

TORONTO TRANSIT COMMISSION

SERVICE STANDARDS AND DECISION RULES FOR PLANNING TRANSIT SERVICE

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1 INTRODUCTION

The Toronto Transit Commission (TTC) is responsible for providing public transit in the City of Toronto. The TTC's vision and mission are:

- Vision: moving Toronto towards a more equitable, sustainable and prosperous future.
- Mission: to serve the needs of transit riders by providing a safe, reliable, efficient and accessible mass public transit service through a seamless integrated network to create access to opportunity for everyone.

The TTC strives towards making public transit the simplest, fastest and most cost efficient way to move around in Toronto. The service standards lay out a framework for achieving these goals. Service standards are the process by which the TTC plans and evaluates transit services. The TTC has two major objectives in planning transit services:

- to maximize mobility within the City of Toronto by ensuring that public transit is provided in the right places, at the right times, to satisfy the changing travel needs within the community
- to ensure that all transit services operated by the TTC are as efficient and cost-effective as possible and, therefore, affordable to both TTC customers and citizens

In achieving these goals, the TTC must strike a balance between the benefits achieved from providing transit services and the cost to provide these services. The service standards provide a formal mechanism for measuring trade-offs in an objective and equitable way. The service standards are decision rules and guidelines that are:

- grounded in business logic and principles;
- transparent, quantifiable and reproducible; and
- applied consistently, fairly and equally.

The service standards provide a systematic and objective means of planning, monitoring, adjusting and evaluating conventional transit services throughout the City of Toronto. These service standards apply to conventional transit services only and exclude paratransit (Wheel-Trans) service.

1.1 **Planning and Managing the Transit Network**

The service standards are applied at every level of service planning that the TTC undertakes, this includes: 5-Year Service Plans, Annual Service Plans, Area Studies/New Services and during each Board Period.

1.1.1 5-Year Service Plan

A 5-Year Service Plan is the blueprint for service needs during a five year interval. It identifies resource and funding requirements and serves as the basis for annual operating budgets and annual 10-year capital plans. The service standards play a role in shaping initiatives that are included in this strategic document.

1.1.2 Annual Service Plan

A detailed Annual Service Plan is prepared each year to refine the actions identified in the 5-Year Service Plan and address any changes that have occurred. TTC staff consults with the public and community partners to refine planned service changes for the upcoming year. The Annual Service Plan includes the following components:

- annual route performance review;
- recommendations for major service changes;
- documentation of any measures taken to avoid, mitigate or minimize impacts on equity groups, based on consultation feedback;
- recommendations for capital improvements related to the 5-Year Service Plan actions;
- operating and capital costs associated with implementing actions;
- post-implementation reviews of previous trial services;
- a description of the consultation process and results; and
- a discussion of service changes that were considered and/or evaluated, but are not recommended at the time.

The Annual Service Plan works towards achieving the performance objectives articulated in the service standards.

1.1.3 Area Studies

TTC works with community partners and the general public to review transit services in different geographically focused areas of the city. The objective of an area study is to better tailor surface transit to meet current travel patterns, this can include route restructuring or new services. Recommendations in area studies must work towards achieving the performance objectives in the service standards.

1.1.4 Board Period

TTC makes schedule changes approximately ten times a year during its regular Board Period process. Schedules are adjusted for construction, service reliability, increase or decrease in service levels, seasonal changes, etc. The service standards are used to guide decision-making on schedule changes.

2 NETWORK DESIGN STANDARDS

2.1 Transit Service Classifications

The TTC operates an integrated multi-modal transit network that provides customers the following services:

- rapid transit
- streetcar
- bus

2.1.1 Rapid Transit

The TTC currently operates three rapid transit lines along dedicated rights-of-way across the City of Toronto. Current rapid transit lines include:

- Line 1 – Yonge-University
- Line 2 – Bloor-Danforth
- Line 4 – Sheppard

2.1.2 Streetcar

The TTC currently operates 11 streetcar routes predominantly in downtown Toronto. The streetcar routes operate on surface streetcar tracks making frequent stops similar to local bus routes. Some streetcar routes operate either in mixed traffic or partly or wholly within their own rights-of-way. To maintain service overnight, TTC operates four overnight streetcar routes.

2.1.3 Bus

The TTC currently operates over 190 bus routes via four types of services – local, overnight, express and community – each designed to meet specific customer travel requirements.

Local

The TTC currently operates more than 130 local bus routes in mixed traffic on major arterials, minor arterials and collector roads across the City of Toronto. Local bus routes are designed as fixed routes with frequent stops and are intended to serve and connect residential, employment and institutional areas with each other. These connections occur either directly or indirectly through a connection to other surface and rapid transit services.

Overnight

The TTC currently operates over 25 overnight bus routes. Similar to a local bus route, the overnight routes operate in mixed traffic on major arterials, minor arterials and collector roads across the City of Toronto overnight.

Express

The TTC operates two types of express bus services: Tier 1 and Tier 2 express bus services.

Tier 1: Tier 1 express services are limited stop bus services that are designed to complement the rapid transit network and provide frequent and faster service on high-demand bus corridors with major urban nodes. These routes operate at a minimum frequency of ten minutes or better during peak periods and fifteen minutes or better outside of peak periods. The minimum span of service is from 6:00 am - 10:00 pm on weekdays and from 8:00 am - 7:00 pm on weekends.

Tier 2: Tier 2 express services are designed to provide frequent and faster service on busy bus corridors generally during the weekday peak periods. These routes operate at a minimum frequency of fifteen minutes or better on weekdays from 6:00 am - 9:00 am and from 3:00 pm – 7:00 pm.

Community

Community bus routes are fully accessible transit services that can be used by anyone, but are designed primarily for seniors and people with disabilities who are Wheel-Trans customers and who are able to include conventional transit as part of their travel plans

Community bus services operate on fixed routes, can be flagged down at any point along the route where it is safe to stop and are designed to provide easier access to facilities oriented to the target market group, such as seniors' apartments, medical facilities, community centres and shopping centres.

2.2 Key Principles of System Structure and Design

Transit network design must take into account both the needs of the customer and the transit operator, as well as the practical ability to provide the service. From the customer's perspective, the transit network should provide convenient and reliable service when and where they need to go, with good customer communication and service. From a system-wide transit operations perspective, the transit network must be manageable, operable and sustainable – all within the constraints of a fixed operating budget. The following are key principles that are critical in building an effective and efficient transit network.

2.2.1 Accessibility

The TTC has a strong organizational commitment to accessibility and is making continuous progress towards making all of its vehicles, facilities and services accessible, consistent with Provincial AODA legislation. This work to make our facilities and services accessible also aligns with the TTC's Corporate Plan, which has adopted Equity, Diversity, Inclusion, and Accessibility (EDIA) as a key principle. The TTC's implementation of accessibility improvements is guided by the TTC's 5-Year Accessibility Plan, which outlines the TTC's long-term vision for a barrier-free accessible transit system. All TTC bus, streetcar and subway services are operated using accessible vehicles. TTC is continuing work to make subway stations and surface transit stops accessible.

2.2.2 Grid Network

Surface (i.e. streetcar, bus) routes will conform or be oriented to the grid system of major arterial roads in the City of Toronto. A basic grid network of surface transit services provides an efficient means of supplying convenient service between the majority of origins and destinations throughout the city, and it provides the maximum number of route combination choices for customers.

2.2.3 Network Connectivity

Connections between surface routes and rapid transit lines will be maximized. This allows for faster service for long distance trips, and is more cost-effective for moving high volumes of customers. An integrated surface and rapid transit network maximizes travel choices, yet necessitates transfers for the majority of TTC customers. Therefore seamless connections between surface routes and rapid transit stations, and between surface routes on-street are essential. Seamless connections will be provided between services regardless of the transit provider.

