# MEMORANDUM

**DATE:** 08/24/2023
**TO:** City of Victoria / Victoria MPO
**CC:**
**FROM:** Alliance Transportation Group
**RE:** Plan Development: Facility Types

## INTRODUCTION

The ATG project team conducted a review of active transportation facility types to support the Victoria Active Transportation Master Plan (ATMP). This included identifying facility types that are appropriate within the City of Victoria and the City's Extraterritorial Jurisdiction (ETJ) boundaries. This memo reviews 16 different facility types and highlights benefits, considerations, and typical design standards. The project team appended a table providing cost estimates by facility type.

The information presented in this memorandum was conducted as a deliverable associated with **Task 4 Plan Development**. The ATG team appreciates your review and looks forward to any client feedback and questions.

# SHARED USE PATH

Shared use paths are intended to be used by both bicyclists and pedestrians. Shared use paths occupy corridors that are completely separated from streets, such as waterways, utility right of ways, greenbelts, or areas within parks.

## BENEFITS

- Highest level of comfort and safety for bicyclists and pedestrians.
- Encourages a wide variety of users.

## CONSIDERATIONS

- Appropriate for corridors along bodies of water, irrigation channels, drainage canals, utility right of ways, and existing or abandoned rail lines.
- Develop stronger linkages for pedestrians and bicyclists between park facilities and key destinations.
- Depending on the context, variations to the design/construction of a shared use path could include presence or absence of a curb edge and choice of surface materials such as crushed granite, asphalt, or concrete.

## TYPICAL DESIGN STANDARDS

- The minimum paved width for a two-directional shared use path is 10 ft with a maximum of 14 ft, but a width of 8 ft may be used for a short distance due to physical constraint.
- Pathways with heavy peak hour and/or seasonal volumes should use a centerline stripe to clarify the direction of travel and organize pathway traffic.
- Vertical clearance of obstructions should be at least 8 ft.
- Minimum separation of trails from roadways should be 5 ft.
- Path/roadway intersections should be carefully designed.

**Figure 1: Shared Use Path**

*Source: ATG*

# SIDE PATHS

Side paths are a type of shared use path but are located adjacent to a roadway. Unlike sidewalks, side paths are intended for use by both bicyclists and pedestrians and are therefore wider than traditional sidewalks. The co-location of a side path and a sidewalk may be appropriate in locations with high pedestrian traffic.

## BENEFITS

- Removes bicyclists from the roadway while keeping them connected to the overall street network.
- Encourages a wide variety of users by increasing a sense of safety and comfort.

## CONSIDERATIONS

- May connect to shared use paths that diverge from the roadway.
- Suitable for streets that have heavy traffic, high speed limits, and few driveway intersections.
- Provides two-way bicycle flow on one side of the street.
- Appropriate where bicycle and pedestrian interactions won't create continual conflict.

## TYPICAL DESIGN STANDARDS

- Side paths are most commonly designed for two-way travel accommodated in a single treadway, though multiple treadways are possible.
- The minimum width for a two-directional side path is 10 ft, with the desired width of 12-14 ft.

**Figure 2: Side Path**


*Source: ATG*

# CYCLE TRACK

Cycle tracks are exclusive bike facilities that combine the user experience of a separated path with the on-street infrastructure of a conventional bike lane. Cycle tracks are always physically separated from motor traffic and distinct from the sidewalk. Some may be raised to the level of the sidewalk or a level between the roadway and the sidewalk. Cycle tracks traditionally refer to protected bike facilities offering two-way movement for people on bikes, but a protected bike lane in a single direction may be referred to as a one-way cycle track as is the case in the NACTO Urban Bikeway Design Guide.

## BENEFITS

- Improves real and user-perceived safety for bicyclists by protecting cycling space from motor vehicles.
- Track separation prevents motor vehicles from parking in the cycling space.

