Transport Impact Assessment

Guidelines for Developments

2019 Edition

No.	Section	List of Changes in Guidelines
1	3	Updated guidelines on pedestrian & cyclists assessment
2	Annex A	Updated WCP requirements in Table A.1
3	Annex B	Revised TIA & WCP checklists
4	Annex C	Updated guidelines for pedestrian accesses and conflict treatments
5	Annex D	Updated guidelines for adequate provision of wayfinding signage within developments
6	Annex E	Updated guidelines for bicycle parking and related facilities

Land Transport Authority

Singapore

Contents

1. Introduction

1.1. About the Guidelines

The Land Transport Authority (LTA) has developed this set of Guidelines to assist those preparing a Transport Impact Assessment (TIA) report for submission to the LTA. These Guidelines (i) specify when a TIA is required to be submitted as part of a development application, and (ii) sets out the standards and general technical requirements for the preparation of TIA reports.

This set of Guidelines replaces the previous "*Guidelines for Preparation of Traffic Impact Assessment Reports*" (also known as the TIA Guidelines), which was introduced in 2002 and subsequently updated in 2007, 2011 and 2016[1].

It includes a number of amendments to ensure that the Guidelines are up to date with on-going conditions and take into account feedback gathered from the industry. Furthermore, the LTA has embarked on a strategy to reduce reliance on cars, and to promote walking, cycling and public transport as the choice modes under the banner of Walk Cycle Ride Singapore (WCR SG). The main objective of these Guidelines is to strengthen the application of the WCR SG strategy on new development and redevelopment projects. As such, these Guidelines are to serve as a guide for developers to work closely with the LTA to develop transport connectivity plans centred on Walk, Cycle and Ride to serve their respective development or redevelopment projects.

The purpose of this document is therefore to:

- Assist developers (and transport professionals who are engaged) by outlining the requirements and the level of detail required for the TIA studies; and
- Provide greater clarity, and maintain uniformity and consistency in the preparation and evaluation of TIA studies in order to expedite the approval of development applications.

1.2. Purpose of a TIA

In summary, the objectives of a TIA study are to:

- Determine the transportation requirements of a new development / redevelopment, and propose adequate and appropriate design features, facilities, and infrastructural improvements to meet future transport demand;

[1] Walking and Cycling Plan was introduced in July 2016, as part of TIA submission.

- Enhance the development's overall active and mass transport connectivity, accessibility and convenience in relation to the wider transport network with a focus on promoting walking, cycling and mass transport; and
- Identify the development's impacts on the surrounding transport network and recommend necessary measures to mitigate its negative impacts.

Given the above objectives, TIAs shall focus on: 1) putting forth proposals to achieve higher mass transport and/or active mobility mode shares, and 2) where possible, to prioritise mass transport and active mobility modes over private transport modes while at the same time striking a balance with overall traffic efficiency.

TIA studies help in the early identification of potential provision / design issues and can thus help avoid expensive remedial actions if the issues are addressed upfront in tandem with the implementation of the development. In addition, a TIA assists the LTA to better plan and design the wider transportation system by enabling it to anticipate incremental changes in transport demand for each new development.

1.3. When is a TIA submission required?

Generally, a TIA submission is required if the type and size of the proposed development meets one or more of the criteria stipulated in Annex A. The size of a given development is correlated with the additional trips that it generates, which in turn determines the likelihood of impact to the surrounding transport network.

Due to the variances in the type, size and location of a development(s), it is not practical to describe a single scope of work that can be applicable for all proposals. As such, while this document is intended to serve as a guide, **developers and consultants are still strongly encouraged to discuss and review their scope of work with the LTA before proceeding with their respective TIA studies.**

1.4. Who Prepares a TIA?

The TIA report shall be prepared by a professional organisation (referred to as Consultant in this document) appointed by the developer. The Consultant should ensure (a) accuracy and validity of all information and assumptions to be used in the study and (b) discuss the project scope with the LTA in advance of commencing the study.

For developments requiring a Walking and Cycling Plan (WCP) submission as part of the TIA, the WCP shall be prepared by the Consultant together with the Qualified Person (Architect) appointed by the developer. As the architectural design of a development and its connectivity to the surrounding transport network directly affects the user experience of pedestrians and cyclists, it is important for the Qualified Person (Architect) engaged for the development project to work closely with the Consultant in the preparation of WCP. The Qualified Person (Architect) shall design for safe access and routing of pedestrians and cyclists within the development, between the development and other developments, as well as between the development and the

major transportation nodes surrounding it. The content to be included in WCP is summarized in Annex B. **A preliminary WCP shall be submitted at the pre-scoping stage to facilitate the discussion at the scoping meeting with the LTA** (See Annex B for the submission procedure of WCP).

2. Transport Impact Assessment Process and Inception Stage

2.1. The TIA Process

A typical TIA exercise involves a few stages, from the initial site visit to the receipt of LTA's acceptance of the full TIA report. Figure 1.1 shows a typical TIA process, which will include 3 stages for most TIA studies, and an additional stage if a Post Implementation Review (PIR) is required. The detailed requirements for each of these stages are specified in the subsequent sections of this document.

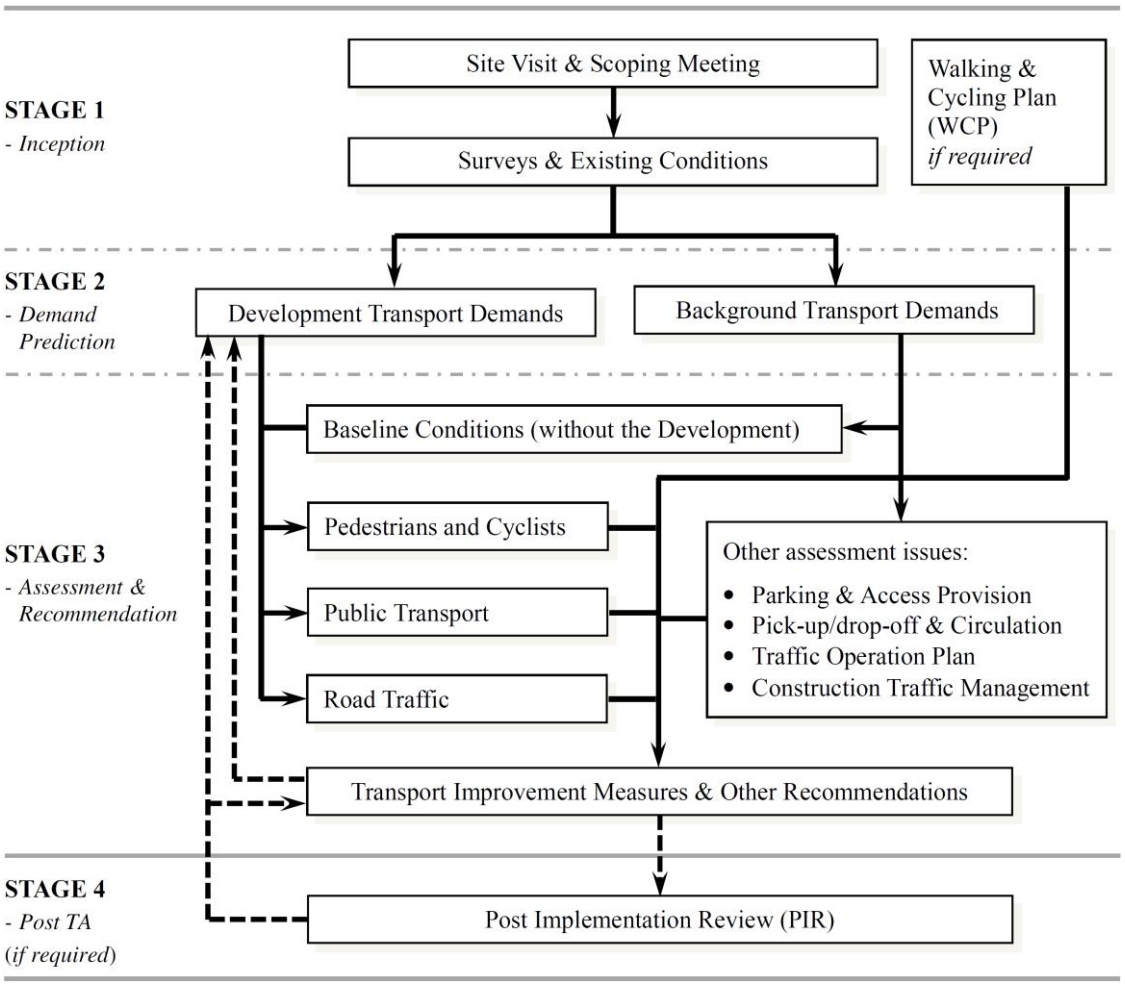


Figure 1.1 – Transport Impact Assessment Process (For Developments)

2.2. Pre-Scoping Meeting

The Developer, Architect and Consultant shall be required to discuss their scope of study, as well as any specific requirements that may apply to the development, with the LTA prior to commencing the TIA study. Such a discussion ensures a common understanding of issues pertinent to the development. Prior to the Scoping Meeting or even before involvement of a Consultant, the Developer is encouraged to furnish the LTA with the transport information relevant to the development in order to facilitate the scoping exercise.

Where applicable, the LTA will then provide additional transport related information, such as planned cycling path networks in the vicinity of the development. The Developer and/or Consultant are to submit a preliminary WCP prior to the scoping meeting. In addition, the Consultant is strongly encouraged to conduct a site visit to gain an appreciation of the existing site conditions, and to provide the LTA with questions/queries before the meeting. Site photos should be provided to support the identification and description of existing transport and/or traffic conditions.

A checklist is provided in Annex B. The Consultant is to submit the completed checklist to LTA-DBC_Registry@lta.gov.sg when initiating the Scoping Meeting with the LTA.

2.3. Scoping Meeting

The scope of a TIA is dependent on the type, size, and location of the development. As such, studies may vary between localised evaluation of a development's internal transport facilities and access point(s) for smaller developments, to regional transport impact assessment for larger developments.

A senior level representative of the Developer and Consultant is to attend the Scoping Meeting with the LTA. This is to facilitate clear understanding of the extent of the TIA to be done. Developers and/or Consultants are advised to submit to the LTA the minutes of the Scoping Meeting based on the agreed timeline and scope discussed at the Scoping Meeting.

Issues typically discussed at the Scoping Meeting include but are not limited to:

- Study purpose and objectives;
- Proposed methodology and assumptions;
- Existing data intended to be used;
- Size of the study area and transport elements to be studied;
- Assessment years;
- Forecast background traffic growth rate and/or method to be adopted;
- Type of surveys to be undertaken e.g. trip rate, mode share, junction traffic counts, pedestrian and cyclist counts, travel time, origin-destination, etc.;
- Relevant peak hour(s) and site(s) for the conduct of traffic surveys;
- Derivation of vehicular and/or person-trip generation rates;

- Proposed modelling / assessment tool(s) and parameters to be used;
- Whether microscopic simulation/network assessment is required, and if yes, what are the assessment area(s) and scenario(s) required and the requirements for model calibration and validation;
- LTA road and/or junction improvement plans for the study area to be taken into consideration as a base for analysis for corresponding assessment year(s);
- Intended location of development's vehicular, pedestrian and cyclist access point(s), supporting cycling facilities, parking provision and vehicular circulation;
- Whether public transport/pedestrian/cyclist analyses, development traffic operation plans, construction traffic management plans and/or PIR are required and to what extent;
- Whether there is a planned cycling path/covered link way abutting the development;
- Whether there is a need for an Inception Report and/or Interim Report;
- Comments and requirements on the preliminary WCP;
- Other requirements if any, that may apply to the proposed development; and
- Deliverables of the TIA study and timeline of submissions.

After the scoping meeting, the Consultant is encouraged to follow up expeditiously with the LTA to finalise the parameters used for the TIA.

2.4. Assessment Years

The assessment years generally include the opening year, or when the development is expected to be fully operational. The LTA may request for an assessment to be carried out for a design year, which is typically five years after the opening year. However, LTA may propose a different design year from the typical definition according to respective study needs. For developments that are expected to be opened or completed in phases, a separate assessment representing the expected completion date of each major phase may be required.

Table 2.1 – Assessment Years for New Developments / Redevelopments

Type	**Assessment Year**
Single phase developments	- Anticipated opening year assuming full occupation - Anticipated design year (might be required)
Multiple-phase developments	- Anticipated major phases of completion of the development including the first and the last phase - Anticipated design year (might be required)

If different areas of assessment are required, such as for road traffic, public transport and / or pedestrians / cyclist connectivity, the assessment years may be different. Certain assessment year(s) may be required for some of the assessment areas but not for the rest. Consultants are to seek the LTA's direction on the assessment year(s) to adopt for case specific development proposals.

2.5. Assessment Periods

An assessment of the surrounding transport infrastructure is to be undertaken for the period that is expected to be significantly affected by trips associated with the proposed development. These peak hours to be assessed shall be determined in consultation with the LTA during the Scoping Meeting.

Under circumstances where the development's peak trip generation occurs outside of regular commuting peak hours, the periods to be surveyed and/or studied may include both commuting peaks as well as the development's peak period(s), which may occur in the off-peak periods or at the weekend.

2.6. Study Area

The study area will depend on the type, size and transport conditions in the vicinity of the development. Generally, small developments that are not expected to generate high volume of vehicular, cyclist and pedestrian traffic are likely to experience localised impacts only, and as such the area to be studied may include the development's own vehicular, pedestrian and cyclist access point(s) and the immediate intersections. In contrast, larger developments with higher volumes of additional trips may have a wider impact on the surrounding transport network over a longer distance from the development site. As such, a wider study area will be needed. A wider study area may also be applicable for developments situated within an already congested transport network. Consultants are advised to confirm the extent of the study area with the LTA prior to commencing the study.

2.7. Traffic Surveys

The existing transport / traffic condition in the vicinity area of the development shall be well appreciated as it forms the base for the impact analysis. Traffic survey is a common practice to collect basic information to support analysis and understanding of existing conditions.

Generally, for commercial, industrial and residential developments, traffic surveys are conducted in the morning and evening weekday peak periods. Retail developments may require surveys at the weekend as well as weekday. Traffic surveys are commonly carried out in 15 minute intervals and classified by vehicle type to determine the profile of traffic changes within the peak hours. Unless specified, traffic surveys shall be undertaken on a typical weekday, excluding Mondays, Fridays, weekends and public / school holidays, and not be affected by inclement weather. The results of the surveys

shall be summarised with the peak hours identified and graphically illustrated within the main body of the report.

For certain locations where there is already or is expected to have high volume of pedestrians / cyclists, surveys shall include pedestrians / cyclists movements. For TIA cases requiring calibration and validation of the existing year models, surveys shall include traffic queue lengths at junctions, travel times along major routes and/or other data as specified by LTA. For surveys used to determine development trip generation rate, Section 5 of this Document specifies the requirements.

Consultants shall agree with the LTA on the intended survey scope, location(s), period(s) and date(s), at least 3 working days prior to the survey. Consultant is to seek LTA's agreement on any change to the plan at least 1 working day prior to the survey date, unless the change is due to unexpected incidents such as inclement weather or occurrence of a traffic accident at the survey site(s). During the intended survey period(s), LTA officers may selectively undertake survey observations.

The LTA may request for raw data of traffic surveys conducted by consultants. Consultants are to ensure that the survey data are appropriately formatted and the raw data are to be kept for at least six months for LTA's possible audit.

2.8. Existing Development Site and Surrounding Transport Condition

The Consultant is to provide a description and/or analysis of the existing site and transport condition of the proposed development within its vicinity as follows:

- Analysis of contextual site issues e.g. size, current use, vehicular, cyclist and pedestrian access point(s) etc;
- Description of the road geometry, pedestrian routes, cycling paths, bus stops and MRT/LRT stations near the development;
- Appreciation of surrounding land use and environs; and
- A map with the location of the proposed development in relation to its surrounding road network and the overall study area is to be included.

An assessment of the transport elements likely to be affected by additional trips from the development during the peak hours is to be undertaken. The scope of assessment should be determined in consultation with the LTA during the Scoping Meeting. Identifications of existing transport problems are to be supported by site survey and photos.

The following sections of this Document will specify the technical requirements of the TIA. The techniques adopted for assessment shall be consistently applied to the various assessment years including the existing year as applicable or unless specified / agreed by the LTA.

3. Pedestrians and Cyclists Assessment

3.1. Introduction

The Land Transport Authority (LTA) has developed this set of Guidelines to assist consultants in designing developments to be walking and cycling friendly, to realise the Walk Cycle Ride vision. This set of Guidelines also stipulates the best practices that consultants shall follow as part of their submission of the Walking and Cycling Plan (WCP).

Due consideration shall be given to pedestrian and cyclist[2] safety and needs at the design stage of all new developments or redevelopments. As part of a Pedestrian and Cyclist Assessment, the consultant is to identify major desired pedestrian lines and cycling route(s) to/from the development to MRT, bus stops or existing pedestrian/cycling network (including places of attractions/amenities such as supermarkets, markets, schools, hawker centre, etc.), based on the shortest and/or most convenient route. If there are no existing cycling paths, consultants are to assess and propose the provision of cycling paths linking the proposed development to existing/planned cycling paths and MRT/LRT stations nearby, subject to LTA's approval. For more information, the consultant can refer to the Walking and Cycling Design Guide. The location of crossing facilities i.e. at-grade crossings and grade-separated crossings shall match pedestrian movement needs with minimal diversion from the most convenient route. All infrastructure design (e.g. cycling path, footpath, ramp, etc.) within the Road Reserve shall comply with LTA's prevailing Standard Details of Road Elements (SDRE).

Pedestrian and cyclist safety in terms of visibility and sight distance at the corners and edges of the development plot, access points to the development and road crossings shall also be addressed. Likewise, pedestrian and cyclist safety and ease of circulation shall also be catered for within the development. These accesses and internal routes will have to meet BCA's barrier free access (BFA) standards according to BCA's prevailing Code on Accessibility In The Built Environment.

The provision of bicycle parking facilities shall be made in accordance with the LTA's guidelines in **Annex E**. The development is also highly encouraged to provide End-of-Trip (EOT) facilities according to the suggested stipulated quantum in **Annex E**. Proper signage shall be provided to guide cyclist users in the development to the Bicycle Parking and EOT facilities.

3.2. Walking & Cycling Plan

The Walking and Cycling Plan (WCP) is an in-depth study of pedestrian and cyclist circulations within and around the development to design a safe and convenient

[2] The term "cyclist" here refers to cyclists and PMD users.

environment for pedestrians and cyclists. The WCP will thus require the developer to consider the walking and cycling connectivity in the design of the development; direct and seamless connection to major transport nodes and related facilities shall be provided for wherever possible.

A WCP is required for developments that meet the Transport Impact Assessment (TIA) criteria stipulated in **Annex A**. Developments that are not required to conduct a TIA but are located near major transport nodes or are of uses that typically generate high pedestrian and cyclist footfall i.e. Retail, Office and Mixed Used developments may also be required to conduct a WCP, including developments within car-lite[3] precincts. Developments that are not required to conduct a WCP will be required to submit a Pedestrian and Cyclist Assessment as described in Section 3.1.

For master developer-based proposals which consist of more than one development plot with different staging years, the consultant is required to submit an area-based Walking and Cycling Plan at the concept design stage. This area-based WCP will typically entail a brief report that consists of but is not limited to the following:

- Cluster boundary;
- Parcel outline and land use;
- Location of the developments in relation to its surroundings;
- Surrounding transport network and services (MRT stations, bus stops, cycling paths);
- Existing and proposed covered linkway, underground pedestrian network and elevated pedestrian network;
- Development accesses (pedestrian, cyclist and vehicular);
- Through-block links and open spaces;
- Pedestrian and bicycle crossings;
- Cycling route, vehicular route and major pedestrian circulation;
- Walking and cycling network and interactions within the cluster;
- Indicative location of bicycle parking and EOT facilities; and
- Wayfinding master plan.

Thereafter, each individual development within the cluster which meets the respective use threshold will be required to submit a WCP as part of its Development Control submission to LTA. LTA may require the master developer to update the area-based WCP if the subsequent development intention of the individual plots deviates from the area-based WCP.

[3] The car-lite precincts are Bayshore, Jurong Lake District, Kampong Bugis, Marina South and Woodlands North.

3.3. General Design Considerations

- Pedestrian and cyclist accesses shall be located along the natural desired routes i.e. the most direct path. For developments that are gated, such as private residential buildings or industrial developments, the placement of pedestrian and cyclist access(es) should provide the most direct route to/from key amenities and transport nodes. Likewise, for large gated developments, the provision of more than one pedestrian/cyclist access is highly encouraged (see Figure 3.1).

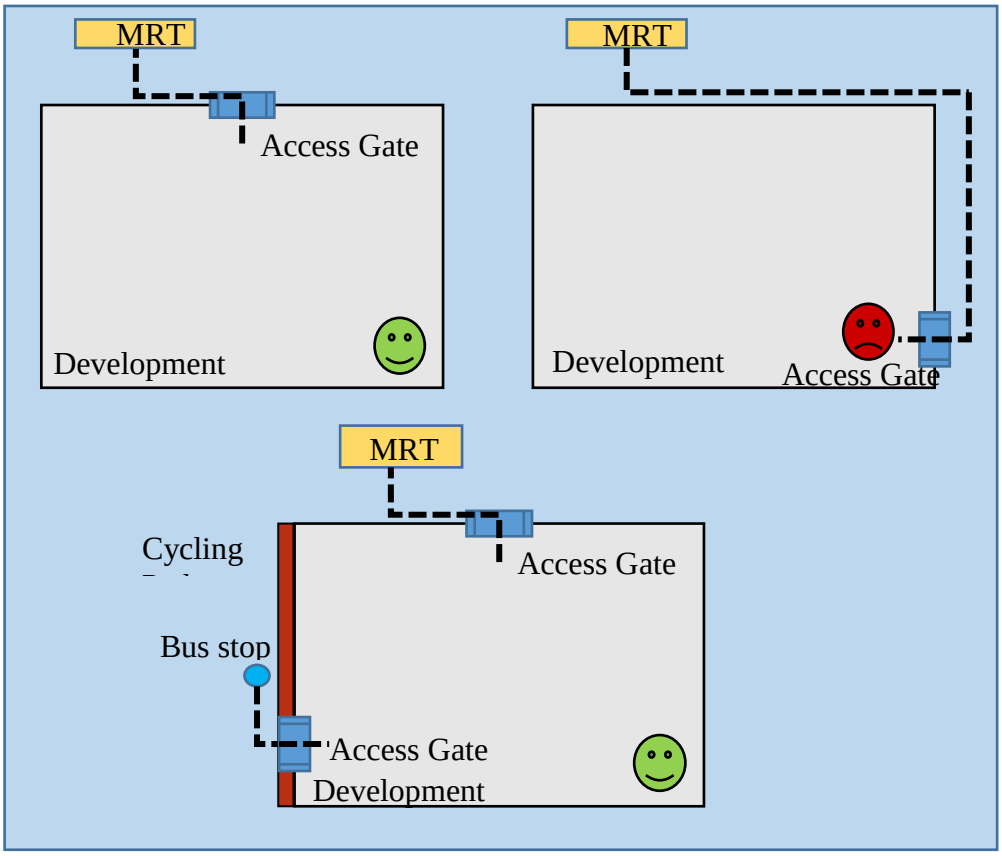


Figure 3.1 – Examples of good placement of access(es) to provide direct access

- There shall also be seamless connections between developments and adjacent transport nodes such as MRT stations, bus stops and the existing pedestrian/cycling network as shown in Figure 3.2. Segregated paths for pedestrian and cyclist is preferred. However, shared paths for pedestrians and cyclists can be considered where there are site constraints.

Figure 3.2 – Examples of seamless connectivity

- Vehicular access(es) of the developments shall be located away from major pedestrian and cyclist routes, where the site permits. Where pedestrian and cyclist routes intersect with vehicular access points, appropriate measures are to be adopted to safeguard pedestrian and cyclist safety. Hard structures such as concrete boundary walls/fencing/etc. are to be recessed adequately to allow sufficient line of sight between vehicles exiting the development & pedestrians/cyclists using the footpath/cycling path(s) (see **Annex C** for more details). Alternatively, the boundary wall/ fencing/etc. shall be constructed with porous materials. The placement of warning signs shall also be considered alongside these design considerations.
- Where existing footpaths/linkways/pedestrian crossings/cycling paths are to be removed upon hoarding of the development site, there should be provision of interim linkages and alternative pedestrian crossings during the construction phase of the development.

3.4. Design for Pedestrians

An assessment of pedestrian circulation associated with the development shall be shown in the WCP. In addition to the general considerations in Section 3.3, other areas of consideration include:

- Provision of sheltered pedestrian routes to adjacent developments surrounding pedestrian network and major transport nodes e.g. MRT and bus stops where adequate.
- Seamless connection between covered walkways/linkways and open walkways. The levels of the covered walkway/linkway shall not be grade separated with the open walkway where possible. Where there is level difference, it shall be mitigated by ramps instead of stairs (see Figure 3.3) and step free access is highly encouraged at all pedestrian gates.

