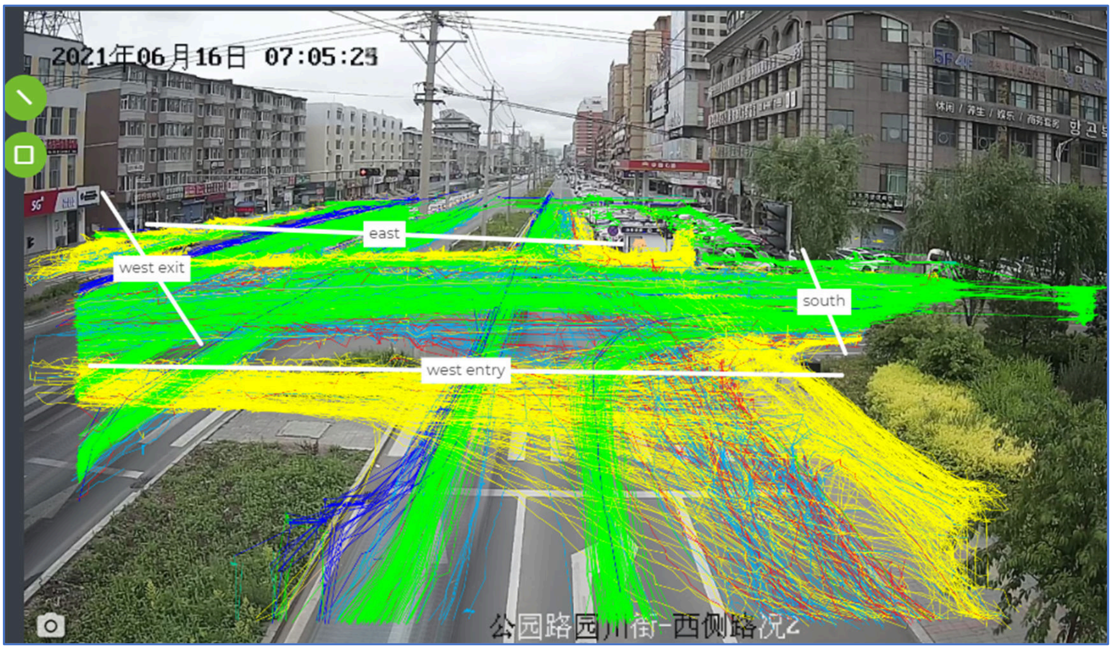
Far East Mobility
BRT & Urban Transport Planning

ADB Loaned Jilin Yanji Low-Carbon Climate-Resilient

Healthy City Project



INCEPTION REPORT

Draft, 30 June 2021

Consulting Services for Low-Carbon City Action Plan preparation, Traffic Impact Assessment, Modelling and Evaluation, Parking Management Study and for BRT Operation Capacity Development and BRT Network Planning, and Pedestrian and Bicycle and Universal Design Master Planning

Contents

Abbreviations

ADB – Asian Development Bank

BRT – Bus Rapid Transit

FEM – Far East Mobility

NMT – Non-motorized transport (pedestrians and bicycles, including e-bikes)

PCU – Passenger Car Unit

PMO – Project Management Office

TOD – Transit-oriented development

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1 Introduction

1.1 Project Scope

A series of major low-carbon, healthy-city and transit-oriented development measures centred around a Bus Rapid Transit (BRT) corridor are being implemented under an Asian Development Bank (ADB) loan funded project in Yanji, Jilin Province.

Far East Mobility (FEM) is one of several consultant teams in the project, and is responsible for technical input assisting the Project Management Office (PMO), local agencies and the ADB in the following areas:

- BRT
- Non-motorized transit
- Traffic impact analysis and road safety
- Low Carbon Action Plan
- Transit Oriented Development (TOD)
- Parking management.

Far East Mobility was mobilized in early May 2021 and carried out a visit to Yanji in May 2021, taking part in an ADB mission and carrying out initial site visits and familiarization, as well as setting up an office and identifying and training survey personnel for the initial data collection.

This report considers each topic in turn, providing:

1. An outline of the proposed work plan;
2. Observations on data collection, including information requirements;
3. Preliminary observations and, in some cases, recommendations.

1.2 Project Background and Timeline

The overall project timeline, updated with information from visits to Yanji and the ADB mission in May 2021, is shown in Figure 1, and is regularly updated at https://www.fareast.mobi/yanji/workplan. The key feature of the work plan and schedule is that the construction of the Phase 1A BRT corridor has already commenced, at approximately the same time as Far East Mobility (FEM) was mobilized in early May 2021.

The traffic impact analysis, parking study and NMT Master Plan components are all related to the BRT corridor and commenced in May 2021. The TOD and Low Carbon Action Plan components are not directly tied to the BRT project, and these components have not yet commenced beyond some initial work planning as part of this report. Most early attention has been on issues related to the phase 1A BRT design and implementation given the corridor is commencing construction.

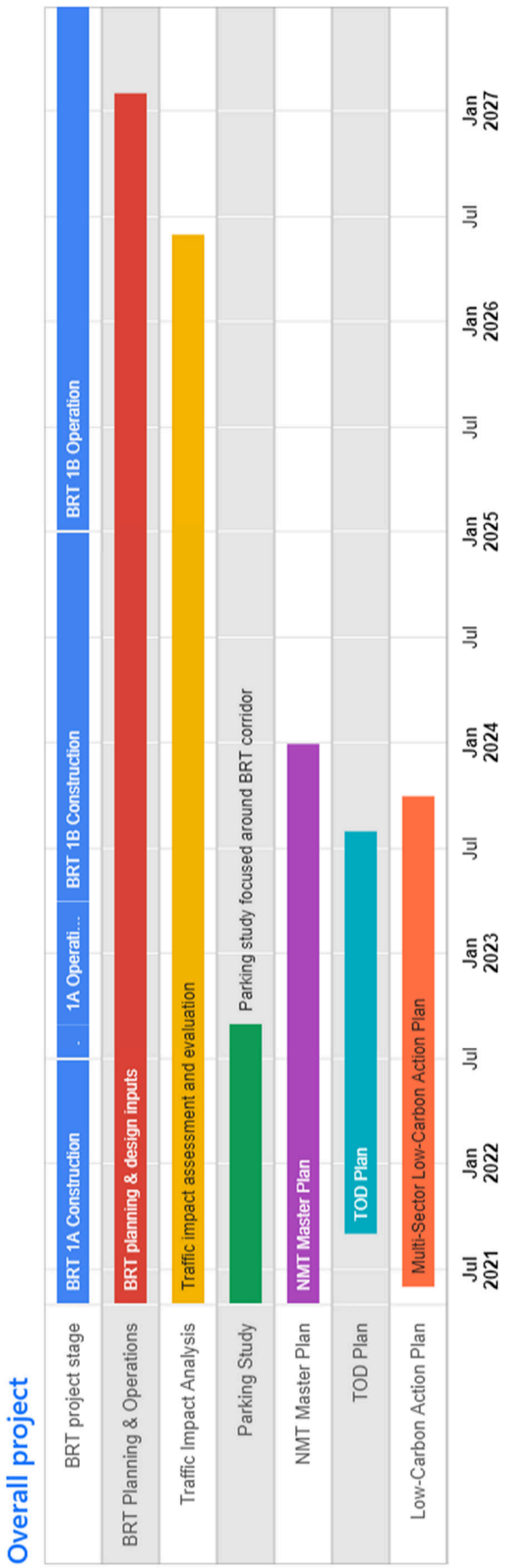


Figure 1: Overall project timeline and work plan.

2 BRT

2.1 Work Plan

The BRT project components and work plan are shown below, in the context of the overall project, also highlighting the Phase 1A component of the project.

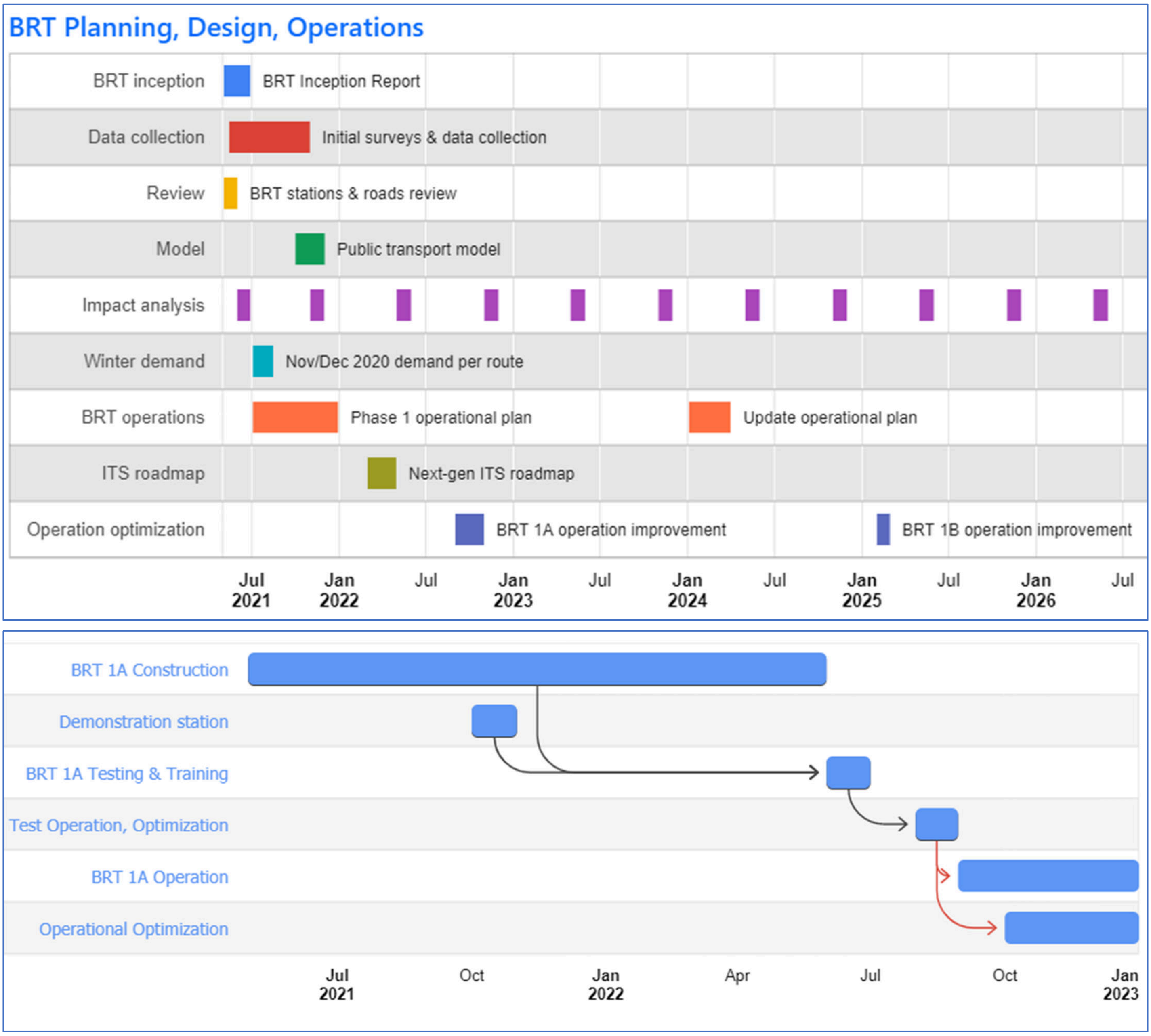


Figure 2: Outline work plan and timeline for the BRT planning, design and implementation.

2.2 Data Collection

Substantial work on the BRT demand modelling and operational planning has commenced and is ongoing. This includes:

1. Frequency and visual occupancy counts carried out over a 4 hour period around the AM and PM peak hours, in order to define precisely the peak hour for transit passenger flows.
2. Identification of all operating routes, and their peak hour frequency, through frequency and visual occupancy counts, also cross-checked with the Bus Company departure schedule information for each route.
3. Setting up a POSTGIS database for recording, querying and analysing demand and other spatial data.
4. On-bus surveys of bus speed and boarding and alighting. A database has been set up to record these values directly from GPS files, with the on-bus surveys ongoing.
5. Identification of all bus stops used by all bus routes. This is done by a combination of sources including:
    a. On-bus surveys which record stopping locations directly in GPS format;
    b. Data from bus company surveys carried out at bus stops in November and December 2020;
    c. Online sources, including online Baidu and Gaode maps, and Baidu Streetview which has street imagery enabling bus stops to be identified from 2019 and 2020.
6. Site visits and field observations of the operating conditions, throughout May and June 2021.
7. Consultation with the Bus Company, who have been very helpful and forthcoming in regard to provision of information.

This data collection and database development, especially considering the bus stop count data available from a Bus Company survey as part of the Five Year Plan cycle in November and December 2020, has led to a rapid development of demand profiles for the current bus system and future BRT system.

Interview questionnaires were also carried out for more than 500 bus passengers in the BRT corridor, as part of the BRT impact analysis.

2.3 Access to Gongyuan and Yanbian University stations

Coding used for the BRT stations is shown in Figure 3. Yanbian University is station B16, and Gongyuan is station B17. These are the two easternmost stations in the Phase 1A BRT corridor currently under construction.

Access to the Gongyuan BRT station is very important to the success of the BRT system, noting that it will be by far the largest demand station in the Phase 1A BRT system. After Gongyuan, the University station is the second-most important station. These two stations together account for more than half of the entire Phase 1A boarding and alighting demand, as shown in the demand graphics in Figure 4, Figure 5 and Figure 6. Figure 4 shows the current citywide bus demand based on bus stop counts carried out by the bus company in November and December 2020. (These counts were not processed or otherwise used, but Far East Mobility has in May and June 2020 processed the data and made it available online at www.yanjibrt.net.) Figure 5 shows the current bus demand allocated to nearby BRT stations for the whole Phase 1 BRT corridor, with Figure 6 showing just the Phase 1A corridor stations.

It was decided earlier in 2021, before the consultant team was mobilized, that the Gongyuan BRT station would be accessed by a bridge rather than pedestrian crossing, and that the University station would be located 940m away from the Gongyuan station. (An ideal spacing in this high demand part of the corridor would be 500-600m.)

As shown in the demand graphics in Figure 5 and Figure 6, when the current bus stop demand located within 600m of a BRT station is allocated to the nearest BRT station, the Gongyuan station alone accounts for 42% of the entire phase 1 boarding and alighting demand in the AM peak (2,543 out of 6,055). In the PM peak, Gongyuan station accounts for 41% of total boarding and alighting demand (1,999 out of 4,887).

The BRT stations are coded as B1 in the west to B25 in the east, with phase 1A stations from B7 to B17, as shown in Figure 3.

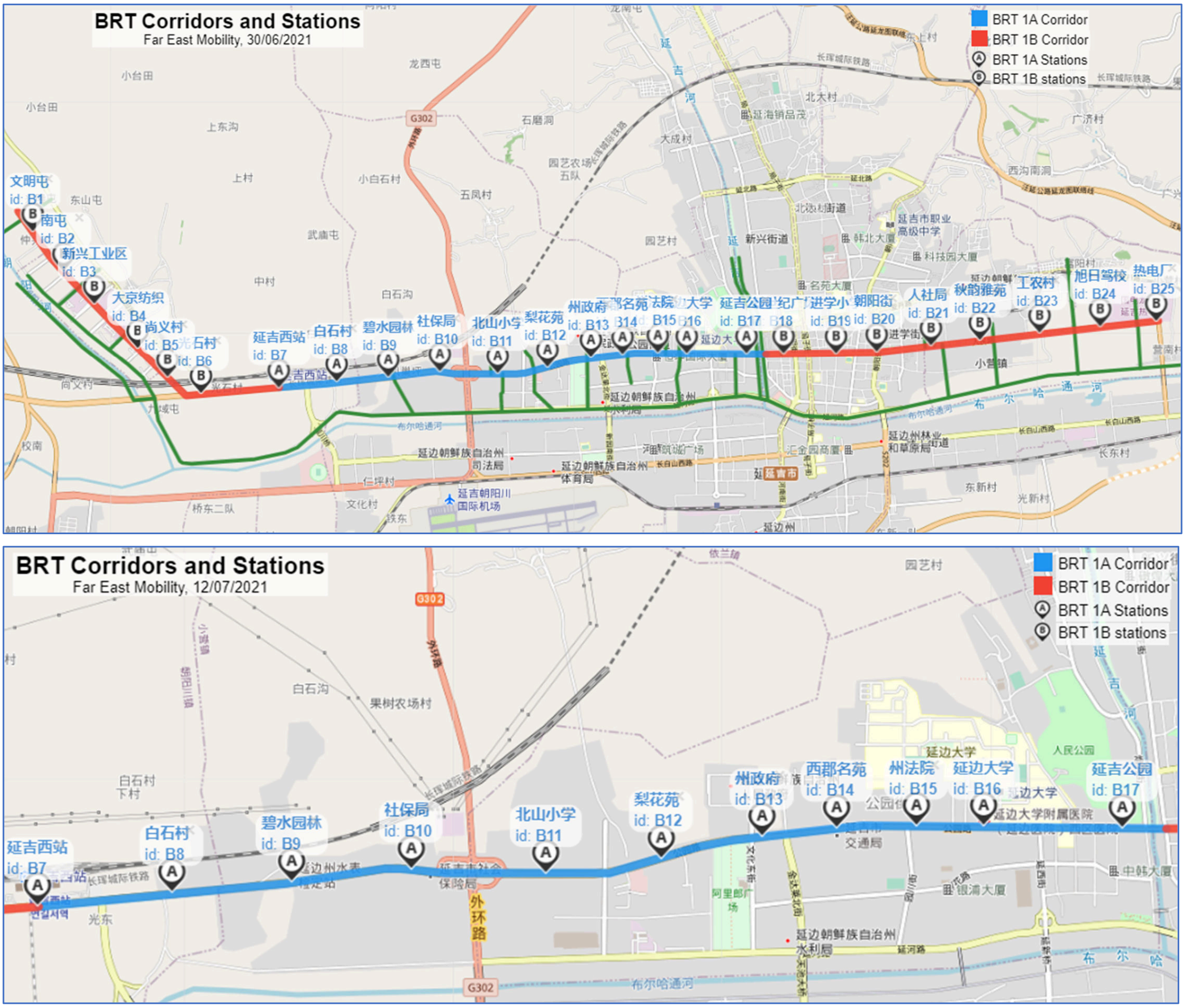


Figure 3: BRT station codes, from B1 to B25.

The demand at current bus stops, based on counts at bus stops carried out by the bus company in November and December 2020 and supplied to Far East Mobility in May 2021, show the concentration of demand in the central area, especially around the Gongyuan station in phase 1 (marked in red outline in Figure 4).

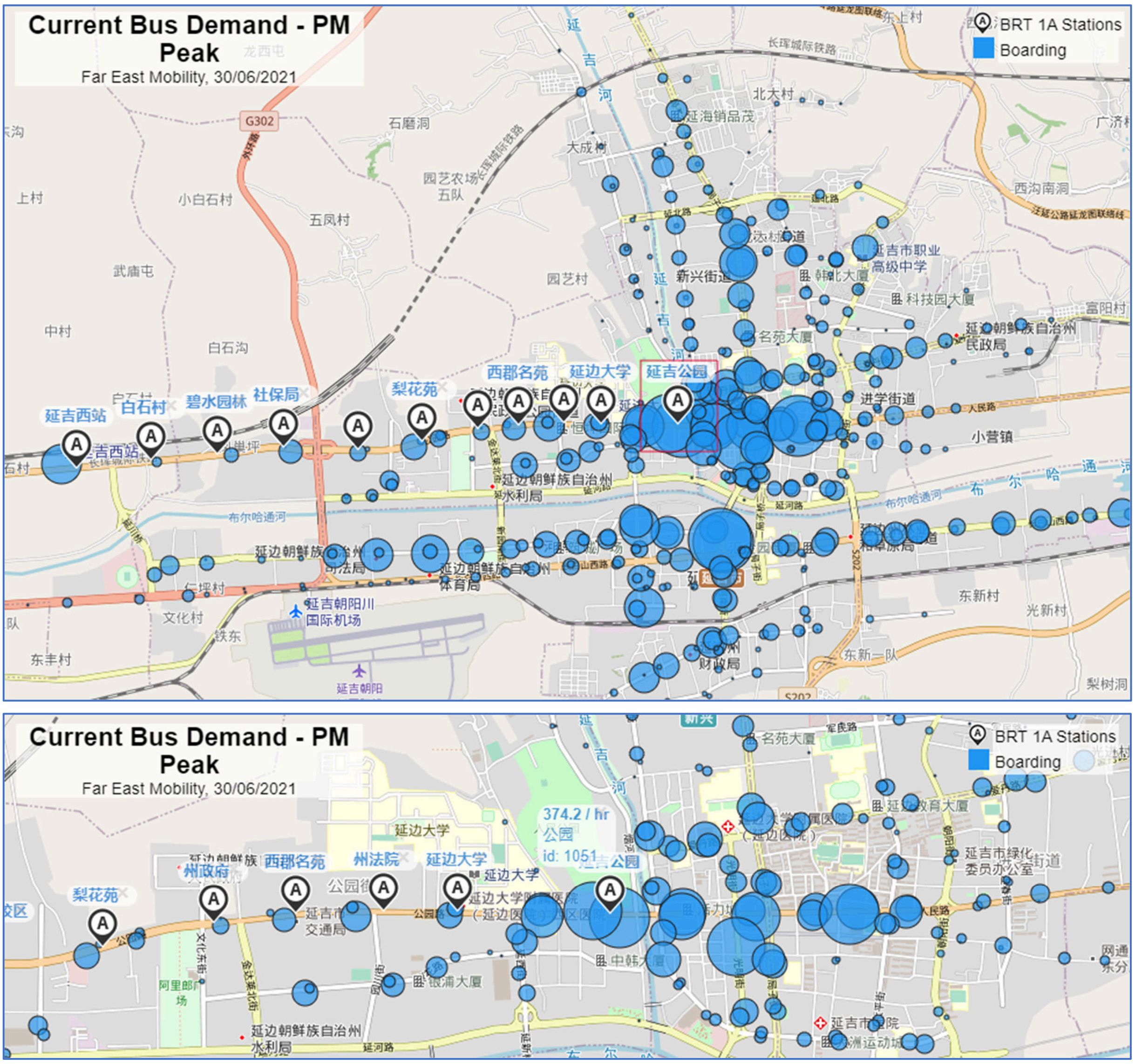


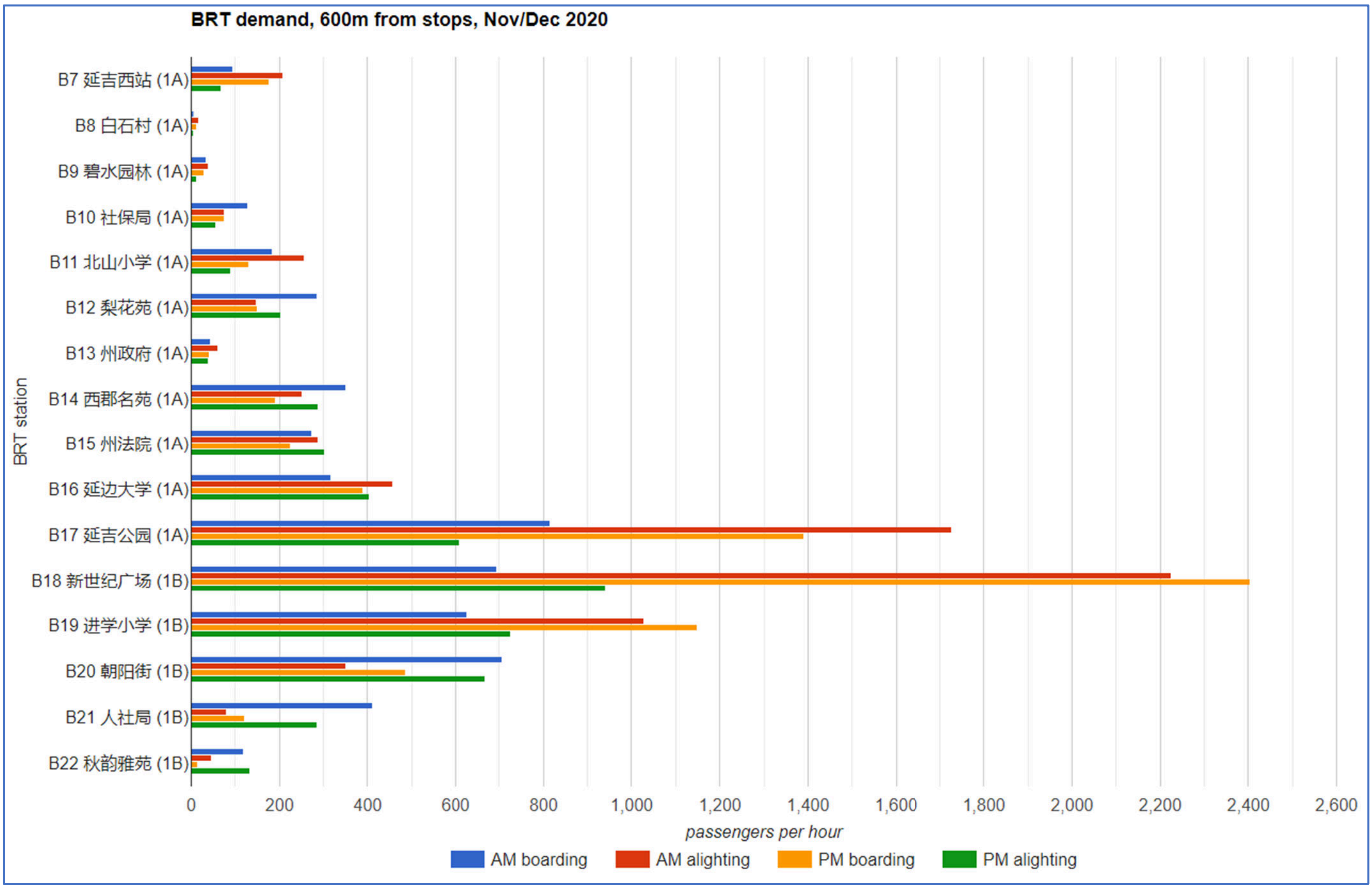
Figure 4: Bus stop boarding during the PM peak in November and December 2020.

The following graphics show the importance of the three central BRT stations – B17, B18 and B19 – in the full Phase 1 BRT corridor, with demand at these three stations far outweighing demand at the all the other stations combined.

When only the Phase 1A BRT stations, which are currently under construction, are considered, the dominance of the Gongyuan station (B17) is even more apparent, accounting for nearly half of the whole Phase 1A boarding and alighting demand, as shown in the cumulative demand curves in Figure 6. (Note that the actual BRT demand can be expected to be significantly higher, due to mode shift to BRT from other modes.)

In this context, access to the Gongyuan station is extremely important, and the University station is also important.

The BRT station access at Gongyuan station as currently designed is likely to negatively impact demand, similar to BRT stations in Nanning, Guangxi Province. Some passengers only 20m from the platform will need to walk 195m to access the station, including going up and down two sets of stairs (Figure 7). The BRT station access at Yanbian University station also imposes long additional walking distances on some passengers, which is likely to suppress transit demand at an important BRT station.



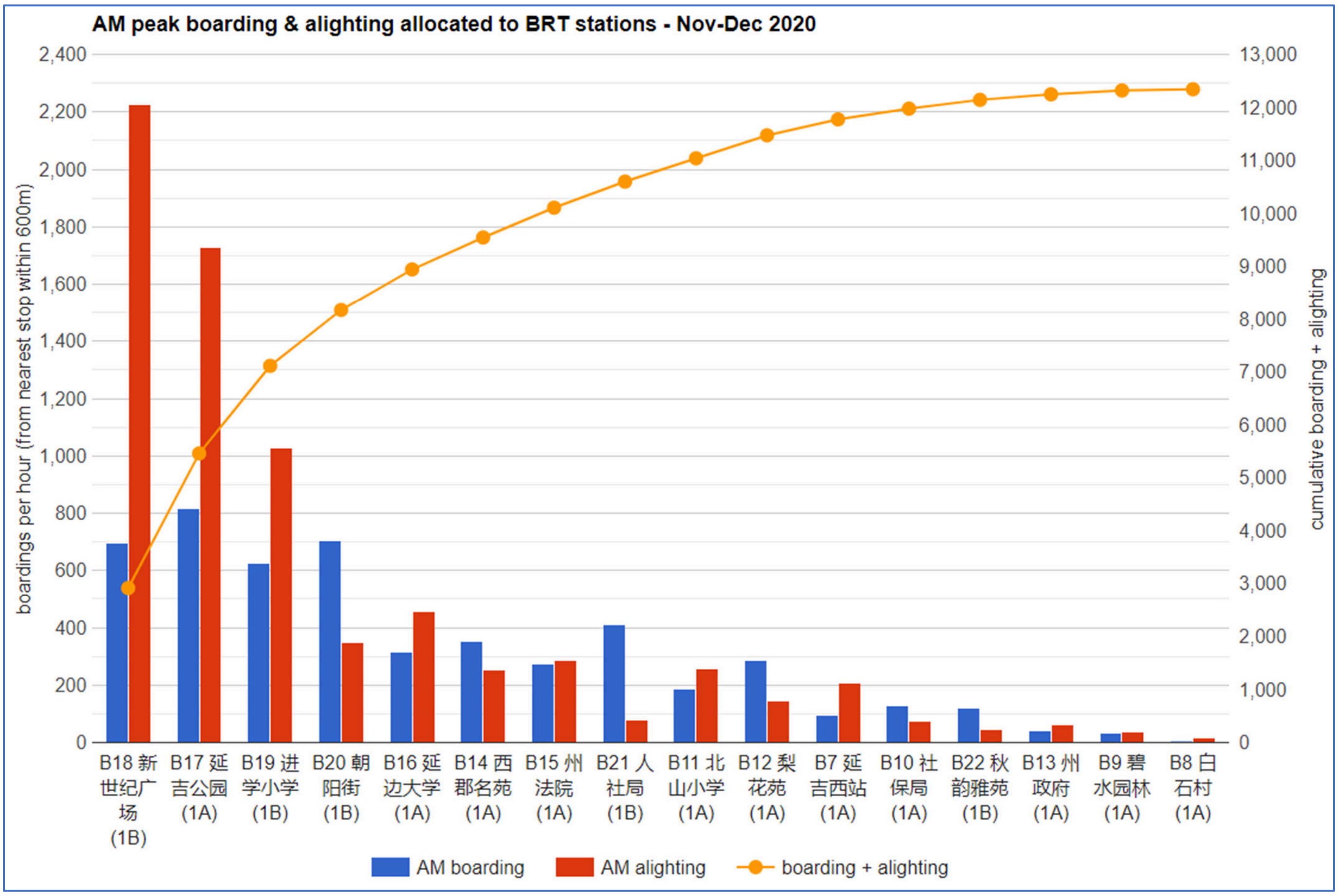
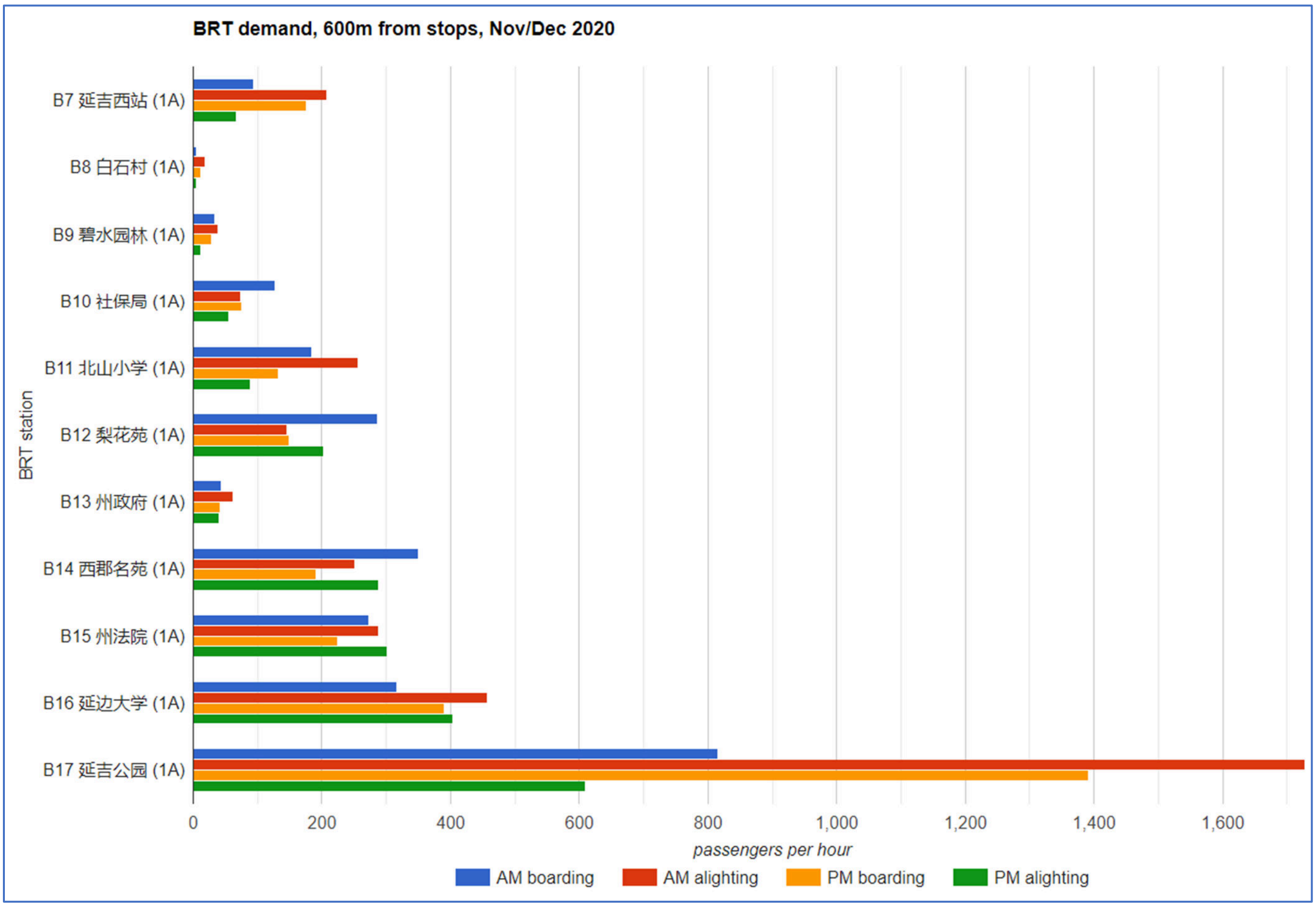


Figure 5: Boarding and alighting demand at BRT stations based on Nov-Dec 2020 bus demand.



