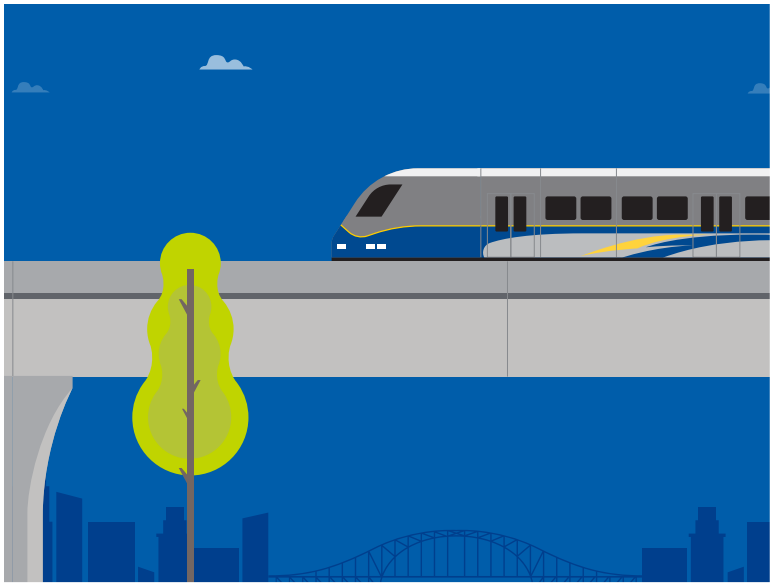
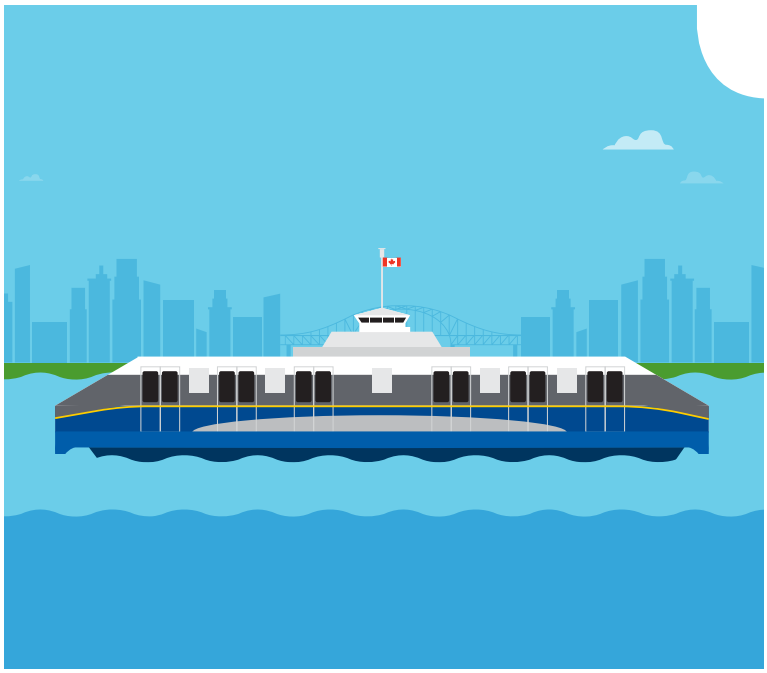


2017 Transit Service Performance Review

Bus and SeaBus

Report Definitions & Assumptions

TRANSLINK



The TSPR report was developed using a number of assumptions and calculations. It relies on a number of important definitions. This section outlines those definitions, assumptions and calculations for bus and SeaBus that are most critical to understanding this material.

Key Characteristics

Sub-Region of Primary Service

Bus routes are allocated to one sub-region based on their geographic location (even though they may serve two or more). Metro Vancouver is divided into eight sub-regions:

- Burnaby/New Westminster
- Ladner/South Delta/Tsawwassen
- Maple Ridge/Pitt Meadows
- Northeast Sector
- North Shore
- Richmond
- South of Fraser
- Vancouver/UBC

These sub-regions are primarily used in TransLink's Area Transit Planning process for the purpose of recognizing regional differences and aligning local plans with transit planning. Dividing the Metro Vancouver area into sub-regions allows for enhanced local involvement in transit planning and creation of a vision for the future within a sub-regional context, addressing land use, transit supply and supporting infrastructure.