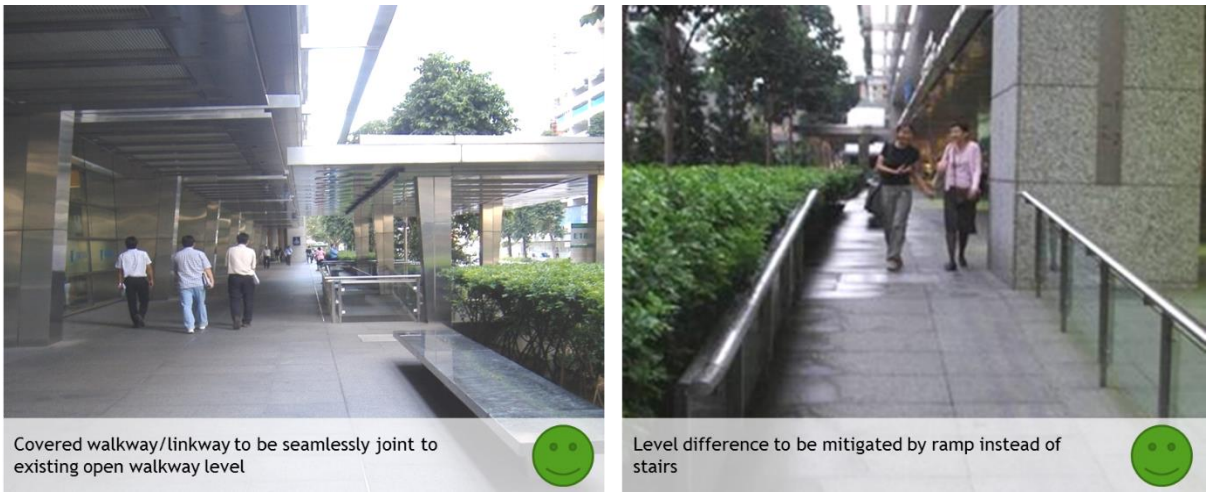


Figure 3.3 – Provision of covered walkway/linkway with ramps

- Provision of current pedestrian counts and assessment of pedestrian numbers, capacity and performance of nearby pedestrian facilities including walkways, stairways and crossings to substantiate the adequacy of the design to accommodate the expected pedestrian volume.
- Enhancement of pedestrian safety - e.g. adequacy of sight distances at crossing facilities, mitigating conflicts at driveways and cycling paths, provision of slow points/ signage/markings to alert pedestrian, cyclist and motorists (see **Annex C**); extra care and attention shall be given to developments such as hospitals and schools that are frequented by vulnerable groups.
- Provision of wayfinding signs to direct pedestrian to public transport nodes, key activity generating areas, and adjoining buildings within the development as shown in Figure 3.4. The signs shall be well-positioned within the development and integrated with the overall development design. It is also recommended that barrier-free and sheltered routes within and outside the development are clearly shown (see **Annex D** for more details on the wayfinding proposal).

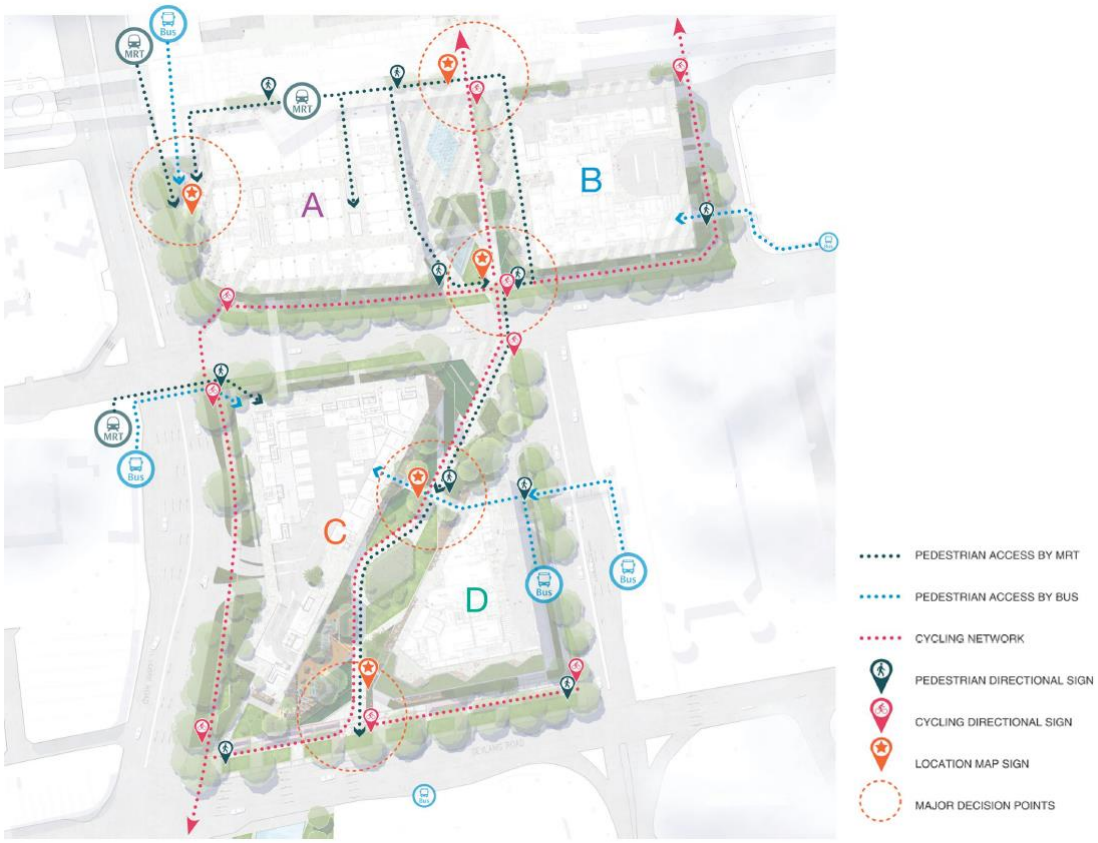


Figure 3.4 – Example of a Way-finding Map

3.5. Design for Cyclists

An assessment of cyclist circulation associated with the development shall be shown in the WCP. In addition to the general considerations in Section 3.3, other areas shall include:

- Construction of cycling path if there is a planned cycling path abutting the development. The developer is required to make good the side table by including a 2m wide dedicated cycling path in addition to the footpath, lane markings and lighting within the road reserve to extend/complete the existing cycling network; details of the cycling path design can be found in LTA's prevailing SDRE. Should the surrounding cycling path network not be ready when the development is completed, the developer shall provide a widened footpath with embedded conduits for the provision of future cycling path lighting according to LTA's prevailing SDRE standards. LTA will complete the cycling path finishing and the network in due course.
- Enhancement of cyclist safety - the finishing of the cycling routes within the development boundary shall be designed to be suitable for cyclist, e.g. comply to cycling skid resistance requirement.
- Provision of proper parking bicycling parking facilities in the building. The development shall provide bicycle parking lots within the development boundary

to cater to both tenants/staff and visitors of the development. The bicycle parking guidelines can be found in **Annex E**.

- Provision of EOT according to the guidelines and design considerations stipulated in **Annex E** is also highly encouraged where possible to complement the bicycle parking.
- Provision of cyclist counts and assessment of cyclist numbers, capacity and associated facilities such as shower facilities, lockers, bike sharing facilities to accommodate the expected cyclist demand.
- Provision of cyclist friendly access(es) to and within the development e.g. automated sliding door. If the development is unable to provide a separate access for cyclist from pedestrian gates, the access shall be a step free access (see Figure 3.5).

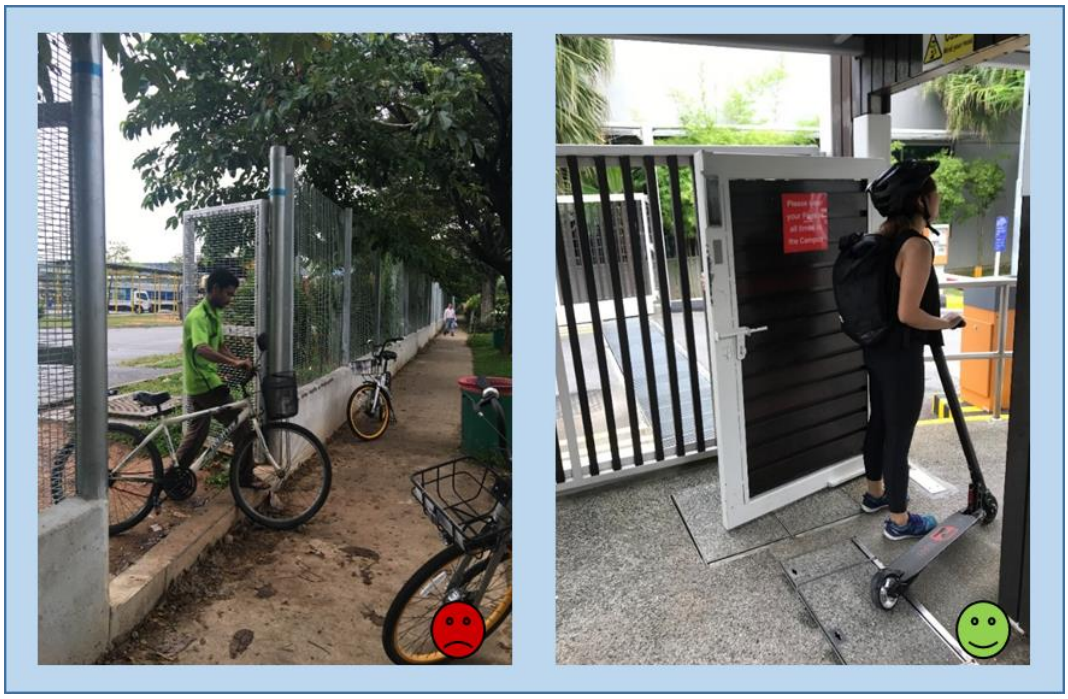


Figure 3.5 – Provision of step free access for cyclist

- Enhancing cyclist safety - e.g. adequacy of sight distance at crossing facilities, conflict at driveways, pedestrian paths, provision of slow points etc (see **Annex C**); internal cyclist routes to bicycle parking location shall not cut through car parks and internal driveways. Where it is unavoidable, the provision of safe crossing measures is recommended.
- Provision of wayfinding signs to direct cyclist to facilities such as bicycle parking, shower areas, lockers etc. within the development, especially when the facilities are provided at multiple locations. The provision of innovative and artistic signs and/or floor markings with clear information is also encouraged to guide cyclist to bicycle parking spaces and nearby end-of-trip facilities (see Figure 3.6 and refer to **Annex D**).

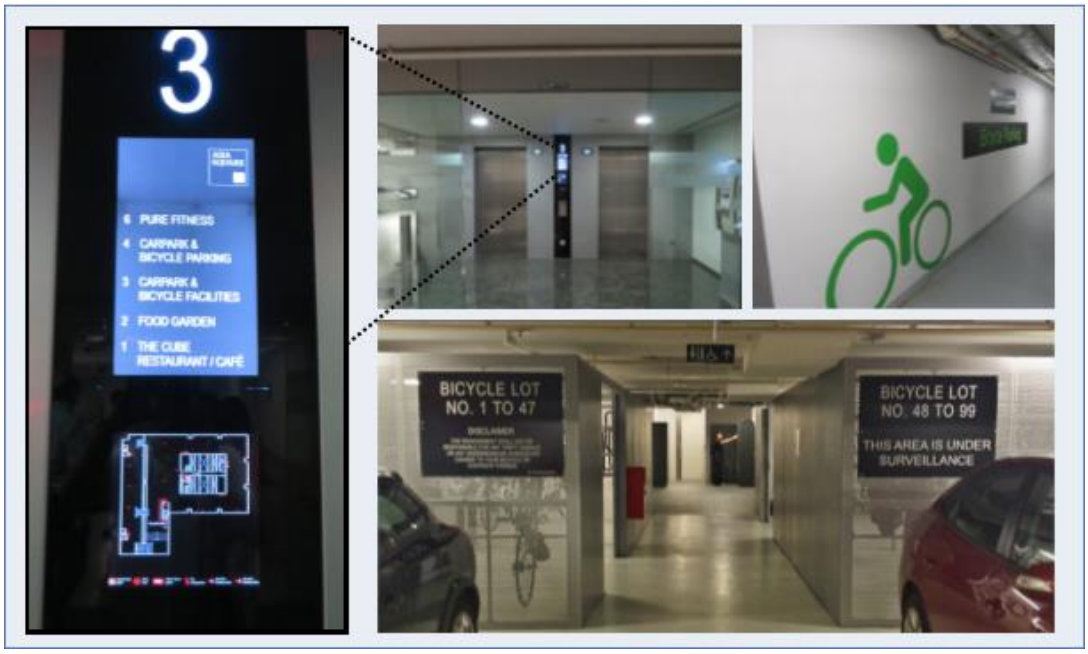


Figure 3.6 – Example of Way-finding Signs for Cyclists

3.6. Demand and Infrastructure Provision

Where the proposed development is expected to generate high pedestrian and/or cyclist volume, the TIA is to include an assessment of the capacity requirements and performance of the pedestrian and/or cyclist facilities to substantiate the adequacy of the design to accommodate the expected pedestrian and/or cyclist demand. Consultants are to seek the LTA's advice on the requirements specified for such an assessment.

3.7. Walking and Cycling submission requirement

Taking into consideration the design guidelines presented in Sections 3, the aim of the WCP is to ensure that the diverse flows (pedestrian, cyclist and vehicular) within and around the development are gelled into a network to achieve seamless connectivity. It is also a comprehensive approach that attends to all users and ensures that pedestrian and cyclist are a priority.

The rigorous process of the WCP shall be demonstrated and presented in written report form that explains the rationale for the following 5 sets of plans:

(1) Location and Connectivity Plan

(2) Circulation Plan

(3) Conflict Mitigating Plan

(4) Bicycle Parking and End of Trip Facility Plan

(5) Wayfinding Plan

The five sets of plans shall find its base in development plans that show good level of details. Consultants may choose to show them in simplified form within the written report and attach A3 development plans with the relevant circulation markings as the Annexes of WCP report.

The (1) Location and Connectivity Plan situates the development within the wider urban and transportation network, whereas the (2) Circulation Plan highlights the different pedestrian, cyclist and vehicular flows going into the development and within the development. The (3) Conflict Mitigating Plan is then the attempt to manage and de-conflict these flows and circulations in a bid to achieve a smooth network. The (4) Bicycle Parking and End-of-Trip Facility Plan locates the cyclist infrastructure needs and thus highlights the due considerations given to pedestrian/cyclist circulation and ensures pedestrian/cyclist safety. Lastly, all these will be aided by the fifth plan (5) Wayfinding Provision Plan that directs users, with the aim of keeping the different users' circulation neat. For more details, please refer to **Annex B**.

4. Public Transport

4.1. Introduction

Emphasis is expected for the following:

(1) Improved public transport (PT) accessibility of new development

(2) Measures to encourage future site users to take PT to/from the new development, especially for developments with high PT accessibility.

Specifically, the TIA is to demonstrate that it provides a more multimodal approach in the assessment of the likely travel behaviours of site users to/from the proposed development (e.g. through person-trip generation surveys).

Improving PT accessibility and services[4] is a "win-win" as it not only benefits site users but also enhances the attractiveness of the development. To help quantify PT accessibility, LTA has adapted the London's Public Transport Accessibility Level (PTAL) methodology and made it relevant to Singapore. All TIA submissions would now need to undertake a PTAL assessment for the proposed development using LTA's PTAL methodology.

[4] if demand justifies

For large-scale developments, an assessment should also be made of the available capacity on the PT network relevant to the development. This is particularly important when considering rail network capacity, which is generally less variable compared to the bus network. Developers/Consultants should consult LTA on the need for such analysis during the pre-application/scoping stage. LTA will assess such a need and decide on the scope of the study on a case-by-case basis taking the scale, size, use, type and location of the development, as well as network performance into consideration. Upon developments' request the LTA would help outline the study requirements even before a Consultant is involved.

4.2. Objectives

One of the main objectives of the TIA Guidelines is to make PT an integral part of the development planning process. To this end, developers shall demonstrate that the development would:

(1) provide safe and efficient access to PT services

(2) undertake PTAL assessment for the proposed development

(3) minimise adverse impact on the PT networks and the users of those networks

(4) promote the use of PT

4.3. Safe and Efficient Access to PT Services

The main issue to be addressed is whether access to nearby bus stops and MRT/LRT stations[5] from a development is direct, safe, attractive and convenient. Factors that may be considered include:

- Directness of pedestrian routes to nearby bus stops and MRT/LRT stations
- Walk time to/from nearby bus stops in view of whether new bus stops are required or existing ones ought to be relocated
- Ability of pedestrians to cross major roads
- Potential conflicts between pedestrian and vehicular movements along the way leading to nearby PT services
- Minimise walk distance to PT nodes in view of the location of pedestrian entrance (including side gate) and building orientation of the proposed development
- Provision of sheltered walkway
- Standards and conditions of existing PT infrastructure and passenger facilities (comply with prevailing design standards). For example,

[5] Up to 400m (or 5-min walk) for a bus stop/LRT station, and up to 800m (or 10-min walk) for a MRT station.

- http://www.lta.gov.sg/content/ltaweb/en/industry-matters/development-and-building-and-construction-and-utility-works/architectural-standards.html
- http://www.lta.gov.sg/content/dam/ltaweb/corp/Industry/files/SDRE%282014%29/SDRE14-REVA-OCT15-0contentA1-7.pdf[6]

- Convenient and useful information for potential PT users (e.g. directional signs and way-finding maps)

The pedestrian routes to all bus stops/stations within catchment areas is to be well integrated with public footpaths. They are to be well surfaced, well lit, without steep inclines or barriers that are difficult to negotiate, and protected from the weather (if demand warrants). PT passengers from the proposed development should be able to cross the road(s) conveniently to the bus stops on the opposite side, and vice versa. Individuals should not have to cross major traffic flows to reach a bus stop without pedestrian crossing facilities.

For developments served by the MRT, the aim is to provide safe, direct and convenient pedestrian and cycling routes to and from the development. For the purpose of the TIA, the maximum walking distance to bus/LRT and MRT services is 400m (or 5-min walk) and 800m (or 10-min walk), respectively. There are existing websites which can help measure actual walking distance[7], e.g. http://sg.mapometer.com/[8] or http://www.onemap.sg/index.html.

When determining the pedestrian access point(s) of the development site, consideration is to be given to providing direct and high quality access for pedestrians who walk to nearby PT nodes, as well as whether the site has been provided with adequate level of access(es) (both capacity and connectivity) to all nearby PT nodes within the catchment areas. In addition, developers are to consider the needs of individuals with mobility impairments for accessing PT services.

Bus services are generally more accessible and affordable compared with most other PT services. If well planned, they help promote social inclusion and transport equity, and benefit the vulnerable the most. Therefore, greater effort is to be placed on improving accessibility to nearby bus services, as well as their associated facilities wherever possible.

To facilitate LTA's evaluation of TIA, developers should provide the following plans:

- 400m & 800m walk radius and indicative walk time isochrones from the proposed development (See example in Annex F)
- Pedestrian routes to nearby bus stops and LRT stations (both within 400m walking distance) and MRT stations (within 800m walking distance), as well as cycle routes to nearby MRT stations (within 2km cycling distance) from the development site.

[6] These design standards and guidelines will be updated from time to time.
[7] Actual walking distance should be based on network distance (not 'the crow-flies' distance)
[8] The LTA take no responsibility for the accuracy of the information provided by the website.

For each bus/LRT/MRT service, only the walk route to the nearest bus stops (for both directions)/station entrance would need to be indicated (See example in Annex G). However, the LTA might also request for additional walk routes (to any bus stops within 400m walking distance) to be included in the plan if there is reason(s) to believe that those bus stops are also likely commonly used by future site users.

Mapping this information where possible will present a clearer picture. Interactive, bus maps, timetable and frequencies of existing services are available at:

- https://www.transitlink.com.sg/TIdetail.aspx?ty=catart&Id=15
- http://www.mytransport.sg/content/mytransport/home.html#
- http://www.onemap.sg/index.html

Overall, developers are required to clearly describe and indicate the level of access to the site by PT, and identify areas where possible improvements can be made to encourage site users to use PT, and provide the necessary support to those without access to cars.

The requirements above are not exhaustive and further supplementary information may be required to take into account local condition and other material considerations. Equally, TIAs of some developments may not need to meet all the requirements mentioned above. Therefore, it is important that the scope of work is agreed with LTA as early as possible.

4.4. Public Transport Accessibility Level (PTAL) Assessment

PTAL is a measurement of a combination of how close PT services are from a given point (walking time) and the frequency of those services (waiting time). The PTAL methodology was developed in 1992 by the London Borough of Hammersmith and Fulham. It was adopted by Transport for London (TfL) about 10 years later, and has now become the most recognised method of measuring a combination of accessibility (or First Last Mile Connectivity (FLMC)[9]) and availability of PT services. Some regard PTAL as the density of the PT network.

An appreciation of the level of PT accessibility of a development site would enable developers to maximise the PTAL potential of the site by strategically placing pedestrian access gates nearer to PT service access points without compromising on safety, convenience and accessibility of other road users. The location of pedestrian access gates, put forward by developers, would be considered by the LTA on a case-by-case basis with an objective of balancing the interests of site users, other road users and wider WCR objectives. The PTAL score would also help LTA decide on whether

[9] FLMC is the journey leg that, combined with the services at the PT nodes, often determines if PT is the chosen mode of transport.

or not improvements to PT services and/or local walking network (and hence, the overall PT and walking connectivity and permeability of an area) are necessary. This has now become all the more important as LTA's current policy is to promote mode shift from car to sustainable modes of transport, like PT, walking and cycling.

PTAL ranges from Levels 0 to 9 where 9 represents a high level (best) of accessibility and 0 a low level (worst) of accessibility. Level 1 has been further subdivided into two sub-levels to provide greater clarity. A location will have a higher PTAL if:

- It is a short walking distance (proximity) to the nearest stations or bus stops
- Waiting times (frequency) for services at the nearest stations or bus stops are short
- More services (choice) call at the nearest stations or bus stops
- Any combination of all the above (Transport for London, 2010)

As part of the TIA, developers are now required to assess the PTAL rating for the proposed development using the LTA's PTAL methodology (See Annex H). The point chosen for PTAL calculation should be the centre point or the centre of activities (e.g. a building block) within the development site.

As PTAL is calculated on a point basis, multiple PTAL calculations will be required for a single development if it has more than one building on site which is more than 160m apart (i.e. 2-min walk), or if the site has a large site area where centres of activity are more than 160m apart. As a general guide, PTAL should be calculated at 160m intervals.

If a development has more than one building and they are less than 160m apart (measured from the centre point of each building), the mid-point between these buildings should be used for PTAL calculation. For the avoidance of doubt, developers should agree with LTA on the detailed requirements on PTAL during pre-application/scoping stage of a TIA submission.

As far as PTAL is concerned, the important question that LTA is looking to answer are 1) whether the development will enjoy a reasonable level of PTAL in relation to the scale and type of the development, and 2) whether PT and/or walking improvement measures are required to improve the PT connectivity of the development site.

Developers are not obliged to contribute to local PT improvements simply because of low PTAL rating of their development site. However, the LTA strongly encourages developers and their consultants to put forward PT improvement proposals for LTA's consideration. It must however be emphasised that the decision on whether or not to take up any improvement proposals and the level at which the issues identified would be addressed (at local, area-wide or strategic level) is at the discretion of LTA.

4.5. Promotion of PT use

The TIA is considered the most appropriate tool for promoting the use of PT at a development level. Developers are to put forward measures of promoting PT usage as a realistic alternative to private car trips. The purpose is to foster behavioural change and result in increased use of PT.

The key questions to answer here are 1) whether the development has been adequately designed to encourage PT use, and 2) whether the development has put forward reasonable measures (relative to the scale of the development) that would maximise the potential of PT use.

Proposed initiatives/measures are to be in place before site users occupy the new development(s), otherwise the habit of using private cars will become ingrained and the change to PT will be more difficult to achieve. Measures may vary from development to development. Some of these measures are listed in Section 6 of the Guidelines.

4.6. Development Demand and Impact Analysis

As a general guide for PT impact, developers are required to:

- Estimate the number of person-trips generated by the proposed development by transport mode during the peak development generation period(s)
- Establish (or estimate) future mode share pattern of the proposed development during the peak development generation period(s)
- Establish and address access (e.g. barrier-free, directness) and capacity (e.g. crowding) concerns, if any, along access routes between PT nodes (within catchment areas) and the proposed development
- Highlight bus or MRT capacity problems, if any, (within catchment areas) through observations (e.g. by including photographs in the TIA report)[10]

PT capacity is usually not an issue for individual development applications. Therefore, detailed capacity assessments of the bus and MRT/LRT networks are usually not required by TIA. This is also due to the complex patterns of passenger demand using these networks and the fact that a single development application does not usually warrant such an analysis.

