Traffic Volume and Toll Revenue Forecast Analysis of the reconstruction and expansion project of the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway

Technical report

SHENZHEN URBAN TRANSPORT PLANNING CENTER CO.,LTD

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京港澳高速公路广州火村至东莞长安段及广佛高速公路广州黄村至火村段改扩建项目交通量及路费收入预测分析

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1 Overview

1.1 Project background

The Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section), is the first expressway connecting Guangzhou, Dongguan and Shenzhen in Guangdong Province, China. It is a part of Beijing-Hong Kong-Macao Expressway and Shenyang-Haikou Expressway.

The Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) was planned in the 1980s, started construction in 1992, completed acceptance on July 1, 1996, and officially opened on July 1, 1997. At present, the current road of the Expressway has six lanes in both directions, and the toll period is from 1997 to 2027. It is jointly invested and constructed by Guangdong Highway Construction Co., Ltd. and Hong Kong Hopewell China Development (Superhighway) Limited.

The Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) starts from Huangcun Interchange in Tianhe District of Guangzhou in the north and ends at Huanggang Port in Futian District of Shenzhen in the south, with a total length of 122.8 kilometers and a design speed of 120 kilometers per hour.

Figure 1-1 Location Map

Through analysis, it can be predicted that the daily traffic capacity of a single lane is 12,000 ~ 16,500 PCU/d, the traffic service level does not exceed Grade III, and the traffic service level of expressways in the core area of Guangdong-Hong Kong-Macao Greater Bay Area is expected to reach Grade IV or above.

At the same time, in recent years, the urban construction of Guangzhou and Dongguan and the rapid development of the surrounding areas of the project, as well as the unclear freight subsidy policy, in order to more comprehensively understand and grasp the traffic volume of the reconstruction and expansion project of the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway (hereinafter referred to as the Approved Road Section R&E Project) in the coming years, it is urgent to carry out a new round of traffic volume forecasting.

This round of prediction mainly considers the economic development,

the optimization of epidemic prevention and control policies and other factors. Based on the traffic volume and toll income prediction in the existing feasibility report, the traffic flow and toll income of the project are predicted to objectively evaluate the investment value of the project and provide the basis for the asset evaluation of the project.

1.2 Analysis of prediction results over the years

Located in the core area of Guangdong-Hong Kong-Macao Greater Bay Area, the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) is the "golden passage" connecting Guangzhou, Dongguan, Shenzhen and Hong Kong. Since its completion and opening to traffic for more than 20 years, the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) has increased rapidly. According to the operation toll data of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) has increased from 66,000 vehicles per day when it was officially opened to traffic in 1997 to 638,000.The average daily traffic volume in 2023 has reached about 700,000 vehicles. It is of great significance to promote the rapid economic development of Guangdong and Hong Kong, change the investment environment in the Mainland and maintain the prosperity and stability of Hong Kong.

1.3 Forecast years

With the full liberalization of epidemic prevention and control in March 2023, the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) began to rise gradually. Selecting 2023 as the forecast base year is the latest year data on the one hand, and on the other hand, it can effectively reduce the interference of external factors on the forecast model and improve the accuracy of the

forecast results. Therefore, 2023 is selected as the prediction base year for this prediction, and the project is planned to be completed and open to traffic by the end of 2028, so the characteristic years selected for the prediction of traffic volume are 2025, 2029, 2030, 2035, 2040, 2045 and 2052, and the prediction period is from 2024 to 2052.

1.4 Predictive thinking

Traffic model is a mathematical model to simulate the characteristics of travel, mainly including the simulation and evaluation model of regional travel volume, travel spatial distribution, travel mode division and road traffic conditions. Through the simulation and analysis of travel, we can understand the relationship between travel and road traffic and land use, correctly analyze the future traffic demand, and provide the basis for design.

Considering that the traffic of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) affects a large area and the traffic network and traffic demand are complex, in order to accurately grasp the short-term, medium-term and long-term traffic demand conditions, it is necessary to establish a comprehensive traffic model for Guangzhou and Dongguan to analyze and predict the traffic demand from a larger scope. The overall work flow is shown in Figure 1-3 below. The project adopts four-stage traffic model to predict the traffic volume of the Approved Road Section R&E Project, and calculates the corresponding toll revenue based on the predicted traffic volume and toll standards.

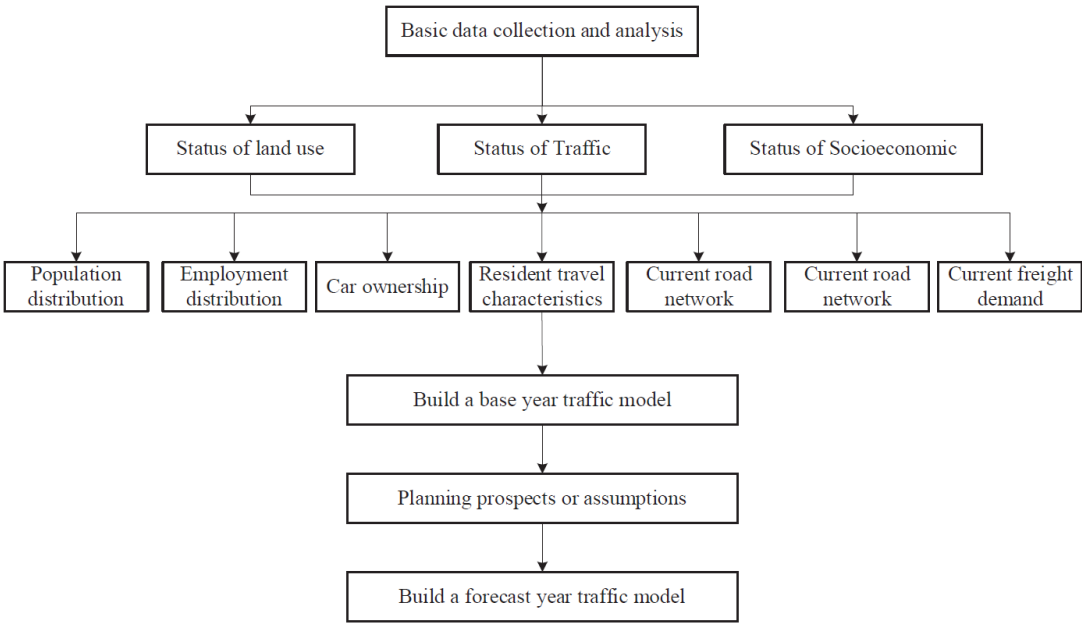

Figure 1-2 Flow chart of prediction method

1.5 Forecast basis

The main basis of this appraisal includes:

(1) Expressway Network Planning of Guangdong Province (2020-2035)

(2) Statistical yearbooks of Guangzhou and Dongguan over the years

(3) Overall planning of land and space of Guangzhou and Dongguan (2020 ~ 2035)

(4) White Paper on Urban Traffic of Guangzhou and Dongguan

(5) District planning, group planning and statutory plans of districts in Guangzhou and Dongguan

(6) Public transport planning of Guangzhou and Dongguan

(7) Rail transit network planning and construction planning of Guangzhou and Dongguan

(8) Layout planning of national railway in Guangzhou and Dongguan

(9) Trunk road network planning of Guangzhou and Dongguan

(10) Investigation on all previous trips of residents in Guangzhou and Dongguan

(11) Traffic volume of the Approved Road Section over the years

(12) Notice of Guangdong Provincial Department of Transportation, Guangdong Provincial Development and Reform Commission and Guangdong Provincial Department of Finance (YJF [2019] No.830) on Adjustment of Toll Charging Method for Expressway Vehicles

(13) Other relevant statistical data, traffic survey data and research reports

2 Planning prospect analysis

2.1 Economic development forecast

The premise of elasticity coefficient method is to determine the future economic growth rate of each traffic zone in the project affected area. Its value is generally determined on the basis of analyzing the historical data of economic development in the affected area and comparing with the economic development planning of each area.The determination of the economic growth rate in this forecast is based on the analysis of the historical data of economic growth in various regions, in combination with the "14th Five-Year Plan" of various regions and the work reports of the municipal governments in the affected regions, and with reference to the economic growth rate adopted in some relatively new preliminary research reports on highway transportation that have passed the expert review and have been approved by experts.

The economic growth rate of each traffic zone in each period in the future is shown in the following table.

Table 2-1 Economic Growth Ratio of Each Region in the Next Year

Name	2023-2025	2026-2030	2031-2040	2041-2052
Guangzhou City	6.0%	5.3%	4.0%	2.5%
Dongguan City	6.0%	5.5%	3.9%	2.5%

2.2 Elastic coefficient analysis of main influence zone

(1) Historical elastic coefficient

This report analyzes the elasticity coefficient of passenger and freight cars based on passenger and freight traffic volume as an indicator. It mainly analyzes the passenger and cargo elasticity coefficients of Guangdong Province, Guangzhou City and Dongguan City, as shown in the following table.

Table 2-2 Economic and Traffic Development of Guangdong Province from 1997 to 2020

Year	Growth rate of indicators				Elasticity to GDP		
	GDP	Van	Passenger	Truck	Van	Pass	Truck
1997	11.20%	6.67%	13.06%	1.72%	0.6	1.17	0.15
1999	10.10%	5.86%	11.65%	0.70%	0.58	1.15	0.07
2000	11.50%	20.56%	22.00%	19.15%	1.79	1.91	1.67
2001	10.50%	11.03%	16.07%	5.94%	1.05	1.53	0.57
2005	13.80%	23.54%	24.51%	21.73%	1.71	1.78	1.58
2006	16.96%	15.04%	22.25%	0.03%	0.89	1.31	0.01
2009	9.70%	14.82%	18.11%	8.35%	1.53	1.87	0.86
2010	12.40%	18.67%	20.93%	10.73%	1.51	1.69	0.87
2011	10.00%	16.41%	18.44%	8.40%	1.64	1.84	0.84
2012	8.20%	13.86%	15.60%	6.22%	1.69	1.9	0.76
2013	8.50%	13.56%	15.18%	5.32%	1.6	1.79	0.63
2014	8.54%	13.21%	15.29%	1.63%	1.55	1.79	0.19
2015	7.38%	10.52%	12.79%	-3.80%	1.43	1.73	-0.52
2016	7.52%	13.87%	15.12%	4.64%	1.51	1.64	0.5
2017	7.49%	13.14%	13.89%	7.09%	1.75	1.85	0.95
2018	6.81%	11.72%	11.78%	11.18%	1.72	1.73	1.64
2019	6.15%	10.33%	10.03%	9.22%	1.68	1.63	1.50
2020	2.25%	7.48%	7.26%	8.82%	3.32	3.22	3.92
1995-2000	10.90%	10.56%	14.54%	7.15%	0.97	1.33	0.66
2001-2005	13.25%	17.33%	23.73%	9.00%	1.31	1.79	0.68
1995-2005	12.20%	14.27%	19.56%	8.18%	1.17	1.6	0.67
2005-2010	13.11%	15.74%	20.53%	4.42%	1.2	1.57	0.34
2010-2015	8.48%	13.38%	15.36%	4.44%	1.58	1.81	0.52
2015-2020	6.03%	11.28%	11.58%	8.17%	1.87	1.92	1.36

Note: Data are from the Statistical Yearbook of Guangdong Province of each year, in which the GDP index is calculated at comparable prices, the same as the following table.

Table 2-3 Economic and Traffic Development of Guangzhou from 1997 to 2020

Year	Growth rate of indicators				Elasticity to GDP		
	GDP	Van	Passenger	Truck	Van	Pass	Truck
1997	13.39%	5.01%	13.41%	-3.19%	0.37	1	-0.24
1999	13.18%	14.96%	19.96%	8.91%	1.14	1.52	0.68
2000	13.35%	13.26%	18.98%	5.66%	0.99	1.42	0.42

2001	12.74%	10.78%	16.52%	2.19%	0.85	1.3	0.17
2005	12.92%	11.59%	18.80%	-5.17%	0.9	1.46	-0.4
2006	14.80%	16.87%	20.81%	4.35%	1.14	1.41	0.29
2009	11.70%	14.41%	18.44%	7.14%	1.23	1.58	0.61
2010	13.20%	19.28%	27.84%	14.08%	1.46	2.11	1.07
2011	11.30%	16.19%	19.16%	9.26%	1.43	1.7	0.82
2012	10.50%	9.90%	10.53%	6.09%	0.94	1	0.58
2013	11.60%	5.24%	4.84%	8.08%	0.45	0.42	0.7
2014	8.60%	3.80%	3.43%	6.29%	0.44	0.4	0.73
2015	8.40%	0.49%	1.26%	-4.56%	0.06	0.15	-0.54
2016	7.60%	1.12%	1.15%	-0.46%	0.14	0.14	-0.06
2017	6.70%	4.80%	3.62%	13.17%	0.72	0.54	1.97
2018	6.00%	7.22%	6.39%	12.66%	1.20	1.06	2.11
2019	6.92%	8.94%	7.80%	11.65%	1.29	1.13	1.68
2020	2.71%	6.89%	6.49%	8.95%	2.55	2.40	3.31
1995-2000	13.26%	11.22%	16.76%	4.88%	0.85	1.26	0.37
2001-2005	13.82%	15.11%	20.18%	5.24%	1.09	1.46	0.38
1995-2005	13.57%	13.36%	18.65%	5.08%	0.98	1.37	0.37
2005-2010	14.99%	16.49%	18.90%	4.28%	1.1	1.26	0.29
2010-2015	9.99%	4.35%	5.31%	6.66%	0.44	0.53	0.67
2015-2020	5.97%	5.76%	5.06%	9.07%	0.96	0.85	1.52

Table 2-4 Economic and Traffic Development of Dongguan City from 1996 to 2020

Year	Growth rate of indicators				Elasticity to GDP		
	GDP	Van	GDP	Van	GDP	Van	GDP
1996 年	16.10%	4.90%	16.02%	-0.24%	0.3	1	-0.02
1999 年	17.90%	11.57%	16.63%	7.82%	0.65	0.93	0.44
2000 年	17.90%	20.85%	25.03%	17.49%	1.17	1.4	0.98
2001 年	18.00%	19.63%	28.74%	11.86%	1.09	1.6	0.66
2005 年	19.40%	27.16%	27.73%	26.07%	1.4	1.43	1.34
2006 年	20.39%	21.28%	30.62%	1.86%	1.04	1.5	0.09
2009 年	5.30%	13.39%	17.21%	0.76%	2.53	3.25	0.14
2010 年	10.30%	15.74%	18.28%	4.13%	1.53	1.77	0.4
2011 年	8.00%	15.27%	17.31%	4.64%	1.91	2.16	0.58
2012 年	6.10%	13.72%	15.61%	2.69%	2.25	2.56	0.44

2013 年	9.80%	15.18%	16.96%	3.02%	1.55	1.73	0.31
2014 年	6.59%	12.32%	14.70%	-6.12%	1.87	2.23	-0.93
2015 年	6.69%	18.37%	20.52%	-1.99%	2.74	3.06	-0.3
2016 年	7.95%	17.27%	18.79%	-1.23%	1.96	2.13	-0.14
2017 年	8.78%	22.89%	24.41%	4.70%	2.61	2.78	0.53
2018 年	7.46%	12.16%	12.41%	8.51%	1.63	1.66	1.14
2019 年	7.36%	9.99%	9.87%	8.34%	1.36	1.34	1.13
2020 年	1.09%	5.39%	4.98%	11.32%	4.96	4.57	10.41
1995-2000	17.89%	13.49%	22.39%	8.22%	0.75	1.25	0.46
2001-2005	19.00%	20.57%	31.02%	11.02%	1.08	1.63	0.58
1995-2005	18.44%	22.20%	26.63%	9.61%	1.2	1.44	0.52
2005-2010	12.17%	17.76%	23.50%	2.04%	1.46	1.93	0.17
2010-2015	7.36%	15.99%	18.00%	-3.11%	2.19	2.47	-0.46
2015-2020	6.49%	13.38%	13.89%	6.24%	2.06	2.14	0.96

By comparing the above tables, we can see that the elasticity coefficient of passenger cars in Guangdong is greater than that of freight cars. Before the purchase restriction of cars in Guangdong, Dongguan and Guangzhou, the elasticity coefficient of passenger cars is basically around 1.5; Before 2018, the elasticity coefficient of trucks was basically between 0.5 and 0.8. Since 2018, due to the rapid development of Guangdong's port and postal industry, the number of trucks has increased rapidly, and the elasticity coefficient is between 1 and 1.5.

(2) Prediction of elastic coefficient

According to the experience of some foreign developed countries, in the high-speed growth stage of economic development, the traffic volume will increase rapidly, its growth rate is higher than economic growth rate, and the elasticity coefficient is greater than 1. With the rapid development of economy, when the economic level reaches a certain height, the growth rate of transportation slows down and almost synchronizes with the economic growth, and the elasticity of transportation is close to 1. After that, the transport growth rate is lower than economic growth rate, and the

transport elasticity is less than 1.

In order to realize the orderly growth of the number of cars and alleviate urban traffic congestion, Guangzhou has implemented the incremental control and management of cars. Since July 1, 2012, Guangzhou has implemented the management of incremental quota indicators for small and medium-sized buses, and the incremental quota for small and medium-sized buses in the city is 120000 vehicles per year. According to the Guangzhou Statistical Yearbook, the number of civilian automobiles in Guangzhou was 2.238 million in 2015 and 2.981 million in 2020, with an average annual growth rate of 5.21% from 2015 to 2020.

Considering the above factors, on the basis of consulting relevant experts, combining with other feasibility reports, and considering the impact of current policy factors such as limited purchase of passenger cars in Guangzhou, the elasticity coefficient of future traffic volume growth of various types of vehicles in the project affected area is proposed as follows.

Table 2-5 Passenger and Cargo Elasticity Coefficient in Future Years

Area	Category	2023~2025	2026~2030	2031~2040	2041-2052
Dongguan	Passenger car	0.63	0.55	0.48	0.40
	Truck	0.45	0.41	0.35	0.27
Guangzhou	Passenger car	0.58	0.46	0.42	0.38
	Truck	0.4	0.37	0.31	0.25

According to the predicted economic growth rate and elasticity coefficient, the growth rate of highway traffic in large areas is predicted as follows.