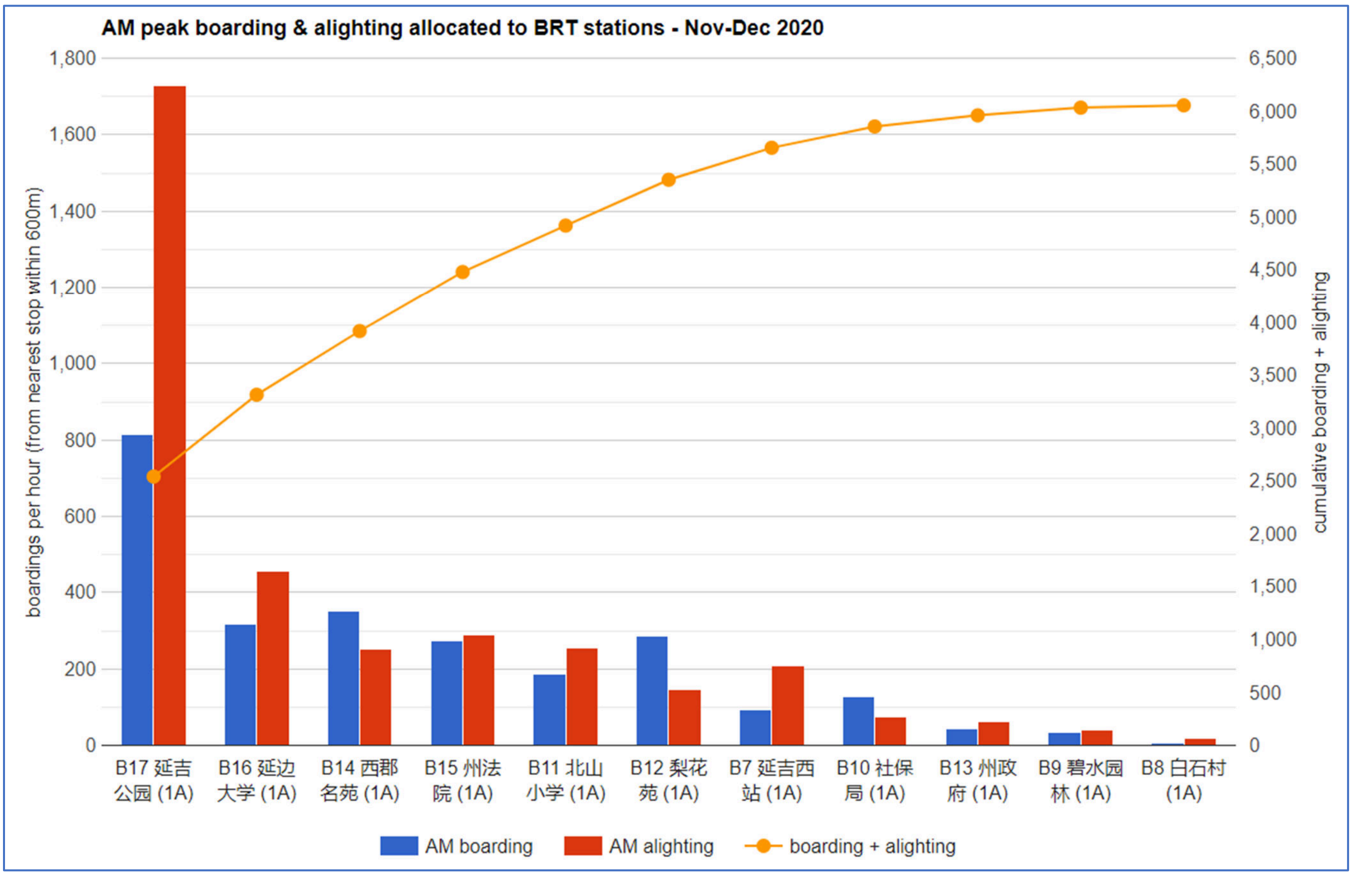


Figure 6: Boarding and alighting demand at BRT stations, based on current bus stop demand.

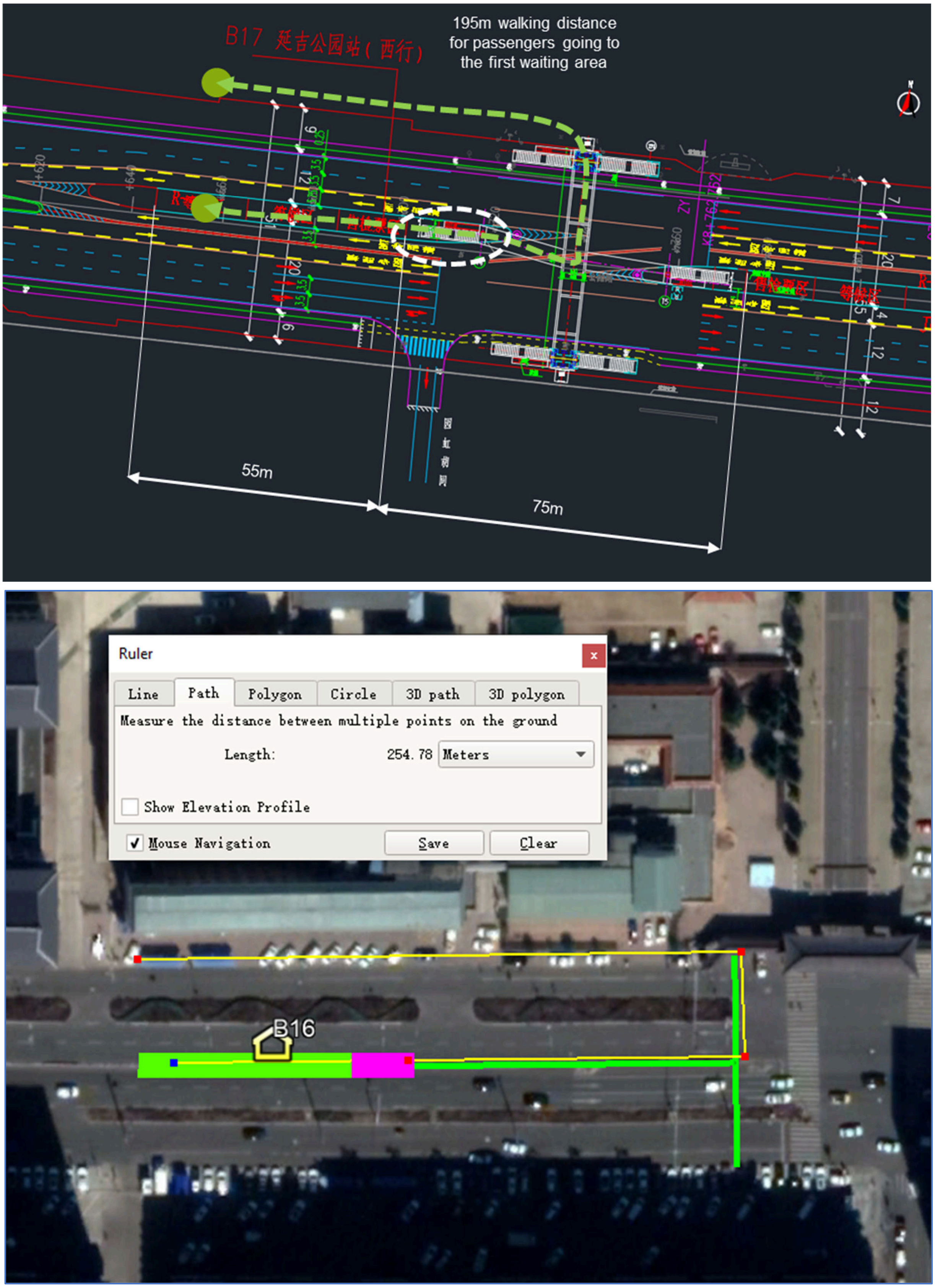


Figure 7: Some passengers will need to walk 195m at Gongyuan station and 255m at University station to access the platform 20m away. At Gongyuan, in addition to the extra walking distance, passengers will need to go up and down two sets of stairs.

At several stations in Nanning, straight line distances of 20m for a prospective BRT passenger require a walking trip of nearly 300m, with the walking trip including going up and down two sets of stairs. This is a heavy penalty to impose on potential BRT passengers, and deters many passengers from using the system. The additional 250m required to reach the BRT station boarding area translates to around 3 minutes for an average passenger at street level, but considering the additional requirement to walk up and down stairs, amounts to an additional 4-5 minute penalty compared to directly accessing the platform 20m away. For many passengers, this access penalty is likely to outweigh any speed benefits of the BRT. For any passengers who are physically challenged by having to go up and down stairs, this access configuration effectively excludes them from the BRT system.

Not surprisingly given the passenger-deterring station access configuration, the Nanning BRT system has very low ridership considering the city centre location. As documented at https://brt.fareast.mobi (see https://brt.fareast.mobi/quane?param=2&c=Nanning), the Nanning BRT has a throughput of only 1,260 passengers per hour per direction in the peak hour, among the lower demand BRT systems in the world.

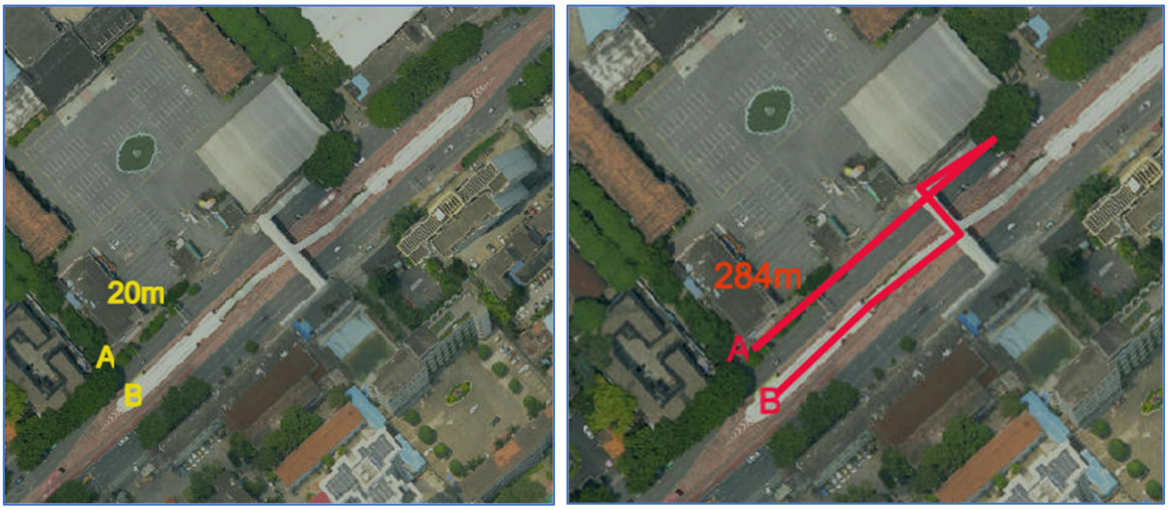


Figure 8: Huge detours imposed on passengers accessing Nanning BRT stations. A straight-line distance of 20m becomes a walking distance of 284m including walking up and down two sets of stairs, in order to access the BRT platform.

The Gongyuan station design, after being changed to a bridge, duplicates many aspects of the BRT station access which leads to low BRT ridership in Nanning. Design approaches were developed which would shorten the station access distance, but the Tianjin-based institute in charge of the bridge design when consulted in June 2021 said they were not able to move the BRT platform location. The institute in charge of the BRT platform location in turn were not willing to consider moving the BRT platforms, as the designs were considered to be already too advanced, and they did not think the access was problematic.

Having poor station access at such a key station will negatively impact future BRT system access and demand. Several options should be considered including:

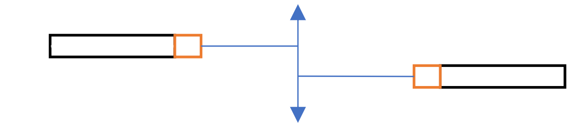
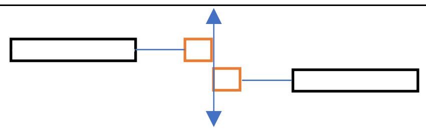
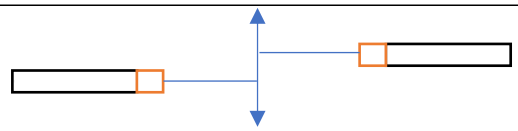
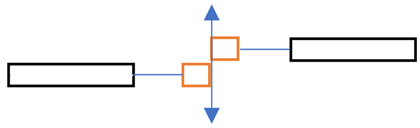
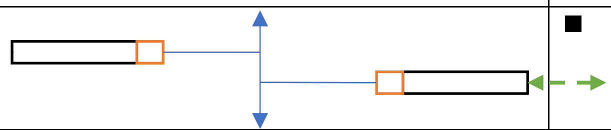
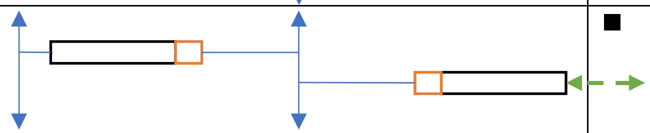
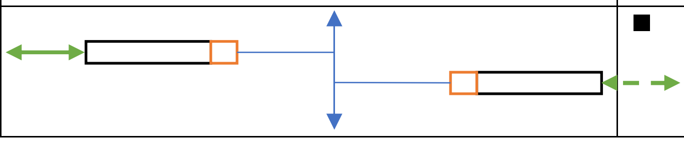
- Reverting to street-level BRT station access at this location, in line with the original project design. This would be far preferable in terms of passenger access to the stations.
- Improving the bridge access by shortening the walking distance to access the platform waiting area, especially by reducing the unnecessarily large gap between the two platforms from 90 to around 52m, but also by considering implementing fare collection on the bridge, as has been done successfully in many BRT systems worldwide.
- Adding a bridge access at the western side, and a tunnel connecting to the greenway on the eastern side. Though still requiring passengers to walk up and down stairs at the

bridge and a ramp at the tunnel, this would result in substantially improved station access and importantly would distribute the high demand between both ends of the BRT platforms.

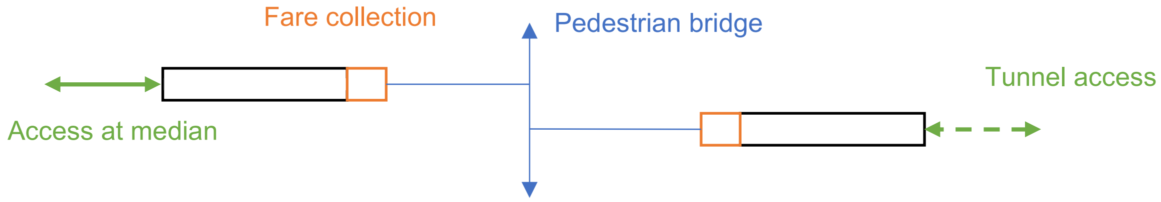
- Adding a street-level access at the western end combined with a tunnel at the eastern end. The street level access to the west could be 200m long, connecting all the way to the signalized intersection with Xishan Jie.
- Reversing the directions of the platforms, so that the main boarding and alighting takes place at the bridge-side of the platform. Though a minor change not addressing the main issue of the platforms being spaced too far apart, this would still save around 30m of walking distance for passengers.

Though inconvenient to consider such options at a late stage of the design, the measures should be considered in the context of the importance of the Gongyuan station for the BRT system demand.

Table 1: Various alternatives for access improvement at Gongyuan Station.

Proposal	Schematic layout	Main configurations
Current design		■ 75m spacing between platforms ■ Long extra walking distance for some passengers
Option 1		■ FC on bridge ■ 52m spacing distance of two platforms
Option 2		■ Reverse platform direction so stopping buses are closer to bridge
Option 3		■ FC on bridge ■ 52m spacing distance of two platforms ■ Reversed platform direction
Option 4		■ Extra tunnel access for east platform based on current design
Option 5		■ Extra pedestrian bridge access for west platform based on Option 4
Option 6		■ Extra access at median from intersection for west platform based on Option 4

Legend



The preferred approach involves a walkway connection to the west (in red in Figure 9), and a tunnel leading to the lower level walkway along the greenway, marked in maroon.

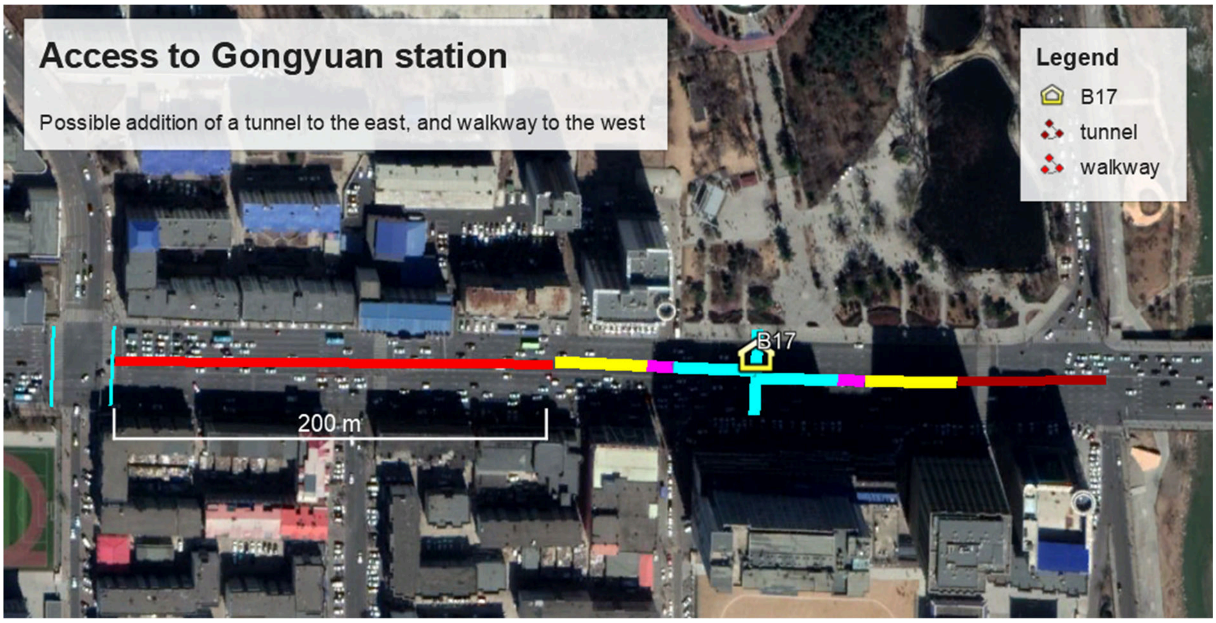


Figure 9: Access improvement to Gongyuan Station, with walkway to intersection on the west, and tunnel to river greenway in the east.

Improving the access to Yanbian University station is much more straightforward. During design discussions in June 2021, the design institute agreed that a pedestrian crossing needed to be added at the point marked blue to the left of Figure 10. Greatly improving the access at this stop requires an approximately 100m extension to the newly added walkway, marked in red. A fare collection point – which could be card-only, without providing a booth with attendant – would need to be added to the western end of the platform.

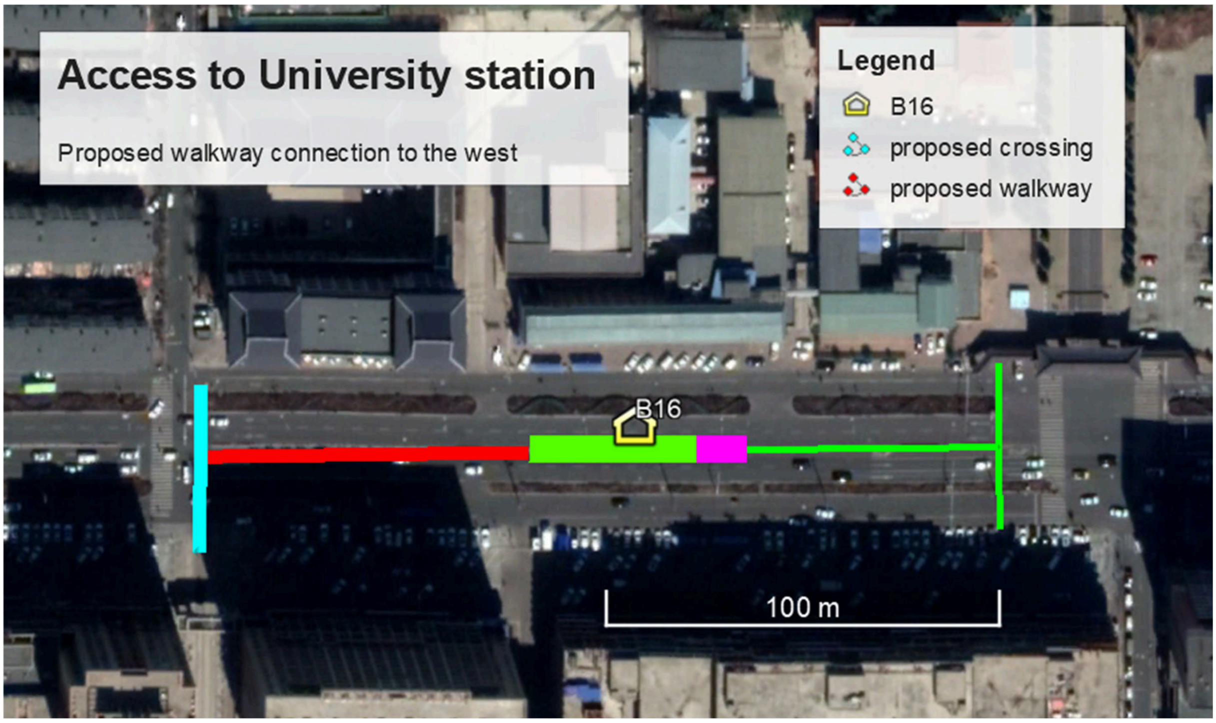
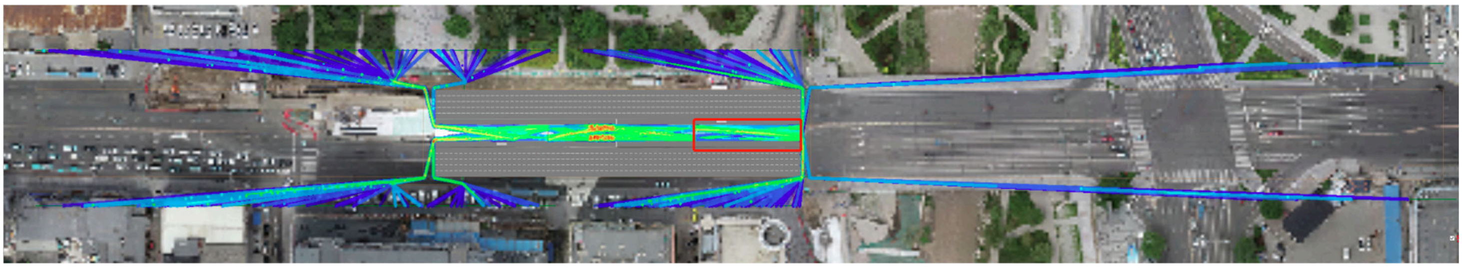


Figure 10: Access improvement to the University BRT station, with walkway to new pedestrian crossing.

A simulation was carried out of 60 minutes of passengers accessing the BRT stations at random access points to the corridor, with the results shown in Figure 11 based on estimated PM peak passenger volumes. (The simulation only tested the eastern platform; similar improvements could be expected at the western platform if the walkway access along the median is provided.)

The simulation showed that the average walking distance to the BRT boarding area without the tunnel, where passengers use only the bridge, is 356m. Walking distance with the tunnel was 299m. **Passengers save an average 57m in walking distance to access the station** when the tunnel is provided. This improved walking distance does not factor in the additional difficulty of walking up and down the stairs to access the station compared to the gradual slope of a tunnel.

Without tunnel (access only via bridge)



With tunnel (access via bridge and tunnel)

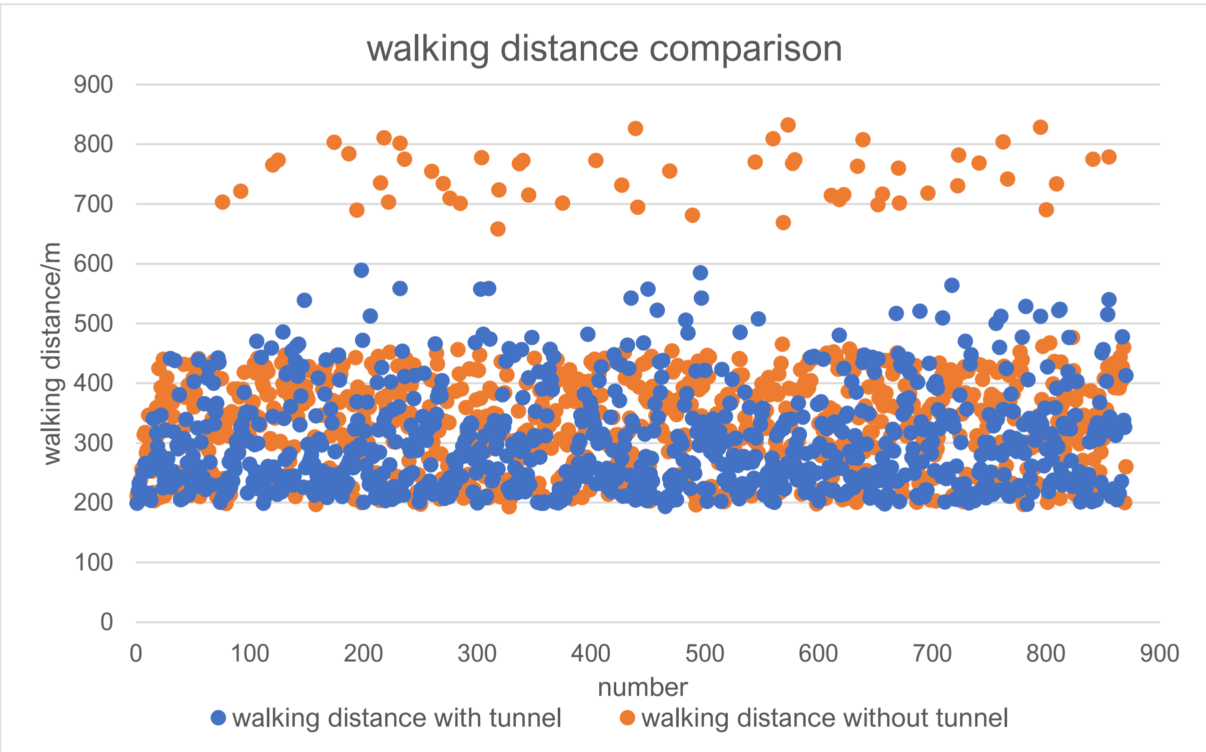


Figure 11: Simulation of access improvement to the eastern platform of Gongyuan Station. Walking distances with a tunnel are an average of 57m shorter.

2.4 BRT Demand, Model, and Operational Plan

As outlined in the preceding section on data collection, the operational planning and demand model inputs are well under way, with surveys ongoing. Some preliminary results relating to the demand profiles of bus routes are shown following. In total, Yanji has around 200,000 bus boardings per day, citywide, based on bus stop counts carried out by the bus company in November and December 2020.

As shown in Figure 5 and Figure 6 above, three city centre stations, B18, B17 and B19, account for 60% of the entire phase 1 corridor demand, based on the demand of bus stops within 600m of BRT stations allocated to the nearest BRT station. (This rough estimate will be further refined as the demand estimates and operational planning proceeds.)

The demand and performance data in Figure 12 covers all routes in Yanji except for two routes which are operated by a different bus operating company.

The peak hour boardings of 19,139 per hour in the AM peak and 16,108 per hour in the PM peak likely translate to a daily rate of around 200,000 bus-boardings. (All of these figures will be further refined in coming stages, including distinguishing regular and transfer boardings.) The average boarding per bus-kilometre of around 5 (5.48 in the AM peak and 4.68 in the PM peak) are an important measure of revenue generation and efficiency, and is quite high. The resulting revenue of 10 yuan per bus-kilometre, though the actual amount will be lower due to concession trips, is probably high enough to cover bus operating costs, but not the replacement cost of buses.

