BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

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TECHNICAL MEMORANDUM

DATE: **February 5, 2015**

TO: **Boston Region Metropolitan Planning Organization**

FROM: **Anne McGahan, MPO Staff**

RE: **Approach and Assumptions for *Charting Progress to 2040* Long-Range Transportation Plan Scenario-Planning Initiative**

The purpose of this memorandum is to document the approach used and assumptions made in the development of the inputs and implementation processes for the MPO's Long-Range Transportation Plan (LRTP) *Charting Progress to 2040* scenario planning. This planning is being conducted to develop information for use in decision-making for the development of this LRTP, which is currently under development.

1 BACKGROUND AND GOAL OF THE LRTP SCENARIO-PLANNING INITIATIVE

The MPO, through its goals and objectives for the region, is considering two different approaches to addressing mobility needs in the MPO region over the next 25 years. One approach is to program primarily high-cost roadway projects, while the other is to concentrate on lower-cost, often multimodal types of investments. The question of which approach to follow is likely just one of several policy issues that will emerge as the LRTP is developed. Right now, however, this is the policy issue that has surfaced and is before the MPO, and the staff sees an opportunity to utilize the federally encouraged approach of scenario planning to help clarify the degree to which each of these two approaches would help the MPO to make progress towards its stated goals.

It must be stressed that, at this time, the use of scenario planning is designed to bring clarity to the one policy issue that has emerged to date. As additional policy issues emerge and begin to be discussed in coming weeks—the degree to which the MPO wishes to flex roadway funding to transit, for example—staff will attempt at those times to generate information to help with policy deliberations. Staff may make additional use of scenario planning, if time permits, or rely on other analytical processes.

All of the scenario planning will be based on the LRTP horizon year of 2040. The first scenario is a High-Capital-Investment (High-Cap) approach to congestion

reduction. It will focus on constructing large capital projects to expand and modernize the highway network through high-cost capital infrastructure improvements such as interchange upgrades and major bottleneck reconstruction. The second scenario is an Operations and Management (O&M) approach to congestion management. It will focus primarily on making lower-cost O&M improvements such as low-cost intersection improvements and Complete Streets solutions to improve mobility on the roadway network. In addition, staff will provide the results of a third scenario, the Current LRTP, to inform the MPO of the benefits of going forward with existing funding assumptions.

Staff will use the transportation-scenario-planning tools available to the MPO to project or estimate the benefits of the two approaches, as they relate to making progress towards the MPO's goals, and will compare the scenarios in order to inform the MPO policy for addressing mobility needs. The goal of this LRTP scenario-planning initiative is to generate information on the benefits of the High-Cap and O&M approaches to capital construction in the Boston region and to understand the outcomes for the transportation network associated with each approach. Both of the scenarios being evaluated are illustrative in nature and are not intended to present a final set of projects and programs for inclusion in the LRTP. Rather, the results of the scenario analyses will be used by the MPO to inform their approach to selecting projects and programs for inclusion in the LRTP.

2 THE PROPOSED SCENARIO-PLANNING PROCESS

Staff proposed descriptions and parameters for the two scenarios described above—High-Cap and O&M. The parameters include establishing programs of specific project types to populate each of the scenarios and assigning to each program the relative percentage of spending for each scenario. The project types are:

- Intersection Improvements
- Complete Streets
- Bicycle Network and Pedestrian Connections
- Clean Air and Mobility, Park-and-Ride, Bicycle Parking, and Community Transportation
- Major Infrastructure, Interchange Modernization, and Bottleneck programs.

The percentage of spending for each of the programs was estimated by considering the current levels of LRTP and Transportation Improvement Program (TIP) spending for the particular project types included in each program and drawing on staff experience to estimate feasible and achievable levels of

spending in each program. Attention was given to developing scenarios that would be archetypes of each of the two approaches to capacity management—the two scenarios need to be different from each other. At the same time, they also needed to be realistic.