Table 2-6 Passenger and freight growth coefficient in the next year

	Average annual growth rate	2023-2025	2026-2030	2031-2040	2041-2052
Passenger car	Guangzhou	5.05%	3.52%	1.60%	0.48%

	Dongguan	5.49%	4.43%	1.80%	0.51%
Truck	Guangzhou	3.48%	3.25%	1.18%	0.34%
	Dongguan	3.92%	3.25%	1.31%	0.34%

2.3 Population planning of cities along the line

(1) Territorial space planning of Guangzhou

Vision: a beautiful and livable flower city and a dynamic global city.

Nature of the city: The capital of Guangdong Province, a national historical and cultural city, a national central city and a comprehensive gateway city, a core engine for the development of Guangdong-Hong Kong-Macao Greater Bay Area regions, a national commercial and trade center, a comprehensive transportation hub, a science, technology, education and culture center, and an international metropolis.

Size of urban population: In 2035, the planned permanent population is about 20 million, and the planned management population is 25 million.

(2) Population development planning of Dongguan City

According to the population development plan of Dongguan City, Dongguan City will implement an active population control policy to keep the population growth in line with the economic society, resources and environment, and achieve steady growth with quality.

Size of urban population: In 2025, the permanent population will reach 9.6 million; in 2030, the permanent population will reach 10.2 million; and in 2035, the permanent population will reach 10.8 million.

2.4 Transportation development planning

2.4.1 Road traffic planning

2.4.1.1 Guangdong Province

The overall goal of Guangdong Province is to build a safe and reliable expressway network with scientific layout, comprehensive coverage and perfect functions by 2035. The comprehensive three-dimensional

transportation network will be more perfect, and the transportation development will be more coordinated with the land space and ecological environment, so as to effectively support the construction of a strong transportation country and the implementation of major provincial strategies.

Planning and layout: With "12 vertical lines, 8 horizontal lines, 2 ring lines and 16 radial lines" as the main framework and 70 densification lines and connecting lines as the supplement, a network of expressways will be formed with the Pearl River Delta as the core, coastal cities, ports, airports and railway hubs as the key points, supporting the deep cooperation and development of Guangdong-Hong Kong-Macao Greater Bay Area, leading the development of the eastern and western wings and the coastal economic belt, and quickly reaching the surrounding provinces and regions. By the end of the planning period (2035), the total mileage of expressways in the province will reach about 15000 kilometers. The overall layout of the expressway network in Guangdong Province is as follows.

Figure 2-1 Expressway Construction Planning Map of Guangdong Province

2.4.1.2 Guangzhou City

Guangzhou Expressway Network Planning (2018-2035) is partially

planned to form an expressway network pattern of "4 rings, 23 radial lines, 3 vertical and 9 horizontal lines and 2 densification lines" under the framework of the existing "four rings and 19 radiations" network, with a total planned mileage of about 1750 km. Among them, 40 projects have been completed and opened to traffic, 7 projects are under construction, 4 projects are prepared in the near future, and 10 projects are planned in the long term. The expressway network pattern of "4 rings, 23 radial, 3 vertical, 9 horizontal and 2 densification lines" includes:

(1) Four rings

First Ring Road: Guangzhou Inner Ring Road; Second Ring Road: Guangzhou Ring Expressway (North Ring Expressway + Southeast West Ring Expressway); Third Ring Road: Guangzhou Ring Expressway (North Second Ring Expressway + East Second Ring Expressway + Guangzhou-Gaoming Expressway + West Second Ring Expressway); Fourth Ring Road: Pearl River Delta Ring Expressway (Zhaoqing-Huadu Expressway + Airport North Extension Line + North Third Ring Expressway + Zengcheng-Dongguan-Shenzhen Expressway + Foshan-Dongguan Expressway + Humen Second Bridge + South Second Ring Expressway).

(2) Twenty-three radial lines

First radial line: Guangzhou-Foshan Expressway; second radial line: Guangzhou-Qingyuan Expressway; third radial line: Airport Expressway-Airport North Extension Line-Guangle Expressway; fourth radial line: Airport Second Expressway (newly planned)-Guangzhou-Lianyungang Expressway (newly planned); fifth radial line: South China Expressway-Beijing-Hong Kong-Macao Expressway; sixth radial line: Jiebei Expressway-Daguang Expressway; seventh radial line: Conghuang Expressway (newly planned); eighth radial line: Guangzhou-Heyuan Expressway; ninth radial line: Zengcheng-Tianhe Section of Zengfo Expressway (newly planned)-East Extension Line (newly planned); tenth

radial line: Fenghuangshan Tunnel – Guangzhou-Huizhou Expressway; eleventh radial line: National Highway G324; twelfth radial line radiations: The Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section); thirteenth radial line: Guangyuan Fast road; fourteenth radial line: National Highway G107; fifteenth radial line: Guangshen Coastal Expressway; sixteenth radial line: Lianhuashan Passage (newly planned) – Zengcheng-Dongguan Expressway (newly planned); seventeenth radial line: Nanda Trunk Line (under construction)-Panyu to Nansha East Line Expressway (newly planned); eighteenth radial line: Xinhua Expressway – Guangzhou-Zhuhai East Expressway; nineteenth radial line: Nansha Port Expressway; Twentieth radial line: Dongsha-Xinlian Expressway; twenty-first radial line: Guangzhou-Zhuhai West Expressway; twenty-second radial line: Guangzhou-Sanshui Expressway; twenty-third radial line: Guangzhou-Foshan-Zhaoqing Expressway (under construction)

(3) Vertical line

The first vertical line: the west line of Fosahn-Qingyuan-Conghua Expressway (under construction); the second vertical line: the north extension line of Foshan-Jiangmen Expressway (newly planned); the third vertical line: Zengcheng-Dongguan Expressway (newly planned).

(4) Horizontal line

The first horizontal line: Huizhou-Qingyuan section of Shantou-Zhanjiang Expressway (under construction); the second horizontal line: north section of Foshan-Qingyuan-Conghua Expressway (under construction); the third horizontal line: west extension line of Huadu-Dongguan Expressway (newly planned) + Huaguan Expressway (under construction) + east extension line of Huaguan Expressway (newly planned); Four horizontal lines: West Extension Line of Foshan-Zengcheng Expressway (newly planned)-Section 2 of Airport No.2 Expressway (newly planned) + Zengcheng-Tianhe Section of Foshan-

Zengcheng Expressway (newly planned)-East Extension Line of Foshan-Zengcheng Expressway (newly planned). Five horizontal lines: Guangzhou-Foshan-Zhaoqing Expressway (under construction) + Hua'nan Expressway Phase III + Fenghuangshan Tunnel; six horizontal lines: Panyu-Shunde Express Line; seven horizontal lines: Huanglan Expressway; eight horizontal lines: Guangzhou-Zhongshan-Jiangmen Expressway + Guige Avenue + Nansha-Dongguan Changping Expressway (newly planned); nine horizontal lines: Nansha-Zhongshan Expressway (newly planned)

(5) Densification line

Densified Line 1: Zengcheng-Tianhe Expressway Branch Line (newly planned); Densified Line 2: Zhengguo Branch Line of Foshan-Zengcheng Expressway (newly planned).

Figure 2-2 Schematic Diagram of Guangzhou Expressway Network Planning

2.4.1.3 Dongguan City

The layout scheme of Dongguan Expressway is "five vertical, four horizontal and six links", and the total length of the expressway network is 434.3 kilometers. According to the calculation of urban area, the density of expressway network in the urban area is 0.18 km/km2, and according to the calculation of urban construction land area, the density of expressway in the urban area is 0.43 km/km2.It is planned to form a multi-center radial fast trunk road network centered on each district and group, with the overall layout of "two rings, seven radial, four horizontal, three vertical and two links". The total length of the express trunk line is 602.7km, and the density of the express trunk line network reaches 0.25km/km2 according to the urban area, and the density of the express trunk line network reaches 0.60km/km2 according to the urban construction land area.

(1) Regional and external road network

The layout plan of the regional and external road network is a layout structure of "one ring, six vertical, six horizontal and eight links", with a total length of 650 kilometers, including 434.3 kilometers of expressways and 215.7 kilometers of express trunk lines.

"One ring" is the ring road;

The "six vertical lines" are the Guangshen Coastal Expressway, The Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section), National Highway 107, Zengcheng-Dongguan-Shenzhen Expressway, Conghua-Dongguan Expressway and Boluo-Shenzhen Expressway;

"Six horizontal lines" are North Ring Road-Guanpai Expressway, Shuixiang Avenue-South Ring Road-Eastern Expressway, Dongguan-Panyu Expressway-Heyuan-Huizhou-Dongguan Expressway, Humen Bridge- Changping-Humen Expressway Expressway (including extension line)-Huizhou-Changping Expressway, Longbeiling–Lincun Expressway and Shenzhen Outer Ring Expressway;

" Eight connecting links " is Longhua-Dalingshan Expressway, Changping–Humen Expressway Humen Port Branch Line, Qingshuihe-Pinghu Expressway, Guangyuan Expressway, Lianhuashan Passage, Xinpai Expressway, Humen Bridge and Qiaoli Expressway.

(2) Urban Trunk Road Network

The total length of the planned urban trunk road network is 1782.3 kilometers, including 434.3 kilometers of expressway network, 602.7 kilometers of urban express road network and 745.3 kilometers of trunk road network.

Figure 2-3 Dongguan Regional Trunk Road Network Planning Scheme

2.4.2 Rail transit planning

2.4.2.1 Guangdong Province

The Guangdong-Hong Kong-Macao Greater Bay Area (Intercity) Railway Construction Plan is planned for the near future to 2022, the long term to 2035, and the future prospect to 2050.

The overall goal is to achieve the integrated development and efficient convergence of high-speed railway, ordinary speed railway, inter-city railway,

urban rail transit and other rail networks in Guangdong-Hong Kong-Macao Greater Bay Area, to create a "Greater Bay Area on the track", and to support the construction of international first-class bay area and world-class urban agglomerations in Guangdong-Hong Kong-Macao Greater Bay Area.

Timeliness target: Build a 1-3 hour access circle inside and outside the Greater Bay Area: 3 hours access from the Greater Bay Area to neighboring provincial capitals;

It takes 1.5 hours to reach the prefecture-level cities in the province from the Greater Bay Area, and the main nodes between the major cities in the Greater Bay Area can be reached within 1 hour.

Coverage target: Use high-speed railway and inter-city rail transit to operate inter-city trains, build a regional inter-city network, cover 100% of the cities above the county level and more than 85% of the cities and towns with a population of 50,000, and promote the coordinated development of the region.

The scale of the planned Guangdong-Hong Kong-Macao Greater Bay Area (intercity) railway network in the Bay Area is about 5322 kilometers, of which the mileage of the projects under construction is about 855 kilometers and the total mileage of the planned projects is about 2443 kilometers.

(1) "Four-way expansion" of external railway corridor

There are 6 northward passages: Wuhan-Guangzhou high-speed railway, Ganzhou-Shenzhen high-speed railway, Guangzhou-Heyuan high-speed railway, Guangzhou-Qingyuan (extending to Yongzhou) high-speed railway, Beijing-Guangzhou railway and Beijing-Kowloon railway (passenger and freight ordinary speed railways);

Three eastward passages: Xiamen-Shenzhen high-speed railway, Guangzhou-Shanwei high-speed railway and Shenzhen-Shanwei high-speed railway;

Five westward passages: Nanning-Guangzhou high-speed railway (Nanning-Guangzhou connecting line), Jiangmen-Zhanjiang high-speed railway, Guangzhou-Zhanjiang high-speed railway, Shenzhen-Nanning high-speed railway, Guangzhou-Maoming railway (passenger and freight railway);

There are two northwest channels: Guiyang-Guangzhou high-speed rail (Guangzhou-Nanjing connecting line) and Liuzhou-Guangzhou railway (passenger and freight railway).

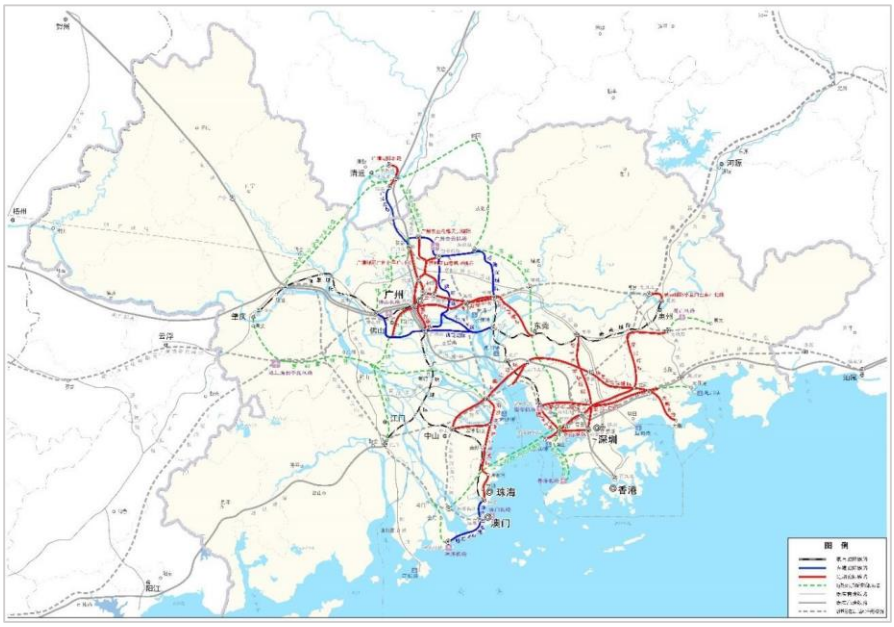

Figure 2-4 Overall Plan of Guangdong-Hong Kong-Macao Greater Bay Area Intercity Railway

(2) Internal intercity railway network of "three levels, three axes and three radiations"

Six Guangzhou-Foshan-Shenzhen-Hong Kong main axes: Guangzhou-Shenzhen-Hong Kong high-speed rail, Guangzhou-Shenzhen Railway, Guangzhou-Dongguan-Shenzhen Intercity Railway, Shenzhen-Hong Kong Western Corridor, Guangzhou-Shenzhen Second high-speed rail, Shenzhen-Dongguan-Zengcheng Intercity Railway;

Four Guangzhou-Foshan-Zhuhai-Macao main axes: Guangzhou-Zhuhai Intercity Railway, Guangzhou-Foshan-Jiangmen-Zhuhai Intercity Railway, Zhuhai-Jiangmen-Zhaoqing High-speed Railway and

Guangzhou-Zhongshan-Zhuhai-Macao high-speed rail;

Three main axes across the Pearl River Estuary: Shenjiang Section of Shenzhen-Maoming Railway, Zhongnanhu Intercity Railway (Nansha Branch of Ganzhou-Shenzhen high-speed rail) and Shenzhen-Zhuhai Intercity Railway;

The Guangzhou-Foshan area covers 6 lines: Guangzhou-Foshan-Zhaoqing Intercity Line, Foshan-Dongguan Intercity Line, Guangzhou-Foshan Ring Line, Guangzhou-Qingyuan Intercity Line, Zhaoqing to Qingyuan to Fogang to Conghua Intercity Line;

Shenzhen-Hong Kong region radiates 4 lines: Dongguan-Huizhou Intercity, Shenzhen-Huizhou Intercity, Tangxia-Longgang Intercity, Changping-Longhua Intercity;

The Zhuhai-Macao region radiates one line: the intercity from the urban area of Zhuhai to Zhuhai Airport.

(3) Hong Kong and Macao convergence plan

Connection with Hong Kong: three corridors in the east, middle and west, namely, the Guangzhou-Kowloon Railway, the Guangzhou-Shenzhen-Hong Kong high-speed rail and the Shenzhen-Hong Kong Western Corridor;

Connection scheme with Macao: there are two passages in the south and north, namely Gongbei-Guanzha Passage and Hengqin-Taipa Passage.

(4) Hub scheme

Guangzhou: It is planned to be a large radial hub, forming a "five main and four auxiliary" layout with Guangzhou Station, Guangzhou South Station, Guangzhou East Station, Foshan Station and Guanghuizou Baiyun Station (Tangxi Station) as the main passenger stations, and Guangzhou North Station, Yuzhu Station (site selection to be further compared), Xintang Station and Nansha Station as the auxiliary passenger stations. Reserve the conditions for Zengcheng South Station, Baiyun Airport Station and Foshan Station to

develop into important passenger transport nodes of the hub.The hub freight system is planned to add Guangzhou South EMU Depot and Dalang Station supporting EMU express facilities. A railway network linking eastern, western and northern Guangdong with Changsha, Nanchang, Xiamen, Shenzhen-Hong Kong, Zhuhai-Macao, Haikou, Nanning and Guiyang will be formed.

Dongguan City: It is planned to form a "one main and five auxiliary" passenger station layout with Dongguan West Station as the main passenger station and Humen Station, Humen South Station, Tangxia Station, Dongguan East Station and Songshan Lake Station as the auxiliary passenger stations. A railway network linking the east, west and north of Guangdong, Guangzhou, Shenzhen, Hong Kong, Nanchang and Haikou will be formed.

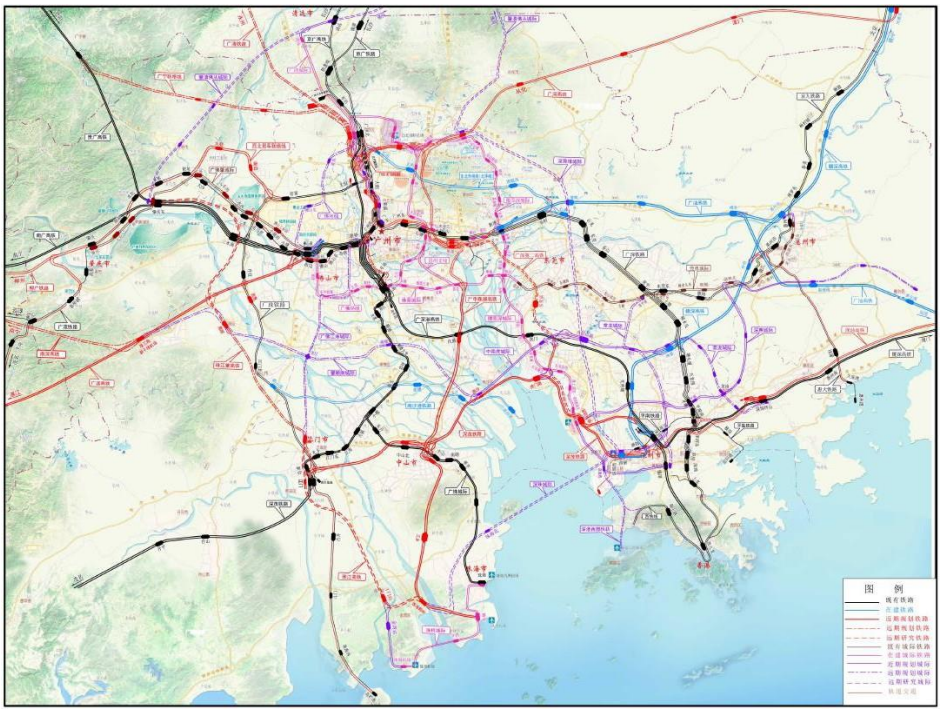

Figure 2-5 General Layout of Guangdong-Hong Kong-Macao Greater Bay Area Railway Terminal

2.4.2.2 Guangzhou City

(1) International railway hub

Construct the Guangzhou railway hub layout of "five main, four auxiliary and two reserved", take Guangzhou Station, Guangzhou East

Station, Guangzhou South Station, Foshan Station and Baiyun Station as the main passenger stations, take Guangzhou North Station, Nansha Station, Xintang Station and Huangpu Station as the auxiliary stations, reserve Zengcheng Station and Airport Station as the important passenger transport node conditions of the hub, and study the new knowledge city, Conghua and other passenger stations.

