



BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair
Karl H. Quackenbush, Executive Director, MPO Staff

MEMORANDUM

DATE May 4, 2017
TO Boston Region Metropolitan Planning Organization
FROM Karl H. Quackenbush, Executive Director
RE Work Program for MBTA SFY 2018 National Transit Database: Data Collection and Analysis

Action Required

Review and approval

Proposed Motion

That the Boston Region Metropolitan Planning Organization (MPO), upon the recommendation of the Massachusetts Bay Transportation Authority (MBTA), vote to approve the work program for MBTA 2018 SFY National Transit Database: Data Collection and Analysis, presented in this memorandum

Project Identification

Unified Planning Work Program Classification

Agency and Other Client Transportation Planning Studies and Technical Analyses

CTPS Project Number

14353

Clients

MBTA

Project Supervisor: Robert Guptill

CTPS Project Supervisors

Principal: Annette Demchur

Manager: Andrew Reker

Funding

Future MBTA Contract

Impact on MPO Work

The MPO staff has sufficient resources to complete this work in a capable and timely manner. By undertaking this work, the MPO staff will neither delay the completion of nor reduce the quality of any work in the Unified Planning Work Program.

Background

For many years, in support of the MBTA's National Transit Database (NTD) submittals to the Federal Transit Administration (FTA), Central Transportation Planning Staff (CTPS) has produced passenger-miles traveled and unlinked trip estimates for the MBTA's bus and trackless trolley modes. In state fiscal year (SFY) 1996, the scope of the analysis was expanded to include the heavy rail and light rail transit modes. In SFY 2000, the scope was expanded further to include the MBTA commuter rail mode. Since SFY 2001, CTPS has also produced passenger-miles traveled and unlinked trip estimates for the MBTA's purchased service bus routes (that is, routes for which the MBTA contracts with a private carrier to provide the service). Beginning in SFY 2014, at the request of the FTA, the MBTA reclassified some of its bus routes as rapid bus for NTD reporting.

The table below summarizes the data CTPS collects and processes to estimate the average trip length, passenger-miles traveled, and unlinked trips for each mode, as well as the sources of these data.

Data and Sources for Average Trip Length, Passenger-Miles Traveled, and Unlinked Trip Calculations that CTPS Collects and Processes for the MBTA

Mode and Service Type	Unlinked Trips	Average Trip Length and Passenger-Miles Traveled
Bus (Directly Operated)*	APC data <i>Source: MBTA</i>	APC data <i>Source: MBTA</i>
	Ridecheck data for APC verification <i>Source: CTPS</i>	Ridecheck data for APC verification <i>Source: CTPS</i>
Rapid Bus (Directly Operated)*	APC data <i>Source: MBTA</i>	APC data <i>Source: MBTA</i>
	Ridecheck data for APC verification <i>Source: CTPS</i>	Ridecheck data for APC verification <i>Source: CTPS</i>
Trackless Trolley (Directly Operated)	Ridecheck data <i>Source: CTPS</i>	Ridecheck data <i>Source: CTPS</i>
Bus (Purchased Service)	Private Carrier Revenue Reports <i>Source: MBTA</i>	Ridecheck data <i>Source: CTPS</i>

	Farebox Noninteraction Survey <i>Source: CTPS</i>	
Heavy and Light Rail in the Subway (Directly Operated)	AFC data <i>Source: MBTA</i>	Transit Trip Survey <i>Source: CTPS</i>
	Faregate Noninteraction Survey <i>Source: CTPS</i>	
Light Rail Surface (Directly Operated)	AFC data <i>Source: MBTA</i>	Transit Trip Survey <i>Source: CTPS</i>
	Farebox Noninteraction and Rear-Door Entry Surveys <i>Source: CTPS</i>	
Commuter Rail (Purchased Service)**	N/A	mTicket origin-destination data <i>Source: MBTA</i> Holiday Scheduling Calendar <i>Source: MBTA</i>

* Mode for which CTPS provides data to the MBTA, so that the MBTA can verify their own calculations.

** Mode for which CTPS provides the average trip length estimate, but does not provide a passenger-miles estimate.

AFC= Automated Fare Collection; APC= Automatic Passenger Counter.

In SFY 2014, the FTA began to allow the MBTA to use its automatic passenger counter (APC) data for reporting to the NTD. In SFY 2016, the MBTA directed CTPS to conduct passenger counts on APC-equipped buses for verifying APC data. The MBTA uses these counts, along with its APC data, to estimate the unlinked passenger trips and passenger-miles traveled on its buses and rapid-bus vehicles. CTPS will continue to collect these data in SFY 2018.