Predominant Vehicle Type

This indicator characterizes the predominantly used scheduled vehicle type for the given bus route. Bus vehicle types and average capacities are classified as follows:

Vehicle Type	Average Seated Capacity	Average Total Capacity
Standard Trolley (40' or 12m)	31	47
Articulated Trolley (60' or 18m)	49	70
Standard Bus (40' or 12m)	35	50
Articulated Bus (60' or 18m)	48	75
Highway Coach	47	50
Mini-Bus	20	24

Population (400m Buffer)

Population density is a key contributor to transit ridership. This indicator shows the number of people who live within 400 metres (800 metres for SeaBus) of the transit service, i.e. from the centreline of each bus route.

Employment (400m Buffer)

Employment density is also a key contributor to transit ridership. This indicator shows the number of jobs within 400 metres (800 metres for SeaBus) of the transit service, i.e. from the centreline of each bus route.

Service Type

This indicator shows the service type category of each bus route. All bus and rail routes are categorized based on purpose, frequency, and hours of operation. TransLink's 2018 Transit Service Guidelines (TSGs) provides a range of transit service types categorized into seven categories, as shown in the following table.

Service Type	Characteristics
Rapid	10 minutes or better frequency throughout the day and evening, every day; predominantly uses exclusive right-of-way like a bus-only lane or rail corridor; could be rail or bus
All Day Frequent	15 minutes or better frequency throughout the day and evening, every day (includes B-Lines as they currently exist)
Peak Frequent	15 minutes or better frequency in peak period and/or in peak direction; less frequent at other times
Standard	15 to 30 minutes frequency throughout the day and evening, every day
Basic	30 to 60 minutes frequency on weekdays; may or may not operate throughout the entire day or 7 days per week
Peak Only – Limited	service offered only in peak periods and only on weekdays; service frequency may vary.
Special	special services that perform unique purposes; unlikely to be duplicated elsewhere; includes NightBus, SeaBus, West Coast Express

Average One-Way Trip Distance

Average one-way route distance in kilometres based on the Fall 2017 sheet, including any special patterns and short turns a route may have. As an average, this figure may not reflect the most dominant or longest trip pattern.

Service Changes

Comments regarding service changes implemented between December 13, 2010, and December 17, 2017. Service changes implemented after December 17, 2017, are not included and will be addressed in the next version of the TSPR report.

Ridership

Boarding

A Boarding represents each time a customer enters a fare paid zone using Compass fare media or other proof of payment. Transfers are counted as additional boardings. If a customer transfers between two vehicles (including different modes) to reach a destination, that customer would generate two boardings.

Annual APC Boardings

This indicator shows the total number of annual 2017 APC boardings associated with the given bus route which does not consider any transfers between bus routes or other transit modes. APC data for the entire year are used. In rare cases, there are no trip samples for certain routes for an entire sheet. In these situations, averages by line and by day-type from the remainder of the year are used to fill in any blanks. The resulting annual boardings are an approximation of the total boardings for the given bus route and may produce a few outliers.

Average Daily APC Boardings by Day Type

These indicators illustrate the number of average daily APC boardings associated with a given bus route, organized by day type (average weekday – Monday to Friday, Saturday, Sunday/Holiday).

$$= \frac{Annual\ APC\ Boardings\ by\ Day\ Type}{\#\ of\ Days\ (by\ Day\ Type)\ per\ Year}$$

Cost

Annual Revenue Hours (ARH)

Revenue hours include running time and recovery time at the ends of a given bus route (also commonly referred to as layover), but do not include deadhead; i.e. the time it takes for a vehicle to travel between the depot and its designated route at the beginning and end of service.

= Running Time + Recovery Time

The methodology used to calculated Annual Revenue

Hours was changed starting in 2016 and first used for the TSPR 2016. Previously, revenue hours were extrapolated from three days in the Fall into the entire year. Since 2016, the actual revenue hours for all 365 (or 366) days were taken to better reflect seasonal variations in revenue hours across the full calendar year. Therefore, changes in ARHs before 2016 may be a result of this methodology change and do not represent actual changes to service levels or schedules.

Furthermore, in previous TSPRs we defined revenue hours as including running time and recovery time, but the values given were understated because they failed to include the correct values for recovery time.

For the above two reasons, we adjusted and re-estimated annual revenue hours between 2013 and 2016 for this TSPR. Thus, historical revenue hour values published in this 2017 report might differ from those published in previous TSPRs. Direct comparisons cannot be made between separate reports.