An international railway hub that radiates the whole country will be built, connects Southeast Asia and connects Eurasia, enhance the capacity of railway corridors introduced into urban centers, and strengthen the interconnection of hubs. Ten new high-speed railways (including connecting lines) will be added, including Guangzhou-Zhanjiang, Guangzhou-Heyuan, Guangzhou-Yongzhou, Guangzhou-Zhongshan-Zhuhai-Macao and Guangzhou-Shenzhen Second High-speed Railway, etc. Priority will be given to the construction of direct access to the Yangtze River Delta (Shanghai) and Chengdu-Chongqing urban agglomeration, so as to realize high-speed rail access to the city center, one-hour access to the city center of Guangdong-Hong Kong-Macao Greater Bay Area, and it takes 1.5 hours to reach each other, 3 hours to reach each other with neighboring provincial capitals, and 5-8 hours to reach each other with major cities of national urban agglomerations, so as to realize the normal operation of Guangzhou Railway Hub with the Eurasian Continental Bridge and the Pan-Asian Railway. It is planned that by 2025, the passenger volume will reach 250 million person-times and the freight volume will reach 60 million tons; by 2035, the passenger volume will reach 400 million person-times and the freight volume will reach 77 million tons.

(2) Intercity direct rail

In coordination with the inter-city railway, we will build a cross-city urban high-speed rail. According to the operation mode of "one network, one ticket,

one city", we will realize the inter-city public transport and closely link the important groups of Guangzhou and neighboring cities. The design speed of urban high-speed rail is more than 160 km/H.

The intercity railway network includes the Guangzhou-Zhuhai and Guangzhou-Foshan-Zhaoqing intercities that have been completed and opened to traffic, the Guangzhou-Qingyuan, Guangzhou-Dongguan-Shenzhen, Foshan-Dongguan and Guangzhou-Foshan ring intercities that are under construction, the planned Guangzhou-Foshan-Jiangmen-zhuhai, Zhaonan and Zhongnanhu intercities, as well as the long-term planned Zhaoqingcong and Shenzhen-Dongguan-Zengcheng intercities, with a total mileage of 428 km in Guangzhou.

The urban high-speed rail network includes Rail Transit Line 17, Line 18, Line 22, Line 28 and Line 37, with a total mileage of 390.2 kilometers in Guangzhou.

(3) Urban rail express line

We will improve the rail express network, support the integrated development of Guangzhou, and achieve a 5-minute commute in the city. The design speed of the urban rail express line is 100-140 km/H.

The urban rail express network planning scheme includes Rail Transit Line 3, Line 7, Line 13, Line 14, Line 16, Line 21, Line 24, Line 25, Line 26, Line 27 and Line 29, with a total mileage of 599 kilometers in Guangzhou.

(4) General line of urban rail

Increase the density of rail transit network, realize the full coverage of important passenger flow corridors, and improve the service level of rail transit. The design speed of the general urban rail line is 80-100 km/H.

The general urban rail network planning scheme includes Line 1, Line 2, Line 4, Line 5, Line 6, Line 8, Line 9, Line 10, Line 11, Line 12, Line 15, Line 19, Line 20, Line 23, Line 30, Line 31, Line 32, Line 33, Line 34, Line 35, Line 36, Guangfo Line, Foshan Line 2, Foshan Line 4, Foshan Line 5,

Foshan Line 8, Foshan Line 11, Dongguan Line 4, Dongguan Line 1 and so on, totaling 37, with a total mileage of 1001 kilometers.

By 2035, a total of about 2000 kilometers of rail network, including urban high-speed rail, urban express line and urban general line, will be built in Guangzhou.

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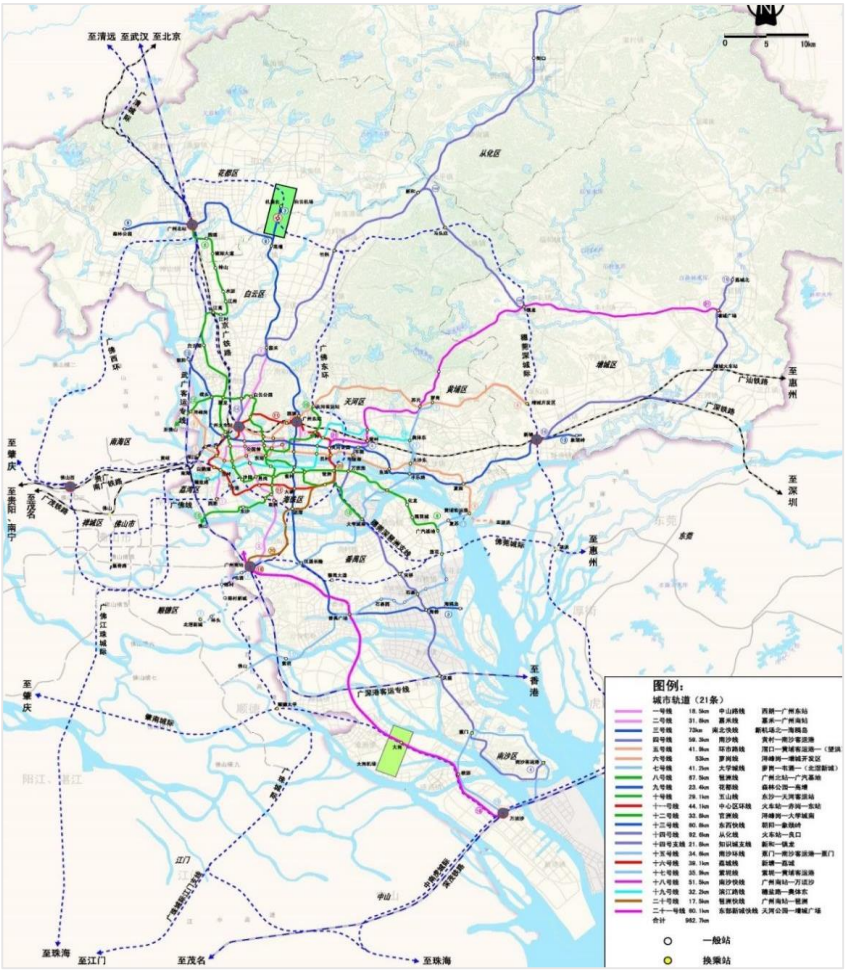

Figure 2-6 Schematic Diagram of Long-term Urban Rail Transit Network Planning of Guangzhou

2.4.2.3 Dongguan City

(1) Railway

There are five railways in Dongguan, including Guangzhou-Shenzhen Railway, Guangzhou-Meizhou-Shantou Railway, Guangzhou-Shenzhen-Hong Kong Passenger Dedicated Line, Shenzhen-Maoming Railway and Xinshanan Operating Area. There are four main railway passenger

transport hubs, namely Dongguan Station, Dongguan East Station, Dongguan Changping Station and Dongguan South Station (Humen Railway Station). The general passenger station is Zhangmutou Station. There are five railway freight stations, namely Dongguan Changping Station, Dongguan East Station, Chashan Station, Shilong Station and Zhangmu Station.

(2) Intercity railway

In the Pearl River Delta Intercity Rail Network, five intercity lines pass through Dongguan, namely, Guangzhou-Dongguan-Shenzhen Intercity Line, Dongguan-Huizhou Intercity Line, Foshan-Dongguan Intercity Line, Zhongshan-Humen Intercity Line and HuGang Intercity Line.

Within the scope of Dongguan City, there are 22 intercity stations, including 3 major intercity hubs, namely Wanghong Intercity Station, Chang'an Xiabian Station and Chang'an Jinsha Station.

It is planned to reserve the inter-city rail transit corridor of Guangzhou Eastern New Town-Dongguan City-Dongguan Songshan Lake High-tech Park-Shenzhen Guangming New District-Shenzhen Liuxiandong High-tech Park-Shenzhen Nanshan High-tech Park-Shenzhen Central District (Qianhai), and to implement the specific line location and construction standards of Guangzhou-Dongguan-Shenzhen Passage as soon as possible.

(3) Urban rail transit

It is composed of two levels of city express line and general rail line, with a total of 17 planned lines. By 2035, it is planned to form four urban rail express lines (224 km), eight urban rail commuter lines (242 km), and one section (7 km) of Shenzhen extension line in Dongguan, with a total planned mileage of 473 km.

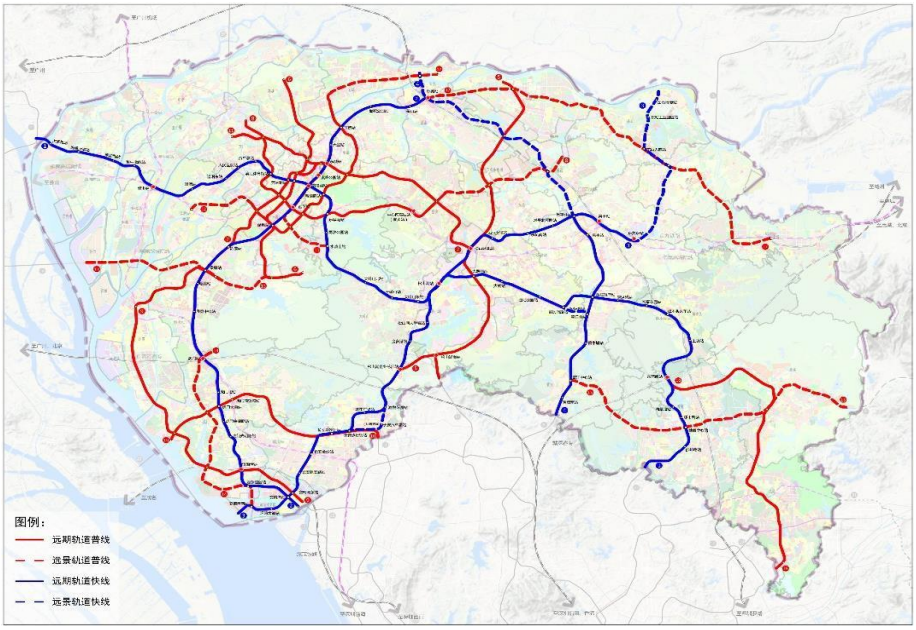

Figure 2-7 Schematic Diagram of Long-term Urban Rail Transit Network Planning of Dongguan

3 Traffic model structure

3.1 Model ideas and architecture

This project is the toll assessment of the Approved Road Section R&E Project, which is to be predicted based on the urban traffic model of Guangzhou and Dongguan. At present, there are many kinds of macroscopic transportation planning models, including "FourStepModel", "TourBasedModel", "Activity-based Model" and so on.The model adopts an improved four-stage model, On The basis of establishing the traffic model according to the four steps of "Trip Generation", "Trip Distribution", "Modal Split" and "Traffic Assignment" in turn, the traffic flow is divided into four stages: Increase the process of iterative optimization of loop feedback.

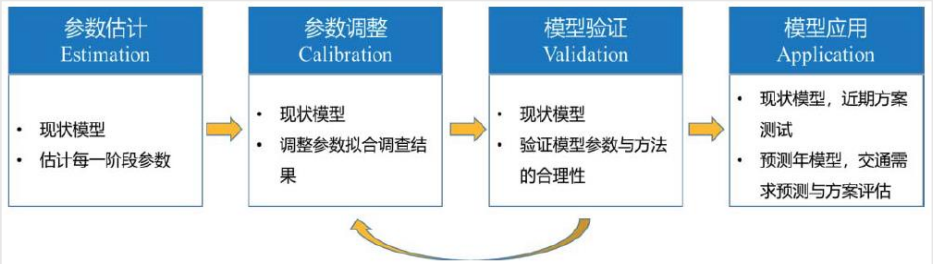

Figure 3-1 Overall construction idea of the model

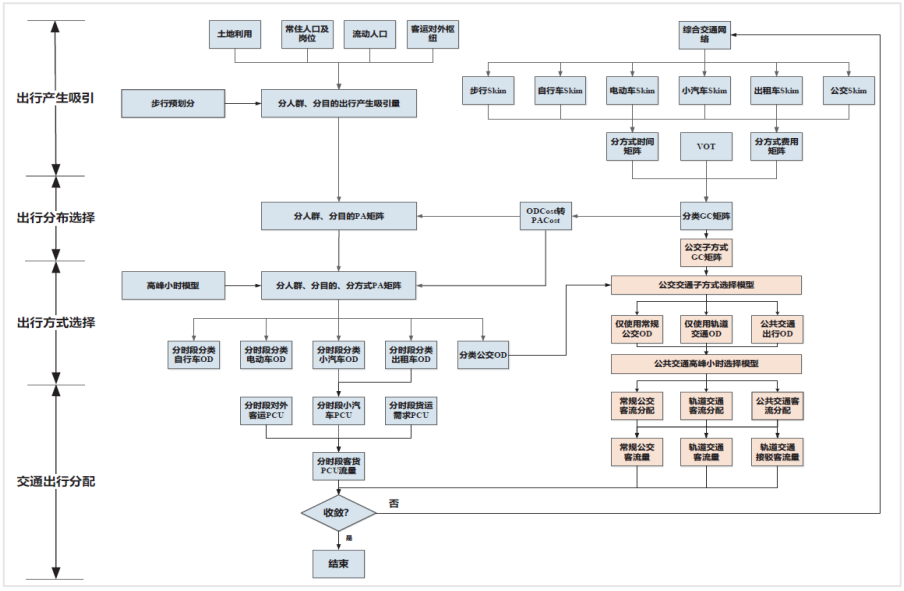

Figure 3-2 Macroscopic Model Construction and Application Technology Process

In combination with the improvement of computing power, the application of traffic big data, the advantages and disadvantages of models at different stages and the change of core demands for future model evaluation and analysis, the model architecture is greatly adjusted and optimized. The optimized and adjusted model construction and application technology process are shown in the figure above.

3.2 Traffic zoning and network

3.2.1 Macro Traffic Model of Guangdong Province

The traffic prediction model of the Approved Road Section R&E Project is built on the basis of the existing traffic model of Guangdong Expressway. The model basis is shown in the following figure:

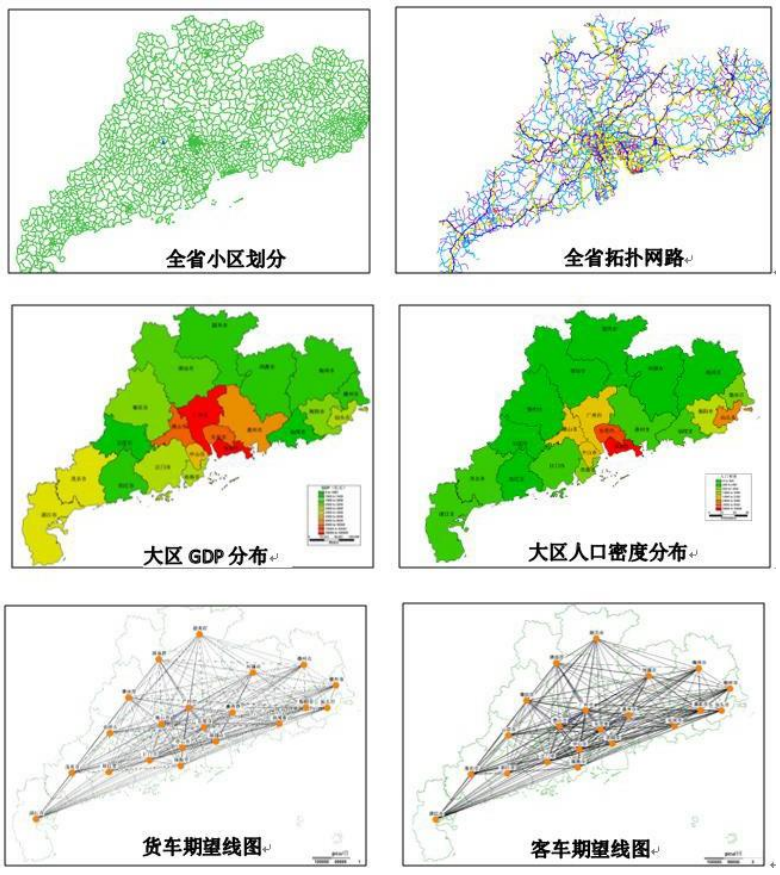

Figure 3-3 Data Base of Guangdong Province

The provincial road network model is based on administrative divisions, combined with the road network structure and the distribution of

interchange exits, which divides 1606 traffic zones. At the same time, considering the developed economy in the core area of Guangdong-Hong Kong-Macao Greater Bay Area, the high density of expressway entrances and exits, and the regional expressway undertaking part of the urban traffic demand function, the provincial road network model is divided into zones to refine the traffic zones in Guangzhou, Dongguan and Shenzhen. There are 101 new districts, with a total of 1707 districts. The districts of Guangdong Province and the Greater Bay Area are shown in the figure below.