However, this needs to be addressed if a proposed development is expected to generate a significant amount of PT trips. The extent to which capacity analysis would depend on the size and significance of the development. Developers should discuss what the

[10] It is at the full discretion of LTA to decide whether the issues would be taken up at a development, area-wide or strategic level.

analysis requirements are with LTA prior to commencing the study so that agreement can be reached on what level of analysis is appropriate.

To facilitate TIA evaluation, developers should provide maps showing the catchment areas of a development in 400m & 800m walk time isochrones on maps based on the walking network (i.e. using network distance instead of 'the crow-flies" distance). As the choice of time-bands may vary in response to the use and scale of the development, it is important that further guidance be sought from LTA at the scoping stage.

5. Road Traffic

5.1. Introduction

The LTA has embarked on the Walk Cycle Ride (WCR) SG strategy to build a car-lite society. An effective road network is required to facilitate urban mobility, especially to ensure the efficiency and safety for pedestrian, cyclist and bus movements on road elements. Measures are required to make sure that the proposed development / redevelopment has minimal traffic impact to the surrounding road network. This section is to provide a guide on how to assess the development's traffic impacts on the surrounding road network and requirements to mitigate the negative impacts.

5.2. Background Traffic Forecast

In general, the future background traffic volume can be estimated using the growth factor method for forecasts from the current year. Typical growth factors between 0% and 0.5% per annum may be considered appropriate. Notwithstanding this, the location and proximity of the development to other major new developments and/or new roads are likely to influence the extent of background traffic. Thus, other growth rates may be more applicable in some circumstances. Consultants are required to consult with LTA to confirm on appropriate growth rate(s) to be adopted for the estimation of background traffic.

Where applicable (e.g. areas to have significant changes in landuse and/or infrastructure), the LTA may advise on the methodology to estimate the future background traffic.

5.3. Development Traffic Forecast

Trip Generation

Trip generation rates are to be based on survey(s) of similar development(s) agreeable to LTA. Such survey(s) data shall have a maximum validity of not more than two years prior to the date of the TIA study. The survey information including site(s), location(s), date(s) and time period(s) is to be included in the TIA report to substantiate similarities.

Trip generation rate surveys are commonly classified by vehicle type. For large developments, person-trip rate survey classed by transport mode might be required. Certain types of developments may generate a significant volume of goods vehicles traffic. If necessary, the LTA may require survey to be done at similar developments to identify the goods vehicles' travelling profiles including volume and timing. For developments where a comparable site may not exist, trip generation may be estimated from first principles e.g. employee numbers, number of visitors etc. based on the methodology agreeable to the LTA.

For mixed developments such as retail/office or retail/residential where there may be interaction between various land uses, a portion of the trips will be generated from within the development. The total traffic generation of the development is likely to be lower than the sum of individual uses if the rates are derived from stand-alone developments. A reduction in the development's trip generation rate may be warranted when estimating additional traffic on external roads.

The type, the choice of site(s) and the time of survey(s) to obtain trip generation survey rates, or the intent to use historical trip/traffic generation survey data, shall be discussed at the Scoping Meeting and agreed by the LTA prior to commencing the study.

Trip Distribution

A description of the methodology used to distribute traffic is to be provided for LTA's review. For most developments, the distribution of development traffic may be based on the survey of an existing nearby development that is similar to the proposed development. Where such development is unavailable, current travel patterns on nearby links and intersections may be used to distribute traffic to/from the development onto the road network. For larger developments or those likely to attract traffic from further afield, traffic distribution may be based on the area of influence of the development e.g. retail centre catchment area or from an origin and destination study to assign the development's traffic to the appropriate routes.

Diagrams are to be included with clear indications of directional and turning distributions (in percentage) of the proposed development trips onto the road network.

For mixed developments, different trip distribution for different components of the development may need to be adopted to account for different travel behaviour of users.

For certain cases where it is required to project the proposed development/ redevelopment's public transport demand and/or assess on its impacts to the public transport system, the LTA will advise on the methodology to derive the distribution of public transport trips.

Modal Split of Development Trips

Developments located away from major public transport nodes are likely to have higher vehicular generation compared to those nearer to public transport facilities. The vehicular trip generation rates shall therefore account for the differences in level of public transport accessibility to ensure relevance. For a same development, the vehicular trip generation rate could also be changed over the years where the transport mode share has a significant change. Adjustments to the vehicular trip rates might be required where the level of public transport accessibility and/or transport situation will be significantly different. Modal split of a similar development in a similarly located site with similar level of public transport service would provide useful information and should be used wherever possible. For those areas the public transport accessibility is expected to be different than today's, the LTA will advise on whether there is a need to adjust the vehicular trip generate rate corresponding to the future mode share.

If required, the TIA shall address alternative modes of travel and the provisions to cater for pedestrians and cyclists' needs (refer to Section 3). The methodology being used to estimate the development demand for walking and/or cycling shall be agreeable with the LTA.

Development Traffic Assignment and Traffic Forecast Results

The assignment of traffic from the development shall be based on shortest travel time/cost in the peak periods (where appropriate, the LTA may request the inclusion of weekend peak period) and shortest travel distance/cost in the off-peak periods. For larger developments, traffic assignment accounting for travel condition on available routes needs to be considered. The appropriate methodology is first to be accepted by the LTA.

On routes with ERP, the applicable rate is to be converted to generalised time and added to the travel time for that route. The LTA will provide the appropriate values of time for private and public vehicles.

The LTA may require the consultant to substantiate the routes chosen for the assignment using field travel time and/or origin-destination surveys.

A diagram with the routes and the assigned volumes (in pcu/hr) is to be included in the report.

5.4. Assessment of Development Traffic Impact

Priority for Walking, Cycling and Mass Transport

For all developments, developers are strongly advised to consider transport improvement measures which can encourage the use of mass transport, and/or walking and cycling as a mode and hence reduce reliance on cars. These measures would bring

down the vehicular trip generation rate of the proposed development/ redevelopment and hence to have less traffic impact on the surrounding road network. A list of transport improvement measures is provided in Section 6 of this Document for developers/consultants to review if applicable for the proposed development/ redevelopment.

In general, priorities for bus, pedestrian and/or cyclist movements shall be considered and encouraged to ensure these modes of travellers are able to get through roads/junctions with reduced delays where possible. For identified locations, the LTA will guide on specific measures to prioritise buses and/or pedestrians/cyclists.

Junction Evaluation Criteria

For individual signalised road junctions, traffic situation in general may be considered acceptable where:

- All the vehicular traffic turning movements are able to clear the individual junction within three (3) traffic light cycles.
- The additional development traffic does not increase the individual junction's delay by 1 or more traffic light cycles.

For areas where there is significant volume of public buses and/or a higher traffic efficiency is required, the LTA will advise on the possible use of other performance standard(s) – e.g. if all the traffic turning movements are able to clear the individual junction within two (2) traffic light cycles. For junctions without traffic signals, the LTA will advise on the appropriate traffic performance standard, such as the acceptable average delay for vehicles on opposed traffic turning movement(s). Consultant shall seek the LTA's instruction if there is any uncertainty on the expected traffic performance standard required.

Road Junction Analysis

The performance of the affected junctions shall be assessed using a commercially available intersection modelling program. The LTA uses the latest version of the SIDRA software. Generally, intersection assessment outcomes produced by an outdated version of the software will not be acceptable, if there has been a newer version(s) available to users for more than two years. The use of other types of software for analysis is acceptable provided that it can produce results comparable to SIDRA. Consultants are advised to seek the LTA's approval on the suitable software to be used at the Scoping Meeting.

The LTA road and/or junction improvement plans (if any) for the study area shall be taken into consideration as a base in the analysis for corresponding year(s) assessment. The TIA report shall include intersection and road analyses for each year of assessment, with separate analysis for the scenarios of with and without the development traffic. Changes in the average delay for all vehicles at each of the affected intersections as

well as the average travel speed along each of the affected roads (where applicable) due to traffic associated with the proposed development shall be analysed and clearly stated in the report.

The values listed below are provided as a guide for the evaluation of isolated signalised junctions.

- Cycle time: Existing cycle time in peak period for existing junctions, or an optimised cycle time within the range of 90-150 seconds to determine a new or future traffic signal along arterial roads,
- Peak flow factor: 0.95 in general. Lower values are to be used for areas with significant demand peaks e.g. areas for schools, cinema, stadium,
- Basic lane saturation flow rate: 2,000pcu/hr/lane for arterial roads. Lower values are to be used for residential streets and environment with high roadside friction e.g. CBD,
- Queue definition: 95% back of queue. When necessary the LTA may request consultants to assess the queue length based on other specified definitions,
- Passenger Car Unit (PCU) factors: as shown in Table 5.1.

Table 5.1 – Passenger Car Equivalent Unit Factors

Vehicle Type	Passenger Car Unit Equivalent (pcu/veh)
Passenger cars & vans	1.0
Single unit trucks: - LGV - HGV	 1.5 2.25 - 2.75
Buses - Small - Large - Articulated	 1.6 2.5 2.9
Motorcycles	0.7

LGV: Light good vehicles with laden weights up to 3 tonnes
HGV: Heavy goods vehicle with laden weights more than 3 tonnes or with 3 or more axles
HGV: Lower pcu value appropriate for arterial roads higher value for expressways
Bus: Small bus includes up to 30 seats. Large bus more than 30 seats

Subject to Consultants' justification and the LTA's approval, other values for the above parameters can be adopted if they are considered more appropriate to the circumstances. For other parameters which are not defined above, consultants shall justify the parameter values adopted if they are different from their defaults provided in the intersection analysis software. For simulating existing traffic situation, the outputs of mean back of queue shall be comparable to the observed average queues or the difference between the two shall be justified.

Road Network Analysis

In some cases, though individual junctions may be assessed to perform at a level acceptable to the LTA, traffic queues may be created resulting in a gridlock situation especially where intersections are closely spaced to each other. To prevent such a situation, traffic queue lengths and the impacts are to be assessed specifically. For areas where queues at various intersections are likely to interact and significantly affect traffic, a traffic simulation model may be required for assessing traffic performance at the network level. This can include conducting microscopic traffic simulation for the study area or parts of the study area where queues become a concern.

For cases where the traffic situation is sensitive to driving behaviour parameters, such as complex road layout with many interactions, schemes with special road priorities, etc., very detailed assessment is necessary. Microscopic traffic simulation might hence be most suitable and thus required.

To ensure the accuracy of the traffic simulation model, the LTA will specify the criteria for model calibration / validation based on traffic counts, queue lengths, travel times and/or origin-destination matrices. At the Scoping Meeting, Consultants shall propose and seek LTA's agreement on the suitable software to be used, the extent of the area(s) to be included in the microscopic traffic simulation model and the requirements on model calibration / validation.

Measures to Mitigate Negative Traffic Impact

Developers are to demonstrate best effort to encourage / promote walk / cycle / mass transport modes for trips related to the proposed development / redevelopment. This helps to minimise vehicular traffic generated by the development and its impact on the road network. More stringent transport improvement measures are required to encourage the change of travelling behaviour if the development traffic impact is significant.

If the resultant traffic performance after mitigating measures have been incorporated is still unable to achieve the specified performance standard(s), the Consultant is to recommend junction/road improvement measures and include them in the TIA report. Where necessary, at-grade widening of roads/junctions within the safeguarded road reserve lines can be considered prior to considering/proposing other infrastructure improvement proposals. In areas where the specified performance standard(s) of road/junction performance are not achievable, the LTA may request the Consultant to conduct further scenario tests and/or sensitivity analysis as appropriate.

The TIA report is to include relevant tables that clearly explain the summarised assessment of results, including traffic volume, delay, back of queue and/or travel speed as appropriate, of individual transport facilities pertaining to each assessment year. The summary tables are to include separate results for the scenarios with and without the proposed development. If road/intersection improvements and/or additional scenario

tests or sensitivity analyses are required, the report is to also incorporate tables with a separate summary of the assessment results. Relevant proposals/assumptions for each scenario are to be clearly listed in the tables.

The LTA generally requires the submission of softcopies of all data files and modelling files for verification of results.

6. Transport Improvement Measures

6.1. Introduction

To achieve the TIA objectives, transport improvement measures are required to be applied to new developments/redevelopments, particularly with the priority to promote walking, cycling and mass transport.

The LTA will advise on the applicable measures for new developments/ redevelopments as listed in the following section. The Consultant is required to work closely with the Developer and the LTA to go through these measures and adopt those that are applicable to the proposed development/redevelopment.

Apart from the measures advised by the LTA, the Consultant can also recommend other transport improvement measures that may help the proposed development in the use of more sustainable modes of transport, reduce reliance on private transport and/or change travel patterns to mitigate the development's traffic impact.

6.2. List of Transport Improvement Measures

Consultant is required to duly complete Table I.1 in Annex I and submit it as part of the TIA report. Explanation/justification is required for measures that are not to be implemented.

Walking & Cycling Provision within the Development

M1 – Access Consideration

Ensure that access to and around the development is considered in the design process to improve accessibility for non-car users and the disabled, e.g. site and building accesses are laid out to prioritise pedestrians and cyclists

M2 – Design Integration

Ensure that the design of the developments is walking and cycling friendly (E.g. level difference is mitigated by ramps instead of steps; bicycle parking and related facilities shall be located near cycling path or access points.)

M3 – Control Measures

Implement lower speed limits and traffic control measures within the development

M4 – Safety of Pedestrian

Implement traffic management or traffic calming measures to make walking safer, including the provision of new footways, raised pedestrian crossing, speed humps/ cushions and etc.

M5 – Way Finding for Pedestrian

Provide way finding maps to nearby amenities such as MRT station, bus stops/ interchange, community spaces, etc.)

M6 – Bicycle Parking

Provide bicycle parking space that is above and beyond minimum standard.

M7 – Bicycle Parking for different users

Provide short term and long term bicycle parking facilities.

M8 – Facilities for cyclist

Provide shower, changing, drying, lockers and other end-of-trip facilities

M9 – Bicycle Friendly Access

Provide bicycle-friendly access points to development via lift, auto door and cyclist ramp.

M10 – Dedicated Bicycle Routing

Provide demarcated cycling path to link the development to the surrounding cycling path and within development to the bicycle parking and end-of-trip facilities

M11 – Signage for Cyclist

Provide clear location signs to guide cyclists to the bicycle facilities and other end-of-trip facilities

Walking & Cycling Provision surrounding the Development

M12 – Connectivity for Pedestrian

Ensure that suitable pedestrian links serve and run through the area and link with existing routes.

M13 – Priority for Pedestrian

Give priority to pedestrian circulation and ensure that vehicular circulation is located away from pedestrian circulation.

M14 – Accessibility for Non-car Users

Access improvement initiatives, i.e. make it easy to reach the development by public transport, walking or cycling (e.g. connections such as underground/elevated pedestrian links, crossing, covered linkway, cycling path).

M15 – Safe Connectivity

Ensure footpaths/cycling paths leading to nearby PT nodes are properly demarcated and well lit.

M16 – Cycling at Crossings

Provide wider crossing at road junctions and bicycle crossing at midblock pedestrian crossings (e.g. wider crossing, bicycle box).

M17 – Cycling Route Maps

Provide maps / map display boards indicating cycling routes of the local area.

M18 – Place Making

Implement place-making environment within the ground floor of the development e.g. city room

M19 – Share Space Design

Development designed to create a shared space - style atmosphere

Mass Transport

M20 – Shuttle Bus Service

Private shuttle bus service is to ferry staff/residents/visitors to and fro the development and provide direct connection to nearby main transport node(s) such as bus interchange or MRT station. Providing this service will greatly enhance the accessibility to the development for public transport users.

M21 – Educational Engagement

Engaging and educating staff and residents on the benefits of walking, cycling and taking public transport (PT) and what the developer has provided for easy or improved connectivity will provide awareness on the benefit of public transport and active modes for travelling. (Example: conducting a lunch time talk, activities, games, exhibits, and etc.)

M22 – Facility / Service for Shoppers Taking Public Transport

Being able to shop without worrying on how to bring home bulky items makes trips to shopping malls by public transport more attractive and hassle free. This can be achieved by providing a centralised delivery service for shops/tenants to deliver items bought by shoppers.

Programmes / Schemes to Promote Walk Cycle Ride

M23 – Promote Early with Walk, Cycle and Ride

Informing potential clients/tenants/residents that the development design considers the needs of cyclists and non-car users with the provision of cycling connections to park connectors, cycling routes and public transport facilities can be a value add to the attractiveness of the development. Promoting walking, cycling and public transport accessibility early through marketing information demonstrates that the development has the added value of an inclusive design for all modes of transportation.

M24 – Engage Interest Group to Organise Courses

It is important to ensure that cyclists are aware and well informed on the dos and don'ts when cycling either on the cycling paths, shared paths or on roads. This can be achieved by engaging interest groups to conduct training/induction course/road safety education to educate safe cycling and promote cycling skills

M25 – Encourage Cycling Community

As cycling is increasing as a form of alternative mode of traveling in Singapore, there are situations/locations that may act as a barrier against cyclists. This can be addressed by establishing a Bicycle User Group (BUG) to help overcome barriers to cycling for tenants/staff/residents.

M26 – Bicycle Sharing

Traveling to a few places to run errands or to another building in a large development may involve some distance to walk. Generally, those with cars will opt to drive. Providing "bikes for sharing" to staff/tenants/residents can reduce the need to use the car or walk long distances.

M27 – Events to Promote Cycling

Organising events such as Cycle to Work Day can help to convey awareness on alternative modes to the private car.

Demand Management

M28 – Parking Provision

The Ranged-Based Car Parking Standard (RCPS) allows developers the flexibility to manage parking provision. Providing parking lots close to or at the lower bound of the RCPS can help reduce private car demand to the development.

M29 – Daily Season Parking

Instead of applying the monthly season parking charging method, the daily flat rate charging with unlimited use of parking lot gives drivers more flexibility of commuting by public transport.

M30 – Reduce Allocation for Season Parking

Reducing the allocation of season parking lots upon benchmarking with similar developments in the vicinity may help in reducing development private car trips.

M31 – Delivery and Goods Vehicles Management

Developments that generate significant volume of delivery or goods vehicles trips during the traditional peak hours can contribute to congestion. Moving the operations of delivery and/or goods transferring outside of the morning and evening peak periods may help relieve / reduce congestion on the road network.

Developers are also encouraged to work with Urban Logistics (UL) operators to manage deliveries effectively. UL aims to reduce the dwelling time of goods vehicle within the shopping malls by having an assigned UL service provider taking over the goods from the various suppliers and disbursing them to the outlets in the mall. The UL also allows for delivery traffic to be better distributed by the use of pre-booked delivery slots thus resulting in time savings for the suppliers. This would also ease congestion on the roads leading to the shopping malls. More information on the adoption of UL could be obtained from the Info-communications Media Development Authority and Spring Singapore.

M32 – Car Club

With the rising cost of owning a private car, an alternative where the cost of utilisation may be shared with others may be an attractive scheme for residential developments. Developing a car club scheme or partnering with one/a few existing car club(s) and

allocate dedicated parking lots for car club vehicles, can provide residents the option to use/drive a car when they need/want to.

M33 – Car Sharing Parking Allocations

Car club/sharing may be supported by allocating parking spaces near the access, for example allocating parking spaces near to the lift lobby or exit door of the parking area.

M34 – Parking Charges

In promoting the use of the public transport, increase in parking charges may dissuade drivers from driving. The additional revenue may be used by the developer to subsidise other measures – for example: to improve end-of–trip facilities for cyclists.

M35 – Travel Smart Scheme

Travelling on public transport outside the peak hours may help spread commuter peak demand. This may be achieved by periodically conveying awareness on the LTA's Travel Smart scheme to companies/tenants/staffs/residents.

M36 – Adjustment to Working Hour

The use of technology such as tele-conferencing, e-mail and instant messages have made working away from the office desk a possibility. By encouraging companies/ tenants to adopt or permit flexible working hours/compressed working weeks (e.g. 9 working days fortnightly)/teleworking from home for staff, demand for trips can be reduced and collectively may help alleviate traffic congestion.

M37 – Onsite Facilities

Having onsite facilities such as child care, healthcare and shopping/home delivery may reduce the need to travel. Developers are encouraged to incorporate a certain number of on-site facilities.

M38 – Onsite Services

Services such as cafeteria, convenience shopping, canteen and/or cash dispensers are important to reducing the need to travel. Developers are encouraged to provide a certain number of on-site services to reduce the need to travel.

M39 – Home Delivery

As delivery services are becoming more common to Singaporeans, the developer may want to provide tenants/companies with home delivery services so that customers do not have to carry items home when taking public transport.

Other Measures

M40 – Provide Charging Facility for Electric Vehicle

The use of alternative energy will help in reducing the emission of GHG and carbon footprint. Providing electric vehicle charging points within the development to facilitate charging of vehicles may help encourage drivers to consider eco-friendly private vehicles over conventional combustion engine vehicles.

M41 – Eco-Driving Course to Promote Fuel Efficiency

Providing courses on environmentally and climate friendly driving techniques may benefit not only the environment but also improves safety, reduces stress levels and save costs for the driver.

M42 – Road / Junction Improvements

Propose measures to prioritise bus, pedestrian and cyclist movements at roads and junctions, and propose improvements to ensure the traffic performance meets the LTA's standard as specified in Section 5.4.

7. Other Assessment Issues

7.1. Parking and Pick-up/Drop-off Provision

The consultant shall document the analysis for parking provision. The number of parking spaces and access arrangement of new developments shall comply with the requirements stipulated in "Code of Practice for Vehicle Parking Provision in Developments" and "Street Works Proposals Relating to Development Works".

The consultant shall also consider the potential traffic impact and externalities that may arise as a result of car parking operations, and provide appropriate mitigation measures as necessary. If the proposal is unable to meet the access provision and arrangement requirements or the LTA considers that the development access point warrants detailed evaluation, the consultant is to demonstrate the viability of the proposed arrangement.

For different relevant modes, such as taxi, coach, car (including private cars and hired cars such as Uber and Grab cars), motorcycle, etc., the Consultant is to assess whether there is a need to provide dedicated pick-up/drop-off facilities and to estimate the number of bays required and to propose suitable location(s). If the development design is carried out as the TIA is in progress, the Consultant is to comment on the layout, identify potential traffic problems associated with the proposed pick-up/drop-off facilities and recommend necessary improvements to the plan.

7.2. Site Access and Traffic Circulation

Provision of good site access and circulation for all users whether for motorists, public transport commuters or pedestrians help towards the successful operation of a development. The ease with which users move to/from the development and nearby areas, roads and public transport facilities is important to the long-term success of the development.

The proposals (access, lay-by, pick-up/drop-off point, pedestrian facility etc.) are to take into consideration the following requirements:

(a) Safety – The location and configuration of the access, lay-by, pick-up/drop-off point, pedestrian facilities etc shall not pose a danger to motorists and pedestrians. Good sight visibility are to be ensured in order not to allow motorists' lines of sight to be obstructed by trees, structures, buildings, etc. Generally, the proposal to locate the development access at major arterial roads may not be supported when there are alternative feasible option(s) available.

(b) Capacity of road – This is to be considered when designing the configuration of the access. For example, a Left-In-Left-Out (LILO) arrangement of an access connecting to a road with heavy traffic may be more appropriate.

(c) Queue length – Sufficient queue space within the development is to be provided at the proposed access, lay-by or pick-up/drop-off point(s) to prevent queues encroaching onto main road carriageways as these can obstruct traffic. The TIA is to include an assessment of entry barrier capacity and queue length to demonstrate that the distance between the development boundary line and the car-park barrier is sufficient to accommodate the expected queue.

(d) Traffic conflicts – Proposals shall not create conflicts of traffic. Access points are not to be located opposite of each other, near bus stops or traffic junctions.

(e) Obstruction to traffic – Vehicles manoeuvring into access(es) are not to obstruct traffic along the road carriageway. All vehicles are to enter and exit the site in a forward direction. Reversing of vehicles is not allowed onto a public road.

(f) Pedestrian/commuter facilities – Should a pedestrian crossing facility be proposed, analysis of its impact on traffic flow is to be done. Depending on pedestrian/traffic volumes, other facilities such as a barrier-free accessible overhead bridge or underpass are to be considered if these are considered to be more appropriate. These facilities are to be made accessible to the public at all times.

Generally, proposals to introduce a traffic signal at the junction of the development access on arterial roads will not be favoured unless it can be justified. If a new traffic signal is proposed, the impact of the traffic signal on the traffic flow along affected roads is to be evaluated as described in Section 5 of the Guidelines. This is to demonstrate that the proposed traffic signal will not significantly affect the traffic flow or reduce travel speeds along the roads.