	AM PEAK			PM PEAK		
	average frequency	boardings	on / bus-km	average frequency	boardings	on / bus-km
Nov-Dec 2020	4.4 buses/hr	19,139 pax/hr	5.48	4.5 buses/hr	16,108 pax/hr	4.68

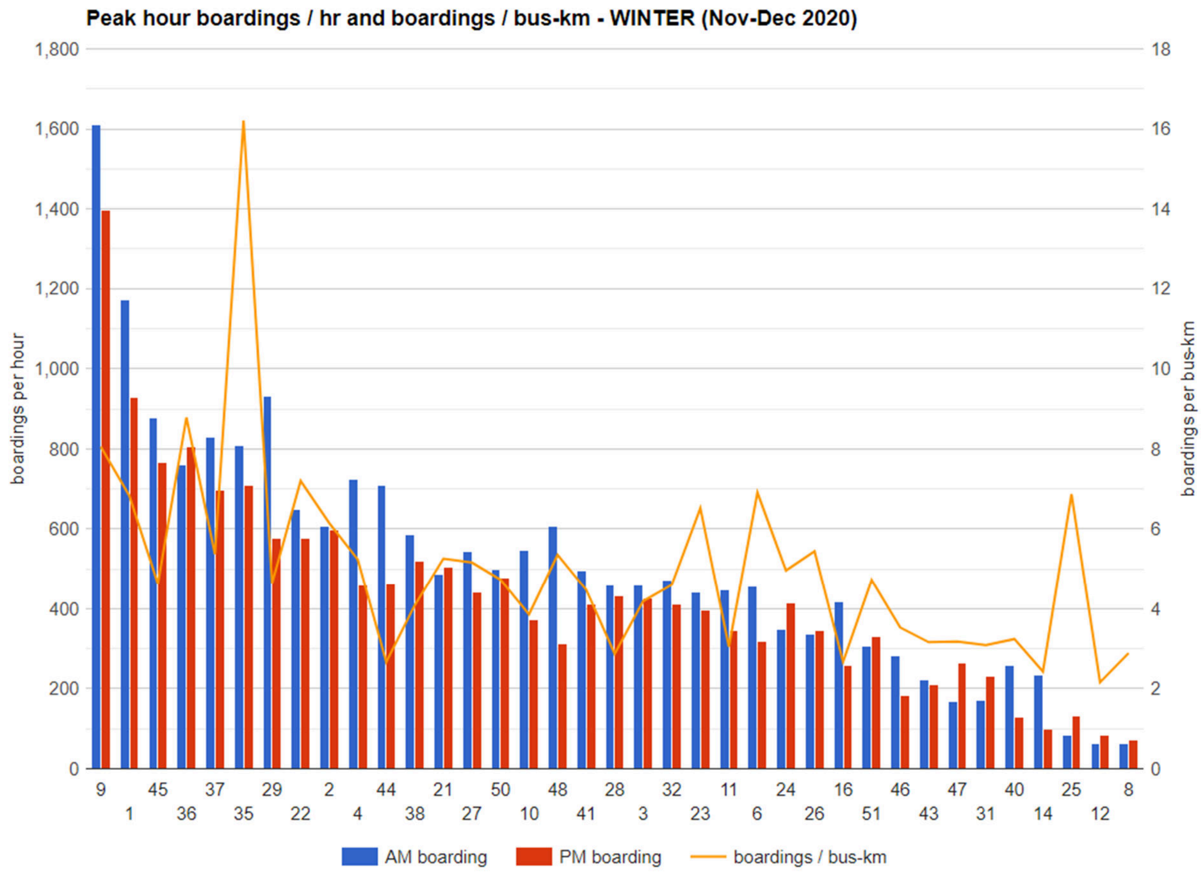


Figure 12: Yanji bus demand in Nov/Dec 2020.

Winter performance

AM Peak Performance

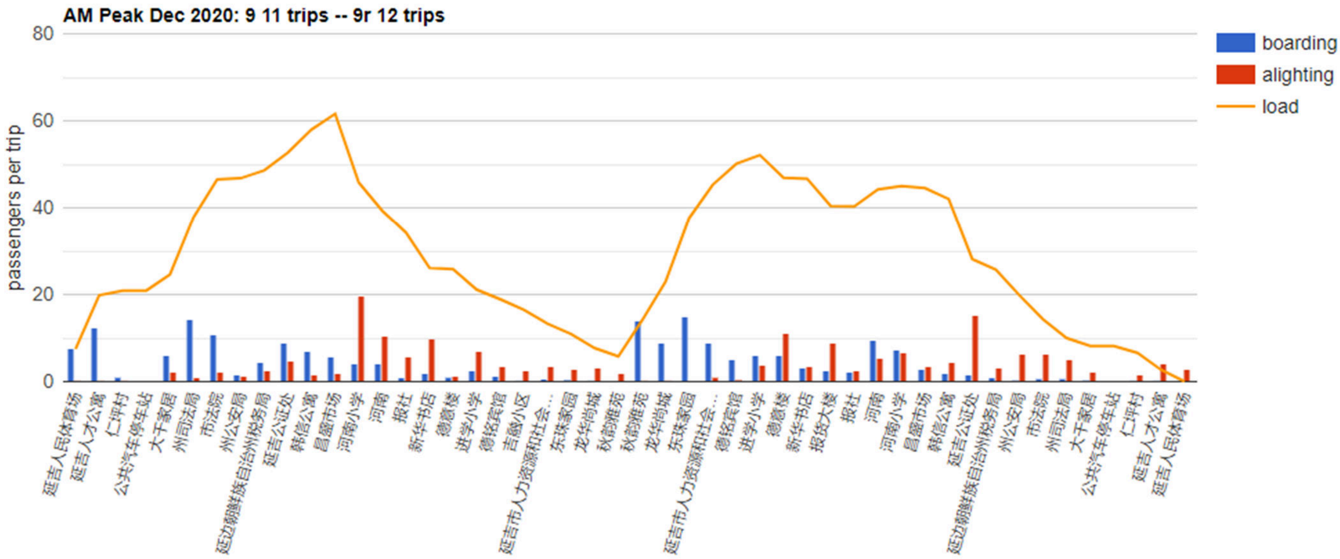
Route	From-to	AM Peak					
		Buses/hr	Boarding/bus-km	Speed	Trip time	Route on / trip (hour)	Trip max load (route)
9	秋韵雅苑 - 延吉市人民体育场	9.00	9.60	km/hr	mins	96 (780)	61.6 (554)
9r	延吉市人民体育场 - 秋韵雅苑	9.00	9.78	km/hr	mins	98 (832)	52.1 (469)

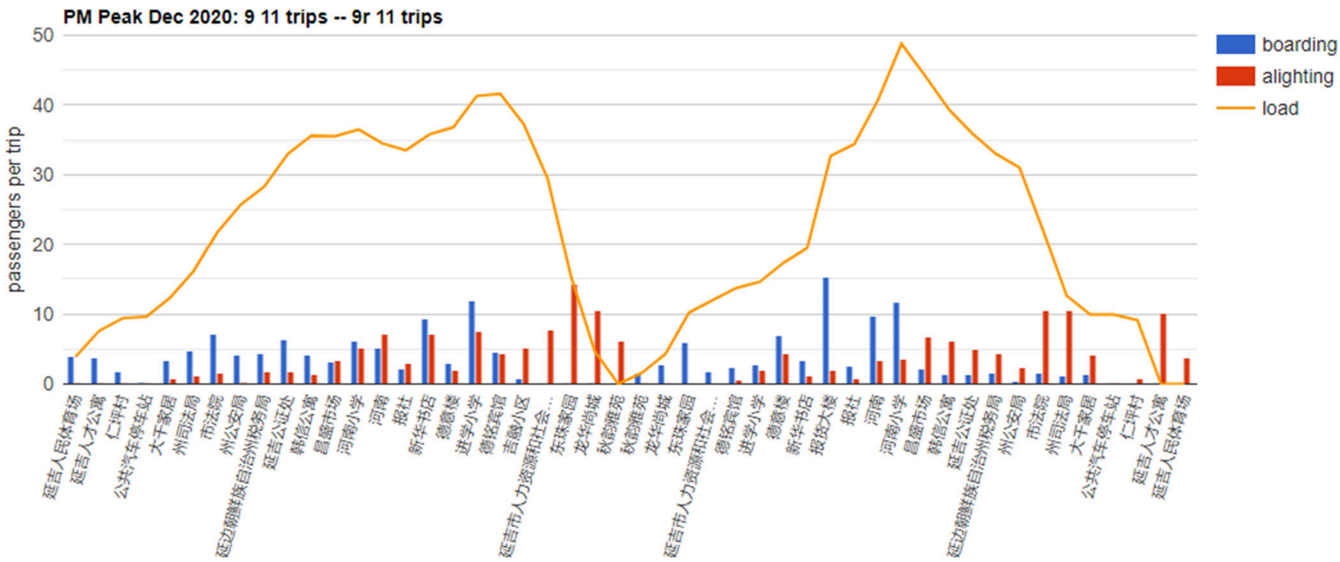
PM Peak Performance

Route	From-to	PM Peak					
		Buses/hr	Boarding/bus-km	Speed	Trip time	Route on / trip (hour)	Trip max load (route)
9	秋韵雅苑 - 延吉市人民体育场	8.00	9.03	km/hr	mins	90 (700)	41.6 (333)
9r	延吉市人民体育场 - 秋韵雅苑	8.00	7.75	km/hr	mins	78 (698)	48.8 (390)

9 秋韵雅苑 - 延吉市人民体育场
AM freq: 9.0, PM freq: 8.0

9r 延吉市人民体育场 - 秋韵雅苑
AM freq: 9.0, PM freq: 8.0





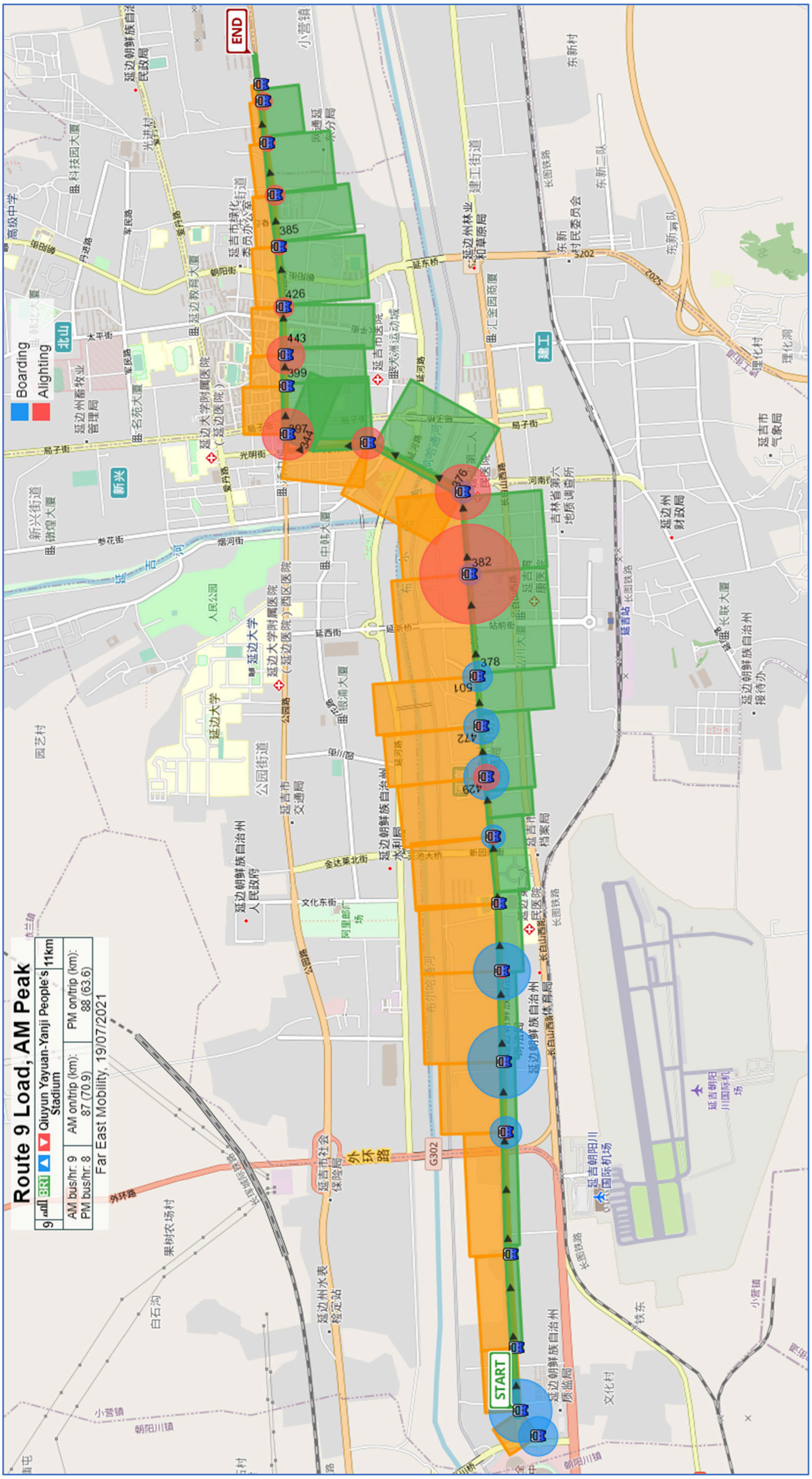


Figure 13: Demand profile for route 9 (see https://yanjibrt.net/rtrip?rt=9).

Far East Mobility has developed demand profiles for all routes using the November-December 2020 stop count data from the bus company, with an example demand profile for route 9 (the highest demand route in Yanji) provided in Figure 13. Note that since the data from the 2020 stop counts, where the bus company set up cameras at each bus stop to record and count the boarding and alighting passengers, did not include on-bus surveys, trip speed data is not available from Winter 2020. Speed surveys will be carried out in Winter 2021 and compared with the Summer speed surveys currently being done.

Demand profiles for 2021 are being developed based on a combination of on-bus surveys and bus stop counts.

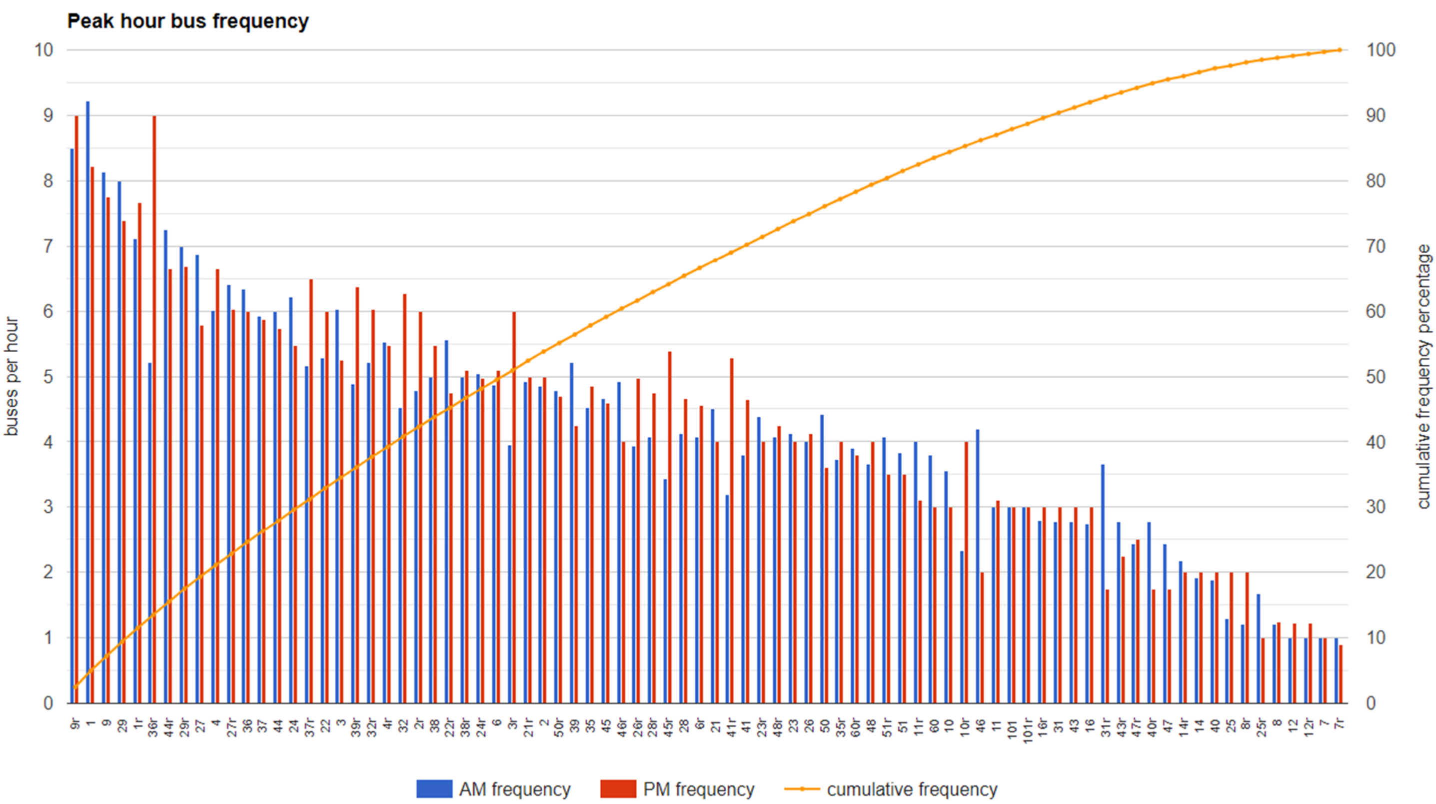
Our preliminary goal is to develop separate BRT operational plans for both the Winter and Summer periods, as demand patterns are likely to differ, and services are expected to finish earlier during Winter.

2.5 BRT and High-Frequency, All-Day Service

Service frequency varies greatly between routes, from nine down to less than one per hour (Figure 14). One-third of the routes account for half of the overall bus frequency.

In order for the BRT system to provide an attractive service, the BRT routes should operate at high frequencies, with at least 5-6 buses per hour during the peak hour. High frequency service enables passengers to use the system without needing to consult a timetable. They can simply arrive at the stop and expect to wait no more than 10-12 minutes, and on average 5-6 minutes.

Several cities worldwide – but not yet in China – have implemented specially-branded high frequency services to help prospective passengers associate the services with reliability and high frequency, and a similar measures is likely to be recommended in Yanji.



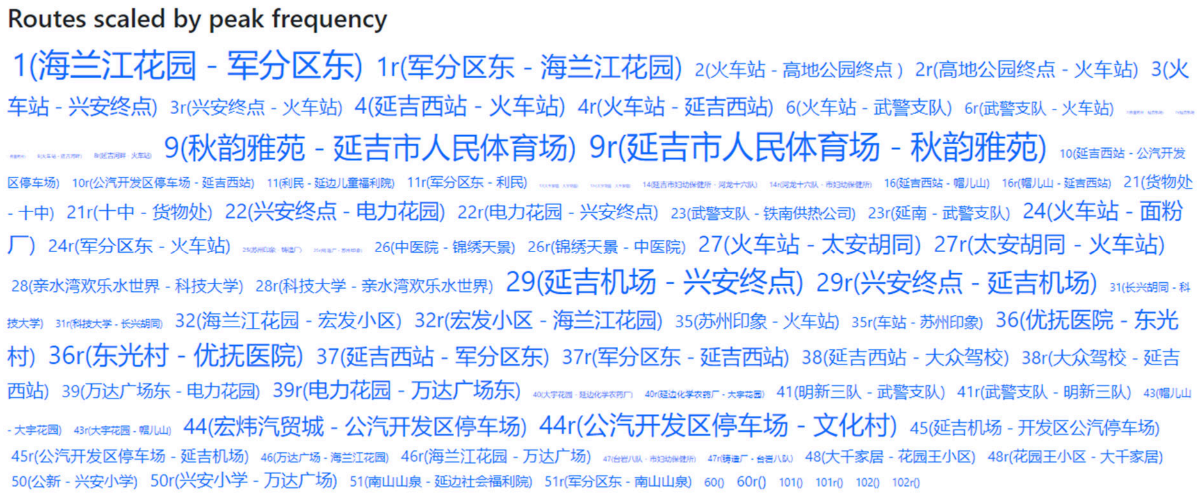


Figure 14: Yanji bus frequency.

Just as important as the peak hour frequency is that the BRT routes should provide all-day service. Figure 15 shows the total vehicle flows at the largest intersection in Yanji, with significant traffic flows even up to 9:30pm and 10:00pm, in a traffic count carried out on a Friday and Saturday evening in June 2021. The survey shows that overall traffic flows are quite similar; slightly higher earlier in the evening on Saturday, and slightly higher later in the evening on Friday, but in both cases there is substantial traffic flow well beyond 9pm.

This traffic pattern can be compared to bus service operating hours shown in Figure 16. Only four out of 41 routes in Yanji operate beyond 8pm at night, and no routes operate beyond 10pm. Just five routes operate after 7:15pm, and only four still operate after 7pm in Winter. More than 85% of all routes finish operating by 7pm at night.

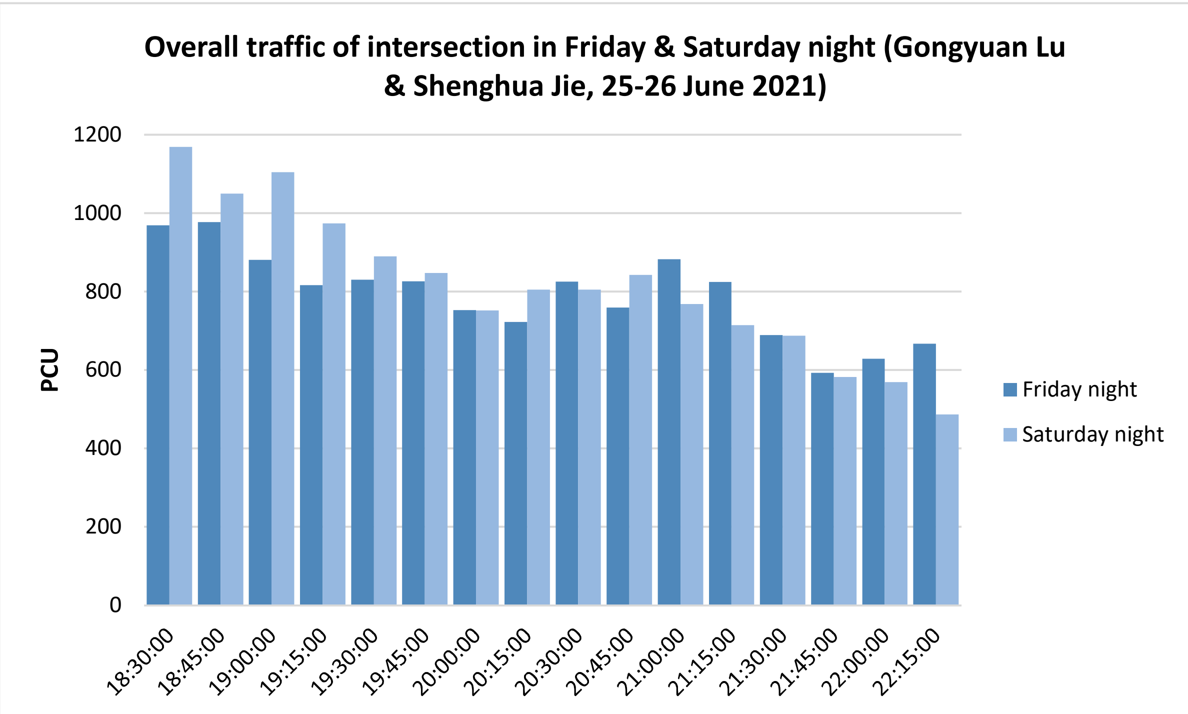


Figure 15: Evening traffic flows.

This pattern of service, where few routes operate even after 7pm, is certain to greatly depress bus ridership in Yanji. Anybody who plans to go shopping, or eat out, or meet colleagues from work, or work late, or just enjoy the park or taking a walk in the evening, cannot rely on the bus system to get home, and will need either a car, motorcycle or e-bike, noting that incomes are relatively low and few people can afford to regularly take taxis. Nearly all routes have stopped operating even before it gets dark between May and August (Figure 17). It is important that the BRT service address this issue, with service provided to 10pm which is when the malls close.

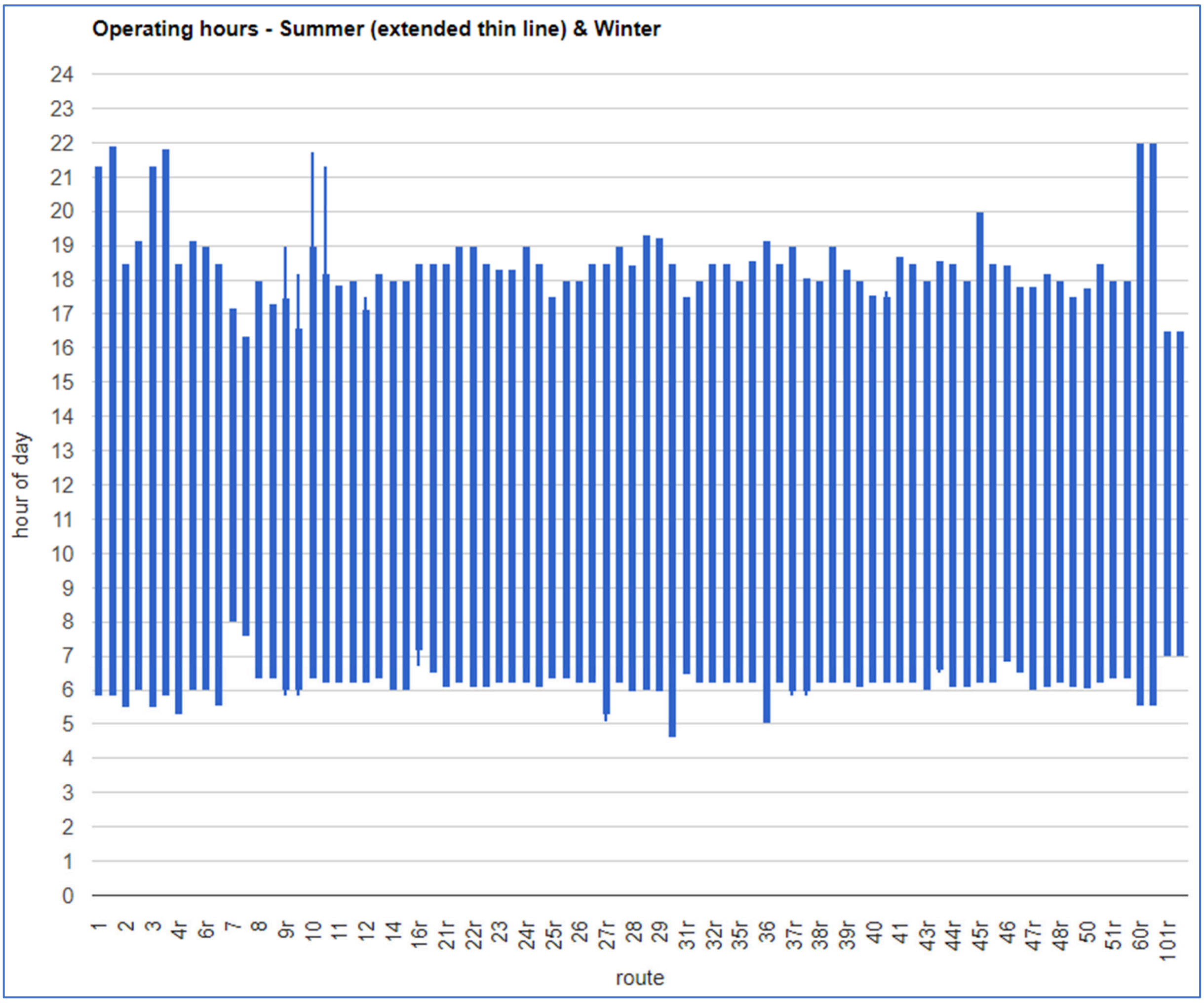


Figure 16: Operating hours of Yanji bus routes.

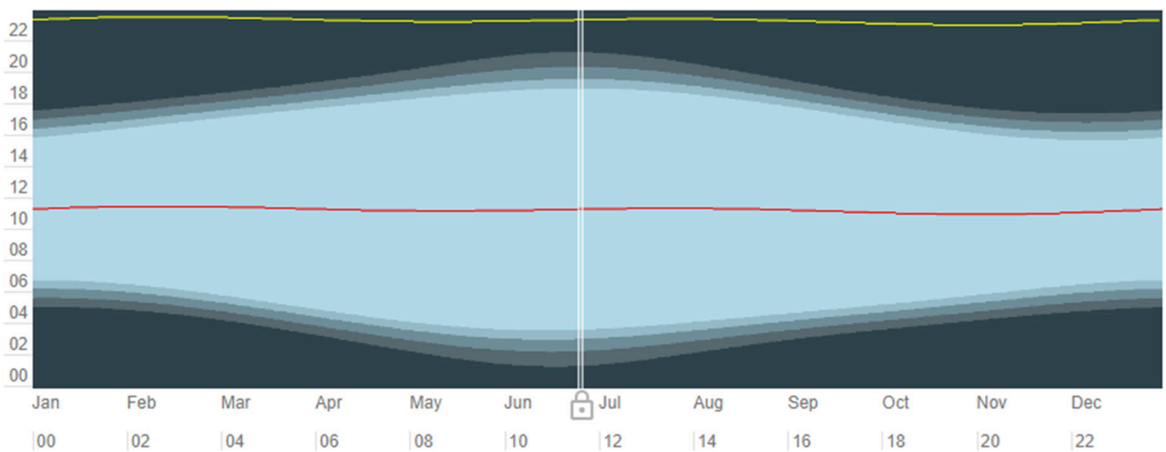


Figure 17: 2021 Yanji Sun graph, with twilight until 7:40pm in July. Nearly all bus routes finish by 7pm.
Source: https://www.timeanddate.com/sun/china/yanji

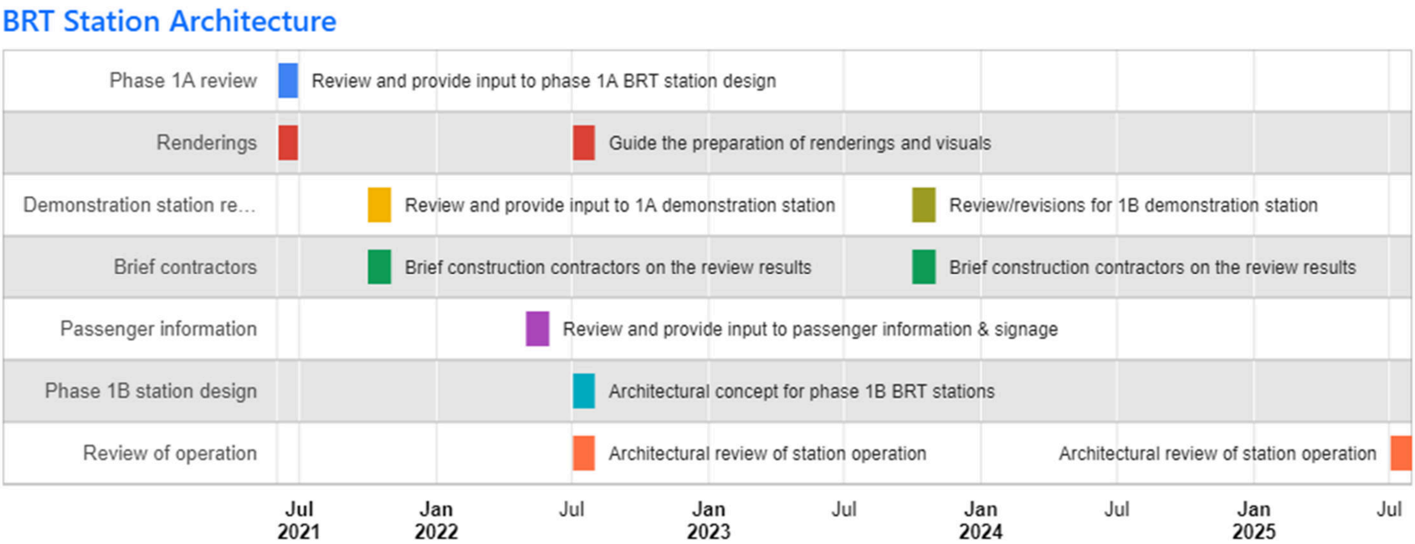
2.6 BRT Architecture and Configuration

The BRT architecture inputs are divided into stages as outlined in the work plan following. The most immediate and urgent task is to provide initial design review input to the Phase 1A BRT stations.

As planned, an initial review of the Phase 1A BRT architecture is being carried out.

Issues of heating and station configuration are being considered, noting the constraints that the Phase 1A BRT station architecture cannot be changed in major ways at this stage of the project.