## CONSIDERATIONS

- Suitable for streets with parking lanes and high parking demand, high traffic volumes and speeds, and high bicycle volumes.
- Two-way cycle tracks may be used on one-way streets.
- Can control flow of bicyclists between the cycle track and the street by using different separating elements, such as curbs for controlled entrances/exits and bollards or armadillo bumps for more free-flowing entrances/exits.

## TYPICAL DESIGN STANDARDS

- Bike lane markings should be painted at the start of the track and at intervals along the facility.
- Depending on context, painted markings or physical barriers can separate the track from adjacent facilities.
- Minimum track width is 6 ft, increased to 7 ft for high bike volume or uphill areas, and 3 ft of buffer should be left between the track and adjacent parking.

**Figure 3: Cycle Track**

*Source: ATG*

# PROTECTED BICYCLE LANE

A protected bike lane is an on-street bike lane with an item that provides vertical physical separation from sidewalks and/or motor vehicle traffic. Physical separation can be created by concrete curbs, planters, "armadillos," or bollards. Low-cost premade delineators can be upgraded to more permanent barriers after implementation.

## BENEFITS

- Provides a high level of comfort for a variety of users due to separation from traffic and increased safety.
- Slows traffic and alerts drivers to the presence of bicyclists.

## CONSIDERATIONS

- Traffic volume and speed determine what type of barrier is most appropriate, with higher levels benefiting from barriers that provide a significant amount of separation.
- Parked cars can be used as a mean of separation, but access to the sidewalk should be considered for passengers with disabilities.
- Delineators that are frequently hit by vehicles may have high maintenance costs.

## TYPICAL DESIGN STANDARDS

- Minimum desired width is 5 ft, with a passing width minimum of 7 ft in uphill or high-volume areas.
- If parking is used as a barrier, a buffer of 3 ft should be included to prevent collisions with doors, with a total desired width of 11 ft for parking and the parking buffer.
- Signage and markings should be used to give priority to the bike lane.

**Figure 4: Protected Bicycle Lane**

*Source: ATG*

# BUFFERED BICYCLE LANE

A buffered bike lane is a conventional bike lane paired with a designated buffer space separating the bike lane from the adjacent motor vehicle travel lane and/or parking lane. The buffer typically consists of a zone incorporating pavement striping.

## BENEFITS

- Increases distance between motor vehicles and bicyclists, thereby increasing the space for bicyclists to maneuver and encouraging more cycling by improving perception of safety for bicyclists.
- Separates bicycle and pedestrian traffic.

## CONSIDERATIONS

- Appropriate anywhere a standard bike lane is being considered, where existing paving allows for more substantive bicycle facilities, and on streets with high speeds and traffic/truck volumes.
- Where street parking turnover is high, consider placing the buffer between the parking lane and the bike lane.

## TYPICAL DESIGN STANDARDS

- Typical width for a buffered bike lane is 8 ft - 5 ft bike lane plus a 3 ft buffer.
- Buffer may be less than 3 ft if vertical delineators are used.
- Bike lane markings should be used to designate the cycling space.
- The buffer should be marked with two solid white lines, with diagonal hatching or chevron marks on the interior if the buffer is 3 ft or wider.
- Buffer boundary lines should be solid if crossing is discouraged and dashed if crossing is permitted.

**Figure 5: Buffered Bicycle Lane**

*Source: ATG*

# BICYCLE LANE

Bike lanes use pavement markings and signage to designate cycling space directly on roadways. Bike lanes are generally found adjacent to and on the right side of the outermost motor vehicle lane, between motor vehicle traffic and the parking lane, curb, or roadway edge. Bike lane traffic typically flows the same direction as motor traffic.

## BENEFITS

- Increases bicyclists' comfort and confidence on busy streets by creating separation between them and motor vehicles.
- Increases predictability of bicyclist and motorist interactions and movements.
- Relatively low-cost treatment for establishing bicycle facilities.

## CONSIDERATIONS

- Have the most positive impact on streets with average daily traffic of more than 3,000 vehicles, streets with posted speed between 25-35 mph, and streets with high transit vehicle volume.