Annual Service Hours (ASH)

The unit by which the supply of bus and SeaBus transit service is measured. One service hour is equal to one vehicle on the road (or water) for one hour. These values include running time, recovery time at the ends of a given bus route (also commonly referred to as layover), and deadhead (time to and from the depot).

= Running Time + Recovery Time + Deadhead Time

Thus, the difference between revenue and service hours is that the latter include deadhead time, whereas revenue hours exclude deadhead time.

In previous, TSPRs, we only reported annual revenue hours. For the 2017 TSPR, it is the first time we report both revenue hours and service hours.

Annual Service Cost

Annual Service Cost describes the cost to provide one year of service.

*= Annual Service Hours * Average Cost per Service Hour*

Cost per service hour is the average cost to provide one hour of bus or SeaBus service. The cost can vary by time of day and vehicle and include the following: wages for operators and training, fleet maintenance and overhaul, trolley overhead, road services and inventory management, materials, fuel and insurance for revenue vehicles.

For the 2017 TSPR, the following average cost per service hour have been used:

- **Conventional Bus** (12/18m)– $103
- **Minibus (Community Shuttles)** – $66
- **SeaBus** – $805

The values used in previous TSPR reports are slightly different, and are no longer used in this report. The values used in this 2017 TSPR represent the latest figures determined in collaboration with Coast Mountain Bus Company (CMBC) Finance. These values have been used to refine cost estimates between 2013 and 2017. The TSPR uses a unified cost for all five years to remove external variations, which are out of the scope of this review.

In addition, annual revenue hours were used to calculate annual service cost in previous TSPRs. Starting in 2017, we used service hours (replacing revenue hours) to calculate service cost. Service hours have also been used to refine cost estimates between 2013 and 2017.

Thus, the values for annual service cost in the 2017 TSPR for 2013-2017 differ from those published in previous TSPRs and direct comparisons cannot be made between separate reports.

Service Cost per APC Boarding

As a way to evaluate the cost-effectiveness of the given bus service, this indicator measures the cost of providing revenue service compared to the total number of boardings generated by that service. Having efficient and productive ridership-generating services helps to off-set costs of providing service in other areas.

= Annual Service Cost / Annual APC Boardings

The annual service cost differentiates between vehicle types and utilizes the cost per service hour discussed above. This indicator accounts for differences in ridership, service hours and differentiates between vehicle types. However, this metric should not be used as 'cost recovery' as it does not include fare revenue and does not consider transfers.

Due to the change in methodology and input to calculate service cost, values for this indicator (2013 to 2017) will also differ from those published in previous TSPRs and direct comparisons cannot be made between separate reports.

Utilization

Average APC Boardings per Revenue Hour[1]

This indicator measures the total volume of ridership as compared to the supply of transit service.

= Annual APC Boardings / Annual Revenue Hours

Boardings per revenue hour account for total passenger activity and consider the length of time a vehicle is in revenue-generating service. A disadvantage of this measure is that it does not take into consideration the size of the vehicle or the operating cost of different vehicle types. There are different expectations for the productivity depending on vehicle type (e.g. articulated buses vs. standard vs. minibuses). As such, boardings per revenue hour should be used in conjunction with other indicators to give a more holistic view of service performance.

Due to the change in methodology to revenue hours, values for this indicator (2013 to 2017) will also differ from those published in previous TSPRs and direct comparisons cannot be made between separate reports.

Average Passenger Turnover

This indicator measures the total number of APC boardings compared to the total number of spaces provided by transit vehicles.

$$= \frac{\textit{Avg. Boardings per Trip}}{\textit{Avg. Vehicle Capacity}}$$

weighted by the number of stops

Passenger turnover can be used to measure the degree to which customers are using the number of seats and spaces provided on a given route. In many cases it is possible for passenger turnover to be greater than 100%. This indicates that a service is generating multiple passenger boardings and alightings using the same number of spaces; i.e. same spaces being used by different passengers along the route.

A disadvantage of passenger turnover is that it does not consider the length of time a vehicle is on the road. As such, it favors longer services, with a greater number of stops, which have a greater opportunity to generate boardings.

Average Peak Passenger Load (Bi-directional)

This indicator is a measure of how many people are on board a vehicle at its busiest segment along its route. It helps to determine how crowded the service becomes while in service.