In this scenario-planning initiative, the two scenarios will be analyzed and the results will be compared to each other as well as to two additional modeling scenarios: a no-build scenario and a scenario that includes projects in the current LRTP. The Current-LRTP scenario will be analyzed to inform the MPO of the benefits of going forward with the funding assumptions in the current LRTP. The funding assumptions of the Capacity Management scenarios and Current-LRTP scenario are shown in Table 1 and are also described in the text below.

TABLE 1
Scenario Funding Assumptions

Proposed Program	Current LRTP % Funding	Current LRTP Funding Allocation	O&M % Funding	O&M % Funding Allocation	High-Cap % Funding	High-Cap Funding Allocation
Intersection Improvements	12%	$242,000,000	15%	$300,000,000	8%	$160,000,000
Complete Streets	21%	$423,000,000	60%	$1,200,000,000	8%	$160,000,000
Bicycle Network and Pedestrian Connections	2.5%	$50,000,000	10%	$200,000,000	2%	$40,000,000
Clean Air & Mobility,	2.5%	$50,000,000	2.5%	$50,000,000		$0
Park-and-Ride,		$0	12.3%	$245,000,000	1.8%	$35,000,000
Community Transportation		$0	0.2%	$5,000,000	0.2%	$5,000,000
Major Infrastructure, Interchange Modernization, Bottlenecks	62%	$1,235,000,000	0%	$0	80%	$1,600,000,000
Total		**$2,000,000,000**		**$2,000,000,000**		**$2,000,000,000**

Note: All of the projected costs are in current (2015) dollars.

This scenario-planning initiative will use two methods to estimate performance measures—one is for programs and projects that can be evaluated by using the MPO's regional travel demand model and the second is a sketch-planning approach (off-model analyses) for everything else. Programs and projects that can be modeled are those that have a regional impact, add capacity to the transportation system, or change an attribute of the system (for example, change the delay or capacity, or add an alternative travel option). For something to be modeled, staff require detailed information on the transportation project that can

be reflected in the model. This isn't always possible when one is dealing with programs that are conceptual in nature. When detailed information wasn't available or when the project wasn't deemed regionally significant, staff utilized the off-model approach.

Among the benefits that are estimated through modeling are:

- Change in vehicle-miles traveled (VMT)/person-miles traveled
- Mode share
- Average travel time (auto and transit)
- Additional jobs in the region
- Cost savings for transit, single-occupant vehicles, and high-occupant vehicles

Many of the projects, particularly lower-cost projects with smaller footprints that aren't regionally significant, cannot be modeled. For these projects, an off-model analysis process was developed to identify the benefits. This involves determining the benefits of various types of projects through the evaluation of sample projects that are included in the TIP Universe of Projects. The benefits are then extrapolated for use in the off-model analysis. A variety of tools are used to determine the benefits, including greenhouse gas calculations, TIP "Before and After" project evaluations and evaluations from other MPO-funded studies, data collected or developed by the MPO for TIP project evaluations, and analyses of completed TIP-funded projects.

Among the benefits that are estimated off-model are:

- Number of high-crash locations addressed
- Miles of improved substandard pavement, sidewalk, and bicycle lanes
- Addresses areas that are vulnerable to extreme conditions
- Number of projects with safety improvements in EJ areas
- Number and cost of projects that serve Areas of Concentrated Development

2.1 High-Capital-Investment (High-Cap) Congestion Management Scenario

As noted above, this scenario includes a high percentage of high-cost capital infrastructure improvements such as interchange upgrades and major bottleneck reconstructions. The High-Cap Congestion Management scenario was crafted to emphasize high-cost highway infrastructure projects as a means of reducing congestion in places where lower-cost solutions would not apply or do not appear to be viable. The benefits will be evaluated using computer modeling tools.

In addition, this scenario includes a small percentage of projects that have lower costs (under $20,000,000) and do not add capacity to the system. This includes low-cost intersection improvements, Complete Streets projects, bicycle and pedestrian projects, and a variety of projects that improve air quality and mobility and reduce congestion, such as additional park-and-ride facilities and additional small-scale transit services in areas unserved or underserved by the existing transit system. These will be evaluated off-model, as discussed above.