Access, road carriageway and junction improvements are to be designed in accordance with the relevant LTA design standards and specifications. Site constraints are also to be taken into consideration.

7.3. Development Traffic Operation Plan

For developments expected to have significant surge in traffic (e.g., shopping mall opening stage, school morning arrival peaks, development major events, etc.), the Consultant may be required to:

(a) Establish the traffic and pedestrian surge profile;

(b) Estimate the traffic and pedestrian volumes during the peak hours of the surge periods;

(c) Assess the impacts of traffic within the proposed development as well as on surrounding public roads during the peaks;

(d) Develop conceptual traffic operation plans to mitigate the negative impacts. The plans are to cover transport facilities which can potentially create significant traffic concerns due to high traffic demand such as car-park accesses, lay-bys, pick-up/drop-off points, loading/unloading schedules, pedestrian crossings, immediate junctions with traffic approaching the proposed development, pedestrian holding areas, etc.

(e) Recommend whether it is necessary to engage Auxiliary Police Officers (APO) to implement the proposed traffic operation plans.

A diagram indicating the proposed traffic control measures at relevant locations is to be included in the report.

7.4. Traffic Management during Construction

For developments associated with a significant volume of traffic during the construction period, an assessment of the impact may be required as a separate assessment/submission (not as part of the TIA report). The LTA will advise whether such a study/evaluation is required to be submitted.

Where there are significant impacts caused by the development's construction traffic, the LTA may require the Consultant to propose measures to mitigate the negative impacts.

7.5. Post Implementation Review

For large developments or developments with uncertainty on whether certain Transport Improvement Measures are necessary to be adopted, the LTA may require the developer to conduct a Post Implementation Review (PIR) about 12 months after the development's opening. For multi-phase developments, a PIR may be required for the

final opening. If relevant, a PIR may also be imposed when the development is partially open.

The objective of a PIR is to review the transport situation with the additional development transport demand and to evaluate the implementation and effectiveness of the Transport Improvement Measures adopted, and if necessary to explore further measures for improvement. For a PIR, the Developer may consider involving the same or a different Consultant from the one who conducted the development TIA.

The following scope may be required for a PIR:

- Classified vehicular traffic counts and/or pedestrians and cyclists counts associated with the development may be required. This is to determine the demand by transport mode / trip purpose;
- Observation of transport and/or traffic situation and highlighting of issues relating to the surrounding transport network;
- Certain type(s) of traffic and transport survey(s), other than counts, may be required. The main aim is to evaluate the transport and/or traffic situation surrounding the development;
- Transport / traffic assessment using suitable tool(s) may be required to quantitatively evaluate the situation;
- Propose further improvements and/or mitigation measures as necessary.

Prior to commencing the PIR, the developer / Consultant is to discuss and seek agreement from the LTA to determine the scope and requirements. The Developer is strongly encouraged to seek LTA's advice at an early stage to outline the scope and requirements of the PIR, even before a Consultant is involved.

8. TIA Submissions and Reports

8.1. Submissions may be required

As shown in Figure 8.1, during the course of a TIA, various submissions may be required. These submissions can be in different formats, such as reports, plans, survey data, modelling files, etc. For each meeting with the LTA, Consultant is required to undertake the minutes of meeting. The Consultant is advised to confirm with the LTA on the submission requirements during the inception stage. PIR Report may be required for certain developments, and the LTA may be able to advise during the inception stage or at a later stage depending on whether the adoption of Transport Improvement Measures are clear during the TIA exercise.

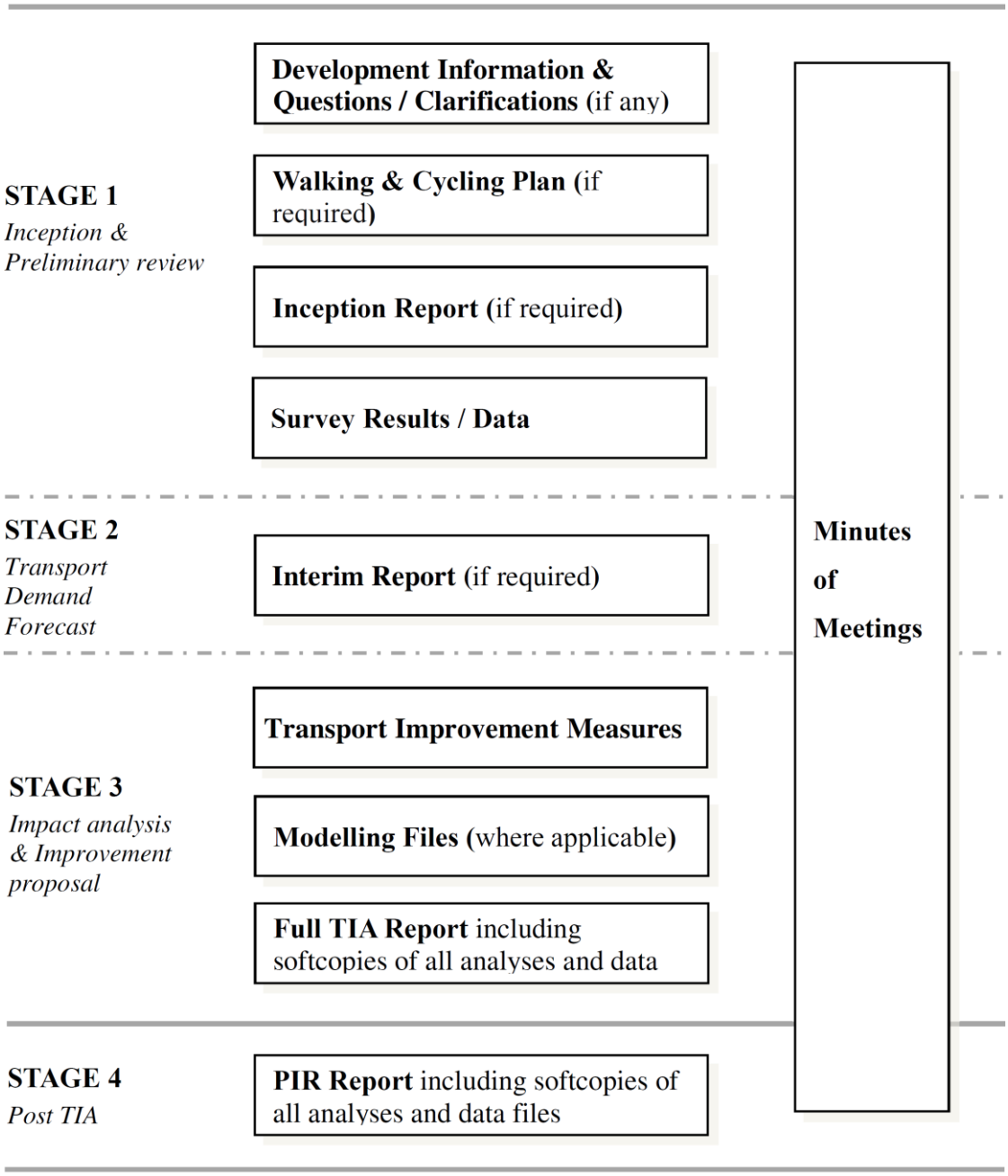


Figure 8.1 – TIA Submissions and Reports

8.2. Inception Report

Where appropriate especially for large development TIAs, the LTA may require the submission of an Inception Report to ensure that all involved parties are clear about the scope and approach to conduct the analysis. The report may include but not be limited to the following:

- Study objectives and scope of work,
- Description of the proposed development, size, location of vehicular, pedestrian and cyclist access point(s), parking provision and intended circulation, for vehicles, pedestrians and cyclists,
- Study area, roads and intersections,
- Existing land use/transport network nearby,
- Assessment years,
- Study methodology and assumptions,
- Model development approach and calibration/validation target as applicable,
- Survey plan,
- Historical data/overseas data intended for use.

The consultant is required to obtain LTA's endorsement of the Inception Report prior to commencing the study.

8.3. Interim Report

For large development TIAs, the LTA may require the submission of an Interim Report. The report may include but not be limited to the following:

- Survey(s) conducted and results,
- Progress or results of major tasks such as PTAL, refinements to WCP if applicable, etc.
- Assessment of the existing traffic conditions and/or mode split for similar developments in the area,
- Background traffic forecasts for the assessment years,
- Development vehicular traffic generation and/or person-trip generation where applicable by transport mode (e.g. public transport, walking and cycling),
- Trip distribution (including diagrams as specified in Section 5),
- Estimated development's modal split as applicable,
- Traffic / trip assignment.

To avoid delays to the study, the Consultant is advised to obtain the LTA's endorsement of the Interim Report before further progressing on the study.

8.4. Full TIA Report

The TIA report is to be set out logically with clear analyses, conclusions and recommendations. All assumptions and sources of information are to be clearly documented. Inadequate reports are to be returned to the Consultant for completion or modification as required.

The report is to include an Executive Summary to provide concise and clear information on the study purpose, major findings, conclusions and recommendations. Improvements recommended in the TIA are to be illustrated using appropriate plan(s) with sufficient detail to substantiate their feasibility.

All the analysis files and data related to the study are to be submitted as appendices to the Report for LTA's records.

8.5. General Note

This set of Guidelines sets the general technical requirements for the preparation and submission of TIA reports. Some requirements stated in this document may not be imposed for a particular TIA if unsuitable. **The Consultant is to follow the LTA officers' instructions during the course of preparing the TIA. Ambiguities and validity/lack of information are to be resolved with the LTA as early as possible.**

ANNEXES

ANNEX A – Conditions When a Transport Impact Assessment (TIA) is Required

A TIA and WCP are required to be prepared prior to the Development Control stage if one or more of the conditions specified in the following table apply to the development. However, if other specific developments are expected to generate high pedestrian and cyclist volume, the LTA will advise the applicant on whether a WCP is required.

Development Type	**Scale**
1. Residential	
1.1. Landed properties/ Condominiums/ Executive Condominiums	≥ 700 units
1.2. HDB housing[11]	≥ 1,000 units
2. Commercial	
2.1. Shopping centres/ Retail uses	≥ 10,000m2 GFA
2.2. Office development	≥ 20,000m2 GFA
2.3. Hotel	≥ 700 rooms
3. Industrial	
3.1. Light/ General Industry[12]	≥ 60,000m2 GFA
3.2. Warehousing/ Distribution[12]	≥ 50,000m2 GFA
3.3. Science park/ High tech park/ Business park	≥ 40,000m2 GFA
4. Educational	
4.1. Primary school	≥ 1,500 students (single-session) or. ≥ 2,000 students (double-session)
4.2. Secondary school	≥ 2,000 students
4.3. International school	≥ 2,000 students
4.4. Junior college	≥ 2,000 students
4.5. University, polytechnic, ITE campus	TIA Required
5. Medical	
Hospital	≥ 40,000m2 GFA or ≥ 320 Beds (whichever is triggered)
6. Recreational	
Exhibition centre & major tourist attraction	≥ 30,000m2 GFA

Figure A.1 – TIA & WCP requirements

[11] LTA and URA will work with HDB on the WCP requirements.

[12] Only industrial developments located within car-lite precincts or 400m of major transport nodes i.e. within Zone 2, will be required to submit a WCP.

Note:
Generally, for mixed-use residential/retail developments, a TIA is required if the total trip generation of the development exceeds 200pcu/hr either inbound or outbound. However, if the development is located in an area with already high traffic volume, LTA will advise the applicant on whether a TIA or certain part(s) of a TIA submission is required.

For developments not listed in table above and for temporary developments with leases of over 5 years, WCP submission may be required if one of the following conditions is applicable:

- Development is located within car-lite precincts; or
- Development located within 400m (5mins walking time) of key transportation nodes, i.e. within Zone 2; or
- Retail, Office, Mixed Used Developments.

ANNEX B – Checklist to facilitate TIA processing at Pre-Scoping Stage

Please provide the required information in the last column. If item is not applicable, please insert "NA".

PART I: Site Information		
Types of information to be submitted at Pre Scoping Stage	**Description of information required**	**Input by Traffic Consultant**
Site Area	To provide site area in square meter (sqm)	
Approved Land Use	To provide Land Use Type as approved in Masterplan	
Quantum Mix	To provide the proposed GFA breakdown of the development e.g. office, retail, residential, etc.	
Gross Plot Ratio (GPR)	To provide the proposed and allowable GPR	
Development Type	To state the development type**(s)** and relevant information as stated below: 1. Residential: To provide number of Dwelling Units 2. Retail/Commercial/Industrial: To provide GFA (in sqm) 3. Educational: To provide Student & Teacher population, Single or double Session 4. Medical/Recreational: To provide number of car parking spaces 5. Hotel: to provide number of rooms	
General Description	Please describe other relevant site information. For schools, please describe whether parents are allowed and/or will be allowed in school compound for drop-off/pickup.	
Observation of Existing Transport Conditions in the Area	Please conduct a site visit and thereafter describe briefly the existing transport conditions in the proposed development site's surrounding area, such as public transport accessibility, provision of walking and cycling facilities, traffic situation (i.e Queue length	

	& no. of traffic light cycles to clear junctions in general), etc.	

PART II: Proposal Information		
Types of information to be submitted at Pre Scoping Stage	**Description of information required**	**Input by Traffic Consultant**
Opening Year	To provide the Opening Year of the development	
Phasing Years	To provide the different phases' Opening Years of the development, if applicable	
Operating Hours	To provide the Operating Hours of the development	
Peak Hours	To indicate the estimated Peak Hours of the development traffic	
Trip Rate	For existing development, to provide existing trip rate and future trip rate, if applicable. For new development, to identify an existing development which is comparable to the proposal, and use its existing trip rate and future trip rate, if applicable.	
Proposed Car Parking and Bicycle Parking Provision	To provide the numbers of car parking and bicycle parking lots, specify if it is below or above requirement.	
Software	To indicate what software is proposed to be used for the assessment	

Part III: Relevant Information to be Provided by LTA *Where applicable, LTA will provide the following information*	
Type of information	**Input by LTA**
Any planned LTA road widening works abutting the development? Tentative start and completion date?	
Any planned covered linkway abutting the development?	
Any planned cycling path abutting the development?	
Other information that could affect development layout	
Whether WCP submission is required for the development?	

PART IV: Supporting Plan		
Types of information to be submitted at Pre Scoping Stage	**Description of information required**	**Input by Traffic Consultant**
Location and Connectivity Plan (A Location and Connectivity Plan is required to show the development in relation to the surrounding context of at least 500m - 1km radius from development. (See Figure B.1 for an example of a Location Plan)	**<u>Location of the development</u>** 1. Highlight the development plot 2. Annotation of road names around the development 3. Adjacent development name **<u>Public Transport Facility</u>** 4. MRT station and entrance(s)/exit(s) (Open/within building/underground) 5. Taxi stand(s) 6. Bus stop(s)/bus interchange **<u>Existing and Planned Facilities</u>** 7. Footpath (including those for temporary use) 8. Cycling path abutting the development 9. Covered walkway / linkway within and abutting development (including those for temporary use) 10. Adjacent pedestrian crossing(s) eg. signalised PC, zebra crossing, informal crossing point, overhead bridge, underpass, underground linkage 11. Elevated/underground pedestrian network 12. Through-block links 13. Vertical circulation areas **<u>Accesses</u>** 14. Proposed cyclist access(es) 15. Proposed vehicular access(es) 16. Proposed pedestrian access(es)	

PART V: Walking & Cycling Plan (WCP)

Consultant to submit WCP (prior to scoping meeting) after receiving information in Part III. (See figure B.6 for submission flowchart for WCP). The final approved WCP submission is to be included as a sub-report in TIA.

The WCP is to be submitted in the format of a report that is inclusive of a write up accompanying the 5 plans. All plans submitted in the Walking and Cycling Plan shall be submitted with a minimum print size of A3, showing good level of details.

Types of information to be submitted at Pre Scoping Stage	Description of information required	Input by Traffic Consultant
(1) Location and Connectivity Plan	**<u>Write up on Location and Connectivity Plan</u>** 1. Assessment of existing public transport, footpath (e.g. at grade, elevated link, underpass), cycling path and PCN connectivity to the development 2. Assessment of the existing cycling facilities (e.g. bicycle parking, EOT facilities) provision around and within development 3. Pedestrian and cyclist counts at junctions, footpaths and cycling paths 4. Photographs (e.g. of existing site conditions or useful examples) 5. Overall vision, goals and strategy of the walking and cycling design for the development 6. Expected pedestrian and cyclist trip generated from development 7. Indication of other submissions/requests in relation to WCP proposals (e.g. GFA exemption, BCA Green Mark) 8. Relevant diagrams and sketches to elaborate on pedestrian/cyclist/traffic issue The submission of the write up will be accompanied by the details	

	of **Part IV: Supporting Plan** listed hitherto.	
(2) Circulation Plan The plan finds its base within building plan(s) of the first and other relevant storeys. The plan shows the location of the existing and/or planned footpaths/ cycling paths, bicycle parking, access routes to bicycle parking area, supporting facilities such as showers, lockers and changing rooms. The circulations for pedestrian, cyclist and vehicles shall be represented in different color overlay in one plan. (See Figure B.2a for an example of a Circulation Plan)	**Write up on Circulation Plan** 1. Describe and explain the circulation of pedestrian and cyclist coming into the development and within the development 2. To indicate if development is open/porous or gated **Development boundary lines** 3. Road Reserve line 4. Plot boundary line 5. Kerb line 6. Building line **Accesses** 7. Proposed pedestrian access(es) 8. Proposed cyclist access(es) 9. Proposed vehicular access(es) **Existing and Planned Facilities** 10. Location(s) of proposed/existing taxi stand, pick-up point, drop-off point 11. Footpath, cycling path, covered walkway and linkway within and abutting development 12. Number of bicycle racks at the proposed location(s), and also the proposed type of bicycle racks (e.g. single, double tier). Please number the bicycle lots. 13. Location(s) and number of other supporting infrastructure e.g. showers, lockers. Please number the lockers. 14. Proposed location and dimension of bicycle lifts/ramps indicated with gradient; 15. Location(s) of the proposed wayfinding signage to bicycle parking, End-of Trip facilities, major transport nodes, nearby amenities and 16. Other pedestrian/cyclist facilities within development	

	17. Indication of public accessible area and non-public accessible area (with different colour hatching) **<u>Routes/Circulation</u>** 18. routes across/ to & from development site and the MRT station(s), bus stop(s), taxis stand(s) & adjacent buildings 19. Proposed interim linkages during construction phase of the development where existing footpaths / linkways / cycling paths are affected upon hoarding of the development 20. Barrier free accessibility (BFA) route(s) within development and how it connects to the adjacent public pedestrian footpath 21. Pedestrian circulation route(s) including through-block link and vertical circulation within development and how it connects to the adjacent public pedestrian walkway, nearest bus stop, MRT station and taxi stand 22. Cyclist circulation route(s) from the adjacent cycling path/PCN to the proposed bicycle parking area(s) and EOT facilities 23. Vehicular circulation route(s) within development and how it connects to the adjacent vehicular roads 24. Cyclist/pedestrian conflict area(s) with vehicular traffic (details of treatment to be presented in conflict mitigating plan with relevant write-up) **<u>Cross Sections and longitudinal sections</u>** 25. Showing level difference between development plot and surrounding areas if any	
(See Figure B.2b for an example of a cross section and longitudinal cross section required)		

	26. Detailed side table cross sections and longitudinal sections if any 27. For cross section please indicate the width of the footpath, covered link way, green verge, service verge, distance between building line to the RRL, as well as level differences across the side table (if any) 28. For longitudinal sections, please indicate the gradient along the sidetable.	
(3) Conflict Mitigating Plan A conflict mitigating plan shows a zoom in plan of the conflict points identified in the circulation plan, indicating the adequate traffic mitigating measures to enhance safety of pedestrian and cyclist. (See Figure B.3a for an example of a Conflict Mitigating Plan, Figure B.3b for an example of an elevation view of the pedestrian gate and Annex C for design guidance)	**Write up on Conflict Mitigating Plan** 1. Elaboration of conflict mitigating strategy at each conflict points highlighted in Circulation Plan **Details on Conflict Mitigating Measures** 2. Detailed plan for the treatment at conflict point(s) 3. Cross section for the conflict point(s) 4. Plan and elevation view of the boundary wall, pedestrian gate(s), vehicular accesses and development corner(s) 5. 3D Rendering of conflict point(s) – useful to provide 6. Image to illustrate proposed conflict mitigating measures (e.g. signs, logo)	
(4) Bicycle Parking and End-of-Trip Facility Plan A bicycle parking and EOT facilities Plan is to show a zoom-in plan at each bicycle parking and EOT facility cluster, to	**Write up on Bicycle parking and End-of Trip Facility Plan** 1. Indicate rational of the proposed bicycle parking rack design, as well as the types of EOT facilities 2. Operation model of the Bicycle parking and EOT facilities (e.g. open to public, chargeable)	

ensure the facilities are designed to be accessibility and convenience for users. (See Figure B.4a and Figure B.4b for an example of a Bicycle Parking and End-of-Trip Facility Plan, and refer to Annex E for design guidance)	**<u>Provision Matrix of Facilities</u>** 3. A table indicating the total number of bicycle lots provided, and a breakdown of the total number of bicycle lots per storey and per cluster 4. A table indicating the total number of EOT facilities (e.g. shower, Air pump) provided, and a breakdown of the total number of EOT per storey and per cluster 5. Proposed area for GFA exemption **<u>Layout plan for Bicycle Parking and End-of-Trip Facility Plan</u>** 6. Bike Parking layout plan with indication of dimension (e.g. spacing of the rack, circulation space, length of the parking lot) and type of bicycle parking 7. EOT cluster layout plan with annotation of each types of End-of-Trip facilities 8. Label and number each bicycle lots, shower stalls and lockers in the plan 9. Highlight the doors along the internal circulation routes, and its width. Label if the doors are cyclist friendly door (e.g. auto sliding door.) 10. Image or 3D rendering to illustrate the bicycle parking rack design as well as the proposed End-of-Trip facility cluster	
(5) Wayfinding Provision Plan A Wayfinding Provision Plan is to show details of the signage proposal, to ensure the	**<u>Write up on Wayfinding plan</u>** 1. Indicate rationale and principles for wayfinding provision on wayfinding plan write-up	

wayfinding signage are designed/placed to be clear, concise and intuitive for users. (See Figure B.5 for an example of a Wayfinding Provision Plan, and refer to Annex D for wayfinding design considerations)	**<u>Notional Pedestrian/Cyclist Circulation and Wayfinding Plan</u>** 2. Indicate on floor plans (1st & other storey plan(s) with pedestrian & cyclist facilities) the predicted pedestrian/cyclist circulation corridors from entrances around development from entrances leading to key transport nodes and bicycle parking as well as key activity generating nodes 3. Provide indicative locations of wayfinding signs along main circulation corridors leading to: (a) Publicly accessible bicycle parking (at grade), and bicycle lifts for bicycle parking that is on other levels (b) Public transport nodes (MRT stations, Bus interchanges, Bus stops, etc) (c) EOT facilities (from entrance and bicycle parking locations) (d) Nearby cycling paths and Park Connectors 4. Provide indicative locations for Inter-development signage placement and circulation corridor. This is only applicable to developments which link to a larger pedestrian network, eg: JWalk/Orchard Road Underground or developments with 24h through block links *The following details are to be submitted at DC/BP stage* **<u>Signage Family</u>** 1. Signage family of internaland external signs, categorised into the types of signage as mentioned in Annex D	

	Detailed Pedestrian/Cyclist Circulation and Wayfinding Plan 1. For all signs proposed during WCP stage, indicate on wayfinding plan all proposed signage location, type and information as per Annex D 2. Indicate any additional signage may be required to complete the holistic wayfinding environment 3. Provide relevant section drawings of side-table abutting the development, showing wayfinding signage in context of development	