One issue already identified in initial discussions in June 2021 and passed on to the design institute to fix is that the slope of the station roof was incorrect. The slope in the design was against the slope of the road, effectively making the roof flat and preventing proper drainage. The design institute is urgently fixing this problem in July 2021, so that the slope of the roof is compatible with the slope of the roadway.



Another issue in the BRT station configuration is the fare gate layout and provision. A basic design goal in any mass transit fare collection area is to maximize fare gates according to the available space. Consider for example the example in Figure 18 of more than 25 fare gates in a metro station in Shenzhen, which moreover is only part of the station. BRT stations generally have much less available space for fare collection compared to metro stations, so it is important to maximize the possible fare gates. Fare gates can become a bottleneck, especially if the city either immediately or later decides to apply distance-based fares requiring exit validation.

Figure 18: Fare gates in a Shenzhen Metro station (top and middle) and in high demand Bogota BRT stations (above).

The current design concept for Yanji, shown in Figure 19, only provides 2 entry and 2 exit gates. In Yichang, the 5m wide platform has 5 fare gate entry/exit points. In Guangzhou, 1m is allocated to a connection to the other platform, and the remaining 4m has 5 fare gate entry/exit points (Figure 21). The functioning fare gates should be increased from 4 to either 5 or 6, as in Figure 20.

The middle fare gate space has been disabled, open only by special operation from the ticket booth personnel. This is a waste of scarce space and capacity, especially in the highest demand two stations of Gongyuan and University, especially noting that the current configuration of both stations is that each platform will have only one access point. The middle section should be opened and used as a regular functioning fare gate, as in ‘proposed option 1’ in Figure 20. At the Gongyuan and University stations, especially if the platforms have only one access point (as is currently designed), the 'proposed option 2' below should be considered. This would increase the functioning gates open to all passengers to six from the four in the current design.

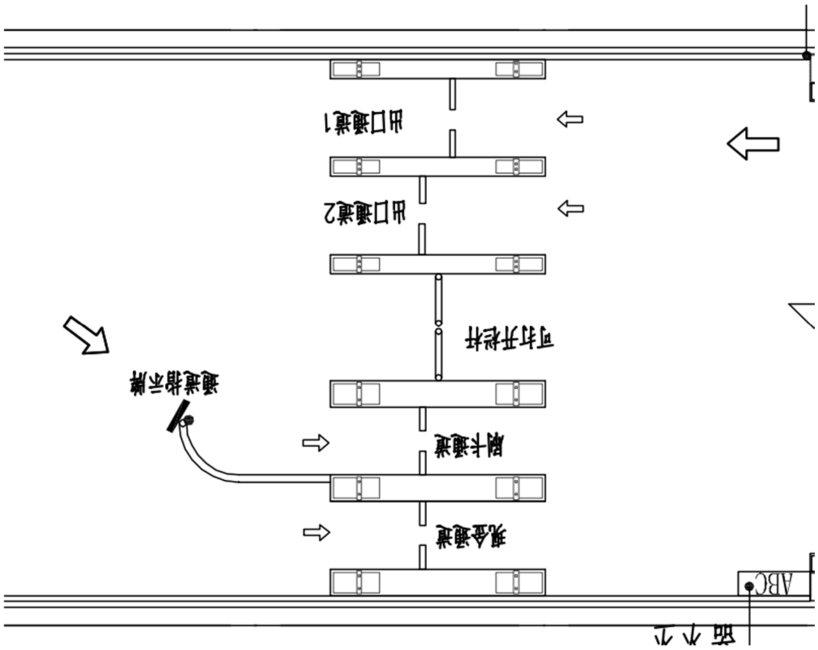


Figure 19: Fare gate configuration in the Yanji BRT design.

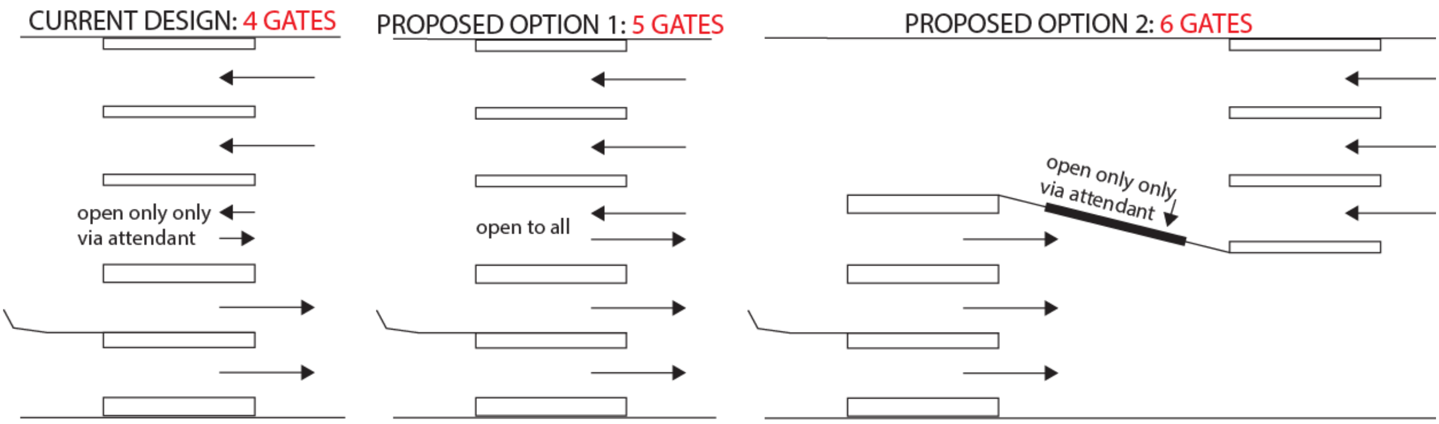
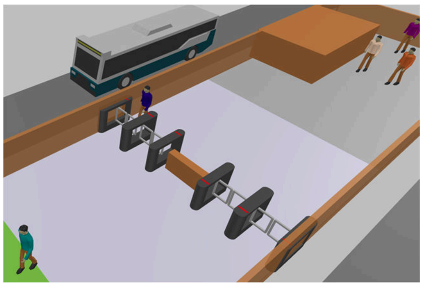


Figure 20: Proposal to increase fare gates in Yanji BRT stations from 4 to either 5 or 6.

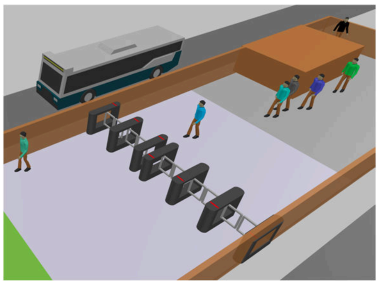
Figure 21: Guangzhou and Yichang BRT fare gates.

The benefit of using additional fare gates (five instead of four) and adding access at the other end of the platform is shown in the following simulation analysis carried out using the early estimate of

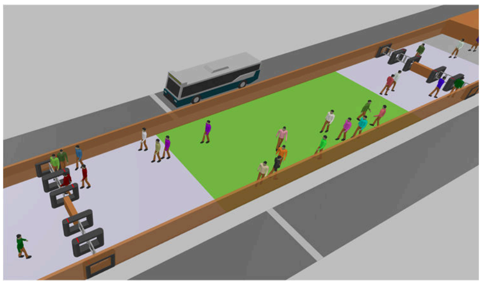
Gongyuan BRT station demand in the PM peak. The results show delays at the fare gates over a 1 hour period, with the fare gate position outlined in black.



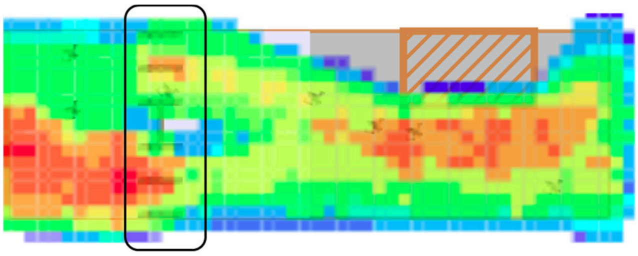
Current (4 fare gates)



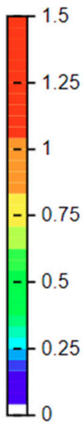
increase to 5 fare gates

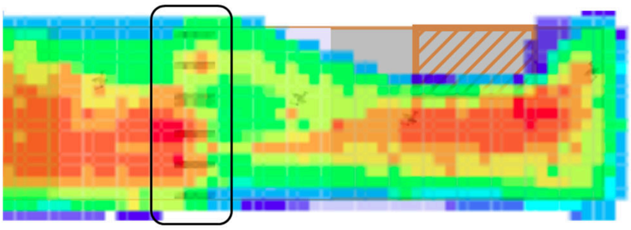


4 fare gates at each end

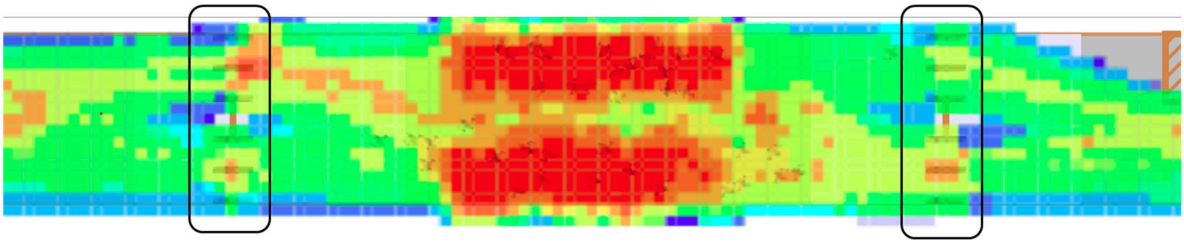


Current design :Pedestrian density is high in front of exiting the gates

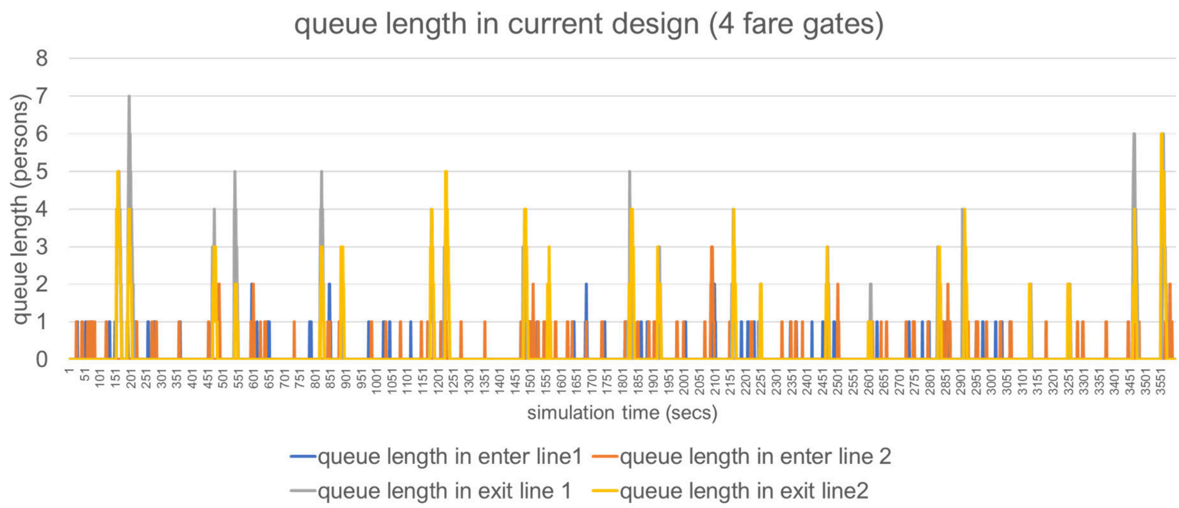




Improved design 1: Pedestrian density is similar, but spread out over 3 gates rather than concentrated in 2



Improved design 2 :Pedestrian density is significantly reduced in front of gate exits



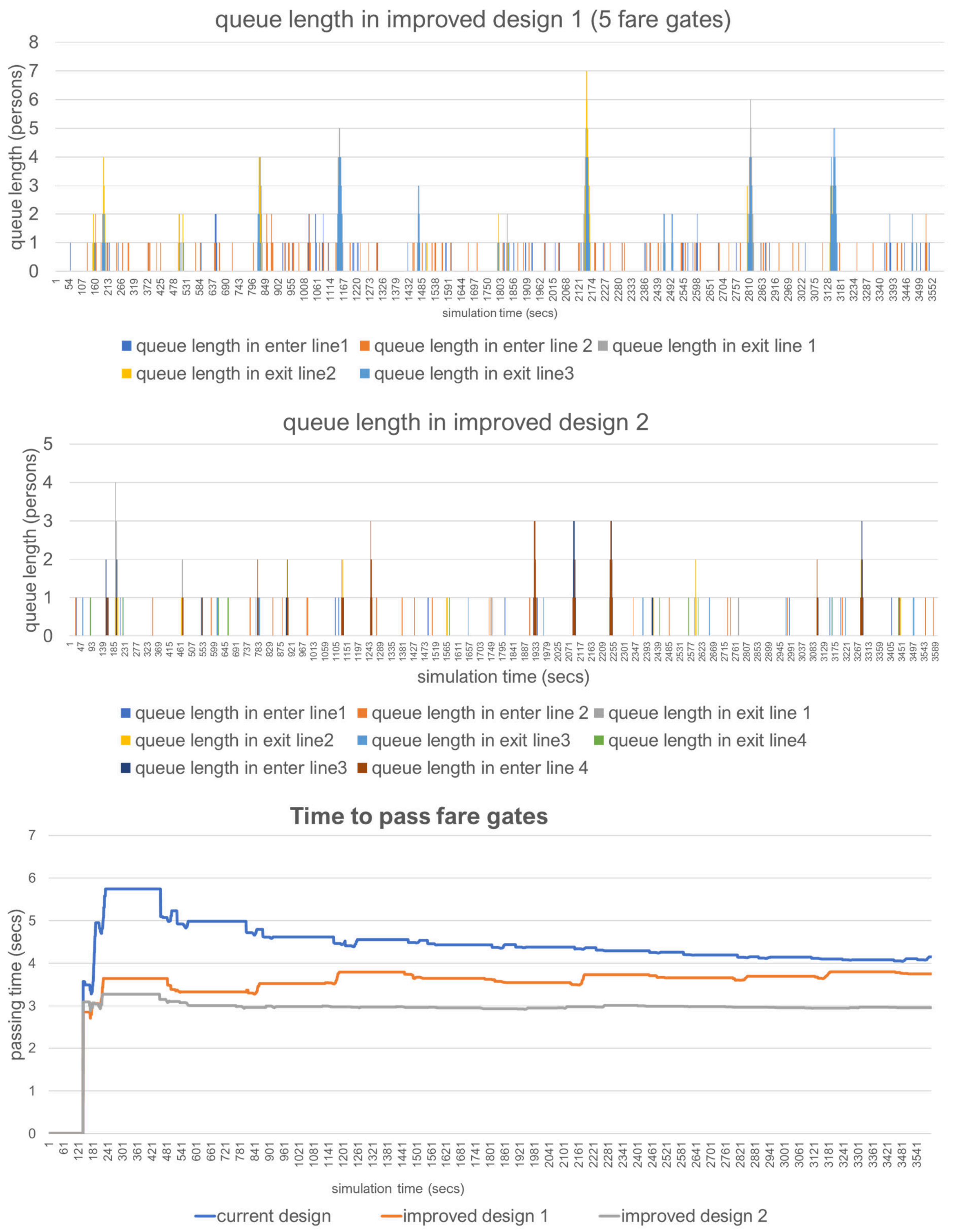


Figure 22: Simulation results of fare gates and platform access.

The simulation results (Figure 22) show significant improvements with 5 compared to 4 fare gates, and even larger improvements with access at both ends. In the current design, queues of 5 or more people form at 8 times during the hour. With 5 gates such queues are only reached 4 times and with access at both ends the queue only exceeds 2 people 6 six times in the hour. Delay at the gates is an average of one second less per passenger with access at both ends. Note that this does not include the walking distance access benefits of access at both ends.

An important consideration in any BRT plan is that the system should be able to accommodate significant increases in demand. The preceding simulation is based on the current bus passenger demand within 600m of a BRT station, where Gongyuan is the closest station. However, significant mode shift is expected in Yanji, along with population and economic development. A simulation was carried out based on a demand 1.5 times higher than the current demand, to account for possible mode shift and growth.

The result, shown in Figure 23, shows that the current design experiences congestion and delays, with passengers mostly taking 6-7 seconds to pass the fare gates. When 5 gates are used ('improved design 1' in Figure 23), even with a 1.5 times increase in demand, the delay only slightly increases, by around 0.5 seconds per passenger. When fare gates are installed at both ends of the platform ('improved design 2'), there is almost no increase in time required to pass the fare gates despite the increased demand.

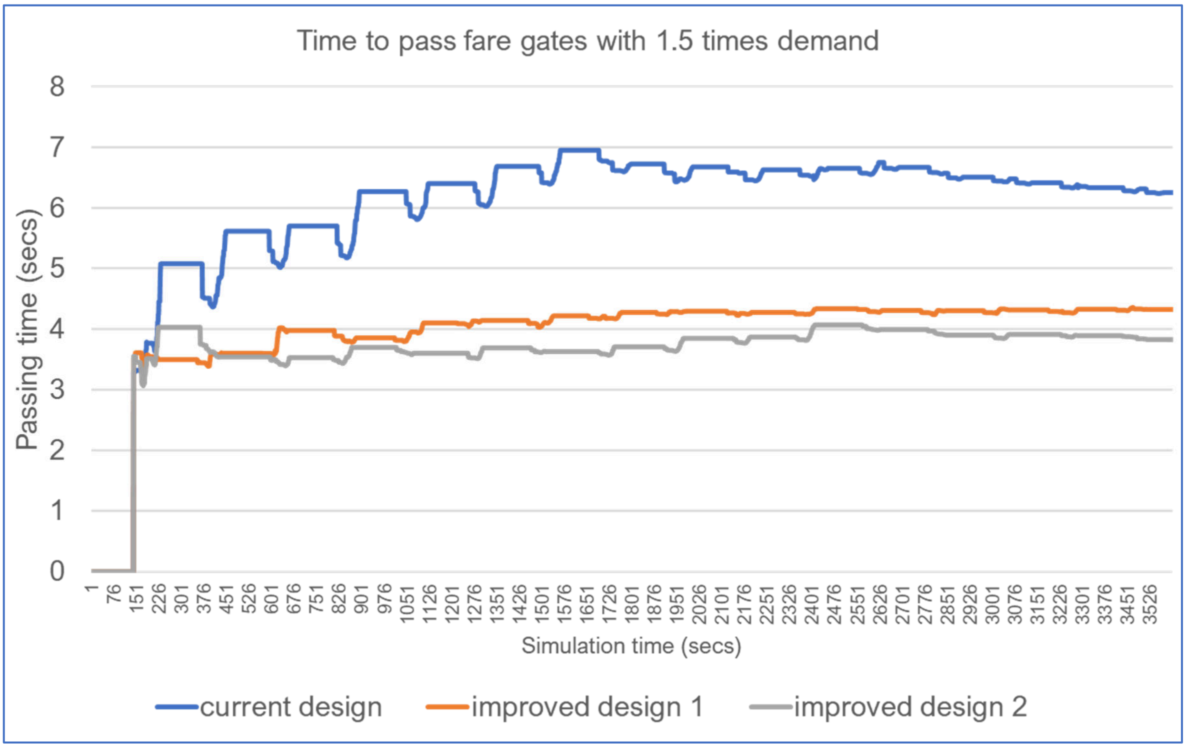


Figure 23: Time required to pass fare gates with demand 1.5 times higher than bus demand in December 2020.

3 Low Carbon Action Plan & TOD

3.1 Work Plan

The Low Carbon Action Plan work plan is outlined following.

	Project stages		PHASE 1A CONSTRUCTION												testing				PHASE 1A OPERATION								PHASE 1B CONSTRUC						
	Year	2021										2022												2023									
	Month of year	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
	Month of project	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
D-5	**Target 5: Low carbon city TOD & sustainable transport action plan**																																
1	TOD																																
a	Identify applicable TOD topic areas based on TOD Standard categories			x																													
b	Identify role of Jilin province vs Yanji city zoning regulations				x																												
c	Develop action plan items for each key topic area										x																						
d	Provide input to TOD site plans being developed along corridor										x																						
2	Low Carbon Action Plan																																
a	Identify tasks, data collection and research plan, compile work plan				x	x																											
b	Site visit, data collection, interview local government bureaus					x	x	x																									
c	Finalize the city level carbon emission inventory																	x	x														
d	Provide low carbon city development action plan and policy suggestions, finish the first draft report																				x	x	x										
e	Seminars, communication with local govt, revision, finish final report																					x	x	x	x	x	x	x	x				
f	Training and project promotion, seminar and public awareness																												x	x	x	x	x
2	Transportation sector																																
a	Initial data collection and spatial analysis related to land use				x	x	x																										
b	Use MXD model applied by CAS for Chinese context as land use model									x	x	x	x	x	x	x	x				x												
c	Initial carbon emission inventory for transport sector										x	x	x	x																			
d	Develop transport & land use action plan items												x	x	x	x					x	x											
e	Develop action plan items in other transport sectors, esp. vehicles												x	x	x	x																	
3	Urban energy																																
a	Data collection from relevant depts focusing on demand, consumption				x	x	x																										
b	Data collection on power generation and sources; coal phase-out plans				x	x	x																										
c	Initial carbon emission inventory for urban energy sector										x	x	x	x																			
d	Action plan items related to urban energy demand and consumption												x	x	x	x						x											
e	Action plan items related to energy generation, China Grid												x	x	x	x						x											
4	Industry																																
a	Data collection from relevant departments; industry composition trends				x	x	x																										
b	Initial carbon emission inventory for energy and industrial sector										x	x	x	x																			
c	Develop action plan items for industry												x	x	x	x						x											
5	Housing, Commerce and Public utilities																																
a	Data collection on the sectors of housing, commerce and public utilities				x	x	x																										
e	Initial carbon emission inventory for residential, commercial sector and public utilities, and related low carbon policy research and evaluation										x	x	x	x																			
b	Develop action plan items for housing, commerce and public utilities												x	x	x	x						x											
6	Information & communication																																
a	Outreach and promotion related to action plan items																					x	x			x			x		x		x
b	Outreach on low carbon, healthy cities combined with BRT, TOD, NMT																					x				x			x		x		x
c	Integrate action items with city government targets																												x		x		x

3.2 Low Carbon Action Plan

Data collection for the Low Carbon Action Plan has not yet started. The China Academy of Sciences team will make an initial site investigation and commencement of data collection during the 3rd quarter of 2021.

Data collection for the TOD planning aspect has started, with some preliminary research including on the relevant zoning codes applicable to Yanji, and on recent TOD-related trends in other Chinese cities regarding transit station area zoning, density, and mixed-used applications, as well as related areas such as ‘garden city’ policies.

The consultant's Low Carbon Development Planning Specialist, from the China Academy of Sciences, will focus on the development of the multi-sector low carbon action plan.

Compilation of a greenhouse gas inventory is a basic work plan to deal with climate change. Through the inventory, government can identify the main emission sources of greenhouse gases, understand the emission status of various departments, and predict the future mitigation potential, thus contributing to the formulation of response measures. In September 2010, the General Office of the National Development and Reform Commission officially issued the Notice on Starting the Compilation of Provincial Greenhouse Gas Inventories (DRC[2010] No.2350), requiring all localities to formulate work plans and preparation plans and organize the compilation of greenhouse gas inventories. In 2012, a related research institute and government offices from Beijing issued Provincial Greenhouse Gas Inventory (Trial). However, until now, local government actions are still limited, due to the lack of experience and best practices at city level.

The provincial government is currently required to submit statistics each year in a defined format. How to calculate emissions from different sectors and sources is already defined. However, how to transform the current greenhouse gas inventory to the city level, and how to apply the inventory and targets to the city level urban plan and land use, industry, energy infrastructure, housing and other sectors still lacks capacity and best practices. To date Beijing, Shanghai, Tianjin, Chongqing, and Harbin have produced city level low carbon greenhouse gas inventories, but the corresponding targets and action plans are still missing. The inventory and studies are mainly focused on current emissions indicators and introduce some city level policies regards inventory, but few cases or targets are provided from an overall urban planning perspective are integrated with any action plans.

In addition to regulations such as zoning policies affective TOD, inventory data the consultants need to collect from relevant departments for calculations in the inventory stage are listed in Table 2.

The Low Carbon Urban Development Action Plan, drawing from the inventory analysis, will identify key areas for Yanji to work toward low carbon development in different sectors, and estimate and provide emissions reductions targets.

The action plan will include proposals on incorporating low carbon development measures into the planning of new districts as Yanji's urban area expands, noting that current policies such as excessive setbacks and high minimum off-street parking standards are antithetical to low carbon objectives, and that many lessons can be learned from the planning of new towns and district in China and internationally. This will be closely related to the input of the Transit-Oriented Development expert, as new urban development is a major focus of TOD planning, especially noting the major planned urban expansion to the east and west along the full Phase 1 BRT corridor.

Since there are many sectors involved and not all can be considered in detail, areas of major focus of the Action Plan will be determined after the initial inventory stage is completed, and after consultation with key stakeholders related to the project.

Table 2: Data needed from departments in the initial data collection stage.

Source of emissions	CO2 (tons)	CH4 (tons)	N2O (tons)	HFCs (tons equivalent)	PFCs (tons equivalent)	SF6 (tons equivalent)	GHG (tons equivalent)
Total emission (NET)	×	×	×	×	×	×	×
Summary of energy activities	×	×	×				×
1. Subtotal of fossil fuel burning	×	×	×				×
• Energy Industry	×		×				×
• Agriculture	×						×
• Industry and Architecture	×						×
• Transportation	×	×	×				×
• Service	×						×
• Residents life	×						×
2. Biomass burning		×	×				×
3. Coal mining escape		×					×
4. Escape of oil-gas system		×					×
Total process of industrial production	×		×	×	×	×	×
1. Cement production	×						×
2. Lime production	×						×
3. Steel production	×						×
4. Calcium carbide production	×						×
5. Adipic acid production		×					×
6. Nitric acid production		×					×
7. Aluminum production					×		×
8. Magnesium production						×	×
9. Electric power equipment						×	×
10. Others	×	×	×	×	×	×	×
Total process of Agriculture		×	×				×
1. Paddy field		×					×
2. Agricultural land			×				×
3. Animal intestinal fermentation		×					×
4. Animal manure management system		×	×				×
Total land use change and forestry	×	×	×				×
1. Forests and other woody organisms change of carbon stock	×						×
• high-forest	×						×
• economic forestry	×						×
• bamboo forest	×						×
• spinney	×						×
Sparse forests, scattered trees and surrounding trees	×						×
Living tree consumption	×						×
2. Subtotal of carbon emissions from forest conversion	×	×	×				×
Combustion emissions	×	×	×				×
Decomposition emissions	×						×
Total waste disposal	×	×	×				×
1. Solid waste	×	×					×
2. Waste Water		×	×				×
International fuel tank	×						×
• International air	×						×
• International navigation	×						×

(Note: X denotes data is needed from Provincial level)

3.3 Transit-Oriented Development

Transit-Oriented Development (TOD) covers many topic areas including parking, density, pedestrian and bicycle facilities and networks, mixed-use development and transit itself, and while there are examples of improvements in each of these areas in the context of BRT projects, a comprehensive package of TOD measures has not yet been systematically applied in the context of a BRT corridor in China.

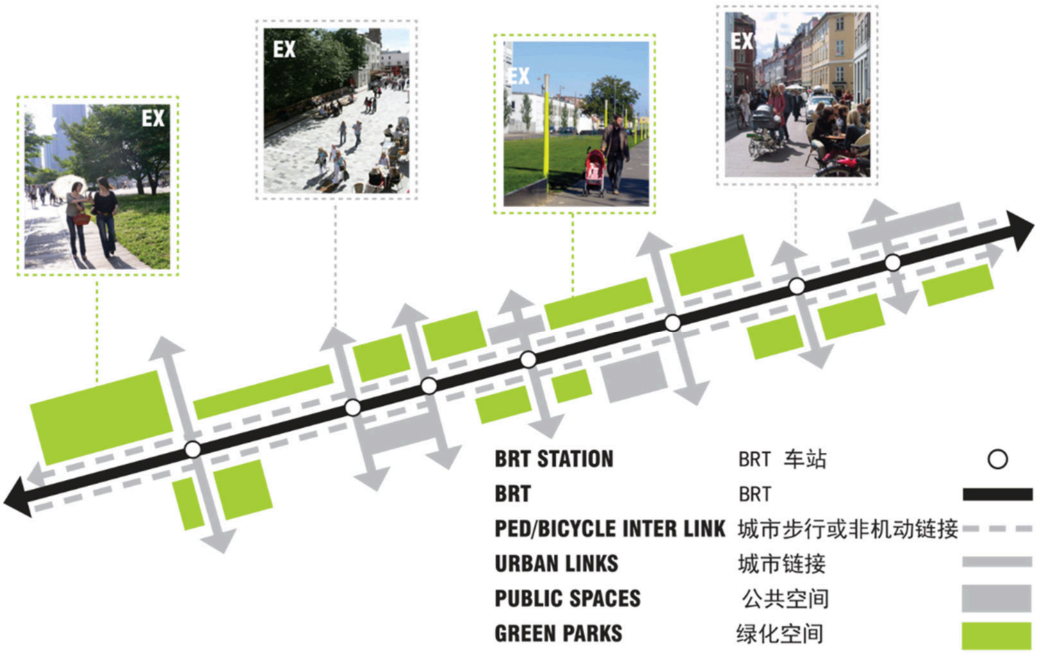


Figure 24: BRT station area improvements concept.

Table 3: Mass transit station area zoning approaches in Chinese cities.

City	Increase FAR	Encourage mixed-use	Parking reduction	Pedestrian access requirements	Bike facility requirements
National policy					
Hong Kong					
Shanghai					
Shenzhen					
Nanjing					
Wuhan					
Guangzhou					
Beijing					

Figure 24 and Table 3 illustrate a couple of basic concepts in TOD planning which will be applied in Yanji. Figure 24 shows the concept of BRT station area planning, with robust public spaces concentrated around the immediate station vicinity and parks somewhat offset from the immediate station area, and with access improvements for non-motorized transport. Table 3 shows examples of cities which have defined special zones around mass transit stations relating to various TOD topics. The TOD work will recommend Yanji develop such a zoning approach.

We have already provided input into the BRT station area planning and design in the form of renderings prepared for the PMO during June 2021 (Figure 25). These were developed rapidly over a period of a couple of days in response to an urgent deadline to provide some input to the PMO, and more will be prepared during the project, including some more attractive night views.

Figure 25: Renderings prepared in June 2021 showing BRT station setback approaches.

The renderings in Figure 25 show two alternatives, as requested by the PMO. One variation keeps a row of parking, and the second alternative completely removes the parking in the setbacks in the immediate BRT station area vicinity.

Development of TOD proposals will be carried out focusing on the BRT corridor and using the *TOD Standard* developed by ITDP several years ago (but subsequently dropped, with no further development) as a useful framework. The *TOD Standard* – a lead author of whom is our international Low Carbon Development Planning and Implementation Specialist in this project – is not a detailed manual but provides a useful framework, with the principles listed in Table 4.

