



## BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

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Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair  
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### *WORK PROGRAM*

## MBTA SFY 2021 NATIONAL TRANSIT DATABASE: DATA COLLECTION AND ANALYSIS

JUNE 11, 2020

### Proposed Motion

The Boston Region Metropolitan Planning Organization (MPO) votes to approve this work program.

### Project Identification

Unified Planning Work Program (UPWP) Classification

Agency and Other Client Transportation Planning Studies and Technical Analyses

Project Number 14366

Client

Massachusetts Bay Transportation Authority (MBTA)

*Client Supervisor:* Robert Guptill

Project Supervisors

*Principal:* Annette Demchur

*Manager:* Bradley Putnam

Funding Source

Future MBTA Contract

### Schedule and Budget

Schedule: 18 months from notice to proceed

Budget: \$123,317

Schedule and budget details are shown in Exhibits 1 and 2, respectively.

This budget was developed using a billing overhead rate of 104.89 percent as approved by the Boston Region MPO for state fiscal year (SFY) 2020. Beginning with July 1, 2020, and each July 1 thereafter, the overhead rate will be adjusted to reflect the SFY rate approved by the MPO.

## Relationship to MPO Work

This study is supported in full with non-MPO funding. Committing MPO staff to this project will not impinge on the quality or timeliness of MPO-funded work.

## Background

For many years, in support of the MBTA's National Transit Database (NTD) submittals to the Federal Transit Administration (FTA), the Central Transportation Planning Staff (CTPS) has produced passenger-miles traveled and unlinked trip estimates for the MBTA's bus and trackless trolley modes. In SFY 1996, the scope of the analysis was expanded to include 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 part of the rapid-bus mode for NTD reporting. Beginning in SFY 2017, the MBTA and CTPS decided to use a rolling three-year average for some of the intermediate factors used to derive passenger-miles traveled and unlinked trips.

Table 1 summarizes the data that CTPS collects and processes to estimate the average trip length, passenger-miles traveled, and unlinked trips for each mode, and the sources of these data.

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 directly operated bus and rapid-bus modes. CTPS will continue to collect these data in SFY 2021.

In SFY 2019, some of the purchased service bus routes and all of the directly operated trackless trolley routes began to use APC-equipped vehicles. For these routes, the MBTA used APC data to estimate unlinked trips and passenger-miles traveled. As with directly operated buses, CTPS conducted ridechecks on APC-equipped purchased service buses for verifying APC data. CTPS used full-route ridechecks to estimate total passenger-miles traveled and unlinked passenger trips for non-APC-equipped purchased service bus routes. CTPS will continue to collect these data in SFY 2021.

In SFY 2021, CTPS will begin collecting data to estimate unlinked passenger trips and passenger-miles traveled for temporary bus bridge service.

**Table 1: Data and Sources for Unlinked Passenger Trip and Average Trip Length Calculations**

Mode	Unlinked Passenger Trips							Average Trip Length						
	MB	RB	MB	TT	HR	LR	CR	MB	RB	MB	TT	HR	LR	CR
	DO	DO	PS	DO	DO	DO	PS	DO	DO	PS	DO	DO	DO	PS
<b>CTPS Data</b>														
Ridecheck data for APC verification	X	X	X	X				X	X	X	X			
Full-route ridecheck			X							X				
Noninteraction survey					X	X								
Fare-mix survey			X											
Transit trip survey					X	X						X	X	
<b>MBTA Data</b>														
APC data	X	X	X	X				X	X	X	X			
AFC boardings					X	X								
Revenue reports			X											
ODX data (potential)					X	X						X	X	
Passenger counts (Keolis or CTPS)														X
mTicket data														X

Note: ODX data, if used, would replace transit trip survey data to estimate transfer factors and average trip lengths. AFC = Automated Fare Collection. APC = Automatic Passenger Counter. CR = Commuter Rail. CTPS = Central Transportation Planning Staff. DO = Directly Operated. HR = Heavy Rail. LR = Light Rail. MB = Motorbus. MBTA = Massachusetts Bay Transportation Authority. mTicket = Mobile Ticketing. ODX = Origin-Destination-Transfer Model. PS = Purchased Service (Purchased Transportation, PT, in the NTD). RB = Rapid Bus. TT = Trackless Trolley.

