation of the Trans Sumatra Toll Road, it can be seen that the formation of zones is represented by 23 zones with 18 internal zones represented by 18 sub-districts in Palembang City and 5 external zones represented by sub-districts or sub-districts. surrounding districts. The zones with the lowest seizures were Indralaya (684 pcu/hour) and Ilir Timur II (789 pcu/hour) and the highest awakenings were in the Ilir Barat zone I (2212 pcu/hour) and Banyuasin zone (2821 pcu/hour). While the majority of mode choices are motorcycles (74%), cars (15%) while the rest are trucks (5%), buses (4%), and *unmotorized* (2%).

The performance of the road network as indicated by the LOS value, in the existing condition, the roads around the Palembang - Indralaya Toll Road are already at *Level of Service* (LOS) C and B. Then the *forecasting* shows that these roads require handling in 10 years future and the next 15 years. Details of road network conditions around toll roads are shown as follows:

1) Soekarno Hatta Rd with an existing VCR of 0.62, requires handling for operations in 2031 on a 0.84 VCR.
2) Letnan H. Alamsyah Ratu Perwiranegara Rd with an existing VCR of 0.50, requiring

treatment for operations in 2036 on a 0.79 VCR.

3) Mayjen Yusuf Singadekane Rd with existing 0.47 VCR, requires handling for operation in 2036 on 0.75 VCR.
4) Ki Merogan Rd with an existing VCR of 0.43, will not require treatment for the next 15 years.
5) Lingkar Selatan Rd with existing VCRs around 0.47, 0.48, and 0.49, requires handling for operations in 2036 on 0.765 VCRs.

The Handling Solutions offered in this study are carried out in 2 years, namely in 2031 (10 years) and 2036 (15 years). Where *details* of the handling carried out are as follows:

1) Road widening on Soekarno Hatta Rd from 4/2 D 12.96 m to 6/2 UD 19.96 m with 7 m width, with widening carried out in 2031
2) Road widening on Letnan H. Alamsyah Ratu Perwiranegara Rd from 4/2 D 11.91 m to 6/2 UD 18.91 m with 7 m width, with widening carried out in 2036.
3) Road widening on Mayjen Yusuf Singadekane Rd from 4/2 D 14.56 m to 6/1 UD 21/56 m with 7 m width, with the widening done in 2036.
4) Road widening on Lingkar Selatan Rd from 4/2 D 12/39 m to 6/2 UD 19.39 m with 7 m width, with widening carried out in 2036.
5) The unification of the Keramasan toll gate and the Palembang toll gate into one at the Palembang toll gate. This handling improves the connectivity of the Palindra Toll Road and Kapal Betung Toll Road and increases the LOS of Srijaya Raya Road from LOS C to LOS B.

Based on the analysis and discussion that has been carried out, suggestions for this study include:

1) There is a need for further studies on the development of areas affected by land use in the city of Palembang due to the limited data currently available
2) Additional handling is needed that must be synchronized with the local government so that the forecasting carried out can be according to other developments that will be carried out in the city of Palembang. In future research, it is hoped that multimodal modeling can be developed, namely private vehicles and public transportation.

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