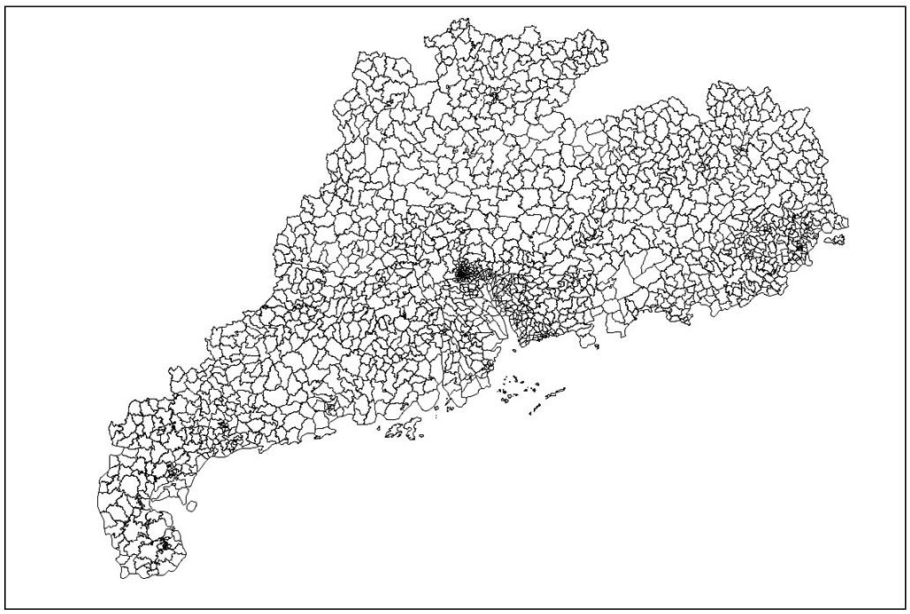

Figure 3-4 Traffic Zone Division of Guangdong Province

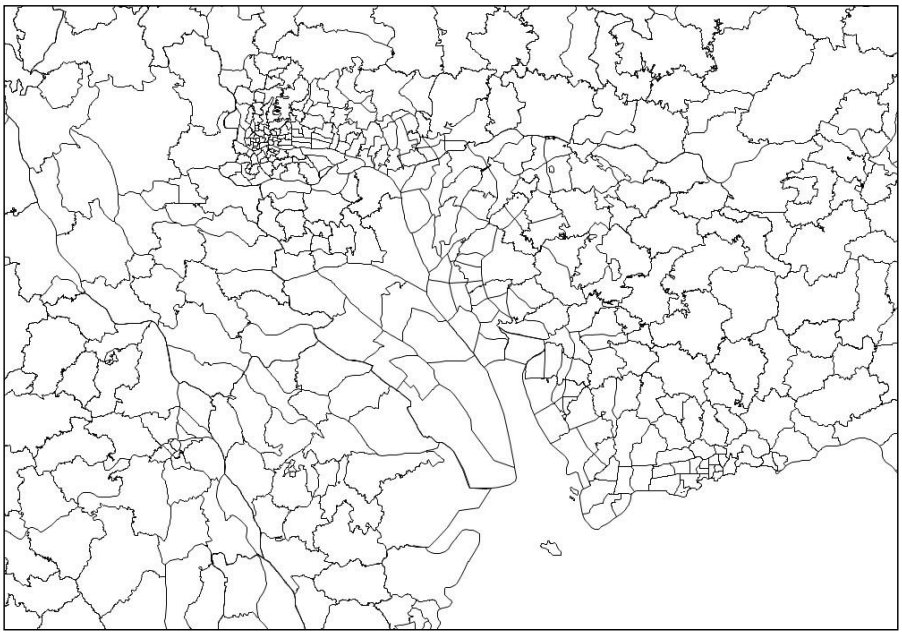

Figure 3-5 Division of traffic zones in the Greater Bay Area

3.2.2 Road Network Model of Guangdong Province

It is an important preparation for traffic volume forecast to draw up the road network of the future characteristic year. The road network in the characteristic year proposed in this report follows the following five principles: (1) the same coverage as the road network in the base year; (2) meeting the specific requirements of the project construction; (3) conforming to the road network planning of Guangdong Province; (4) conforming to the road network planning around the project; (5) conforming to the municipal road construction and development planning of the cities along the line.The road network in the characteristic year is developed on the basis of the road network in the base year, and its basic pattern is stable. Therefore, the standard grade of the proposed project is described in detail by mainly referring to the road network of the base year when drawing up the road network of the characteristic year, and adjusting the changed road conditions according to the relevant traffic planning data.According to the construction schedule of the main projects in the plan, the report draws up the road network of the project in the future characteristic year based on the expressway network planning of

Guangdong Province, the general national and provincial highway network planning and the road network planning of Guangzhou, Dongguan and Shenzhen.

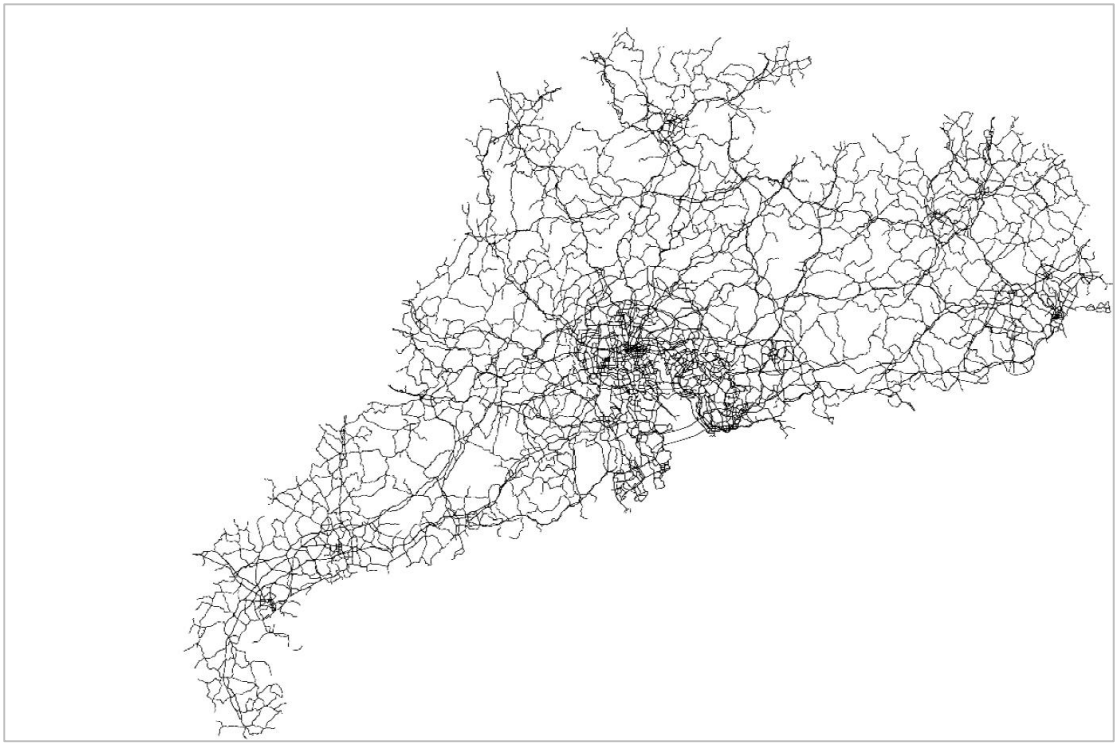

Figure 3-6 Schematic Diagram of Topological Road Network of Guangdong Province

3.3 Passenger traffic generation

The objective of passenger traffic generation is to estimate the total number of trips generated by or originating from each zone by trip purpose. Trip generation is to establish the relationship between the number or frequency of trips and the characteristics of travelers, regions, and transportation networks. Based on the comprehensive traffic survey data of the characteristic year, the cross-classification method is used to classify and predict the traffic absorption of households.

Trip generation adopts the generation rate method of middle scale.

$$p_i = \sum R_{ik} * T_{ik}$$

Where:

p_i is the trip generation of traffic zone i;

R_{ik} is the travel rate of the travel group of type k in the traffic zone i;

T_{ik} is the total number of travel groups of type k in traffic zone i.

●The travel incidence rate is determined by analogy with cities at home and abroad on the basis of referring to the resident travel surveys in Guangzhou and Dongguan over the years;

●In order to fully reflect the impact of the development of motor vehicles and the change of residents' income on travel, cross-classification is carried out according to these two factors, which is directly reflected in the travel classification;

●According to the characteristics of population composition in Guangzhou and Dongguan, the collective households are calculated separately;

●Take full account of the composition of the family population, and calculate the employed population, students and other population separately;

●Considering the difference of urbanization level in different regions, different parameters are used to calculate separately;

●Given the difficulty of defining walking trips, we have used the incidence of motorized trips instead of the traditional incidence of all-mode trips.

Travel Attractions are forecasted by categories as follows: Home-based Work Travel Attractions are calculated based on the location of the employment area, Home-based Other Travel (HBO) and Non-Home-based Travel (NHB) Attractions are calculated based on the distribution of business and office areas, and Home-based School Travel (HBS) is calculated based on the distribution of degrees. Generally, the proportion of employment attraction rate in the central area is higher than that in other areas. Therefore, in the process of attraction calculation, different weights

are used according to the location relationship.

The linear regression method of zonal scale is used for trip attraction.

$$Y_i = A_1X_1 + A_2X_2 + A_3X_3 + \cdots A_nX_n$$

Where:

Y_i is attract traffic for the traffic zone i;

A_1、A_2、A_3 ... A_n is the partial regression coefficient;

X_1、X_2、X_3 ... X_n is a factor related to the amount of attraction.

3.4 Freight traffic generation

Four types of freight traffic forecasting models are constructed: internal freight trips, external freight trips, port evacuation freight trips and Hong Kong cross-border freight trips.

The internal freight trip occurrence model is calculated according to the industrial posts and service posts in each district, and the calculation formula is as follows:

$$G = aX + bY$$

Where:

G is the freight volume;

X industrial posts;

Y service posts;

a、b is the weigh.。

The elasticity coefficient method is used to forecast the external freight. The elastic coefficient method can directly reflect the influence of economic growth on the traffic, can better grasp the influence of the improvement of regional productivity level and the adjustment of industrial structure on the traffic growth from the total amount, is easy to synthesize qualitative factors and quantify them, and has better practicability and reliability when used in the medium and long-term prediction of traffic

volume.Its principle is to study the elastic relationship between social economy and transportation indicators, and to determine the growth rate of traffic generation and attraction in each traffic zone in the future through the prediction of social and economic development and freight elasticity coefficient of each traffic zone, so as to predict the total traffic generation and attraction in the future. The model is as follows:

$$P_i^f = P_i^0 * (1 + E_i * r_i)^n$$

Where:

P_i^f is the future traffic generation (attraction) of the district i;

P_i^0 is the current traffic generation (attraction) of the district i;

E_i is the elasticity coefficient of the freight index of the region to the economic index i;

r_i is GDP growth rate of the region i(%);

n is the prediction period (determination of the characteristic year).

The port cargo volume is mainly composed of the planned cargo throughput of each port and airport in the next year. As this project is only for road traffic, the proportion of land transportation with the port and airport cargo and the empty container rate are considered. The specific formula is as follows:

$$Y_i = \frac{T_i * r}{(1 - a) * w}$$

Where:

Y_i the number of land freight vehicles in Hong Kong i;

T_i port throughput i;

r is the proportion of land transportation for the port i;

a the empty container rate of the port i;

w is the freight factor of the port i.

The relationship between Hong Kong's total cross-border freight volume and trade volume is as follows:

$$Y = aX + bY$$

Where:

Y is the total volume of cross-border freight;

X is export trade volume;

a、b is the parameter to be calibrated.

The formula for cross-border freight vehicle travel demand is as follows:

$$G = rY$$

Where:

G is cross-boundary freight traffic;

r is the truck load factor.

3.5 Trip distribution model

The trip distribution model is to calculate the trip exchange volume between the traffic zones according to the trip generation volume and attraction volume of each traffic zone, and obtain the PA matrix of the trip.

Basically, trip distribution models can be divided into two broad categories: the growth factor approach and the composite approach. The growth coefficient method is a growth trend model based on the current travel origin and destination. The synthesis rule is a probability model that considers both the travel space impedance factor and the regional characteristics.

Guangzhou and Dongguan are both fast-growing cities, and their urban form and spatial characteristics are changing rapidly. According to this characteristic, the comprehensive distribution model is more suitable for the actual situation of the above cities.

According to the definition of generalized travel impedance, the comprehensive distribution model can take into account different planning strategies, various traffic system improvement schemes and travel costs by analyzing the comprehensive relationship between the current travel distribution and the generalized travel impedance.

The most widely used integrated trip distribution model is the gravity model. The model assumes that the amount of travel between two cells is proportional to the amount of occurrence of the starting cell and the amount of attraction of the destination cell, and is inversely proportional to the impedance from the starting cell to the destination cell. The travel impedance between cells usually refers to the distance or travel time. In this project, we use a generalized trip impedance (integrated trip cost utility) gravity model to calculate the trip distribution.

The integrated cost utility gravity model is formulated as follows:

$$P_{OD} = \frac{FF * GC^{a} * e^{bGC}}{\sum FF * GC^{a} * e^{bGC}}$$

Where:

P_{OD} is the proportion of the distribution quantity of a certain OD pair to the total occurrence quantity;

FF is the distance dependent impedance (in minutes);

GC is the combined trip cost utility (minutes, including time and money spent);

a、b is the parameter to be calibrated.

The functional form of the integrated travel cost utility is:

$$GC = G_T + G_C$$

Where:

G_T is the travel time (minutes);

G_C is the travel cost (minute), $G_C = kC/VOT$, where is the cash

payment, is the time value, and is the scaling factor.

The trip distribution matrix calculated by the gravity model generally needs to be balanced according to the total amount of attraction. The FURNESS method is used in this project to constrain and adjust the trip distribution according to the total amount of occurrence and attraction of each cell (i.e., double constraint model).

3.6 Mode partition model

Modal classification models can be divided into four types according to their different combination positions in the traffic volume prediction simulation program:

● Combined with the trip generation model, that is, the trip generation is counted according to different traffic modes at the beginning:

● Divide the traffic mode between trip generation and trip distribution, that is, assume that there is no relationship between trip generation and traffic mode for the time being, and complete the division before calculating the trip distribution;

● Integration with the trip distribution model, i.e., the modal split is performed simultaneously with the distribution model as part of the trip distribution process;

● Modal split is performed between trip distribution and traffic assignment, that is, modal split is completed before traffic assignment.

Each of the above methods has its own characteristics, and the third division method is adopted in this project. According to the difference of comprehensive travel cost between individual transport mode (car, taxi) and public transport mode (conventional bus, subway),

the proportion of the two modes is determined by using the binary logarithm model.

3.6.1 Primary Mode Partition Model

The main mode division model refers to the mode division model between individual transportation and public transportation. The functions used in the model are as follows.

$$P_{PV} = \frac{1}{1 + e^{(GC_{PT} - GC_{PV})a + b}}$$

Where:

P_{PV} is the probability of choosing an individual travel mode for an OD pair;

GC_{PT} is the comprehensive cost (minutes) for a certain D pair to travel by public transport mode;

GC_{PV} is the combined cost (in minutes) of travel by private means of transport selected for a certain OD pair;

a is the curvature parameter;

b is the mode constant, which represents the tendency to choose the mode of travel.

3.6.2 Division of public transport sub-modes

Bus sub-mode division model is the core of rail transit model. On the basis of the previous step, it further divides the bus trip into rail and bus modes (bus sub-mode division). The structure of the model and the form of the formula are similar to the main mode division, and the piecewise function is used to calculate according to the rail distance. The function formula of bus sub-mode division is as follows:

$$P_r = \frac{1}{1 + e^{(GC_b - GC_r)a + b}}$$

Where:

P_r is the possibility of selecting an orbital mode for any OD pair;

GC_b is the comprehensive travel cost from the place of departure to the destination by conventional public transport;

GC_r is the comprehensive travel cost from the departure point to the destination by rail mode;

a is the slope parameter;

b is the mode constant.

In the sub-mode division model of public transport, the current common practice is to consider the impact of transfer by walking weight, waiting weight and so on. However, according to the actual test, for the transfer between different systems (such as the transfer between conventional bus and rail), the simple walking weight, waiting weight and other factors can not reflect the real wishes of travelers.According to the fitting test of the actual rail passenger flow, the transfer within and between the same public transport system is distinguished, that is, in the model, different model parameters are used for the division of public transport sub-modes in the rail influence area and non-influence area, which can better fit the intention of travelers (of course, this difference can also be reflected by defining different transfer walking weights and waiting weights between different public transport systems).

Through continuous tracking of actual rail passenger flow operation data and model fitting results, the bus sub-mode division model of rail transit model in Guangzhou and Dongguan is improved.According to the difference of rail trips between the current rail influence area and non-influence area, different bus sub-mode division model parameters are adopted.

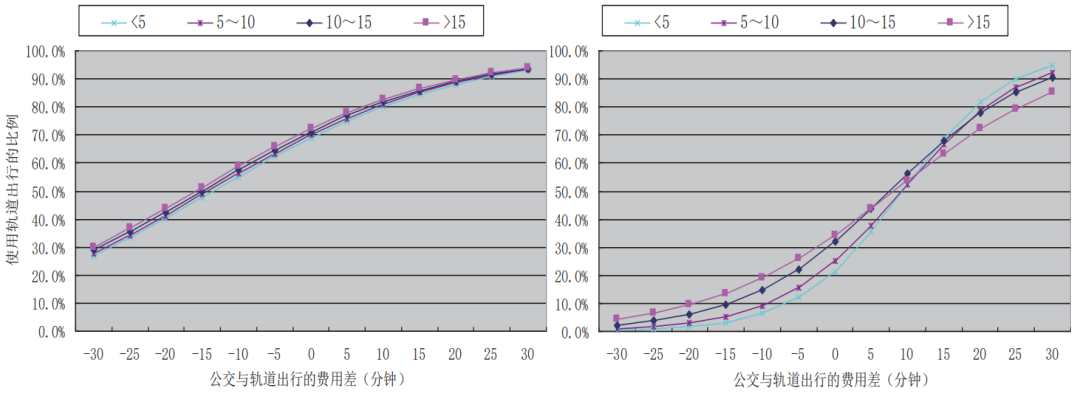

Figure 3-7 Bus Sub-Mode Division Curve Between Track Influence Zones and Between Influence Zones and Non-Influence Zones

3.7 Traffic assignment model

Traffic assignment refers to the assignment of the travel volume between districts to the road network to obtain the simulated traffic volume of the road network. In order to ensure the accuracy of the model prediction, it is necessary to compare and analyze the distribution flow and the observation flow, and to calibrate the model repeatedly. After the traffic model is established and checked, the corresponding parameters are modified according to the change of the future environment, and the flow of the future road section can be predicted.