It is useful for analysis on an individual route on a trip-by trip or time period-by-time period basis, but loses value when aggregated to a sub-regional or system-wide level. Peak passenger loads consider the size of the vehicle, but not the length of time the vehicle spends in revenue service.

Average Peak Passenger Load Factor

Related to the previous indicator average peak passenger load factor (PLF) is measured by dividing the average peak passenger load by the number of spaces provided on each trip.

$$= \frac{\textit{Avg. Peak Passenger Load}}{\textit{Avg. Vehicle Capacity}}$$

This indicator refers to the ratio of passengers actually carried versus the capacity of a vehicle expressed as a percentage, where a factor of 84% or more means the vehicle is crowded and 100% or more means that the vehicle is overcrowded. For TransLink's purposes, the number of spaces provided is based on our Transit Service Guidelines as illustrated in the vehicle capacity table above.

[1] Boardings per revenue hour is different from boardings per service hour (service hours include deadhead). This accounts for any differences between the values in this system performance review and values reported through the TransLink Transportation and Financial Plan.

Average Capacity Utilization

This indicator measures the total number of passenger kilometres compared to the capacity-kilometres.

Taking into account how far passengers travel, capacity utilization demonstrates what percentage of delivered capacity is utilized by customers along the entire route.

Capacity utilization, unlike passenger turnover, considers the length of time a vehicle is on the road and compares how available spaces are filled over the length of the route. It favors long, limited-stop services where customers tend to ride from end-to-end, with little opportunity for intermediate boardings and alightings (passenger turnover). The service design of most routes means that the majority of vehicle spaces may only be utilized for a small portion of the route. Therefore, the capacity utilization is typically lower than the peak passenger load factor, which considers only the busiest segment along the route (see above). Due to a lack of data, this indicator is only available for 2016 and 2017.

Reliability

Percentage of Revenue Hours with Overcrowding

This indicator is based on the number of actual annual revenue hours where the average peak passenger load factor (PLF), at the hourly level for each direction of service for a given bus route, is above the overcrowding guidelines (100%).

$$= \frac{Actual\ ARHs\ where\ (PLF > 100\%)}{Actual\ Total\ ARHs}$$

This performance indicator is intended to identify annual revenue hours where buses experience chronic overcrowding. It does not reveal all instances of overcrowding because it relies on averages of sample trips by hour. Thus, customers may still experience overcrowding on some trips, but they may not be captured here if it is not a prolonged and significant issue.

Due to the change in methodology to revenue hours, values for this indicator (2013 to 2017) will also differ from those published in previous TSPRs and direct comparisons cannot be made between separate reports.

Annual Revenue Hours with Overcrowding

This indicator is based on the number of actual annual revenue hours where the average peak passenger load factor (PLF), at the hourly level for each direction of service for a given bus route, is above the overcrowding guidelines (100%).

This performance indicator is intended to identify annual revenue hours where buses experience chronic overcrowding. It does not reveal all instances of overcrowding because it relies on averages of sample trips by hour. Thus, customers may still experience overcrowding on some trips, but they may not be captured here if it is not a prolonged and significant issue.

Unlike other overcrowding measure, Percentage of Revenue Hours with Overcrowding, this measure is no scaled by the total number of ARHs. This means that this measure is sensitive to revenue hour changes, and routes with more scheduled hours will on average have a higher value.

On-Time Performance

On-time performance, or schedule adherence, compares the number of on-time bus departures at timing points to the total number of scheduled bus departures for the route. A bus is considered on-time if it departs at a timing point between one minute before and three minutes after the scheduled time.

$$= \frac{On\text{-}Time\ Bus\ Departures}{Total\ Scheduled\ Bus\ Departures}$$

There are many factors that impact on-time performance such as traffic, construction, collisions, detours, volume of passengers, weather, etc. Routes are monitored in real-time using the Automatic Vehicle Location (AVL) systems, on-street inspections, and the Transit Communications Centre.

Bus Bunching

Bus bunching occurs when two or more transit vehicles, which were scheduled to be evenly spaced running along the same route, instead arrive in the same location at the same time or close to one another. In TransLink's terms, bus bunching is defined as the percentage of bus arrivals at timing points within 25 percent of the scheduled headway of another bus arrival. For example, a route with 12-minute headways would be classified as "bunched" if two vehicles on the route arrive at a timing point within 3 minutes of one another.