## 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: bus, rapid bus, 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, estimates of passenger-miles traveled and unlinked trips for contracted MBTA local bus service, and estimates of passenger-miles traveled and unlinked trips on temporary bus bridge service. Finally,

CTPS will review the MBTA's APC-derived passenger-miles traveled and boarding estimates.

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

- Ridechecks on a sample of APC-equipped buses on the directly operated bus, rapid bus, trackless trolley, and the purchased service bus modes
- Full-route ridechecks, including farebox fare-mix surveys, on the purchased service bus mode for the routes without APC-equipped buses
- Transit trip surveys on heavy rail, light rail, and rapid-bus modes to determine origin-destination information (transfer rates and average trip lengths)
- Faregate noninteraction, farebox noninteraction, and rear-door entry surveys from stations or Green Line and Mattapan High-Speed Line vehicles equipped with automated fare collection (AFC) technology
- Inferred origin-destination information from AFC data, if available from the MBTA or its partners, to determine origin-destination information (transfer rates and average trip lengths)
- Commuter rail ridership data from passenger counts conducted by the MBTA or its contractors or from the MBTA's mobile ticketing (mTicket) vendor
- Counts of temporary bus bridge passengers during sample periods when portions of rail service are temporarily suspended for maintenance and replaced with bus service

## Work Description

### Task 1 Develop Sampling Plans

For the directly operated bus and rapid bus modes, CTPS will develop a sampling plan for conducting ridechecks on a selection of 60 scheduled trips on each mode over the course of a single quarter during SFY 2021. CTPS's staffing availability will determine the selection of quarters.

For the directly operated trackless trolley mode, CTPS will develop a sampling plan for conducting ridechecks on a selection of 60 scheduled trips over the course of a single quarter during SFY 2021. CTPS's staffing availability will determine the selection of quarters.

For the purchased service bus mode, CTPS will develop a sampling plan for conducting ridechecks on a selection of 60 APC-equipped trips to verify the accuracy of the APC data. CTPS will also develop a sampling plan for conducting full-route ridechecks on the non-APC equipped routes, including fare-mix surveys. CTPS will perform the ridechecks over the course of a single quarter during SFY 2021. CTPS's staffing availability will determine the selection of quarters.

For the heavy rail mode, light rail mode, and rapid-bus mode, CTPS will develop a sampling plan for passenger surveys that will ensure that surveys are conducted at a random selection of stations over the course of an entire year and that the results represent all days of the week and all service periods. CTPS will also conduct noninteraction surveys at the stations.

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 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). CTPS 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 four potential data sources: conductor audits, data from the MBTA's mobile ticketing vendor, Keolis Commuter Services' passenger counts, and CTPS's passenger counts collected as a part of a separate project. No direct data collection is planned for commuter rail.

For the ferry mode, CTPS may obtain and analyze passenger counts or other data from the MBTA's ferry operator. No direct data collection is planned for ferries.

For temporary bus bridge service, CTPS will develop a sampling plan that may involve counting passengers who board or alight buses that are providing substitute service for segments of rail lines that have been temporarily suspended for maintenance.

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

CTPS will work with the MBTA to modify all SFY 2021 sampling plans as needed in response to the COVID-19 pandemic.

#### *Products of Task 1*

- Sampling plan for SFY 2021 directly operated bus and rapid-bus ridechecks
- Sampling plan for SFY 2021 directly operated trackless trolley ridechecks
- Sampling plan for SFY 2021 purchased service bus ridechecks and fare-mix surveys
- Sampling plan for SFY 2021 passenger surveys
- Sampling plan for SFY 2021 faregate noninteraction counts and surface light rail observations

- Sampling plan for SFY 2021 temporary bus bridge counts

## Task 2 Collect Data

The ridecheck assignments generated by the sampling plans created in Task 1 for the directly operated bus mode, the rapid-bus mode, the trackless trolley mode, and the purchased service bus mode will be executed by CTPS. CTPS will classify how passengers on non-APC-equipped purchased service buses 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. For temporary bus bridges, CTPS will count bus boardings or alightings at locations where the MBTA is substituting bus service for regular rail service.