After calculating the travel matrix of vehicles in peak hours in the next year, the travel of each district can be allocated to the road network according to the network traffic conditions, and finally the vehicle flow of each section can be obtained.

The core problem of traffic assignment is route choice, and different route choice principles lead to different traffic assignment modes. Traffic assignment modes are generally divided into two categories: balanced assignment and unbalanced assignment. At present, the widely used balanced allocation mainly includes two allocation modes, namely, system optimization and user balance.

Both modes are derived from the two flow distribution principles proposed by Wardrop.The system optimization principle assumes that drivers cooperate for the benefit of the system to minimize the total travel cost of the system, while the user equilibrium is defined as that a user in a traffic network knows all the States of the network and always chooses the route that minimizes the cost to himself. When the equilibrium state is reached, the cost of each used route between any OD pair is equal and not greater than cost of the unused route.

The project adopts the optimal balanced allocation algorithm of the system, and its objective function is as follows:

$$Min\big(f(v)\big) = \sum_{\alpha\in A}\int_0^{V_\alpha} s_\alpha(v+x_\alpha)dv + \sum_{i\in\bar{I}}\sum_{\alpha 1\in A_i^-}\sum_{\alpha 2\in A_i^+}\int_0^{v_{\alpha 1\alpha 2}} p_{\alpha 1\alpha 2}(v+x_{\alpha 1\alpha 2})dv$$

Where:

v distribute traffic to the network;

X_a allocate flow for the addition;

$S_\alpha(v+X_\alpha)$ is an impedance function related to the flow of a certain road section in the network;

$p_{\alpha 1\alpha 2}(v+x_{\alpha 1\alpha 2})$ is a function of intersection turning impedances associated with flow from segment to segment in the network $\alpha 1\alpha 2$.

$\sum_{\alpha\in A}\int_0^{V_\alpha} s_\alpha(v+x_\alpha)dv$ is the sum of the impedances of all road sections in the network;

$\sum_{i\in\bar{I}}\sum_{\alpha 1\in A_i^-}\sum_{\alpha 2\in A_i^+}\int_0^{v_{\alpha 1\alpha 2}} p_{\alpha 1\alpha 2}(v+x_{\alpha 1\alpha 2})dv$ is the sum of the turning impedances of all intersections in the network.

Residents' travel costs are mainly composed of two parts: time

and money. Money cost is converted into time cost according to the time value of different income and different purpose travel. Travel cost is related to the choice of travel mode and route, network conditions, traffic congestion and so on.

3.7.1 Cost of travel by car

The travel cost of cars mainly consists of pick-up time (waiting time), travel time, road tolls, car wear and tear, parking fees, etc. The vehicle loss is calculated according to the travel distance and is positively correlated with the travel distance.

3.7.2 Travel expenses by taxi

The cost of taxi travel increases the taxi fare on the basis of the cost of car travel, and no longer considers the cost of car wear and tear. The calculation of taxi fare does not take into account the additional cost due to time.

3.7.3 Travel cost by public transport

Bus travel costs mainly include: walking time, waiting time, boarding time, bus travel time, bus ticket fees, and time and money (ticket fees) incurred by transfer.

The travel time in the vehicle (excluding the clearance penalty) in the travel cost is calculated by the following model formula:

$$d = l * \left[a + b * \left(\frac{V}{C}\right)\right]^n \; V \leq C$$

$$d = l * \left[a + b * \left(\frac{V}{C}\right)\right]^n + 30 * \frac{V - C}{C}, V > C$$

Where:

d is the travel time (minutes);

l is the length of the road (km);

V is the traffic flow rate on the road (pcu/hour);

C is the road capacity (pcu/hour);

a, b, n is an undetermined parameter and is related to the road type;

For the case of $V \leq C$, there is a trip:$speed = \frac{l}{d} = \frac{1}{a+b*(\frac{V}{C})^n}$

4 Traffic volume forecast

4.1 Forecast the future

The Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) is the first expressway jointly built by Guangdong and Hong Kong in China. It was put into trial operation on July 18, 1994 and officially opened to traffic on July 1, 1997, with a total length of 122.8 kilometers; Among them, the reconstruction and expansion project of the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway has a total length of 71.126 kilometers, which has been constructed at the end of 2023 and will open to traffic at the end of 2028, with a construction period of 5 years and an operation period of 25 years. According to the stipulations of the Compilation Methods for Feasibility Study Report of Highway Construction Projects and the Technical Standards for Highway Engineering issued by the Ministry of Transport, the prediction period of the prospective traffic volume of the expressway is 20 years after the opening to traffic. In addition, considering the needs of the financial analysis of the project, the prediction period of the traffic volume this time is 2052.

In combination with the relevant transportation development planning of Guangzhou, Dongguan and Shenzhen, consider the completion of important channels closely related to the project in the project affected area within the forecast period, among which the relatively clear ones are mainly the Shenzhen-Zhongshan Link. Multiple scenarios are set for the influencing factors with uncertain completion time: the Lianhuashan Passage is set to open in 2035 and 2040, the Shiziyang Passage is set to open in 2027, 2028 and 2035, and the Lingdingyang Passage is set to open in 2035, 2040 and 2045.The reconstruction and expansion project of

Dongguan-Shenzhen Expressway has three scenarios of opening in 2025, 2030 and 2035, and the long-term rail line has two scenarios of opening in 2035 and 2040.At the same time, considering that the speed of social and economic development is affected by many complex factors, three prediction scenarios of high, medium and low are set.

Table 4-1 Forecast Scenario Prospect

Programme	Socio-economic Development	The Lianhuashan Passage is open to traffic	The Shiziyang Passage is open to traffic	The Lingdingyang Passage was opened to traffic	Dongguan-Shenzhen Expressway Reconstruction and expansion completed	Remark
Scheme I	High	2040	2035	2045	2035	High traffic volume
Scheme II	Medium	2035	2028	2040	2030	Medium traffic volume
Scheme III	Low	2035	2027	2035	2025	Low traffic volume

4.2 Base year traffic

During the period from 2010 to 2017, the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) showed an overall growth trend, and then the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) declined to a certain extent due to the opening of relevant roads and changes in relevant traffic policies. At the end of 2013, the Guangshen Coastal Expressway was opened to traffic, resulting in a 6.17% decrease in the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) in 2014. The Guangzhou section remained basically stable (the Guangzhou-Shenzhen section along the north of the Guangshen Coastal Expressway was opened to traffic in 2012), and the Dongguan section decreased by 7.00%.

From 2016 to 2017, the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) increased steadily; in 2018, the traffic volume of Guangzhou and Dongguan sections decreased to a certain extent due to the impact of the opening of Fenghuangshan Tunnel in Guangzhou and the second phase of Dongguan Ring Expressway;

In 2019, due to the impact of Nansha Bridge and the first phase of Dongguan-Panyu Expressway, the traffic volume also declined to a certain extent, with an average daily decline of 3.20%, of which the Guangzhou section declined the most, 9.85%, and the Dongguan section 1.08%.

The traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) in 2020 decreased by 2.27% compared with that in 2019, which was mainly due to the normal social production activities affected by the COVID-19 epidemic. Meanwhile, the first phase of Guangzhou-Guangzhou-Shenzhen Intercity Railway was opened to traffic at the

end of 2019, which had a certain diversion impact on passenger transport.

The traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) in 2021 decreased by 11.12% compared with that in 2020, mainly due to the impact of the COVID-19 epidemic in Guangzhou, Dongguan and Shenzhen from the end of April to June 2021, during which the average traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) decreased by 33%; at the same time, the opening of Shenzhen Outer Ring Expressway had a certain diversion impact on the Beijing-Hong Kong-Macao Expressway (Shenzhen section). Therefore, in 2021, the average daily traffic volume of the whole line decreased by 11.29% in Dongguan and 10.19% in Guangzhou.

In 2022, the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) decreased by 20% compared with 2021 due to the strict control measures of the national epidemic situation.

In March 2023, after the full liberalization of epidemic prevention and control, the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) rose steadily, and the traffic volume in 2023 recovered to more than 90% of that in 2019.

Table 4-2 Traffic Volume of the Approved Road Sectionby Vehicle Type from 2016 to 2024

Year	Passenger car (vehicle/day)					Truck (including operation vehicle) (vehicle/day)					Natural vehicle (unit/day)			Standard car (PCU/day)		
	Class 1 vehicles	Class 2 vehicles	Class 3 vehicles	Class 4 vehicles	Class 5 vehicles	Class 1 vehicles	Class 2 vehicles	Class 3 vehicles	Class 4 vehicles	Class 5 vehicles	Passenger car	Truck	Total amount	Passenger car	Truck	Total amount
2016	85691	706	1430	4683	-	6176	1120	5409	1218	3927	92510	17850	110360	95566	40131	135698
2017	93904	862	1266	4501	-	6983	1348	5985	1169	4078	100533	19564	120098	103417	43204	146621
2018	92934	891	1025	3696	--	7415	1338	5664	952	3590	98546	18959	117504	100906	40322	141228
2019	89616	806	799	2793		7561	1226	5622	805	3478	94014	18692	112706	95810	39378	135188
Year	Passenger car (vehicle/day)				Truck (including operation vehicle) (vehicle/day)						Natural vehicle (unit/day)			Standard car (PCU/day)		
	Class 1 vehicles	Class 2 vehicles	Class 3 vehicles	Class 4 vehicles	Class 1 vehicles	Class 2 vehicles	Class 3 vehicles	Class 4 vehicles	Class 5 vehicles	Class 6 vehicles	Passenger car	Truck	Total amount	Passenger car	Truck	Total amount
2020	81679	357	315	1890	13227	5329	2751	866	312	1965	84242	24450	108692	85344	39372	124716

2021	84090	275	281	1500	13677	5116	3287	685	123	743	86146	23631	109777	87037	34744	121781
2022	62436	125	138	816	10616	3715	1199	560	298	1665	63515	18054	81568	63992	28438	92430
2023	91840	184	277	1058	10962	3651	921	568	405	1880	93359	18388	111747	94027	29303	123330
2024 January-June	90240	186	277	1102	10497	3666	878	575	468	1728	91805	17813	109618	92495	28415	120910

Note: Before 2020, the toll standard of expressway is divided into "5 passenger cars and 5 trucks", and after 2020, it will be changed to "4 passenger cars and 6 trucks".

The unit of the predicted traffic volume is PCU/d, which represents the annual average daily traffic volume of the current road (the Approved Road Section), and is the equivalent traffic volume of the whole journey after conversion.`

4.3 Traffic demand forecast

Considering the rebound of traffic volume in the base year after the basic lifting of epidemic prevention and control, the completion time and diversion of Shenzhen-Zhongshan Link, Shiziyang Passage, Dongguan-Shenzhen Expressway Reconstruction and Expansion, Lianhuashan Passage and Lingdingyang Passage, the transfer during the construction of the Approved Road Section R&E Project and the induction after completion, a comprehensive traffic model based on multiple characteristic years with different forecasting prospects is established. The prediction results of the Approved Road Section R&E Project are as follows through traffic model prediction and verification.

4.3.1 Forecast results of traffic volume in Scheme I (high scheme)

Table 4-3 High Scheme Traffic Volume Forecast Results of the Approved Road Section R&E Project

Year	Passenger car					Truck (including operation vehicle)							natural vehicles (vehicle/day)	Standard car (PCU/d)
	Class 1	Class 2	Class 3	Class 4	Subtotal	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Subtotal		
2023	91840	184	277	1058	93359	10962	3651	921	568	405	1880	18388	111747	123330
2024	96318	191	282	1114	97905	11573	3880	999	597	420	2021	19489	117394	128749
2025	101623	201	298	1176	103298	12022	4030	1037	620	436	2100	20245	123543	135351
2026	105889	210	310	1225	107634	12426	4166	1072	641	451	2170	20926	128560	140771
2027	110337	218	323	1276	112155	12844	4306	1108	662	466	2243	21629	133784	146411
2028	112673	223	330	1303	114530	13010	4361	1122	671	472	2272	21908	136438	149236
2029	136194	270	399	1575	138439	15598	5229	1346	804	566	2724	26268	164706	180058
2030	141921	281	416	1641	144260	16122	5405	1391	831	585	2816	27150	171410	187286
2031	144294	286	423	1669	146671	16319	5471	1408	842	592	2850	27482	174153	190228

2032	146706	290	430	1697	149123	16518	5538	1425	852	599	2885	27817	176940	193217
2033	149158	295	437	1725	151616	16720	5605	1442	862	607	2921	28157	179773	196253
2034	151651	300	445	1754	154150	16924	5674	1460	873	614	2956	28501	182651	199338
2035	146570	290	430	1695	148985	16284	5459	1404	840	591	2845	27424	176409	192470
2036	149021	295	437	1723	151476	16483	5526	1421	850	598	2879	27759	179235	195498
2037	151512	300	444	1752	154009	16684	5594	1439	861	606	2915	28098	182106	198573
2038	154046	305	452	1781	156584	16888	5662	1456	871	613	2950	28441	185024	201698
2039	156621	310	459	1811	159202	17094	5731	1474	882	621	2986	28788	187990	204873
2040	151278	300	444	1749	153771	16437	5511	1417	848	597	2872	27683	181454	197694
2041	152027	301	446	1758	154532	16493	5530	1422	851	599	2881	27777	182309	198605
2042	152779	303	448	1767	155296	16549	5548	1427	854	601	2891	27871	183167	199521
2043	153535	304	450	1775	156064	16606	5567	1432	857	603	2901	27966	184030	200442
2044	154294	306	453	1784	156836	16662	5586	1437	860	605	2911	28061	184898	201366
2045	153507	304	450	1775	156036	16551	5549	1427	854	601	2892	27875	183911	200272
2046	154266	305	452	1784	156808	16608	5568	1432	857	603	2901	27970	184778	201196
2047	155029	307	455	1793	157584	16664	5587	1437	860	605	2911	28065	185649	202125
2048	155796	308	457	1802	158363	16721	5606	1442	863	607	2921	28160	186524	203057
2049	156567	310	459	1811	159147	16778	5625	1447	866	610	2931	28256	187403	203994
2050	157342	312	461	1819	159934	16835	5644	1451	869	612	2941	28352	188286	204936
2051	158120	313	464	1828	160725	16892	5663	1456	872	614	2951	28449	189174	205882
2052	158902	315	466	1837	161520	16949	5683	1461	875	616	2961	28545	190066	206832

Remarks: The above is considered according to the completion of Shenzhen-Zhongshan Link in 2024, the completion of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) reconstruction and expansion project in 2029, the completion of Shiziyang Passage in 2035, the completion of Dongguan-Shenzhen Expressway reconstruction and expansion, the opening of Lianhuashan Passage in 2040, and the opening of Lingdingyang Passage in 2045.

Table 4-4 High Scheme Vehicle Type Proportion of the Approved Road Section R&E Project (Natural Vehicles)

Year	Passenger car					Truck (including operation vehicle)						
	Class 1	Class 2	Class 3	Class 4	Subtotal	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Subtotal
2023	82.19%	0.16%	0.25%	0.95%	83.54%	9.81%	3.27%	0.82%	0.51%	0.36%	1.68%	16.46%
2024	82.01%	0.16%	0.24%	0.94%	83.35%	9.89%	3.32%	0.86%	0.50%	0.35%	1.73%	16.65%
2025	82.22%	0.16%	0.24%	0.95%	83.57%	9.76%	3.28%	0.85%	0.49%	0.35%	1.70%	16.43%
2026	82.33%	0.16%	0.24%	0.95%	83.68%	9.70%	3.25%	0.85%	0.49%	0.35%	1.69%	16.32%
2027	82.43%	0.16%	0.24%	0.95%	83.78%	9.63%	3.23%	0.84%	0.49%	0.34%	1.68%	16.22%
2028	82.54%	0.16%	0.24%	0.95%	83.89%	9.57%	3.21%	0.83%	0.48%	0.34%	1.67%	16.11%
2029	84.34%	0.17%	0.28%	0.91%	85.71%	8.53%	2.84%	0.64%	0.49%	0.38%	1.41%	14.29%
2030	84.45%	0.17%	0.28%	0.92%	85.82%	8.46%	2.82%	0.63%	0.49%	0.38%	1.40%	14.18%
2031	84.50%	0.17%	0.28%	0.92%	85.87%	8.44%	2.81%	0.63%	0.49%	0.38%	1.39%	14.13%
2032	84.55%	0.17%	0.28%	0.92%	85.92%	8.41%	2.80%	0.63%	0.49%	0.38%	1.39%	14.08%
2033	84.60%	0.17%	0.28%	0.92%	85.96%	8.38%	2.79%	0.63%	0.48%	0.38%	1.38%	14.04%
2034	84.65%	0.17%	0.28%	0.92%	86.01%	8.35%	2.78%	0.63%	0.48%	0.37%	1.38%	13.99%
2035	84.69%	0.17%	0.28%	0.92%	86.06%	8.32%	2.77%	0.62%	0.48%	0.37%	1.37%	13.94%
2036	84.74%	0.18%	0.28%	0.92%	86.11%	8.29%	2.76%	0.62%	0.48%	0.37%	1.37%	13.89%
2037	84.79%	0.18%	0.28%	0.92%	86.16%	8.26%	2.75%	0.62%	0.48%	0.37%	1.36%	13.84%
2038	84.84%	0.18%	0.28%	0.92%	86.21%	8.23%	2.74%	0.62%	0.48%	0.37%	1.36%	13.79%
2039	84.88%	0.18%	0.28%	0.92%	86.26%	8.20%	2.73%	0.61%	0.47%	0.37%	1.35%	13.74%
2040	84.93%	0.18%	0.28%	0.92%	86.31%	8.17%	2.72%	0.61%	0.47%	0.37%	1.35%	13.69%
2041	84.95%	0.18%	0.28%	0.92%	86.32%	8.16%	2.72%	0.61%	0.47%	0.37%	1.35%	13.68%
2042	84.97%	0.18%	0.28%	0.92%	86.34%	8.15%	2.71%	0.61%	0.47%	0.37%	1.35%	13.66%
2043	84.98%	0.18%	0.28%	0.92%	86.36%	8.14%	2.71%	0.61%	0.47%	0.37%	1.34%	13.64%
2044	85.00%	0.18%	0.28%	0.92%	86.38%	8.13%	2.71%	0.61%	0.47%	0.36%	1.34%	13.62%
2045	85.02%	0.18%	0.28%	0.92%	86.39%	8.12%	2.70%	0.61%	0.47%	0.36%	1.34%	13.61%
2046	85.04%	0.18%	0.28%	0.92%	86.41%	8.11%	2.70%	0.61%	0.47%	0.36%	1.34%	13.59%
2047	85.05%	0.18%	0.28%	0.92%	86.43%	8.10%	2.70%	0.61%	0.47%	0.36%	1.34%	13.57%
2048	85.07%	0.18%	0.28%	0.92%	86.45%	8.09%	2.69%	0.61%	0.47%	0.36%	1.34%	13.55%
2049	85.09%	0.18%	0.28%	0.92%	86.46%	8.08%	2.69%	0.60%	0.47%	0.36%	1.33%	13.54%