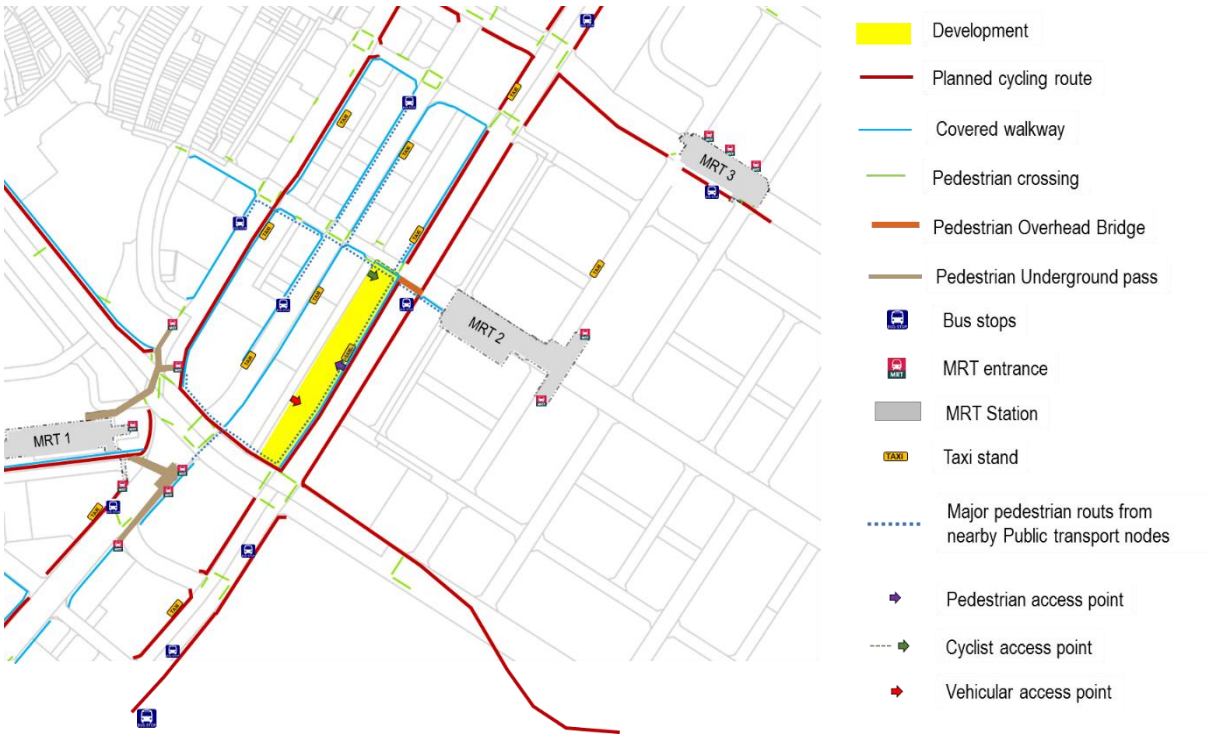


Figure B.1 – Example of a Location Plan

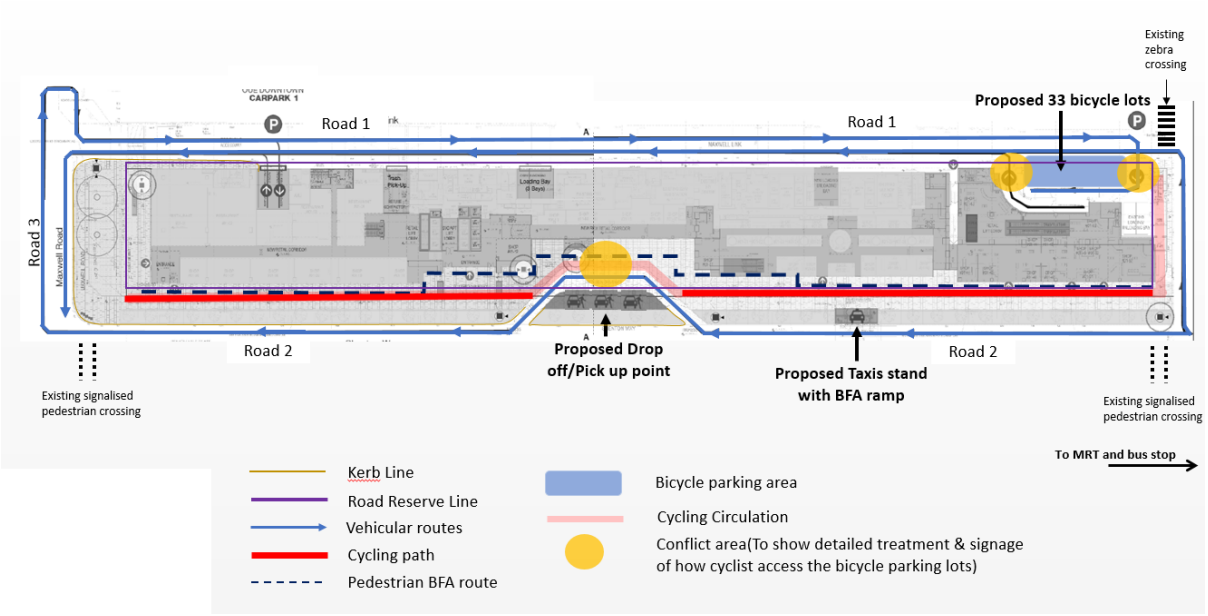
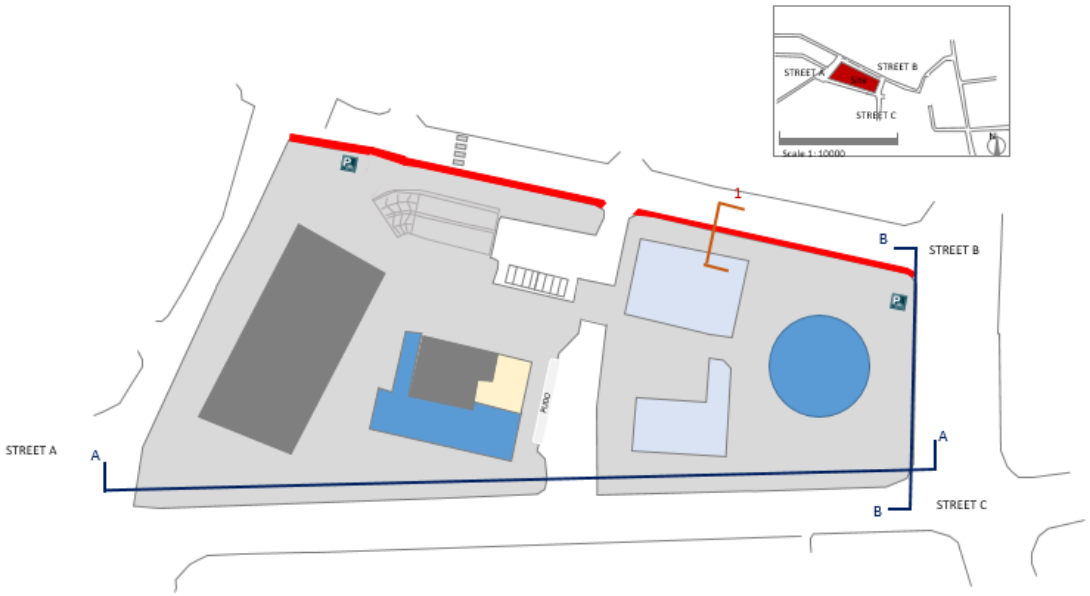
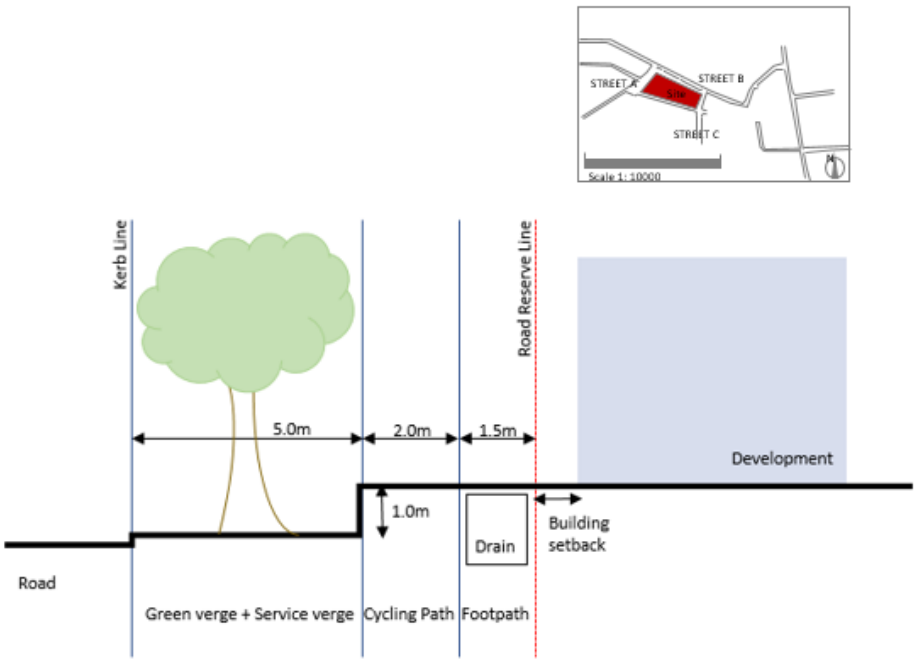


Figure B.2a – Example of a Circulation Plan

Overview plan indicating cross and longitudinal sections



Cross Section



Longitudinal Section

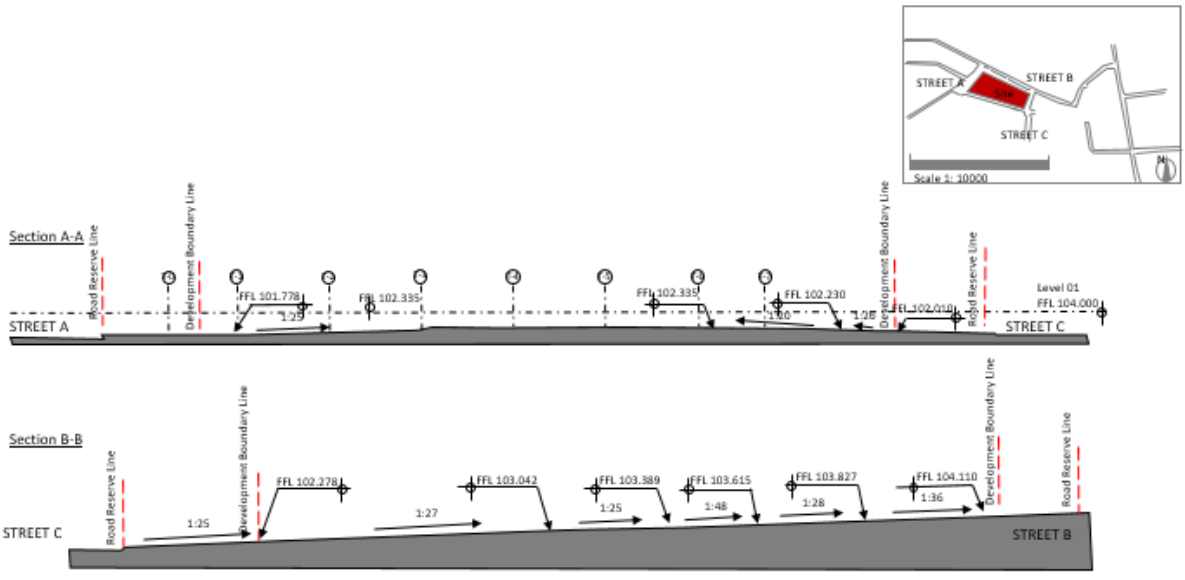


Figure B.2b – Examples of Longitudinal and Cross section

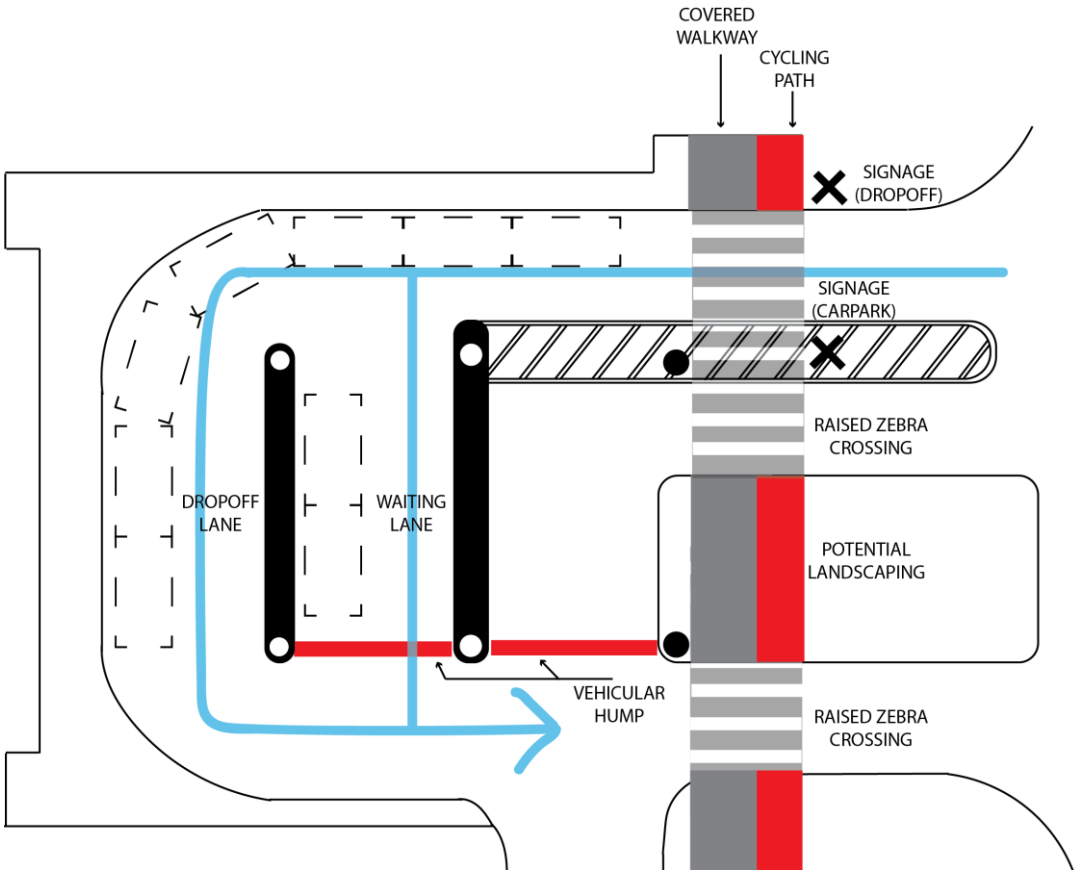


Figure B.3a – Example of a Conflict Mitigating Plan

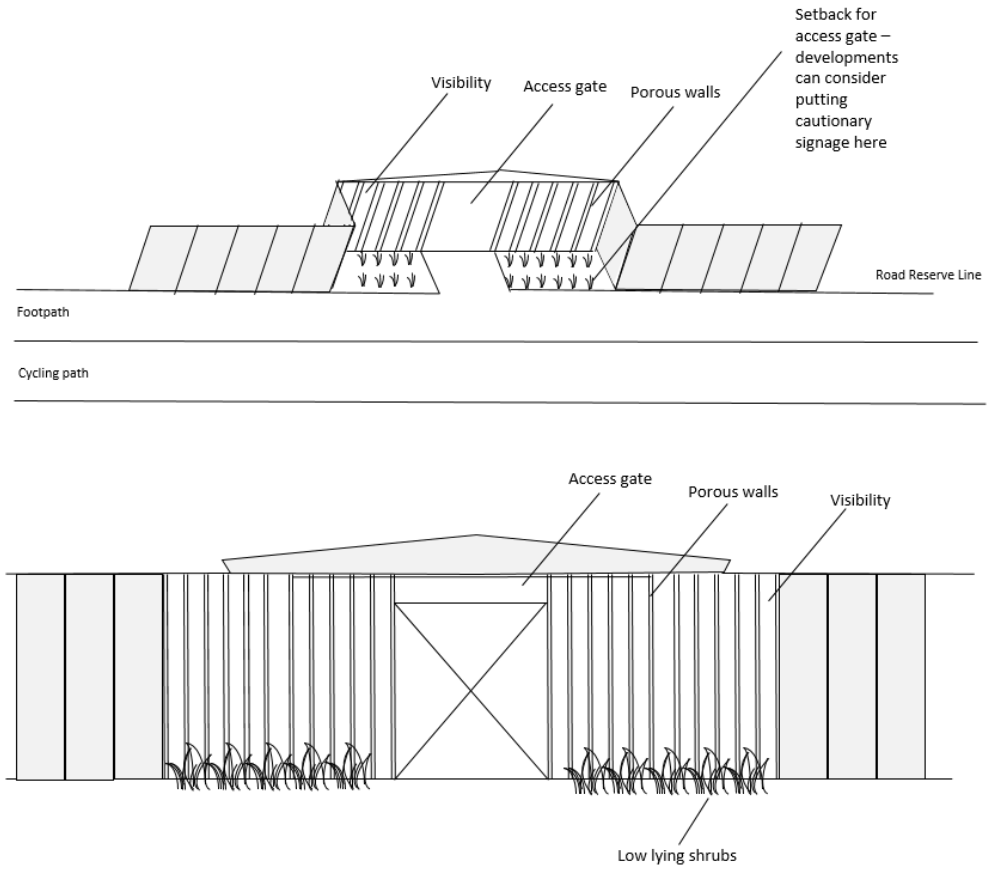


Figure B.3b – Example of an elevation view of the pedestrian gate

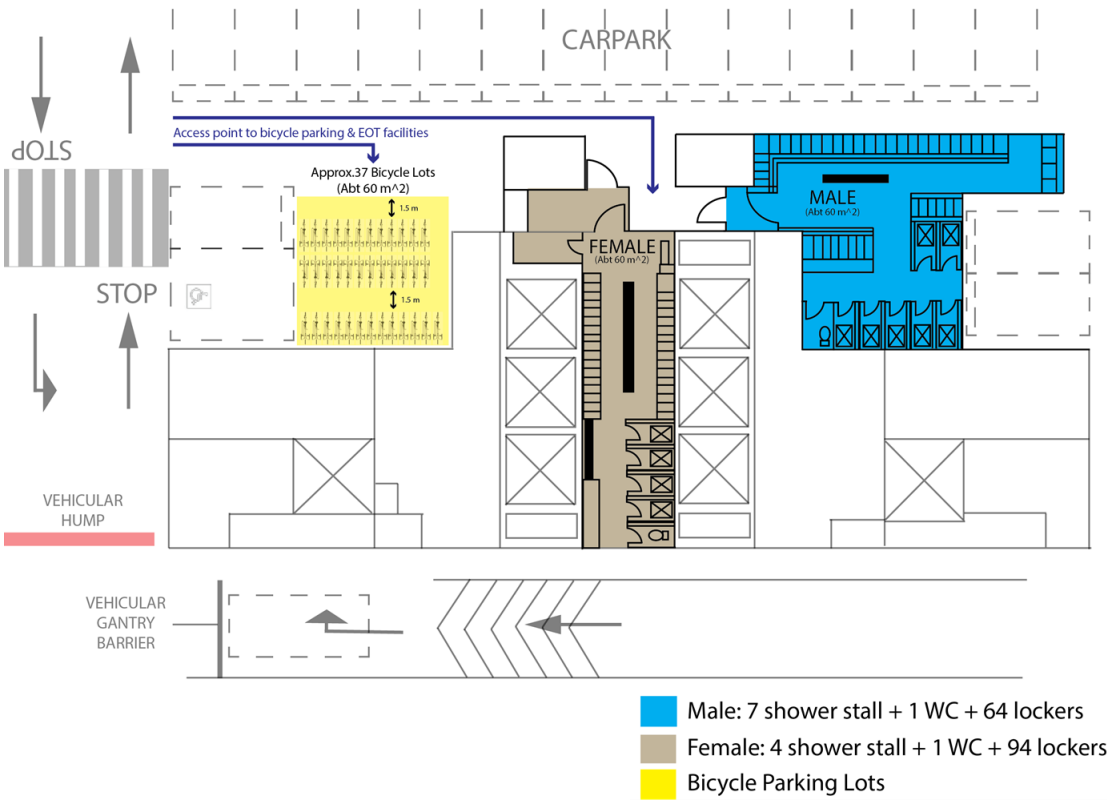


Figure B.4a – Example of a Bicycle Parking and End-of-Trip Facility Plan

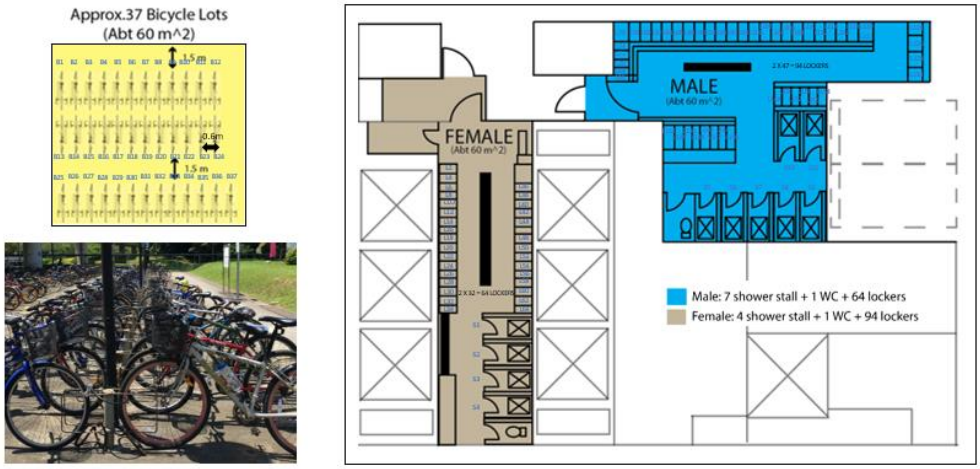


Figure B.4b – Example of a Bicycle Parking and End-of-Trip Facility Plan detailed zoom in Plan

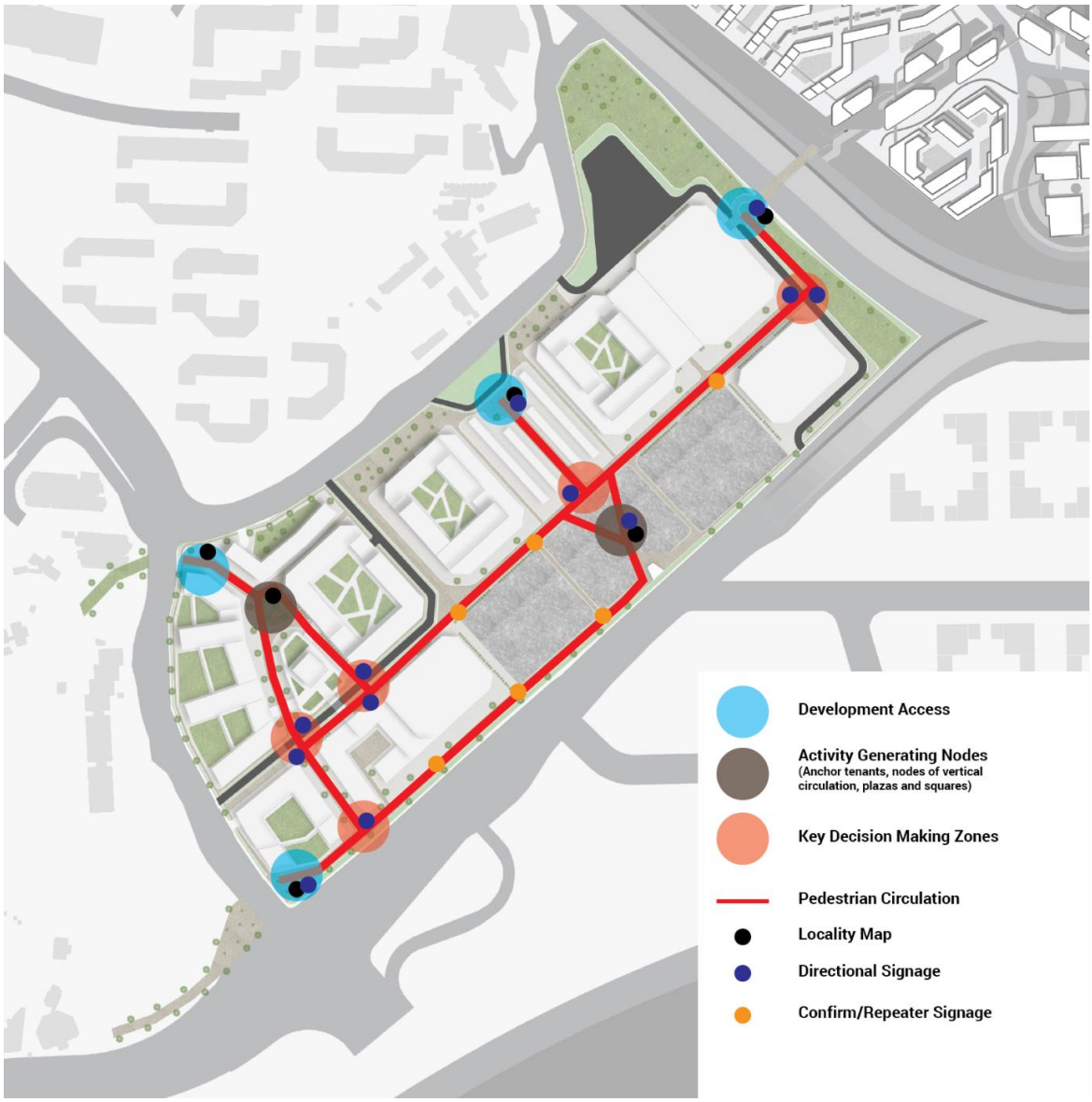


Figure B.5 – Example of a Wayfinding Provision Plan

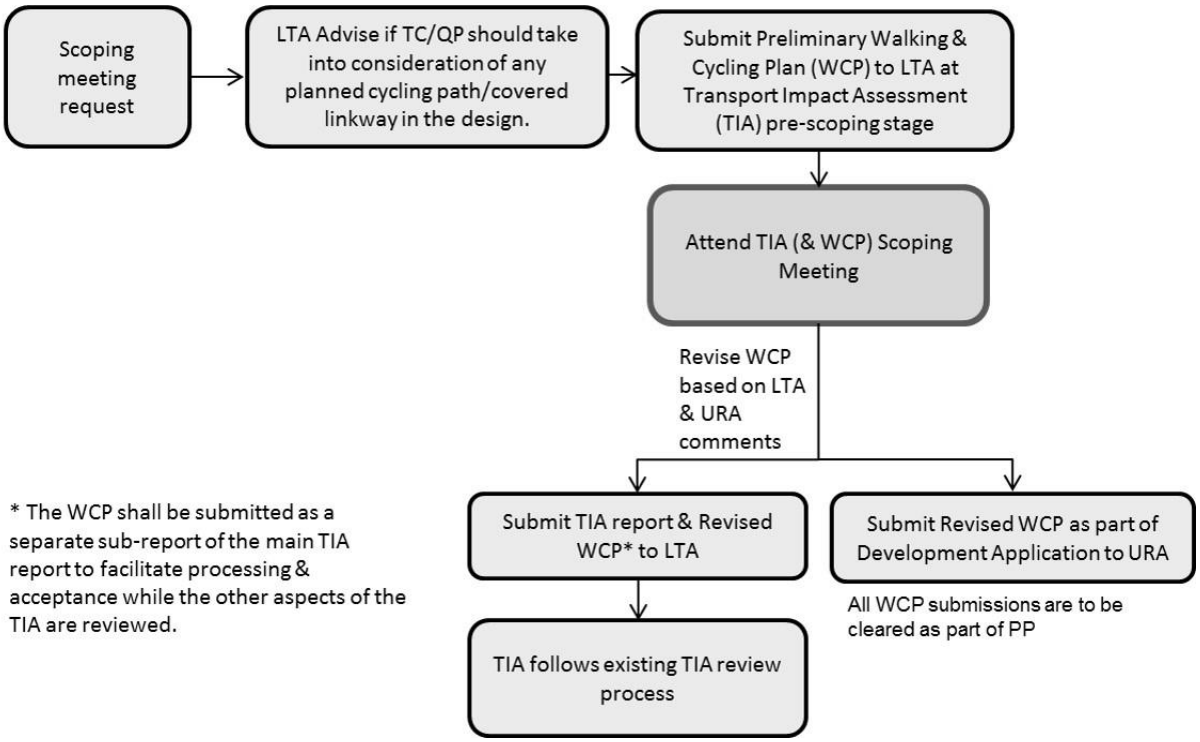


Figure B.6 – Submission Flow Chart for WCP

ANNEX C – Guide for Safety at Pedestrian Accesses and Conflict Treatments

In designing pedestrian accesses and crossing points at the developments, the consultant is to ensure that the facilities are safe and user-friendly. Pedestrian and cyclist routes and accesses shall be de-conflicted with vehicular traffic and be clearly seen by all users. Where possible, they shall be segregated. This guide serves to include good practices for designing of pedestrian accesses and conflict treatments with the objective to meet pedestrian' needs, therefore encouraging proper use of the facilities.