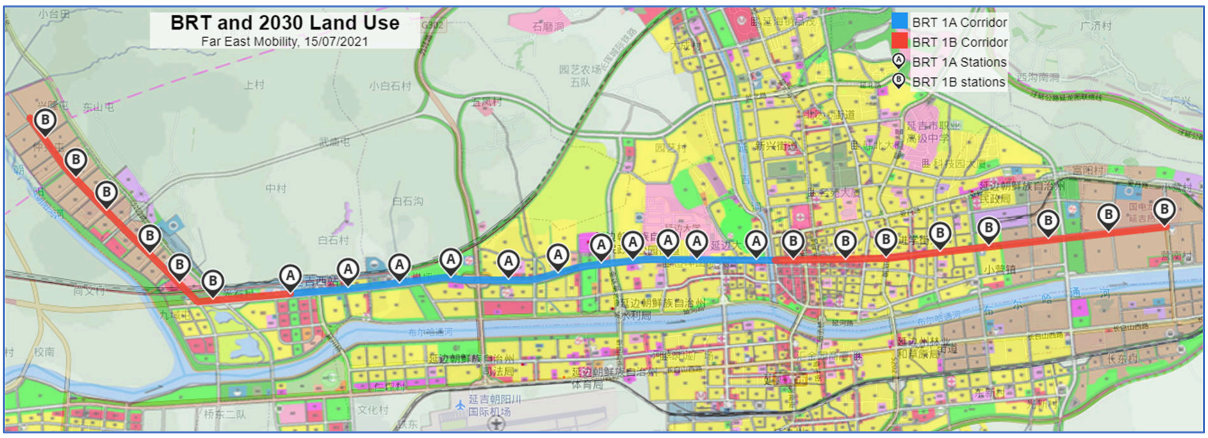
Table 4: TOD principles from the TOD Standard.

Principle 1 WALK. • OBJECTIVE A. The pedestrian realm is safe, complete, and accessible to all. • OBJECTIVE B. The pedestrian realm is active and vibrant. • OBJECTIVE C. The pedestrian realm is temperate and comfortable. Principle 2 CYCLE • OBJECTIVE A. The cycling network is safe and complete. • OBJECTIVE B. Cycle parking and storage is ample and secure. Principle 3 CONNECT • OBJECTIVE A. Walking and cycling routes are short, direct, and varied. • OBJECTIVE B. Walking and cycling routes shorter than motor vehicle routes. Principle 4 TRANSIT • OBJECTIVE A. High-quality transit is accessible by foot. (TOD Requirement)	Principle 5 MIX • OBJECTIVE A. Opportunities and services are within a short walking distance of where people live and work, and the public space is activated overextended hours. • OBJECTIVE B. Diverse demographics and income ranges are included Principle 6 DENSIFY • OBJECTIVE A. High residential and job densities support high-quality transit, local services, and public space activity. Principle 7 COMPACT • OBJECTIVE A. The development is in, or next to, an existing urban area. • OBJECTIVE B. Traveling through the city is convenient. Principle 8 SHIFT • OBJECTIVE A. The land occupied by motor vehicle is minimized.

TOD recommendations will be incorporated in the Low Carbon Urban Development Action Plan.

Important issues to be considered will be the status of relevant planning and zoning codes and their application in Yanji, with the City Planning Bureau the main counterpart agency. Yanji is considering TOD applications at sites along the BRT corridor, and planning and design input will be provided according to opportunities which arise.

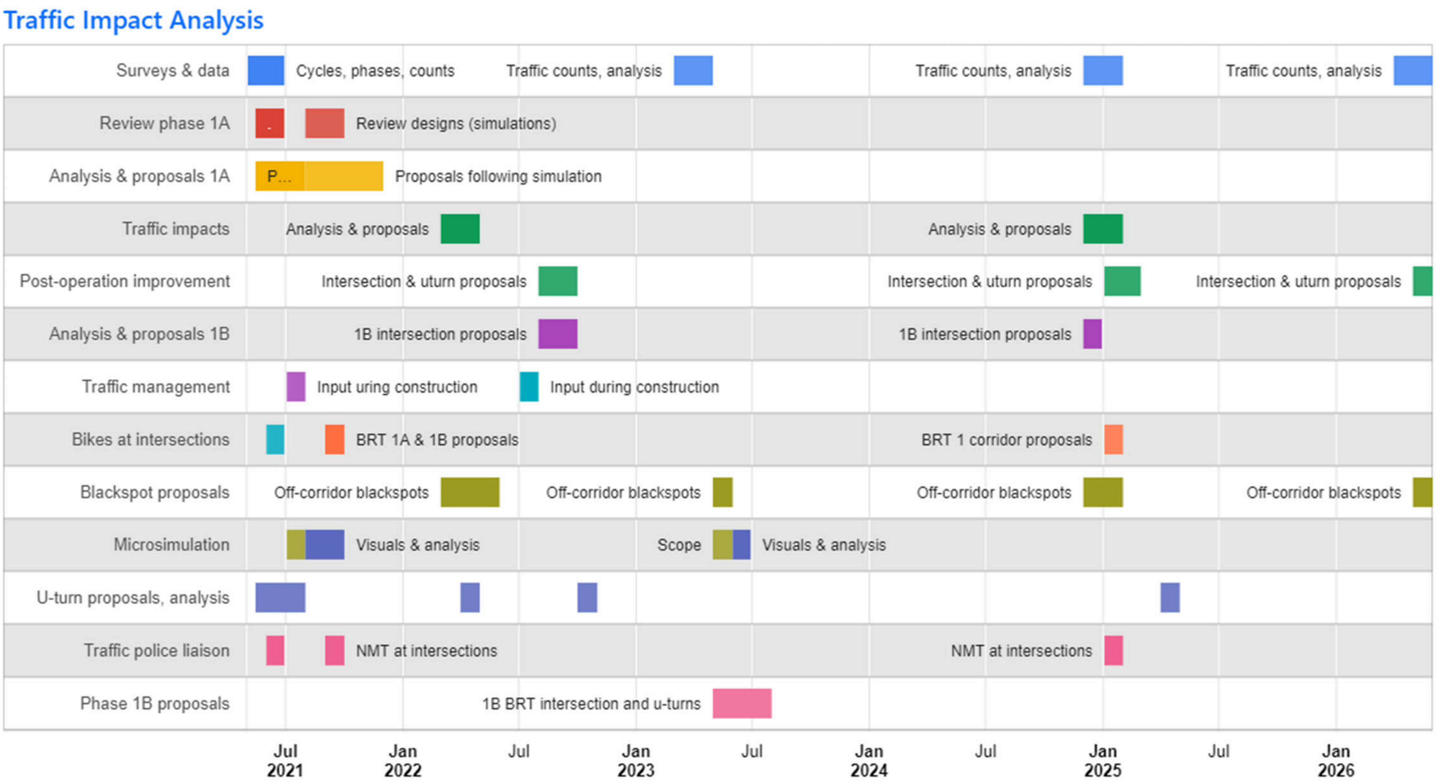
Preliminary research on the TOD situation has been carried out, with relevant local zoning regulations identified, though there are still many gaps where it is not clear what regulation applies given the lack of detailed local regulations on many issues. The zoning regulations on key TOD issues like setback parking, density, mixed use, parking and other areas are often either difficult to find or seemingly not defined in detail. More research is being carried out in this area.



4 Traffic Impact Assessment

4.1 Work Plan

The work plan for the traffic impact assessment is outlined following. Though listed separately in the work plan, in practice much of the traffic impact, traffic management and road safety is an integral part of the major work components of BRT and NMT.

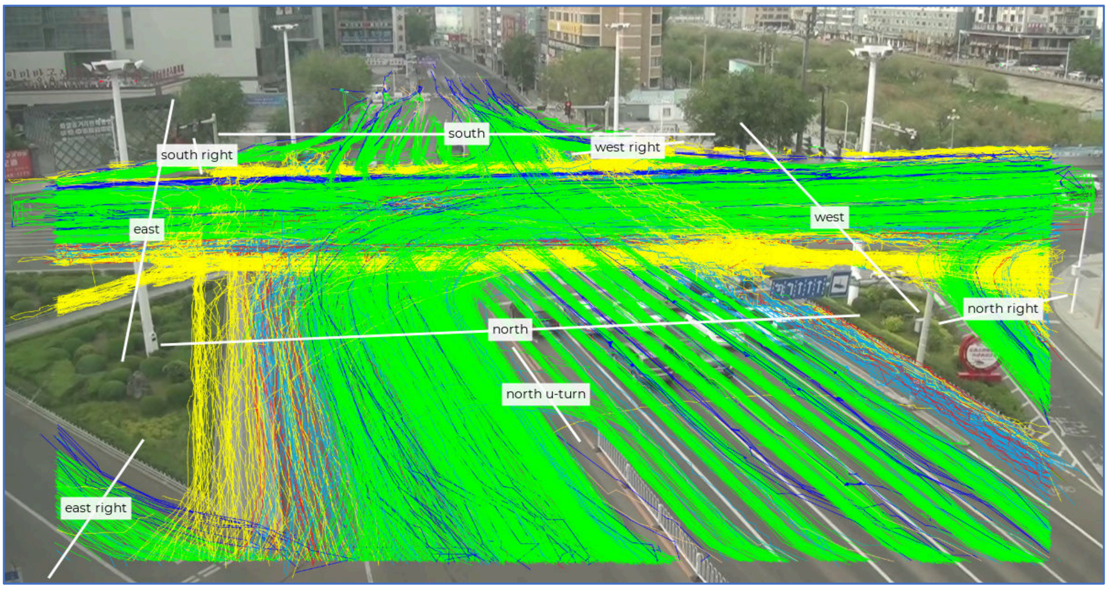


4.2 Data Collection

4.2.1 Traffic counts and turning movements

Extensive data collection started in May 2021 and continued throughout June, with the initial intersection counts to be completed during July 2021. An example of the traffic trajectories view from video processing is shown in Figure 26.

The top image in Figure 26 is from a video image taken by television company contractors hired by Far East Mobility overlooking the largest intersection in the BRT corridor in central Yanji. The lower image in Figure 26, with the date and time stamp, is from a traffic camera video feed recorded by the traffic police camera. The traffic-related data collection involves a combination of videos from survey personnel, traffic camera videos, and on-site spot counts.



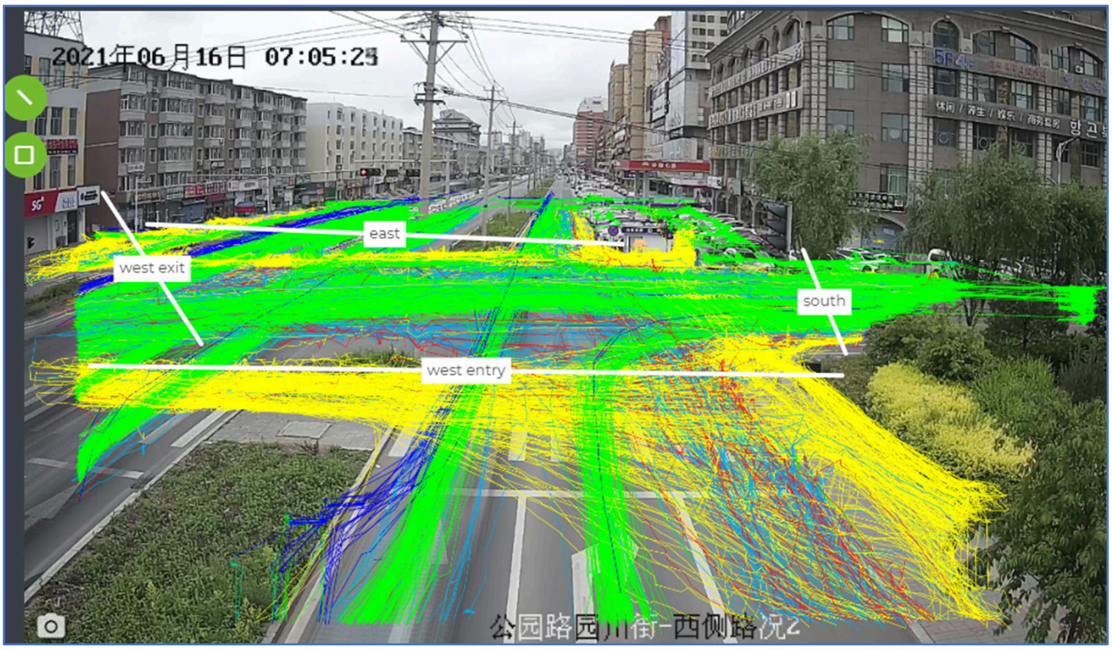


Figure 26: Traffic trajectory and classified turning counts are being carried out at major intersections.

The traffic police have been extremely helpful, allowing the local project coordinator to access the control room in order to take videos of the traffic camera displays, and also providing data from their traffic counts from the cameras.

Traffic counts have been carried out during four hour extended periods covering the AM and PM peak periods, in order to define the peaks precisely, and also during weekends, including during the evening after bus services drop off sharply around 7pm.

By the end of July 2021 FEM will have carried out a combination of spot counts and video counts to define the traffic volumes and turning movements at all major intersections along the corridor, as well as in the corridor itself. This will form the basis of phase 1A BRT intersection proposal development.

AM peak and PM peak traffic flows at all segments and intersections as well as access roads along the BRT corridor are mapped at www.yanjibrt.net, regularly updated with new count data.

These traffic counts show that even during peak hours traffic volumes in the corridor do not exceed 2,000 passenger car units (PCU) per hour in all but the innermost section of the Phase 1A corridor, where PM peak flows of 2,364 PCU per hour are reached. In much of the western section of the corridor, west of the outer ring road (marked with yellow text in Figure 27), traffic flows are even less than 1,000 PCU per hour.

With these volumes, the current traffic flows can be accommodated in virtually the entire Phase 1A corridor, except for the section around Gongyuan in the city centre, where the design provides three lanes in each direction.

This also addresses the concern raised in the inception meeting about the adequacy of two lanes each way for mixed traffic in the western part of the corridor. With only 1,500 PCU/hr or less, and even less than 1,000/hr in many segments even during peak hours, even a doubling of current traffic can still be accommodated by the two lanes for mixed traffic in the western part of the corridor. In addition, a road parallel to the BRT corridor will soon open in the west of the corridor.

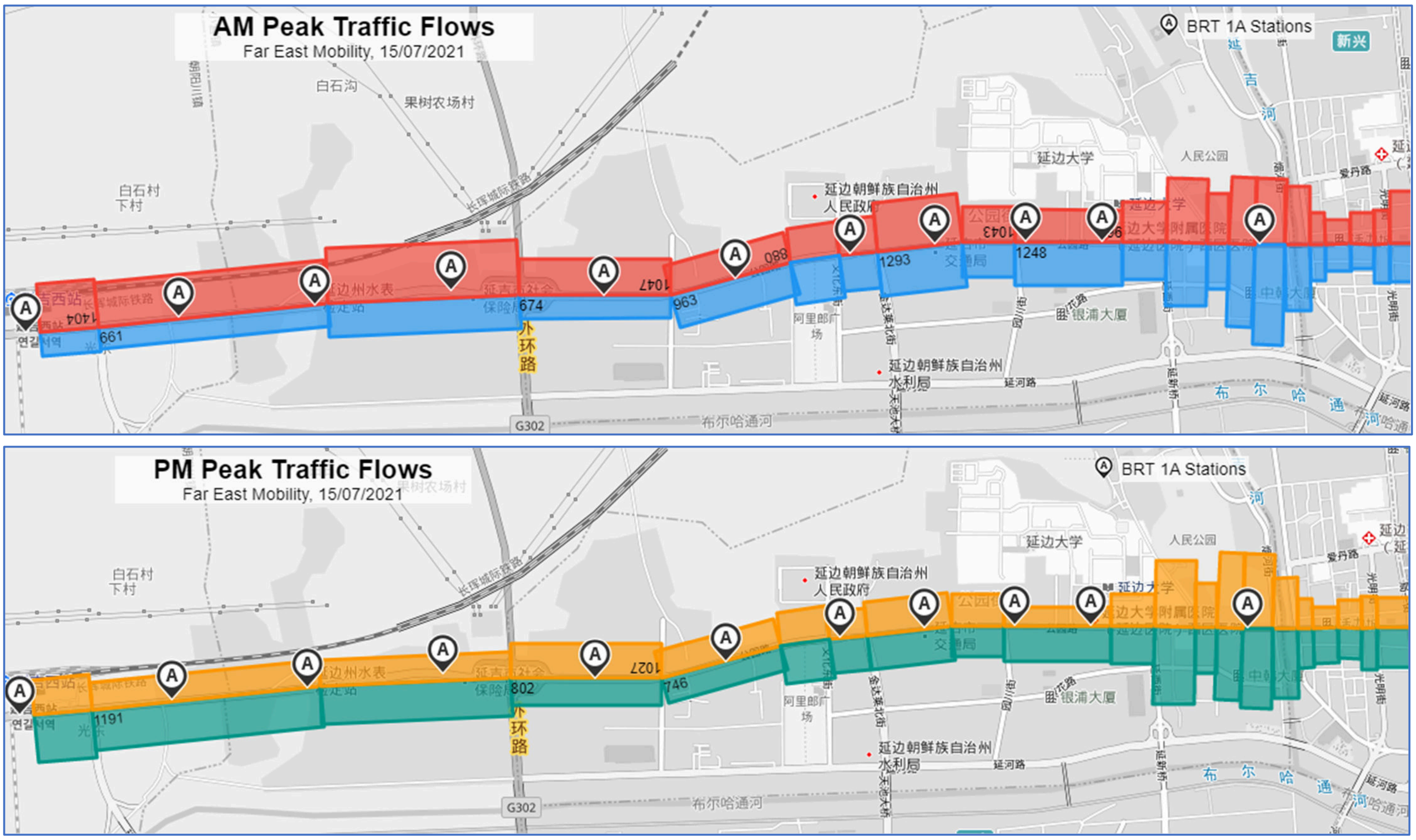


Figure 27: Peak hour traffic flows in the BRT corridor, excluding buses.

4.2.2 Summer and Winter traffic

It is expected that as with public transport demand, two sets of data collection will be needed, one in Summer and one in Winter, noting what is likely to be significantly different trip demand and traffic flows. The counts being carried out from May to July 2021 cover the Summer period. Surveys will then be carried out later in 2021 and in early 2022 to cover the Winter period.

Traffic conditions and speed will be affected by Winter conditions, especially when road conditions are icy and slippery, with bus operating speeds also likely to be affected. Pedestrian and bicycle conditions will also need to be assessed during Winter, with appropriate considerations incorporated into the planning and design as well as the NMT Master Plan.

4.3 Initial Issues

The major initial traffic impact related issues relate to intersection configurations. The proposed signals have not yet been finalized by the design institute, but left turns are marked in the intersection drawings, indicating the proposed phases. The current signal phases were documented in site visits in May 2021 and are shown in Figure 28. The multiple 4 and even 5-phase intersections result in slow traffic speeds in the BRT corridor.

Figure 28: Current intersection phases along the Phase 1 BRT corridor, overall (top) and zooming in to the central part of the phase 1A corridor (above).

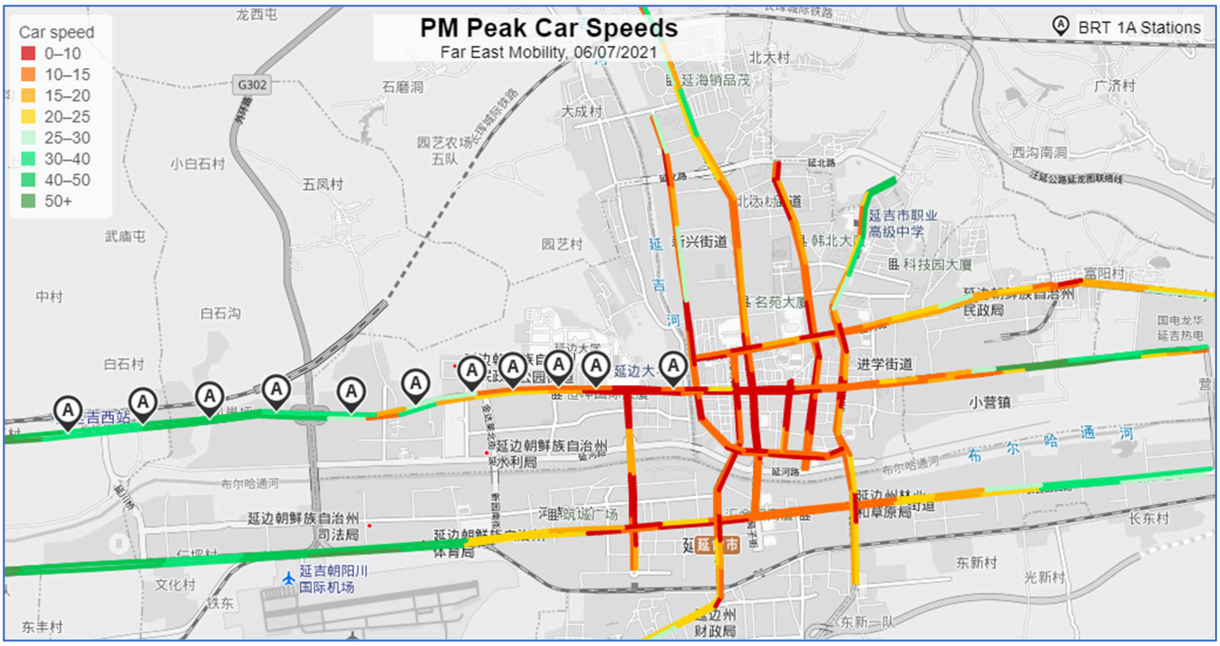


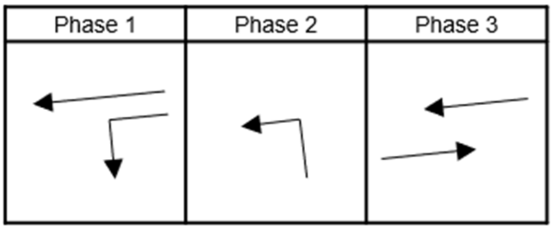
Figure 29: PM peak traffic speeds are low, primarily due to the intersection signal configuration.

As noted, Far East Mobility's proposals for intersection phases are still being developed, with the data collection being completed during July 2021. However, in two locations there is already a clear case for an intersection phase adjustment. Between B7 and B8, and B11 and B12 stations, the current design is for 3 phases at both intersections, and in both cases FEM recommends reducing the phases to 2 by eliminating left turns. This will in both cases provide a significant time saving for BRT, while combining u-turns with BRT station access at all four stations.

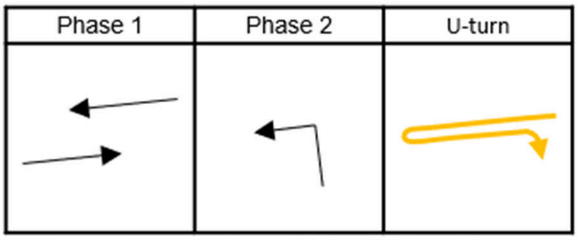
Figure 30: Proposed phase adjustments in two locations.

Yanchuang Bei Jie intersection

Between B7 and B8 stations, at the intersection of the BRT corridor with Yanchuang Bei Jie, the current design has 3 phases.



3 signal phases in design



Proposed signal phases -
reducing 3 phases to 2 phases

Alternative/U-turn for restricted left turning from east to south.

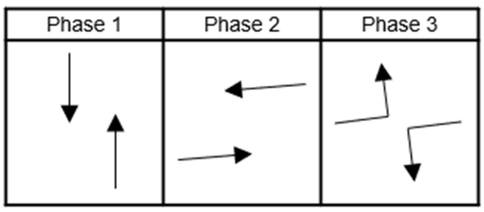
Figure 31: Proposed phase reduction from 3 to 2 between BRT stations B7 and B8.

There is a u-turn in the design before the B7 station, at the location marked above. Instead of turning left at this intersection, from the BRT corridor into Yanchuang Bei Jie, mixed traffic should just utilize this u-turn 300m to the west, as indicated above. The large taxi volume at the high speed railway station also needs to be considered. It is likely that a direct left turn from the taxi exit point of the high-speed railway station could be implemented together with the u-turn at the BRT station. This would result in three 2-phase signals in this section, far preferable to having a three-phase intersection. Both mixed traffic and the BRT would benefit from this configuration.

When discussed with the design institute, they said that they would agree to this change only if the traffic police agreed.

Wolong Jie intersection

In the second location, between stations B11 and B12 at the intersection with Wolong Jie, the design indicates three phases (according to the left turn road markings), as following. However, this can be reduced to two phases by using u-turns which are already in the design. The design institute agrees with this proposed change.



3 signal phases in design

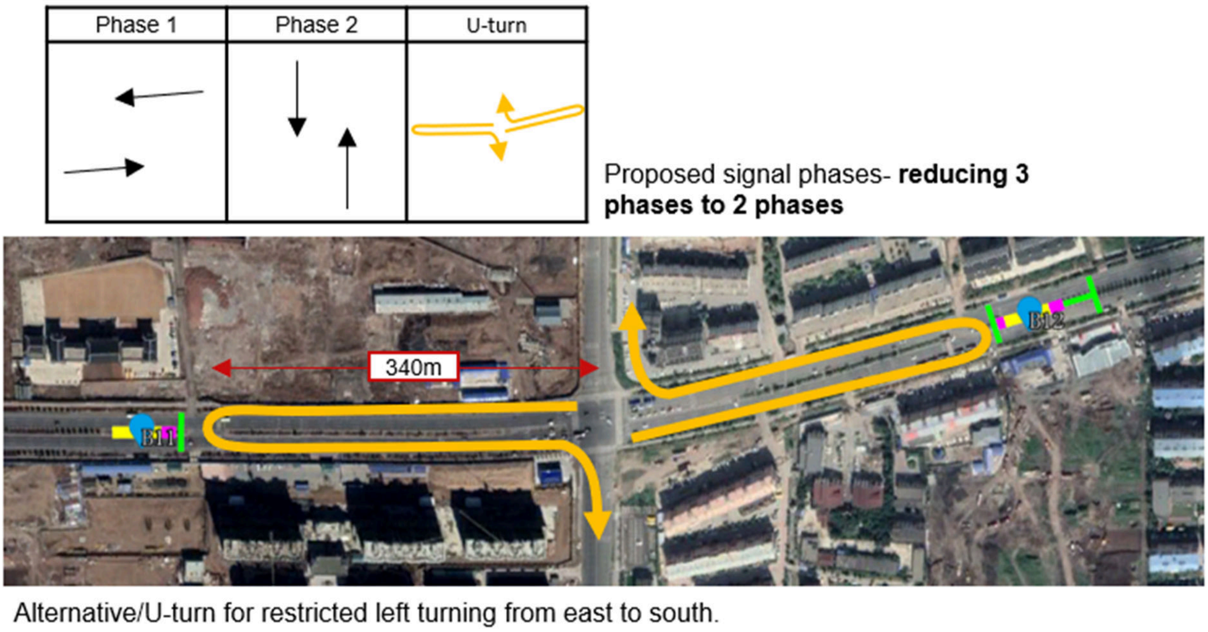


Figure 32: Proposed change from 3 to 2 phases by using u-turns already in the project design.

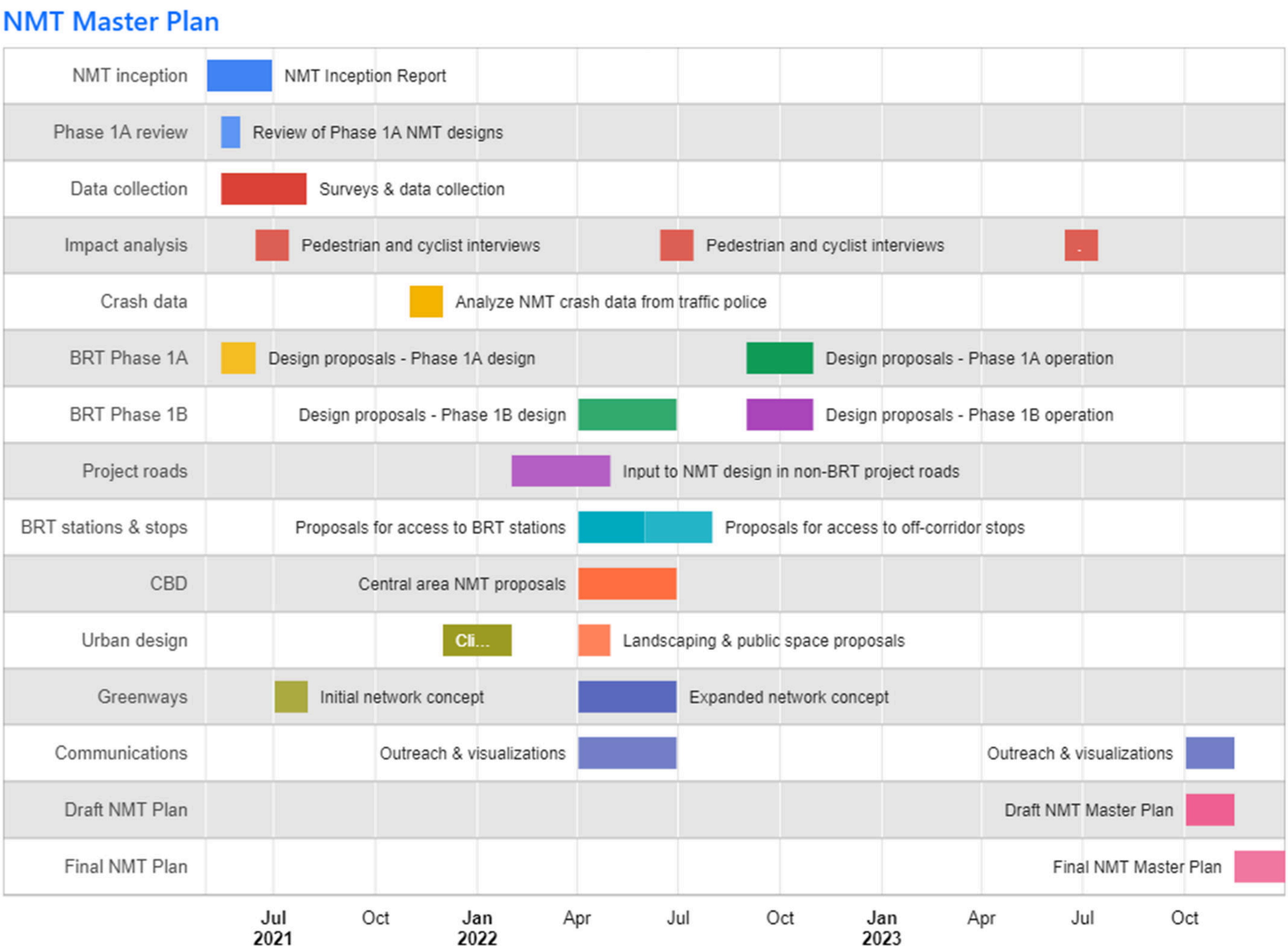
Other intersections

Proposals for signal phases of other intersections are still in preparation, with data collection, simulation and other analysis ongoing.

5 Non-Motorized Transport

5.1 Work Plan

The NMT work plan is outlined following. The NMT Master Plan, as explained in the project proposal methodology, will be developed after the other NMT inputs, and will largely draw from these inputs and the project experience to date. In this way, the NMT Master Plan is expected to have maximum local relevance.



5.2 Data Collection

Data collection on NMT has taken place initially focusing on the phase 1A BRT corridor, in order to provide input to the design. The main remaining data requested is the detailed accident / crash data, especially for crashes involving pedestrians and cyclists.

5.3 Issues with Phase 1A BRT Design

NMT issues with the Phase 1A BRT design were the major focus of the NMT inputs during May and June 2021. These issues were documented and submitted to the PMO, and then discussed in detail on several occasions with the design institute. The following table provides an outline summary of the discussions, Far East Mobility's proposals, and the design institute responses.

Table 5: NMT design issues and discussions.