## TYPICAL DESIGN STANDARDS

- Minimum 5 ft width against a curb or adjacent to a parking lane.
- Adjacent to curb face: desired width of 6 ft.
- Adjacent to parking lane: desired width from curb face to edge of bike lane is 14.5 ft (minimum width is 12 ft), with a bike lane width of 5 ft minimum unless there is a marked buffer between the parking lane and the bike lane.
- Bike lane markings should be used to designate the cycling space.
- A 6-8 in solid white line should be used to mark the boundaries of the bike lane.
- Gutter seams, drainage inlets, and utility covers should be flush with the ground to prevent conflicts with bike tires.

**Figure 6: Bicycle Lane**

*Source: pedbikeimages.org / Dan Burden*

# BICYCLE BOULEVARD

Bicycle boulevards are streets with low motorized traffic volumes and speeds, designed and designated to give bicycle travel priority. Bicycle boulevards use signs, pavement markings, and volume/speed management to discourage through trips by motor vehicles and create safe, convenient bicycle crossings at busy streets.

## BENEFITS

- Increases comfort and safety for bicyclists.
- Cost effective use of existing roadways by connecting a series of relatively minor treatments that substantially improve bicycling conditions on local streets.
- Creates alternate routes for bicycles that are still connected to the street network.

## CONSIDERATIONS

- Suitable for streets with low traffic volumes/speeds and streets that run parallel to popular arterials or collectors.
- Intersection improvements should take advantage of actuated signaling, such as bicycle activated signals, bicycle sensitive loop detectors, or push button signals conducive to bicycle access.
- A pocket lane at intersections is an appropriate treatment to increase visibility and safety of bicyclists.

## TYPICAL DESIGN STANDARDS

- Volume and speed management techniques should be implemented if necessary.
- Treatments for minor street crossings, major street crossings, and offset intersections should be implemented to minimize bicyclist delay and maximize bicyclist safety and comfort.

**Figure 7: Bicycle Boulevard**


*Source: pedbikeimages.org / Adam Fukushima*

# SHARED LANE

A shared lane is a travel lane specifically designated to serve both bicyclists and motor vehicles. This treatment is often used on streets where there is insufficient width for a bicycle lane but where bicycle travel is also likely.

## BENEFITS

- Motorists are made aware of the presence of bicycles within the travel lane.
- Relatively low cost to implement.
- Provides bicyclists guidance and wayfinding within the street cross section.

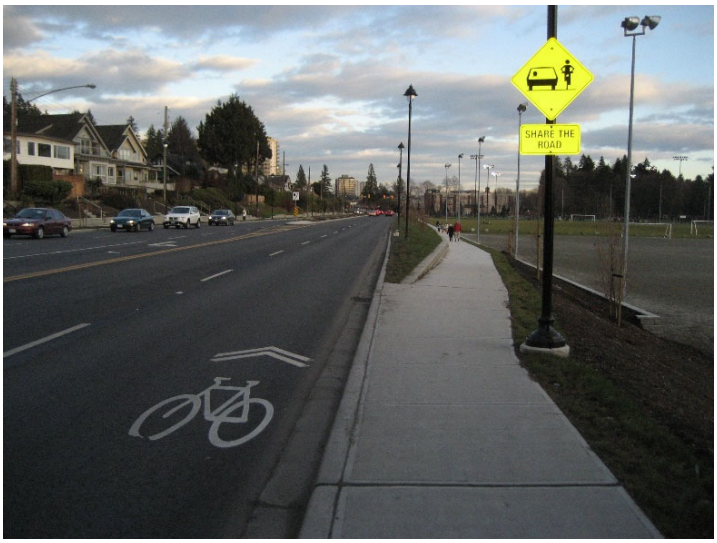
## CONSIDERATIONS

- Suitable on streets with low traffic volumes/speeds, but not recommended where speeds and volumes are higher.
- Typically incorporates shared lane pavement markings in addition to bikeway signage.
- Shared lanes indicate where bicyclists may likely be found, but do not necessarily confine bicyclists to a rigidly defined path.