As part of the WCP's conflict mitigating plan (Annex B Plan (3)), the development is strongly encouraged to follow the following guidelines and practices.

A. Creating safe pedestrian accesses

Designers shall take into consideration the potential pedestrian flows from major transport nodes when determining the location for the pedestrian accesses. The pedestrian routes within the development shall be located away from the major vehicular movements.

Designers, as far as possible, shall provide separate pedestrian access from both cyclist and vehicular access to the building. This is especially important for developments such as hospitals and schools that are frequented by vulnerable groups such as the elderly, disabled and the young. Markings and signs to alert motorists to give way to pedestrian and for pedestrian to look out for traffic shall be provided when there is inevitable conflict between vehicular and pedestrian movements (see Figure C.1 and C.2).

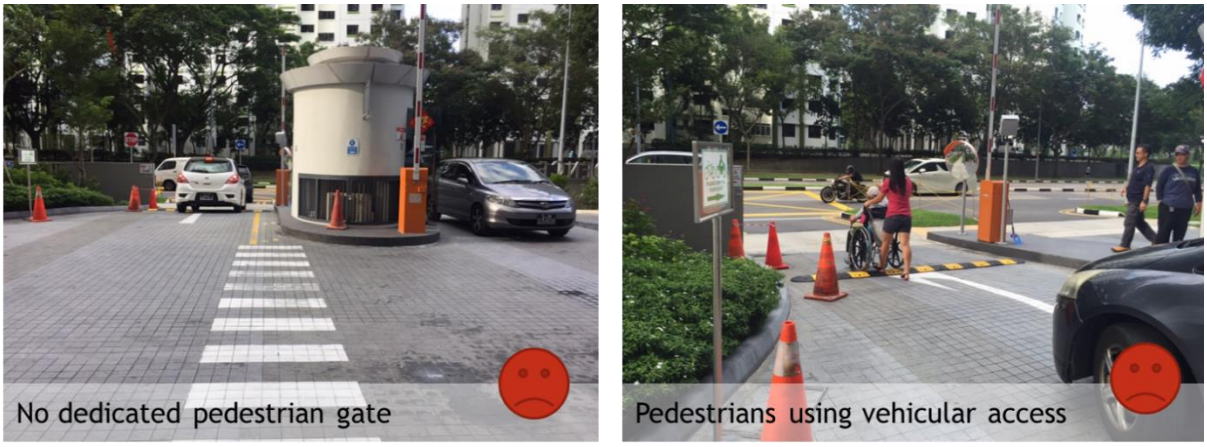


Figure C.1 – No Separate Pedestrian Gate at Development Access

Figure C.2 – Provision of Separate Access Gate for Pedestrian

B. Providing safe sight distance and traffic calming measures at corner and accesses

There are several measures to increase pedestrian safety within the developments. When pedestrian and motorists come into conflict at crossing points, the designer shall consider features that can highlight pedestrian' presence as well as to slow motorists and cyclist down.

Creating safe sight distance is key in ensuring pedestrian and cyclist safety at the main building access i.e vehicular access. There shall be enough time for motorist to react when he sees a pedestrian/cyclist especially when exiting from a building access (see Figure C.3). Measures include setting back the boundary wall with splayed ends and using porous materials shall be considered (see Figure C.4, see Figure C.5 for poor design considerations for corner plots).

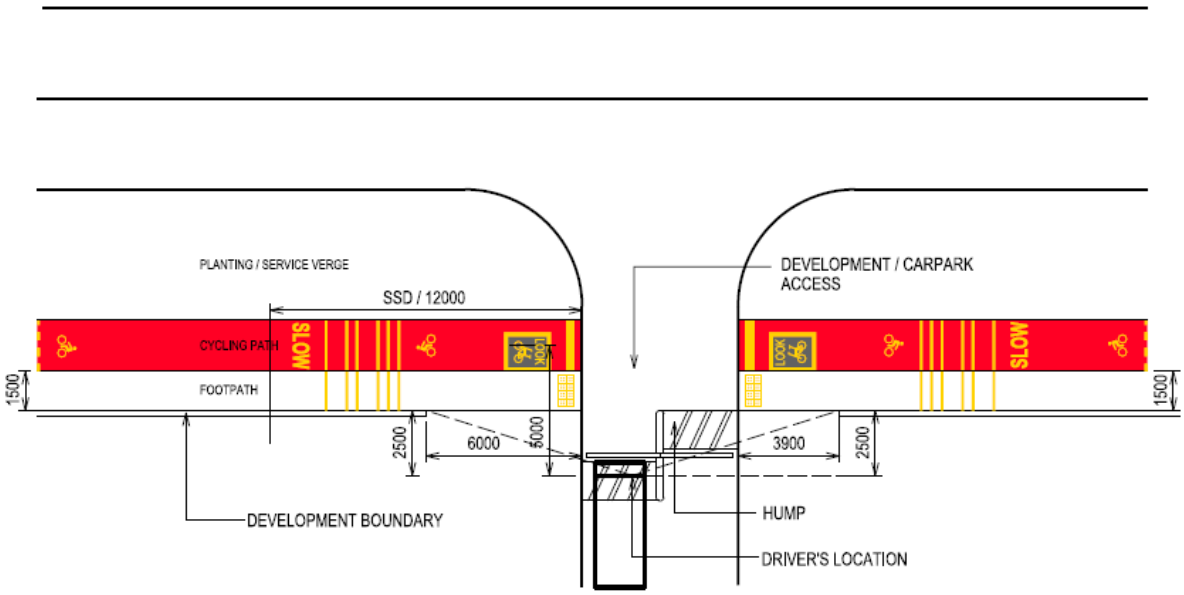


Figure C.3 – Intersection Sight Distance

Figure C.4 – Setback of Boundary Wall with Splays to Improve Sight Distance

Figure C.5 – Negative example where there is no clear line of sight at corner plots

Similar design considerations shall apply to the development's pedestrian access points/gates to ensure sufficient time for pedestrian, cyclist and PMD users to react, especially when pedestrian are leaving the development. Sight distance of cyclist and PMD users are important as they tend to travel much faster than pedestrian – pedestrian are at risk of being hit by oncoming cyclist and PMD users, and the latter are at risk of an unsuspecting out swinging gate. Gated developments such as private residential developments and industrial developments shall take particular care of these potential conflicts. Measures such as the provision of porous walls and gates, as well as the putting up of warning signs are thus highly encouraged as they create safe stopping sight distance (see Figure C.6). For pedestrian and cyclist access gates that open towards a bus stop, please provide a Pedestrian Priority Zone (PPZ) according to LTA's prevailing SDRE markings.

Figure C.6 Examples of access gates to create safety sight distance

C. Treatment at vehicular driveway and drop off points

Traffic calming measures like similar textured pavement for both vehicular driveway and pedestrian walkway, raised crossings that could enhance visibility of pedestrian to motorists, warning markings/signage and speed regulating features like humps or vehicle gantry can also be used to mitigate conflict between the users (see Figure C.7 and Figure C.8).

Figure C.7 – Traffic Calming Measures at Pedestrian and Vehicular Conflict Points

Figure C.8 – Use of Varying Materials near to Ingress/Egress Points

ANNEX D – Guide for Adequate Provision of Wayfinding Signage within Developments

Wayfinding is an integral part of a user's experience during their visit to developments for a safe, direct and comfortable walking or cycling experience. This is especially so if it is the first visit to the development, which is why providing proper signage is of utmost importance. This section aims at guiding the designer in providing adequate signage for intra-development wayfinding.

The design of an effective wayfinding environment is more than just the design of the signage system, and shall include the physical design of spaces as a visual cue for wayfinding. Therefore, designers are encouraged to embark on the wayfinding provision journey as early as the planning stage of the project.

As part of WCP submission, all developments will be required to submit a detailed Wayfinding Provision Plan to document the principles they have adopted when designing a wayfinding system. Please refer to Annex B Plan (5) for more details of the submission. The designer is strong advised to refer to the following sections below for more details of the signage placement and design principles, as well as different sign types.

A. General requirement for Wayfinding Signage to bicycle parking and End-of-trip facilities

As part of Singapore's car-lite vision, developments are required to provide Active Mobility infrastructure within the development, such as bicycle parking and EOT facilities as shown in Annex E. Sometimes, these facilities are not immediately apparent to both long term and short term users. Providing adequate wayfinding signage helps to inform users of the presence of such facilities and in turn supports the take-up of active mobility.

Wayfinding signage to active mobility infrastructure shall be placed along the main cyclist circulation corridor to guide users entering the development from the entrances near key transport nodes and cycling paths/park connectors. If the bicycle parking is not at grade, signs shall be provided directing users from entrances to designated bicycle lifts leading to bicycle parking and EOT facilities. In such situations, indication shall be made on level directories and lift directories to show the provision of bicycle parking and EOT facilities. If there are alternative bicycle parking locations in and around developments, they shall be shown as well for the benefit of users.

B. Wayfinding Signage design principle for Publicly Accessible and Mixed Used developments

For publicly accessible and mixed use developments, apart from the requirements mentioned in section A, more comprehensive design considerations need to be taken

care of to ensure the wayfinding system is able to provide clear navigation to the general public.

Proper design and placement principles are important to ensure the design of a holistic wayfinding system that is not only **clear** and **concise**, but **intuitive** for first-time and even regular visitors. These fundamentals shall be covered:

Clear – Easily identifiable and understandable
Concise – To-the-point and comprehensive
Intuitive – Easy to use and instinctive

The development's wayfinding system is to be developed based on the clear principles. This will enable developments to have a better understanding of the goals of the wayfinding system and the steps required to reach these goals. The principles of the wayfinding system shall be elaborated clearly in the Wayfinding Provision Plan as part of WCP submission (refer to Annex B Part (5)). Below is a short non-exhaustive list of example considerations the developer may wish to adopt:

Principles for the placement of the wayfinding signage

Principle	**Description**	**Fulfilled Fundamental**
Within pedestrian line-of-sight	For easy identification without the need for excessive effort	Clear Intuitive
At key decision making areas	At junctions and atria where users are likely to pause to find their bearings	Clear Intuitive
Along pre-determined pedestrian flows	To understand where people are more likely to walk and subsequently require more detailed directions	Clear Intuitive
At consistent and predictable locations	So that users do not need to actively look for signage	Intuitive
Along long passages	For reassurance that users are going in the correct direction	Intuitive
Exclusion zone around signs	Protect from visual clutter	Clear
Appropriate placing of signs	To avoid clustering of signage leading to confusion	Clear

Principles for design of the way finding signage

Principle	**Description**	**Fulfilled Fundamental**
Concise and consistent	To use of simple language to avoid confusion	Concise
Avoid visual clutter	To use of easy-to-understand icons and pictograms	Clear Concise

Effective and intuitive communication	To avoid lengthy labels	Clear Concise
Well-structured and organised	To have proper categorisation of information	Clear Concise
Standardised nomenclature	To adopt a fixed system of naming	Clear Intuitive
Multilingual signage	To avoid misunderstandings due to inability to read signs	Clear
Reinforcement and reassurance	To use the same design for peace of mind	Clear Intuitive
Colour coding	For better differentiation of zones and types of information	Intuitive

C. Types of Wayfinding Signs

Each type of sign is unique in its usage and meaning, even though they are all common in their aim at pointing users to their desired destination and to achieve a walk, cycle, ride-friendly environment. In total, there are four types of signs: identity, directional, informational, and confirmation. These four types shall be clearly indicated on submitted plans to ensure clarity.

Identity

The purpose of identity signs is to enable users to know their exact location the moment they see the sign. These signs shall all be designed in the same design language for quicker and more precise identification.

Identity signs are not solely to identify buildings, but also various amenities within the building such as zones, key businesses, entrances, rooms, departments, activities/usage, and ancillary amenities. Identity signs may also relate to the branding of places, and shall be sensitive to colour scheme, typeface and graphical layout (refer to Figure D.1).

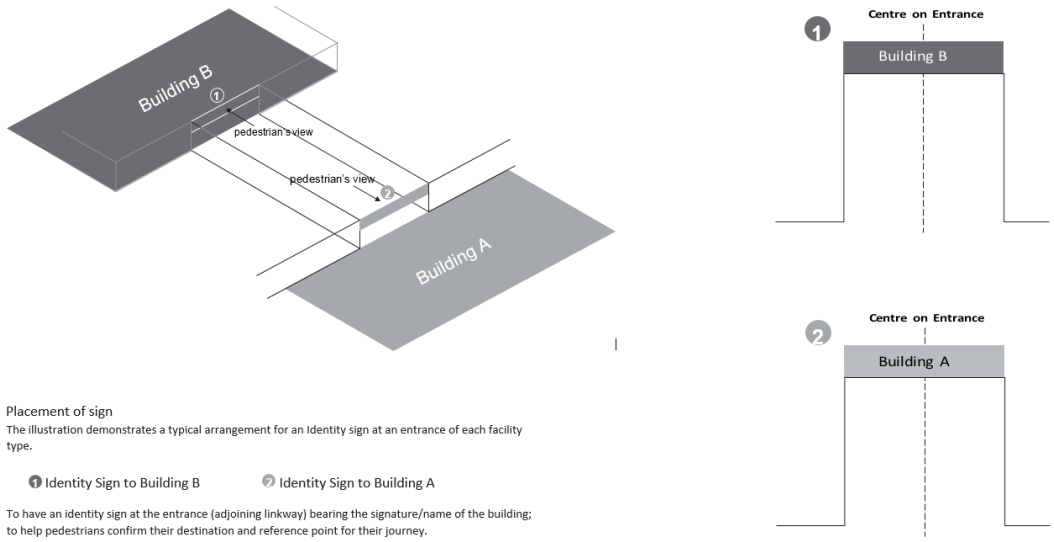


Figure D.1 – Identity Signage

Directional

Directional signs provide users with the guidance required to lead them to transport nodes, bicycle parking and other related facilities, and their desired destination. Such signage may take the form of overhead signboards, finger-posts, wall mounted signboards, among others. Since the purpose of this type of signage is to provide directions to people, it is vital to keep information simple and easy to read. It shall also stand out from the environment and be easily recognisable while also harmonizing with the same design language as the rest of the wayfinding system.

Due care shall also be taken while determining the placement of directional signs as well. Such signs shall be placed where a user intending to go to a certain location will look to for directions, such as junctions, such as along long passages or at turnings. Well placed directional signage will greatly enhance a user experience as part of a larger holistic wayfinding framework (see Figure D.2).

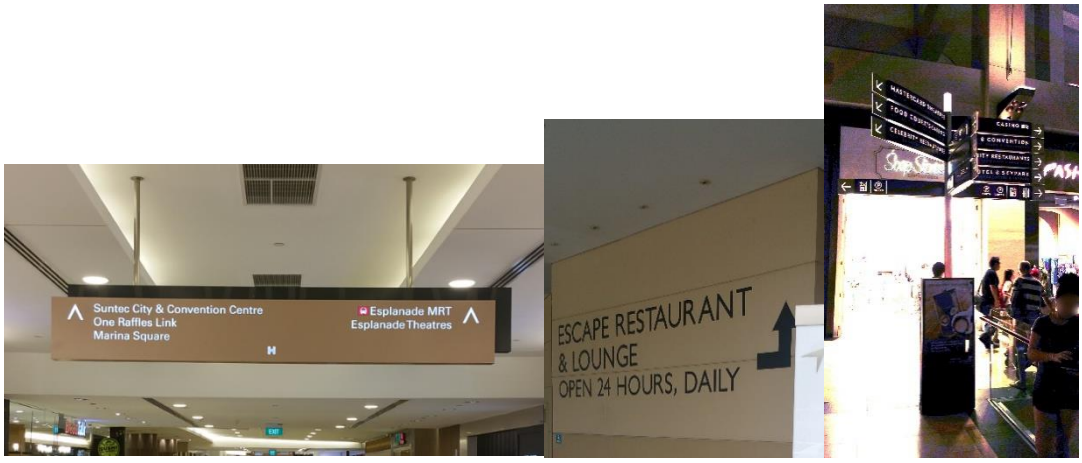


Figure D2 – Directional Signage

Informational

Information signs are a supplementary system that display any necessary information regarding building activity and tenants. This shall take the form of layout maps, plans and floor directories recommended to be placed at entrances, lobbies, atria, and any points within the development where users stop and congregate. Ancillary amenities, such as vertical circulation, critical links (sky bridges, underpasses, etc), and cycling facilities (bicycle parking and end-of-trip facilities) shall also be displayed (refer to Figure D.3).

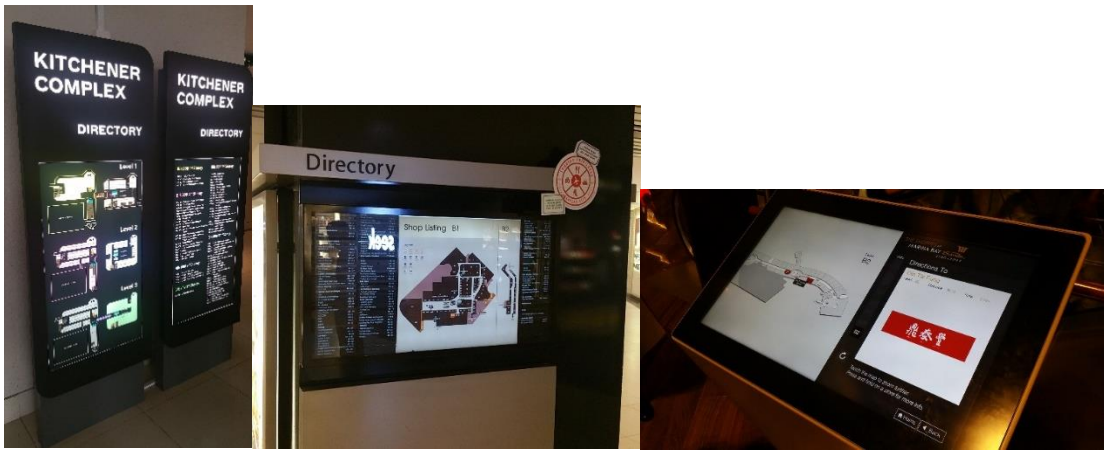


Figure D.3 – Informational Signage

Generally, these maps shall be designed for easy updating whenever there are new additions within the development, and take a heads-up approach so that users will not need to mentally re-orientate themselves. A “you-are-here” marking shall also be provided such that users can quickly and intuitively find their location on the map.

Confirmation

Signs along a significantly long route shall be repeated at an interval that allows predictability (between 20m-30m indoors and 50-100m outdoors depending on the straightness and distractions along the path), serving to remind users that they are still moving along the correct path, until the presence of another decision-making point, where directional signage and information signage will take over. Confirmation and repeater signs need not be newly designed, but could instead follow the same design as a directional sign for ease of integration with the whole wayfinding system, but the information on these signs shall reflect its nature as a confirmation or repeater sign (see Figure D.4).

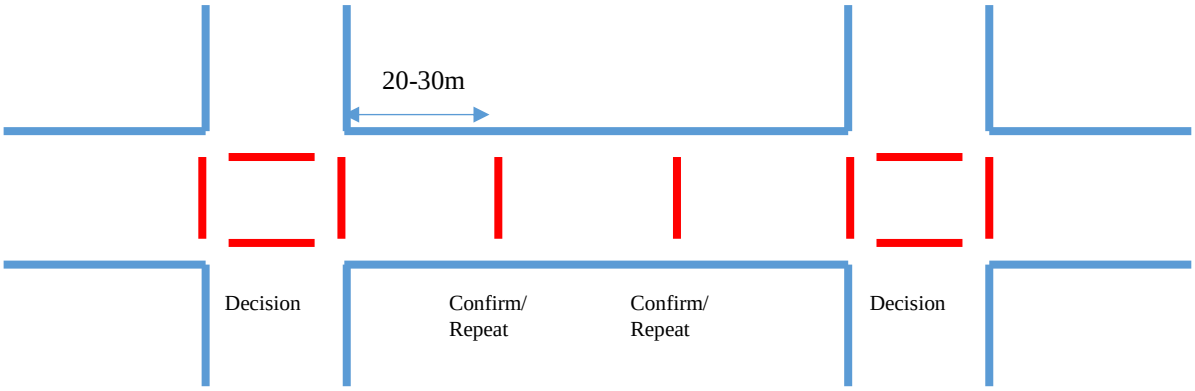


Figure D.4 – Confirmation/Repeater Signage

D. Other Design considerations for wayfinding system design

Developments with nearby Key Transport Nodes (MRT stations, Bus Interchanges and bus stops)

For developments within 400m of an MRT station and Bus interchange, and 50m from bus stop, developments are strongly recommended to provide a signs directing commuters to these key transport nodes, including underpasses, overhead-bridges and walkways, facilitating increased footfall to the development. The wayfinding signage for the key transport nodes may be integrated with the signage of the development, according to the guidelines provided above. However, the information depicting the key transport nodes shall remain clearly identifiable using standard transit pictograms and associated text messages. These signs shall be designed to be very prominent.

Proper clear signage shall be provided at the entrances/exits and linkages to the development from key transport nodes identifying and indicating the access to these facilities. Where the existing entrance of the transit facility is modified or subsumed, identification of the transit facility at the interface shall be addressed with signage in accordance with the LTA's transit signage guidelines. For developments located new

stations which are not yet open, provisions shall be made for wayfinding signage within these developments to be updated when these stations are open in the future.

These signs shall be included on submitted plans, showing the proposed artwork as well as information provided. Drawing notation shall clearly indicate direction of signage placement for evaluation.

Wayfinding provision for inter-development linkage

Developments are to ensure that there are adequate wayfinding signs provided along the main circulation corridor to lead users between linked developments, as well as to key transport nodes not immediately apparent (see Figure D.5).