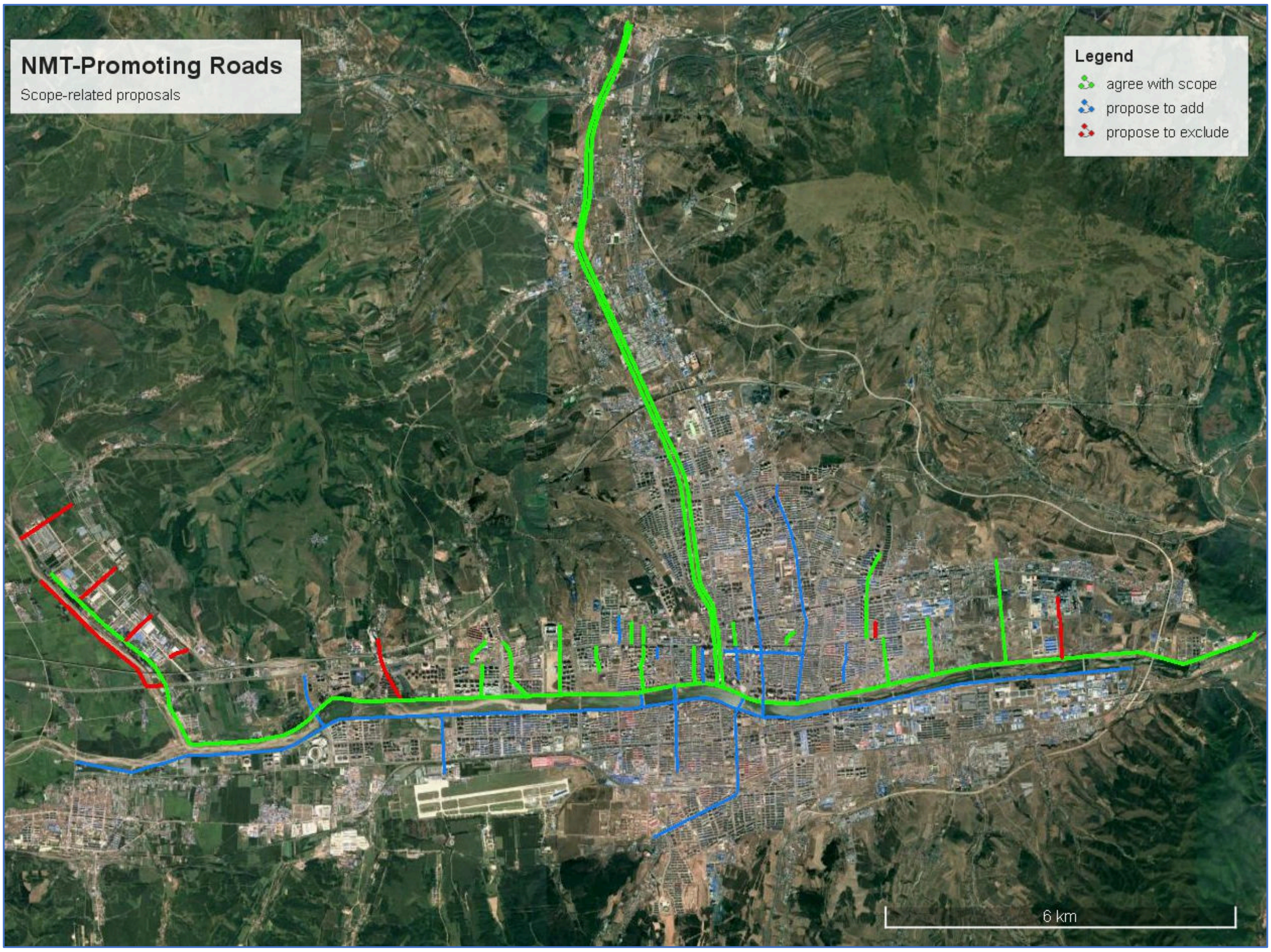
Topic	Issue	Design team feedback
Continuity of bicycle lane and sidewalks in W3	In the W3 section from Jindalai Beijie to Yanji Jie, the bicycle lane is located at sidewalk level. Several issues were addressed: 1. Continuity: 9 locations were identified where the bicycle lane and sidewalk are very narrow or mixed. Design adjustments were proposed, reorganizing the width of bicycle lane, sidewalk, green belt and other existing green space. 2. Separation: For better separation between pedestrians and cyclists, it is proposed to lower the bicycle lane level by 5cm	1. Agreed 2. Not agreed
Pedestrian / bike crossings	The current design includes 29 locations for pedestrian and bicycle crossings. An additional 4 mid-block crossings are proposed.	1 crossing is agreed, 3 to be discussed
B16 Station access	At station B16 it is proposed to add a crosswalk with median walkway access on the western side.	To be discussed
Pedestrian bridge at B17 Gongyuan Station	To reduce the walking distance for passengers and better connect high demand locations 5 options were proposed.	Not agreed, since not considered critical.
Cyclist and pedestrian safety at intersections	1. Turning radius: it is proposed to extend the fence divider between cycle lane and mixed traffic lanes up to the crosswalk, and add these same fence dividers in the side streets. Proposed extensions were made for 3 intersections 2. Right-turn slip lanes: the width of right-turn slip lanes is proposed at 1 location 3. Refuge islands: nose tips at refuge islands need to be moved at 2 intersections. A refuge island was proposed to be added at 1 location. 4. Ramps for bicycle lanes: cyclists need to merge with pedestrians to access bicycle lanes at intersections along W3. It is proposed to add bicycle ramps at each intersection, driveway and mid-block crossing	1. Agreed 2. Agreed 3. Agreed 4. To be discussed
Driveways	The design brings the sidewalk (and bicycle lanes for W3) down to street level at every small driveway. It is proposed to raise the sidewalk and bicycle lane (for W3) up to the regular level at driveways when the number of vehicles using these driveways is minimal. The cycle lane is also proposed to be colored through the driveway.	Agreed
Extension of fence divider	In 2 locations it is proposed to extend the fence divider to prevent mixed traffic from entering and parking on the bicycle lane.	Undecided
Car parking on sidewalks and setbacks	Current parking on sidewalks and setbacks are proposed to be banned altogether within the 'red line'. In central locations where the setback stretches beyond the red line, physical measures are needed to prevent cars from entering sidewalk and cycle lane.	Segregation is agreed, but authority is with Project Command Group
Taxi stands on bicycle lane	It is proposed to cancel taxi bays on the bicycle lane at 3 locations at and near the West Railway Station.	Agreed in principle, to be decided in a later stage
Bicycle parking	Proposals are made to change the location, size and type of bicycle parking stands along the BRT corridor. Proposals for 24 bicycle parking locations developed at each BRT station, and additional central locations.	To be discussed

Presentation slides outlining each design aspect were prepared and then revised multiple times after discussion with the design institute. The slides are attached as an annex to this report.

5.4 NMT Road & Greenway Scope

We propose to adjust the NMT road scope following site visits in May 2021.

The planned greenway network includes access roads to the BRT corridor, as well as the northern banks of the Bu'erhatong river. Based on site visits in May 2021, it is recommended to expand the greenway network and make some adjustment to proposed corridors as in Figure 33.



Scope agreed (green)	Scope proposed to cancel (red)	Scope proposed to add (blue)
57.98 km	8.26 km	36.86 km

Figure 33: Proposed NMT network scope adjustment.

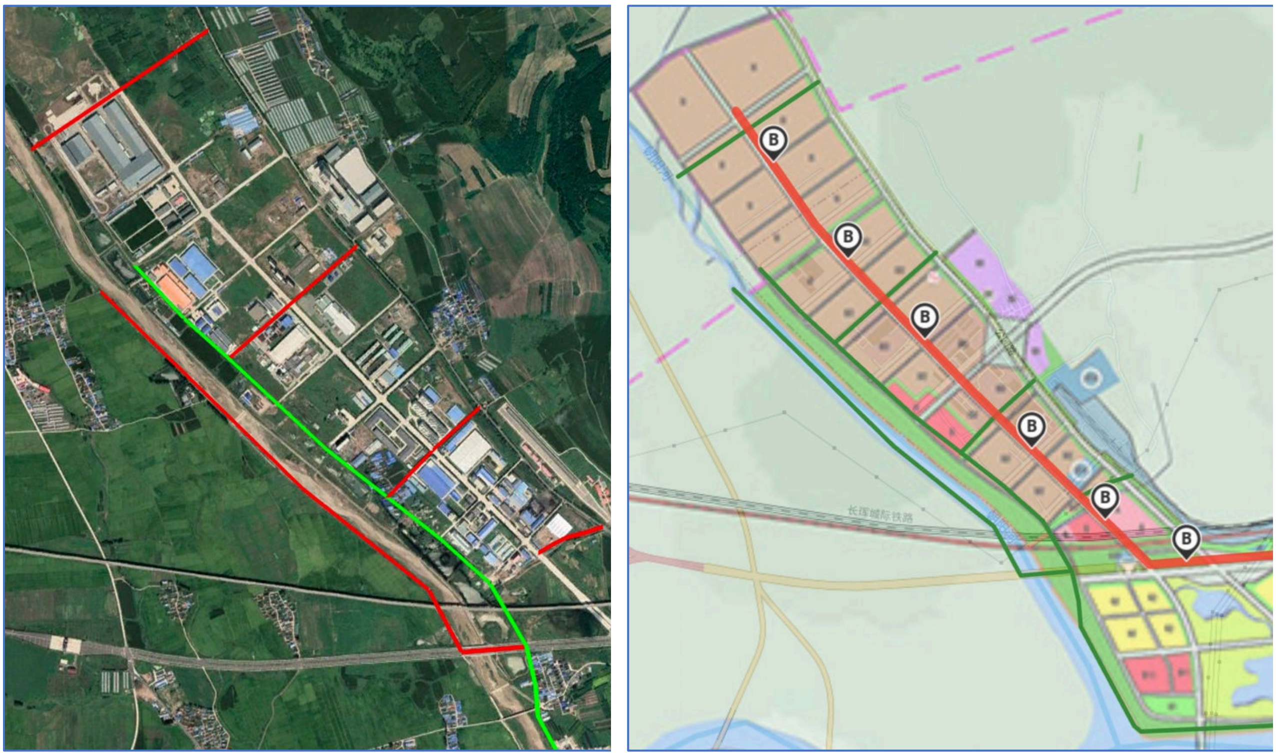
These proposed changes would result in the NMT-promoting / Greenway network being expanded from the current 66.24km to 94.84km, a nearly 50% increase in length. Most importantly, the proposed changes will provide improved connectivity and access for higher demand areas, including existing greenway links along the river and city centre areas of high activity, allowing the greenway network to serve much more than just recreational trips.

The main proposed additions to the greenway network include:

- A greenway on the southern bank of the Bu'erhatong river. A riverside boulevard is already in place, and popular with the locals, along the majority of the river. Connectivity across intersections is a major issue for this boulevard. Access to the riverside must also be improved
- Greenways in central Yanji, connecting the northern areas the BRT corridor, shopping and leisure centers
- Connection towards the popular Mao'ershan National Forest Park
- Connection to the southern bus station
- Connection from the West Railway Station to the southern riverside boulevard, Yanji People's Sports Stadium.

Site visits to these corridors show that some of the streets currently do not exist and the proposed greenways are likely to be proposed based on 2030 land use plan and future road network.

The corridors in red are proposed to be cancelled. The corridor in green is proposed to be included.

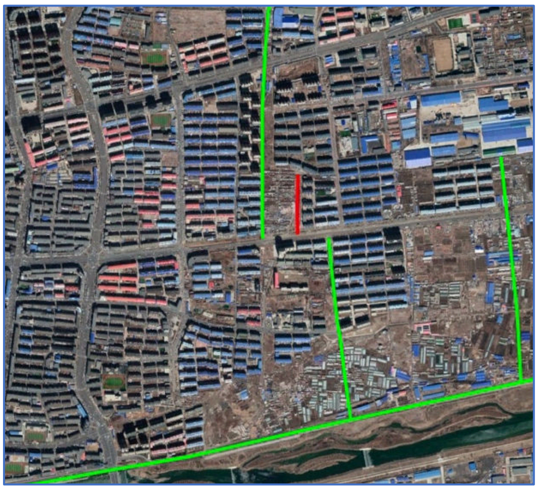


Above: The proposed greenways on the western end of the corridor are located in rural areas with industrial land use, and no changes are planned for this in the 2030 land use plan. It is proposed to cancel all but the northern riverside greenway noting that the absence of residential or commercial areas means there is little for these side roads to connect to.

The short access roads to the industries which are perpendicular to the river and BRT corridor are certain to have very low motorized traffic volumes. Pedestrians or cyclists using these very low traffic access roads do not require any special infrastructure in terms of bike lanes or special pedestrian infrastructure, though some signage and perhaps road markings could be incorporated to point people towards the greenway along the river.

Above: The proposed greenway on the southern side of the BRT corridor is located inside a gated residential community on private land, in Bishui Yuanlin (碧水园林). On the northern side it does not connect to much, current or future. It is proposed to cancel this greenway.

Above: On the far eastern side of the corridor the proposed greenways are located in current wasteland. The western corridor is located alongside a future park, but the far eastern corridor will be in industrial land. It is proposed to cancel this greenway.



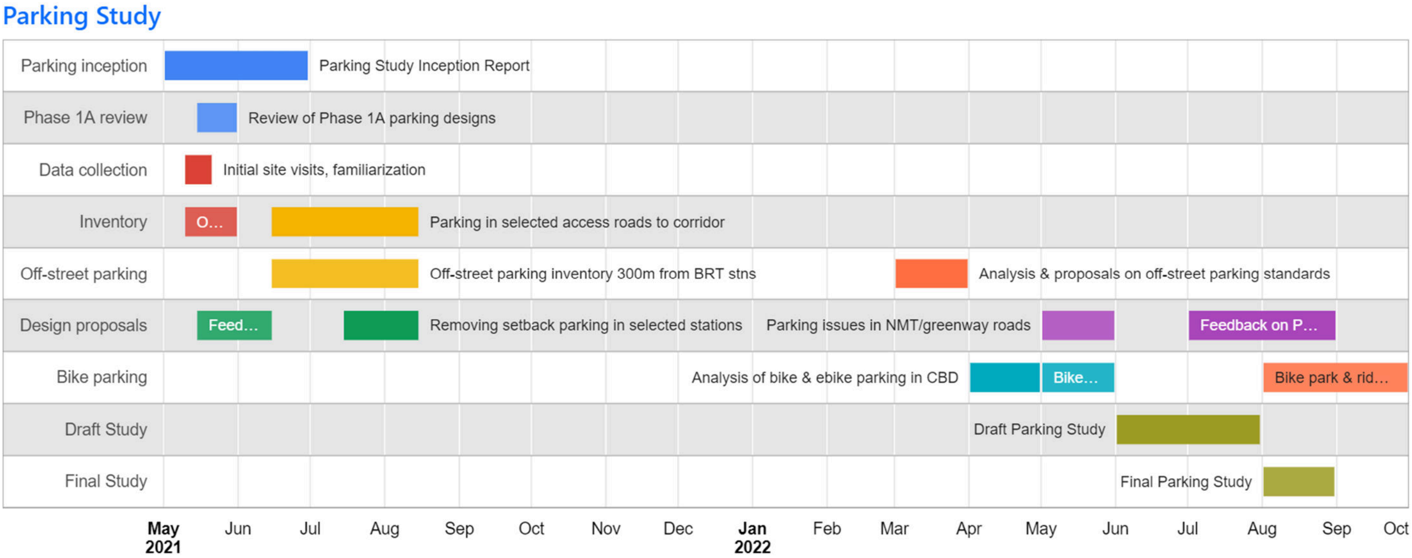
Above: On the eastern side of the corridor there are two adjacent greenways proposed in the Linyu Dongcheng area. It is recommended to extend the western corridor, which connects further north, and cancel the eastern corridor.

6 Parking

6.1 Work Plan

The parking work will focus on and around the BRT corridor, considering:

- On-street parking
- Setback parking
- Off-street parking.



6.2 Data Collection

As of 30 June 2021, the following parking data has been collected:

- On-street parking along the BRT corridor
- Setback parking inventory along the BRT corridor
- * On-street parking supply along the majority of phase 2
- * Off-street parking within 300 meters from the BRT corridor Phase 1 (~50% complete).

In addition, in June 2021 high-resolution drone imagery was gathered for the central 11km section of the full Phase 1 BRT corridor. This imagery, which extends 200m to the north and south of the corridor, provides a snapshot of the corridor, including detailed identification of the parking situation. This high resolution imagery will be collected at 6-12 month intervals during the course of the project and amongst other things will provide a record of the provision of on-street, setback, or outdoor parking areas along the BRT corridor.

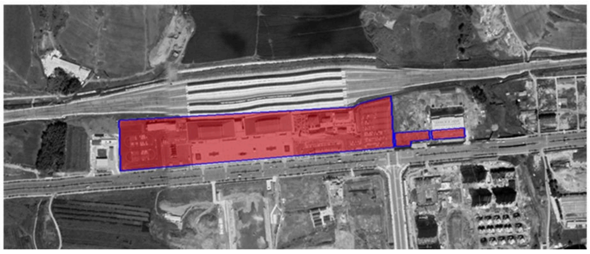
Some preliminary data and observations on parking along the BRT corridor is provided in Figure 35.

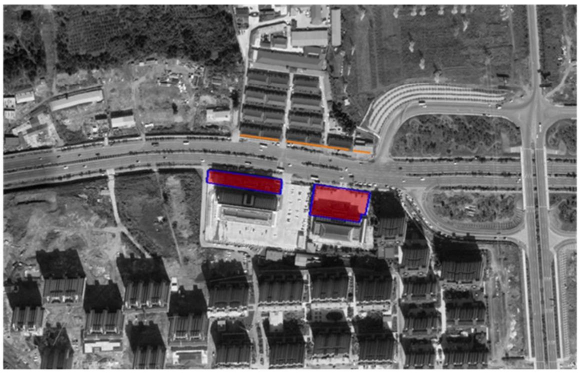
Figure 34: High resolution photogrammetric images of the BRT corridor, June 2021.

Current Parking Supply along Phase 1A

Surveys were conducted into all existing, formalized parking supply along the corridor, between the buildings.

Documented were the:
- Location of the parking supply
- Number of parking spaces
- Kind of parking: on-street, sidewalk, setback
- Publicly or privately accessible parking
- Positioning of the parking: parallel, at angle, perpendicular
- Paid or unpaid, parking fees and hours





Current Parking Supply along Phase 1A

Surveys were conducted into all existing, formalized parking supply along the corridor, between the buildings for corridors Phase 1A and 1B. Parking supply is considered 'formalized' when parking spaces are demarcated with paint.

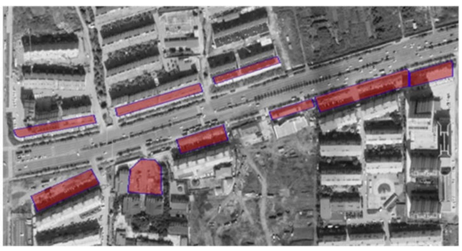
Documented were the:
- Location of the parking supply
- Number of parking spaces
- Kind of parking: on-street, sidewalk, setback
- Publicly or privately accessible parking
- Positioning of the parking: parallel, at angle, perpendicular
- Paid or unpaid, parking fees and hours

Formal parking supply:

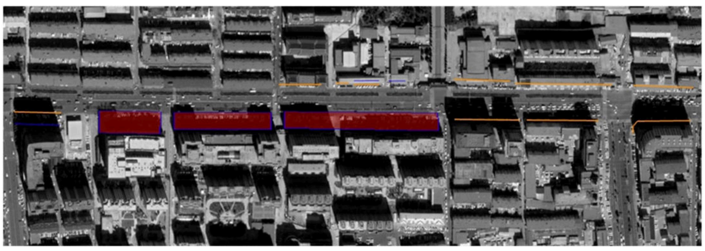
Section	On-street	Sidewalk	Setback	Total
W1	0	52	866	918
W2	0	0	725	725
W3	0	670	244	914
Total	0	722	1835	**2557**

Current Parking Supply along Phase 1A

Observations:
- Nearly all parking supply on sections W1 and W2 is setback parking, away from the street and sidewalk. More parking supply can be expected when new developments will open.
- Most parking supply on section W3 is on sidewalks, mostly perpendicular to the street, leaving little to no space for pedestrians to use the sidewalk.
- The sidewalk space seems to be designed for maximum parking load, with parking available where the sidewalk width allows
- Illegal ***on-street*** parking rarely occurs along the entire corridor
- Only 10% of parking supply is paid, all at 2 adjacent parking lots across from the Yanbian University. Parking fees are low, at 5 CNY for two hours (first 15 minutes free), and 2 CNY for every subsequent hour
- All parking supply is publicly accessible, except for some locations at the university campus



Above: W2 – mostly setback parking, free of charge



Above: W3 – mostly sidewalk parking, and 2 paid setback parking lots

Figure 35: Preliminary data and observations on parking along the BRT corridor.

7 Capacity Building

During the inception mission the importance of a capacity-building program was emphasized by the ADB. There is no separate work plan for this item; rather, capacity building will be incorporated into many aspects of the project.

In addition to incorporating capacity-building in the regular project operation through regular technical exchanges, meetings, presentations, visits and reports, the consultants expect to carry out a form of capacity needs assessment relating to the BRT system, and propose steps to address shortcomings especially related to the BRT system but also considering NMT, parking and other project elements.

These steps will include the kinds of capacity building measures outlined by the ADB in the inception mission, such as longer 1-2 week programs combined with site visits and technical presentations. (A longer 3 week version was mentioned, but it is probably unlikely that the related officials and technical personnel will be available for that long, even if the limitations on study trip duration can be circumvented.)

Visits to other cities are very useful both for higher level policy-making and support, and for technical staff involved in all aspects of the project. Far East Mobility hosts a regular BRT, TOD and low carbon development oriented site visit and training program and our team has hosted dozens of visiting delegations to the Guangzhou BRT and related urban development projects. Study tours are often the key to convincing senior leaders of the viability of BRT in a dense city centre area, and valuable capacity building for technical personnel.

In Yanji the Vice Mayor and some government agency leaders have visited Guangzhou and Yichang to see the BRT systems, but the Mayor and Party Secretary have not yet visited. We will plan to help arrange such visits, and to host them, together with providing technical briefings on-site (with wireless headsets) and in a separate technical briefing session. We will also arrange a visit to the system control centre and meeting with system regulators.

Based on experience hosting numerous visiting delegations related to BRT, TOD, and urban development, we suggest the cities in Table 6 are of most interest, with the actual visit schedule to be determined according to the available time and budget.

In China, a one-week visit could cover three cities, such as Guangzhou, Yichang and Shanghai. Internationally, a visit to Europe of two weeks could cover cities such as Amsterdam and Paris in addition to Rotterdam and Copenhagen. In South America, Bogota is a leading choice, and Cali is also very useful as a smaller city example for Yanji. In a 10-day visit including travel time, a trip to In addition to Bogota and Cali, South America could include either Lima, Peru or Quito, Ecuador, both of which have BRT systems and a range of other urban improvement measures.

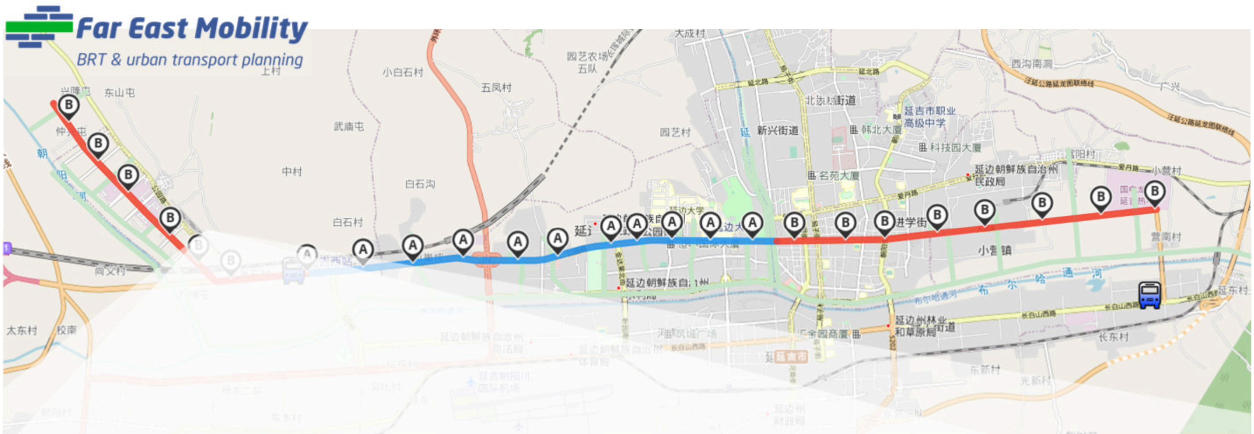
Regarding Winter conditions, a study trip to Finland would be useful, as Finnish cities are considered world leaders in terms of retaining high bike mode shares even in extended sub-zero temperature periods, and have much experience in this area. In that case, a one-week visit to Finnish cities could be followed on the same trip to slightly more temperate cities further south, such as Barcelona, Rotterdam, or other cities in Holland, Germany or Spain. These cities provide many examples of design and planning excellence in urban transport including bus systems, greenways, pedestrian and bicycle facilities, road safety, public space improvements, and the revitalization of older housing stock.

Study tour, training and technical briefing programs could be based around combinations of the cities listed in Table 6. Currently the Covid-related travel restrictions make even domestic travel difficult. For example, travel to or from Guangzhou was not possible in June 2020 due to lockdowns. Substantial work on study trips/training is probably best delayed to 2022, as travel is expected to remain greatly limited during 2021.

Table 6: Suggested study tour, training and capacity building cities.

City	Topic	Cost
Bogota and Cali, Colombia	BRT, NMT, TOD, greenways (Cali, Colombia can be combined). A longer trip to South America could also include Lima (NMT, BRT, urban revitalization), and possibly Curitiba and Sao Paul in Brazil.	Very high
Rotterdam, Utrecht, Copenhagen	Low carbon urban development (multi-sector), transit system ITS and design, greenways, NMT, new area planning and design, cold weather (heating etc) issues. Healthy city planning in Copenhagen. High quality NMT networks. Best visited in Summer, providing extended daylight hours.	Very high
Finnish cities such as Helsinki, Oulu	Finnish cities are often considered to be world leaders in the area of winter cycling, retaining high proportions of trips by bike even in extended periods of sub-zero temperatures. Would need to be visited in Winter.	Very high
Seoul, Korea	Bus system, greenways (especially along waterways), sponge city applications, ITS applications, off-corridor bus stops, cold weather issues (e.g. bus stop waiting areas), parking management systems	Moderate
Guangzhou, China	BRT, revitalization of 'danwei' or work unit housing (see https://www.fareast.mobi/en/bestpractices/introduction/Good-Practice-Case-Studies), greenways, Urban Renewal Agency projects (many focused on NMT infrastructure and waterways).	Low
Yichang, China	BRT, roadway utilities/waterways upgrading together with BRT	Low
Shenzhen, China	High frequency bus networks, TOD aspects (mixed-use and higher density zoning codes in station areas, reduced setback requirements in TOD zones, others), NMT improvements	Low
Chengdu, China	BRT, sponge city and greening applications, new development planning, some river greenways, CBD NMT	Low
Shanghai, China	NMT improvements, bikes at intersections, bus stop technology, bus ITS, median bus lanes/BRT, low carbon action plan (碳排放达峰行动计划)	Low

Annex 1: NMT Proposals in Phase 1A Design



亚行贷款吉林延吉低碳气候适应型健康城市项目

机构能力建设CS4——低碳城市行动计划、交通影响评估、停车管理研究、BRT运营能力建设、BRT线网规划、慢行交通总体规划设计咨询服务

BRT走廊一期设计建议 V2

2021年7月

1

BRT走廊一期设计建议 V2（根据广州院回复整理）

编号	设计建议内容	设计院回复	远东城市交通回复
1	调整公园路-延川北街路口相位与交通组织（2相位，东进口禁止左转）	不建议调整，但如果交警同意可以减少到2相位	下阶段会做进一步的数据调查和分析，并与交警沟通
2	自行车道标高降低5cm	不建议调整，不利于非机动车道排水，部分自行车道1.5m，冬天不利于除雪	原道路设计中人行道自行车道采用1.5%放坡，不存在排水问题 原道路设计中，3标的道路横断面设计图中自行车道宽度均为1.5m.
3	民族广场（公园小学对面）取消商铺台阶，拓宽人行道	不建议，该方案对商铺造成较大影响，难以协调。同时取消楼梯后，需增设护栏，商铺门前通行空间不足。	与设计院讨论后，该位置缩窄机动车道宽度，自行车道设在机动车道旁边，用标线分隔。
4	二期走廊自行车道隔离设施（矮隔离带）	原设计已对具备条件的支路口进行了抬高处理	除了小路口抬升，如果流量大的路口保持原设计，连续设置彩色的自行车道
5	碧水园林站位置的人行道开口过宽，缩窄开口，调整路边线	无回复	请回复。**建议方案见第34-35页**。
6	交叉口采用小半径	不同意，按道路规范设计转弯半径	有自行车道的路缘石转弯半径最小为5m——城市道路交叉口设计规程(CJJ152-2010)，城市道路交叉口规划规范(GB50647-2011)
7	交叉口右转弯车道设计建议采用4m宽，调整路边线，形成30°角	支路口按小半径设计，主干道交叉口考虑公交车等大车通行，按道路规范设计转弯半径	右转弯专用车道跨度大型车用5米——城市道路交叉口设计规程(CJJ152-2010)
8	保留大学城门口的行人过街	照片位置为延边大学对出斑马线，原方案设计已设置平面过街	图纸上没看到设计。**建议方案见第37页**。
以下为新增的一些设计建议			
9	延吉西站路边的出租车停靠点建议取消——**第15页**		
10	保持机非隔离护栏的连续性——**第17/18页**		
11	出租车上下客点的平台设置和护栏——**第22页**		
12	交叉口范围内的机非护栏延伸——**第27-30页**		
13	无障碍坡道位置的自行车道连续性——**第32页**		
14	补充的路中行人过街设施——**第38页**		

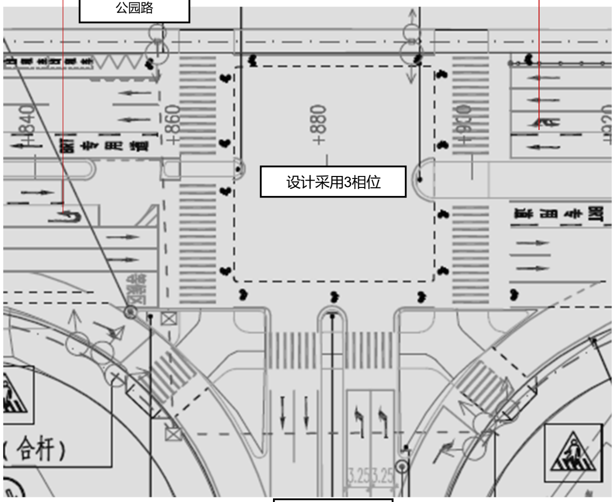
Far East Mobility
BRT & urban transport planning

2

交叉口西进口道比路段增加了1个车道：3个社会车道+1个BRT车道

交叉口东进口道比路段增加了1个车道：3个社会车道+1个BRT车道

交叉口信号与交通组织建议



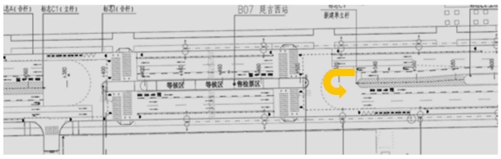
来源：广州市政设计院图纸

交叉口东往南左转取消后的车辆掉头和绕行路径

初步分析该路口可以采用2相位：

- 延川北街北往南方向早高峰流量为264 pcu/hr，晚高峰流量为459 pcu/hr （**注：该流量还包括了公园路西往南的右转流量和其他方向的汇入流量**）
- B07 延吉西站设计了掉头，距离该路口380m

下阶段会做进一步的数据调查和分析。



B07 延吉西站结合行人过街和进出站设计了掉头车道

交叉口信号与交通组织设计建议 小结

部分交叉口信号相位和交通组织可以再优化。

例如延川北街、卧龙街交叉口，目前设计3相位，从目前的交通流量来看，路口左转流量较小，而且在路口前后的BRT车站位置设置了掉头车道，这些路口可以采用2相位（取消路口左转），利用附近的掉头进行绕行。

交叉口的设计需要有充分的数据支持，CS4目前正在进行数据收集，下阶段将会进行交叉口建模分析。

BRT三标自行车道和人行道设计建议

对三标的设计建议包括:

1）在困难位置收窄绿化设施带

绿化带不仅分隔机动车和人行道，也作为设施带（含路灯、信号灯、交通标志灯）使用，不能完全取消。对于自行车道、人行道窄的位置可以从设计的1.5m收窄到75cm。

2）充分利用目前的道路宽度

在一些困难位置，可以从“设计红线”之外的可用空间进行拓宽。

3）降低自行车道高度

建议整个三标的自行车道高度降低5cm，与人行道形成物理隔离。这样可以促进行人在人行道上行走，减少侵入到自行车道。见下图荷兰阿姆斯特丹的案例。

5

BRT三标- we01处的自行车道和人行道设计建议

当前设计:

绿化设施带宽度 1.5m

自行车道宽度 1.5m

人行道宽度 1.5m

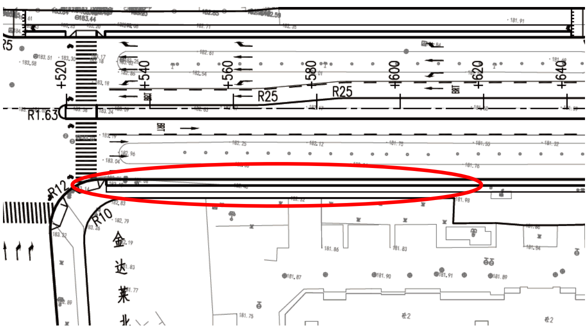
建议设计:

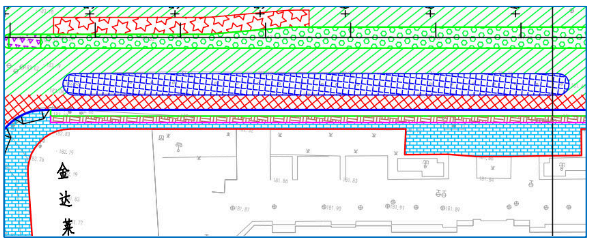
保持绿化设施带宽度至 1.5m

拓宽自行车宽度至 2m

拓宽人行道宽度至 2.5m

该位置的现状绿化带没有实际用处（见下图），减少了自行车道、人行道的宽度，当前设计绿化设施带、自行车道和人行道总宽度只有4.5米。建议这个绿化带缩窄1.5米宽度，进而拓宽自行车道和人行道。





绿化带/设施带
自行车道
人行道

6

BRT三标- we03处的自行车道和人行道设计建议

当前设计：

绿化设施带宽度 1.5m

自行车道宽度　1.5m

人行道宽度　　1.5m

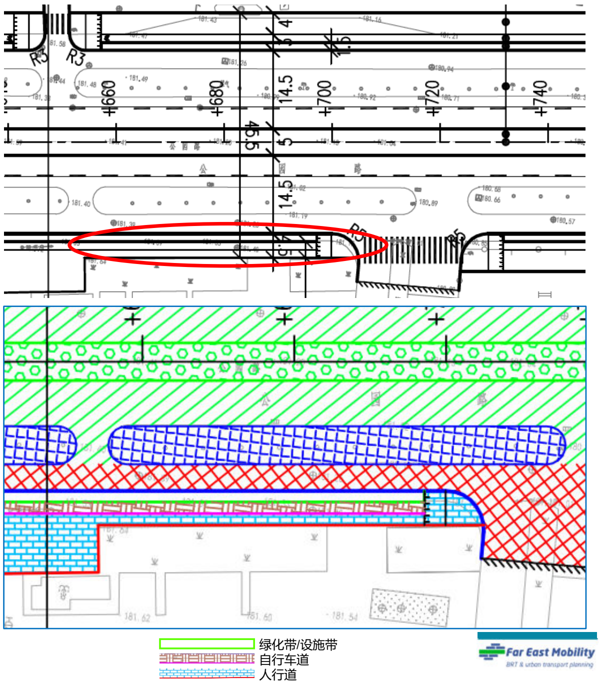
建议设计：

保持绿化设施带宽度至 1.5m

拓宽自行车宽度至　　2m

拓宽人行道宽度至　　2.5m

该位置的现状绿化带没有实际用处（见下图），减少了自行车道、人行道的宽度，当前设计绿化设施带、自行车道和人行道总宽度只有4.5米。建议这个绿化带缩窄1.5米宽度，进而拓宽自行车道和人行道。



Far East Mobility

7

BRT三标- we05处的自行车道和人行道设计建议

当前设计：

绿化设施带宽度　　　　　1.5m

混合的自行车道和人行道宽度 2.0m

建议设计：

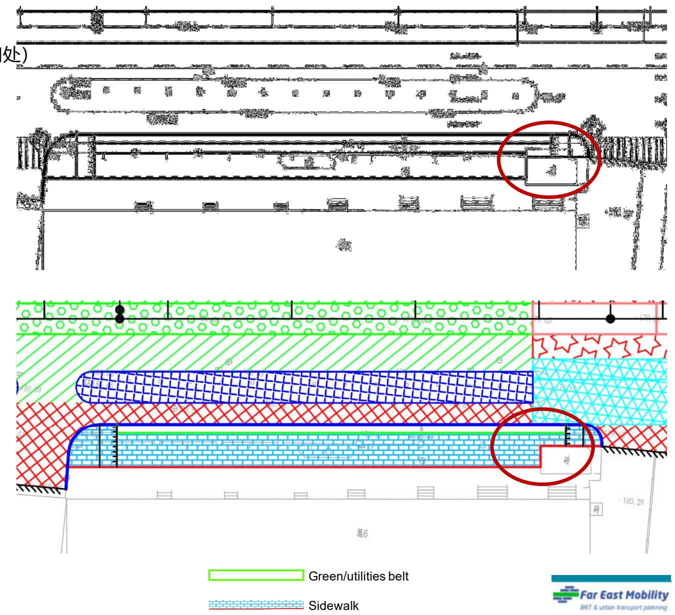
取消绿化设施带（靠近路口处）

自行车道宽度 1.5m

人行道宽度　 2.0m

道路设计中包括了独立的自行车道，但在路面改造设计中没有。采用彩色路面是保证自行车道连续性的重要措施。

靠近出入口处，图中右侧标注位置。建议取消绿化设施带（大约20米范围），保证自行车道和人行道连续穿过出入口。



Far East Mobility

8

BRT三标- we20处的自行车道和人行道设计建议

当前设计:

绿化设施带宽度 1.5m

自行车道宽度 1.5m

人行道宽度 3.0m

建议设计:

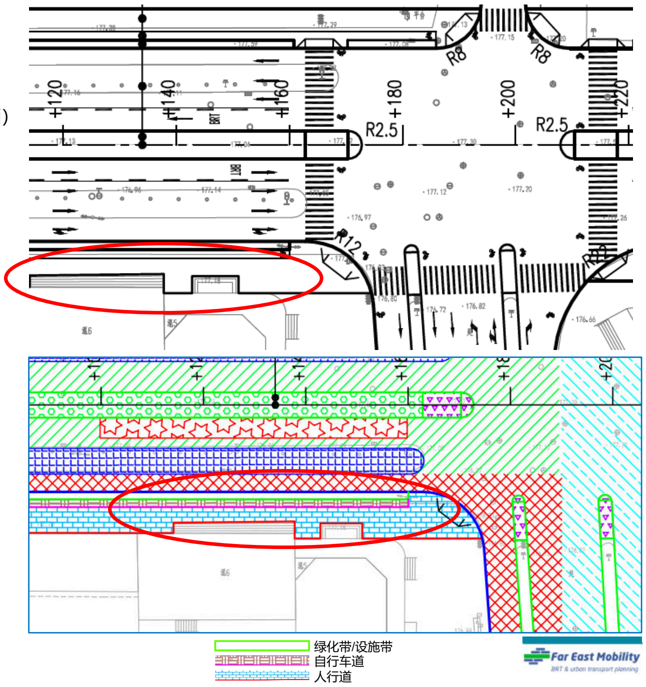
缩窄绿化设施带宽度至 0.75m （或取消）

拓宽自行车宽度至 2.25m

保持人行道宽度至 3.0m

该处位于市中心繁忙路段，建议缩窄绿化设施带宽度，拓宽自行车道。

这个位置最好能够取消绿化设施带，把多余空间给到人行道。



Far East Mobility

9

BRT三标- we22处的自行车道和人行道设计建议

当前设计:

绿化设施带宽度 0m

自行车道宽度 3.0m

人行道宽度 1.5m

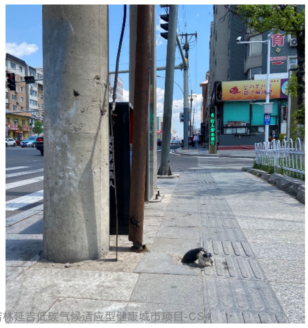
建议设计:

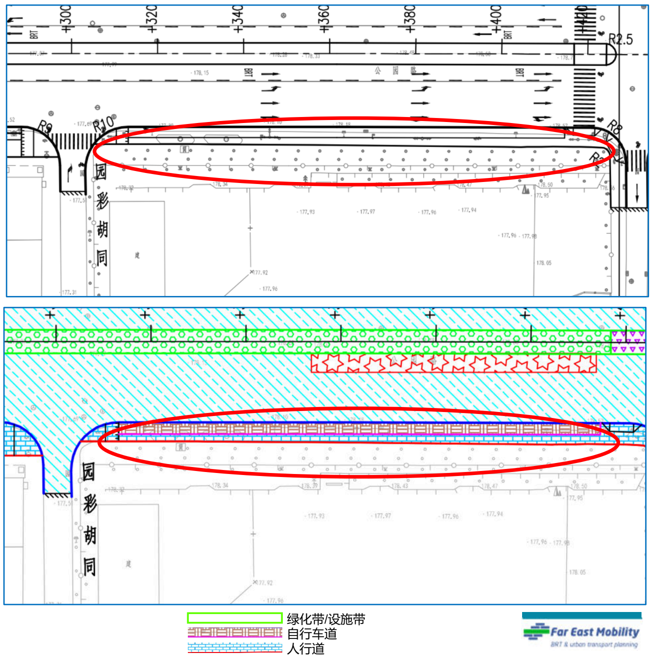
拓宽绿化设施带宽度至 1.5m

缩窄自行车宽度至 2.5m

拓宽人行道宽度 3.5m

延吉市公园小学校门口没有设计绿化设施带，但现场有很多电杆。同时，靠近学校一侧有很宽的绿化带，位于“设计红线”外。建议缩窄这个绿化带3米（或以上），设置绿化设施带和拓宽人行道。绿化带中的树木可以迁移到新设的绿化设施带上。





Far East Mobility

10

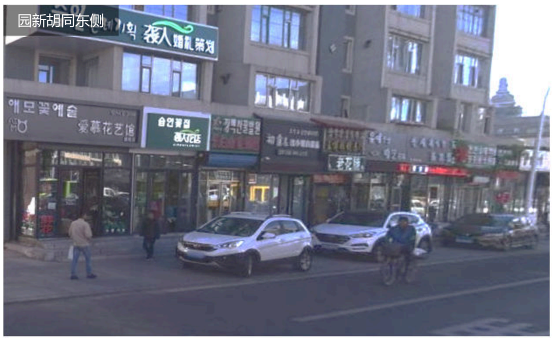
BRT三标- we23处的自行车道和人行道设计建议

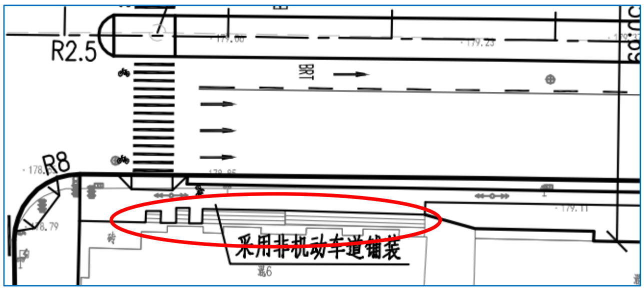
当前设计:

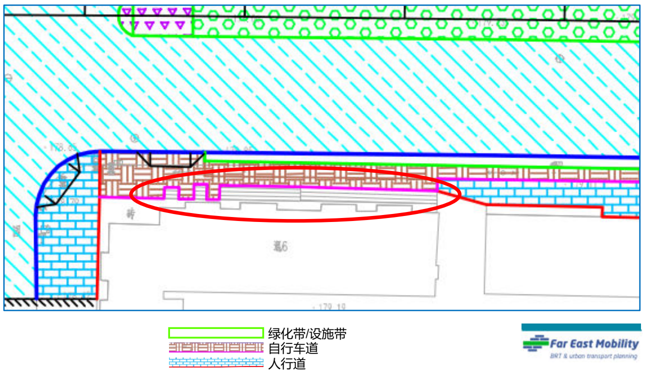
当前设计		建议设计	
绿化设施带宽度	1.5m	缩窄绿化设施带宽度至	0.75m
混合的自行车道和人行道宽度	3.0m	自行车道宽度	2.0m
		人行道宽度	1.75m

建议设计:

商铺门前的楼梯使得本来就不宽的人行道更窄了。建议缩窄绿化设施带宽度，设置独立的自行车道和人行道。







Far East Mobility

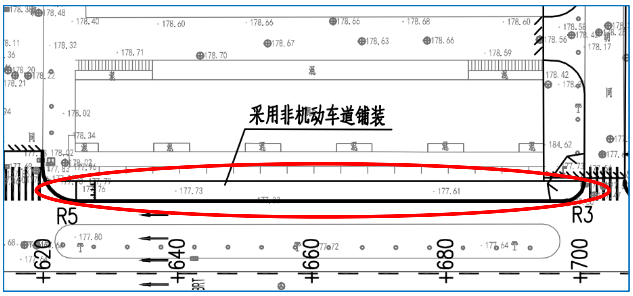
| 7/19/2021 | 亚行贷款吉林延吉低碳气候适应型健康城市项目-CS4

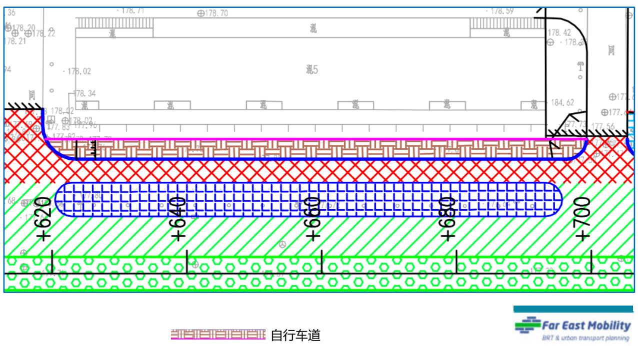
11

BRT三标- ew12处的自行车道和人行道设计建议

当前设计		建议设计	
绿化设施带宽度	0m	保持绿化设施带宽度	0m
混合的自行车道和人行道宽度	3.0m	自行车道宽度	1.5m
		人行道宽度	1.5m

建议不要将自行车道和人行道混合使用，独立设置各1.5米宽。





Far East Mobility

| 7/19/2021 | 亚行贷款吉林延吉低碳气候适应型健康城市项目-CS4

12

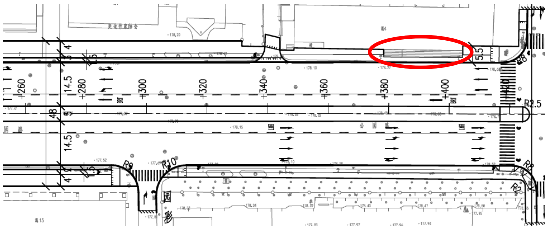
BRT三标- ew18处的自行车道和人行道设计建议

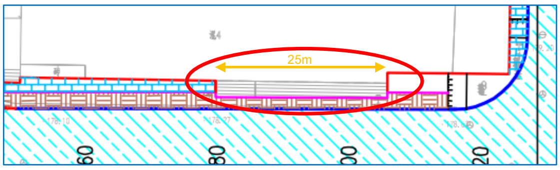
当前设计:
绿化设施带宽度 0m
自行车道宽度　1.5m
人行道宽度　　0m

建议设计:
保持绿化设施带宽度 0m
保持自行车道宽度　1.5m
拓宽人行道宽度至　1.5m

在这个大约25米长的狭窄路段，商铺门前楼梯占据了大部分人行道空间。建议：
- 拆除商铺门前3级台阶，在平台两侧新建台阶供商铺使用（如右下图）。
- 或者取消正面的台阶，改成直接连接商铺的陡一点的形式。

取消商铺门前的3级台阶（1.5米）作为人行道





自行车道
人行道

Far East Mobility

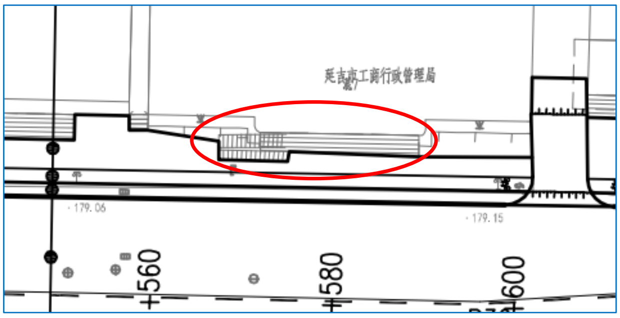
13

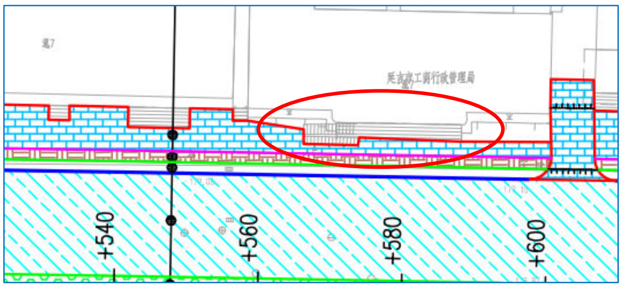
BRT三标- ew20处的自行车道和人行道设计建议

当前设计:
绿化设施带宽度　1.5m
自行车道宽度　　1.5m
人行道宽度　　　1.25m

建议设计:
缩窄绿化设施带宽度至 0.75m
保持自行车道宽度　　1.5m
拓宽人行道宽度至　　2.0m

建议缩窄该位置的绿化设施带，拓宽人行道至2米。



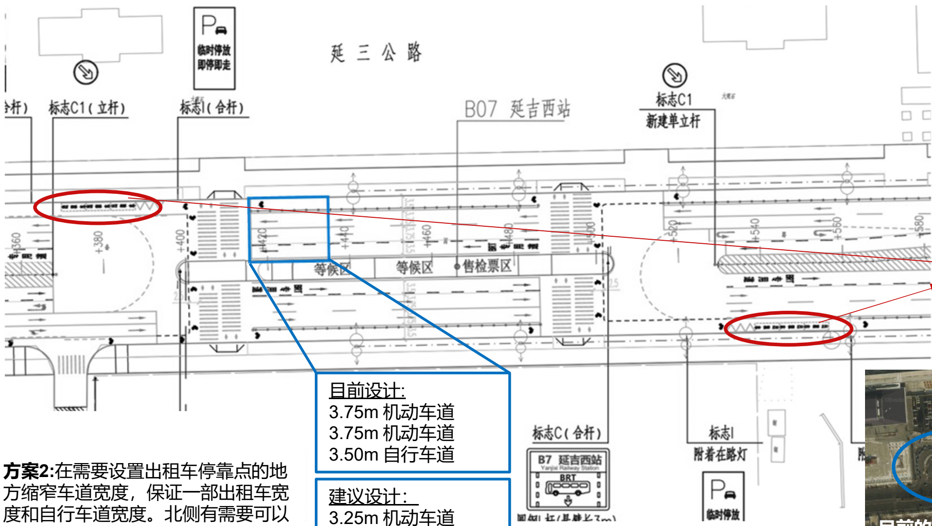


绿化带/设施带
自行车道
人行道

Far East Mobility

14

西站位置的出租车停靠点不应该阻拦自行车道



目前设计:
3.75m 机动车道
3.75m 机动车道
3.50m 自行车道

建议设计:
3.25m 机动车道
3.25m 机动车道
2.50m 出租车停靠
0.50m 分隔带
1.50m 自行车道

方案2:在需要设置出租车停靠点的地方缩窄车道宽度，保证一部出租车宽度和自行车道宽度。北侧有需要可以设置较长的出租车排队区域。

目前正式的出租车排队上下客区在BRT车站的右侧，排队车道在交叉口北侧（见下图）。因此在BRT车站西侧以及道路南侧路边完全没有必要再设出租车上下客点。

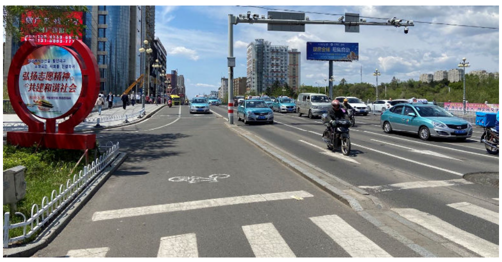
方案1: 建议取消这些路边临时停靠

-- *图纸16页*–

15

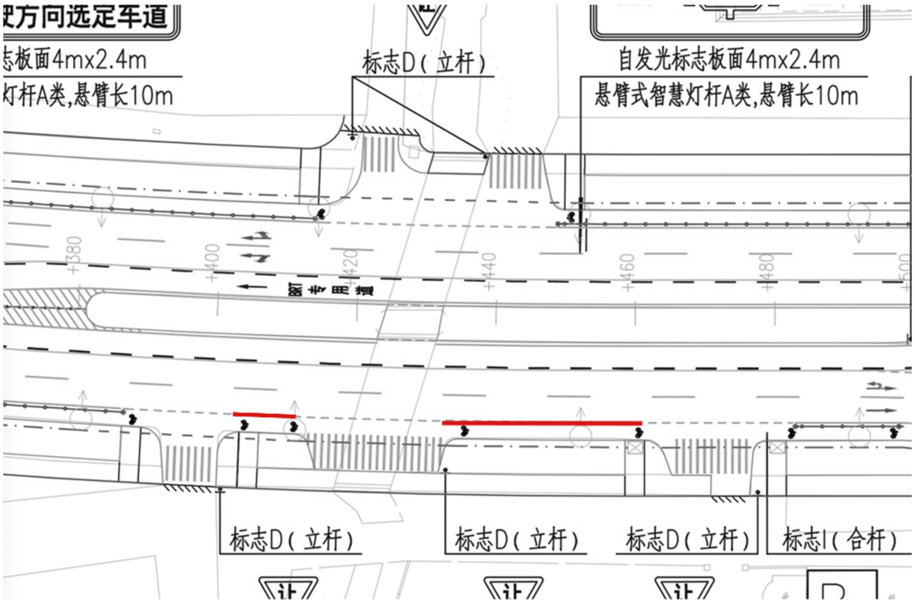
自行车道分隔设施的类型与建议

BRT二期工程可以考虑采用其他的分隔设施。下图左侧是阿姆斯特丹的案例，分隔带的底部是弧形，高度足够隔离机动车，相对于护栏更能融入道路设计。视觉上效果更好，冬季也能方便把堆雪从机动车道清扫到路边。延吉目前在几个路口也使用了类似的分隔带，如下右图所示（右上图公园路-参花街路口，右下图参花街-河南街路口）



16

保持连续的机非隔离护栏(1)

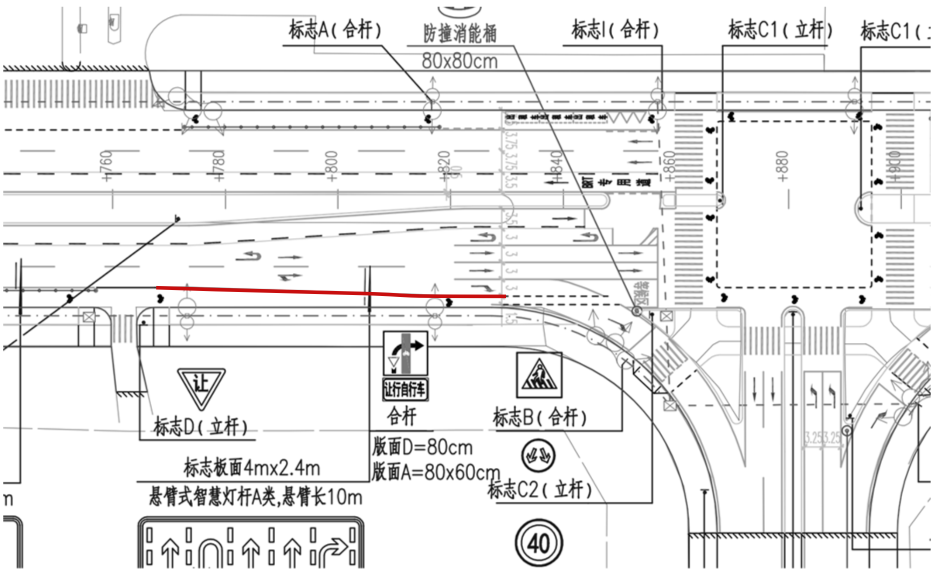


图中红色标注的是简易安装护栏，除了在沿线开口处，应该保持连续设置。
此处仅是一个示例，设计中有很多地方护栏都缺失。

-- 图27页 --

17

保持连续的机非隔离护栏(2)



图中红色标注的是简易安装护栏，除了在沿线开口处，应该保持连续设置。
此处仅是一个示例，设计中有很多地方护栏都缺失。

-- 图17页 --

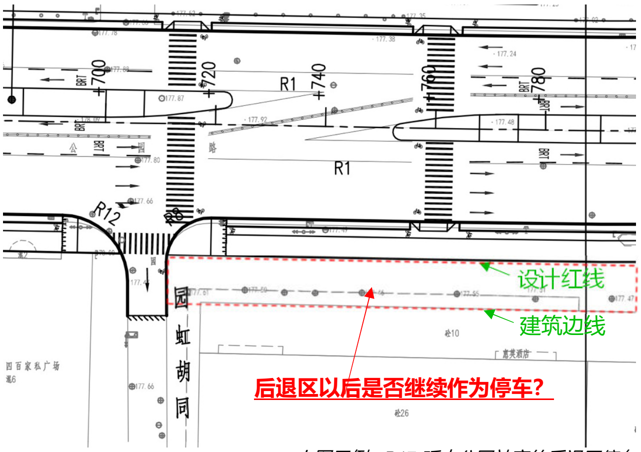
18

"设计红线"外的后退区停车

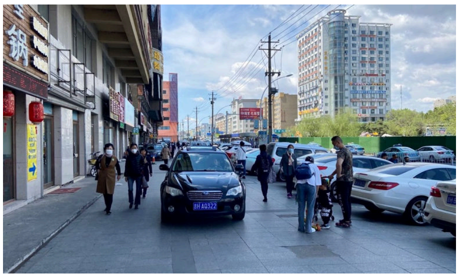
一期走廊是在"设计红线"范围内进行的空间改造。走廊沿线很多区域在"设计红线"以外，这个也不是建筑红线，这种情况下在建筑红线和"设计红线"之间有很多属于后退区的空地。目前大部分是作为停车场使用。

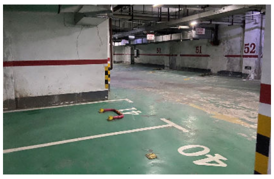
建议在三标范围内，取消这些后退区的停车。停车转移到其他街道或者公共停车场。实施停车付费也可以减少停车的需求，增加泊位的使用率。

如果不能取消后退区的停车，至少需要设置物理隔离设施，避免停车侵入到人行道和自行车道。



上图示例：B17 延吉公园站旁的后退区停车

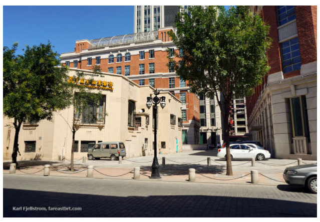


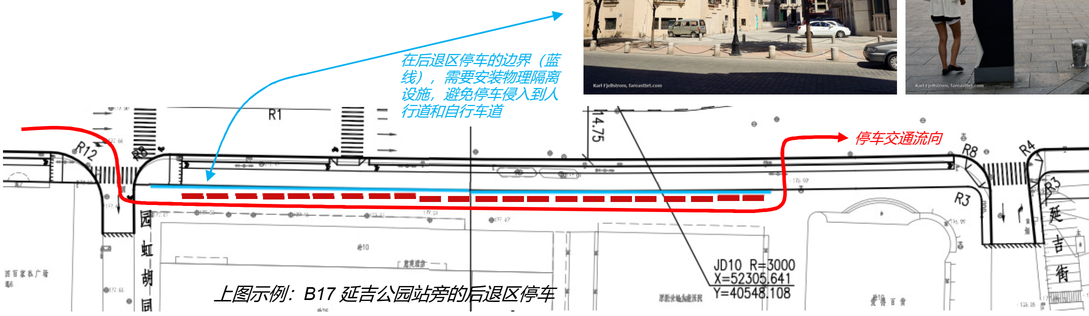


"设计红线"外的后退区停车

在保留后退区停车的位置，需要重点考虑确保人行道和自行车道不被违章停车占用。在"设计红线"位置需要安装物理隔离设施，保证车辆不能进入，这些设施的形式可以有：护柱（可以有一些粗的，可以供人坐）、公共座椅、旅游地图牌、公交信息牌，及其他能隔离的设施。

最好的方式就是取消三标沿线的后退区停车。

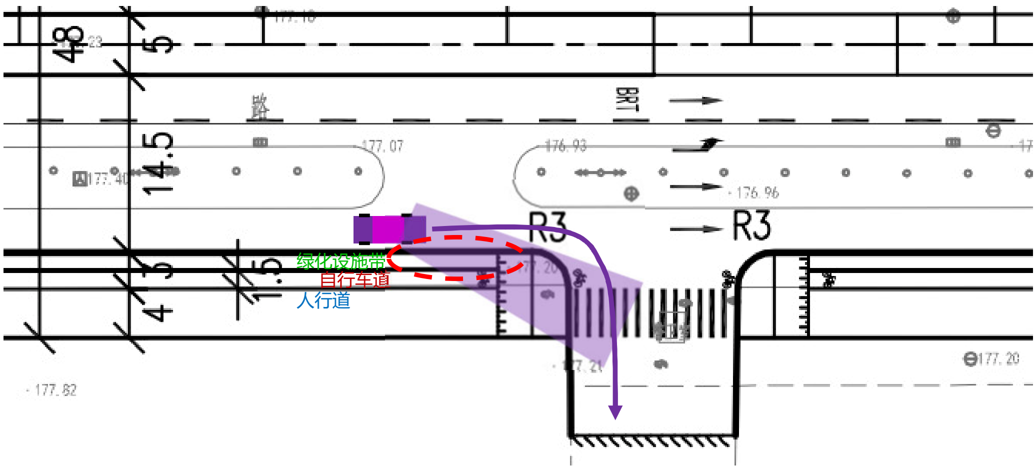




上图示例：B17 延吉公园站旁的后退区停车

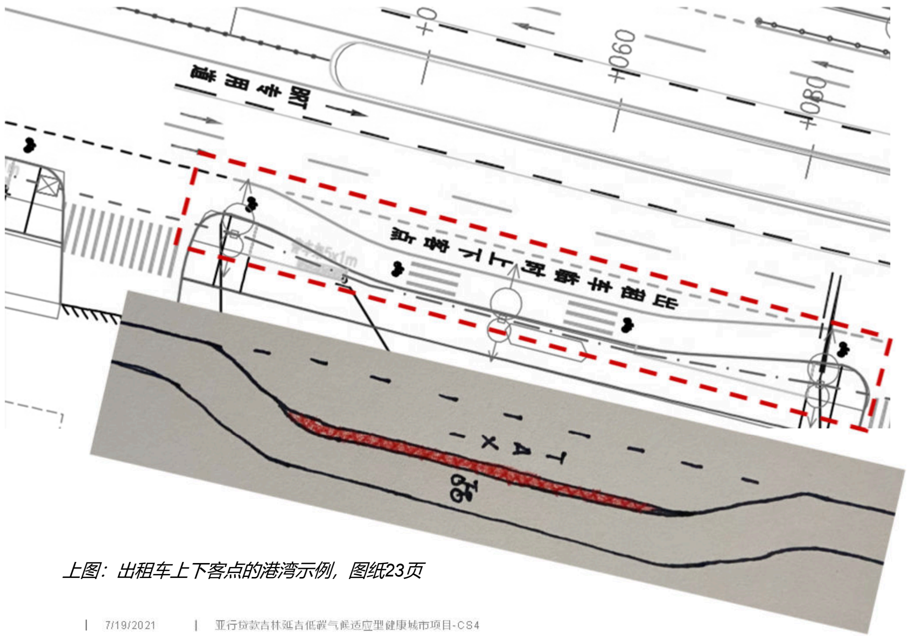
交叉口和出入口位置的绿化带与视线

目前绿化设施带的种植情况还不清楚，但重要的一点是需要考虑机动车右转弯时的安全视线，避免该范围内有植物或绿化带遮挡。如果绿化带遮挡，右转弯时驾驶员不能看到过街的行人和自行车，会造成安全事故。建议这个位置的绿化种植高度低于30cm。