2.2.4 Route Directness

Surface routes will be planned so that they meet customers' travel needs as well as possible. Routes will be as direct as possible to minimize customer travel time. Diversions off a direct path will only occur where the benefit to customers of the diversion exceeds the inconvenience to all other customers.

2.2.5 Duplication of Service

In most cases, only one local route will operate on each major arterial roadway or on closely spaced parallel roadways (less than 800 metres) to make the best use of available resources. When parallel routes operate closer together, they split the potential demand for service. In areas and time periods of low demand, this can result in many routes competing for the same passengers and no route attracting enough demand to warrant higher frequency service. It may

be necessary in some cases, however, to duplicate service along major arterials where a) routes merge to feed a rapid transit station, b) routes are designed and function as branch services, or c) to achieve other system design objectives.

2.3 Coverage and Access

An important aspect of providing the City of Toronto with adequate access to transit services is the proximity or accessibility of transit service to population and employment areas. The coverage and access standard addresses the accessibility of transit by targeting a maximum walking distance that a customer will have to travel to reach a transit station or stop.

The TTC provides public transit services 24-hours a day, seven days a week. Coverage and access to transit service varies by operating day and depends on customer demand (see **Section 3.0**).

2.3.1 Base Network – “All-Day, Every-Day”

The TTC provides base (subway, streetcar and bus service) coverage and access to transit services in the City of Toronto during regular daytime and evening hours, aligned generally with the operating hours of the rapid transit network approximately from:

- 6:00 am to 1:00 am, on weekdays and Saturdays and holidays; and
- 8:00 am to 1:00 am on Sundays.

The base network, also known as the All-Day, Every-Day network, will be provided with regular rapid transit, streetcar and bus routes. The base network of transit services is designed so that 90% of the population and employment is within a 400 metre (5 minute) walk of transit service seven days a week.

2.3.2 Overnight Network – “Blue Night”

The TTC’s overnight network of bus and streetcar service, known as the Blue Night Network, will be provided between approximately 1:30 am and 5:30 am from Monday to Saturday, and between approximately 1:30 am and 8:00 am on Sunday and holidays, after the regular daytime and evening services have ended.

The overnight network is designed so 95% of the population and employment is within a 1,250 metre walk (15 minutes) of transit service. Consequently, overnight services may be provided on different routes than the base network in order to meet these requirements. Where possible, however, overnight routes will follow daytime routing and be identified in a manner consistent with the daytime route. The overnight network is an important part of the TTC's commitment to maximizing the mobility of people in the City of Toronto and meeting all of their diverse travel needs.

2.3.3 Coverage and Access Standard

The TTC will provide, at minimum, coverage and access to transit service as presented in **Table 1**.

Table 1: Coverage and Access Standard

| Operating Day | % of Population and Employment | Within Walk Distance | Within Walk Time |
|--|--------------------------------|----------------------|------------------|
| Base Network - “All-Day, Every-Day” Weekdays* - (6:00 am to 1:00 am) Saturdays** - (6:00 am to 1:00 am) Sundays** - (8:00 am to 1:00 am) | 90% | 400 metres | 5 minutes |
| Overnight Network - “Blue Night” Every Day (1:30 am to 6:00 am) | 95% | 1,250 metres | 15 minutes |

* Proximity standard measured against service during AM peak operating period.

** Proximity standard measured against service during afternoon operating periods.

The TTC will strive to meet coverage and access standards from a city-wide, network level perspective, recognizing that the provision of transit service in some areas is conditional on density, land use and street network design to support viable transit operations.

2.4 Surface Stop Spacing

Surface stops should be designed in accordance with the TTC’s Technical Criteria for the Placement of Transit Stops. When the locations of stops are being planned for a route, it is necessary to strike a balance between the competing objectives of passenger convenience, operating efficiency, safety and community impacts. In general, increasing the number of stops on a route results in shorter walking distances for passengers but it also slows down service. To achieve a proper balance, the TTC will place bus stops in accordance with the standard presented in **Table 2**.

Table 2: Surface Route Stop Spacing Guidelines

| Service Classification | Stop Spacing Range |
|------------------------|---|
| Streetcar | 300 - 400 metres |
| Bus – Local | 300 - 400 metres |
| Bus – Express (Tier 1) | 800 – 1,200 metres |
| Bus – Express (Tier 2) | 800 – 1,200 metres |
| Bus – Community | flag stop, including designated stops at major destinations |

2.5 Early / Late Connections

An integrated surface and rapid transit network maximizes travel choices, yet necessitates transfers for the majority of TTC customers. At the beginning of the regular service day and at the end of the core service hours, the TTC will schedule surface routes to connect to first/last rapid transit services. In some cases, service on surface routes may be provided earlier/later if the demand warrants it.

3 QUALITY OF SERVICE STANDARDS

The TTC's existing and potential customers place a high value on frequent, reliable and comfortable transit service. The following guidelines set out specific criteria for the quality of service that customers can expect. Quality of service standards outline span of service (operating hours), service levels (frequency of service), vehicle crowding and service reliability.

3.1 Span of Service & Service Levels

The TTC provides transit service 24-hours a day, seven days a week. The span of service (operating hours) and service levels (frequency of service) determine the availability and convenience of transit service for customers. The span of service and service levels vary for each transit service classification: rapid transit, streetcar and bus.

Table 3 presents the minimum span of service and service levels for each transit service classification. In many cases, however, routes need to operate more frequently than the minimum frequencies in order to accommodate higher ridership levels. In these cases, vehicle crowding standards (see **Section 3.2** below) match service to the number of riders using a particular transit service at a given time.

The minimum frequency levels may not be met for no longer than one year if required during temporary service changes for construction related traffic delays.

3.1.1 Frequent Network – “Ten Minute Network”

The TTC's frequent network, known as the Ten Minute Network, is a network of rapid transit, streetcar and bus services that operate every ten minutes or better from approximately 6:00 am to 1:30 am from Monday to Saturday and from approximately 8:00 am to 1:30 am on Sundays.

Table 3: Minimum Span of Service, and Service Levels

| Operating Period | Minimum Service Levels (minutes) | | | | | |
|---|----------------------------------|-----------|-------------|------------------------|------------------------|--------------------|
| | Rapid Transit* | Streetcar | Bus - Local | Bus - Express (Tier 1) | Bus - Express (Tier 2) | Bus - Community ** |
| Weekdays | | | | | | |
| Morning Peak 6:00 am - 9:00 am | 6 | 30 | 30 | 10 | 15 | |
| Midday 9:00 am - 3:00 pm | 6 | 30 | 30 | 15 | | 90 |
| Afternoon Peak 3:00 pm - 7:00 pm | 6 | 30 | 30 | 10 | 15 | 90 |
| Early Evening 7:00 pm - 10:00 pm | 6 | 30 | 30 | 15 | | |
| Late Evening 10:00 am - 1:00 am | 6 | 30 | 30 | | | |
| Overnight 1:30 am - 5:30 am | | 30 | 30 | | | |
| Saturdays | | | | | | |
| Early Morning 6:00 am – 8:00 am | 6 | 30 | 30 | | | |
| Morning 8:00 am – 12:00 pm | 6 | 30 | 30 | 15 | | |
| Afternoon 12:00 pm – 7:00 pm | 6 | 30 | 30 | 15 | | |
| Early Evening 7:00 pm – 10:00 pm | 6 | 30 | 30 | | | |
| Late Evening 10:00 pm – 1:00 am | 6 | 30 | 30 | | | |
| Overnight 1:30 am - 5:30 am | | 30 | 30 | | | |
| Sundays/holidays | | | | | | |
| Early Morning 6:00 am – 8:00 am | | 30 | 30 | | | |
| Morning 8:00 am – 12:00 pm | 6 | 30 | 30 | 15 | | |
| Afternoon 12:00 pm – 7:00 pm | 6 | 30 | 30 | 15 | | |
| Early Evening 7:00 pm – 10:00 pm | 6 | 30 | 30 | | | |
| Late Evening 10:00 pm – 1:00 am | 6 | 30 | 30 | | | |
| Overnight 1:30 am - 5:30 am | | 30 | 30 | | | |
| Note: Service is subject to ridership meeting minimum performance standards. For local bus routes, the standard applies to all branches of the route. *New rapid transit lines may have a frequency of up to 10 minutes in the first few years of operation until ridership matures. **Community bus routes may operate fewer than 5 days per week | | | | | | |

3.2 Vehicle Crowding

Average vehicle crowding sets a standard of comfort for passengers while on board transit vehicles. The standard determines the appropriate level of service based on the maximum load point, or the greatest number of customers riding at one time, in the busiest direction, along a route during the busiest 60 minutes of each period of service. The number of customers at other locations along the route, and in the reverse direction, is lower (often much lower) than the maximum load point.