2.2 Operations and Management (O&M) Scenario

This scenario is a congestion management approach that will focus on making typically lower-cost O&M improvements, such as low-cost intersection improvements and Complete Streets solutions, to improve mobility on the roadway network. The O&M scenario was crafted to emphasize capacity management through the use of low-cost investments, as well as to address the MPO's top-rated goals of safety and system preservation. The O&M scenario comprises mostly projects and programs that cannot be modeled and will therefore need to be evaluated off-model.

2.3 Current-LRTP Scenario

This scenario includes all of the projects listed in the current LRTP that are not yet funded. It also includes additional projects and programs (not listed in the current LRTP), using all of the unallocated funding that is in the current LRTP. The assumption is that the unallocated funding from the current LRTP would be programmed over the next 25 years in the same funding proportions as it has been programmed over the previous 10 years for intersection improvements, Complete Streets projects, bicycle and pedestrian projects, and Clean Air and Mobility projects. This planning analysis will include both model and off-model analysis.

2.4 2040 No-Build Scenario

This scenario assumes that there will be no improvements to the existing transportation network other than those that are currently under construction, advertised for construction, or included in the first year of the Federal Fiscal Years (FFYs) 2015–18 Transportation Improvement Program (TIP) of the Boston Region MPO and TIPs of adjacent MPOs.

3 DEVELOPMENT OF THE SCENARIOS

The identification of projects for the programs in the scenarios described above includes only those projects that address needs identified in *the Charting Progress to 2040* Long-Range Transportation Plan Needs Assessment. The programs will be financially constrained to the MPO's target funding and the

MPO's share of federal major infrastructure funding, which, totaling the two sources and assuming current dollars, amounts to approximately $2 billion.

Transit expansion and state-of-good repair projects are not included in these scenarios. These projects will be identified through the development of MassDOT's Program for Mass Transportation and the MBTA's Capital Investment Program. Low-cost transit improvements will be funded in both scenarios (for example, park-and-ride and community-based transportation). The O&M scenario will provide more funding for these improvements.

The following sections of this memo describe the assumptions and methods used in selecting projects in each program for each of the scenarios. It must be stressed again that these scenarios are being constructed and analyzed for illustrative purposes—to provide insights into the degree to which different investment approaches are likely to advance the MPO towards attainment of its stated goals. For that reason, the reader should not be concerned about which specific projects are included in this analysis. Each project simply needs to meet an identified need and be compatible with the investment approach being analyzed. Furthermore, there is no attempt being made to forecast the specific benefits associated with any particular project. To the contrary, the performance measures whose values will be estimated from the model and off-model analyses will represent the collective benefits of all of the projects and programs in a scenario.

3.1 Intersection Program

Estimated Cost per Intersection

Intersection improvement projects that had been evaluated as part of past TIPs were reviewed to determine the average cost per intersection, which was $2.8 million.

Analysis of Intersection Locations for Scenarios

All of the intersections included in the TIP Universe of Projects were included—Pre-TIP (those projects that have at least a 25 percent design) and conceptual projects (44 locations). These locations were identified as first-tier projects for this analysis. The remaining intersection locations, or second-tier projects, are those that have been studied by the MPO through a Unified Planning Work Program (UPWP) project (77 locations). These projects were prioritized—first through determining if they are high-crash locations to address the MPO's safety goal, and then if they are located in high-priority-development, environmental-justice, or Title VI areas, which are the criteria for projects that would be necessary for the MPO to meet its economic and equity goals. In addition, locations that were identified as bottleneck locations in the LRTP Needs

Assessment were examined to determine if associated intersections could be part of the improvement projects, and, if so, the associated intersections were included.

Selection of Intersection Locations for Scenarios

Taking into account the average cost per intersection and the prioritization of intersections discussed above, the number of intersections that will be included in each scenario was determined:

- High-Cap – 57 intersections
- O&M – 107 intersections
- Current-LRTP – 86 intersections

Analysis Approach

A combination of model and off-model analysis will be used for intersections.

3.2 Complete Streets Program

Estimated Cost per Mile

The Complete Streets projects that had been evaluated as part of past TIPs were reviewed to determine the average cost for this type of project, which would be $6 million per mile.