This occurs when at least one of the vehicles is unable to keep to its schedule and the vehicle(s) behind catch up to the delayed bus.

The result is unreliable service and longer and more inconsistent effective wait times than scheduled. Another result can be overcrowded vehicles followed closely by near-empty ones. As buses get delayed there will be more people waiting at the next stop than typical. The extra passengers' boarding time makes the bus even later, resulting in even greater delays.

This metric measures all trips throughout the day, including late evenings and weekends when there are fewer causes of delay. Actual customer experiences of bus bunching are likely to be higher, since the majority of ridership occurs during peak periods where bus bunching is more likely.

Average Speed

Average speed is measured for all trips using the route distance and the trip time from the Automatic Vehicle Location systems.

= Trip Distance / Trip Time

Average speed is for all trips at all times of day and includes stop dwell time (time spent unloading and loading passengers). Actual vehicle speed will vary by the volume of passengers, time of day, and day of the week. It is also affected by roadway conditions, such as construction, collisions, detours, weather, etc.

Performance by Day of Week

Some indicators presented on an annual basis above, are broken down by day type and time periods to represent hourly performance by day type. These include:

- Fall Sheet Revenue Hours
- Fall Sheet Service Hours
- Average APC Boardings per Revenue Hour
- Average Peak Passenger Load
- Average Peak Passenger Load Factor

Methodology, data sources and assumptions are similar to the annual measures. It is noteworthy that these hourly indicators by day type have been based on Fall (usually the busiest time period of the year) sheet data only.

In addition, the following two indicators (not presented on an annual basis above) are presented on an hourly and by day type basis:

Average Trips per Clock Hour

This indicator describes the average number of trips of a given bus route by day type and time period. The average number of trips per hour does not take into consideration hours with no scheduled services. For example if a route does not run between 1 am and 5 am, but runs every 15 minutes between 5 am and 6 am, the average trips per clock hour for the 1 am to 6 am time period would be four trips per hour.

Average APC Boardings per Trip

Related to the previous indicator, average APC boardings per trip describes the average number of boardings for a typical bus trip of a given bus route by day type and time period.

Hourly Passenger Volume/Capacity Charts- *SeaBus only*

These charts show average hourly passenger volumes along with hourly SeaBus capacity by day type and direction (southbound to Waterfront or northbound to Lonsdale Quay). Averages are calculated at the clock hour, for all scheduled sailings within that hour. SeaBus capacity is 385 passengers for all vessels.

Data Sources

Bus/SeaBus data for this 2017 TSPR was collected from the following data sources:

Bus APC and AVL Data
Most data was collected from the Automated Passenger Counter (APC) and Automatic Vehicle Location (AVL) systems, consistent with past years. APC units are installed on about 33% of the current bus fleet, which are rotated to sample all bus routes.

SeaBus Turnstile Data

Passenger count data was collected from passenger turnstiles at both SeaBus terminals. Data was collected for every SeaBus sailing, encompassing the complete calendar year (January 1 to December 31) for each year included in this report.

Why not Compass Data for bus?

Both datasets, APC and Compass, are incomplete. Bus APC data are a sample on a route level as discussed above and Compass bus tap-offs would need to be inferred. Therefore, we continue to use APC data on a bus route level because it also includes alightings (exits). In the future, once a data conflation project is completed, we will be switching to a new database taking both data sources, APC and Compass into account.

Service Schedule Data

For determining revenue and service hours, service schedule data was used.

Population/Employment Data

Population and employment numbers are estimated from the Canadian Census by MapInfo and are adjusted for census undercounts. All demographic data is rounded.

Transit Service Guidelines

TransLink's latest Transit Service Guidelines (TSGs) are used to guide some of the indicators in the TSPR, such as TSG Service Type, Vehicle Type and Revenue Hours with Overcrowding.

Limitations of the Analysis

For the purpose of this report, bus system performance refers to fixed-route bus services. This includes services operated by contractors West Vancouver Transit and First Transit. This report only includes limited information on HandyDART services in the Summary of Highlights.

This performance review does not consider external factors that may impact transit ridership including fare increases, fuel prices, economic conditions, and others. All these factors were assumed to have affected equally all services across the transit system and are not analyzed in this performance review.