2050	85.10%	0.18%	0.28%	0.92%	86.48%	8.07%	2.69%	0.60%	0.47%	0.36%	1.33%	13.52%
2051	85.12%	0.18%	0.28%	0.92%	86.50%	8.06%	2.68%	0.60%	0.47%	0.36%	1.33%	13.50%
2052	85.14%	0.18%	0.28%	0.92%	86.51%	8.05%	2.68%	0.60%	0.47%	0.36%	1.33%	13.49%

4.3.2 Forecast results of traffic volume in Scheme II (medium scheme)

Table 4-5 Medium Scheme Traffic Volume Forecast Results of the Approved Road Section R&E Project

Year	Passenger car					Truck (including operation vehicle)							natural vehicles (vehicle/day)	Standard car (PCU/d)
	Class 1	Class 2	Class 3	Class 4	Subtotal	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Subtotal		
2023	91840	184	277	1058	93359	10962	3651	921	568	405	1880	18388	111747	123330
2024	95502	189	280	1104	97075	11481	3849	990	592	416	2005	19333	116409	128663
2025	97672	193	286	1130	99282	11565	3877	998	596	420	2020	19476	118757	131115
2026	99615	197	292	1153	101257	11698	3922	1009	603	424	2044	19699	120956	133460
2027	109772	217	322	1270	111580	12784	4286	1103	659	464	2233	21528	133108	145677
2028	109759	217	322	1270	111567	12676	4250	1094	654	460	2214	21347	132914	145384
2029	131414	260	385	1520	133579	15051	5046	1298	776	546	2629	25346	158926	173739
2030	134085	265	393	1551	136294	15229	5105	1314	785	552	2660	25646	161940	176937
2031	136399	270	400	1578	138647	15421	5170	1330	795	559	2694	25970	164616	179807
2032	138754	275	407	1605	141040	15615	5235	1347	805	567	2728	26297	167337	182724
2033	141149	279	414	1632	143475	15812	5301	1364	816	574	2762	26629	170103	185690
2034	143586	284	421	1661	145951	16011	5368	1381	826	581	2797	26964	172916	188704
2035	138761	275	407	1605	141048	15403	5164	1328	795	559	2691	25939	166987	182180
2036	141157	279	414	1632	143483	15597	5229	1345	805	566	2725	26266	169749	185139
2037	143594	284	421	1661	145960	15793	5295	1362	815	573	2759	26597	172558	188147
2038	146074	289	428	1689	148480	15992	5362	1379	825	581	2794	26933	175413	191204
2039	148596	294	436	1718	151044	16194	5429	1396	836	588	2829	27273	178317	194312
2040	149650	296	439	1731	152116	16234	5443	1400	838	590	2836	27340	179456	195497
2041	150391	298	441	1739	152869	16289	5461	1404	841	592	2846	27433	180302	196399
2042	151135	299	443	1748	153625	16345	5480	1409	844	594	2856	27527	181151	197305
2043	151882	301	445	1756	154385	16400	5498	1414	847	596	2865	27620	182005	198215

2044	152634	302	448	1765	155149	16456	5517	1419	849	598	2875	27714	182863	199129
2045	153389	304	450	1774	155916	16512	5536	1424	852	600	2885	27808	183724	200048
2046	154148	305	452	1783	156687	16568	5555	1428	855	602	2895	27903	184590	200971
2047	154910	307	454	1791	157463	16624	5574	1433	858	604	2904	27998	185460	201899
2048	155676	308	457	1800	158242	16681	5593	1438	861	606	2914	28093	186334	202831
2049	156447	310	459	1809	159024	16738	5612	1443	864	608	2924	28188	187213	203767
2050	157221	311	461	1818	159811	16794	5631	1448	867	610	2934	28284	188095	204707
2051	157998	313	463	1827	160602	16852	5650	1453	870	612	2944	28380	188982	205652
2052	158780	314	466	1836	161396	16909	5669	1458	873	614	2954	28477	189873	206602

Remarks: The above is considered based on the completion of Shenzhen-Zhongshan Link in 2024, the completion of Shiziyang Passage in 2028, the completion of the the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) reconstruction and expansion in 2029, the completion of Dongguan-Shenzhen reconstruction and expansion in 2030, the opening of Lianhuashan Passage in 2035, and the opening of Lingdingyang Passage in 2040.

Table 4-6 Medium Scheme Vehicle Type Proportion of the Approved Road Section R&E Project (Natural Vehicles)

Year	Passenger car					Truck (including operation vehicle)						
	Class 1	Class 2	Class 3	Class 4	Subtotal	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Subtotal
2023	82.19%	0.16%	0.25%	0.95%	83.54%	9.81%	3.27%	0.82%	0.51%	0.36%	1.68%	16.46%
2024	82.04%	0.16%	0.24%	0.95%	83.39%	9.86%	3.31%	0.85%	0.51%	0.36%	1.72%	16.61%
2025	82.25%	0.16%	0.24%	0.95%	83.60%	9.74%	3.26%	0.84%	0.50%	0.35%	1.70%	16.40%
2026	82.36%	0.16%	0.24%	0.95%	83.71%	9.67%	3.24%	0.83%	0.50%	0.35%	1.69%	16.29%
2027	82.43%	0.16%	0.24%	0.95%	83.78%	9.64%	3.23%	0.84%	0.49%	0.34%	1.68%	16.22%
2028	82.53%	0.16%	0.24%	0.95%	83.89%	9.57%	3.21%	0.83%	0.48%	0.34%	1.67%	16.11%
2029	84.34%	0.17%	0.28%	0.91%	85.71%	8.53%	2.84%	0.64%	0.49%	0.38%	1.41%	14.29%
2030	84.45%	0.17%	0.28%	0.92%	85.82%	8.46%	2.82%	0.63%	0.49%	0.38%	1.40%	14.18%
2031	84.51%	0.17%	0.28%	0.92%	85.87%	8.43%	2.81%	0.63%	0.49%	0.38%	1.39%	14.13%
2032	84.56%	0.17%	0.28%	0.92%	85.92%	8.40%	2.80%	0.63%	0.49%	0.38%	1.39%	14.08%
2033	84.61%	0.17%	0.28%	0.92%	85.97%	8.37%	2.79%	0.63%	0.48%	0.38%	1.38%	14.03%
2034	84.66%	0.17%	0.28%	0.92%	86.02%	8.34%	2.78%	0.62%	0.48%	0.37%	1.38%	13.98%
2035	84.71%	0.17%	0.28%	0.92%	86.08%	8.31%	2.77%	0.62%	0.48%	0.37%	1.37%	13.92%
2036	84.76%	0.18%	0.28%	0.92%	86.13%	8.28%	2.76%	0.62%	0.48%	0.37%	1.37%	13.87%
2037	84.81%	0.18%	0.28%	0.92%	86.18%	8.25%	2.75%	0.62%	0.48%	0.37%	1.36%	13.82%
2038	84.85%	0.18%	0.28%	0.92%	86.23%	8.22%	2.74%	0.62%	0.48%	0.37%	1.36%	13.77%
2039	84.90%	0.18%	0.28%	0.92%	86.28%	8.19%	2.73%	0.61%	0.47%	0.37%	1.35%	13.72%
2040	84.95%	0.18%	0.28%	0.92%	86.33%	8.16%	2.72%	0.61%	0.47%	0.37%	1.35%	13.67%
2041	84.97%	0.18%	0.28%	0.92%	86.34%	8.15%	2.71%	0.61%	0.47%	0.37%	1.35%	13.66%
2042	84.99%	0.18%	0.28%	0.92%	86.36%	8.14%	2.71%	0.61%	0.47%	0.36%	1.34%	13.64%
2043	85.00%	0.18%	0.28%	0.92%	86.38%	8.13%	2.71%	0.61%	0.47%	0.36%	1.34%	13.62%
2044	85.02%	0.18%	0.28%	0.92%	86.40%	8.12%	2.70%	0.61%	0.47%	0.36%	1.34%	13.60%
2045	85.04%	0.18%	0.28%	0.92%	86.41%	8.11%	2.70%	0.61%	0.47%	0.36%	1.34%	13.59%
2046	85.06%	0.18%	0.28%	0.92%	86.43%	8.10%	2.70%	0.61%	0.47%	0.36%	1.34%	13.57%

2047	85.07%	0.18%	0.28%	0.92%	86.45%	8.09%	2.69%	0.61%	0.47%	0.36%	1.33%	13.55%
2048	85.09%	0.18%	0.28%	0.92%	86.47%	8.08%	2.69%	0.60%	0.47%	0.36%	1.33%	13.53%
2049	85.11%	0.18%	0.28%	0.92%	86.48%	8.07%	2.68%	0.60%	0.47%	0.36%	1.33%	13.52%
2050	85.12%	0.18%	0.28%	0.92%	86.50%	8.06%	2.68%	0.60%	0.47%	0.36%	1.33%	13.50%
2051	85.14%	0.18%	0.28%	0.92%	86.52%	8.05%	2.68%	0.60%	0.47%	0.36%	1.33%	13.48%
2052	85.16%	0.18%	0.28%	0.92%	86.54%	8.04%	2.67%	0.60%	0.46%	0.36%	1.33%	13.46%

4.3.3 Traffic volume forecast results of Scheme III (low scheme)

Table 4-7 Low Scheme Traffic Volume Forecast Results of the Approved Road Section R&E Project

Year	Passenger car					Truck (including operation vehicle)							natural vehicles (vehicle/day)	Standard car (PCU/d)
	Class 1	Class 2	Class 3	Class 4	Subtotal	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Subtotal		
2023	91840	184	277	1058	93359	10962	3651	921	568	405	1880	18388	111747	123330
2024	94705	187	277	1096	96266	11455	3840	988	590	415	2001	19289	115555	126789
2025	96301	191	282	1114	97888	11543	3869	996	595	418	2016	19437	117325	128652
2026	99089	196	290	1146	100722	11808	3958	1019	609	428	2062	19884	120606	132197
2027	99919	198	293	1156	101565	11838	3968	1021	610	429	2068	19935	121500	133125
2028	100756	199	295	1166	102417	11868	3978	1024	612	430	2073	19985	122402	134061
2029	119227	236	349	1379	121191	13962	4680	1205	720	506	2439	23512	144703	158424
2030	122682	243	360	1419	124703	14283	4788	1232	736	518	2495	24053	148756	162798
2031	124975	247	366	1446	127034	14478	4854	1249	746	525	2529	24381	151415	165654
2032	127311	252	373	1473	129408	14676	4920	1266	757	532	2564	24715	154123	168561
2033	129690	257	380	1500	131827	14877	4987	1283	767	540	2599	25053	156880	171521
2034	132115	262	387	1528	134292	15080	5055	1301	778	547	2634	25395	159687	174533
2035	126577	251	371	1464	128663	14377	4820	1240	741	522	2511	24211	152873	167032
2036	128943	255	378	1491	131068	14573	4885	1257	752	529	2546	24542	155610	169967
2037	131354	260	385	1519	133519	14772	4952	1274	762	536	2581	24877	158396	172954
2038	133810	265	392	1548	136015	14974	5020	1291	773	544	2616	25217	161233	175996
2039	136312	270	400	1577	138559	15179	5089	1309	783	551	2652	25562	164121	179091
2040	138862	275	407	1606	141150	15386	5158	1327	794	559	2688	25912	167061	182242
2041	140235	278	411	1622	142546	15495	5195	1336	800	563	2707	26096	168642	183933
2042	141622	280	415	1638	143956	15605	5232	1346	805	567	2726	26281	170237	185639
2043	143023	283	419	1654	145380	15716	5269	1355	811	571	2746	26468	171848	187362
2044	144438	286	424	1671	146818	15828	5306	1365	817	575	2765	26655	173474	189101
2045	145867	289	428	1687	148270	15940	5344	1374	823	579	2785	26845	175115	190857

2046	147310	292	432	1704	149737	16053	5382	1384	828	583	2805	27035	176773	192629
2047	148767	295	436	1721	151218	16167	5420	1394	834	587	2824	27227	178446	194417
2048	150239	297	441	1738	152714	16282	5459	1404	840	591	2845	27421	180135	196223
2049	151725	300	445	1755	154225	16398	5497	1414	846	595	2865	27615	181840	198046
2050	153226	303	449	1772	155751	16514	5536	1424	852	600	2885	27811	183562	199886
2051	154742	306	454	1790	157291	16631	5576	1434	858	604	2906	28009	185300	201743
2052	156272	309	458	1807	158847	16749	5615	1444	864	608	2926	28208	187055	203618
Remarks: The above is considered based on the completion of Shenzhen-Zhongshan Link in 2024, the completion of reconstruction and expansion of Dongguan-Shenzhen Expressway in 2025, the completion of Shiziyang Passage in 2027, the completion of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) reconstruction and expansion in 2029, and the opening of Lianhuashan Passage and Lingdingyang Passage in 2035.														

Table 4-8 Low Scheme Vehicle Type Proportion of the Approved Road Section R&E Project (Natural Vehicles)

Year	Passenger car					Truck (including operation vehicle)						
	Class 1	Class 2	Class 3	Class 4	Subtotal	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Subtotal
2023	82.19%	0.16%	0.25%	0.95%	83.54%	9.81%	3.27%	0.82%	0.51%	0.36%	1.68%	16.46%
2024	81.92%	0.16%	0.24%	0.94%	83.26%	9.94%	3.34%	0.87%	0.50%	0.36%	1.73%	16.74%
2025	82.04%	0.16%	0.24%	0.94%	83.39%	9.87%	3.31%	0.86%	0.50%	0.35%	1.72%	16.61%
2026	82.12%	0.16%	0.24%	0.95%	83.47%	9.82%	3.30%	0.86%	0.50%	0.35%	1.71%	16.53%
2027	82.20%	0.16%	0.24%	0.95%	83.55%	9.77%	3.28%	0.85%	0.49%	0.35%	1.71%	16.45%
2028	82.27%	0.16%	0.24%	0.95%	83.62%	9.73%	3.26%	0.85%	0.49%	0.35%	1.70%	16.38%
2029	84.07%	0.17%	0.27%	0.91%	85.43%	8.69%	2.89%	0.65%	0.50%	0.39%	1.44%	14.57%
2030	84.15%	0.17%	0.28%	0.91%	85.51%	8.65%	2.88%	0.65%	0.50%	0.39%	1.43%	14.49%
2031	84.21%	0.17%	0.28%	0.91%	85.57%	8.61%	2.87%	0.65%	0.50%	0.39%	1.42%	14.43%
2032	84.26%	0.17%	0.28%	0.91%	85.62%	8.58%	2.86%	0.64%	0.50%	0.38%	1.42%	14.38%
2033	84.32%	0.17%	0.28%	0.91%	85.68%	8.55%	2.84%	0.64%	0.49%	0.38%	1.41%	14.32%
2034	84.37%	0.17%	0.28%	0.91%	85.74%	8.51%	2.83%	0.64%	0.49%	0.38%	1.41%	14.26%
2035	84.43%	0.17%	0.28%	0.91%	85.79%	8.48%	2.82%	0.64%	0.49%	0.38%	1.40%	14.21%
2036	84.48%	0.17%	0.28%	0.92%	85.85%	8.45%	2.81%	0.63%	0.49%	0.38%	1.40%	14.15%
2037	84.54%	0.17%	0.28%	0.92%	85.90%	8.41%	2.80%	0.63%	0.49%	0.38%	1.39%	14.10%
2038	84.59%	0.17%	0.28%	0.92%	85.96%	8.38%	2.79%	0.63%	0.48%	0.38%	1.38%	14.04%
2039	84.65%	0.17%	0.28%	0.92%	86.02%	8.35%	2.78%	0.63%	0.48%	0.37%	1.38%	13.98%
2040	84.70%	0.17%	0.28%	0.92%	86.07%	8.31%	2.77%	0.62%	0.48%	0.37%	1.37%	13.93%
2041	84.73%	0.17%	0.28%	0.92%	86.10%	8.29%	2.76%	0.62%	0.48%	0.37%	1.37%	13.90%
2042	84.76%	0.18%	0.28%	0.92%	86.14%	8.27%	2.75%	0.62%	0.48%	0.37%	1.37%	13.86%
2043	84.80%	0.18%	0.28%	0.92%	86.17%	8.26%	2.75%	0.62%	0.48%	0.37%	1.36%	13.83%
2044	84.83%	0.18%	0.28%	0.92%	86.20%	8.24%	2.74%	0.62%	0.48%	0.37%	1.36%	13.80%
2045	84.86%	0.18%	0.28%	0.92%	86.23%	8.22%	2.73%	0.62%	0.48%	0.37%	1.36%	13.77%
2046	84.89%	0.18%	0.28%	0.92%	86.27%	8.20%	2.73%	0.61%	0.47%	0.37%	1.35%	13.73%
2047	84.92%	0.18%	0.28%	0.92%	86.30%	8.18%	2.72%	0.61%	0.47%	0.37%	1.35%	13.70%
2048	84.96%	0.18%	0.28%	0.92%	86.33%	8.16%	2.72%	0.61%	0.47%	0.37%	1.35%	13.67%
2049	84.99%	0.18%	0.28%	0.92%	86.36%	8.14%	2.71%	0.61%	0.47%	0.36%	1.34%	13.64%

2050	85.02%	0.18%	0.28%	0.92%	86.39%	8.12%	2.70%	0.61%	0.47%	0.36%	1.34%	13.61%
2051	85.05%	0.18%	0.28%	0.92%	86.43%	8.10%	2.70%	0.61%	0.47%	0.36%	1.34%	13.57%
2052	85.08%	0.18%	0.28%	0.92%	86.46%	8.08%	2.69%	0.61%	0.47%	0.36%	1.33%	13.54%

4.4 Analysis of influencing factors

4.4.1 Impact of road traffic

Highway traffic impact mainly considers two types of channels, one is river-crossing channel. The opening of Shenzhen-Zhongshan Link, Shiziyang Passage, Lianhuashan Passage and Lingdingyang Passage in the future will reduce the bypass between the east and west sides of the Pearl River Estuary and weaken the east-west traffic function of the Approved Road Section; The other is the parallel channel, which mainly refers to the improvement of the transport capacity of the reconstruction and expansion of DongGuan-Shenzhen Expressway, which will divert part of the traffic of the Approved Road Section.