For the purchased service bus mode, CTPS began collecting full-route ridecheck data in SFY 2010 rather than collecting data for a random sample of trips. It was determined that the methodology employing full-route ridechecks satisfies the FTA's requirement that the true values for passenger-miles traveled and unlinked trips have a 95 percent probability of falling within 10 percent of the estimates. In addition, this methodology provides ridership and schedule adherence data for each purchased bus route that could be used for planning purposes. In SFY 2018, CTPS will continue to use full-route ridechecks to estimate total passenger-miles traveled and unlinked trips.

Objectives

The objectives of this project are to develop estimates of passenger-miles traveled and unlinked trips for the following MBTA directly operated transportation modes: trackless trolley, heavy rail, and light rail. CTPS will also develop an estimate of the average trip length per passenger for the commuter rail mode and estimates of passenger-miles traveled and unlinked trips for contracted MBTA local bus service. Finally, CTPS will review the MBTA's APC-derived passenger-miles traveled and boarding estimates for the bus and rapid-bus modes.

CTPS will collect the data upon which these estimates will be based in a variety of ways:

- Ridechecks on a sample of APC-equipped buses on the directly operated bus mode
- Full-route ridechecks on the directly operated trackless trolley mode
- Full-route ridechecks, including farebox fare-mix surveys, on the purchased service bus mode
- Transit trip surveys on the heavy rail mode, light rail mode, and gated portions of the rapid-bus mode to determine origin-destination information
- Faregate noninteraction, farebox noninteraction, and rear-door entry surveys from stations or vehicles equipped with automated fare collection (AFC) technology
- Inferred origin-destination information from AFC data, if available from the MBTA or its partners
- Commuter rail ridership data from passenger counts conducted by the MBTA or its contractors, or from the MBTA's mobile ticketing (mTicket) vendor

Work Description

Task 1 Develop Sampling Plans

For the directly operated bus and rapid-bus modes, CTPS will develop a sampling plan for conducting full-route ridechecks on a selection of routes on the MBTA bus and rapid-bus route network. Staff will perform these ridechecks on 125 scheduled trips on selected routes over the course of a single quarter during SFY 2018. The selection of quarters will be determined by CTPS's staffing availability.

For the directly operated trackless trolley mode and purchased service bus mode, CTPS will develop sampling plans for conducting full-route ridechecks on each route. Staff will perform these ridechecks on each scheduled trip for each route, one time for each mode, over the course of a single quarter during SFY 2018. The selection of quarters will be determined by CTPS's staffing availability.

For the heavy rail mode, light rail mode, and gated portions of the rapid-bus mode, staff will develop a sampling plan for passenger surveys that will ensure that there is a random selection of stations over the entire year for all days of the week and all service periods.

For light rail service at surface stops, onboard observations are necessary because not all passengers interact with fare-collection equipment when boarding Green Line and Mattapan High-Speed Line vehicles. CTPS will conduct counts of passengers who do not interact with the farebox. For each car, it may be necessary to have two ridecheckers: one to count the number of rear boardings and the other to count the number of passengers boarding through the front door by category—those who interact with the farebox and those who do not interact with the farebox (the latter include flash-pass trips, children, and fare evaders). Staff will develop a sampling plan that will ensure that these observations are conducted on surface light rail over the entire year for all days of the week and all service periods.

For the commuter rail mode, CTPS may obtain and analyze two potential data sources: data from the MBTA's mobile ticketing vendor and Keolis Commuter Service's spring 2016 passenger counts. No direct data collection is planned for commuter rail.

CTPS will collect as much data as possible through electronic means, using hand-held mobile devices that support CTPS-developed applications, for the following:

- Directly operated bus and rapid-bus boardings and alightings by stop
- Purchased bus and directly operated trackless trolley boardings and alightings by stop and farebox noninteraction counts
- Purchased bus farebox counts
- Transit trip passenger origin-destination surveys
- Faregate noninteraction counts
- Surface light rail front-door passenger counts, including farebox noninteraction, and rear-door boarding counts

Products of Task 1

- Sampling plan for SFY 2018 directly operated bus and rapid-bus ridechecks
- Sampling plan for SFY 2018 purchased bus and directly operated trackless trolley ridechecks and purchased bus farebox counts
- Sampling plan for SFY 2018 passenger surveys
- Sampling plan for SFY 2018 faregate noninteraction counts and surface light rail observations