Analysis of Project Locations for Scenarios

The analysis of benefits for Complete Streets projects was based on the benefits of existing Complete Streets projects that have been funded by the MPO. Specific project locations will not be designated for the analysis of this type of project. The benefits will be calculated using the total number of miles of Complete Streets projects.

Selection of Complete Street Mileage for Scenarios

The mileage of Complete Streets projects used for each scenario is listed below:

- High-Cap – 27 miles
- O&M – 200 miles
- Current-LRTP – 71 miles

Analysis Approach

A model run was performed for 77 Complete Streets projects (for improving 135 miles of roadway) that have been submitted to the MPO for funding consideration in order to determine the benefits associated with those Complete Streets projects. In addition, a review of past Complete Streets projects was conducted

to determine other benefits associated with this type of project, which will be analyzed off-model.

3.3 Bicycle Network and Pedestrian Connections

Estimated Cost per Mile

Bicycle and pedestrian projects that had been evaluated as part of past TIPs were reviewed to determine the average cost per mile, which was $2 million. This assumption was used only for conceptual projects for which there are no cost estimates.

Analysis of Project Locations for Scenarios

The locations identified in the 2014 Bicycle Network Evaluation study performed by the MPO were reviewed for this analysis. In addition, all bicycle and pedestrian projects included in the TIP Universe of Projects were reviewed.

Selection of Project Locations for Scenarios

Three systems of project rankings were jointly considered for prioritizing bicycle and pedestrian projects for inclusion in the various scenarios:

- TIP projects that had been evaluated
- The 2014 Bicycle Network Evaluation study scored projects by the importance of locations served and paths connected.
- Using the 2011 Massachusetts Household Survey, the sizes of potential bicycle travel markets were estimated; those estimates were then used to estimate the cost per potential rider for each project.

The scenarios include projects that have preliminary cost estimates and projects that don't have a formal cost estimate but use the estimate of $2 million per mile. The mileage of the bicycle and pedestrian projects used for each scenario is listed below:

- High-Cap – 14 miles
- O&M – 94 miles
- Current-LRTP – 19 miles

Analysis Approach

This approach will primarily use off-model analysis, but the locations of the projects will also be included in the model to identify mode shift and reduction in vehicle-miles of travel.

3.4 Park-and-Ride

Estimated Cost per Parking Space

Costs associated with the construction of new park-and-ride spaces were evaluated to determine the average cost per space. This process assumed an average cost of $20,000 per surface-lot space and $45,000 per garage space. Both rates assume additional costs for land acquisition that would be required for expanding the lots. Therefore, an average rate of $35,000 per space was assumed in this analysis to account for not knowing if additional land would be available for expansion.

Analysis of Project Location for Scenarios

Staff ran the travel demand model that assumed no constraint on parking at existing park-and-ride locations throughout the region in order to determine the projected demand in 2040 at these locations. In addition, information on the utilization rates that was noted in the Needs Assessment was considered when determining the locations used in this analysis.

Selection of Project Locations for Scenarios

Only locations at the terminus of rapid transit lines and locations along commuter rail outside of the MBTA's Zone 1 were considered for this analysis in order to allow for the most benefits from the park-and-ride program.

- High-Cap – 1000 spaces ($35 million)
- O&M – 7000 spaces ($245 million)
- Current-LRTP – 0 spaces (No past spending therefore assumption there will be no future spending)

Analysis Approach

This approach will use model analysis.

3.5 Community Transportation

Estimated Cost for the Community Transportation Program

An analysis was performed to determine the cost per vehicle-hour of service ($60/vehicle-hour) associated with providing or purchasing bus service for a "first mile/last mile" program to access transit using information from the Federal Transit Administration's National Transit Database, the MBTA, and MetroWest Regional Transit Authority. It was assumed that shuttle service would operate at least six hours of service during the morning and evening peak periods (combined) for 252 days per year. American Public Transit Association data were used to determine that the average cost of a shuttle bus is approximately $165,000. It was assumed that for the locations identified below, the estimated

cost for this service would be approximately $1.5 million per year. Assuming that operating funds would be available for a three-year time frame in MPO's the Congestion Mitigation and Air Quality funding program, the total amount allocated for this program is approximately $4.5 to $5.0 million.