Vehicle crowding standards are applied as an average. For example, the off-peak crowding standard for vehicles calls for a seated load, with no standees. This standard does not guarantee that no customers will stand; it does ensure that, on average, vehicles will carry a seated load of customers during the busiest 60 minutes during off-peak periods of service. **Table 4** provides a summary of the TTC's vehicle crowding standards.

Table 4: Vehicle Crowding Standards

| Transit Service Classification / Vehicle Type | Peak periods | Off-peak periods |
|---|--------------|------------------|
| Bus (local, express) | | |
| 12-metre low-floor bus | 51 | 35 |
| 18-metre articulated low-floor bus | 77 | 46 |
| Bus (community) | | |
| 7-metre low-floor bus | seated load | seated load |
| Streetcar | | |
| Articulated 30-metre low-floor streetcar | 130 | 70 |
| Rapid transit | | |
| Train (6 cars, TR-series) | 1100 | 540 |
| Train (6 cars, T-series) | 1000 | 500 |
| Train (4 cars, TR-series) | 740 | 370 |

With respect to rapid transit, it is important to note that the distribution of customers on trains is almost never even; some cars will be more crowded than others.

3.3 Service Reliability

Convenience, comfort, predictability and dependability are the main features customers expect of a transit system. A person using any transportation mode has an expectation that the service will be reliable. Services that cannot meet their published schedules or provide a consistent headway lose the loyalty of their customers. A consistent and reliable service reduces the variability of wait times for customers and improves comfort as customers are evenly distributed between vehicles.

The TTC is focused on continuously improving the on-time performance and reliability of transit services to provide customers with a predictable and consistent travel experience. The TTC uses the following standards to measure service reliability.

3.3.1 Surface Transit

3.3.1.1 *On-Time Performance*

The on-time performance of a route is affected by many variables including: traffic congestion, traffic incidents, construction related delays, weather, etc. On-time performance standards vary by frequency of service and provide the tools for evaluating the on-time performance of individual TTC routes. Passengers using high-frequency services are generally more interested in regular, even headways than in strict adherence to published timetables, whereas passengers on less frequent services expect arrivals/departures to occur as published.

On-Time Departure

To be considered on-time, a vehicle must leave its origin timepoint between 1 minute early and 5 minutes late. TTC's goal is to have 90% of all trips depart on-time.

On-Time Arrival

To be considered on-time, a vehicle must arrive at its terminal timepoint between 1 minute early and 5 minutes late. TTC's goal is to have 60% of all trips arrive on-time.

Headway Performance

Service frequency > 10 minutes

Service is considered to be on time if it is no more than 1 minute early and no more than 5 minutes late. TTC's goal is to have 60% of all trips meet the on-time performance standard.

Service frequency ≥ 5 minutes and ≤ 10 minutes

For services that operate between 5 and 10 minutes, passengers do not rely on printed schedules, but expect vehicles to arrive at prescribed headways. Therefore, on-time performance for frequent service is measured by how well actual headways correlate to

scheduled headway intervals. Trips are monitored at a location based on arrival time, without regard to whether the trip that arrived was scheduled for that time slot. The vehicle is considered on-time when the headway deviation is less than 50% of the scheduled headway. For example, a service that operates every 6 minutes is deemed on-time if the headway deviation falls between 3 minutes and 9 minutes. TTC's goal is to have 60% of all trips operated within $\pm 50\%$ of the scheduled headway over the entire service day.

Service frequency < 5 minutes

For services that operate better than 5 minutes, the vehicle is considered on-time when the headway deviation is less than 75% of the scheduled headway. For example a service that operates every 3 minutes is deemed on-time if the headway deviation falls between 0.75 minutes and 5.25 minutes. TTC's goal is to have 60% of all trips operated within $\pm 75\%$ of the scheduled headway over the entire service day.

3.3.1.2 Missed Trips

Any vehicle leaving more than 20 minutes late from an end is considered a 'missed trip'. TTC's goal is to minimize the number of missed trips on each route.

3.3.1.3 Short Turns

A short turn is when a vehicle is turned back and taken out of service before reaching the terminus of a route. While some short turns are necessary, TTC's goal is to minimize short turns due to schedule and operator issues.

3.3.2 Rapid Transit

3.3.2.1 On-Time Performance

As with frequent bus service, passengers on rapid transit do not rely on printed schedules, but expect trains to arrive at prescribed headways. Two different measures are used to evaluate on-time performance: headway performance and average trip time on each line.

Headway performance

Service frequency ≤ 6 minutes

For services that operate better than 6 minutes, the vehicle is considered on-time when the headway deviation is less than 100% of the scheduled headway. For example a service that operates every 3 minutes is deemed on-time if the headway deviation falls between 0 minutes and 6 minutes. TTC's goal is to have 95% of all trips operated within $\pm 100\%$ of the scheduled headway over the entire service day.

Average Trip Time

The TTC's goal is to have 85% of trips operated within 5 minutes of scheduled total trip time by time period or $\pm 10\%$ of scheduled trip time. The average trip time is measured as the train departs the terminal to when the train arrives at the terminal.

3.3.2.2 Capacity Delivered

Capacity delivered is measured as the number of trains that pass the peak point during the peak hour divided by the scheduled number of trains during the peak hour.

The TTC's capacity delivered target is to deliver 90% of the scheduled trains per hour.

If the above performance standards are not met on a regular basis for a specific route, TTC will consider a range of options including, adjusting the published schedule, adjusting route timing, providing additional training for drivers or modifying or adding transit priority measures.

4 PERFORMANCE TARGETS

Performance targets are used to set desired and achievable goals for transit services. The following section provides guidance on overall performance of the system in terms of the effectiveness and efficiency of the service provided. This includes specific criteria for measuring service productivity and economic performance. The goals are set in an effort to encourage continuous incremental improvement over time to achieve the desired targets.

4.1 Service Productivity

4.1.1 Surface Transit Service Productivity

Service productivity is a measurement of the effectiveness of the application of the TTC's resources. The performance measurement must take into account that each service classification has different performance expectations and ridership potential, and, even within the same service classification, performance will vary. Therefore, the following performance targets have been established for every service classification for each operating period:

- Class average target, based on the average boardings per revenue hour that all routes within each service classification should achieve in each operating period.
- Route minimum performance target, on the basis of average boardings per revenue vehicle hour, for each of the individual routes within the classification. Routes consistently not meeting the prescribed minimum thresholds would be subject to compulsory review to recommend a change to improve or remove the service. Individual route performance will be assessed annually, as a minimum.

To support the City's efforts to address inequity within Toronto, an equity-based productivity measure will weight all customer trips accessing transit stops in or within 400 metres of a residential zone within a Neighbourhood Improvement Area by 125%. Weighted routes must still meet the prescribed route productivity minimum performance targets. If weighted equity-based productivity does not meet the prescribed minimum thresholds, the route will be subject to a compulsory review. For more information please see **Appendix 1**.