Task 2 Collect Data

The ridecheck assignments generated by the sampling plans created in Task 1 for the directly operated bus, rapid-bus, and trackless trolley mode and purchased service bus mode will be executed by CTPS. CTPS will classify how purchased bus passengers pay for their trips. For heavy rail and light rail, CTPS will conduct passenger surveys at each of the survey locations, and will conduct counts of the number of passengers passing through faregates—including those who do not interact with the faregates—at survey locations in stations that have faregates. Along Green Line and Mattapan Line surface routes, CTPS will conduct onboard counts of passengers, including those who do not interact with the farebox.

CTPS will perform ridechecks, passenger surveys, and passenger counts, using mobile devices where practicable. The data collected on ridechecks will be uploaded directly to CTPS's bus ridership information database, and these data will be checked for completeness and accuracy. Passenger survey results and passenger count data will be uploaded directly to a different database, and these data also will be checked for completeness and accuracy.

The MBTA will provide CTPS with detailed AFC data for the heavy rail, light rail, and gated portions of the rapid-bus network and APC data for the purposes of verifying directly operated bus unlinked trips and trip length.

Products of Task 2

- APC data for unlinked passenger trips and passenger-miles traveled on the directly operated bus and rapid-bus modes
- Ridecheck data for a selection of directly operated bus and rapid-bus mode trips
- Ridecheck data for purchased bus and directly operated trackless trolley modes
- AFC data for total boardings for directly operated heavy rail, light rail, and gated portions of the rapid-bus mode
- Transit trip survey results
- Noninteraction data for faregates at stations and for fareboxes on the directly operated surface light rail and trackless trolley modes

Task 3 Process Ridecheck, Passenger Survey, and Passenger Count Data

CTPS will process the ridecheck, passenger survey, and passenger count data, including noninteraction data for faregates and fareboxes.

Product of Task 3

Processed ridecheck, passenger survey, and passenger count data

Task 4 Estimate Passenger-Miles Traveled and Unlinked Trips

Subtask 4.1 Estimate Passenger-Miles Traveled and Unlinked Trips for Directly Operated Services

For the MBTA's directly operated bus and rapid-bus modes (excluding the gated Silver Line waterfront stations), CTPS will select some bus trips that have APC-equipped buses to conduct passenger counts for use in APC data verification. CTPS will then provide the results of these counts to the MBTA as reports of vehicle passenger loads and trip summary statistics. The MBTA will use these CTPS-produced results in estimating passenger-miles traveled and unlinked passenger trips. CTPS will then assess the MBTA's estimates of passenger-miles traveled and unlinked passenger trips.

CTPS will obtain AFC faregate passenger counts from the MBTA, which will provide information about the total number of passengers boarding at subway stations on the heavy rail, light rail, or rapid-bus mode. Staff will then estimate the factors that account for the number of transfers between modes, based on the findings of the origin-destination passenger surveys conducted in Task 2 and the processed AFC data. In addition, staff will develop a faregate noninteraction factor from the observations at station survey locations, and will apply the factor to the AFC faregate counts to estimate the total number of unlinked heavy rail and light rail riders attributable to subway unlinked trips.

For light rail surface stops, CTPS will use counts of boarding passengers who do not interact with the farebox to develop a farebox noninteraction factor. Staff will apply this factor to the AFC farebox counts of the total number of passengers on surface light rail. Staff will then apply additional factors to account for transfers made to other light rail lines or to heavy rail lines, which will generate estimates of the total of unlinked light rail and heavy rail riders attributable to light rail surface boardings.

For the heavy rail and light rail modes, CTPS will convert the origin-destination data generated by the passenger surveys and the processed AFC data into estimates of the average passenger-miles traveled per transit mode. The average passenger-miles traveled per passenger will be multiplied by the total number of passengers to yield estimates of the total number of passenger-miles traveled for each mode. CTPS may also generate an estimate of passenger-miles traveled using an origin-destination model.