21

出租车上下客点需要在自行车道处安装护栏

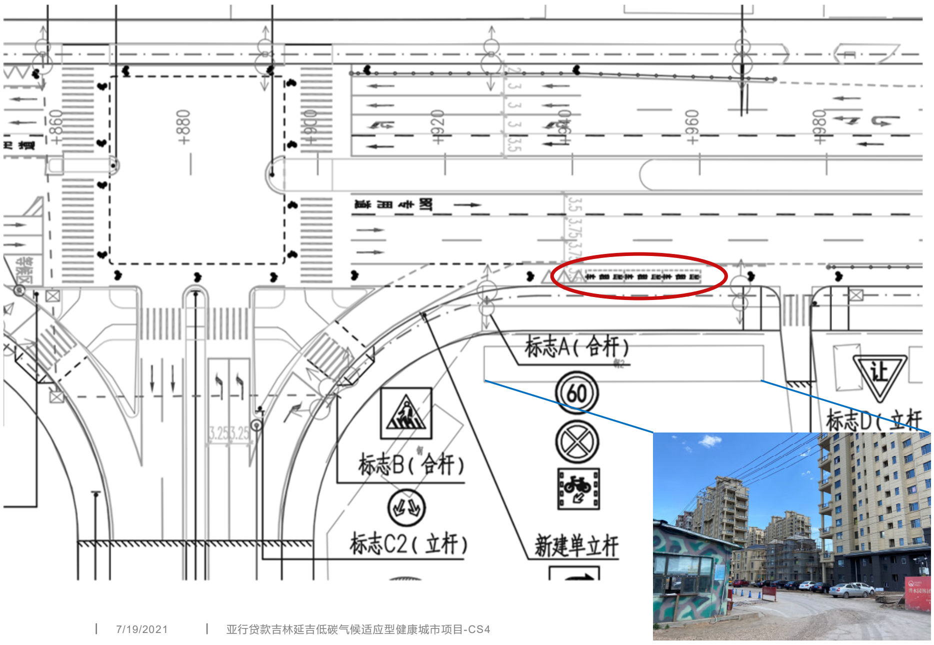


上图：出租车上下客点的港湾示例，图纸23页

走廊沿线有几处设置了出租车临时上下客点。
在自行车道和出租车停靠位之间需要设置护栏进行隔离，保障自行车道不被占用。
另外，最好的方案是设置一个0.75m宽的平台，供乘客排队候车。

22

自行车道处的出租车上下客点不建议设置，也没有需要



有的出租车停靠位置在自行车道上，基本上挡住了骑车人，增加了开车门与自行车的安全隐患。而且，很多这些停靠点的位置并没有需求。以左图为例，这样的临时停靠点应该取消。

-- 图17页 –

下图的建筑就离开路边一段距离。出租车完全可以开进去这里上下客。

23

交叉口自行车道的设计建议

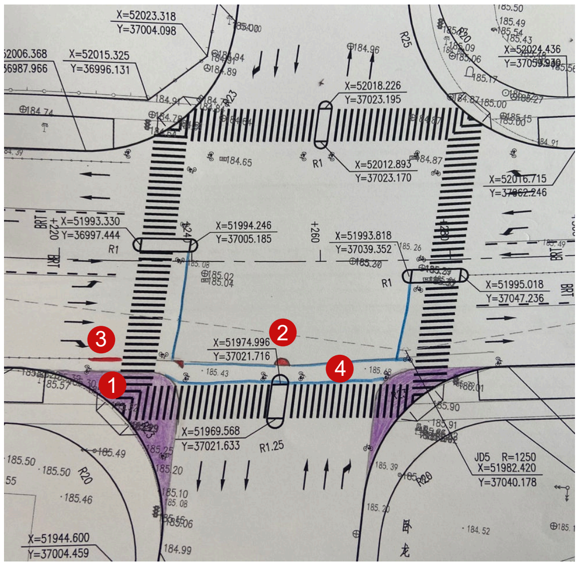
目前的设计中，交叉口的自行车道设计只有地面标识外，没有其他措施。下面是针对交叉口自行车道设计的一些建议。

1) 机动车转半径过大会带来行人过街距离长、车辆转弯速度快的问题。设计保留了原来道路平面的大转弯半径，没有进行修改。中国的规范：城市道路交叉口设计规程(CJJ152-2010)，城市道路交叉口规划规范(GB50647-2011)要求最小转弯半径为5-10米。最好的方案是拓宽转角人行道，如图中紫色部分。另外一种造价更便宜、实施更快、更简单的方案是在原有路面安装护栏。这些都是减小机动车转弯半径，进而减少行人和骑车人过街距离的一些措施。也能够阻止出租车等车辆在转角处违章停车上下客。

2) 目前设计的路中过街安全岛端部岛头阻碍了自行车的通行，建议如右图设置（红色2）可以起到保护自行车过街的作用

3) 进口道机非分隔设施（图中红色3）应当延长至斑马线位置，避免机动车转弯进入自行车等候区

4) 通过交叉口的自行车道路面应采用红色涂装，增加骑车人的视觉辨认。



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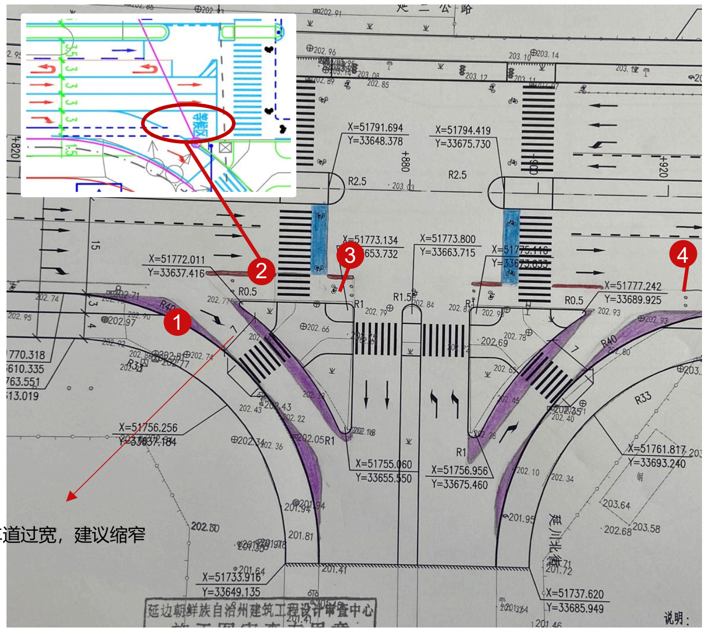
交叉口右转弯车道的设计建议

1) 右转弯车道宽度应当从7米缩窄到4米，采用30°角的设计，避免转弯车辆速度过快。这也可以改善过街行人和自行车的安全性。多余的空间作为人行道，如右图紫色标记部分。

2) 交叉口安全岛旁边设置为非机动车等候区，采用机非隔离设施（图中红色2），过了斑马线也继续设置这个等候区（图中红色3），这个等候区也可以供左转非机动车使用。

3) 交叉口出口道的非机动车道开口处安装护柱，避免违章车辆驶入非机动车道，但允许铲雪车进入

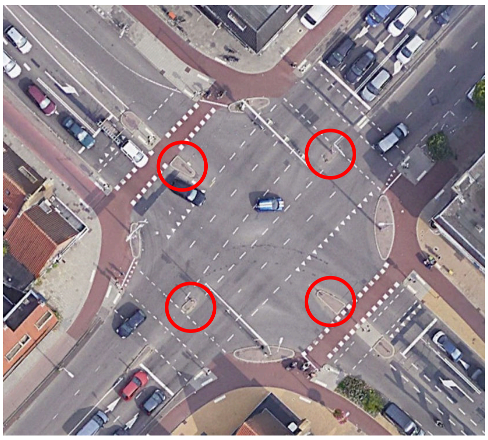


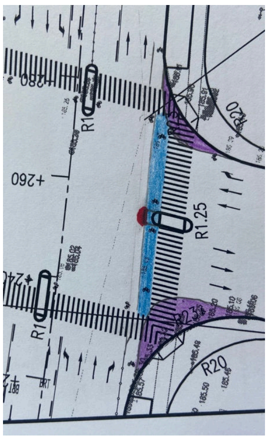
7米的右转弯车道过宽，建议缩窄至4米

上图: 公园路 - 参花街交叉口右转弯车道好的设计示例

交叉口自行车道的设计建议

下面的案例显示了交叉口最短过街距离、彩色自行车道以及安全岛端部岛头的设计理念

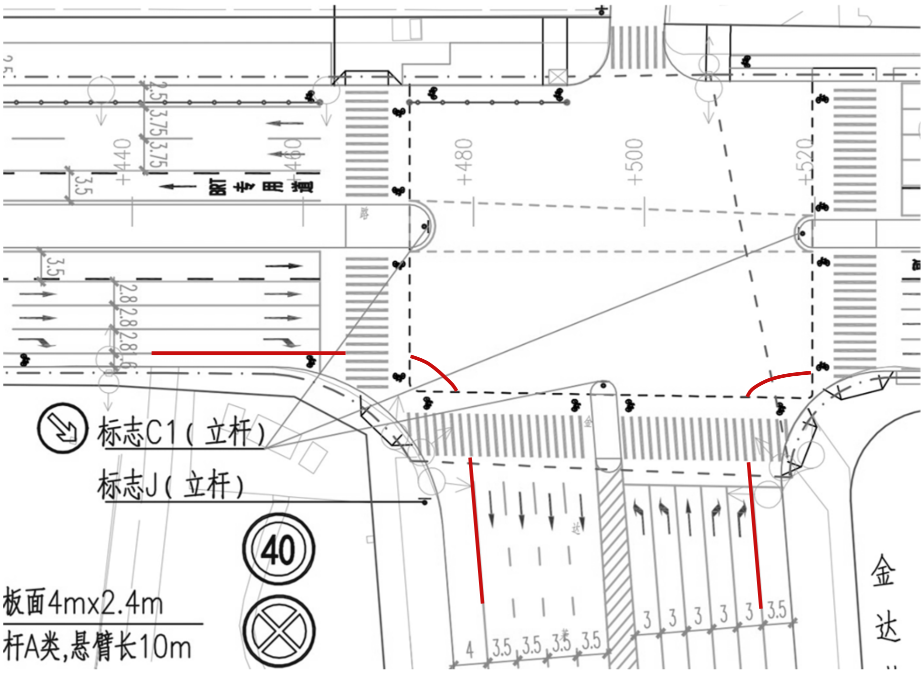




上图：荷兰 乌得勒支的安全岛端部设计

西班牙 巴塞罗那

丹麦 哥本哈根



延伸或增加护栏

红色标注部分是建议增加的护栏。护栏延伸到行人过街位置。另外相交道路也需要安装护栏。

-- 图纸30页 --

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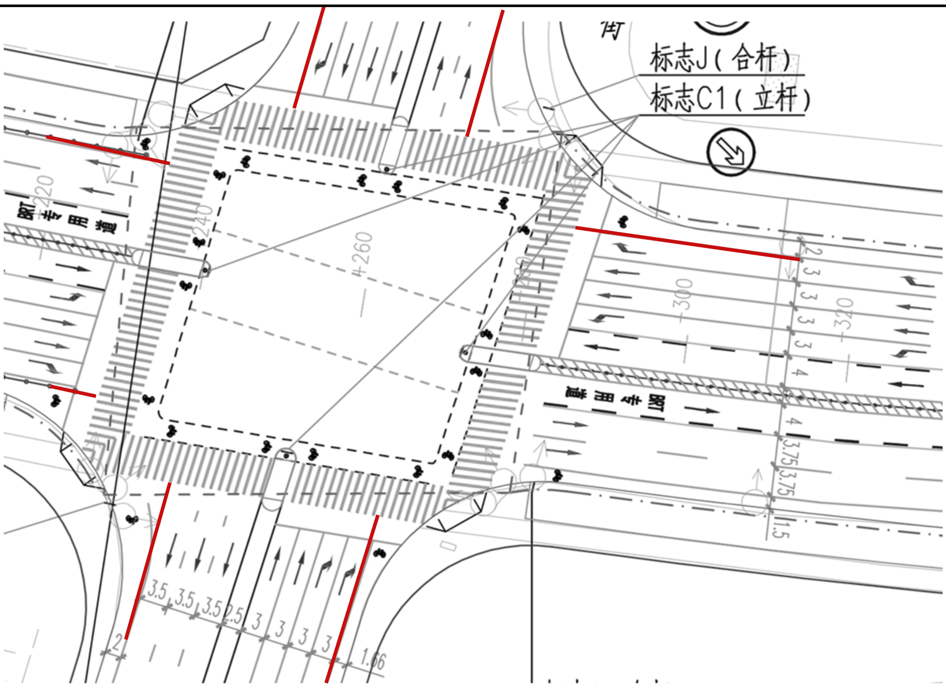

延伸或增加护栏

红色标注部分是建议增加的护栏。护栏延伸到行人过街位置。

也可以考虑安装一些护柱，保护骑车人和行人。

-- 图纸27页 --

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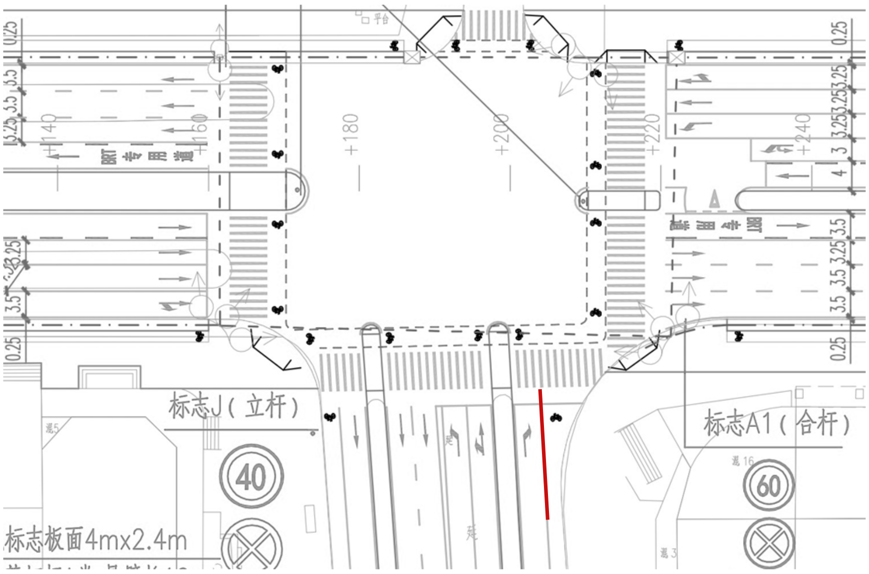

延伸或增加护栏

红色标注部分是建议增加的护栏。
护栏延伸到行人过街位置。

-- 图纸35页 --

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交叉口机非护栏安装示例（杭州、成都）

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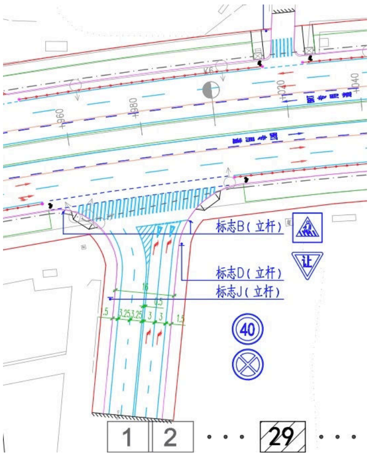
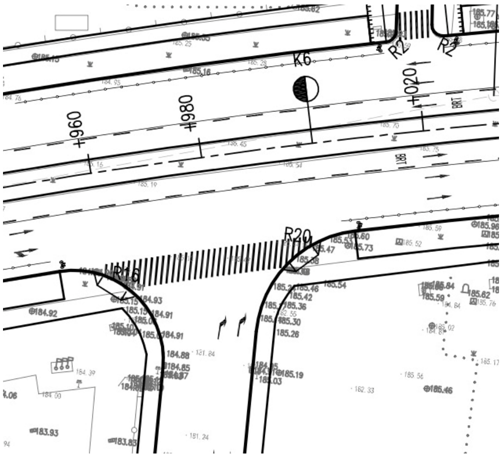
交叉口的安全过街设施建议

1) 没有必要采用两个转弯车道，会对过街行人和自行车带来危险，缩窄至一个转弯车道即可
2) 需要设置过街安全岛
3) 缩小转弯半径，减小转弯车速提供更好安全性





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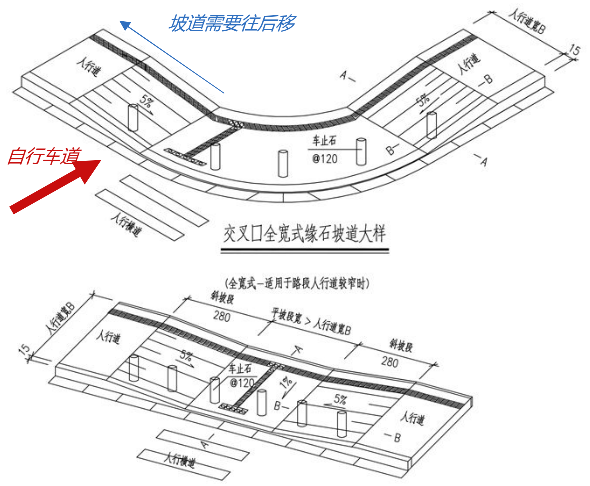
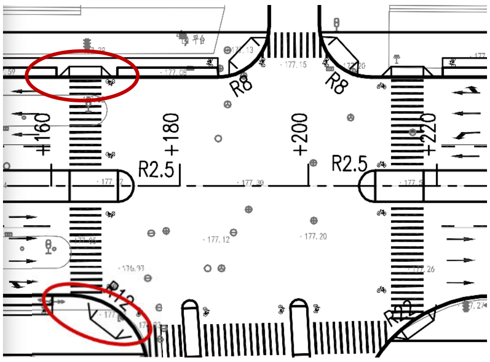
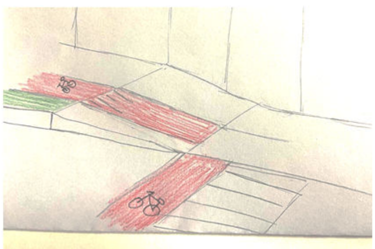
3标段的行人过街和交叉口处的自行车坡道

3标段的自行车道设置于人行道，在交叉口和人行过街位置也需要考虑自行车道。现在的设计中，骑车人需要从坡道出通过。因此，自行车道在过交叉口和过街位置应该用标线、路面颜色清楚的表示出来。





建议设计：



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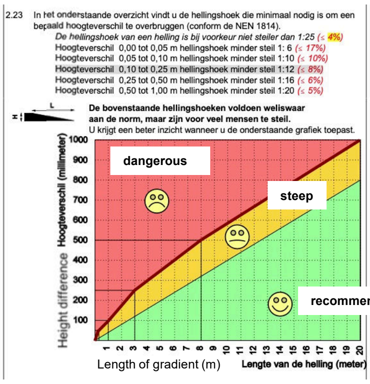
交叉口和行人过街无障碍坡道

目前设计的交叉口和人行道开口的无障碍坡道采用5%的坡度。建议参考无障碍的最佳案例，采用4%坡度。较缓的坡度可以减少行人滑倒的风险，特别在下雪和结冰气候下。

除采用坡道的形式外，人行道开口最佳的方案是抬升行人过街路面，与两侧人行道齐平。



上图: 在荷兰的规范（NEN1814）中，建议的通行坡度为4%

上图: 日本札幌市缓和的无障碍坡道

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出入口位置的自行车道

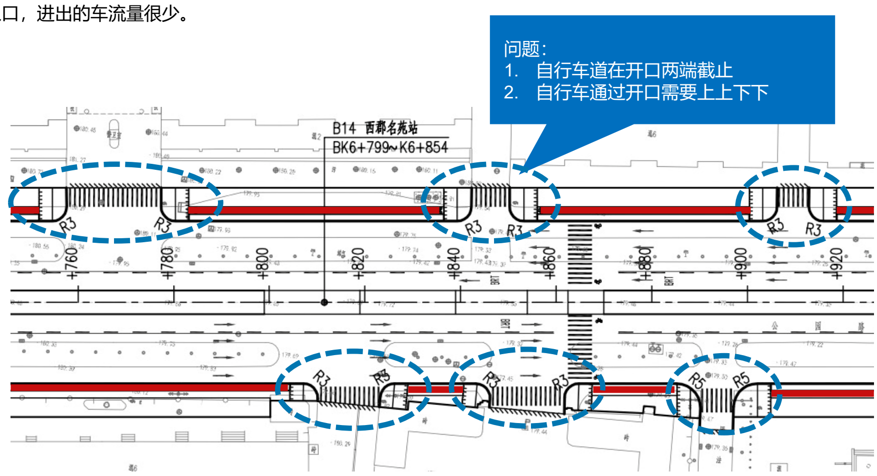
当前设计:

基本上自行车在经过所有沿线相交小街道和建筑出入口都要通过坡道上上下下。这样的话，很多骑车人会选择骑在机动车道上而不是自行车道。这些开口绝大部分是建筑和车库的出入口，进出的车流量很少。

建议:

对于车流量很少的单位出入口和小街巷: 抬升开口处的人行道和自行车道，让进出的车辆通过斜坡上下

对于车流量较大的街道开口: 维持原设计，但采用连续的彩色自行车道通过这些开口，减少行人过街开口的距离，保证机动车道通过的最小需要



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建议收窄的沿线开口

沿线有12处道路开口太大，给行人和骑车人带来不必要的长距离过街。而且，很多小汽车、出租车和货车也会在这些地方违章停车。

右图: 公园路沿线开口过大，带来很多违章停车

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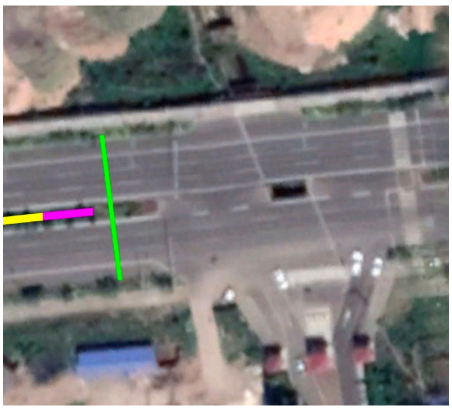
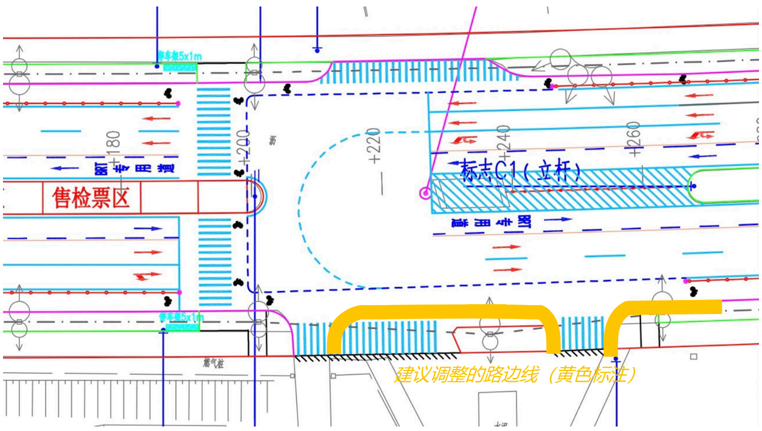
出入口位置的自行车道和人行道

该位置道路平面设计中包括了几个没有必要的、过于宽的开口。建议维持道路边线（不要缩进去），这样会造成过街距离过长，对于行人和自行车有危险。建议减小开口距离，保证最低通过需求就行（如下图黄线所示）。





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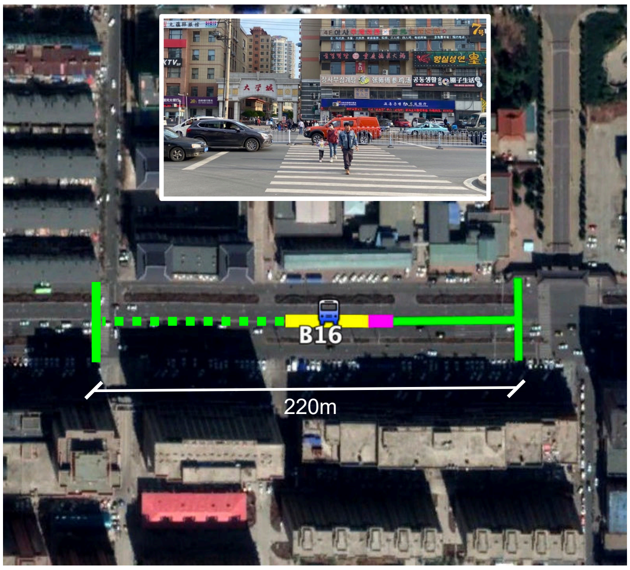
出入口位置的自行车道

这些自行车道能够连续的通过小路口以及人行道开口

比利时 安特卫普

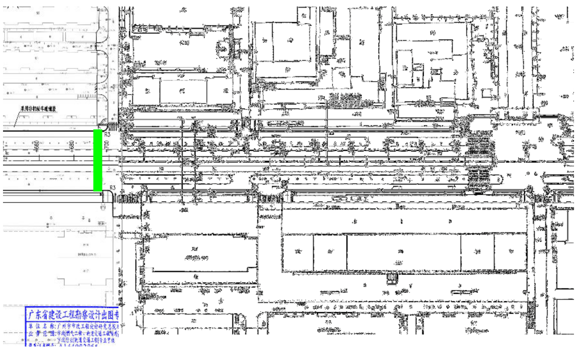
哥伦比亚 波哥大

B16站增加一个进站口



上图: 左侧绿线表示建议的行人过街，通过中央绿化带可以进站（虚线部分）

B16 站位于延大，也是客流最大的其中一个站。设计的进站位置只有东侧一个，行人要步行60米距离进出站。建议在西侧（园林胡同）增加一个进出站。这样可以减少从西边过来进出站乘客的步行距离，从目前的570米减少到350米，同时也是一个高需求的路中过街设施（每小时约1000人流量，2021年5月14日下午4:26做的一个5分钟调查数据）

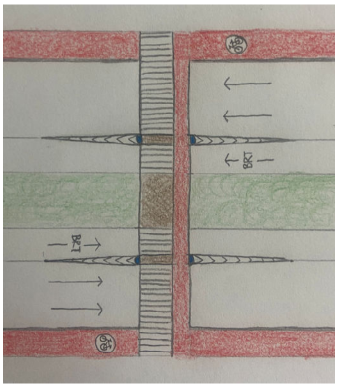


上图: 绿线表示建议的行人过街位置，并通过中央绿化带进出站

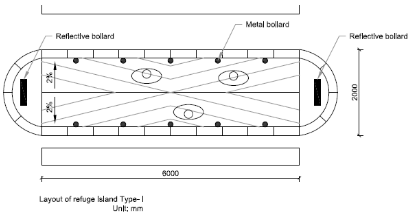
补充的行人和自行车过街设施

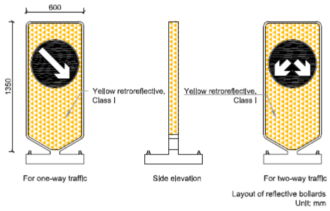
BRT走廊沿线有的路段行人过街间距太长，其中一个超过800米。本次建议新增4个行人和自行车过街设施，如下图绿色线条所示。过街1/2/3采用非信号控制，在BRT车道和社会车道之间设置2个安全岛。如右图所示。过街4建议和B16号站结合，见上一页内容介绍。

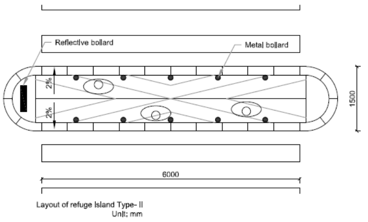
右图: 为了保障行人和骑车人更好的安全性，建议在社会车道和BRT车道之间增加安全岛。安全岛应有1.5米宽，足够长度以供自行车通过，两端设置岛头设施和标线。

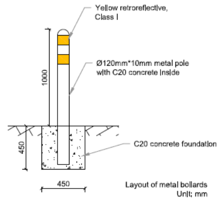


过街安全岛设计建议









带反光警示条的护柱

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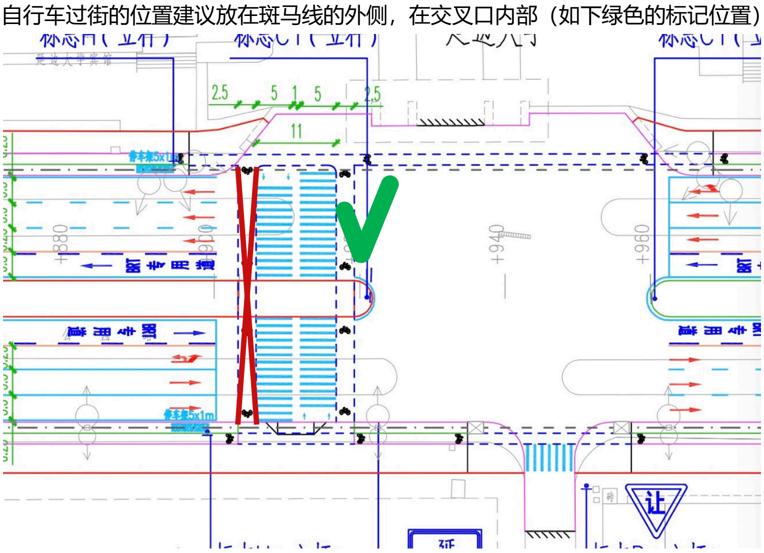
中央过街安全岛

自行车过街的位置建议放在斑马线的外侧，在交叉口内部（如下绿色的标记位置）



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BRT走廊沿线的自行车停车设施

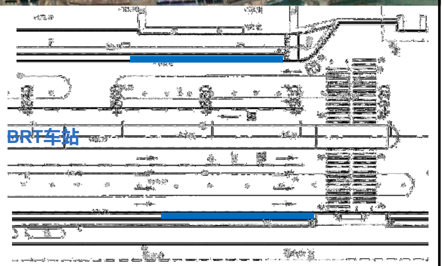
BRT车站的两侧路边需要考虑设置自行车停车。下图重新梳理了停车点，自行车停车设施的标准之一就是要在BRT车站中心区域范围内。

位于绿化带的自行车停车
日本名古屋

反U型停车栏杆
澳大利亚悉尼

右图: 在绿化设施隔离带上设置自行车停车，条件允许最好能靠近行人过街位置。

左图: 自行车停车设计方案。可以在每个自行车停车区安装几十个这样的反U行停车栏杆。



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冬天：全世界的自行车出行都会减少，但自行车出行仍是受欢迎的

荷兰阿姆斯特丹（冬季平均气温0~5度）：自行车出行量下降15%

丹麦哥本哈根（冬季平均气温-1~3度）：自行车出行量下降20%

瑞典伦德（冬季平均气温-3~2度）：自行车出行量***没有***下降

比起下雪环境，不良的自行车设施和道路安全设施要更有危害性

丹麦 哥本哈根

芬兰 奥卢

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