This program may also fund transit services that provide intramunicipality and intermunicipality services. Identifying possible feasible locations for these services and possible project costs was more difficult and could not be done with sufficient reliability to be included in this analysis.

Selection of Program Locations for Scenarios

Staff performed an analysis to determine the locations of potential new services using data from the LRTP Needs Assessment, to identify several areas for pilot services. This program assumes that service would be provided at the following locations:

- Anderson/Woburn Station
- Waltham/Route 128 Area
- Foxborough (Patriot Place)
- Westwood/Route 128 Station
- South Weymouth Naval Air Force Base
- Littleton

For each scenario below, the following assumptions for Community Transportation projects were used:

- High-Cap – all projects listed above ($5 million)
- O&M – all projects listed above ($5 million)
- Current-LRTP – no projects

Analysis Approach

This approach will use model analysis.

3.6 Clean Air and Mobility Program

Estimated Cost per Project

Clean Air and Mobility projects funded as part of past TIPs were evaluated to determine the average cost per project. Examples of the types of projects in this program include transportation demand management projects (with an average cost of $140,000 per project), bike share projects (an average cost of $200,000 per project), shuttle bus services (an average cost of $100,000 per project), and

small infrastructure projects—for example, bike connections and power retrofit projects (an average cost of $400,000 per project).

Selection of Projects for Scenarios

A review of the benefits associated with past Clean Air and Mobility projects was conducted to determine the types of projects and their associated benefits. This information will be used to analyze the scenarios.

The funding for Clean Air and Mobility projects for each scenario is listed below:

- High-Cap – No projects
- O&M – $50 million, assumes that $2 million in Clean Air and Mobility projects will be funded each year
- Current-LRTP – $50 million, assumes that $2 million in Clean Air and Mobility projects will be funded each year

Analysis Approach

This approach will use off-model analysis.

3.7 Major Infrastructure

Locations and Costs per Project

The interstate-highway and arterial bottleneck locations identified in the Needs Assessment were used to determine the major infrastructure projects that would be included in the High-Cap scenario. Many of these locations are also high-crash locations. Any bottleneck location thought to be amenable to a relatively low-cost solution was eliminated from consideration for this funding category. Costs were associated with each project based on the costs that were included in current or past LRTPs adjusted to current dollars or costs from studies that were performed for selected locations. All of the interstate bottlenecks were included in the High-Cap scenario, with the exception of the Southeast Expressway between Braintree and Boston, which was excluded because of cost considerations. The following interstate projects are included:

- I-93/I-95 (Woburn) – *Paths to a Sustainable Region* project
- Extend I-93 HOV lane into Somerville and/or Capacity Improvements to Route 128, Woburn
- Braintree Split – *Paths to a Sustainable Region* project
- Route 1: Revere to Saugus – *Paths to a Sustainable Region* project
- Route 128 Capacity Improvements: Between Exit 26 and Exit 28, Peabody
- I-90, Interchange 17
- I-95 Capacity Improvements: Lynnfield to Reading

Twenty-four arterial bottleneck locations from the Needs Assessment were examined to determine if capacity improvements were feasible. It was determined that seven locations could accommodate major infrastructure improvements. Studies that included recommended improvements were conducted for two of those locations—Route 1: Westwood to Sharon (the I-95/Route 1 Study, 2010) included recommended intersection improvements, which were therefore included in the intersection program; and Route 16/Mystic Valley Parkway and Revere Beach Parkway (a 2013 study for the new casino indicating that the developer would pay for improvements in that area). Therefore, the following arterial locations will be included in the High-Cap scenario:

- Route 1A: Mahoney Circle: Revere (*Journey to 2030* project but not included in the current LRTP)
- Route 1A: Boardman Street (*Journey to 2030* project but not included in the current LRTP)
- Concord Rotary: Concord (*Journey to 2030* project but not included in the current LRTP)
- Routes 62, 225, and 4: Lexington
- Route 18 Weymouth (*Paths to a Sustainable Region* project)

Analysis Approach

For major infrastructure projects, model analysis will be used.

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