## TYPICAL DESIGN STANDARDS

- The shared lane pavement marking, also called a "sharrow," includes a bicycle below two chevron markings.
- Shared lane markings should not be used on shoulders, in designated bike lanes, or to designate bicycle detection at signalized intersections.
- Lateral placement of the marking within the travel lane is critical to encourage bicyclists to avoid the "door zone[1]" and to encourage safe passing behavior.

**Figure 8: Shared Lane**




*Source: pedbikeimages.org / Margaret Gibbs*

[1] The "door zone" is the common term for the space that an open car door extends beyond a car parked at the curb.

# SIDEWALKS

Sidewalks are the basic facility necessary to establish a pedestrian network. Sidewalks are designed for pedestrian use only and are intended to serve all people regardless of age or ability. These facilities are located within or parallel to the street right of way.

## BENEFITS

- Increase comfort and safety by providing a distinct area of travel for pedestrians and significantly limiting their interaction with motor vehicles.
- Provide connectivity within and between urban areas and neighborhoods.

## CONSIDERATIONS

- Context of the area and the adjacent roadway should help determine the facility's distance from the street and other dimensional characteristics that will optimize comfort and safety for pedestrians.
- If possible, including a buffer of trees or other vegetation as well as lighting and furniture such as benches adjacent to or along the edge of the sidewalk facility can greatly improve the pedestrian's perception of comfort and safety.

## TYPICAL DESIGN STANDARDS

- Minimum desired width for a sidewalk: 5 ft excluding any attached curb.
- Ideally, sidewalks should be separated from the roadway by an unpaved buffer. If the facility is flush against the curb, wider sidewalk widths of 8-10 ft are preferred.
- If the facility must be less than 5 ft wide, passing spaces of at least 5 ft wide should be provided at reasonable intervals.
- Desired width outside core urban area: 6-8 ft.
- Desired width in core urban area: 10 ft or wide enough to provide desired volumes.

**Figure 9: Sidewalk**

*Source: ATG*

## CROSSWALK

Crosswalks are designated pedestrian paths that traverse the width of roadways to allow pedestrians to cross streets. Crosswalks are most commonly found at roadway intersections.

### BENEFITS

- Provide a distinct space for pedestrians to cross a street safely.
- Can draw the attention of motor vehicles to the presence of pedestrians.
- Provides clarity to both pedestrians and motor vehicle drivers where pedestrians are expected to cross a street.

### CONSIDERATIONS

- Frequency of crosswalks should increase where pedestrian volumes are greater.
- Location and illumination of crosswalks should allow pedestrians to see and be seen by approaching motor vehicle traffic while crossing.
- Pedestrians should experience a short wait to cross and adequate time to cross a street.
- Crossing distance should be short or divided into shorter segments with crossing islands when necessary.
- Conflict points with motor vehicle traffic should be few.

### TYPICAL DESIGN STANDARDS

- Crosswalk width should reflect the width of the sidewalks that approach the intersection, but no less than 6 ft wide.
- Intersections also require extra consideration for grade changes to ensure the necessary ADA requirements are met.

**Figure 10: Crosswalk**

*Source: pedbikeimages.org / Dan Burden*

# PEDESTRIAN REFUGE ISLAND

Pedestrian refuge islands utilize median space to create a refuge area between the two directions of traffic flow on a wide and/or busy street. Pedestrians may use the island after crossing one half of the street to wait until it is safe to cross the second half. This shortens the distance a pedestrian needs to travel at once.

## BENEFITS

- Increases pedestrian safety and comfort level when crossing wide and/or busy streets.

## CONSIDERATIONS

- Can be utilized on busy two-way streets that have available median space.
- Recommended where pedestrian crossing activity is high.

## TYPICAL DESIGN STANDARDS

- The designated pedestrian space on the island should be the same width as the connecting crosswalk.
- Should be protected by some type of barrier element.
- Use of curbing and planted medians clearly differentiates the pedestrian refuge space from the motor vehicle travel area.
- In instances where both pedestrians and bicyclists will share the crossing and median area, additional space or parallel facilities may be appropriate.