Table 5 presents the service productivity performance targets for surface transit services. Rapid transit productivity numbers are large and vary by line. It is impractical to apply a common standard to all rapid transit lines; therefore, the productivity of each line will be assessed on an individual basis.

Table 5: Surface Transit Service Productivity Targets – Average boardings per revenue service hour

| Operating Period | Streetcar | | Bus – Local | | Bus – Express (Tier 1) | | Bus – Express (Tier 2) | | Bus – Community | |
|------------------|------------|------------|-------------|------------|------------------------|------------|------------------------|------------|-----------------|------------|
| | Class Avg. | Route Min. | Class Avg. | Route Min. | Class Avg. | Route Min. | Class Avg. | Route Min. | Class Avg. | Route Min. |
| Peak Periods* | 95 | 50 | 75 | 20 | 65 | 40 | 50 | 40 | 6 | 4 |
| Off-Peak Periods | 85 | 35 | 55 | 10 | 55 | 30 | N/A | N/A | 6 | 4 |

* Monday to Friday: 6:00 am - 9:00 am, 3:00 pm - 7:00 pm

4.2 Economic Performance

The TTC requires a municipal subsidy to deliver public transit service within the City of Toronto. Therefore, a primary objective of planning transit services is to ensure that all transit services operated by the TTC are as efficient and cost-effective as possible and, for that reason, affordable to both TTC customers and citizens.

4.2.1 Net Cost per Passenger

In planning transit services it is important to have a measure that can compare the economic productivity of any given route in relation to other routes within a service classification or to the service classification average. Economic performance will be assessed based on the net cost per passenger. This is an allocation of costs, revenue and ridership to individual routes to provide a relative measure of economic performance on a route by route basis. It is defined as the amount of subsidy the TTC requires per boarding passengers, over and above fare revenue collected, to operate a given route. It is calculated by dividing the cost of operating the route by the number of passengers and subtracting the average fare per boarding. This ratio reflects the benefits of a given service (measured in customers) against the public cost of operating the service.

$$\text{Net cost per passenger} = \frac{\text{Route Operating Cost}}{\text{Route Boardings}} - \text{Average Fare per Boarding}$$

The net cost per passenger measure will be reviewed annually, during the Annual Route Performance Review (see **Section 6.1**). Routes that perform within the bottom 10% of the service classification would be subject to compulsory review to recommend a change to either improve or remove the service. Individual route performance will be assessed annually.

4.2.2 Change in Ridership per Net Dollar

The TTC also measures return on investment through the change in ridership per net dollar metric. The goal of this measure is to ensure that service changes achieve better ridership results than would be achieved through fare changes. To do this, the metric compares service changes to fare changes because both result in a) changes to ridership and b) changes to subsidy. Service increases and fare reductions result in increases in ridership and subsidy. Service reductions and fare increases result in reductions in ridership and subsidy.

The TTC can estimate the change in ridership based on increases and decreases to fares. As seen in **Table 6**, a 10% reduction in fare will gain 11 new customers per \$100 spent in lost revenue (or \$100 in additional subsidy). An increase in fare will lose 11 customers per \$100 saved in new revenue (or \$100 in less subsidy). All service changes (outside changes required for passenger comfort and schedule adherence) must do better than the threshold set by fare changes. Service increases must gain 11 or more new customers per \$100 spent and service reductions must lose less than 11 customers per \$100 saved to be worthwhile. This metric is not intended to replace the cost recovery targets set through the budget process but is intended to ensure service changes yield the best value for money results. For more information please see **Appendix 2**.

Table 6: Change in Ridership per Net Dollar Spent, TTC 2023 example

| |
|--|
| 2023 Inputs Annual Fare Paying Customers: 396.3M Annual Fare Revenue \$935.8M Average Revenue Per Passenger: \$2.36 Assumed Fare Elasticity: -0.20 |
| For a 10% Fare Increase: Annual Passengers Lost: $(396.3\text{M} \times -0.20 \times 0.1) = 7.9\text{M}$ New Annual Fare Revenue: $((396.3\text{M} - 7.9\text{M}) \times \$2.36 \times 1.1) = \$1,008.8\text{M}$ Net increase in Revenue: $(\$1,008.8\text{M} - \$935.8\text{M}) = \$73.0\text{M}$ |
| Passengers Lost per Dollar of Adjusted Subsidy $(7.9\text{M} / \$73.0\text{M}) = 0.11$ |

Community Bus

Community bus services are designed to act as an intermediary between conventional and Wheel-Trans service, as a result they will be measured against a lower performance standard. For community bus to be cost effective the cost per passenger trip must be less than the Wheel-Trans taxi cost per passenger trip. Therefore, a minimum number of Wheel-Trans door-to-door trips must be diverted to each viable community bus route such that each route serves no less than the average number of trips performed by a door-to-door vehicle per service hour.

5 Service Change & Warrant Guidelines

The following section specifies the procedure for changing service levels, routing alignments and when new services are warranted.

5.1 Service Change Guidelines

Changes to TTC services are made regularly and frequently to meet the changing transit requirements in the city. Minor changes developed through the continuous monitoring of services are introduced every Board Period.

Changes which are more substantial, either affecting the travel options of current TTC customers or requiring additional resources for operation, undergo a more rigorous review. Included in this category are requests and proposals for new routes or route extensions, additional periods of service on the present routes (e.g. new weekend service) and major changes to the structure of routes in a community. These major changes require TTC Board approval. **Table 7** provides a summary of minor and major service changes.

Table 7: Summary of Minor and Major Service Changes

| Magnitude | Types of Service Changes | Resource Implications |
|-----------|--|--|
| Minor | <ul style="list-style-type: none">• Service level changes to match capacity with demand• Span of service changes within 90 minutes or less, such as earlier or later trips• Routing changes resulting in service being removed from a road (or portion of a road) where there are multiple transit services on the road• Schedule changes to improve service reliability• Recurring seasonal route changes that have been previously approved by the Board | Changes that can be implemented with existing equipment and within the adopted budget |
| Major | <ul style="list-style-type: none">• Routing changes resulting in service being proposed on a road (or portion of a road) where there was no previous transit service• Routing changes resulting in service being removed from a road (or portion of a road) where it is the only transit option available• Addition/removal of a period of service on a route where it is the only transit option available | Changes that will have a significant effect on resources, and may potentially have a significant effect on customers |

5.1.1 Comparison of Effects on Customers

Major service changes including routing changes, the provision of new service and the addition or removal of service must result in an overall benefit for customers. The net benefit is measured by estimating the net change in weighted travel time for customers.

Each of the four components of a trip – walking to the stop, waiting for the bus or streetcar to arrive, riding in the vehicle and transferring from one vehicle to another – is weighted differently, according to how each is perceived by customers and how it affects customers' travel decisions (see **Appendix 3** for more details).

The weights that are applied to each component of a trip were developed from research based on several surveys of travel behaviour. With the use of these weights, it is possible to predict customers' travel patterns.

Trip component weight:

- Each minute of effective in-vehicle travel time 1.0
- Each minute of effective wait time 1.3
- Each minute of walk time 1.8
- Each subway transfer 1.0
- Each right-of-way surface transfer 2.0
- Each mixed-traffic surface transfer 6.0

To make recommendations on proposed service changes, the change in weighted travel time is calculated for each group of customers who are affected by a change, both those for whom the change will improve their service and those for whom the change will cause an inconvenience.

Proposals which have an overall benefit for customers are those with a net reduction in weighted travel time. These beneficial proposals will also, over time, attract increased numbers of customers to the TTC's transit services.

5.1.2 Service Level Change

Service level changes will be made based on the following conditions.