For the commuter rail mode, CTPS will use one or more of the sources of ridership counts described in Task 1 as the basis for estimating unlinked passenger trips. In the past two years, because conductor audit data were not available, CTPS obtained anonymized origin-destination data from the MBTA's mobile ticketing vendor. That dataset was sufficient for estimating the average passenger-miles traveled per trip. In addition, in SFY 2018, CTPS

will examine Keolis's spring 2016 passenger counts; this dataset should be sufficient for calculating the average passenger-miles traveled per trip. However, CTPS does not produce estimates of unlinked passenger trips for commuter rail, and does not expect to conduct any direct observations of the commuter rail mode.

Subtask 4.2 Estimate Passenger-Miles Traveled and Unlinked Trips for Purchased Bus Services

For purchased bus services, CTPS will produce estimates of passenger-miles traveled and unlinked trips using revenue data from the MBTA and output from CTPS's database of bus ridership information. CTPS will generate estimates of the average farebox deposit, and will then estimate the average trip length per passenger based on ridecheck observations. The total unlinked trips will be estimated by dividing the average farebox deposit by the total revenue. The total passenger-miles traveled will be calculated by multiplying the total unlinked trips by the average trip length per passenger. With the change in the terms of the contract with the Winthrop bus service, CTPS will work with the MBTA to develop procedures to estimate passenger-miles traveled and unlinked trips for these routes.

Product of Task 4

Estimates of passenger-miles traveled and unlinked trips, including a summary by service day of week, for all MBTA modes, except commuter rail

Task 5 Document Results

CTPS will document the results of Task 4 and the methodology of the study in three technical memoranda: one for purchased bus services, one for directly operated services, and one for the commuter rail mode. The technical memoranda will describe the data-collection and analysis processes and present a summary of the results. In addition, CTPS will document the results of Task 4 in a summary table presenting the data for the MBTA's directly operated modes by the service day of week. The MBTA has requested that CTPS transmit a draft copy of the memoranda and table by October 15, 2018, and a final version by October 31, 2018.

Products of Task 5

Three technical memoranda and one table

Task 6 Assist with the Compliance Audit

The FTA requires that an independent auditor review and verify the MBTA's estimates of directly operated bus and rail passenger-miles traveled and unlinked trips. As the agency responsible for these estimates, CTPS will provide any materials and assistance necessary for the audit.

Estimated Schedule

It is estimated that this project will be completed 17 months after the notice to proceed is received. The proposed schedule, by task, is shown in Exhibit 1.

Estimated Cost

The total cost of this project is estimated to be \$152,752. This includes the cost of 98.5 person-weeks of staff time, overhead at the rate of 102.70 percent, and travel. A detailed breakdown of the estimated costs is presented in Exhibit 2.

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Exhibit 1
ESTIMATED SCHEDULE
MBTA SFY 2018 National Transit Database: Data Collection and Analysis

Task	Month																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Develop Sampling Plans	█																
2. Collect Data	█																
3. Process Ridecheck, Passenger Survey, and Passenger Count Data	█																
4. Estimate Passenger-Miles Traveled and Unlinked Trips														█			
5. Document Results														█		A	
6. Assist with Compliance Audit														█			

Products/Milestones

A: Three technical memoranda and table

Exhibit 2
ESTIMATED COST
MBTA SFY 2018 National Transit Database: Data Collection and Analysis

Direct Salary and Overhead										\$152,252
Task	Person-Weeks							Direct Salary	Overhead (102.70%)	Total Cost
	M-1	P-5	P-3	SP-3	SP-1	Temp	Total			
1. Develop Sampling Plans	0.1	0.6	1.0	2.1	1.5	0.5	5.8	\$5,906	\$6,066	\$11,972
2. Collect Data	0.5	0.7	2.6	11.9	22.4	45.5	83.6	\$58,444	\$60,022	\$118,465
3. Process Ridecheck, Passenger Survey, and Passenger Count Data	0.0	0.0	0.8	0.0	0.8	1.0	2.6	\$2,161	\$2,220	\$4,381
4. Estimate Passenger-Miles Traveled and Unlinked Trips	0.0	0.0	3.0	0.0	0.0	0.0	3.0	\$3,756	\$3,857	\$7,613
5. Document Results	0.5	0.2	2.4	0.0	0.0	0.0	3.1	\$4,344	\$4,461	\$8,805
6. Assist with Compliance Audit	0.0	0.0	0.4	0.0	0.0	0.0	0.4	\$501	\$514	\$1,015
Total	1.1	1.5	10.2	14.0	24.7	47.0	98.5	\$75,112	\$77,140	\$152,252
Other Direct Costs										\$500
Travel										\$500
TOTAL COST										\$152,752

Funding