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 will be checked for completeness and accuracy.

The MBTA will provide CTPS with detailed AFC data for the heavy rail, light rail, and trackless trolley modes; monthly and annual fare revenue reports for the purchased service bus routes; and APC data for the purposes of verifying directly operated bus, directly operated trackless trolley, rapid-bus, and APC-equipped purchased service bus unlinked passenger trips and average trip length. If the MBTA concludes that data from the MBTA's origin-destination-transfer model (ODX) is sufficient for NTD reporting purposes, the MBTA will provide CTPS with relevant ODX output in addition to AFC data.

### *Products of Task 2*

- APC data for unlinked passenger trips and passenger-miles traveled on the directly operated bus mode, the rapid-bus mode, the trackless trolley mode, and the purchased service bus mode
- Ridecheck data for a selection of trips on the directly operated bus mode, the rapid-bus mode, the trackless trolley mode, and the purchased service bus mode with APC-equipped buses for verifying APC data
- Full-route ridecheck data for the purchased service bus mode without APC-equipped buses
- AFC data for total boardings for directly operated heavy rail, light rail, and trackless trolley
- Transit trip survey results

- Noninteraction data for faregates at stations and for fareboxes on the directly operated surface light rail mode
- Potential ODX transfer factors and average passenger trip length for heavy rail, light rail, and gated portions of the rapid-bus mode
- Counts of temporary bus bridge boardings or alightings

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

CTPS will process the ridecheck, passenger survey, and passenger count data, including data on passenger noninteraction with 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 mode, rapid-bus mode, and trackless trolley mode, 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. CTPS will then estimate the factors that account for the number of transfers between modes based on the origin-destination passenger surveys conducted in Task 2 and the origin-destination surveys conducted in the preceding two years. In addition, CTPS 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 trips attributable to subway-linked 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. CTPS will apply this factor to the AFC farebox counts of the total number of passengers on surface light rail. CTPS will then apply additional factors to account for transfers made to other light rail or 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.

If the MBTA decides to use ODX as the basis of reporting to the NTD, CTPS will adjust the methodology as needed to incorporate the ODX outputs.

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 four 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 2021, CTPS will examine Keolis's passenger counts; this dataset should also be sufficient for calculating the average passenger-miles traveled per trip. However, CTPS does not produce estimates of unlinked passenger trips or total passenger-miles traveled for commuter rail, and CTPS does not expect to conduct any direct observations of the commuter rail mode.

For the ferry mode, CTPS will assist the MBTA in reviewing ridership counts provided by the ferry vendor. However, CTPS does not produce estimates of unlinked passenger trips or total passenger-miles traveled for ferries, and CTPS does not expect to conduct any direct observations of the ferry mode.

For temporary bus bridge service, CTPS will obtain AFC faregate passenger counts from the MBTA for comparable periods with regular rail service and use counts of temporary bus bridge boardings or alightings to develop a bus bridge scaling factor.

#### *Subtask 4.2 Estimate Passenger-Miles Traveled and Unlinked Trips for Purchased Service Bus Mode*

For the purchased service bus mode, CTPS will produce estimates of passenger-miles traveled and unlinked trips using revenue data from the MBTA for non-APC-equipped routes 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. Considering changes to the equipment servicing the Winthrop bus



routes, CTPS will work with the MBTA to develop procedures to estimate passenger-miles traveled and unlinked trips using APC data.

CTPS will combine the results from APC-equipped and non-APC-equipped routes into a single set of values for the purchased service bus mode.

*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 and ferry.

**Task 5 Document Results**

CTPS will document the results of Task 4 and the methodology of the study in three technical memoranda: one for the purchased service bus mode, 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, 2021, and a final version by November 1, 2021.