Service level increases will be considered on a route when the vehicle crowding thresholds identified in **Section 3.2** are consistently greater than 95% for a period of six months. Corrective actions to maintain the standard can include adding trips to the schedule in the form of a frequency improvement over the whole operating period; addition of individual bus or streetcar trips; and/or restructuring the service to distribute demand among several routes or branches, if applicable.

Service level reductions will be considered on a route when vehicle crowding targets identified in **Section 3.2** are consistently below 80% for a period of six months. A service reduction will be

considered as long as the resulting vehicle crowding target does not exceed 95%. Service reductions should not result in a headway widening greater than 25%¹.

An additional period of operation or an additional first/last trip will be considered on a route if estimated ridership projections demonstrate that the minimum boardings per revenue vehicle hour thresholds identified in **Section 4.1** can be met.

5.1.3 Public and Community Partner Consultation

The TTC strives to engage customers and community partners in an inclusive, equitable and consistent manner to receive feedback on major changes to transit routes and services in Toronto. The following principles will inform all engagement activities related to service changes:

1. **Accessible:** utilization of multiple channels to engage all customers
2. **Equitable:** ensuring disproportionately impacted equity-seeking groups, including, but not limited to, people with low income, women and shift workers, are engaged, regardless of barriers
3. **Meaningful:** discussions with customers and community partners will have purpose and will be used constructively to guide decision-making
4. **Accountable:** engagement materials and summaries will be available to document engagement activities

Staff will develop engagement plans to suit the scale of work to be undertaken. Depending on the type of study, system-wide engagement; area-level engagement; consultation with people with low income, women and shift workers; or route-specific engagement may be required. Tools and approaches such as social media outlets, online surveys, origin-destination surveys, public information centres, charrettes and meet the planners events are just some examples of the kind of engagement that may be applied. For more information on the equity consultation process please see **Appendix 1**.

¹ Service reductions will not be made on a route that belongs to the 10 minute network if the change results in a headway greater than 10 minutes.

5.2 Express Bus Service Warrant

5.2.1 Tier 2 Express Service

Tier 2 express bus services will be considered when all of the following conditions are met during the defined minimum span of service operating the minimum service frequency.

- Minimum Span of Service
 - weekdays: morning & afternoon peak
- Service Frequency
 - 15 min or better
 - 15 min or better (outside minimum span of service)
- Demand
 - existing local bus service on the corridor is every six minutes or better during peak periods
 - demand on the corridor for both local and express services must be at least 75% of the total corridor capacity except on weekend mornings
- Speed and Travel Time Improvement
 - the express service travel time must be approximately 15%-20% less than the existing TTC alternative for each of the operating periods being considered; and the one-way distance between the start and end of the local route must be greater than 10 km, or;
 - express service can be implemented on routes with a one-way distance of less than 10 km if the average customer trip length is 60% or more of the local route's one-way distance.
- Economic
 - the new service must attract a minimum number of new customers for every dollar spent

If a corridor meets the service warrants, a limited stop service can be applied to the corridor.

- Limited stop
 - major intersections and nodes serving 50% in total of the transit corridor ridership at minimum; and
 - average stop spacing should be within 800 to 1,200 metres

New express bus stops can be added to an existing service provided that the resulting service change does not violate any of the preceding demand, speed and economic standards and the service change is a net benefit to customers. Additional consideration should be given to stops that provide transfer opportunities to other routes for customers.

5.2.2 Tier 1 Express Service

Tier 1 express bus service will be considered when all of the conditions for Tier 2 express bus services are met in addition to the following conditions:

- Minimum Span of Service
 - Weekdays: morning & afternoon peak, midday, early evening (approximately 6:00 am to 10:00 pm)
 - Weekends: morning & afternoon (approximately 8:00 am to 7:00 pm)
- Service Frequency
 - 10 min or better (during peak periods)
 - 15 min or better (outside of peak periods)
- Economic
 - the new service must attract a minimum number of new customers for every dollar spent
- Strategic
 - the corridor has been identified as a future rapid transit corridor or fills gaps in the rapid transit network as defined in Metrolinx's Regional Transit Plan and the City's Official Plan; or
 - the express service is able to support a minimum of 10,000 weekday customer-trips

If a corridor meets the Tier 1 service standards, a limited stop service will be established if it does not already exist. The Tier 1 services would stop at major intersections and nodes.

New express bus stops can be added to the existing service provided that the resulting service change does not violate any of the preceding demand, speed and economic standards and the service change is a net benefit to customers.

5.2.3 Local Bus Service Guidelines

When Tier 1 and Tier 2 express bus services are introduced on a corridor, the following guidelines should be considered for changes to the frequency of overlapping local bus service.

- If the existing local bus service is every ten minutes or better, the local service headway should not be widened more than 50%;
- If the existing local bus service is ten minutes or greater, the local service headway should not be widened more than 25%; and
- If the existing local bus service is part of the Ten Minute Network, headways should not be widened to violate the frequent network policy.

5.3 Community Bus Service Warrant

Community bus routes are part of the TTC's Family of Services and act as an intermediary between conventional and Wheel-Trans service. New or modified routes should be designed to capture some of the door-to-door trips that would otherwise be taken by conditionally eligible Wheel-Trans customers.

A community bus route should be considered for operation if the following conditions are met:

- Areas of the city where the population density of seniors over the age of 65 is above average; (measured using Statistics Canada Census Tracts);
- Wheel-Trans is making 25-30 short-distance trips (< 7 km) daily in a concentrated area of the city to common destinations, and these trips could be accommodated on conventional services.

Access distance to the route for targeted customers (as outlined above) should not exceed a walk distance of 175 metres. This figure is in line with the average walking speed for seniors, 1 meter per second, and an average route access time of 2.5 to 3 minutes. Service to larger destinations and designated seniors' apartments should directly enter the driveway and serve the front door when possible. In general, routes should be implemented in areas where they do not largely overlap conventional services.

A community bus route should serve:

- A major shopping facility with a grocery store, bank and pharmacy
- Hospital or major medical centre
- Community centre
- Library
- Other points of interest or cultural centres

Community bus route ridership is closely linked to demographic patterns and the availability of a niche set of trip generators. Therefore, frequent monitoring of demographic changes and the opening and closing of new shopping, health and community centres is required to ensure that routes continue to serve their intended customers and meet minimum performance standards.

6 Service Evaluation

The TTC regularly evaluates the performance of its services. The following sections outline the various ways in which service is evaluated to ensure that available resources are being used in the most effective manner.

6.1 Annual Route Performance Review

The Annual Route Performance Review provides a process with which to measure and evaluate route performance on a year-to-year basis. Under this program existing services are evaluated against the Performance Targets found in **Section 4** and measured against the Quality of Service Standards identified in **Section 3**. The Annual Route Performance Review will be published in the Annual Service Plan.

The Annual Route Performance Review will include:

- a description of the performance of existing services; and
- a list of poor performing routes and time periods which are subject to compulsory review to recommend a change to improve or remove the service as part of the Annual Service Plan.

6.2 Major Service Changes

Major service changes are evaluated during the development of the Annual Service Plan. The process begins by assessing poor performing routes for improvements including an additional equity-based productivity assessment, if applicable, to determine if route changes are required. The plan also consists of a comparative evaluation of all proposed service changes in order to determine which proposals represent the best allocation of available resources.

During this process routes recommended for assessment from the annual performance review, in addition to feedback from customers and TTC staff, will be evaluated. Based on this analysis, TTC staff will propose major service changes. Minor service changes may also be identified at this time; however, they may be implemented as soon as possible, rather than waiting for the Annual Service Plan.