(1) Shenzhen–Zhongshan Link

The Shenzhen-Zhongshan Link is 38 kilometers away from the Hong Kong-Zhuhai-Macao Bridge. The route starts from the airport interchange of Guangshen Coastal Expressway, connects with the Shenzhen side connecting line, crosses the Pearl River Estuary westward, lands at Ma'an Island, Cuiheng New District, Zhongshan City, and ends at Hengmen Interchange, with a total length of about 24 kilometers and a two-way eight-lane construction standard.

After the opening of Shenzhen-Zhongshan Link on June 30, 2024, from the actual situation after the opening, Shenzhen-Zhongshan Link effectively reduced the traffic volume of Humen Bridge and Nansha Bridge bypassing the direction of Pearl River to Shenzhen, and then diverted the traffic flow of Humen Bridge-Hezhou Interchange of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section). According to the traffic volume forecast results, the construction of Shenzhen-Zhongshan Link mainly diverts the traffic of Shenzhen section, which has a certain diversion impact on the vehicles entering and leaving Humen

Bridge and Nansha Bridge through the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section). For the Approved Road Section R&E Project, the diversion effect is relatively small. about 1-2%.

At the same time, as an important transportation link for convenient and direct connection of the Pearl River Delta urban agglomeration, the opening of the Shenzhen-Zhongshan Link has a significant impact on the river-crossing traffic. In Zhongshan, Jiangmen, Zhuhai, Shenzhen on the east coast and the south of Huizhou, the river-crossing distance will be shortened by about 45 km, and the river-crossing time will be shortened to less than one hour (about half an hour). Promote the efficient flow of innovative elements such as passenger flow, logistics, capital flow and technology flow.

(2) Shiziyang Passage and Changhu West Line

Shiziyang Passage connects with Guangzhongjiang Expressway to the west, passing through Tanzhou Town, Dagang Town, Lingshan Town, Huangge Town of Nansha New District, Humen Town of Dongguan City, and finally Xinlian Interchange. The total length of the route is about 34 kilometers. The river-crossing section of the project adopts a double-deck eight-lane expressway with a design speed of 100 km/h.

The opening of Shiziyang Passage will divert the traffic flow of the Approved Road Section (Xinlian-Guangdan), with a diversion ratio of about 3%. At the same time, Shiziyang Passage and Changhu West Extension Line will also divert the traffic flow of the Approved Road Section (Humen Bridge-Wudianmei), which will eventually reduce the average traffic volume of the Approved Road Section R&E Project by about 2% -3%.

(3) Lianhuashan Passage

The Lianhuashan Passage starts at the side of Panyu and connects with Guangming Expressway, and ends at Wangniudun Interchange of the

Approved Road Section. The total length of the route is about 28 kilometers. The river-crossing section of the project adopts the dual twelve-lane Expressway with a design speed of 100 km/H. The opening of Lianhuashan Passage will form a new passageway for Dongguan City and the north to enter Guangzhou City and Foshan.

According to the traffic volume forecast results, the opening of Lianhuashan Passage will divert the traffic volume from Dongguan to Guangzhou urban area, resulting in a 3-5% decrease in the traffic volume of the Approved Road Section.

(4) Lingdingyang Passage

Lingdingyang Passage is mainly responsible for the traffic volume from Zhuhai and the south of Zhongshan to Shenzhen, mainly diverting the traffic volume of Shenzhen-Zhongshan Link. According to the traffic volume forecast results, the opening of Lingdingyang Passage will divert about 6% of the traffic volume of the Approved Road Section (Hezhou-Nantou), and will also have a certain diversion impact on other northern sections, which has little effect on the traffic diversion of the Approved Road Section R&E Project. The proportion of diversion is about 1%.

(5) Reconstruction and expansion of Dongguan-Shenzhen Expressway

The reconstruction and expansion project of Dongguan-Shenzhen Expressway starts from the junction of Shenzhen and Dongguan in the south and ends at Guanlong Interchange in Dongcheng Street of Dongguan City in the north, with a total length of about 56 kilometers. It will be expanded from the existing two-way 6 lanes to two-way 10 lanes, and the local sections with large traffic volume will be expanded to 12 lanes. After the opening of the reconstruction and expansion project of Dongguan-Shenzhen Expressway, the improvement of its traffic capacity and efficiency will divert the traffic between Shenzhen and Dongguan sections

of the Beijing-Hong Kong-Macao Expressway to a certain extent, with a diversion ratio of about 2% -3%.

4.4.2 Impact of rail transit

The current high-speed railway is not obvious to the highway travel diversion, mainly because the time of entering and leaving the railway station is too long, which reduces the competitiveness of the railway; According to the rail network planning, in the future, the main plans on the Guangzhou-Shenzhen axis are Guangzhou-Dongguan-Shenzhen Intercity Railway, Guangzhou-Shenzhen Second high-speed rail, Shenzhen-Dongguan-Zengcheng Intercity Railway and Urban Metro. Although the high-speed rail into the city, the integration of rail network and the improvement of waiting mode will effectively enhance the share rate of the railway, they will be flexible, convenient, timely and comfortable. The overall effect of track on expressway diversion is very limited, and its diversion effect is comprehensively considered in the growth rate of traffic volume in the later period.

(1) Guangzhou-Dongguan-Shenzhen Intercity Railway

The opening of Guangzhou-Dongguan-Shenzhen Intercity Railway will mainly divert the Guangzhou-Shenzhen-Hong Kong high-speed rail and the Guangzhou-Shenzhen Intercity Railway passenger flow; at the same time, it will also divert a small amount of car travel on the Approved Road Section, mainly diverting the scale of medium and large operating passenger cars on the the Approved Road Section. In the future, the Guangzhou-Dongguan-Shenzhen Intercity Railway will extend southward to Qianhai and Futian areas in Shenzhen, with negligible impact on the Approved Road Section R&E Project.

(2) Guangzhou-Shenzhen Second high-speed rail.

The future Guangzhou-Shenzhen Second high-speed rail is currently

a long-term research project, with a design speed of 600km/H. Through the branch line, it can directly connect Guangzhou East Station and Shenzhen Baoan Airport, and can undertake high-end business trips. The impact on the Approved Road Section R&E Project can be ignored.

(3) Shenzhen-Dongguan-Zengcheng Intercity Railway

Shenzhen-Dongguan-Zengcheng Intercity Railway is currently a long-term research project, which has a certain distance from the Approved Road Section and connects Zengcheng direction, so the impact on the Approved Road Section can be ignored.

(4) Urban Metro

The construction of urban Metro will effectively divert the traffic volume of local roads, thereby improving the traffic conditions of local roads and indirectly transferring the traffic volume of the Approved Road Section to local roads. Considering the requirements of cross-city travelers for timeliness, this part of the impact can be ignored.

4.4.3 Impact of the project itself

(1) Construction period

Considering that the traffic relief during the construction of the Approved Road Section R&E Project will reduce the traffic capacity of the corridor, some traffic will be replaced by parallel corridors, and the traffic volume will be reduced by about 2%.

(2) After completion

After completion, the corridor will be widened from two-way 6 lanes to two-way 10 lanes, and the traffic capacity will be increased by more than 1.5 times. The improvement of traffic conditions and efficiency of the corridor will induce more traffic, and the overall traffic volume of the corridor will be increased by 12-16%.

4.5 Analysis of prediction results

In the medium scheme, the economic development level, the completion and opening time of relevant parallel or river-crossing channels and various indexes of induced diversion effect are between the high scheme and the low scheme, and the predicted traffic demand growth and toll revenue are also most likely to occur. Therefore, the analysis of traffic volume prediction results in this section focuses on the medium scheme.

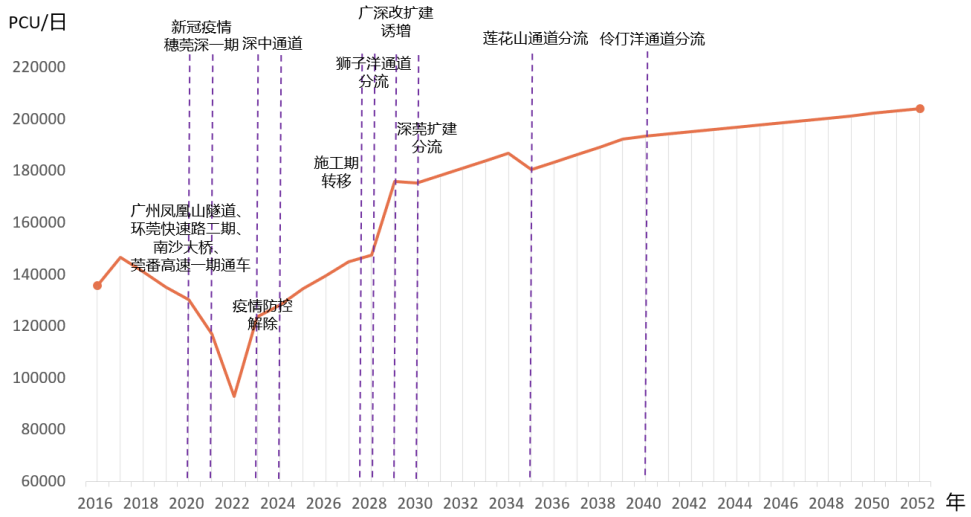

Figure 4-1 Medium Scheme Traffic Volume Growth Trend of the Approved Road Section R&E Project

After the full liberalization of epidemic prevention and control in 2023, the traffic volume of the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section) rebounded, with a growth rate of about 27% and an average annual traffic volume of about 123,000 pcu/day, recovering to more than 90% before the epidemic.

In 2024, the traffic volume of the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway decreased slightly, mainly due to the diversion of the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou

Huocun section of the Guangzhou-Foshan Expressway caused by the opening of Shenzhen-Zhongshan Link, with a diversion of about 1%.

In the second half of 2026, some sections of the reconstruction and expansion of the Approved Road Section R&E Project will be completed. Considering the gradual opening of the sections, the improvement of the whole market economy environment and the partial increase of the traffic volume induced by the reconstruction and expansion of the Approved Road Section R&E Project will increase the passenger and freight traffic volume to a certain extent, among which the freight traffic volume will increase greatly, so the overall freight traffic volume will increase in 2027. Income has also increased synchronously.

In 2028, the Shiziyang Passage will be completed and open to traffic, which will cause diversion to the passage, resulting in a slight decrease in traffic volume, with a comprehensive diversion ratio of about 2%.

By the end of 2028, the reconstruction and expansion of the Approved Road Section R&E Project will be completed, and the whole line will be opened to traffic in 2029, which will greatly increase the traffic volume. At the same time, the psychological impact of the reconstruction and expansion on the public, combined with the impact of its annual growth rate, will lead to a large jump in traffic volume.

In 2030, the reconstruction and expansion of Dongguan-Shenzhen Expressway will be completed, which will divert the passage, resulting in a slight decrease in traffic volume, with a comprehensive diversion ratio of about 2%.

In 2035, the Lianhuashan Passage was opened to traffic, mainly diverting the traffic volume from Dongguan to Guangzhou, with a diversion ratio of about 5%.

In 2040, the Lingdingyang Passage will be opened to traffic. As the passage is mainly positioned as a river-crossing passage between Shenzhen

and Zhuhai, the diversion effect on the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway of the passage is very small, with a diversion ratio of about 1%.

To sum up, considering the diversion of parallel or cross-river channels and the comprehensive impact after the construction and completion of the project, by the end of the forecast year, the annual average daily traffic volume of the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway is about 204,000 pcu/day.

Table 4-9 Analysis of Factors Affecting Traffic Volume Changes in Various Years

Year	Influencing factors	Type	Proportion
2023	Let go of the epidemic	Induced increase	27%
2024	The Shenzhen-Zhongshan Link was opened	Diversion	1%
2028	The Shiziyang Passage was opened	Diversion	2%
2029	Completion of the Approved Road Section R&E Project	Induced increase	16%
2030	Reconstruction and expansion of Dongguan-Shenzhen Expressway completed	Diversion	2%
2035	The Lianhuashan Passage was opened	Diversion	5%
2040	The Lingdingyang Passage was opened to traffic	Diversion	1%

4.6 Scheme comparison

By comparing the traffic volume prediction results of the high, medium and low schemes, the total traffic volume of the Approved Road Section R&E Project from 2023 to 2052 is 2.57% higher in the high scheme than in the medium scheme, and 5.48% lower in the low scheme than in

the medium scheme. The annual traffic volume results are shown in the following table.

Table 4-10 Comparison of Traffic Volume of the Approved Road Section R&E Project in Each Scheme (Unit: pcu/d)

Year	High scheme			Medium scheme			Low scheme		
	Passenger car	Truck	Total amount	Passenger car	Truck	Total amount	Passenger car	Truck	Total amount
2023	94027	29303	123330	94027	29303	123330	94027	29303	123330
2024	98603	30146	128749	97768	30895	128663	96953	29836	126789
2025	104035	31317	135351	99990	31125	131115	98586	30066	128652
2026	108402	32369	140771	101979	31481	133460	101440	30757	132197
2027	112955	33457	146411	112376	33301	145677	102290	30835	133125
2028	115346	33889	149236	112363	33021	145384	103147	30914	134061
2029	139426	40632	180058	134532	39207	173739	122056	36368	158424
2030	145289	41997	187286	137266	39671	176937	125593	37205	162798
2031	147717	42511	190228	139635	40172	179807	127940	37714	165654
2032	150186	43030	193217	142046	40679	182724	130331	38230	168561
2033	152697	43556	196253	144498	41192	185690	132768	38753	171521
2034	155250	44089	199338	146992	41712	188704	135250	39283	174533
2035	150047	42423	192470	142053	40126	182180	129580	37452	167032
2036	152556	42941	195498	144506	40633	185139	132003	37964	169967
2037	155107	43466	198573	147001	41146	188147	134471	38484	172954
2038	157700	43998	201698	149539	41665	191204	136985	39010	175996
2039	160337	44536	204873	152121	42191	194312	139547	39544	179091
2040	154868	42826	197694	153201	42296	195497	142156	40085	182242
2041	155634	42972	198605	153959	42440	196399	143563	40370	183933
2042	156404	43118	199521	154720	42585	197305	144983	40657	185639
2043	157177	43264	200442	155486	42729	198215	146417	40945	187362
2044	157955	43411	201366	156255	42875	199129	147865	41236	189101
2045	157149	43123	200272	157028	43020	200048	149328	41529	190857
2046	157926	43270	201196	157805	43167	200971	150805	41824	192629
2047	158707	43417	202125	158585	43313	201899	152297	42121	194417
2048	159493	43565	203057	159370	43461	202831	153803	42420	196223
2049	160282	43713	203994	160158	43608	203767	155325	42721	198046
2050	161074	43862	204936	160951	43757	204707	156861	43024	199886
2051	161871	44011	205882	161747	43905	205652	158413	43330	201743
2052	162672	44160	206832	162547	44055	206602	159980	43637	203618

4.7 Road service level

It is necessary to calculate and analyze the traffic capacity and service level of road traffic facilities when determining the width of road surface or the number of lanes and evaluating the operation quality and service level of roads after they are built in the stage of road planning and design, whether they are newly built or expanded.

Therefore, when evaluating and analyzing the level of service of different road traffic facilities, we must adopt the measurement index that can reflect the characteristics of their traffic flow.

Table 4-11Service Level of Freeway Section

Types of road traffic facilities	Service Level Evaluation Index of Road Traffic Facilities	
The highway	Basic road section	V/C (actual traffic volume/actual capacity), traffic density (pcu/h/In), vehicle speed (km/h)
	Interlacing section	V/C (actual traffic/actual capacity), traffic density (pcu/h/In)
	Ramp	V/C (Actual Volume/Actual Capacity), Traffic Flow Rate (pcu/h)
Multi-lane highways such as first-class highways	V/C (actual traffic volume/actual capacity), traffic density (pcu/h/In), vehicle speed (km/h)	
Two-lane highway	V/C (actual traffic volume/actual capacity), time delay percentage (%),speed (km/h)	
Road toll station	Average delay time (s/pcu)	
Unsignalized intersection	Average delay time (s/pcu)	
Signalized intersection	Average parking delay time per vehicle (s/pcu)	
The city's main road	Travel speed (km/h)	
Public transport	Load factor (passenger/seat, person/h, pcu/h)	
Pedestrian traffic	Space (m^2/person)	

According to "Technical Standard of Highway Engineering" (JTGB01-2-14), the value of V/C is used to measure the degree of congestion as the main index to evaluate the level of service, and the difference between the actual speed and the free flow speed of passenger cars is used as the secondary evaluation index. The level of service is divided into six levels, which represent the driver's feelings under certain operating conditions. The grading table is as follows:

Table 4-12 Service Level of Freeway Section

Service Level	The value of "v/c"	Design speed

Categories		120	100	80
		Maximum traffic volume served [pcu/(h*In)]	Maximum traffic volume served [pcu/(h*In)]	Maximum traffic volume served [pcu/(h*In)]
Level 1	$v/c \leq 0.35$	750	730	700
Level 2	$0.35 \leq v/c \leq 0.55$	1200	1150	1100
Level 3	$0.55 \leq v/c \leq 0.75$	1650	1600	1500
Level 4	$0.75 \leq v/c \leq 0.90$	1980	1850	1800
Level 5	$0.90 \leq v/c \leq 1.00$	2200	2100	2000
Level 6	$v/c \geq 1.00$	0~2200	0~2100	0~2000

In the Technical Standard for Highway Engineering (JTGB01-2-14), the maximum service traffic volume of a single lane of an expressway with a design speed of 120 km/H is 2200 standard vehicles per hour (PCU/H). Generally, in order to maintain smooth traffic, the service level of the expressway is required to be four or below, that is, the saturation should not exceed 0.9.