In the event that any known adjacent connecting development has not yet been constructed, due consideration is required such that wayfinding signage can be easily updated to reflect connecting developments upon completion. This allows users to better navigate their surroundings especially in an environment where it is difficult for users to find their bearings.

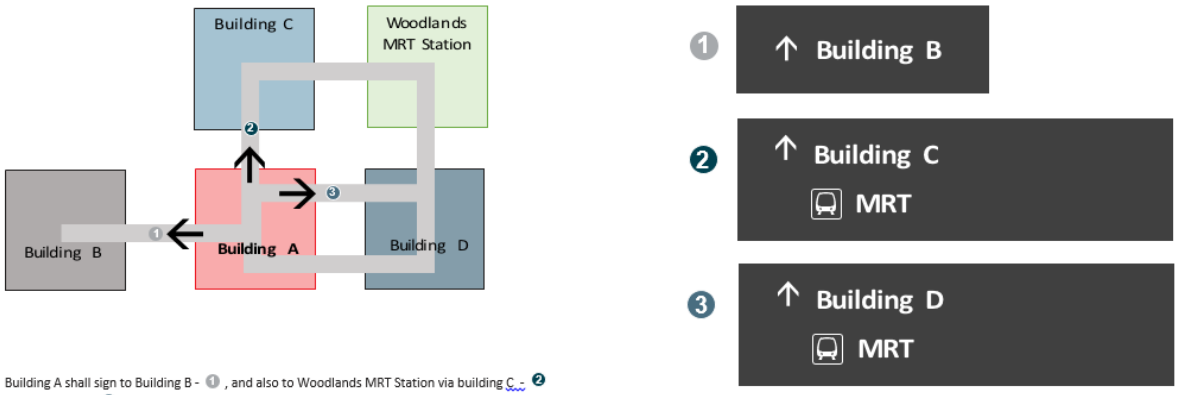


Figure D.5 – Inter-Development Linkage

Signage Design

Signs shall be easily readable from a distance away, with good colour contrast and typography. For easy identification of common facilities such as bicycle parking and EOT facilities, commonly used iconography shall be used (such as a P with a bicycle logo for bicycle parking). Please refer to Singapore Standard 599: Guide for Wayfinding Signage in Public Areas (SS599: 2014) for more detailed physical design consideration for wayfinding signage. Developments are encouraged to comply with SS599 to ensure that the wayfinding design is user friendly. Signage Design shall also be submitted as part of WCP submission.

E. Building Design Strategies to support wayfinding within development

Designing a wayfinding system shall go in tandem with the design of the development. By properly laying the ground work during the building design stage, the whole system will look and feel more intuitive and natural. The number of signs that will need to be put up at later stages will decrease as well.

Below are some possible development design strategies that designers may wish to consider during the building design phase which may assist in designing a wayfinding system later. This list is not exhaustive and designers are encouraged to exercise their creativity in coming up with new and innovative strategies.

Providing an identity for arrival nodes/entrances, zoning of space

Having clear identification of zones provides users with a sense of location and hierarchy which enables users to form a mental map of the development. Integrating easy to remember names and graphics into the overall wayfinding system will also allow users to have a sense of what comes next. Designers may consider the adoption of sculptures, fountains, meeting points, atria and other types of landmarks in the creation of such an identity (refer to figure D.6).

Figure D.6 – Zoning and Identity using colours and icons

Clear and easy to identify decision-making points

By first identifying where the main pedestrian flow is located, decision making points can be easily identified and placed at nodes along this pedestrian flow for users to stop and find their bearings. Decision-making points are usually located at large cross junctions or areas of vertical circulation. These decision-making points shall be easily distinguishable from one another to avoid getting users lost.

At key decision-making points, a concierge, be it in the form of interactive directory or a helpdesk could be placed for users to seek help.

Material treatment of main pedestrian circulation path

Designers may adopt a different material or colour treatment for the main pedestrian circulation path to differentiate it from other paths. This allows users to instinctively find their way back to the main pedestrian flow shall they stray away from it, and for users to follow the path without the need for too many signs. This differential treatment shall follow through if the main circulation flow is split across several stories.

Branding and naming of key pedestrian routes

The naming of pedestrian routes to suit the usage will serve to leave users with a deeper impression of the path taken, such that the path can become a landmark in and of itself, and people will instinctively recognise it by name. Local examples include JWalk.

ANNEX E – Guide for Bicycle Parking and Related Facilities

In the design of bicycle parking lots and its related facilities, the designer shall ensure that the facilities provided are convenient, accessible and user-friendly. This guide serves to include good practices for the designing of bicycle parking and related facilities with the objective of meeting cyclist needs and therefore encouraging proper use of the facilities.

As part of WCP, the development shall submit a Bicycle parking and End-of-Trip Facility Plan to demonstrate a that good design considerations are given in placing and designing the bicycle parking and End-of-Trip facilities, details of the submission requirement can be found in Annex B Part (4).

A. Providing bicycle parking spaces within the development

Shortage of bicycle parking spaces will lead to indiscriminate bicycle parking in the development vicinity. This may lead to an unpleasant streetscapes and blockage of the pedestrian route. Developers are now required to provide adequate bicycle parking spaces for building users (Figure E.1) based on the mandatory provision requirement prescribed in Table 1 below.

Figure E.1 – Sample for Bicycle Parking Racks

Table 1: Mandatory provision requirement for bicycle parking lots

<table>
<tr><th>Proposed use</th><th>Developments located within Zone 1 and Zone 2[13]</th><th>Developments located within Zone 3.</th></tr>
<tr><td rowspan="2">Residential
1. Residential developments
2. Retirement housing</td><td>1 bicycle parking space for every 4 dwelling units</td><td>1 bicycle parking space for every 6 dwelling units</td></tr>
<tr><td rowspan="10">Commercial
3. Cinema, theatre and concert hall
4. Shops and departmental stores
5. Offices
6. Restaurants, night-clubs, coffeehouses, bars, cafeterias, eating-houses and canteens
7. Convention and exhibition halls
Hotel
8. Hotel
9. Boarding houses and hostels14
Industrial
10. Factories
11. Business park, science park, computer software development, distribution services, printing, publishing and allied industries and other Business 1 developments
12. Petroleum, petrochemical, chemical and related industries on Jurong Island[15]
Health & Medical Care
13. Nursing homes
14. Clinic, pharmacies, hospitals and other healthcare institutions
Place of Worship
15. Churches, mosques, temples, any place of worship and other religious and related institutions</td><td colspan="2">a) When 1,000m^2 =< Development GFA =< 3,000m^2</td></tr>
<tr><td>15 bicycle parking spaces</td><td>10 bicycle parking spaces</td></tr>
<tr><td colspan="2">b) When 3,000m^2 < Development GFA =< 15,000m^2</td></tr>
<tr><td>1 bicycle parking space for every 200m^2 of floor area</td><td>1 bicycle parking space for every 300m^2 of floor area</td></tr>
<tr><td colspan="2">c) When 15,000m^2 < Development GFA</td></tr>
<tr><td>1 bicycle parking space for every 200m^2 of floor area, for floor area up to 15,000 m^2, and 1 bicycle parking space for every subsequent 600m^2 of floor area, for floor area in excess of 15,000m^2</td><td>1 bicycle parking space for every 300m^2 of floor area, for floor area up to 15,000 m^2, and 1 bicycle parking space for every subsequent 1,000m^2 of floor area, for floor area in excess of 15,000m^2</td></tr>
<tr><td rowspan="6">Sports & Recreation
16. Sports complex, tennis, squash, badminton, sepak takraw courts, soccer, baseball pitches, bowling alley, swimming pool, ice/roller skating rink, recreational clubs, golf range and other sports and recreation facilities
Civic & Community Institution</td><td colspan="2">a) When 1,000m^2 =< Development GFA =< 3,000m^2</td></tr>
<tr><td>30 bicycle parking spaces</td><td>20 bicycle parking spaces</td></tr>
<tr><td colspan="2">b) When 3,000m^2 < Development GFA =< 15,000m^2</td></tr>
<tr><td>1 bicycle parking space for every 100m^2 of floor space</td><td>1 bicycle parking space for every 150m^2 of floor space</td></tr>
<tr><td colspan="2">c) When 15,000m^2 < Development GFA</td></tr>
</table>

[13] Refer to Zonal Car Parking requirement in Code of Practice Vehicle Parking Provision in Development Proposals for the definition of Zone 1, 2 and 3, via the link below:
https://www.lta.gov.sg/content/dam/ltaweb/corp/Industry/files/parking_zones.PDF

[14] The bicycle parking provision standards apply to Backpackers' Hostels; student hostels are akin to Residential use.

[15] The bicycle parking provision requirement for petroleum, petrochemical, chemical and related industries on Jurong Island is based on office floor area.

Proposed use	Developments located within Zone 1 and Zone 2[13]	Developments located within Zone 3.
17. Community centres, community clubs, welfare houses and other cultural and social welfare institutions 18. Foreign workers' dormitories[16]	1 bicycle parking space for every 100m^2 of floor area, for floor area up to 15,000 m^2 and 1 bicycle parking space for every subsequent 300m^2 of floor area, for floor area in excess of 15,000m^2	1 bicycle parking space for every 150m^2 of floor area, for floor area up to 15,000 m^2 and 1 bicycle parking space for every subsequent 500m^2 of floor area, for floor area in excess of 15,000m^2

B. Creating convenient bicycle parking spaces – Long term and Short term parking

Bicycle spaces shall be located at visible and convenient spots, taking into consideration the alignment of the cycling paths in the vicinity. If there are constraints that prevent all the bicycle lots from being consolidated in one location, the QP can propose more than one bicycle parking location. However, the bicycle lots shall not be scattered throughout the development in an ad-hoc manner and shall be ideally concentrated in no more than 2 to 3 areas depending on the development size and needs. The lots shall be well-organised and each bicycle parking area shall accommodate at least 10 bicycle parking lots.

The designer shall also consider whether the bicycle parking spaces are intended for short or long-term parking. Workers, tenants or occupants of a building who are likely to park long-term will require secured and sheltered parking. Visitors and customers who usually park for a shorter period and will require convenient parking location. The short term bicycle parking shall be provided at first story of the development with high visibility and accessibility by the public, while the long term bicycle parking can be provided at any level of the developments, accessible by clearly designed internal cycling routes to ensure safety of the cyclist when accessing the long term bicycle parking lots. Long term and short term bicycle parking quantum requirement can be found in Table 2 below.

For a multi-blocks development, sufficient bicycle parking spaces shall be provided at the individual blocks to serve the respective users in the development where possible. It is recommended that the bicycle parking provision per block be proportional to its respective blocks GFA.

[16] The bicycle parking requirements will also apply to Foreign Workers' Dormitories located on industrial sites.

Table 2: Recommended ratio for provision of long term and short term bicycle parking

Type	Use	Type of bicycle parking spaces	
		Short-term bicycle parking	**Long-term bicycle parking**
1	Residential 1. Residential developments 2. Retirement housing Commercial 3. Offices Hotel 4. Hotel 5. Boarding houses and hostels Industrial 6. Factories 7. Business park, science park, computer software development, distribution services, printing, publishing and allied industries and other Business 1 developments 8. Petroleum, petrochemical, chemical and related industries on Jurong Island[17] Civic & Community Institution 9. Foreign Workers' Dormitories[18]	20%	80%
2	Commercial 1. Cinema, theatre and concert hall 2. Shops and departmental stores 3. Restaurants, night-clubs, coffeehouses, bars, cafeterias, eating-houses and canteens 4. Convention and exhibition halls Health & Medical Care 5. Nursing homes 6. Clinic, pharmacies, hospitals and other healthcare institutions Civic & Community Institution 7. Community centres, community clubs, welfare houses and other cultural and social welfare institutions Place of Worship 8. Churches, mosques, temples, any place of worship and other religious and related institutions recreational facilities Sports & Recreation 9. Sports complex, tennis, squash, badminton, sepak takraw courts, soccer, baseball pitches, bowling alley, swimming pool, ice/roller skating rink, recreational clubs, golf range and other sports and recreation facilities	60%	40%

[17] The bicycle parking provision requirement for petroleum, petrochemical, chemical and related industries on Jurong Island is based on office floor area.
[18] The bicycle parking requirements will also apply to Foreign Workers' Dormitories located on industrial sites.

C. User friendly design for bicycle parking rack and its circulation space

A bicycle parking rack shall be provided for each bicycle parking space and anchored to the ground so as to allow cyclist to lock their bicycles with ease. The rack shall support the bicycle upright by its frame. Designers shall design for adequate clearance for users to lock/unlock their bicycles onto/from the racks and to push the bicycle in and out of the racks. It is also recommended to provide the minimum aisle width for user to manoeuvre their bicycles when parking. The following are suggested designs and dimensions that designers can adopt for bicycle parking racks.

<u>Single-tier bicycle parking lot</u>
Lot Width: 600mm
Lot Length: 1800mm
Aisle Width: 1500mm (min)

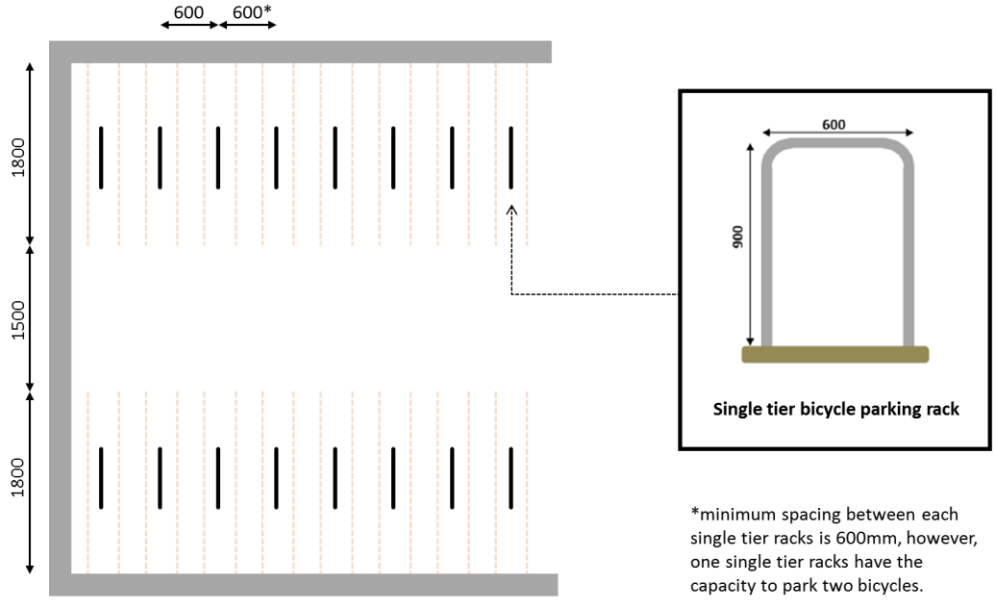


Figure E.2–layout for single tier bicycle parking rack

Double Tier Bicycle Parking lots
Lot Width: 650mm
Lot Length: 2000mm
Aisle Width: 2500mm (min)

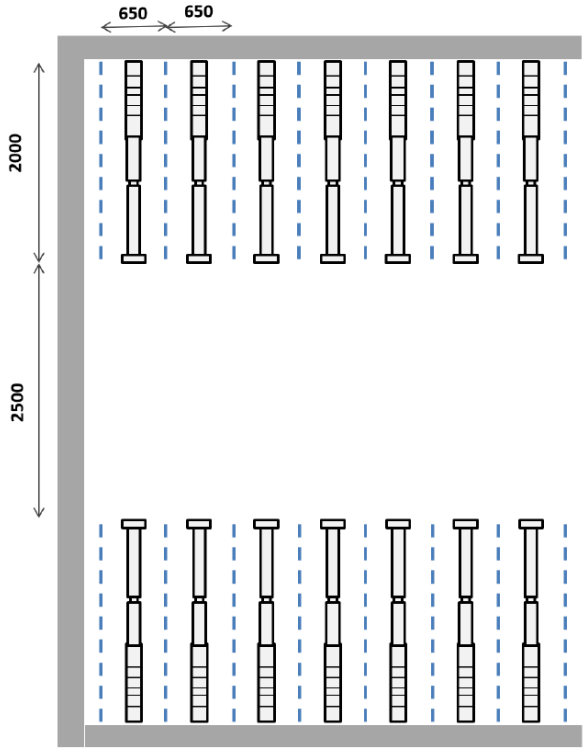


Figure E.3 – Layout for double tier bicycle parking lots

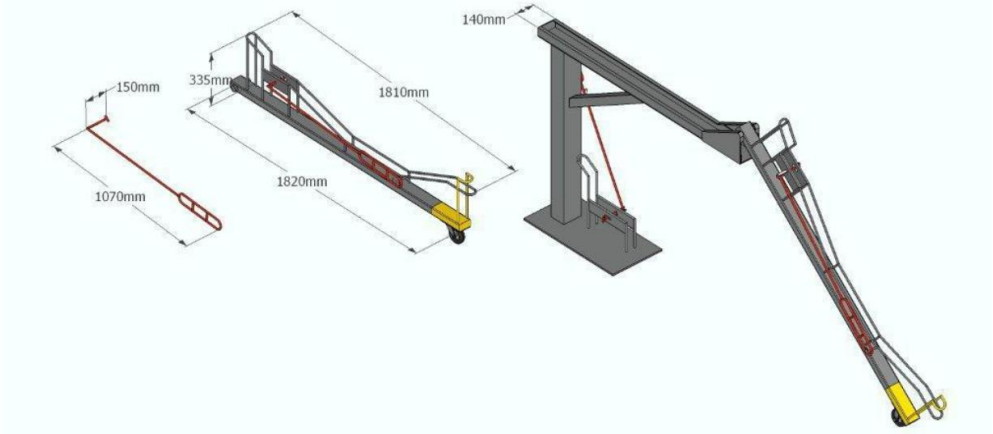


Figure E.4 – Design of double tier bicycle parking lots

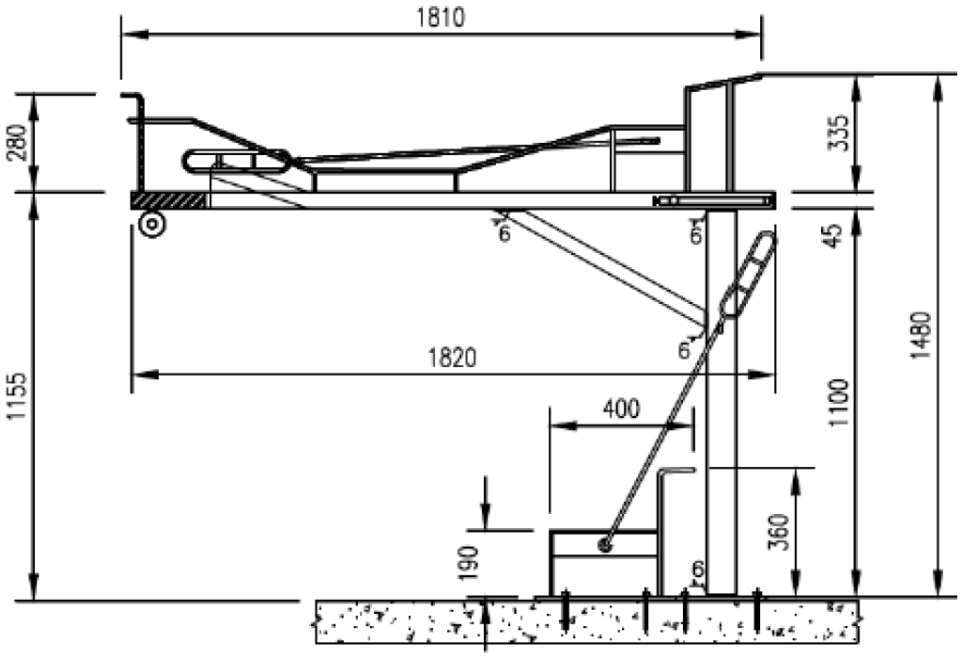


Figure E.5 – Dimension of double tier bicycle parking lots

D. Provision of complementary end-of-trip facilities:

Complementary EOT facilities provide a convenient and comfortable cycling experience for visitors. Therefore, to improve the viability of cycling as a mode of transport, designers are encouraged to provide supporting facilities in close proximity to the bicycle parking spaces (especially for long-term bicycle parking). For large development with several building blocks, each block shall ideally have its own supporting facilities to serve the users of the block. Developers/owners/building management committee may consider providing following facilities within their development:

- Sheltered bicycle parking spaces
- Shower facilities
- Lockers
- Changing Room
- Bicycle repair station
- Security such as CCTV
- Air pump

Recommended provision guideline of the facilities is shown in Table 3 below:

Table 3: Recommended provision guideline of End-of-Trip facilities

Uses	Shower	Locker	Toilet	Other facilities
Residential 1. Residential developments 2. Retirement housing Civic & Community Institution 3. Foreign workers' dormitories Sports & Recreation 4. Sports complex, tennis, squash, badminton, sepak takraw courts, soccer, baseball pitches, bowling alley, swimming pool, ice/roller skating rink, recreational clubs, golf range and other sports and recreation facilities	Not Applicable	Not Applicable	Not applicable	Not Applicable
Commercial 5. Cinema, theatre and concert hall 6. Shops and departmental stores 7. Offices 8. Restaurants, night-clubs, coffeehouses, bars, cafeterias, eating-houses and canteens 9. Convention and exhibition halls Hotel 10. Hotel 11. Boarding houses and hostels Industrial 12. Factories 13. Business park, science park, computer software development, distribution services, printing, publishing and allied industries and other Business 1 developments 14. Petroleum, petrochemical, chemical and related industries on Jurong Island Health & Medical Care 15. Nursing homes 16. Clinic, pharmacies, hospitals and other healthcare institutions, Civic & Community Institution 17. Community centres, community clubs, welfare houses and other cultural and social welfare institutions Place of Worship 18. Churches, mosques, temples, any place of worship and other religious and related institutions	1 shower stall per 10 bicycle lots	5 personal lockers per 6 bicycle lots 1 PMD locker[19] per 6 bicycle lots	1 toilet per cluster	≤4 m2 per 10 bicycle lots (e.g. bicycle repair station, changing room, fresh towel station)

[19] PMD lockers should at least be large enough to accommodate a typical Electric / Kick Scooter, along with personal belongings.

All toilet and shower facilities shall be above National Environment Agency's minimum requirements and comply to Building and Construction Authority's Code on Accessibility in the build environment 2013:
www.bca.gov.sg/BarrierFree/others/accessibility_code_2013.pdf

The developer/owner/ building management committee shall be responsible for the operation and maintenance of the bicycle parking lots and other related facilities at all times.

E. User-friendly access point from outside of development to bike parking and end-of-trip facilities

The access point(s) for cyclist shall be designed to be safe, convenient and user-friendly. If the access is via a ramp, it shall be a dedicated ramp protected with railing, and shall follow anti-skid requirement for footpath (45BPN). The gradient of the ramp is recommended to be 1:25. Routes to bicycle parking spaces shall be separated from vehicular ramps. If this is not possible, cyclist shall be allowed to use passenger lifts. The lift shall be able to accommodate at least one horizontally standing bicycle. The recommended dimensions for the lift shall be 2m x 2m and a minimum of 1.6m x 1.55m if there are alternative routes such as separate bicycle ramps or wheeling ramps available to the bicycle parking and End-of-Trip locations. The door access to the lift lobby shall be automated to facilitate easy access for users with bicycles. If the access is via staircase, wheeling ramp is to be provided along the stair case and ensure width of the stair case is sufficient for both pedestrian and cyclist.

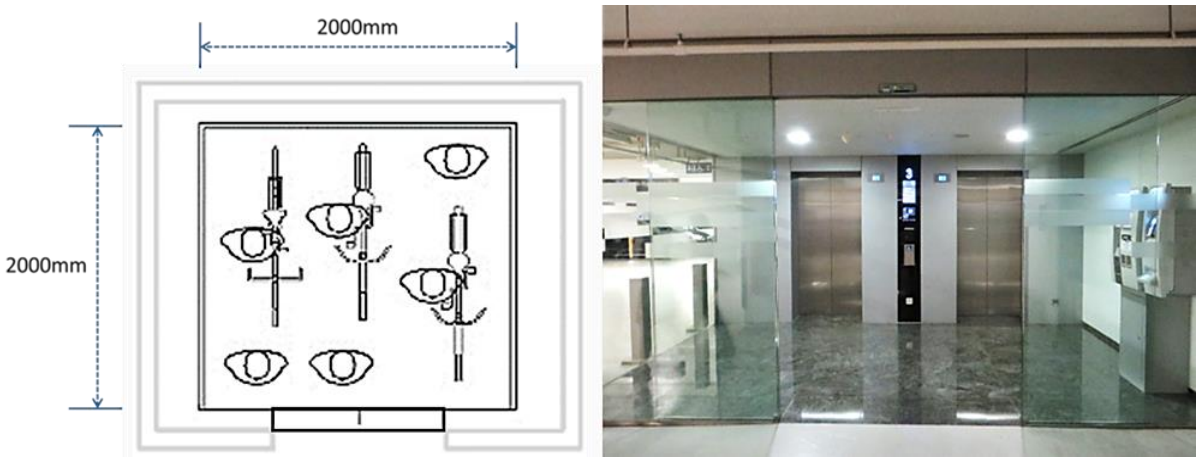


Figure E.6 – Plan View of the Recommended Lift size to Accommodate 3 Bicycles and 3 to 4 Standing Persons and Automated Door for Easy Access by User with Bicycle

F. Creating safe bicycle parking spaces and End-of-Trip facilities

Designers shall take into consideration the vehicle and pedestrian movements when determining the location for the bicycle parking spaces and EOT facilities. The bicycle parking spaces and EOT facilities within the development shall be away from the major

vehicle and pedestrian movements to avoid conflict with the other users as mentioned in Annex C. The routes to bicycle parking areas and EOT facilities shall be carefully considered in the overall design of the development. Designers, as far as possible, shall avoid using vehicular ingress and egress for cyclist access to bicycle parking spaces and end-of-trip facilities. Markings and warning signage that indicate cyclist presence shall be provided when there is inevitable conflict between vehicular and cyclist movements (see Figure E.7).