Major service changes which meet the performance standards and whose economic performance is expected to meet the minimum value for the customer change per dollar of net cost change are referred to the comparative evaluation process. The comparative evaluation process provides an objective and systematic procedure to rank these service changes with respect to their passenger and community benefits, compared to the cost of providing the services. This ranking provides an indication of how best to allocate limited TTC resources to obtain the most benefits from among the service changes proposed.

The proposed service increases are ranked using the number of customers gained per dollar spent: those that garner the most new passengers at the lowest incremental cost are ranked highest priority for implementation. The proposed service reductions are ranked using the customers lost per dollar saved: those that save the most money with the lowest loss of passengers are ranked highest priority for implementation.

Other evaluation criteria are also used in the comparative evaluation, as appropriate, to determine the rank of service change proposals. For example, higher priority would be given to a proposed change that improved a route's performance on one or more of the service standards. After the rankings are completed, the savings from the major service reductions are compared to the cost of major service enhancements to help select the proposed service changes. The goal is to maximize ridership and service performance in a cost-effective manner.

Recommended major service changes resulting from this analysis are included in the Annual Service Plan.

6.3 Ridership Monitoring and Service Adjustments

TTC staff are continuously adjusting transit service levels and hours of operation to match changing customer needs. Ridership counts, customer communications and observations from operating staff are reviewed and analyzed. When passenger counts show that services are overcrowded, the service is made more frequent to increase the passenger-carrying capacity. Service increases are guided by the vehicle crowding standards. Adjustments can also be made to the start and finish times of service, running time and to the scheduled trip times. Minor routing changes using weighted passenger minutes (see **Section 5.1.1**) can also be made. These changes are implemented through the Board Period process, subject to the availability of operating resources in the budget.

6.4 Review of Customer Feedback

TTC staff are constantly reviewing suggestions and complaints from customers. This source of input provides additional information for adjusting service with respect to the intervals between vehicles, the start and finish times and other service details.

6.5 Route Management

Each operating division is constantly measuring and monitoring service reliability and operations. The results are based on the real-life, day-to-day observations of operating staff and the input they receive from customers and are used to improve TTC service.

6.6 Post-Implementation Reviews

Every new service that the TTC introduces is initially operated for a trial period of at least twelve months, during which the service is promoted, and a consistent ridership level becomes

established. Monitoring will be performed at regular intervals to ensure that the new service is trending towards the appropriate standard. A formal evaluation will be conducted after twelve months, the performance of the route is reviewed, and a recommendation is made regarding its future. Service changes are reviewed to ensure that the original objective of better service for customers has been met. New routes, extensions and additional periods of service, which have been introduced at an additional cost, undergo a financial review to check that the service meets the TTC's financial standard. The review also considers comments that have been received from customers and the experience that has been gained in operating the service.

A service change which has met its performance objectives is recommended to be made a regular part of the TTC system. If a service change has been unsuccessful in some way, then a recommendation is made to either make further changes or to remove the service.

The compulsory post-implementation review of every trial of a service change ensures that the success or failure of every service change is assessed consistently and fairly and that there is full accountability to the TTC on matters which affect the service that is provided to customers. These reviews are included in the Annual Service Plan.

Appendix 1 – An Equity Lens for Transit Service Planning

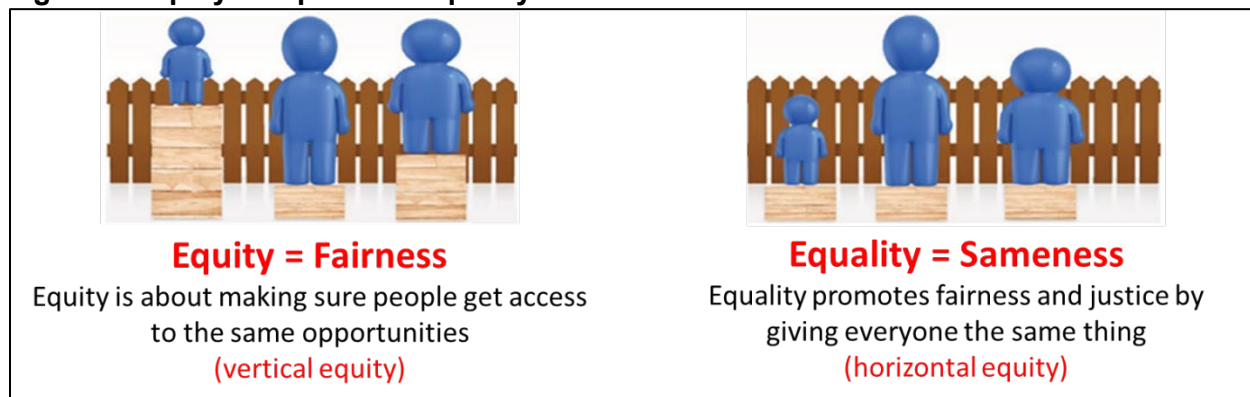
The City of Toronto and the TTC are committed to fairness, access and equity for all. In order to support improved socio-economic vitality and advance favourable outcomes for diverse equity-seeking groups, as envisioned in the *Toronto Poverty Reduction Strategy* and *Toronto Strong Neighbourhoods 2020 Strategy*, the TTC applies an equity lens to transit service planning consultation and route productivity performance measure.

Equity compared to equality

There is a common misconception that equity and equality mean the same thing. The concept of equity ensures that each individual is treated in a fair and just manner. An equitable transit system enables everyone to access the same social and economic opportunities by addressing systemic barriers and historical inequities. This allows all equity-seeking groups to have the same opportunities for social and economic participation.

In contrast, equality assumes that each individual starts out on equal footing and receives equal treatment from the beginning. An example of equity compared to equality is shown in **Figure 1**.

Figure 1: Equity compared to equality



Equity-focused consultation

All major service changes and plans require public consultation. To strengthen and grow the relationship between TTC and customers, TTC staff will conduct regular public consultation with diverse public and community partners.

The most appropriate and respectful consultation efforts to engage with equity-seeking groups are used to ensure that the perspectives of those disproportionately impacted by policy and service changes are considered. Through COVID-19 lessons learned, we found that three key customer groups continued to rely on the TTC during this period: people with low income, women and shift workers. In addition, we understand that youth are often under-represented in the engagement and decision-making process. In an effort to create a focused engagement opportunity to engage with these groups, the TTC's consultation process includes a Youth Ambassador Program, focus groups and community partner meetings.

- The Youth Ambassador Program recruits youth aged 18-29 in the engagement process to target a key demographic that is often under-represented in decision-making.
- Focus groups are a deliberate approach that ensures further engagement is conducted to gather more detailed feedback. This method allows us to provide people with low income, women and shift-workers an opportunity to share their perspectives and ideas.
- Community partner meetings are conducted to gather feedback from external public groups. We continue to expand our list of community partners to include specific groups and work with the City. This expansion allows us to add diverse groups such as women-centred groups to ensure they are represented.

Further work is done to track the demographic characteristics of participants to monitor engagement levels of equity-seeking populations. This helps inform future engagement efforts and determine if further efforts are required to reach under-represented populations.

TTC Staff will perform the following equity assessment for major service changes identified through the Annual Service Plan process:

- Propose a major service change;
- Determine alternatives, if any;
- Evaluate the impact of the proposed change based on performance and economic metrics;
- Consult with the public, including consultation with representatives from equity-seeking groups (Youth Ambassadors, focus groups, community partner meetings and online surveys);
- If possible, refine the changes based on feedback from the consultation;
- Document the process for transparency, including any measures taken to avoid, mitigate or minimize impacts on equity-seeking groups; and
- Make final recommendations in the ASP for Board approval.

Equity-based productivity measure

Boardings on routes have an immense impact on the viability of a route when considering performance measures including service productivity, economic productivity and service levels. If the average boardings per revenue service hour on a route are too low then the route is reviewed for potential service changes to improve productivity (e.g. reduced periods of service or frequency, route re-alignment, etc.).