*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.

The Boston Region Metropolitan Planning Organization (MPO) operates its programs, services, and activities in compliance with federal nondiscrimination laws including Title VI of the Civil Rights Act of 1964 (Title VI), the Civil Rights Restoration Act of 1987, and related statutes and regulations. Title VI prohibits discrimination in federally assisted programs and requires that no person in the United States of America shall, on the grounds of race, color, or national origin (including limited English proficiency), be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination under any program or activity that receives federal assistance. Related federal nondiscrimination laws administered by the Federal Highway Administration, Federal Transit Administration, or both, prohibit discrimination on the basis of age, sex, and disability. The Boston Region MPO considers these protected populations in its Title VI Programs, consistent with federal interpretation and administration. In addition, the Boston Region MPO provides meaningful access to its programs, services, and activities to individuals with limited English proficiency, in compliance with U.S. Department of Transportation policy and guidance on federal Executive Order 13166.

The Boston Region MPO also complies with the Massachusetts Public Accommodation Law, M.G.L. c 272 sections 92a, 98, 98a, which prohibits making any distinction, discrimination, or restriction in admission to, or treatment in a place of public accommodation based on race, color, religious creed, national origin, sex, sexual orientation, disability, or ancestry. Likewise, the Boston Region MPO complies with the Governor's Executive Order 526, section 4, which requires that all programs, activities, and services provided, performed, licensed, chartered, funded, regulated, or contracted for by the state shall be conducted without unlawful discrimination based on race, color, age, gender, ethnicity, sexual orientation, gender identity or expression, religion, creed, ancestry, national origin, disability, veteran's status (including Vietnam-era veterans), or background.

A complaint form and additional information can be obtained by contacting the MPO or at [http://www.bostonmpo.org/mpo\\_non\\_discrimination](http://www.bostonmpo.org/mpo_non_discrimination). To request this information in a different language or in an accessible format, please contact

Title VI Specialist  
Boston Region MPO  
10 Park Plaza, Suite 2150  
Boston, MA 02116  
[civilrights@ctps.org](mailto:civilrights@ctps.org)  
857.702.3700 (voice)  
617.570.9193 (TTY)

**Exhibit 1**  
**ESTIMATED SCHEDULE**  
**MBTA SFY 2021 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	18		
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 the Compliance Audit																	█			

Products/Milestones

A: Three technical memoranda and one table

**Exhibit 2**  
**ESTIMATED COST**  
**MBTA SFY 2021 National Transit Database: Data Collection and Analysis**

<b>Direct Salary and Overhead</b>	<b>\$123,117</b>
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Task	Person-Weeks						Direct Salary	Overhea (104.89%)	Total Cost
	M-1	P-5	P-4	P-2	Temp	Total			
1. Develop Sampling Plans	0.1	0.0	0.2	1.5	0.0	1.8	\$2,213	\$2,321	\$4,534
2. Collect Data	0.5	0.5	0.0	8.2	44.3	53.5	\$36,378	\$38,156	\$74,534
3. Process Ridecheck, Passenger Survey, and Passenger Count Data	0.1	0.0	0.2	9.5	1.8	11.6	\$12,384	\$12,990	\$25,374
4. Estimate Passenger-Miles Traveled and Unlinked Trips	0.1	0.0	0.0	3.0	0.0	3.1	\$3,581	\$3,756	\$7,336
5. Document Results	0.2	0.0	0.6	1.7	0.0	2.5	\$3,326	\$3,488	\$6,814
6. Assist with the Compliance Audit	0.2	0.0	0.3	1.2	0.0	1.7	\$2,209	\$2,317	\$4,525
Total	1.2	0.5	1.3	25.1	46.1	74.2	\$60,089	\$63,027	\$123,117

<b>Other Direct Costs</b>	<b>\$200</b>
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Travel	\$200
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<b>TOTAL COST</b>	<b>\$123,317</b>
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**Funding**  
 Future MBTA Contract