**Figure 11: Pedestrian Refuge Island**

*Source: ATG*

# GRADE-SEPARATED CROSSING

At-grade intersections/crossings of pedestrian facilities and roadways may not always be feasible or safe. Grade-separated crossings provide opportunities to traverse barriers when at-grade crossings are not recommended. Grade-separated crossings include underpasses and bridges.

## BENEFITS

- Provide crossings at dangerous or high-volume roadways.
- Maintain separation of pedestrians from motor vehicle traffic, providing a safer pedestrian environment.

## CONSIDERATIONS

- Can be very expensive to implement.
- May become sites for crime or vandalism or may decrease pedestrian safety if not properly located and designed.
- Grade-separated crossings tend to serve both pedestrians and bicyclists.

## TYPICAL DESIGN STANDARDS

- Facility is located based on need and predicted use.
- Crossing structures should be built with adequate widths for safety and volumes.
- Facility design should be accessible for all users.
- Barriers/railings should be provided to increase perceived/actual safety.
- Facility should be well-lit to provide a sense of security.
- Additional safety features beyond the standard features may be beneficial to promote a sense of comfort and security for users.

**Figure 12: Grade-Separated Crossing**

*Source: NACTO / Dylan Passmore; https://nacto.photoshelter.com/search/result/I0000xg8vj6FrO0o?terms=bridge&download=true&*

# MID-BLOCK CROSSWALK

Mid-block crosswalks facilitate crossings to destinations with high pedestrian volumes. These crossings occur between street intersections, especially on street networks with large block lengths. Depending on traffic volumes and speeds, signalization may be necessary to improve yield and stop behavior (see next page).

## BENEFITS

- Offer convenient locations for pedestrians to cross streets.
- Increase safety and comfort of the pedestrian environment.

## CONSIDERATIONS

- May connect pedestrians to places such as schools, parks, museums, waterfronts, and other major social, cultural, and economic places of interest/employment where pedestrian activity is high.
- Suitable for areas with large block lengths and rural or suburban areas that have fewer intersections to provide standard crosswalks.
- May be appropriate next to mid-block bus stops to accommodate boarding and alighting passengers.

## TYPICAL DESIGN STANDARDS

- Stop lines at the crossings should be set back 20-50 ft.
- Crossings should be striped regardless of paving pattern or material to increase visibility for motor vehicle drivers.
- Pedestrian refuge islands compliment mid-block crossings by increasing pedestrian safety.
- Treatments like restricting parking near the crossing or adding curb extensions help keep the area around the crossing clear and visible.

**Figure 13: Mid-Block Crosswalk**

*Source: pedbikeimages.org / Dan Burden*

# PEDESTRIAN SIGNS AND SIGNALS

Pedestrian signs and signals are used to demarcate the location of pedestrian facilities where they meet, cross, or conflict with other types of travel facilities. These signs also provide information about rules for pedestrians, bicyclists, and motor vehicle drivers based on the context and location of the pedestrian facilities within the travel network. The two most commonly used pedestrian signal types at mid-block (non-intersection) crossings are the Pedestrian Hybrid Beacon (HAWK) and Rectangular Rapid Flashing Beacon (RRFB). A HAWK is a traffic control device which provides a solid red for drivers to stop for pedestrians in a crosswalk. An RRFB is a warning device that uses flashing yellow lights to alert drivers to the presence of pedestrians in the crosswalk.

## BENEFITS

- Increase safety for pedestrians, as well as bicyclists and motor vehicle drivers, by providing clarification and communication for facility users where conflict points occur.
- Help alert bicyclists and motor vehicle drivers of the presence of pedestrians.

## CONSIDERATIONS

- Signs must be easy to read and placed in a readily visible area.
- Vegetation, utility poles, and other objects may obstruct the sightline of pedestrian signs if the signs are not placed carefully and maintained.