Table 4-13 Service Level of Freeway Section

Year	Equivalent traffic volume of the whole journey (10,000 pcu/d)	Traffic flow in peak hour (pcu/h)	Traffic flow per lane (pcu/h)	V/C value	Level of service
2018	14.1	13417	2236	1.02	Level 6
2019	13.5	12843	2141	0.97	Level 5
2028	14.5	13811	1381	0.62	Level 3
2029	17.3	16505	1650	0.75	Level 3
2030	17.6	16809	1680	0.76	Level 4
2035	18.2	17307	1730	0.78	Level 4
2040	19.5	18572	1857	0.84	Level 4
2045	20.0	19004	1900	0.86	Level 4
2052	20.6	19627	1962	0.88	Level 4

The traffic volume at the end of the forecast year (2052) is 206,000 PCU/day. Based on the peak hour coefficient of 9.5% for the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway, the peak hour traffic volume of a single lane in the corridor is 1,962 PCU/H, and the saturation is 0.89, which belongs to the service level IV and is close to the service level V. At the

same time, referring to similar cases such as Jihe Expressway, it is predicted that the daily traffic volume of two-way 10 lanes is above 200,000 PCU, which is at a high level.

Table 4-14 Comparison of the Approved Road Section R&E Project with other similar projects

	The Approved Road Section	Shenzhen Outer Ring Expressway	Shenzhen Bao'an International Airport Expressway	Guangshen Coastal Expressway
Forecast the last year	2052	2040	2048	2038
Forecast the maximum section volume at the end of the year (pcu/d)	206602	91880	103606 (ground floor) 82265 (solid layer)	159285
Saturation	0.89	0.77	0.75 (ground floor) 0.65 (solid layer)	0.91
Level of service	Level four	Level four	Level III (ground floor) Level III (solid layer)	Level five

5 Fee income forecast

5.1 Charging standard

According to the document of YJF [2019] No.830, the toll rate of expressway with six lanes and above is 0.6 yuan/standard vehicle kilometer, and the toll coefficient of each vehicle type is shown in the following table.

Table 5-1Discount Charge Coefficient of Each Vehicle Type

Passenger car			Truck		
category	Models and specifications	Toll coefficient	category	Models and specifications	Models and specifications
Category 1	<=9 seats	1	Category 1	Two axles (vehicle length less than 6000mm and maximum allowable total mass less than 4500kg)	1
Category 2	10-19 seats	1.5	Category 2	Two axles (vehicle length not less than 6000mm and maximum allowable total mass not less than 4500kg)	2.1
Category 3	20-39 seats	2	Category 3	Three axles	3.16
Category 4	>=40 seats	3	Category 4	Four axles	3.75
			Category 5	Five axles	3.86
			Category 6	Six axles	4.09

The total length of the Approved Road Section R&E Project is 71.126 km. According to the above rate and the toll coefficient of each vehicle type, the toll results of each vehicle type are calculated as follows.

Table 5-2 Charge for the whole journey converted by each vehicle type (RMB)

Passenger car				Truck (including operation vehicle)					
Category 1	Category 2	Category 3	Category 4	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
0.6	0.9	1.2	1.8	0.6	1.26	1.896	2.25	2.316	2.454
42.68	64.01	85.35	128.03	42.68	89.62	134.85	160.03	164.73	174.54

Remark

1. The fourth passenger car (large passenger car with more than 40 seats) is charged as 3 passenger cars;
2. The sixth category of trucks implements a differentiated toll policy of 99% discount.

5.2 Toll result forecast

According to the forecast results of the traffic volume of the Approved Road Section R&E Project converted into the whole journey by year and vehicle type, combined with the toll amount of each vehicle type converted into the whole journey, and the average driving distance of each vehicle

type converted into the traffic volume of the Approved Road Section R&E Project, the toll income forecast of each scheme can be obtained. In 2052, the annual income under the high scheme is 3.107 billion yuan, the medium scheme is 3.103 billion yuan, and the low scheme is 3.059 billion yuan.

From 2027 to 2052, the total toll of the Approved Road Section R&E Project is 2.61% higher in the high scheme (76.09 billion yuan) than in the medium scheme (74.16 billion yuan), and 5.89% lower in the low scheme (69.79 billion yuan) than in the medium scheme.

Table5-3 Scheme 1 (High Scheme) Charge Income Forecast Result (RMB 10,000)

Year	Passenger car				Truck (including operation vehicle)						Holiday exemption	ETC Discount	Total charges
	Class 1	Class 2	Class 3	Class 4	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6			
2023	149578	444	876	3461	18256	12851	4979	3528	2554	12909	8195	6767	194472
2024	150030	445	879	3471	18028	12691	4915	3485	2523	12749	8221	6763	194232
2025	158294	470	928	3663	18726	13183	5105	3621	2622	13244	8674	7109	204074
2026	164940	490	967	3816	19356	13626	5276	3743	2710	13689	9038	7393	212182
2027	171867	510	1007	3976	20006	14084	5454	3868	2801	14149	9417	7689	220617
2028	175506	521	1029	4060	20265	14266	5524	3918	2837	14332	9617	7837	224806
2029	212144	630	1244	4907	24297	17105	6623	4698	3402	17184	11624	9455	271155
2030	221065	657	1296	5113	25113	17680	6846	4856	3516	17761	12113	9834	281956
2031	224760	667	1318	5199	25420	17896	6929	4916	3559	17978	12316	9988	286339
2032	228517	679	1340	5286	25730	18114	7013	4976	3603	18198	12521	10145	290791
2033	232337	690	1363	5374	26044	18335	7099	5037	3648	18421	12731	10304	295313
2034	236221	702	1385	5464	26362	18559	7185	5099	3693	18646	12944	10465	299907
2035	228306	678	1339	5281	25365	17858	6913	4907	3554	17941	12510	10104	289528
2036	232123	689	1361	5369	25675	18076	6997	4968	3598	18161	12719	10263	294034
2037	236004	701	1384	5459	25988	18297	7082	5029	3643	18383	12932	10424	298613
2038	239950	713	1407	5550	26305	18520	7168	5091	3688	18608	13148	10588	303263
2039	243963	725	1431	5642	26626	18747	7255	5153	3733	18835	13368	10754	307988
2040	235640	700	1382	5450	25604	18027	6976	4956	3590	18112	12912	10377	297148
2041	236806	703	1389	5477	25691	18088	7000	4973	3603	18174	12976	10425	298502
2042	237977	707	1396	5504	25778	18150	7023	4990	3615	18236	13040	10473	299862
2043	239155	710	1403	5531	25866	18211	7047	5006	3627	18298	13104	10521	301229
2044	240338	714	1410	5558	25954	18273	7071	5024	3639	18360	13169	10569	302602
2045	239111	710	1403	5530	25782	18152	7024	4990	3615	18238	13102	10512	300942
2046	240294	714	1409	5557	25869	18214	7048	5007	3628	18300	13167	10560	302314
2047	241483	717	1416	5585	25957	18276	7072	5024	3640	18362	13232	10609	303692
2048	242678	721	1423	5613	26045	18338	7096	5041	3652	18425	13297	10658	305077
2049	243878	724	1431	5640	26134	18400	7120	5058	3665	18487	13363	10707	306468
2050	245084	728	1438	5668	26223	18463	7145	5076	3677	18550	13429	10756	307866
2051	246297	732	1445	5696	26312	18525	7169	5093	3690	18613	13496	10806	309270
2052	247515	735	1452	5724	26401	18588	7193	5110	3702	18677	13562	10855	310681

Table 5-4 Scheme 2 (Medium Scheme) Charge Income Forecast Result (RMB 10,000)

Year	Passenger car				Truck (including operation vehicle)						Holiday exemption	ETC Discount	Total charges
	Class 1	Class 2	Class 3	Class 4	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6			
2023	149578	444	876	3461	18256	12851	4979	3528	2554	12909	8195	6767	194472
2024	148760	442	872	3443	17883	12589	4876	3456	2502	12647	8151	6706	192612
2025	152140	451	892	3520	18015	12682	4911	3483	2522	12740	8336	6834	196186
2026	155166	461	910	3590	18221	12827	4968	3523	2551	12887	8502	6956	199645
2027	170987	508	1002	3956	19913	14018	5428	3850	2788	14083	9369	7650	219514
2028	170967	508	1002	3955	19745	13901	5383	3818	2764	13965	9368	7635	219005
2029	204698	608	1200	4735	23445	16505	6391	4533	3282	16581	11216	9123	261640
2030	208859	620	1225	4831	23722	16700	6467	4587	3321	16777	11444	9290	266374
2031	212464	631	1246	4914	24021	16911	6548	4645	3364	16989	11642	9441	270650
2032	216131	642	1267	4999	24324	17124	6630	4704	3407	17204	11843	9594	274995
2033	219862	653	1289	5085	24630	17340	6713	4764	3450	17421	12047	9749	279411
2034	223657	664	1312	5173	24940	17559	6797	4824	3494	17641	12255	9907	283900
2035	216143	642	1268	4999	23992	16891	6539	4641	3362	16970	11843	9564	274039
2036	219874	653	1290	5086	24294	17104	6621	4700	3405	17184	12048	9719	278444
2037	223671	664	1312	5173	24601	17320	6704	4760	3448	17401	12256	9877	282921
2038	227533	676	1335	5262	24911	17538	6788	4821	3492	17621	12468	10037	287472
2039	231462	687	1358	5353	25225	17760	6873	4882	3537	17844	12683	10200	292097
2040	233104	692	1367	5391	25287	17804	6889	4895	3546	17888	12773	10262	293830
2041	234257	696	1374	5418	25373	17864	6913	4911	3558	17949	12836	10309	295169
2042	235416	699	1381	5445	25459	17925	6936	4928	3570	18010	12900	10356	296514
2043	236581	703	1388	5472	25546	17986	6960	4945	3582	18071	12963	10404	297866
2044	237751	706	1395	5499	25633	18047	6984	4961	3595	18133	13027	10452	299224
2045	238927	710	1402	5526	25720	18108	7007	4978	3607	18195	13092	10500	300588
2046	240109	713	1408	5553	25807	18170	7031	4995	3619	18256	13157	10548	301958
2047	241297	717	1415	5581	25895	18232	7055	5012	3631	18318	13222	10597	303335
2048	242491	720	1422	5608	25983	18294	7079	5029	3644	18381	13287	10646	304719
2049	243691	724	1429	5636	26071	18356	7103	5046	3656	18443	13353	10695	306108
2050	244896	727	1437	5664	26160	18418	7127	5064	3668	18506	13419	10744	307505
2051	246108	731	1444	5692	26249	18481	7152	5081	3681	18569	13485	10793	308907
2052	247325	735	1451	5720	26338	18544	7176	5098	3693	18632	13552	10843	310317

Table 5-5 Scheme 3 (Low Scheme) Charge Income Forecast Result (RMB 10,000)

Year	Passenger car				Truck (including operation vehicle)						Holiday exemption	ETC Discount	Total charges
	Class 1	Class 2	Class 3	Class 4	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6			
2023	149578	444	876	3461	18256	12851	4979	3528	2554	12909	8195	6767	194472
2024	147519	438	865	3414	17843	12560	4865	3448	2496	12618	8083	6660	191322
2025	150004	445	879	3471	17979	12657	4902	3475	2516	12715	8219	6758	194067
2026	154346	458	905	3572	18393	12948	5015	3555	2574	13008	8457	6944	199372
2027	155639	462	912	3601	18440	12981	5027	3564	2580	13041	8528	6992	200728
2028	156944	466	920	3631	18486	13014	5040	3573	2587	13074	8600	7041	202095
2029	185714	551	1089	4297	21748	15310	5930	4204	3043	15381	10176	8320	238771
2030	191096	567	1120	4421	22249	15662	6066	4301	3113	15735	10471	8549	245310
2031	194668	578	1141	4504	22552	15876	6148	4360	3156	15950	10667	8699	249569
2032	198306	589	1163	4588	22861	16093	6232	4420	3200	16168	10866	8852	253903
2033	202013	600	1184	4674	23173	16313	6317	4481	3244	16390	11069	9007	258313
2034	205790	611	1207	4761	23490	16536	6403	4542	3289	16614	11276	9164	262802
2035	197163	585	1156	4561	22394	15765	6104	4331	3136	15839	10803	8770	251462
2036	200850	596	1178	4646	22700	15981	6187	4391	3180	16056	11005	8924	255835
2037	204605	608	1200	4733	23010	16199	6271	4451	3224	16276	11211	9081	260285
2038	208431	619	1222	4822	23324	16421	6356	4512	3268	16499	11421	9240	264814
2039	212328	631	1245	4912	23643	16645	6443	4575	3314	16725	11634	9402	269423
2040	216299	642	1269	5004	23966	16873	6530	4638	3360	16954	11852	9567	274115
2041	218439	649	1281	5053	24136	16993	6577	4671	3383	17074	11969	9656	276630
2042	220599	655	1294	5103	24308	17114	6623	4704	3407	17195	12088	9745	279169
2043	222781	662	1307	5153	24480	17235	6670	4737	3432	17317	12207	9836	281732
2044	224985	668	1320	5204	24654	17357	6718	4771	3456	17440	12328	9927	284319
2045	227211	675	1333	5256	24829	17481	6765	4805	3480	17564	12450	10019	286930
2046	229458	681	1346	5308	25005	17605	6814	4839	3505	17689	12573	10111	289565
2047	231728	688	1359	5360	25183	17730	6862	4873	3530	17814	12697	10205	292226
2048	234021	695	1373	5413	25362	17856	6911	4908	3555	17941	12823	10300	294911
2049	236336	702	1386	5467	25542	17982	6960	4943	3580	18068	12950	10395	297621
2050	238674	709	1400	5521	25723	18110	7009	4978	3606	18197	13078	10492	300356
2051	241035	716	1414	5575	25906	18239	7059	5013	3631	18326	13207	10589	303117
2052	243419	723	1428	5631	26090	18368	7109	5049	3657	18456	13338	10687	305904

Remark

1. Impact of holiday reduction and exemption: tolls for small passenger cars are exempted on major holidays, which are calculated according to 20 days per year for passenger vehicles with less than 7 seats (including 7 seats);

2. Preferential effect of ETC (Yuetong Card): Starting from July 1, 2019, the toll of national expressways paid by Yuetong Card will be 95% off. Therefore, the preferential coefficient of Yuetong Card in this project is 5%. Considering the current ETC installation of passenger cars (70%) and freight cars (60%), the weighted average toll concession coefficient is 0.965 for passenger cars and 0.97 for freight cars.

5.3 Analysis on the difference between the prediction result and the feasibility report

5.3.1 Traffic volume analysis

The traffic volume forecast is based on the expressway toll data of the base year, i.e., the traffic volume of the forecast base year, taking into account the social development prospects, the level of economic development, the rebound of traffic volume after the optimization of epidemic prevention and control policies, the reduction or induced increase caused by the construction and completion of the corridor itself, as well as the timing and impact of the completion of the relevant river-crossing or parallel corridors.The predicted results are affected by various indexes, including the traffic growth rate brought about by social and economic development, the size of diversion or induced increase in corridor construction, and the time of occurrence. Therefore, even if the traffic volume in the forecast base year is basically the same, the results of traffic volume forecast will still be different under the superposition of various influencing factors.

5.3.2 Analysis of toll revenue

Toll revenue is based on the daily traffic volume, the length of toll sections and the toll standards per kilometer for different types of vehicles, multiplied by the total annual toll revenue of 365 days per year, and then deducted from the ETC concessions, holiday exemptions and other fees.

After comparison, the logic of this round of toll revenue forecast is consistent with that of Engineering feasibility report. In the case of similar number of standard vehicles, there is still a difference in toll revenue. The main reason is that there is a difference in the proportion of vehicle types (passenger and freight). The Engineering feasibility report of the project predicts the toll revenue for the entire section, including the Beijing-Hong

Kong-Macao Expressway (Shenzhen section) reconstruction and expansion project, the proportion of passenger cars will be higher; while this round of forecast is mainly for the reconstruction and expansion project of the Guangzhou Huocun to Dongguan Chang'an section of the Beijing-Hong Kong-Macao Expressway and Guangzhou Huangcun to Guangzhou Huocun section of the Guangzhou-Foshan Expressway (i.e. the Approved Road Section R&E Project), the overall proportion of freight cars will be higher. Converted into standard vehicles, it is actually composed of different categories of trucks (six categories) The unit charge income of the standard car (PCU) converted is slightly lower than that of the standard car (PCU) converted from different passenger cars (four categories). Therefore, under the condition that the number of standard vehicles is similar, the toll revenue of this round of forecast will be slightly lower than that of Engineering feasibility report.

Toll revenue is based on the daily traffic volume, the length of toll sections and the toll standards per kilometer for different types of vehicles, multiplied by the total annual toll revenue of 365 days per year, and then deducted from the ETC concessions, holiday exemptions and other fees.

5.3.3 Rationality analysis

With the goal of "striving to build a 100-kilometer golden inner bay around the Pearl River Estuary, driving the coordinated development of Guangzhou, Shenzhen and the West Bank of the Pearl River Estuary" put forward in the report of the 13th Party Congress of Guangdong Province, the Beijing-Hong Kong-Macao Expressway (Guangzhou to Shenzhen section), as the main corridor of the West Bank of the Pearl River Estuary, will usher in greater travel demand in the future.This forecast is carried out under the background of the optimization of epidemic prevention and control policy, the sustained economic development of post-epidemic era,

the rebound growth of traffic volume and the introduction of several measures to promote automobile consumption by the state.Fully considering the policy planning, the integrated development of Guangdong-Hong Kong-Macao Greater Bay Area, the interconnection of infrastructure, the strong interaction between high-grade corridors such as expressways, and the impact of the completion and opening of relevant major corridors on the traffic volume along the Approved Road Section R&E Project, and other factors, as well as the service level of the existing industrial and commercial corridors, on the basis of the Engineering feasibility report, we have reorganized and demarcated them. Traffic volume and toll revenue prediction results are obtained. The overall forecast results are objective, reasonable and in line with the actual situation.