As part of the *Toronto Strong Neighbourhoods 2020 Strategy*, the City developed a Neighbourhood Equity Index to rank neighbourhoods across the city, using the *Urban Health Equity Assessment and Response Tool (Urban HEART)* as a basis. This tool was developed by international researchers to assess inequality and plan a collaborative response. Based on the ranking, the lowest-ranked 31 neighbourhoods out of a total of 140 across the city are currently designated as Neighbourhood Improvement Areas (NIAs). These areas are shown in **Figure 2** below.

TTC's route productivity measure requires local bus and streetcar service to generate a minimum number of boardings per revenue vehicle hour: 20 in peak periods and 10 during off peak periods. The new policy applies a 125% factor to customer-trips (boardings + alightings / 2) at transit stops in or within 400-metres of residential parts of Neighbourhood Improvement Areas (NIAs) (e.g. 4 boardings = 5 weighted boardings). For the purposes of this measure, the NIAs were narrowed to exclude non-residential areas such as ravines and industrial lands, as shown in **Figure 3**, to reduce the effect on measuring transit productivity that may occur if the full NIAs were used. This policy has two effects. It potentially sustains low performing routes and, vice versa, it potentially justifies new service which would otherwise not meet standards.

Figure 2: Current Toronto Neighbourhood Improvement Areas

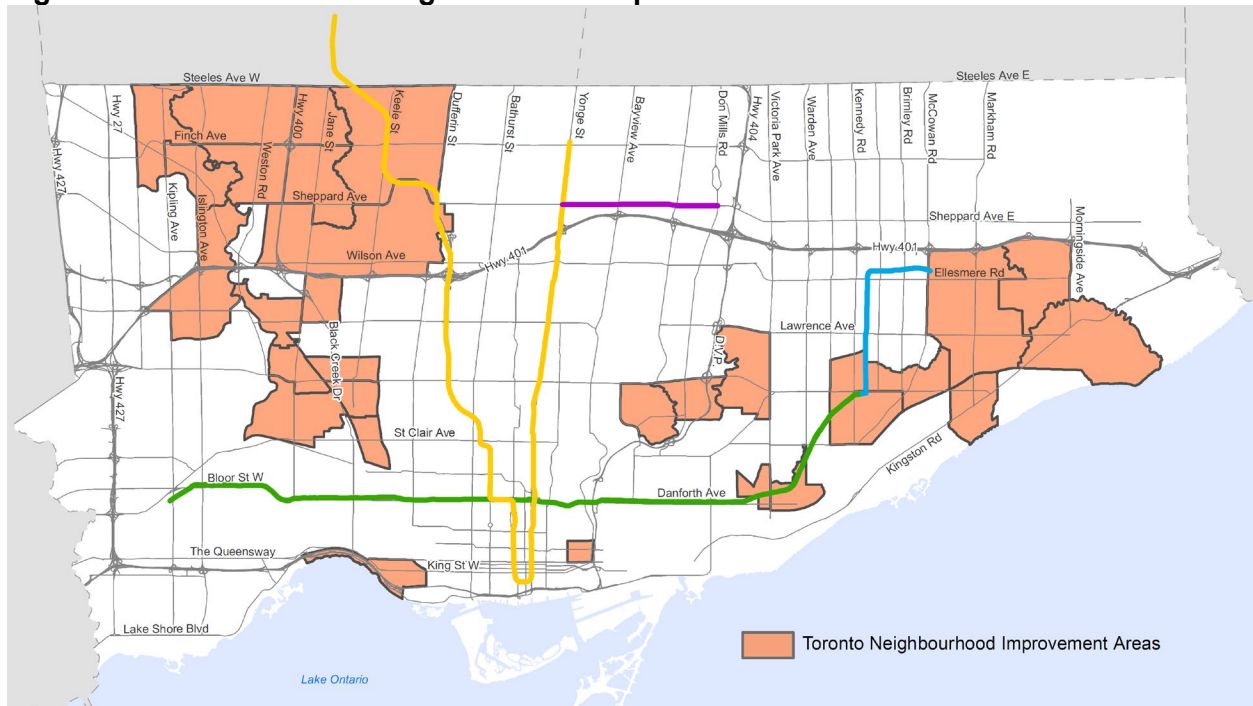
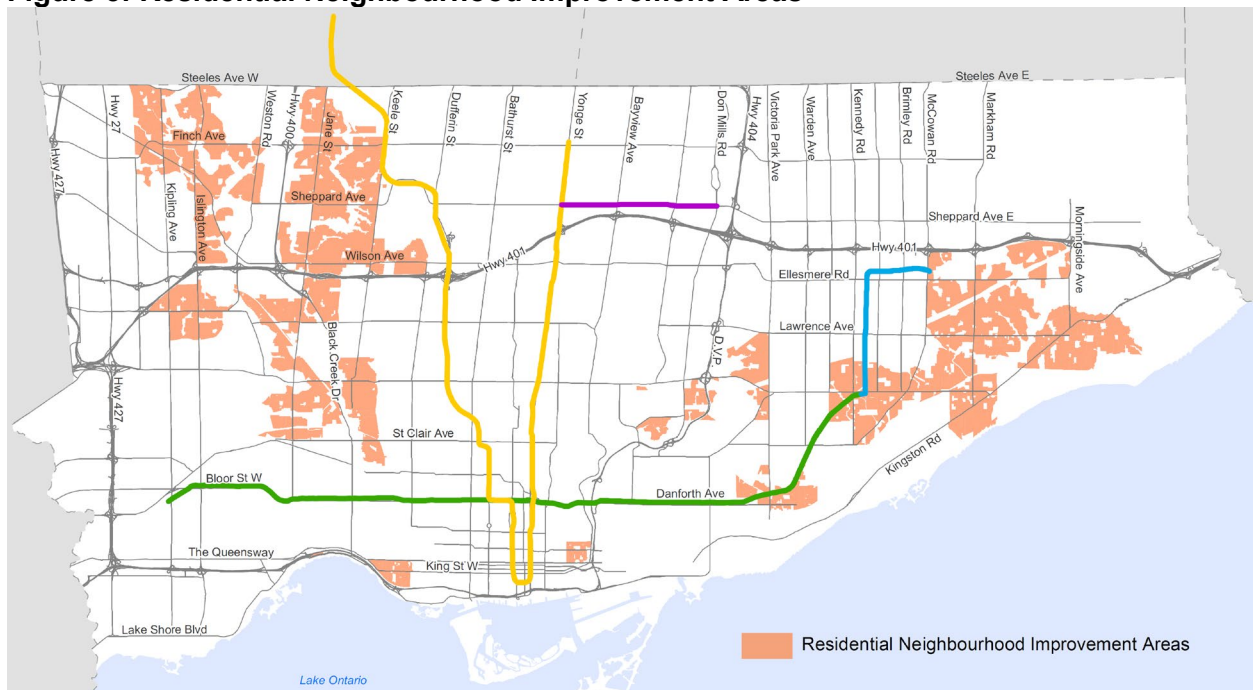


Figure 3: Residential Neighbourhood Improvement Areas



Appendix 2 - Technical Background Paper – Change in Ridership per Net Dollar

The TTC measures return on investment through the change in ridership per net dollar metric. The goal of this measure is to ensure that service changes achieve better ridership results than would be achieved through fare changes.

The metric compares services changes to fare changes because both result in a) changes to ridership and b) changes to subsidy. Service increases and fare reductions result in increases in ridership and subsidy. Service reductions and fare increases result in reductions in ridership and subsidy.

As seen in the table below, ridership effects from service and fare changes balance at 0.11 customers gained or lost per dollar spent or saved.