## TYPICAL DESIGN STANDARDS

- Pedestrian signs have standard design guidelines that can be found in the Manual of Uniform Traffic Control Devices (MUTCD 11th Edition).
- Regulatory signs provide information on the intended use of specific facilities and areas within roadways; Warning signs are used to notify travelers of changes in facility or roadway conditions that will affect traveling actions.
- Accessible pedestrian signals should have audible indications and a tactile push button.

**Figure 14: Pedestrian Sign and Signals**


*Source: pedbikeimages.org / Dan Burden*

# LIGHTING

Lighting is a crucial element of the pedestrian environment on any type of facility. Lighting for pedestrian facilities can include direct lighting fixtures, such as streetlamps, or indirect lighting, such as that from adjacent buildings and digital signage.

## BENEFITS

- Provides the necessary visibility for pedestrians using facilities at night or during other darkened conditions, such as during storms.
- Increases level of comfort and safety for pedestrians using the facility.
- Can create visual appeal and a sense of liveliness in the pedestrian environment.

## CONSIDERATIONS

- Use of lighting at intersections and crossings should be a priority as these are the greatest conflict areas.
- Facilities should be illuminated in a way that prioritizes the visibility of pedestrians and bicyclists.

## TYPICAL DESIGN STANDARDS

- Pedestrian-scaled lighting is a preferred approach to create a more inviting environment and provide the appropriate amount of light.
- Level of brightness is an important factor when choosing types of lighting fixtures and light bulbs.

**Figure 15: Lighting**

*Source: pedbikeimages.org / Dan Burden*

# APPENDIX

**Table 1: Cost by Facility Type – Linear Features**

| Linear Facility Type | Per Mile Assumption | Base Cost Per Mile |
|---|---|---|
| Shared Use Path /Side Path | Assumes excavation, base aggregate, and concrete for 12' wide, 5" thick side path, one side of street. Does not include landscaping, drainage, engineering or survey, utility work. | $525,000 |
| Cycle Track | Curb separated, two-way facility on one side. Assumes 20 pavement marking symbols, 5,280 linear feet, and 20 signs per mile. | $383,960 |
| Bicycle Lane | 2 bicycle lanes and 20 pavement symbols (bike and arrow) | $90,000 |
| Buffered Bike Lane | Same as above, plus 30" diagonal stripe every 15 feet | $150,000 |
| Protected Bike Lane | Same as above, plus bollards | $180,000 |
| Shared Lane (Sharrow) | Shared Lane Markings and Signage. Assumes 20 pavement marking symbols and 20 signs per mile | $24,920 |
| Bicycle Boulevard | Shared Lane Markings and Signage, plus items indicated below. Assumes 20 pavement marking symbols and 20 signs per mile | $24,920 |
| Sidewalk (5") | Assumes 5,280 linear feet | $52,800 |
| Lighting | | $750,000 |

*Sources: TxDOT Bicycle Tourism Trail Study (2018); TxDOT Construction Cost Estimate Assistance Tool; TxDOT Bid Averages; FHWA Visibility Enhancement Worksheet.*

**Table 2: Cost by Facility Type – Spot Treatments**

| **Spot Treatments and Intersection Facility Types** | **Assumption** | **Base Cost Per Intersection** |
|---|---|---|
| Bicycle Boulevard Intersection Improvement | Bulb Out. Assumes 4 bulb outs at an average cost of $13,000 unit. | $52,000 |
| Pedestrian Refuge Island | | $13,520 |
| ADA Ramp Upgrade | | $2,250 |
| Ped Head Upgrade, LPI installation | Install Pedestrian Signal Head at Existing Signal, Re-time | Not Available |
| High Visibility Crosswalk Marking (per intersection) | | $2,540 |
| Pedestrian Hybrid Beacon (PHB) | | $57,680 |
| Mid-Block Crossing (RRFB) | | $22,250 |

*Sources: TxDOT Bicycle Tourism Trail Study (2018); TxDOT Construction Cost Estimate Assistance Tool; TxDOT Bid Averages; FHWA Visibility Enhancement Worksheet.*