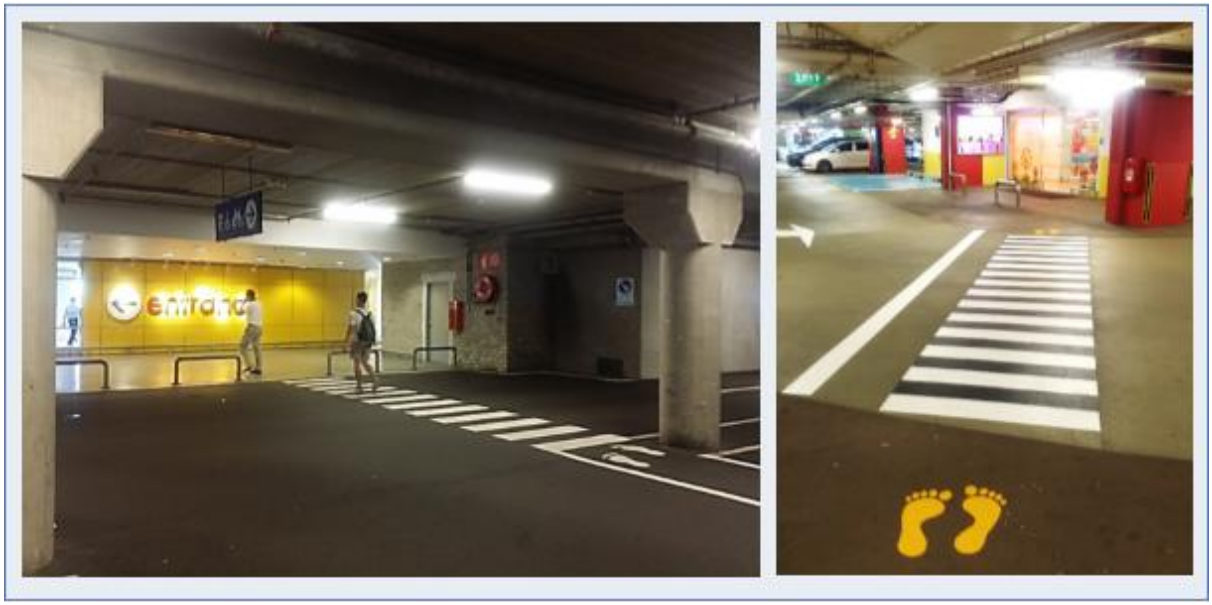


Figure E.7 – Traffic Mitigating Measures at Vehicular, Cyclist and Pedestrian Conflict

When the cyclist is using the internal vehicular driveway to access the bicycle parking and end-of-trip facilities, clearly demarcated lane for dedicated pedestrian and cyclist use is highly recommended to avoid potential collision between cyclist and vehicular users (refer to Figure E.8)

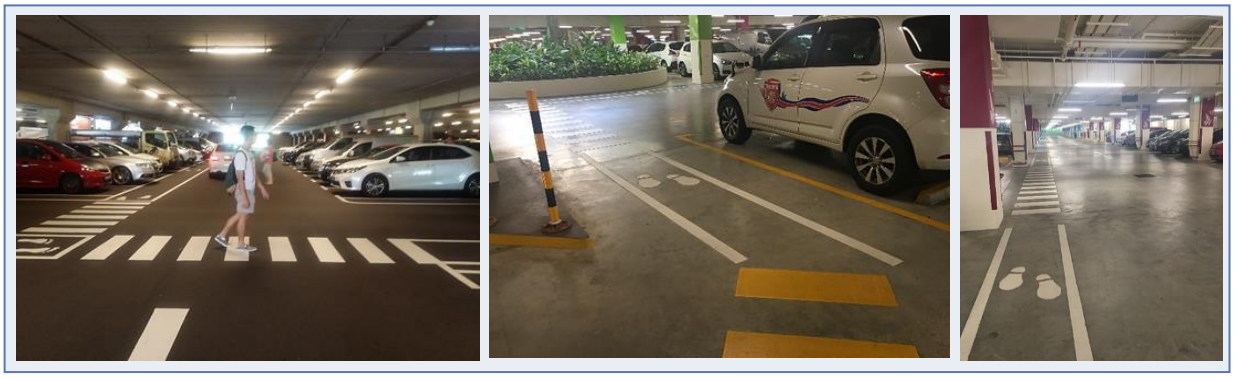
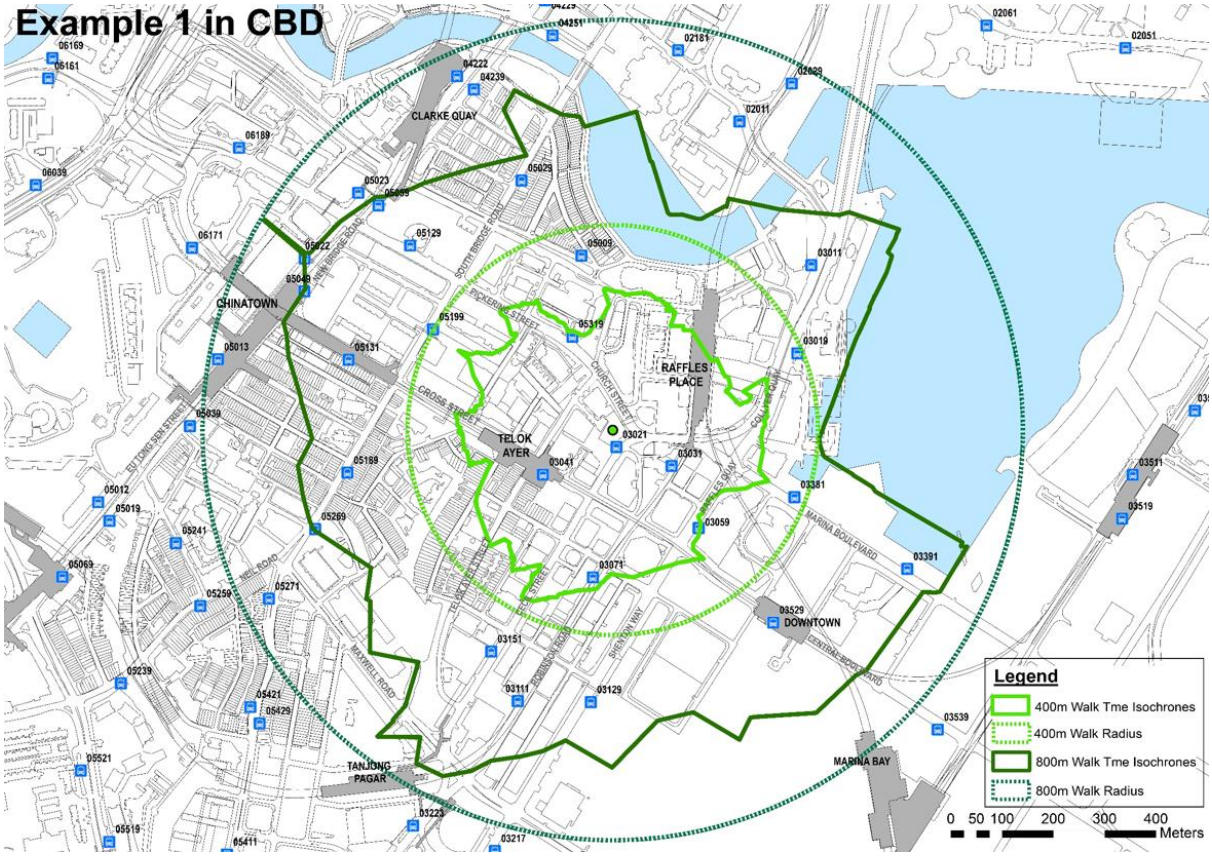
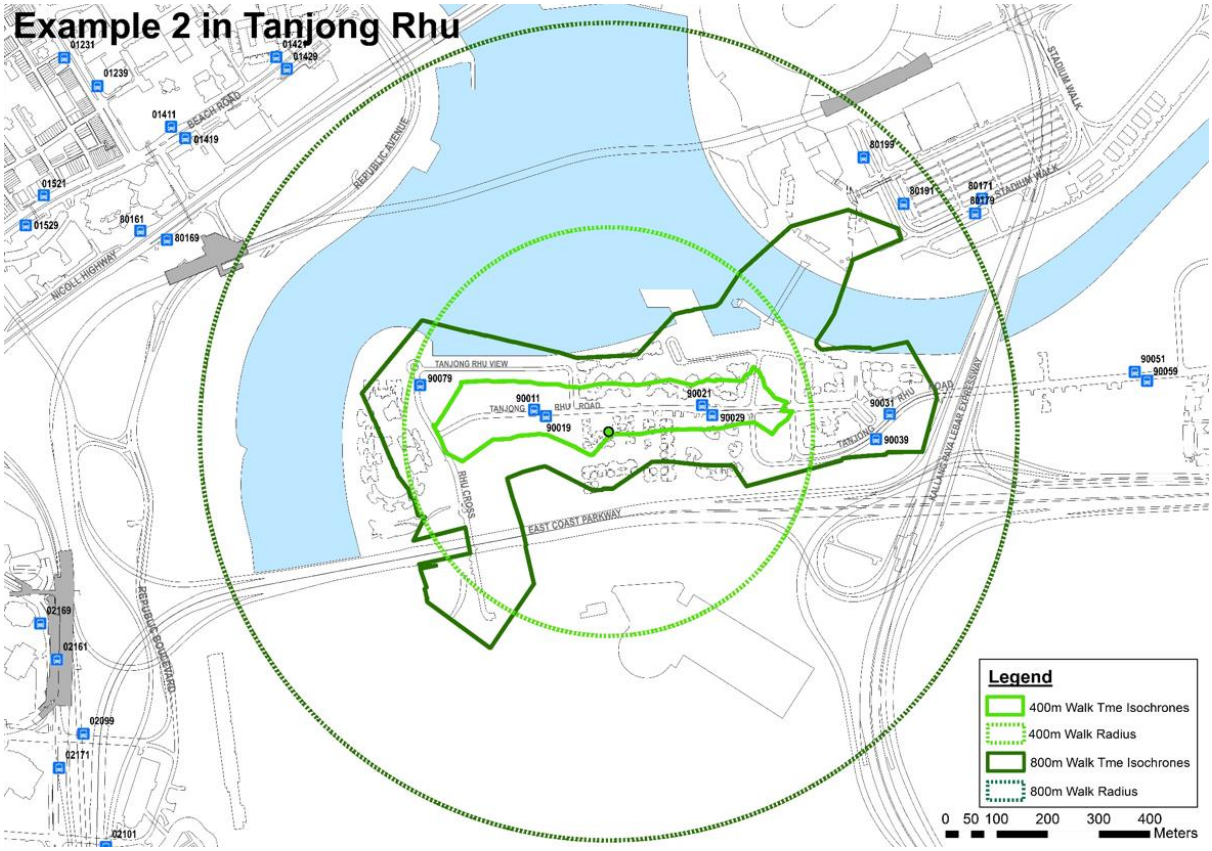


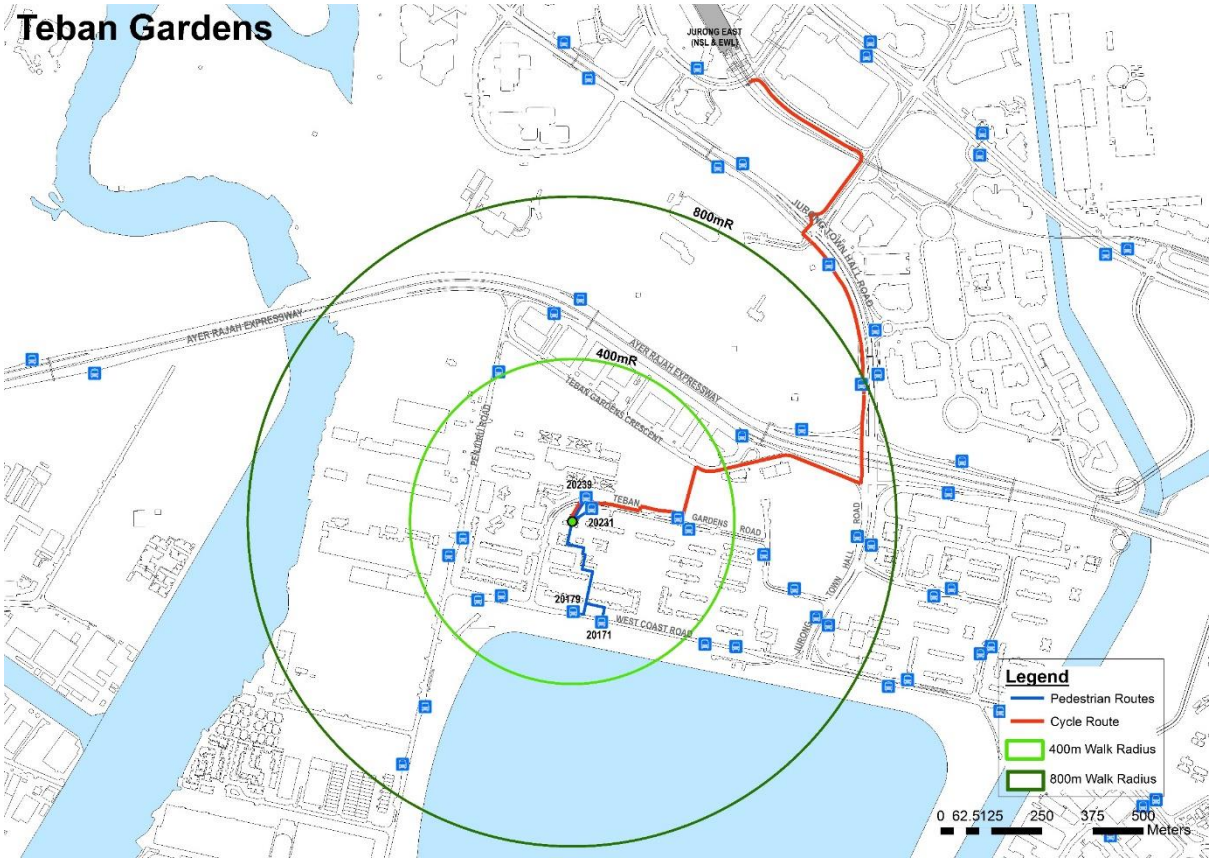
Figure E.8 – Providing Demarcated Lane for Pedestrian and Cyclist

ANNEX F – Examples of Walk Radius and Indicative Walk Time Isochrones





ANNEX G – Example of Pedestrian and Cycle Routes to Nearby PT Access Points



ANNEX H – PTAL Calculation Methodology

LTA has adopted the London's PTAL methodology from Transport for London (and adapted it to suit local circumstances) to objectively assess the public transport accessibility level of proposed development in a consistent manner.

This ANNEX draws heavily on TfL's Assessing Transport Connectivity in London (2015) as this document is a recent, practical and succinct guidance on connectivity assessments.

To calculate PTAL values, the following data/information is required:

(1) A walking network in the vicinity (up to 800m walking distance) of the point of interest (POI). This is to calculate the walk time from the POI to all relevant PT Service Access Points (SAPs), i.e. bus stops and MRT/LRT station entrances

(2) Location of all relevant SAPs (within 400m for bus stops or LRT entrances, and 800m for MRT entrances) walking distances from the POI)

(3) Service frequency of all PT services at the relevant SAPs

The full calculation method for a single location is described below (this needs to be repeated when PTAL is calculated for multiple points):

Step 1 – Calculate **Walking Times (WT)** to all relevant SAPs

- The walking network includes all paved walk paths, including footpaths, alleys, pedestrian crossings, pedestrian overhead bridges (POBs), underpasses, through routes within private/public properties which allow public access during daytime, etc.
- Maximum walking distances to a bus stop/LRT station entrance and a MRT station entrance are assumed up to 400m (5mins) and 800m (10mins), respectively.

Step 2 – Calculate **Service Waiting Time (SWT)** for each service at each relevant SAPs

- The standard PTAL calculation is based on service headway/frequencies during the AM peak, typically between 0800hr and 0900hr on a weekday. [20]
- Service headway can be downloaded from this website: https://www.transitlink.com.sg/TIdetail.aspx?ty=catart&Id=15

[20] AM peak is the basic requirement for all PTAL assessments. Developers may be requested to undertake PTAL assessments for additional time periods (e.g. interpeak, PM peak or off-peak) if their developments have a peak trip generation period outside of the AM peak.

- The SWT (in minutes) is estimated as half the time interval between scheduled arrivals of the service at the SAP, i.e. SWT = 0.5 x (60/frequency). For example, a bus service with a frequency of 12 buses per hour will have an interval of 5mins and a SWT of 2.5mins, which is the average amount of time a passenger who arrives randomly will have to wait.
- If a single route has several stops in the catchment area of a point, only the nearest is considered.
- If a service runs in both directions, the nearer direction should be used in the calculation, i.e. each bus service and rail line should only be considered once, regardless of direction.

Step 3 – Calculate **Average Waiting Times (AWT)** for each service at each relevant SAP

- The AWT (in minutes) is a combination of the SWT and a modal preference value (a time penalty). The latter varies by mode of transport, and reflects the preference of commuters for MRT/LRT over bus.
- LTA recommends modal preference value of 1.5mins and 0.83mins for buses and MRT/LRT, respectively. These values would be reviewed by LTA from time to time.

Step 4 – Calculate **Total Access Time (TAT)** for each service at each relevant SAP

- The TAT (in minutes) combines the walk time to the SAP with the AWT at the SAP, i.e. TAT = WT + AWT

Step 5 – Calculate **Equivalent Doorstep Frequency (EDF)** for each service at each relevant SAPs

- The EDF (services per hour) converts the TAT back into units of frequency, i.e. EDF = 0.5 x (60/TAT). It is a measure of what the service frequency would be like if the service was available without any walk time (as if the services are provided at the doorstep).

Step 6 – Calculate **Access Index (AI)** for each service and Sum of AI for the POI

- Individual AI is calculated by adjusting the corresponding EDF value, i.e. a higher weight (a factor of 1) will be given to the service with the highest EDF for each SAP, and a lower weight (a factor of 0.5) to all other services within the same SAP, before adding them together to get total AI.
- Halving the EDF values for all but the most accessible or dominant route for each SAP compensates for such factors as 1) routes often travel in parallel for some distance, and 2) travellers often have to change routes in order to reach the desired destination – this can add significant delays to the journey.

Step 7 – Convert to a **PTAL Score**

- The sum of AI is converted to PTAL using the bands specified in the following table[21]:

PTAL Score	Access Index (AI) Range	
0 (worst)	0.00	
1a	0.01	2.50
1b	2.51	5.00
2	5.01	10.00
3	10.01	15.00
4	15.01	20.00
5	20.01	25.00
6	25.01	40.00
7	40.01	55.00
8	55.01	70.00
9 (best)	> 70.00	

[21] The bands are subject to further review by the LTA.

ANNEX I – Transport Improvement Measures

As specified in Section 6 of this Document, Consultant is required to duly complete the table below and submit it as part of the TIA report.

Table I.1 – Transport Improvement Measures

Measures	**Implementing**	**Explanation if not implementing**
Walking & Cycling Provision within the Development		
M1 – Access Consideration *Improve accessibility for non-car users and the disabled.*	☐	
M2 – Design Integration *Walking and cycling friendly design.*	☐	
M3 – Control Measures *Lower speed limit and traffic control measures.*	☐	
M4 – Safety of Pedestrian *Make walking safer.*	☐	
M5 – Way Finding for Pedestrian *Maps to nearby amenities.*	☐	
M6 – Bicycle Parking *Parking space beyond minimum standard.*	☐	
M7 – Bicycle Parking for different users *Short/long term parking facilities.*	☐	
M8 – Facilities for cyclist *End-of-trip facilities.*	☐	
M9 – Bicycle Friendly Access *Auto-door, cyclist ramps, lifts, etc.*	☐	
M10 – Dedicated Bicycle Routing	☐	

Measures	Implementing	Explanation if not implementing
Demarcate cycling paths and link them to surrounding cycling paths.		
M11 – Signage for Cyclist *Clear signage to guide cyclists.*	☐	
Walking & Cycling Provision surrounding the Development		
M12 – Connectivity for Pedestrian *Pedestrian links to existing walking routes.*	☐	
M13 – Priority for Pedestrian *Give priority to pedestrian*	☐	
M14 – Accessibility for Non-car Users *Safe crossing points for cyclists.*	☐	
M15 – Safe Connectivity *Proper demarcation and lighting of pedestrian and cycling paths.*	☐	
M16 – Cycling at Crossings *Safe crossing points for cyclists.*	☐	
M17 – Cycling Route Maps *Map of cycling routes in the local area.*	☐	
M18 – Place Making *Place making environment within development ground level.*	☐	
M19 – Share Space Design *Designed to create shared space.*	☐	
Mass Transport		
M20 – Private Shuttle Bus Service	☐	

Measures	Implementing	Explanation if not implementing
Shuttle service to main Public Transport nodes.		
M21 – Educational Engagement *Engage to promote awareness on benefits of walk, cycle and ride PT.*	☐	
M22 – Facility/Service for Shoppers taking Public Transport *Centralised delivery service i.e. Urban Logistics.*	☐	
Programmes / Schemes to Promote Walk Cycle Ride		
M23 – Promote Early with Walk, Cycle and Ride *Include development's connectivity to PT and active mode facilities in marketing promotion for development.*	☐	
M24 – Engage Interest Group to Organise Courses *Conduct trainings/courses for cyclists.*	☐	
M25 – Encourage Cycling Community *Establish bicycle user group.*	☐	
M26 – Bicycle Sharing *Provide bike sharing for development.*	☐	
M27 – Events to Promote Cycling *Organise events to promote cycling.*	☐	
Demand Management		

Measures	**Implementing**	**Explanation if not implementing**
M28 – Parking Provision *Providing parking lots close to or at the lower bound of the RCPS*	☐	
M29 – Daily Season Parking *Daily flat rate charging with unlimited use of parking.*	☐	
M30 – Reduce Allocation for Season Parking *Reducing the allocation of season parking lots by a significant proportion, say, 30 to 40 percent.*	☐	
M31 – Delivery and Goods Vehicles Management *Delivery and/or goods transferring outside of the morning and evening peak period.*	☐	
M32 – Car Club *Car club scheme or partnering with one/ a few existing car club(s).*	☐	
M33 – Car Sharing Parking Allocations *Allocating favourable parking spaces for car sharing.*	☐	
M34 – Parking Charges *Increase in parking charges*	☐	
M35 – Travel Smart Scheme *Periodically convey awareness on the LTA's Travel Smart scheme.*	☐	

Measures	Implementing	Explanation if not implementing
M36 – Adjustment to Working Hour *Encouraging flexible working hours/ compressed working weeks/teleworking.*	☐	
M37 – Onsite Facilities *Provide on-site facilities for example: healthcare, childcare, shopping/home.*	☐	
M38 – Onsite Services *Provide services such as cafeteria, shops, canteen, and/or cash dispenser*	☐	
M39 – Home Delivery *Encourage tenants/companies to provide home delivery services.*	☐	
Other Measures		
M40 – Provide Charging Facility for Electric Vehicle *Provide electric vehicle charging points within the development.*	☐	
M41 – Eco-Driving Course to Promote Fuel Efficiency *Provide/arrange courses on Eco-driving.*	☐	
M42 – Road/Junction Improvements *To prioritise bus, pedestrian and cyclist movements and to meet the LTA's standard*	☐	

9. Acknowledgements

The editors would like to thank the project team, the LTA management and other officers who have contributed to this Guidelines document.

The LTA would also like to thank all participants from the industry including developers, architects, engineers and transport consultants, for their feedbacks and suggestions to enhance the Guidelines.

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