The table shows that a reduction in fare will gain 11 new customers per \$100 spent. An increase in fare will lose 11 customers per \$100 saved. All service changes (outside changes required for passenger comfort and schedule adherence) must do better than this threshold. Service increases must gain 11 or more new customers per \$100 spent and service reductions must lose less than 11 customers per \$100 saved to be worthwhile. This metric is not intended to replace the cost recovery targets set through the budget process but is intended to ensure service changes yield the best results.

| |
|---|
| Customers Gained or Lost per Dollar of Subsidy Adjustment from a Fare Change |
| 2023 Inputs Annual Ridership: 396.3M Annual Fare Revenue \$935.8M Average Revenue Per Passenger: \$2.36 Assumed Fare Elasticity: -0.20 |
| For a 10% Fare Increase / Decrease: Annual Passengers Gained / Lost: $(396.3\text{M} \times -0.20 \times .1) = 7.9\text{M}$ New Annual Fare Revenue: $((396.3\text{M} - 7.9\text{M}) \times \$2.36 \times 1.1) = \$1,008.8\text{M}$ Additional Fare Revenue: $(\$1,008.8\text{M} - \$935.8\text{M}) = \$73.0\text{M}$ |
| Passengers Gained or Lost per Dollar of Adjusted Subsidy $(7.9\text{M} / \$73.0\text{M}) = 0.11$ |

The standard is applied this way: If additional subsidy is available, new services will not be introduced if the number of customers gained per dollar spent is below 0.11, as the additional funds would be better spent to defer or decrease the average fare in order to grow ridership. Services which are on trial will be eliminated if the number of customers gained per dollar spent was below 0.11. Other services which are already being operated will be modified to reduce their costs or to increase fare revenue if the number of customers gained per dollar spent is below 0.11. If no suitable changes can be found for routes on which the number of customers gained per dollar spent is under 0.11, and if service reductions are required, either because of declining ridership or reductions in funding, then these services would be recommended for removal.

If service cuts were to be required because of reductions in funding or because of declines in ridership, the services with the poorest financial performance would be the ones selected to be removed. This would ensure that the service cuts would result in the least possible decline in ridership and thus the least possible loss of fare revenue.

This systematic approach of measuring financial performance, matching supply and demand and determining the effects on customers ensures that, if services must be reduced to re-allocate resources or to meet budgetary requirements, the reductions will be made where the removal of service would have the least detrimental effect on customers' travel needs and the TTC's financial situation.

Appendix 3 – Comparison of Effect on Customers (Weighted Travel Time)

Components of a transit trip

There are four main components of a transit trip: walking from the origin to a stop or station (and walking from the station or stop to the final destination), waiting for the transit vehicle to arrive, riding in the vehicle and transferring from one vehicle to another. Customers may perceive these trip components differently depending on the circumstances under which the time is spent. Accordingly, the journey time of a trip, as perceived by the customer, can be defined as the sum of walking, waiting, in-vehicle and transfer time across all trip components, where the time for each trip component is weighted based on the average customer's perception. This section discusses these components in more detail and explores factors highlighted in the literature and incorporated by other transit agencies or travel demand models.

In-Vehicle Travel Time

Research indicates that time spent aboard transit vehicles (in-vehicle travel time or IVTT) is generally the least onerous part of a trip and is perceived by customers as taking approximately as long as it does in reality. This is because when a customer is travelling on the transit vehicle, there is clear progress towards the destination. In addition, reliability is a major factor impacting customers' satisfaction as variability and uncertainty of travel times increase the risk of customers being late to their planned activities.

In-Vehicle Crowding (Congestion)

Our research indicates that customers perceive IVTT more negatively (and hence longer) if the transit vehicle is crowded. In-vehicle crowding is often used as an indication of customer comfort, which affects their perceived IVTT. Crowding's impact on perceived travel times is best assessed through detailed computer modelling, such as a transit assignment simulation, as it requires numerous iterations. Therefore, it is not recommended for use as part of the customer-minutes evaluation framework.

Walk Time

A significant factor impacting customers' trip experience is walk time or distance that they overcome to access a transit stop or station. Customers' perception of walk time also depends on their walking experience and factors such as walkability, safety and weather. Customers often have a negative perception of walk time since walking requires a greater effort than the time they spend in the transit vehicle and may occur in a less pleasant environment.

Wait Time

Transit customers perceive wait time as longer than it is in reality because it is perceived as a "delay" or "disruption" to progress towards their final destination. This perception is highly

dependent on on-time performance and reliability of the transit service. Customers perceive the service as reliable when its arrival is predictable which results in consistent wait times. Service that is unreliable seems to take longer than it actually does and negatively impacts customers' travel time perception. Our research indicates that the perception of long wait times can be mitigated through the presence of stop or station amenities including real-time information (RTI) and a feeling of safety and security.

Transfers

Transfers are essential parts of a transit system as they improve operational efficiency and increase destinations that are accessible to customers. According to the literature, similar to wait time, customers' perception of transfers is influenced by service-related factors such as transit mode, frequency, on-time performance, amenities and a feeling of safety, as well as customer-related factors like frequency of use and familiarity with the transit system. In general, customers perceive transferring inconvenient and associate a higher inconvenience to surface/bus transfers compared to rail-based modes. Research attributes this preference to level of service frequency and quality of the transfer environment.

Fares

Fares are usually captured as a disutility or converted as a generalized cost in travel demand modeling which in turn impacts the transit assignment.

At this time, the TTC's current flat fare system reduces the importance of fares when evaluating service change proposals through the customer-minute evaluation framework.

Use of weights in the application of service standards

Transit planners estimate weighted travel times when they are investigating service changes. These service changes can be in any of the following forms:

- introducing a new service
- re-allocation of service
- change in routing
- change in speed (e.g. TSP measures)
- change in hours of operation

The above service changes could result in any of the four transit trip components being affected. For example, a change in routing could cause customers to have a longer/shorter walk and/or a longer/shorter in-vehicle travel time.

The weights that are applied to each component of a trip were developed from research based on stated preference surveys and travel behaviour data and were validated through a recent calibration of our transit assignment model in EMME/4 using detailed transit travel information from the 2016 Transportation Tomorrow Survey (TTS) and observed counts. With the use of these weights, it is possible to predict customers' travel patterns and measure how proposed service changes impact them.

A calibration of our model in October 2019 resulted in the following weights which will be used by transit planners when investigating service changes.

| Trip Component | Weight |
|---|---------------|
| Each minute of effective in-vehicle travel time | 1.0 |
| Each minute of effective waiting time | 1.3 |
| Each minute of walking time | 1.8 |
| Each rail transfer | 1 |
| Each right-of-way surface transfer | 2 |
| Each mixed-traffic surface transfer | 6 |

These weights imply, then, that 1 minute of walking time is equivalent to 1.8 minutes of in-vehicle travelling time, that 1 minute of waiting time is equivalent to 1.3 minutes of in-vehicle travel time, and that a transfer to a surface route that operates in mixed-use traffic is equivalent to 6 minutes of in-vehicle travel time.

Additionally, to capture a better representation of actual travel conditions and capture reliability, we added mode-specific measures for travel time and headway variability to our transit assignment model that will be carried through to the customer-minutes evaluation framework. Observed in-vehicle travel times and wait times (headways) shall also be used in the calculations to the highest degree as possible rather than scheduled values. These observations shall also be leveraged to predict travel time, wait time and reliability changes.

To make recommendations on proposed service changes, the change in weighted travel time is calculated for each group of customers who are affected by a change, both those for whom the change will improve their service and those for whom the change will cause an inconvenience. The change in time of each component is multiplied by the number of customers affected by the change and by the weight of the component. The numbers for all the groups are then added to arrive at a change in weighted travel time.

Proposals which have an overall benefit for customers are those with a net reduction in weighted travel time. These beneficial proposals will also, over time, attract increased numbers of customers to the TTC's transit services.